Project: Aqaba-Amman Water Desalination and Conveyance (AAWDC)

2025 Environmental and Social Impact Assessment

Chapter 9: Environmental and Social Impact Assessment, Mitigation and Monitoring

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9 Environmental and Social Impact Assessment, Mitigation and Monitoring

9.1 Introduction

This Chapter of the 2025 Aqaba-Amman Water Desalination and Conveyance (AAWDC) Project Environmental and Social Impact Assessment (ESIA) presents the assessment of environmental and social impacts associated with construction and operational phases of the Project as described within Chapter 5 of this ESIA.

In accordance with the impact assessment methodology (see Chapter 3), scoping was undertaken to identify potential interactions between the Project and potential receptors, and to identify interactions "scoped out" of the full environmental impact assessment process due to their limited potential to result in discernible environmental or social impacts.

Those interactions that have not been scoped out have been initially assessed based on the predicted magnitude of impact and receptor sensitivity, considering existing controls, and the significance of the impact has been determined. Mitigation has been identified to determine the additional controls to be implemented prior to detailed design, at the commencement of construction, during construction, and prior to and during operations. Where relevant, the monitoring and reporting activities to be undertaken to confirm that these controls are implemented and effective are provided. The controls will form commitments for the Project to be implemented through the Construction Environmental and Social Management and Monitoring Plan (ESMMP) and associated supporting plans and procedures, and through the Operational Environmental and Social Management System (ESMS) as relevant.

Topics that have not been included in this Chapter 9 comprise:

- Cumulative and Transboundary impacts – these aspects are assessed within Chapters 10 and 11 of this ESIA
- GHG and climate change risk – this aspect is covered within the Climate Vulnerability Risk Assessment (CVRA) presented within Chapter 12 of this ESIA. The CVRA considers all aspects of the environment that may be impacted as a result of climate change, including both the potential for increased drought and flooding events and the associated vulnerability of the Project. As described in Chapter 5, during operations, power will be routinely provided to the AAWDC Project from the Project RE Facility, supplemented with grid-based power supplied from the Jordanian national electricity transmission and generation companies. The forecast GHG emissions associated with the Project during both construction and operations are presented within Chapter 5 , along with the GHG-related measures incorporated into the Project design to minimise GHG emissions

9.2 Marine Environment

9.2.1 Scoping

Marine construction work with the potential to impact the marine environment is detailed in Chapter 5, Project Description, and will include:

- Construction activities:

  - Construction of a new intake lagoon, incorporating revetment structures to protect against erosion from wave and tidal action
  - Construction of one temporary jetty 5m wide to enable the use of excavators, equipped with peckers for the breaking of rock, if conventional excavator buckets are insufficient, to create a 5m trench. It is assumed the jetty will be constructed of imported material from an onshore quarry. The jetty will be removed following completion of construction. No dredging vessels will be used
  - All material excavated from the trench will be transferred on shore, stored temporarily and used to backfill the trench. No side casting, temporary storage, or permanent disposal of trenched spoil at sea will occur
  - Levelling and bedding within the trench using aggregate materials e.g. assumed to be supplied from an onshore quarry
  - Backfilling of the trench, using excavated material stored onshore and additional imported material and laying of rock armour to protect the outfall from wave action and scour
  - Use of an outfall installation vessel, which will use anchors for positioning
  - Installation of the outfall and concrete ballast collars on the seabed
  - Marine support vessel activity
- Operational activities:
  - The abstraction of seawater via the Project intake infrastructure
  - The discharge of brine, shock dosing, backwash effluents, and treated cleaning-in-place effluent via the outfall diffuser
  - Desalination Plant and Intake Pumping Station site drainage
  - Operational surveys using vessels

Project activities that have the potential to create impacts on the marine environment that have been assessed in this section are summarised below in Table 9-1.

Table 9-1: Overview of "Scoped In" Activities and Marine Environment Impacts

Activity	Type of impact	Receptor	Assessment approach
Construction: Vessel & equipment operation	Underwater sound	Marine megafauna, turtles and fish	• Numerical underwater sound modelling of trenching activity based on client-provided data • Secondary data to determine receptor sensitivity
Construction: Seabed (benthic) disturbance, including anchoring	Changes to water quality, turbidity and light penetration Permanent benthic habitat loss Smothering of benthic habitats	Water quality Benthic habitats	• Baseline data to determine receptor sensitivity • Quantification of impact based on client-provided data
Operations: Abstraction of seawater	Loss of plankton, coral larvae (planula), and other planktonic life forms, including seagrass, bivalves and fish	Benthic habitats	• Industry best practice assessment and judgement • Baseline and secondary data to determine receptor sensitivity • Quantification of impact based on client-provided data
Operations: Discharge of desalination plant effluent	Water quality changes, turbidity and light penetration	Benthic habitats Water quality Marine megafauna, turtles and fish	• Numerical modelling of discharge plume to support fate and effects assessment • Baseline and secondary data to determine receptor sensitivity • Quantification of impact based on client-provided data
Operations: Underwater sound from survey vessels	Underwater sound	Marine megafauna, turtles and fish	• Evaluation of impact based on available Project data • Secondary data to determine receptor sensitivity
Construction and Operations: Desalination Plant and Intake Pumping Station site drainage	Water quality changes	Water quality Marine megafauna, turtles and fish	• Evaluation of impact based on available Project data • Baseline data to determine receptor sensitivity
Construction and Operations:	Disturbance from light	Marine megafauna, turtles and fish	• Evaluation of impact based on available Project data

Activity	Type of impact	Receptor	Assessment approach
Lighting during marine construction and operations			• Baseline data to determine receptor sensitivity
Construction: Project construction activities at shoreline	Disturbance from airborne noise and physical presence	Seabirds	• Evaluation of impact based on available Project data • Baseline data to determine receptor sensitivity

9.2.2 Existing Controls

Existing controls that are assumed to be effective include:

- Construction: Vessel and equipment operation
  - All vessels and marine activities will be compliant with applicable international and Jordanian maritime regulations, including those controlling ballast water management
  - Emergency and spill response plans will be developed before construction for marine activities, aligned with the requirements and capacity of the competent authority, and documented training of all accountable and responsible construction personnel
- Construction: Marine works
  - Working areas, including anchoring locations, will be defined prior to the start of construction, and procedures will be developed for continuous monitoring of the construction work to confirm that the work remains within pre-designated areas
- Operations: Abstraction of seawater
  - The seawater velocity intake will be limited to 0.15 m/s unless demonstrated otherwise. The effectiveness of the seawater abstraction system design in preventing the entrainment of marine megafauna, turtles and fish will be confirmed through routine maintenance and inspection
- Operations: Discharge of Desalination Plant effluent
  - The effluent quality is consistent with the Project's Discharge Standard

9.2.3 Underwater Sound and Marine Disturbance

This assessment focuses on the impacts associated with underwater sound due to:

- The use of excavator mounted peckers/hammers for the breaking of rock to enable trenching of the outfall
- Operational sound associated with the use of survey vessels

In addition, the following aspects are also considered:

- Disturbance due to the use of lighting during construction and operations, airborne noise and physical presence

9.2.3.1 Magnitude of Effect

With respect to the construction phase, underwater sound modelling has been completed as described in Appendix 9A.2 based on the use of the pecker for breaking rocks, which is considered the highest noise source.

The modelling focuses on zones of injury and disturbance (i.e., responsiveness) that are of concern[1], and on the zone of injury/hearing loss that may occur. The zones of injury and disturbance were classified as either:

- Temporary Threshold Shift (TTS) of hearing: the impact of TTS is reversible and can affect an individual's ability to detect prey, avoid predators, communicate or navigate
- Permanent Threshold Shift (PTS) of hearing: the impact of PTS is permanent, and can affect an individual's ability to detect prey, avoid predators, communicate or navigate

The assessment focuses on the following types of cetaceans that have been reported in the Gulf of Aqaba (GoA) and referred to in the Marine Critical Habitat Assessment (CHA):

- Low-Frequency (LF) cetaceans, a term commonly used in marine biology and acoustics to describe species of whales that produce and communicate using low-frequency sounds, typically below 1000 Hz. The Bryde's whale, present within the Gulf of Aqaba, is within this category
- High-Frequency (HF) cetaceans. Species of dolphin and false killer whale/dolphin (*Pseudorca crassidens*), present with in the Gulf of Aqaba, fall within this category

Very High Frequency cetaceans (such as porpoises), and Pinnipeds (seals, sea lions) do not occur in the Gulf of Aqaba and have not been assessed.

To assess the potential for injury to LF and HF cetaceans, Southall et (2019) criteria for Sound Pressure Levels (SPL) for impulsive sound have been used and a comparison made to reference SPLs produced from equivalent impulsive sound sources. This analysis showed that the threshold values for all cetacean groups was above the reference SPL measured during similar impulsive construction activities. As a result, it was considered that the SPLs typically produced during these activities are not sufficient to cause PTS or TTS type injuries to marine mammals. Unlike SPL, Sound Exposure Levels (SEL) is a measure of energy that takes into account both the received level and the duration of the exposure. Based on a 12-hour operational duration (i.e. daylight hours) at the reference levels the modelling study predicted the potential onset of PTS at distances of up to 76 m for LF cetaceans and up to 15 m for HF cetaceans. These thresholds are based on the auditory criteria established by Southall (2019), additional details are provided in Appendix 9A.2.

To assess potential behavioural impacts, the US NMFS Level B harassment threshold of 160 dB re 1 µPa RMS for impulsive sound, has been used. This corresponds to a static marine mammal, with no measures to encourage them to move out of the area. This resulted in a predicted radial distance of approximately 153m for all hearing groups assessed. Based on TTS (which equates to a behavioural change to move away from particular area and uses SELs) a radial distance of approximately 500m is estimated for all hearing groups assessed.

The underwater sound assessment also considered potential impacts to fish, based on the guidance levels described by Popper *et.al.*, (2014). These guidelines provide impact thresholds for different types of fish based on their auditory capabilities, namely:

[1] It should be noted there is insufficient scientific evidence to properly evaluate masking and this is therefore not considered in this assessment

- Fish with no swim bladder (classed as particle motion detective)
- Fish which have a swim bladder, but it is not involved in hearing (classed as particle motion detective)
- Fish which have a swim bladder, and it is involved in hearing (classed as primarily pressure detection)
- Eggs and larvae

The results of the modelling are provided below in Table 9-2. The results are presented for both SPL and cumulative SEL based on an exposure duration of 12 hours. The results indicate that:

- Fish with no swim bladder (cartilaginous fish, including sharks and rays) have the highest sensitivity to sound levels. Mortality from Cumulative Sound Exposure Levels could occur within 16m, recoverable impairment could occur within 24m and reversible changes associated with TSS may occur within 684m
- Fish with swim bladders have a lower sensitivity to sound levels. Mortality from Cumulative Sound Exposure Levels could occur within 44m to 64m, recoverable impairment could occur from 104m and reversible changes associated with TSS occur within 684m
- Fish and larvae mortality from Cumulative Sound Exposure Level could occur within 44m
- Sea turtles are predicted to be at risk of mortality or potential mortal injury within 44m from the sound source

Adult fish not in the immediate vicinity of the sound-generating activity are generally able to move away and avoid the likelihood of physical injury. However, larvae are not highly mobile and are therefore more likely to incur injuries from the sound energy, including damage to their hearing, kidneys, hearts and swim bladders. Damage from shock to eggs and developing embryos consists of deformation and compression of the membrane, spiral curling of the embryo, displacement of the embryo, and disruption of the vitelline membrane. Although such effects are unlikely to happen outside of the immediate vicinity of the pecker trenching activities.

In terms of disturbance (or behavioural response), the impacts of construction activities are presented qualitatively rather than quantitatively. Based on these qualitative criteria, there is a high level of risk of disturbance up to 'tens of metres' from the source and low at distances of 100s of metres. For eggs and larvae, the risk is high close to the centre of activity (tens of metres) and low beyond this point.

In summary, using the approach adopted by Popper *et al.,* (2014), the area of behavioural change will extend beyond 10m from the source, but the risk of disturbance will be moderate and is unlikely to be significant beyond 6m.

Table 9-2: Predicted Underwater Sound Impacts to Fish and Sea Turtles

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	Temporary Threshold Shift	
Fish: no swim bladder (particle motion detection)	SELcum dB re 1 µPa 2 ·s.	16m	24m	684m	(Near) High (Intermediate) Mod. (Far) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	SELcum dB re 1 µPa 2 ·s.	44m	104m	684m	(Near) High (Intermediate) Mod. (Far) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	SELcum dB re 1 µPa 2 ·s.	64m	104m	684m	(Near) High (Intermediate) Mod. (Far) Low
Eggs and larvae	SELcum dB re 1 µPa 2 ·s.	44m	(Near) Mod (Intermediate) Low (Far) Low	(Near) Mod (Intermediate) Low (Far) Low	(Near) Mod (Intermediate) Low (Far) Low
Sea turtles	SELcum dB re 1 µPa 2 ·s.	44m	(Near) Mod (Intermediate) Low (Far) Low	(Near) Mod (Intermediate) Low (Far) Low	(Near) Mod (Intermediate) Low (Far) Low

Overall, the impact of underwater sound on fish, turtles and cetaceans is assessed as **Minor Adverse**, with the following justification:

- Construction noise that exceeds existing shipping traffic noise within the area affected by trenching related underwater sound (ESIA Study Area) has been assumed to be generated for a period of 1 month and will be intermittent (not continuous for 24 hours)
- It is not considered that cetaceans will be significantly impacted by the SPLs produced by pecker trenching activities due to both the spatial area over which impacts are likely to occur (see below) and the low levels of occurrence/density at which cetaceans are thought to occur. Cetaceans are also considered likely to take avoiding action (which equates to only very minor, temporary disturbance)
- Based on the acoustic characteristics of the pecker trenching equipment, the modelling predicted potential onset of PTS at distances of up to 76m for LF cetaceans and up to 15m for High Frequency (HF) cetaceans
- The spatial extent of the impact on cetaceans for temporary changes to behaviour within approximately 500m of the noise source; producing a potential impact area of approximately 0.79 km^2
- The spatial impacts to fish and larvae include mortality within 16 metres for the most sensitive species, behavioural impacts within 684 metres and impacts to turtles, eggs and larvae within 44m

- The area within which marine mammal behaviour changes may occur is predicted to be within 500m for all marine mammals
- Underwater sound from operations phase activities will be limited to the use of small vessels (with a maximum crew of <10) to deploy environmental sampling equipment, and no maintenance dredging is planned. Underwater sound from the Project's use of small vessels is considered insignificant relative to existing port activities and is well below the range of sound levels from shipping and port operations. On this basis the magnitude of impacts is considered to be negligible conservatively ranging to minor adverse

Impacts associated with other disturbances include lighting within the vicinity of construction works and permanent lighting associated with the intake and outfall infrastructure is required for health, safety (including navigation) and security reasons. During construction, lighting will be temporary with permanent lighting during the operations phase anticipated to be limited and not anticipated to elevate existing levels of light pollution to the marine environment. A negligible to minor adverse magnitude of effect is anticipated.

9.2.3.2 Receptor Sensitivity

During construction, the Area of Influence for underwater sound is considered to be within 500m of the intake channel area for marine mammal behaviour changes, and within 76 m for mortality or injury impacts to fish and marine mammals.

The sensitivity of fish, turtles and cetaceans to underwater sound is assessed as **High**, with the following justification:

- Vulnerability and presence:
    - The vulnerability of the fish, turtle and cetacean species likely to be present within the Area of Influence to underwater construction sound is considered relatively low within the Area of Influence due to the:
        - Extent of existing vessel activity
        - Low level of abundance
        - Lack of unique habitat features that could support aggregation and/or breeding areas compared with the wider Study Area
    - The vulnerability of fish, turtle and cetacean species likely to be present within the Area of Influence to disturbance such as light and airborne sound is considered relatively low given the existing characteristics of the area (a port environment) and the absence of turtle nesting areas in the Study Area. Similarly, seabirds present in the area are expected to be largely habituated to airborne noise
- Value
    - The CHA has confirmed that there are 3 species of fish triggering Critical Habitat criteria and 13 species including turtle, cetacean and fish species triggering Priority Biodiversity Feature (PBF) criteria
    - The Marine CHA identified two species of seabird as Priority Biodiversity Features, which are within the wintering range, but neither of them nests in the Study Area
- Resilience

- The resilience of fish, turtles and cetacean species likely to be present within the Study Area and the Area of Influence to underwater construction sound is considered relatively high, given the likely movement away from sound in the marine environment (aside from fish larvae) unless they are conservatively within 76m of the sound source (based on worst case PTS estimates). Numbers affected are likely to be on an individual basis if at all. No irreversible impact to the ecological function of habitats (including critical habitat) through underwater sound impacts are anticipated. Seabirds are also expected to be largely tolerant and will move away from the potential airborne noise generated during the construction activities

9.2.3.3 Impact Significance, Mitigation and Residual Impacts

The impact significance of disturbance effects and underwater sound is considered to be **Medium**.

Mitigation to reduce the potential impact significance are defined below:

- Construction planning, to be completed prior to construction:
  - The Marine Construction Works Management Plan to include underwater sound avoidance, mitigation and monitoring requirements consistent with applicable guidance that will include the JNCC guidance and the IMCA ES005 “Guidance on Mitigation of Underwater Noise” (2025) and “World Bank Environmental, Health, and Safety Guidelines Ports, Harbors, and Terminals February 2, 2017
  - The Marine Construction Works Management Plan will include an underwater sound adaptive management and reporting system to integrate a marine mammal observation program with construction vessel and trenching equipment management controls that will include a soft start and a stop work protocol in the event underwater sound receptors are observed by Marine Mammal Observers
  - Once the final construction activities and vessel and equipment types are defined, the associated schedule and underwater sound sources are confirmed, a competent underwater sound expert uses the E&S Management of Change Process to validate that there is no material change in impact
  - Prior to the start of construction, complete a pre-construction survey of the shoreline construction to confirm the absence of nesting birds and require the application of appropriate mitigation if nesting sites are found
  - Working at night during construction will not occur routinely
  - A lighting plan for the careful selection and placement of lighting to reduce additional light pollution to the marine environment will be developed for the construction phase
  - Prior to the completion of detailed design, undertake review of the lighting requirements and measures to reduce additional light pollution to the marine environment
- Construction: Vessel & equipment operation
  - Underwater sound components during construction, supported by trained Marine Mammal Observers (MMO)
- Operations: Vessel operation

- Once the final operational phase maintenance activities are defined and the associated schedule and underwater sound sources are confirmed, a competent underwater sound expert will validate the absence of material change in impact from underwater sound

With the mitigation incorporated into the Project ESMS, and with verification and reporting, the residual impact is considered **Negligible**. The justification for impact significance is:

- A reduction in impact magnitude due to a decrease in the potential exposure, through the use of a soft start and stop work protocol to reduce the potential for disturbance or harm to marine mammals, fish and turtles exposed to underwater sound by allowing any such species present in the area to move away

9.2.4 Marine Construction Impacts

This assessment focuses on the construction phase impacts associated with water quality changes, turbidity and light penetration and benthic habitat, associated with:

- Construction of a new intake lagoon, using revetment structures for erosion protection
- A sediment curtain will be deployed around the perimeter of all trenching, jetty construction and lagoon construction and back filling to prevent turbidity impacts
- Construction of one temporary jetty, 5m wide, to enable the use of, equipped with peckers for the breaking of rock, if conventional excavator buckets are insufficient, excavators to create a 5m wide trench. It is assumed the jetty will be constructed of imported material from an onshore quarry. The jetty will be removed following completion of construction. No dredging vessel will be used
- All sediment/material excavated from the trench will be transferred on shore, stored temporarily and used to backfill the trench. No side casting, temporary storage, or permanent disposal of seabed sediment/material will occur
- Levelling and bedding within the trench using aggregate materials e.g. assumed to be supplied from an onshore quarry
- Backfilling of the trench, using excavated material stored onshore and additional imported material and laying of a concrete mattress to protect the outfall from wave action and scour
- Use of an outfall installation vessel, which will use anchors for positioning. It is assumed that anchors with a 4m^2 seabed footprint will be deployed at 12 locations
- Installation of the outfall, including concrete ballast collars (every 5 metres) along the outfall from the 10 metre water depth
- Vessel operation, including ballast water handling
- Drainage and runoff from the IPS and desalination plant during construction

9.2.4.1 Magnitude of Effect

Impacts from construction work to benthic habitats are anticipated to include:

- Lagoon construction
- Trenching & temporary jetty
- Anchoring

- Outfall installation
- Change to shoreline dynamics associated with the construction and permanent presence of shoreline infrastructure

Accidental events have also been considered, with the most likely being a hydraulic-fluid spill or a loss of containment during refuelling or storage of hazardous material.

With regard to drainage and runoff-related discharges from the IPS and desalination plant during construction, it is assumed these will comprise normally clean runoff only with operational and design systems in place to segregate drainage to avoid mixing of drainage from areas with hazardous materials with areas only exposed to rainwater and as such no impact to the marine environment is anticipated. Mitigation is however specified to ensure safeguards are appropriately specified and in place.

With respect to turbidity impacts, it is assumed that the use of turbidity curtains for all trenching, jetty construction, lagoon construction and backfilling will prevent turbidity impacts to pelagic species such as plankton, fish, turtles, and cetaceans. This assumption will be validated before the start of construction (refer to mitigation below).

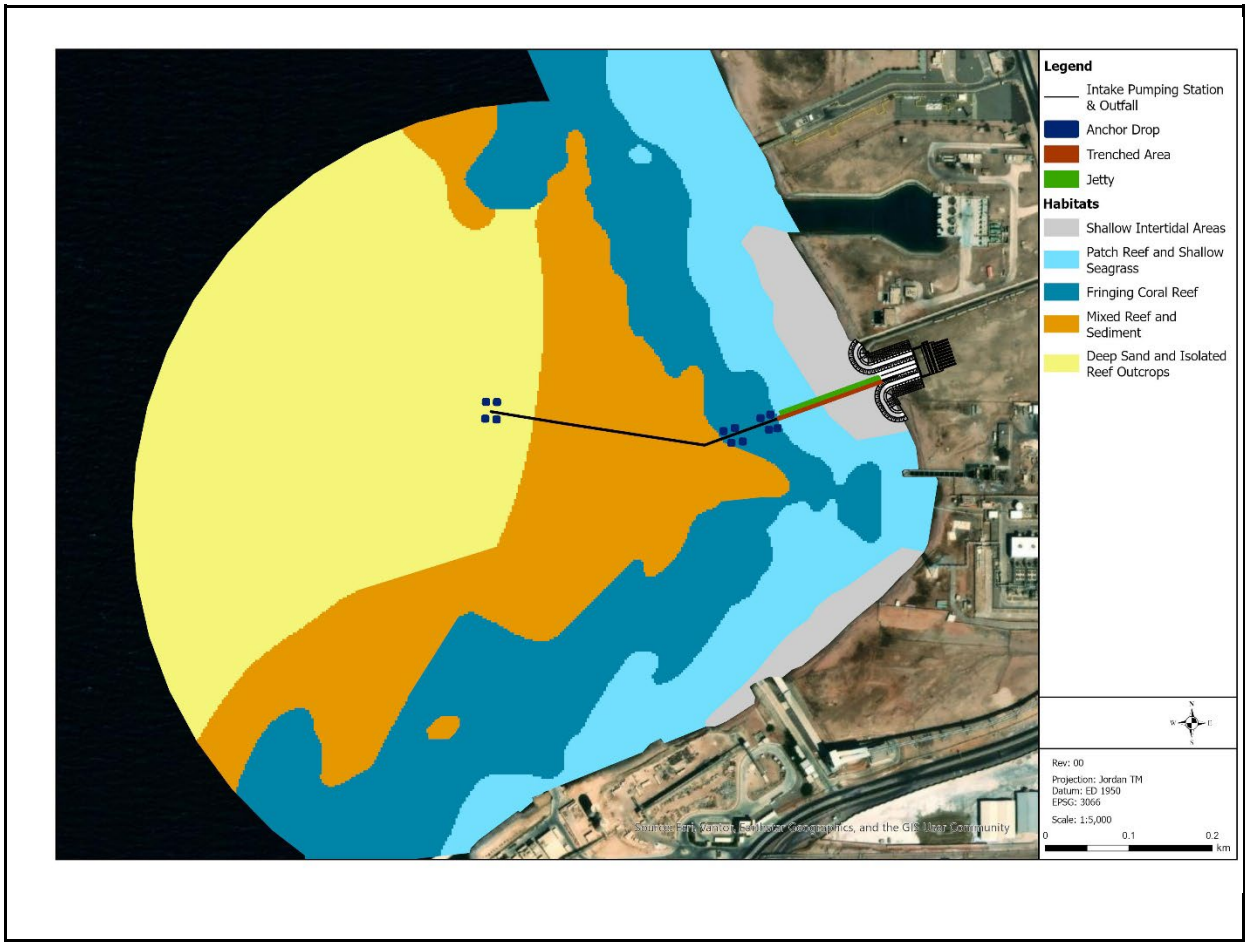
Quantification of impacts has been undertaken using the 2025 marine baseline survey and is provided in Table 9-3. The overall area of coral habitats in the study area affected by construction is less than 1%.

The seabed habitat types directly affected by the construction activities are provided in Figure 9-1 below.

Table 9-3: Quantification Of The Marine Construction Affected Area Within the Study Area

Habitat type	Coral cover	Depth range	Total reported in the study area m^2	Trenching, temporary jetty & anchoring area m^2	Lagoon construction and outfall installation area m^2	Total area m^2 affected by construction
Shallow Intertidal Areas	10%	0-5m	48,841	507	247	754
Patch Reef and Shallow Seagrass	10%	5-15m	119,648	466	25	491
Fringing Coral Reef	40%	15-35m	204,822	172	224	396
Mixed Reef and Sediment	15%	35-75	153,756	0	752	752
Deep Sand and Isolated Reef Outcrops	15%	75-150+m	225,372	86	167	253
Total area affected:			752,438	1,231	1,415	2,646 This represents 0.35% of the coral habitat in the study area

Figure 9-1: Predicted Areas and Habitats Directly Affected by Marine Construction



Overall, the impact magnitude of marine construction is assessed as **Minor Adverse**, with the following justification:

- The most significant impacts will occur due to the disturbance of seabed habitats, affecting less than 1% of the coral habitat in the study area
- Recovery of seagrass and coral will depend on a range of factors, most critical of which are suitable substrate types (hard substrates for coral and sandy sediments for seagrass) and water quality, including low turbidity. The construction work associated with lagoon construction, concrete mattress to protect the outfall, and the use of concrete ballast collars on the outfall, will provide a suitable habitat for coral recolonisation. The removal of the temporary jetty will enable the recovery of seagrass
- It has been assumed that the use of turbidity curtains will be effective in avoiding turbidity impacts, noting the additional mitigation provided below to verify this assumption
- Risks from sediment contamination remobilisation are considered low to insignificant, as is the risk/impacts from spills due to the limited number of construction vessels needed and the reliance on shore-based excavators for trenching, reducing the inventory of hazardous material and refuelling at sea
- Construction access jetty will be temporary and removed. The permanent seabed installation to protect the outfall, such as concrete mattresses, will be similar in seabed profile to the existing

undulating coral reef structures. The new lagoon seawall will extend less than 10m from the current shoreline, which includes mixed sand and hard substrate. The current wave and nearshore water movement is considered low due to prevailing wind strength and direction, and the potential for disruption to shoreline dynamics is considered minor (see mitigation below)

- Impacts will be localised and confined to the ESIA Study Area

9.2.4.2 Receptor Sensitivity

For marine construction impacts, the Area of Influence is considered to be within the seabed habitat footprint of the lagoon construction, trenching and temporary jetty, anchoring, and outfall installation.

The sensitivity of benthic habitats is assessed as **High**, with the following justification:

- Vulnerability and presence:
  - Coral and seagrass habitats are sensitive to direct impacts from smothering from the placement of material to construct the jetty, install the outfall and collars, and lagoon seawall
  - The vulnerability of the fish, turtle and cetacean species to trenching within the Area of Influence is considered low. This is due to controls to avoid turbidity, their potential to use behavioural responses to avoid prolonged exposure and, in the case of turtle and cetacean species, their low level of abundance
- Value
  - The 2025 marine baseline survey has confirmed the presence of natural habitat and the following Critical Habitat as per the classification in the Critical Habitat Assessment:
    - Coral reef and seagrass
    - Giant clam
    - Teleosts fish (Humphead wrasse (*Cheilinus undulatus*), Sky emperor (*Lethrinus mahsena*), Red Sea coral grouper (*Plectropomus marisrubri*)
- Resilience
  - Areas of coral and seagrass present within the Area of Influence will be directly affected by marine construction. However, natural regeneration is anticipated; hard substrate will be colonised by coral as observed within the study area, with coral growing on existing marine infrastructure. As coral habitats re-establish following construction, there will be no permanent physical loss of hard substrate; there will likely be an increase in hard substrate from the lagoon seawall, outfall and concrete collars. Losses to coral habitat are not considered irreversible or permanent, and overall habitat functionality/value could be enhanced by the installation of additional hard substrate to support coral growth and fish habitat. Opportunities to promote habitat enhancement are provided in the mitigation below.

9.2.4.3 Impact Significance, Mitigation and Residual Impacts

The impact significance of marine construction is considered **Medium.**

Mitigation to reduce the impact significance are defined below:

- Translocation of all critical habitat (coral and giant clams) within water depths that can be safely accessed by divers. In Jordan, it is an established practice to translocate coral under the

supervision of the ASZEA and the Jordan Marine Reserve, with reported survival rates of 80%. Coral Translocation Plans will be developed in consultation with applicable authorities, and finalised at least 3 months before the start of construction

- Construction planning, to be completed prior to construction:
  - The final design and marine construction methods selection process shall incorporate requirements for the avoidance and reduction of impacts, including:
    - Silt curtain deployment
    - Consideration of the feasibility of seasonal sensitivities associated with breeding/reproduction periods, especially coral, giant clam and seagrass
    - Onshore storage of trenched material storage with appropriate drainage control to prevent impacts to seawater quality, seagrass and coral
    - Post-construction benthic habitat restoration goals
    - An assessment of the construction, temporary, and permanent shoreline and submerged structures will be completed. The assessment will identify appropriate mitigation to avoid impacts associated with changes in shoreline dynamics, which will be incorporated into the design and associated monitoring plans, including the Biodiversity Management Plan
    - Materials and handling methods that will not leach pollutants and affect water quality will be promoted
  - Undertake a pre-construction marine environmental survey, including a diver cultural heritage assessment, before the start of construction, ensuring sufficient time to support:
    - Focusing on ROV data below 70m, the need for EDNA sampling to confirm the presence of fish and other CH and PBF fauna and the need to quantify coral to be impacted by construction
    - Survey of coral settlement using settlement tile arrays and assessing the potential to collect and include as supplementary material for the translocation plan
    - The evaluation of micro-routing of temporary and permanent shoreline and submerged Project infrastructure
  - Prepare the Coral Translocation Plan that will include:
    - Detailed mapping of coral/reef substrate within the construction footprint to identify material to be translocated
    - The process to create an inventory of associated corals to quantify the number, health and types of coral
    - How the inventory data will be integrated into defined reinstatement goals
  - Develop a spill prevention plan for the construction and operations phases, supported by engagement with the 3rd party asset owners and competent authorities integrated into the Pollution Prevention Management Plan
  - Construction Phase Pollution Prevention Plan will include hazardous materials, waste management, drainage and surface water controls to be implemented at the IPS to ensure avoidance of discharge to the sea of any potentially polluted drainage or run off

- Pollution Prevention Plan to include design safeguards, hazardous materials storage and handling, waste management, drainage and surface water, as well as the operational controls, including housekeeping, to be implemented at the Desalination Plant to ensure avoidance of discharge to the sea via the site drainage system of any potentially polluted drainage or run off, including elevated levels of suspended solids. The Pollution Prevention Plan will be prepared for the construction phase and updated for the operations phase
- Pollution Prevention Plan to include design safeguards, hazardous materials storage and handling, waste management, drainage and surface water, as well as the operational controls, including housekeeping, to be implemented at the Desalination Plant to ensure avoidance of discharge to the sea via the site drainage system of any potentially polluted drainage or run off, including elevated levels of suspended solids. The Pollution Prevention Plan will be prepared for the construction phase and updated for the operations phase and include inspection and monitoring requirements to verify controls effectiveness
- Prepare Pollution Prevention Management Plan to:
  - Prepare a hydrotesting procedure detailing how water will be sourced, describing and assessment the treatment, reuse and discharge activities, ensuring avoidance of pollution and erosion as well as management of water reuse for agricultural purposes
  - Assess contamination risk at the Project sites, using a risk-based approach
  - Hazardous materials (selection, management and use), drainage, wastewater (including all camp and construction site wastewater) and surface water discharges comply with applicable standards in Chapter 2 and avoid risk of pollution
- Prepare Navigation Safety Plan commensurate with the risks and impacts of the construction phase and operation phase, if required
- The Marine Construction Works Management Plan that will be included in the marine construction and installation contractor specification will include:
  - Requirements and controls for avoidance/reduction of benthic (seabed) habitat loss, turbidity, underwater sound, daily operational monitoring and reporting, refuelling, hazardous materials management, waste management, emergency and spill response, including the requirement for all galley waste, solid and liquid waste from vessels, is contained and shipped to shore, all vessel black and grey water is contained, collected and shipped to shore, vessel ballast water is segregated from sources of pollution and vessel deck drainage and wash water will be discharged to sea as long as no visible sheen is observable
  - Adaptive management requirements to respond to defined thresholds, within defined timescales, to manage construction and operational underwater sound, turbidity in the water column and other environmental criteria

- Construction phase:
  - Prior to the demobilisation of the marine construction and installation contractor, undertake a diver survey of the construction area to confirm that the marine habitat restoration targets have been achieved
  - Prior to demobilisation of the lagoon construction contractor, undertake a walkover survey of the construction area to confirm habitat restoration targets have been achieved and

integrate the findings into the Contractor's completion and demobilisation governance system

With the mitigation incorporated into the Project ESMS, including verification and reporting, the residual impact is considered **Medium**. The justification for impact significance is:

- The translocation of coral and giant clams in water depths of less than 35m, will target 1,641m^2, 62%, of the seabed habitat where coral is present within the study area. Coral translocation within a total area of 1,005m^2 is considered non-viable due to the water depths preventing access by divers
    - The Jordan Marine Reserve has reported a survival rate of 80% for translocated coral
- The outfall, the concrete collars, the lagoon seawall and the concrete mattress to protect the outfall to a depth of 10m, will provide an estimated 1,500m^2 of suitable substrate for coral, giant clam and fish habitat. This is considered sufficient to provide replacement habitat for which is considered non-viable due to the water depths preventing access by divers to translocate corals
    - Assess the feasibility of providing suitable habitats for the giant clam that embeds into substrate, noting that concrete will likely not be suitable
- The operational and monitoring controls that will support the planning of the work, effectiveness of the mitigations, as well as BMP and BAP that will validate the residual impact and mitigations
- A residual impact on Critical Habitat is currently predicted, associated with the forecast 80% survival of translocated coral. An offset to provide a net gain of an estimated 1,313 m^2 of equivalent habitat with coral cover ranging from 40% to 10% and consideration of seagrass cover, is required; this is further assessed in the BAP framework, which also considers the need for quality habitat metrics and offset multipliers (including time discounts) to provide net gain to all critical habitat species

9.2.5 Desalination Plant Operational Discharges

This assessment focuses on the routine discharge of effluent from the Desalination Plant (primarily brine from the reverse osmosis process), including backwash effluents and treated and neutralised Cleaning-In-Place (CIP) effluent that will be co-mingled with the desalination effluent discharge before discharge, as described in Chapter 5.

In alignment with Jordanian 2022 Guideline on EIA for Sea and Brackish Water Desalination Plants and considering other jurisdictions in the GoA (Saudi Arabia and Egypt), the proposed Desalination Plant discharge has been assessed using a mixing zone concept.

It is common for assessments of desalination plant effluent discharges to focus primarily on salinity and temperature. However, the discharge from a desalination plant may contain chemical components from other plant operations. These chemical components have the potential to impact the marine environment, as the dense brine plume is often poorly diluted in the near field and sinks to the seabed near the point of discharge. This can expose seabed habitats to high salinity and other chemical components at harmful concentrations, which, over the long term, can have environmental effects.

The assessment presented in this section used a mixing-zone approach to provide a robust evaluation of the environmental effects of the discharge plume, considering temperature, salinity, and chemical components.

The approach to defining the mixing zone presented in this section is based on the following:

- A 100-metre mixing zone has been adopted for discharge assessment. This is defined as a designated area in the receiving water body, extending up to 100 meters from the discharge point, where the effluent undergoes initial dilution and where certain water quality standards may be temporarily exceeded. The concept is widely used worldwide for environmental permitting
- For salinity, the criteria applied in the 2022 AAWDC Project ESIA at the boundary of the mixing zone was based on no exceedance greater than 2% of the natural ambient concentration in the receiving water; however:
    - No specific reference is provided in the 2022 AAWDC Project ESIA for this 2% value.
    - This 2% level is understood to likely refer to the ambient environment's monthly average salinity in the Environmental Controls for the industrial development of Jubail and Yanbu (which is a special case in Saudi Arabia)
    - Applying a 2% criterion requires that the salinity is no more than 0.82 ppt (0.82 PSU) above the monthly average value. This value is less than the measured natural variation in salinity and is considered highly conservative
- For other chemical components in the brine discharge (excluding salinity): A consistent approach has been adopted with other jurisdictions in the Gulf of Aqaba. The criteria applied at the boundary of the mixing zone were based on the requirement that no more than 5% of the natural ambient concentrations in the mixing zone can be exceeded
    - The chemical components assessed include those chemicals that may create pollution based on a review of the EPC Contractor's provided data on chemical injection into the desalination process plant. In addition, the Project discharge standards in Chapter 2 were considered, which include zero chlorine in desalination plant effluent

To determine the magnitude of effects, the plume behaviour, and plume composition (temperature, salinity, and concentrations of chemical components) have been considered.

9.2.5.1 Magnitude of Effect Plume Behaviour

An assessment of plume dispersion was undertaken using Delft3D modelling software (see Appendix 9A.1) to support the adoption of a mixing zone approach based on the discharge outfall characteristics and design parameters as provided in Chapter 5. Key inputs included:

- Discharge flow rate of 11.78m^3/s (based on daily average flowrates)
- Elevated temperature of the discharge compared to the ambient temperature of the seawater intake of 1^oC
- Outfall diffuser located in water depths of -50m to -80m
- Diffuser designed to maximise dilution prior to discharge plume reaching the seabed (termed as “touchdown”). The outfall diffuser design features vertically oriented ports at 60°. In the absence of current effects, this design results in the discharge plume's initial trajectory being driven upwards until it reaches its maximum rise height, and its negative buoyancy causes it to fall back towards the seabed. The falling brine plume will then interact with the seabed, and further spreading is dominated by a gravity wave effect (see Figure 9-2)

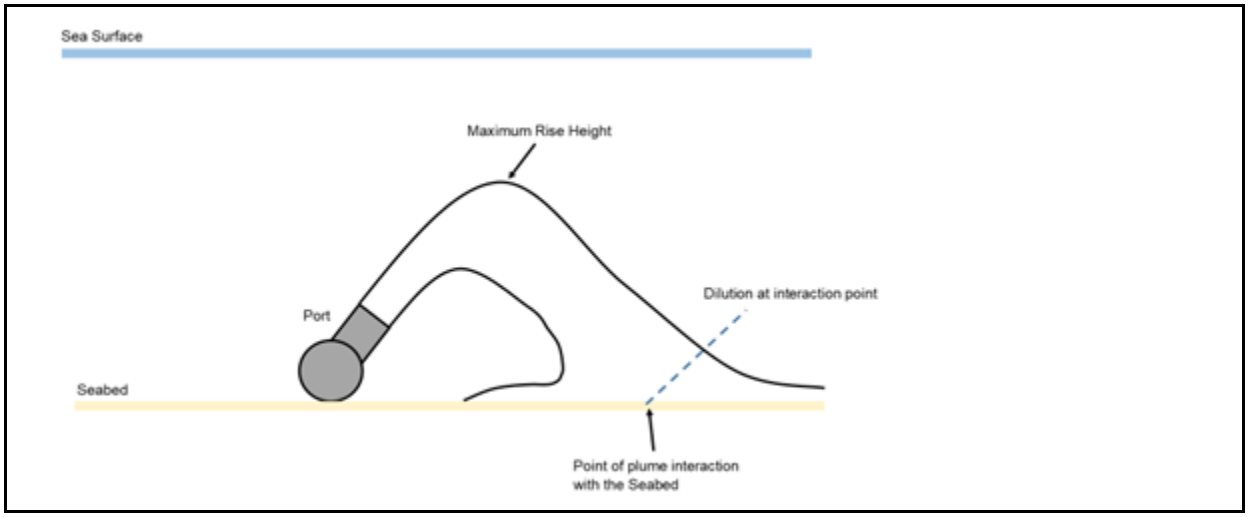
The results of the discharge plume dispersion modelling are presented in Table 9-4 assuming worst-case winter conditions. The modelling limitations include a simplified approach to seabed topography in the

absence of high-resolution bathymetry data. The plume dispersion modelling results indicate that the point of interaction between the plume and the seabed, the distance to the seabed touch down, occurs approximately 17m from the diffuser. At this point, a dilution of 31 times from the outlet of the diffuser is achieved, see Figure 9-2. At the edge of the 100m mixing zone, a dilution of 39 times is achieved. The plume is not predicted to reach the sea surface.

Table 9-4: Summary of Discharge Plume Dispersion Modelling Results

Parameter	Results
Horizontal distance to the maximum rise height	10m
Maximum rise height (relative to the seabed)	18m
Distance to seabed touch down from diffuser	17m
Dilution at touchdown	31 times
Minimum Dilution at 100 m	39 times

Figure 9-2: Theoretical Behaviour of Dispersion Plume from Outfall Diffuser



9.2.5.2 Magnitude of Effect Plume Composition

The effluent discharge temperature is expected to be 1°C above seawater intake temperature. This is expected to have no significant environmental impacts, with the plume reaching ambient seawater temperatures well within the mixing zone before the touchdown point, 17 m from the diffuser ports.

The modelling demonstrated that the 2% salinity criterion within the 100 m mixing zone was exceeded, with the plume extending by 153 m beyond the mixing zone perimeter, see Figure 9-3. The total area of seabed habitat that will be exposed to a greater than the 2% value of 0.82 psu is 9,076m^2. Water depths within this area exceed 100m, and coral cover is reported to be less than 15% due to light availability and a lack of suitable substrate. A summary of the spatial area impacted by the salinity plume is provided in Table 9-5.

Figure 9-3: Predicted Extent of Excess Salinity Relative to Natural Background Concentration (Winter Conditions with NE Wind)

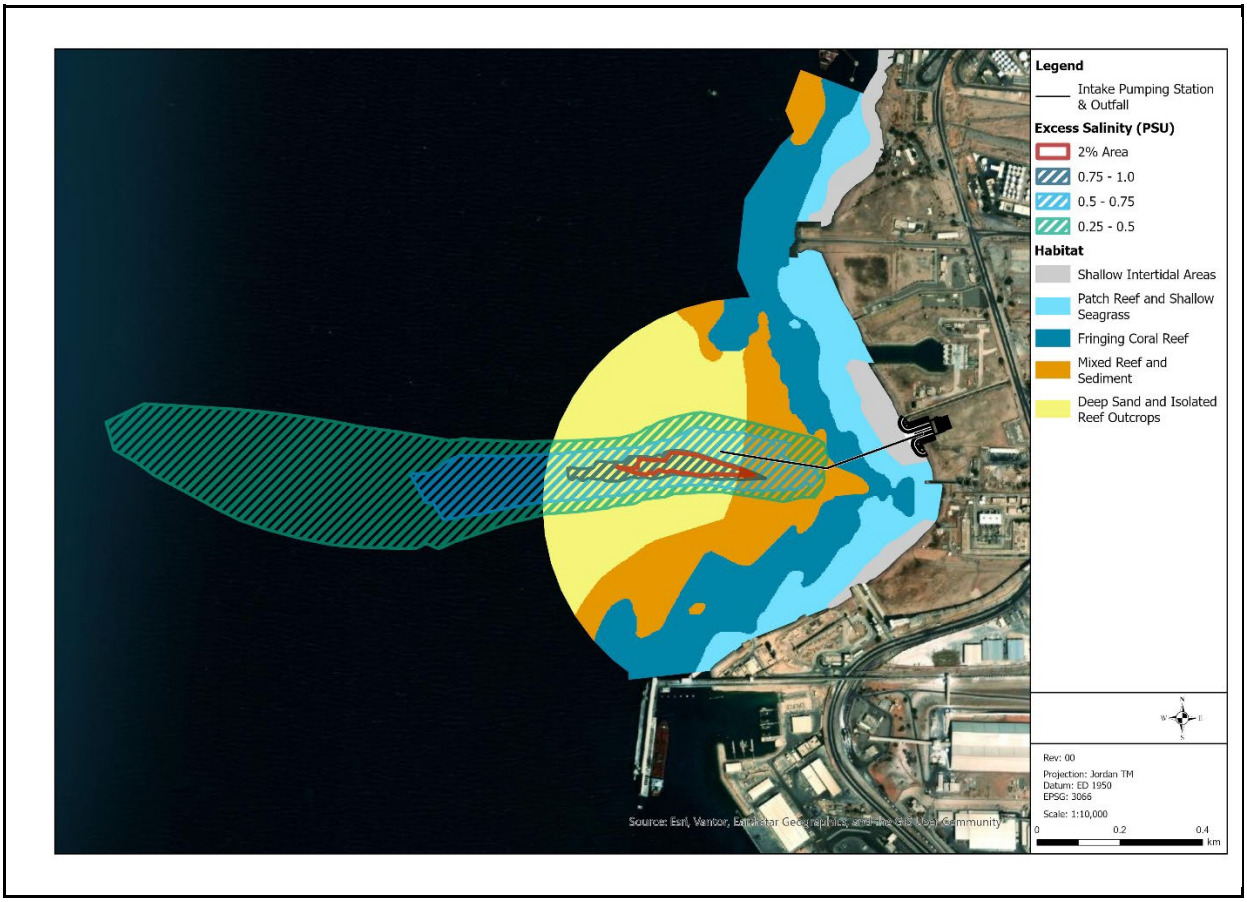


Table 9-5: Quantification of Plume Affected Area Within The Study Area

Habitat type	Coral cover %	Depth range	Total reported in the study area m^2	Total area m^2 affected by the plume
Shallow Intertidal Areas	10%	0-5m	48,841	No impact
Patch Reef and Shallow Seagrass	10%	5-15m	119,648	No impact
Fringing Coral Reef	40%	15-35m	204,822	No impact
Deep Mixed Reef and Sediment	15%	35-75	153,756	305
Deep Sand and Isolated Reef Outcrops	15%	75-150+m	225,372	8,771
Total within the study area			752,438	9,076 This represents 1.2% of the coral habitat in the study area

Modelled concentrations of brine at the Egyptian and Saudi Arabian border were predicted to be 0.1 to 0.15 PSU (at the 98th percentile level), well below the 2% salinity criterion. This value is less than the measured natural variation in salinity and below thresholds of measurable impacts.

To assess the chemical components in the plume, the following components are not considered significant, noting that within the mitigation section, verification and monitoring commitments are included for additional assurance:

- Chlorination and halogenated organic compounds
    - Sulphuric acid/sodium hypochlorite shock dosing will occur for 4 hours every six months to dosing at the outlet of the IPS upstream of a manifold (preventing back-flow into the intake lagoon) to remove any biofouling of these structures. Hypochlorite is a short-lived chemical species in seawater and is unlikely to be detectable within the desalination plant after seawater intake treatment; however, it can be transformed into halogenated disinfection by-products (halogenated organic compounds). Any halogenated organics or halogenated compounds are likely to be removed during the water treatment process by the coagulation and filtration of the feed water, and the subsequent solids handling process, which will remove coagulated solids, including added polymers and some iron, from the effluent. Halogenated organic compounds, hypochlorite and polymers are therefore not expected to be discharged in the brine effluent. The plant will include online continuous monitoring to confirm zero chlorine in the effluent as an additional safeguard. Additional monitoring commitments are included in the mitigation section below
- The use of 2-2 dibromo-3-nitrilopropionamide (DBNPA) during Cleaning in Place (CIP) and its neutralisation prior to mixing with the brine and discharge
    - Whilst 2-2 dibromo-3-nitrilopropionamide (DBNPA) will be used as a CIP chemical at a concentration of 0.2 g/litre in a 300 m3 batch, this material will be deactivated by alkaline hydrolysis before mixing with the discharge stream. Alkaline hydrolysis of DBNPA yields ammonia, carbon dioxide, bromide ions, and cyanoacetic acid
    - Currently, DBNPA is a candidate for substitution under the EU REACH regulations; however, it does have an approved use[2] under three product types and an ongoing evaluation[3] for use as product type 12; slimicide for the prevention or control of slime growth on materials, equipment and structures, used in industrial processes. Within the European context, if this approval is granted, then DBNPA is considered appropriate for use in the EU on desalination plants and therefore not subject to the provisions of the European Development Finance Institutions (EDFI) and French Development Agency (AFD) exclusion lists
- Limiting nutrients, such as phosphorus and nitrogen (ammonia and nitrate), and high chemical oxygen demand
    - The Gulf of Aqaba is an oligotrophic environment; in such environments, the discharge of limiting nutrients can impact water quality and ecosystems due to eutrophication and oxygen depletion. It is therefore important to fully understand and assess all components of routine discharges. The currently available information on chemicals to be used in the plant does not list any such chemicals and impacts from limiting nutrients

[2] https://echa.europa.eu/regulations/biocidal-products-regulation/approval-of-active-substances/bpc-opinions-on-active-substance-approva
[3] https://echa.europa.eu/pt/information-on-chemicals/biocidal-active-substances/-/disas/factsheet/1224/PT12

The assessment of chemical components has focused on the process chemicals listed in Chapter 5 for routine water treatment and CIP. Table 9-6 and Table 9-7 below provide the results of the calculations to determine the concentrations at the outfall (end-of-pipe), targets and predicted concentrations at the edge of the 100m mixing zone and the point of interaction (touchdown) between the plume and the seabed. The results show key parameters within the discharge would be expected to reach 5% of ambient seawater concentrations both within the 100m mixing zone and at the predicted touchdown distance (at 17m from the point of discharge), with the exception of iron.

In its simplest form, the discharge of brine from a desalination plant may be viewed as a discharge of concentrated seawater, which will be diluted back to seawater after discharge. However, if significant quantities of major ions are added to the discharge, such that the ratio of major ions is significantly altered from that of the ambient seawater, it is possible for the seawater to impact sensitive life stages of marine life.

The additional ionic chemicals used in the desalination plant are generally not expected to make a significant contribution to the concentrations of the various anions and cations discharged from the desalination plant, as the concentrated brine is by far the more dominant source of these. Based on the proposed dosage rates, the added chemicals are not expected to be present at concentrations that would cause any significant distortion of the ratios of major ions in the desalination plant effluent relative to seawater.

The exception to this is iron derived from the ferric chloride used as a flocculant in the process. This has been assessed at the project's stated average and maximum discharge concentrations of 0.3 and 0.5 mg/l, respectively. These concentrations are larger than the natural ambient concentrations of iron in the Gulf of Aqaba (1.94 µg/l maximum) and there is insufficient dilution of the discharge to achieve sufficient dilutions within the 100 m mixing zone. Metal tolerance is a well-described phenomenon in marine invertebrates living in metal-polluted environments, where they are exposed to elevated concentrations of soluble (<0.45 µm) and particulate iron. For corals, there is evidence that they may be able to effectively regulate, or even exclude, heavy metals from entering coral tissues, and/or sequester them into their skeletons. However, for corals not acclimatised to metal-polluted environments, exposure can lead to a loss of their symbiotic zooxanthellae algae with concurrent physiological effects. Experiments have indicated that corals acclimatised to metal-polluted sites showed an effect of iron at concentrations above 0.01mg/l and non-acclimatised corals at concentrations above 0.005mg/l (Harland & Brown, 1989; Brown, Tudhope, Le Tissier, & Scoffin, 1991). The predicted iron concentration at the edge of the 100m is highest during CIP, at 0.014 mg/l.

Overall, based on the proposed dosage rates, except for iron, the added chemicals are not expected to be present at concentrations that would significantly distort the ratios of major ions in the desalination plant effluent relative to seawater.

Table 9-6: Routine Scenario Discharge Quality Excluding Salinity and Temperature

Discharge Components	Ambient (based on June 2024 projections feed data)	Predicted End-of-Pipe Concentration (mg/l)	Target concentration to achieve 5% ambient criteria (mg/l)	Predicted Concentration at edge of 100m mixing zone (5% criteria) (mg/l)	Predicted Concentration at touchdown (5% criteria) (mg/l)	5% criteria achieved at the edge of the 100m mixing zone and before touchdown
Iron	0.00194	0.300	0.00204	0.0094	0.0116	No
Chloride	24,074	48,933	25,278	24,695	24,876	Yes
Sodium	12,997	26,417	13,647	13,332	13,430	Yes
Magnesium	1,730	3,516	1,817	1,774	1,788	Yes
Calcium	611	1,242	642	627	631	Yes
Potassium	559	1,136	587	573	578	Yes
Sulphate	3,250	6,606	3,413	3,334	3,358	Yes
Bicarbonate	174	354	183	178	180	Yes

Table 9-7: CIP Scenario Discharge Quality Excluding Salinity and Temperature

Discharge Components	Ambient (based on June 2024 projections feed data)	Predicted End-of-Pipe Concentration (mg/l)	Target concentration to achieve 5% ambient criteria (mg/l)	Predicted Concentration at edge of 100m mixing zone (5% criteria) (mg/l)	Predicted Concentration at touchdown (5% criteria) (mg/l)	5% criteria achieved at the edge of the 100m mixing zone and before touchdown
Iron	0.00194	0.500	0.00204	0.014	0.018	No
Chloride	24,074	48,936	25,278	24,696	24,876	Yes
Sodium	12,997	26,444	13,647	13,333	13,431	Yes
Magnesium	1,730	3,516	1,817	1,775	1,788	Yes
Calcium	611	1,242	642	628	631	Yes
Potassium	559	1,136	587	573	578	Yes
Sulphate	3,250	6,607	3,413	3,334	3,358	Yes
Bicarbonate	174	354	183	178	180	Yes

Overall, the impact of routine discharge of brine from the desalination plant and non-routine discharge, including treated and neutralised Cleaning-In-Place effluent, is assessed as **Minor Adverse,** with the following justification:

- The maximum excess salinity at 100m from the diffuser is close to the 2% criterion, i.e. maximum increase of 2% as compared to background salinity concentrations. While the criterion is slightly exceeded based on the assessment completed, the total exposed coral habitat is less than 2% of the total coral habitat in the Study Area
- The assessment of other inorganic components within the effluent discharge under routine and non-routine discharge conditions (i.e. with and without the neutralised Cleaning-In-Place effluent), aside from iron, is predicted to be below the +5% criteria within 17m from the point of discharge, i.e. concentrations at 17m from the discharge will be within 5% of ambient seawater concentrations

Other discharges during operations include drainage and runoff from the IPS and desalination plant. It is assumed these will comprise normally clean runoff only with operational and design systems in place to segregate drainage to avoid mixing of drainage from areas with hazardous materials with areas only exposed to rainwater and as such no impact to the marine environment is anticipated. Mitigation is however specified to ensure safeguards are appropriately specified and in place.

9.2.5.3 Receptor Sensitivity

For routine discharges from the desalination plant, the Area of Influence is considered to be the area where salinity is greater than 2% of the natural ambient concentration. This focuses on impacts on the exposed deep mixed reef and sediment habitat, deep sand and isolated reef outcrops habitats, as well as pelagic species.

The sensitivity of seabed habitats and pelagic species is assessed as **High**, with the following justification:

- Vulnerability and presence:
    - The deep mixed reef and sediment, and deep sand and isolated reef outcrops habitats that will be exposed to the discharge plume represent less than 2% of the total coral habitat in the Study Area
    - The vulnerability of the fish, turtle and cetacean species likely to be present within the area affected by the discharge is considered low due to the low habitat quality compared to the higher quality shallower water coral and seagrass habitats and behavioural avoidance
- Value
    - The Critical Habitat Assessment has confirmed that there are 3 species of fish triggering Critical Habitat criteria and 13 species, including turtle, cetacean and fish species, triggering Priority Biodiversity Feature criteria, as well as coral reef and seagrass and a species of clam triggering Critical Habitat criteria in the benthic environment
    - The deep coral habitats that are exposed have up to 15% coral cover and have the lowest biodiversity within the Study Area. Note that the higher value shallower water reef and seagrass habitats that are richer, have more diverse and abundant coral, will not be affected
- Resilience
    - The resilience of coral present within the Area of Influence to the effects of the discharge plume is considered to be moderate on the basis that, aside from iron and salinity, the

increases in concentrations above ambient seawater concentrations were within 2% of the ambient concentration within 17m from the point of discharge

- While the modelling predicts an exceedance of the 2% criterion for salinity, no more than 2% above ambient at 100m from the discharge, there is evidence that coral has the potential to adapt to higher salinities within the expected range and that natural succession may enable salt-tolerant coral taxa to replace those taxa that are not tolerant

9.2.5.4 Impact Significance, Mitigation and Residual Impacts

The impact significance of Desalination Plant operational discharges is considered **Medium.** Mitigation to reduce the potential impact significance are defined below:

Before the completion of the detailed design:

- Completion of a Remotely Operated Vehicle survey of the outfall diffuser and plume area where the 2% salinity criteria is exceeded, to assess presence, abundance and quality of seabed habitats
- The final outfall and Desalination Plant design and operations and maintenance (O&M) procedures selection process shall incorporate the findings of this assessment and:
  - Assess the feasibility of process controls or treatment that can be integrated into the plant to reduce the discharge concentration of iron
- Diffuser and port configuration will be designed to maximise dispersion near the diffusers and to minimise the extent of the area where salinity exceeds 2%
- Prior to the selection of the outfall and Desalination Plant design and O&M procedures, implement the E&S Management of Change Process to validate that there is no material change in impact
- Desalination Plant O&M procedures to comply with the discharge standards and the results of this assessment of operational discharges, which will include a reporting system for process controls and chemical usage that are critical to maintain compliance with discharge standards Desalination Plant O&M procedures to comply with the discharge standards and the results of this assessment of operational discharges, which will include:
  - Reporting system for process controls and chemical usage that are critical to maintain compliance with discharge standards
  - Detailed commissioning and operational sampling and monitoring plan to include intermediate sampling points monitoring, not only at the end of pipe, with the frequency of sampling consistent with a review of plant operational variability and O&M activities
  - An online water quality monitoring station that will be installed on the discharged water line, if equipment available in Jordan and if security authorities allow. This will continuously monitor, at a minimum, turbidity, conductivity, temperature, residual chlorine, pH and pressure
  - A non-continuous, routine sampling and offline laboratory analysis will be performed of chemical oxygen demand, iron and halogenated organic compounds and other parameters included in the Project Discharge Standards
- The plant commissioning sampling schedule will initially be frequent (e.g. at least daily) and ensure that discharges during all modes of plant operation are sampled and analysed

- Additional sampling of upstream locations will be defined in the process to provide additional information on items of concern, such as complete neutralization of DBNPA, and the potential formation of halogenated organic compounds after treatment of the intakes with hypochlorite. The frequent sampling should continue until the chemical profile of the plant effluent has stabilised and a good dataset describing the effluent's variation with operating modes is established and understood
- After an initial phase, the sampling frequency should be reviewed to ensure that the sampling schedule is such that robust information is available to demonstrate compliance of the discharge with respect to discharge standards for iron (0.3 mg/L average, 0.5 mg/l maximum) and halogenated organic compounds (zero)
- Feasibility of whole effluent toxicity testing will be assessed, noting a review will be completed of the needs and benefits, including the implications of establishing a locally accredited facility
- Detailed design of the Desalination Plant, Pumping Stations and AGI, to include measures to prevent pollution to soils, groundwater and/or surface water from potentially contaminated drainage
- Prior to the start of operations:
    - Update the Project Pollution Prevention Plan and ensure the resources to implement the commissioning and operational sampling and monitoring plan are available
    - Update the Biodiversity Management Plan and benthic habitat monitoring program to support the operations phase
- Operations phase:
    - Implement the operations phase Project Pollution Prevention Plan
    - Implement the Biodiversity Management Plan, Biodiversity Action Plan and associated biodiversity monitoring requirements

With the application of the mitigation incorporated into the Project ESMS, with verification and reporting, the residual impact is considered **Medium**, as the magnitude of the impact is expected to remain minor and not be reduced to negligible. Further reductions in the impact magnitude would require integrating the additional mitigation described above into the Desalination Plant process and outfall design.

A residual impact on critical habitat is currently predicted, associated with increased salinity within the plume above the 2% ambient threshold. An offset to provide a net gain of an estimated 9,076 m^2 of coral habitat with coral cover of 15% or lower is required; this is further assessed in the BAP framework which also considers the need for quality habitat metrics to provide gain to other critical habitat species.

9.2.6 Abstraction of Seawater

This assessment focuses on the operational phase and the impacts associated with seawater abstraction. Key features of the system are provided below:

- The planned intake flow rate is 21.8m^3/s
- A new intake lagoon will be constructed
- A bubble curtain at the mouth will be continuously operated; this will significantly reduce the potential entrainment of suspended and floating material. Further details are provided below

- A fish recovery and return system will be used to recover a fish or other fauna that passes through the bubble curtain and automatically and reliably filter incoming water and discharge recovered marine life and debris into the appropriate handling trough and returned outside of the lagoon
- A two-stage screen that will include a 50mm coarse and 5mm fine mesh

9.2.6.1 Magnitude of Effect

The adoption of an artificial lagoon-based abstraction location, along with the bubble curtain and fish recovery and return system, will provide multiple safeguards to mitigate the entrainment of fish and marine fauna, such as turtles. Impacts on fish and marine fauna are considered negligible, as bubble curtains and fish recovery and return systems have been used at power stations and during marine construction activities as effective barriers (Chang, *et al*., 2024).

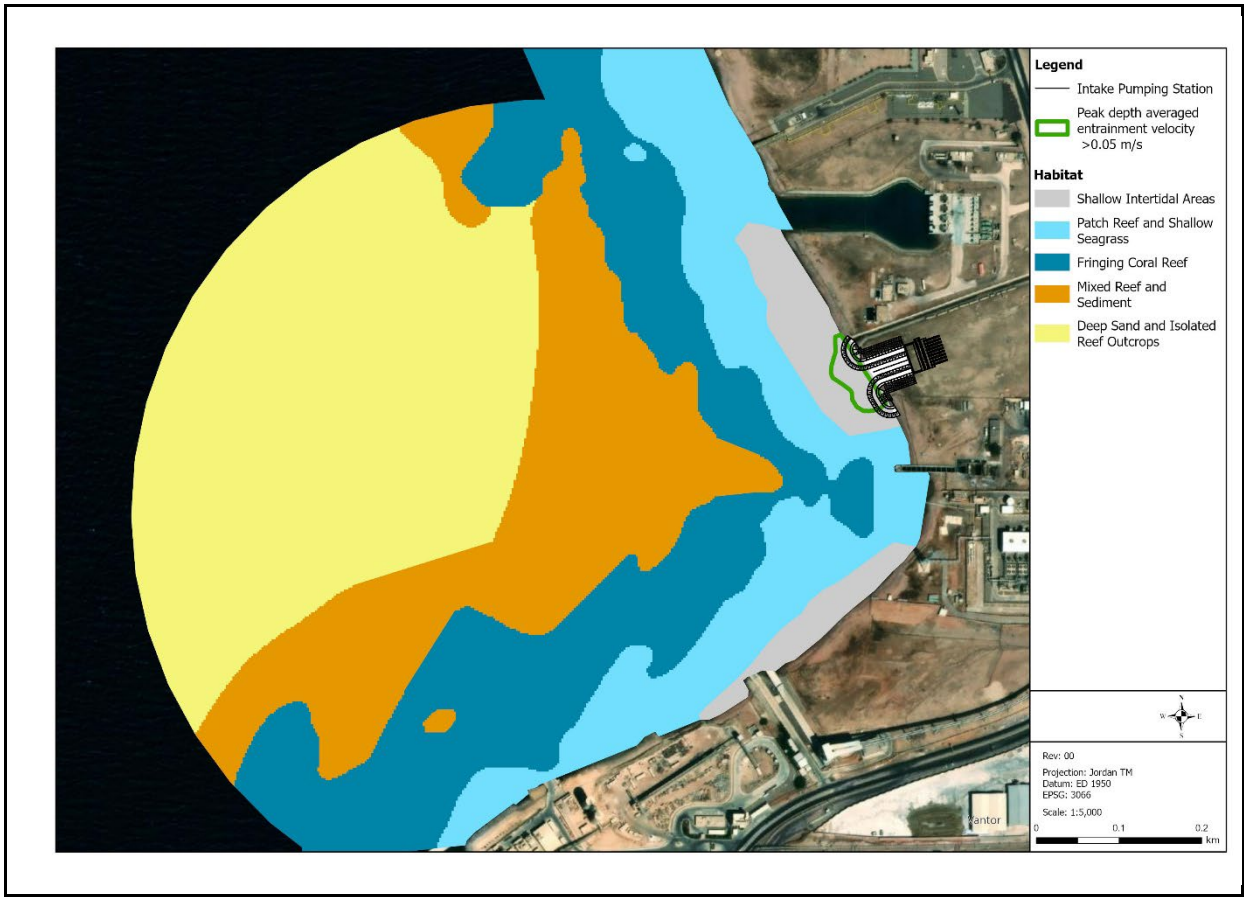
The entrainment of coral larvae, seagrass that pollinate through the water column (which includes most species in the Gulf of Aqaba), and bivalves (specifically the giant clam) that trigger critical habitat is of primary concern. A key factor in determining the magnitude of the impact is:

- The entrainment velocity at the mouth of the lagoon and in the surrounding area
- The habitat within the area that could provide a local source of species with planktonic larval life forms:
    - Seagrass pollen or seeds
    - Coral planula larvae
    - Giant clam gametes (eggs and sperm)
    - Fish, noting the assessment below focuses on coral and clams

The artificial intake lagoon is located in a coastal area not exposed to significant wave action or water currents due to the coastline's morphology. The lagoon is within a discrete bay sheltered in the north and south by headlands that have been developed to provide port facilities. As described in Chapter 6, the dominant current direction is south-east, parallel to the predominant wind direction, with typical current speeds of 0.05 m/s. Shallow intertidal habitat is present on the seaward side of the proposed lagoon, with coral cover reported to be 2%.

An assessment of the entrainment velocity at the mouth of the lagoon has been completed, see Figure 9-4. The results show that within 30 metres from the lagoon, the velocity of the intake suction is similar to typical water current speeds of 0.05 m/s.

Figure 9-4: Entrainment Velocity at the Mouth of the Lagoon



Within the intake suction area where current speeds exceed normal currents, there is no seagrass. The 2025 marine baseline survey recorded intertidal habitats that do not offer suitable sandy seabed conditions for seagrass. Therefore, the potential impact magnitude on seagrass reproduction through pollen or seed entrainment is deemed low, particularly as the bubble curtain would prevent a barrier to the majority of the seagrass pollen or seeds if present, which would typically be non-viable at the entrance to the lagoon since they would be washed ashore under normal conditions.

Current velocity significantly affects coral larvae and giant clam gametes by controlling their dispersal, retention, and settlement. Moderate flows are often ideal for transport, and slow flows (within the benthic boundary layer) are needed for attachment, while strong currents can sweep them away or hinder settlement. Coral larvae and giant gametes rely on currents for dispersal as they are weak swimmers (with reported speeds ranging from 0.005 m/s to 0.0001m/s), so they are largely passive drifters compared to currents.

Key issues that influence the significance of the impact magnitude associated with coral larvae and other species with planktonic larval life forms, including giant clam gametes entrainment into the lagoon, are considered below:

- The bubble curtain will provide a barrier to entrainment, not assumed to be 100% effective for the size range of coral larvae and giant clam gametes (0.1 to 0.09mm), but it is assumed it could reduce entrainment in the range of 40-50% (higher for seagrass pollen and seeds, which are larger, in the range 0.2-5mm), as reported by the EPC contractor. This is an estimate and will be

confirmed by a settlement study within the lagoon during the operational phase and integrated into the BAP, see the mitigation below

- The footprint of the area where intake current velocity exceeds normal current speeds (>0.05 m/s) covers an area of approximately 3,500m^2
    - This seabed habitat in this area is classified as intertidal, with the lowest coral cover at 2% and the giant clam is present
- The impact magnitude on coral reproduction due to entrainment through the bubble curtain is considered negligible for the following reasons:
    - The likely abundance of coral larvae from corals where the intake current velocity exceeds normal current speeds is very low
    - Any coral larvae present that could be abstracted, passing through the bubble curtain, will already be very close to shore/beach, and the chances of them being viable and able to settle are considered very low, as evidenced by the low coral cover recorded
- The impact magnitude on clams, including the triggering critical habitat species, because of entrainment of the reproduction stage gametes through the bubble curtain, is considered moderate for the following reasons:
    - The 2025 marine baseline survey reported giant clams within this area
    - A proportion of the giant clam gametes within the area where the intake current velocity exceeds normal current speeds will potentially be entrained, and it is assumed that the bubble curtain will deflect at least 40% of the gametes
    - Clams from outside of the intake current footprint, but in the Study Area, may likely suffer some reduced reproductive success (albeit natural reproductive success is less than 10%) as prevailing currents will keep gametes close to shore and thereby potentially enter the intake current footprint
    - Overall, the total area of habitat that will potentially become non-viable for the settlement of clam larvae, as it's within the abstraction suction footprint, is estimated to be approximately 3,500 m^2

A conservative assessment of the potential impacts to coral and other species with planktonic larval life forms, including the Giant clam, for the whole Study Area has been undertaken, see Table 9-8. The total area that could be affected by plankton larval entrainment is considered less than 5% of the seabed habitat within the Study Area. Impacts beyond the Study Area are not expected.

Table 9-8: Quantification of Abstraction Affected Area Within the Study Area

Habitat type	Coral cover %	Depth range	Total reported in the Study Area m^2	Total area m^2 affected by the abstraction
Shallow Intertidal Areas	10% - noting in the abstraction area a range of 2-	0-5m	48,841	3,500, assuming 100% impacts on viable coral larvae and clam gametes recruitment

Habitat type	Coral cover %	Depth range	Total reported in the Study Area m^2	Total area m^2 affected by the abstraction
	3% was reported			
Patch Reef and Shallow Seagrass	10%	5-15m	119,648	17,947, assuming 15% impacts on viable coral larvae and clam gametes recruitment
Fringing Coral Reef	40%	15-35m	204,822	10,241, assuming 5% impacts on viable coral larvae and clam gametes recruitment
Deep Mixed Reef and Sediment	15%	35-75	153,756	No impact
Deep Sand and Isolated Reef Outcrops	15%	75-150+m	225,372	No impact
Total within the Study Area			752,438	35,946 This represents 4.2% of the coral habitat in the Study Area. Note that 21,447m^2 of the affected habitat has coral cover of 10% or lower

Overall, the impact of routine abstraction of water by the desalination plant is assessed as **Minor Adverse,** with the following justification:

- Potential impacts on viable coral larvae and clam gametes recruitment will occur within less than 5 % of the coral habitat, which also supports clam gametes in the Study Area
- Impacts will be localised and confined to the Study Area.

9.2.6.2 Receptor Sensitivity

For seawater abstraction impacts, the Area of Influence is considered to be within the Study Area and predominantly within the shallower parts of the reef habitat.

The sensitivity of benthic habitats is assessed as **High**, with the following justification:

- Species with planktonic larval life forms are present within the area of influence, including
  - Seagrass pollen or seeds
  - Coral larvae
  - Giant clam gametes (eggs and sperm)
  - Fish, noting the assessment below focuses on coral and clams
- Value
  - The 2025 marine baseline survey has confirmed the presence of natural habitat and the following Critical Habitat as per the classification in the Critical Habitat Assessment:
    - Coral reef and seagrass

- Giant clam
- Teleosts fish (Humphead wrasse (*Cheilinus undulatus*), Sky emperor (*Lethrinus mahsena*), Red Sea coral grouper (*Plectropomus marisrubri*)

- Resilience
  - The resilience of the coral habitat and species impacted by the entrainment is considered high due to the footprint of the area impacted being less than 5% of the equivalent habitat

9.2.6.3 Impact Significance, Mitigation and Residual Impacts

The impact significance of seawater abstraction is considered **Medium**. Mitigation to reduce the potential impact significance is defined below:

- Before the completion of the detailed design and finalisation of the abstraction design:
  - Design and start a coral settlement field study that will confirm the baseline planktonic larval spawning/reproduction periods, and assuming access to the existing intake lagoon can be arranged, install settlement plates in this lagoon
  - EPC to integrate into final design, operations and maintenance (O&M) procedures the results of an intake entrainment mitigation assessment to select:
    - Feasibility and optimum bubble curtain design, including the need for an additional deflector curtain (in addition to the curtain across the mouth of the lagoon) (using results of coral/plankton reproduction assessment
    - Feasibility and optimum design of the fish recovery and return system
  - The outcome of the intake entrainment mitigation assessment and confirmation of the construction benthic habitat impacts and coral settlement field study shall be integrated into the Biodiversity Management Plan and updates to the BAP framework
  - An appropriate coral and seagrass monitoring program will initially support the planning, implementation and target setting to achieve measurable goals (No net loss and or Net Gain) for all critical habitat species and habitats, considering potential entrainment impacts and the environmental baseline limitations identified in Chapter 6
- Prior to the start of operations:
  - Integrate the intake entrainment mitigation assessment and O&M controls to support the entrainment mitigation to reduce planktonic larval spawning/reproduction entrainment
- Operations phase:
  - Implement the operations phase Biodiversity Management Plan, Biodiversity Action Plan, associated biodiversity monitoring requirements and support the coral replenishment program

With the application of the mitigation incorporated into the Project ESMS, with verification and reporting, the residual impact is considered **Medium**, as the magnitude of the impact is expected to remain minor and not be reduced to negligible. Further reductions in the impact magnitude would require integrating the mitigation described above into the intake lagoon bubble curtain, and completing studies to validate the impacts of viable coral larvae, seagrass and clam gamete recruitment.

A residual impact on Critical Habitat is currently predicted, associated with seawater abstraction. An offset to provide a net gain of an estimated 21,447 m^2 of coral habitat with coral cover of 10% or lower is required; this is further assessed in the BAP framework, which also considers the need for quality habitat metrics to provide gain to other critical habitat species.

9.3 Terrestrial Environment

9.3.1 Scoping

Construction and operation activities are detailed in Chapter 5 and will include:

- Construction works at the Intake Pumping Station (IPS), Desalination Plant, Conveyance System AGIs, Renewable Energy Facility, Conveyance Pipeline, the associated facilities (the Overhead Transmission Lines (OHTLs), the substations to support Desalination Plant and Renewable Energy Facility, Abu Alanda Reservoir 2 and Al Muntazah Reservoir in Amman. Construction activities will include:
    - Movement of vehicles, equipment, and personnel
    - Upgrade of existing and creation of new tracks for access
    - Preparation of the Conveyance Pipeline working strip (topsoil removal, vegetation clearance)
    - Backfilling and reinstatement of pipeline trench and temporarily disturbed land from construction
    - Pipeline crossing, including wadi crossings
    - Construction of temporary facilities (camps and yards)
    - AGI construction, including site clearance, temporary and permanent drainage controls
    - Operation of construction camps
- Currently, the locations of the five construction camps have not been confirmed, with 2 or 3 of them not in the urban areas of Amman or Aqaba. Each camp will accommodate up to 1,500 persons and will be operational for approximately 36 months
- Operation and maintenance phase will include movement of vehicles, equipment, and personnel, inspection of the pipeline right of way and operation of the IPS, Desalination Plant, AGIs and the associated facilities
- Construction and Operation phase resource usage, including raw materials such as aggregate, water and electricity
- Construction and Operation phase waste and wastewater generation, and hazardous materials management

Project activities that have the potential to create impacts on the terrestrial environment have been assessed in this section.

9.3.2 Existing Controls

Existing controls that are assumed to be effective include:

- Emergency and spill response plans will be developed for construction stage activities, aligned with the requirements and capacity of the competent authority, and documented training of all accountable and responsible construction personnel
- All waste contractors engaged to store, transport, treat and dispose of waste will be licensed
- All raw material suppliers will be licensed, and a supplier screening and selection process will be in place to include the assessment of environmental and social criteria for primary suppliers, including site inspection and an onboarding process to support compliance with the applicable Project standards in Chapter 2

9.3.3 Terrestrial Biodiversity Impacts

This assessment focuses on the:

- Construction impacts associated with site clearance, construction work, reinstatement of temporary areas, and long-term landscape changes and alteration to drainage at the Desalination Plant, Renewable Energy Site and AGIs
- Commissioning impacts associated with hydrotesting of the pipeline
- Operational impacts associated with the routine inspection of the Conveyance System
- Operational impacts associated with the OHTL
- As noted in Chapter 6, the Conveyance Pipeline for over 90% of its length is adjacent to existing linear assets, including the Disi water pipeline (which has an old construction road/track alongside it) and existing public roads. Notwithstanding the presence of linear infrastructure, the 2025 terrestrial baseline survey completed to support this ESIA confirmed that natural habitat was found for 43% of the route, semi-natural/degraded habitat for 10%, and modified habitat for nearly 45%
- The potential footprint of the project using the current information provided in Chapter 6 is summarised below in Table 9-9. The associated facilities have been excluded from the table as the OHTL will have minimal permanent impact from the towers, the water reservoirs in Amman are in urban areas, and the substations are considered within the footprint of the Project components

Table 9-9: Terrestrial Habitat Types

Project component	Total Hectares	Modified	Natural	Semi-natural/ degraded
Conveyance Pipeline - assuming an average 42 m right of way, excluding the temporary camps and construction areas	1859	831	808	219
Desalination plant and AGIs	86	71	15	-

Project component	Total Hectares	Modified	Natural	Semi-natural/ degraded
Renewable Energy Facility	492	-	492	-
Total	2437	902	1315	219

9.3.3.1 Magnitude of Effect

The construction of the pipeline will require clearing a right-of-way, including removing surface material to provide stable ground that can support construction machinery. A typical right-of-way width of 42 m has been assumed, with the surface material stockpiled in windrows to reduce erosion and wind-induced remobilisation. Subsequent stages of the pipeline construction will include excavation and trenching, movement of material for crushing to provide suitable backfilling grade material, lowering of pipeline sections for welding, and backfilling. The duration that the trench will remain open, either fully before back-filling or partially to enable inspection during hydrotesting, has not been finalised.

Key impacts associated with construction phase activities that have the potential to impact terrestrial biodiversity include:

- Temporary removal of vegetation and surface material within the right-of-way, noting the right of way will be reinstated and earthworks
- Permanent land conversion at the Desalination Plant and AGIs, with modification of the land at the Renewable Energy Facility
- Temporary noise disturbance:
  - Construction:
    - During the pipeline construction, aside from the crushers, vehicle and machinery sources will be transient. The rate of pipeline excavation progress has been reported to be up to 100m per day, with the subsequent pipeline construction steps progressing at rates of up to 800m per day
    - Crushers will be operated in fixed locations for weeks at a time
    - At the camp locations, power generation equipment will be operating 24 hours per day
    - The modelling of the pipeline construction equipment has predicted an elevation of noise levels above ambient up to 1km in remote areas with no human sources that could have noise levels lower than 35 55dB(A). Within 200 metres of the pipeline construction equipment, noise levels of 55dB(A) are predicted
    - Aside from the camps that will have machinery that operates 24 hours a day, construction noise sources will predominantly be operational only in the daytime
  - Operations:
    - All of the operational sites will use grid power, and routine noise sources will be limited to vehicle and plant noise sources
    - Emergency diesel generators will be used to provide back-up power for on-site critical system power in the event of power failure. It is assumed they will be used intermittently

- Air emissions from vehicles and plant will be highest during the construction phase; air quality impacts on vegetation are not considered material based on the air quality screening assessment presented in this Chapter
- Potential introduction of alien species along the route of the conveyance
- Elevated dust to vegetation adjacent to the right of way
- Wildlife entrapment within the trench, temporary excavations and fences
- Collision with vehicles, the majority of vehicle movements associated with the Project will be during the construction
    - Detailed construction traffic planning has not been completed. Initial estimates of truck movements have been provided, with over 1 million vehicle movements predicted, of which the majority will be associated with pipeline right-of-way activities. Approximately 80% of the vehicle movements will be on temporary access tracks adjacent to the right-of-way, the remainder will be on the public road network
    - Operational traffic levels will be very low, especially in remote areas on the right-of-way, limited to inspection activities, the frequency has not yet been defined, but is assumed to be no more than quarterly
- Attraction of wildlife due to uncontrolled waste disposal
- Avifauna electrocution risk from the OHTL
    - High-voltage transmission lines rarely have live and earthed components close enough for a bird to touch both at once, so electrocution risk is considered negligible.
- Avifauna collision risk from the OHTL
    - OHTL bird collisions with the are considered a risk to avifauna. The OHTL is located in the Rift Valley/Red Sea migratory flyway and partly overlaps with the Aqaba Mountains and Coast KBA/IBA, which is an important area for migratory soaring birds, especially in Spring. Species of most concern are soaring birds, especially those of larger size and lower manoeuvrability such as storks and pelicans. Although this area is crossed by thousands of soaring birds each Spring, it is not an aggregation site, in the sense that most species will not stop, and are only crossing at high altitudes. Bird surveys along the proposed OHTL revealed that most migratory soaring birds were recorded in a broad front flying well above the powerline height. Carcass searches along the existing parallel transmission line revealed very low mortality (only one Quail *Coturnix coturnix*). Fatality rates for the OHTL are therefore predicted to be very low
    - Species more at risk are the White Sork *Ciconia Ciconia* and some PBF large birds of prey such as the Eastern Imperial Eagle *Aquila heliacal*, Verreaux's Eagle *Aquila verreauxii*, Greater Spotted Eagle *Clanga clanga*, Griffon Vulture *Gyps fulvus*, Egyptian Vulture *Neophron percnopterus*. Smaller, more agile raptors such as Falcons and the Levant Sparrowhawk *Accipiter brevipes* are considered to be at low risk because of smaller size and high manoeuvrability. Post-construction fatality monitoring at transmission lines along Egypt's Red Sea Coast (the continuation of the same migratory flyway) reveals mortality of White Storks and Great White Pelicans *Pelecanus onocrotalus*, but very low mortality of raptors (no records of Sooty Falcon or Levant Sparrowhawk fatalities). Stork and pelican mortality occurs mostly in discrete hotspots where individuals arrive at low altitude after crossing the Gulf of Suez

  - Post-construction fatality monitoring will determine the significance of this impact and inform the need for adaptive management

- Avifauna collision risk from the renewable energy facility
  - There is some evidence that birds may collide with solar panels (Kagan *et al.* 2014, Visser *et al.* 2019, Kosciuch *et al.* 2020), although the underlying mechanisms behind bird mortality at solar parks are poorly understood, meaning it is currently not possible to predict bird collision rates with solar PV panels. However, it is well established that mortality rates are significantly lower compared to those associated with other types of infrastructure, such as collision with transmission or electrocution on poorly designed local distribution lines. It is also possible that a low number of collisions may occur in the fence surrounding the facility. If mortality occurs, it will most likely affect resident passerines, of low conservation concern. Post-construction fatality monitoring will determine the significance of this impact and inform the need for adaptive management
  - Post-construction fatality monitoring will determine the significance of this impact and inform the need for adaptive management
- Overall, the magnitude of impacts on terrestrial habitats is considered **Moderate Adverse**. Assuming effective reinstatement of the temporary areas, the estimated total area impacted is 1534 hectares, see Table 9-10. This estimate excludes the OHTL however the footprint will be limited to the concrete footings of the towers and the extent of the footprint limited. Final estimates will be made of the area affected when design details are available
- The duration of the impacts will range from weeks in some areas to the full duration of the construction program and the operational phase at the permanent facilities

Table 9-10: Quantification of Onshore Project Impacts

Project component	Total Hectares	Type of impact	Natural and degraded habitatimpacts
Conveyance Pipeline - assuming an average 42 m right of way and excluding the temporary camps and construction areas	1859	Temporary	1027
Desalination plant and AGIs	86	Permanent	15
Renewable Energy Facility	492	Mixed, it is assumed that 70% of the site can be reinstated to pre-construction conditions	492
Total	2437		1534

9.3.3.2 Sensitivity

The sensitivity of terrestrial biodiversity is assessed as **High**, as with the following justification:

- Value
  - The Project is located in an area of critical habitat, triggered by three species are likely to qualify as critical habitat:
    - Two plants (the Jordan Wormwood *Artemisia jordanica* and Egyptian Henbane *Hyoscyamus muticus*)
    - One bird (the Levant Sparrowhawk *Accipiter brevipes*).

    Four species possibly qualify as critical habitat:
    - Two plants (Stipagrostis spp. and Calligonum comosum)
    - Two birds (Sooty Falcon *Falco concolor* and Steppe Eagle *Aquila nipalensis*)

    The Project overlaps with:
    - Two Key Biodiversity Areas (KBAs) and Important Bird and Biodiversity Areas (IBAs), the Hisma Basin – Rum KBA/IBA and the Aqaba coast and mountains KBA/IBA
    - The buffer zone of the Wadi Rum PA and World Heritage Site (WHS)
  - Ten bird species, two reptile species, one plant species and one mammal species have triggered EBRD's priority biodiversity features criteria
    - Additional field surveys are required to confirm the presence (for the plant *Artemesia jordanica* and the reptile *Testudo graeca)* or the extent of presence (in the case of other CH and PBF flora and herpetofauna) within the Project footprint, as their presence/distribution was not confirmed/fully defined during the July 2025 baseline survey. As a precautionary approach, mitigation measures have been adopted; see the mitigation section
- Vulnerability, presence and resilience:
  - Plant, reptile and mammal species present within the footprint of the project in the areas are considered most vulnerable to earthworks during construction
    - Additional field surveys are needed to confirm the presence and detailed distribution of species, and their results will be integrated into the mitigation measures, see the mitigation section
    - Pre-construction avoidance measures, construction and reinstatement controls will be implemented to ensure that impacts to these components are limited to those associated with permanent habitat changes, expected to be less than 25% of the project footprint (see Table 9-10)
  - Flora vulnerability: *Artemesia jordanica*, a shrub or subshrub, *Hysoscyamus muticus* a perennial herb or subshrub and *Calligonum comosum*, a shrub, all are associated with arid habitats and are qualifying Critical Habitat species. *Cleome droserifolia* is a shrub or subshrub inhabiting similar habitats and qualifies as a PBF. All of these species are perennial and as such have stable locations where they occur on a regular basis. This makes all of these species

vulnerable to direct impacts of construction, particularly the pre-excavation clearance operations

- Reptile fauna vulnerability: Egyptian spine-tailed lizard (*Uromastyx aegyptia*) has been identified as PBF. Along the route it is associated with sparsely vegetated/unvegetated desert and is a burrowing species, with burrows of distinctive form. The burrows of this species are vulnerable to direct impacts from construction activities. Individuals may also be vulnerable to open excavations and to the movement of machinery and vehicles along the route. The spur-thighed tortoise (*Testudo graeca*) is a qualifying PBF that has not yet been recorded along the pipeline route. Its vulnerabilities reflect those of *U aegyptiaca* in terms of individuals. It breeds above ground, with eggs buried in shallow nests which would be vulnerable to mechanical disturbance and destruction
- Mammal fauna vulnerability: The presence of Nubian Ibex (*Capra nubiana*) within the Wadi Rum Protected Area has triggered PBF criteria. This is a mobile species and is vulnerable to disturbance through noise and other activity, which may limit its movement through any home range which intersects with the construction area. In cases where movement occurs, it would be vulnerable to any open, uncovered excavations along its path
- Avifauna
  - Most sensitive birds to the development of the pipeline and associated facilities include those species that breed or forage on the ground in bare or sparse vegetation desert habitats where those infrastructures will be built. This is especially the case for the Buff-rumped Wheatear (Oenanthe moesta), which is a PBF for the Project, in accordance with EBRD PR6 criteria. This resident species has been detected in different locations across the pipeline route, including Hisma Basin-Rum IBA/KBA and areas to the north, the wadi ~10 km north of the Project's Regulating Tank 3 proposed site and along segment 7 of the pipeline route. Other ground nesting species (e.g. larks) are also likely to be affected
  - The most important impact will be nest destruction during clearing and construction works
  - Impacts related to disturbance will be temporary and of low magnitude
  - Impacts related to habitat loss and degradation from vegetation clearance and construction works within the pipeline route are expected to be temporary, as cleared areas will be restored after construction has been completed
  - OHTL – Habitat loss in the footprint of OHTL pylons is of a small scale. Also, nest loss of ground breeding birds caused by construction works is expected to be rare and likely not impact any of the Critical Habitat or PBF species. Disturbance will also be temporary and of low magnitude

9.3.3.3 Impact Significance, Mitigation and Residual Impacts

The significance of terrestrial biodiversity impacts is considered **Medium**.

Mitigation to reduce the potential impact significance are defined below:

- Before the finalisation of the construction plans and schedule:
  - Conduct the spring 2026 terrestrial biodiversity survey along the proposed Project works corridor to support the preparation of a Biodiversity Sensitivities and Constraints Assessment

- Undertake a terrestrial Biodiversity Sensitivities and Constraints Assessment to:
  - Support the integration of biodiversity sensitivities into the final design and construction methods selection process
  - Confirmation of the seasonal restrictions where the risk to breeding birds is considered significant, and if required, define seasonal construction restrictions to avoid impacts to CH, PBF and Natural Habitat
  - Confirmation of spatial restrictions for temporary construction facilities and activities where avoidance is recommended to support the avoidance of impacts to CH, PBF and Natural Habitat
  - Confirm the scope and schedule for pre-construction environmental surveys
  - Confirm the locations required for seed collection and replanting. The process for their replanting within the pipeline right-of-way will be defined in the BAP, supported by the BMP that will define construction operational controls, to avoid residual impact on flora
  - Confirm the location for fauna translocation, including the release location. The process will be defined in the BAP, supported by the BMP that will define construction operational controls, to avoid residual impact on fauna
- Within the Biodiversity Management Plan, include the outcome of the Ecological Constraints Assessment and confirm the pre-construction environmental survey program and define the below controls:
  - Demarcation of all areas where construction will occur to ensure that all earthworks will be strictly limited to the required areas, with particular emphasis in areas of natural habitat
  - The need to avoid all construction activities during the breeding season (mid-February to early June) in areas where Buff-rumped Wheatear or any other PBF species (unlikely) has been found in the current/previous breeding seasons
  - Install Bird Flight Diverters along the whole OHTL following good international industry practice
  - Ensure OHTL pylons are wildlife-friendly, meaning that the distance between energised components is enough to prevent electrocutions and/or that these are appropriately insulated, following good international industry practice

- Construction planning, to be completed before construction:
  - On an annual basis, undertake a breeding bird assessment survey to assess the construction areas where work will be undertaken during breeding seasons and update the Biodiversity Sensitivities and Constraints Assessment
  - Undertake the pre-construction environmental survey program, including an assessment of erosion potential/risk and update the Biodiversity Sensitivities and Constraints Assessment
  - The EPC will prepare an Ecological Constraints Assessment with the results of the pre-construction environmental survey program and maintain a register of constraints to support construction
  - Develop a habitat reinstatement protocol and a wadi crossing protocol to be applied for major wadis

  - Prepare a Terrestrial Construction Works Management Plan that will be included in the construction and installation contractor specification and that will include the provisions of the Biodiversity Management Plan relevant to construction

- Construction phase:
  - Implement the Terrestrial Construction Works Management Plan for the duration of the construction work
  - Prior to the demobilisation of the onshore construction contractor, undertake a walk-over survey of the construction area to confirm the habitat restoration targets have been achieved and integrate the findings into the contractor's completion and demobilisation governance system
  - Following confirmation that the onshore construction biodiversity restoration targets have been achieved, update the Biodiversity Management Plan and biodiversity monitoring requirements to support the operations phase and implementation of the Biodiversity Action Plan
- Operations phase:
  - Implement the operations phase BMP, BAP and associated biodiversity monitoring requirements including bird post fatality monitoring (PCFM) program monitoring to determine the significance of impacts from the OHTL and inform the need for adaptive management

With the application of the mitigation incorporated into the Project ESMS, with verification and reporting, the residual impact is considered Medium, as the magnitude of the impact is expected to remain moderate and not be reduced to negligible. Further reductions in the impact magnitude would require integrating the mitigation described above into the final construction schedules as well as full implement of the BAP to avoid all residual impacts to CH, PBF and Natural Habitat.

A residual impact is currently predicted on 368 hectares of natural and degraded habitat:

- A total 162 of hectares of natural and degraded habitat will be permanently lost due to the presence of permanent facilities, via habitat conversion
- A total of 205 hectares of natural and degraded habitat will be impacted, assuming a 20% residual impact from temporal loss, following reinstatement of the pipeline right of way

9.3.4 Physical Terrestrial Impacts

This assessment focuses on the:

- Construction impacts associated with site clearance, construction work, reinstatement of temporary areas, and long-term landscape changes and alteration to drainage at the Desalination Plant, Renewable Energy Site and AGIs

9.3.4.1 Magnitude of Effect

The construction activities associated with the pipeline, Desalination Plant, Renewable Energy Site and AGIs will require clearing of vegetation and topsoil, excavation and earthworks and, for the pipeline, trenching, movement of material for crushing to provide suitable backfilling grade material, lowering of pipeline sections for welding, and backfilling. At the Desalination Plant, Renewable Energy Site and AGIs facilities will be installed as described within Chapter 5 and commissioned prior to operations.

Key physical impacts associated with construction phase activities include:

- Temporary removal of vegetation and surface material within the right-of-way, noting the right of way will be reinstated
- Earthworks including, encountering 3rd party illegally disposed waste and contaminated land
- Permanent land conversion at the Desalination Plant and AGIs, with modification of the land at the Renewable Energy Facility, as well as alteration of drainage to divert surface water around these sites
- Disruption and changes to surface drainage:
    - The ESIA Study Area does not include any perennial watercourses. No natural areas of standing water were observed in the 2025 baseline survey in July
    - All wadis are intermittent and flow only as a result of precipitation that falls over their catchment areas during the rainy season
    - Rainfall in the Project area is very low. The majority of the Project is located within the Badi, with annual rainfall below 50 mm, and the number of days with rainfall ranges up to 15 days per year, most occurring in the winter
    - During construction:
        - The moving nature of the pipeline construction activities may create a temporary disruption to surface water flows; however, it is assumed that reinstatement leaves no permanent alterations to surface water flows or accumulation
        - The highest risk is at major wadi locations; currently, detailed construction plans or schedules have not been developed
        - It is assumed that construction plans will be developed to assess risks when working within wadis from rainfall and surface water, promoting reduced exposure in periods where rainfall is most likely to occur and evaluating the need for installing temporary water by-pass channels
    - During operations:
        - Impacts to surface water flows will be restricted to the permanent facilities, the design of which has yet to be finalised
        - The design of the Project facilities is ongoing; a 1 in 100-year storm rainfall intensity design standard shall be adopted, as per the project agreement, for project structures. Outflow drainage from the Project facilities is considered in the mitigation section
- Water abstraction from existing groundwater is currently not planned; it is assumed that all water for construction, commissioning and operations will be from regulated sources, either from the existing network or via road tankers
- Construction and operations phase drainage from the Project sites will include:
    - Rainwater systems, which will be designed to segregate rainfall from sources of contamination
    - Drainage from areas with hazardous materials, e.g. in areas where hazardous waste or fuel is stored. Drainage from these locations will either be handled as waste and disposed of by

licensed facilities or be treated on-site and discharged in accordance with the applicable standards in Chapter 2

- Accidental spills and incidents associated with the uncontrolled handling of waste and materials, including concrete
- It is assumed all construction waste will be managed from the point of generation to the final disposal site in accordance with applicable standards, mitigation measures are provided

The majority of the physical impacts associated with the Project relate to the potential for disruption to, or potential contribution to, surface water flows either to wadis or the environment via drainage channels as well as the potential for mobilisation of contamination, increase in flood risk and potential for soil erosion. Typically, as described above, given the low intensity of rainfall in the region and the seasonal nature of the wadis, impacts to surface water quality due to drainage and runoff would be anticipated to be low but dependant on the composition of the run-off; while normally uncontaminated there remains potential for a polluted release e.g. in the event of a spill. The design of the permanent and temporary facilities is ongoing and includes design of drainage systems and consideration of flood risk; these details are not currently available. While drainage from the conveyance pipeline and AGIs will be routed to the terrestrial environment, drainage from the Desalination Plant and IPS will be routed via new channels and connections to existing drainage channels to sea (see Section 9.2.5).

Overall, taking a precautionary approach, the magnitude of terrestrial physical impacts is considered to be potentially **Major Adverse.**

The duration of the impacts will range from weeks in some areas to the full duration of the construction program and the operational phase at the permanent facilities.

9.3.4.2 Sensitivity

The sensitivity of the physical terrestrial environment is assessed as **Moderate**, with the following justification:

- Value, vulnerability, presence and resilience:
  - There are no perennial watercourses within the ESIA Study Area
  - The wadis present across the Study Area vary in character depending on the underlying landscape and geological conditions with high volume fast flows through wadis in rocky areas e.g. Wadi Yutum and slower flows through flatter, sandier areas draining small catchment areas of a few tens of square kilometres water. These wadis are of value from a biodiversity perspective for sustaining biodiversity (with floral and faunal species present being tolerant to desert conditions and little rainfall) and, where water collects either naturally or artificially, provide a drinking supply for livestock and to support herding activity. Water derived from wadis is not used by communities for a potable water source
  - There are areas of land that may be affected by Project activities across the Study Area used for herding and grazing activity however there are no areas of land used exclusively for this purpose. Soil is not used as a resource in any location across the Study Area
  - Groundwater is an important water source across the Study Area serving as a source of irrigation and potable water through wells. Quality and supply have, however, been severely affected by over extraction and hence there is a strain on supply increasing the value of this resource. There are a significant number of wells present across the Study Area used by the local communities and a system of above ground pipes for supply to communities and farms

- Natural soil erosion and flooding events occur across the Study Area due to natural conditions which include sandstorm events lasting days and concentrated storm rainfall which can occur over a few hours. These events can lead to rapid change in the landscape and integrity. In Diesah specifically, residents raised existing sand encroachment and instability of the dunes as an ongoing concern

9.3.4.3 Impact Significance, Mitigation and Residual Impacts

The significance of terrestrial physical impacts is considered **Medium**.

Mitigation to reduce the potential impact significance are defined below:

- Before the completion of the detailed design and finalisation of the construction plans and schedule:
  - Undertake a review of potential spill risks covering construction and operations phases to, this will be supported by engagement with the 3rd party asset owners, competent authorities. The outcome of these studies and engagement will be used to complete a spill risk assessment and document the safeguards e.g. engineering, process, procedural etc and be integrated into the Pollution Prevention Management Plan
  - Prepare Pollution Prevention Management Plan to:
    - Prepare a hydrotesting procedure detailing how water will be sourced, describing and assessment the treatment, reuse and discharge activities, ensuring avoidance of pollution and erosion as well as management of water reuse for agricultural purposes
    - Assess contamination risk at the Project sites, using a risk-based approach
    - Hazardous materials (selection, management and use), drainage, wastewater (including all camp and construction site wastewater) and surface water discharges to comply with applicable standards in Chapter 2 and avoid risk of pollution
  - Prepare a Waste Management Plan, with sufficient time to enable the selection of an appropriate contractor that will:
    - Be supported by a waste forecast, that will be used to plan a due diligence of the potential waste transportation, treatment and disposal companies to confirm their capacity to manage the forecasted waste types and quantities in accordance with the project waste standards
    - Define the waste management operational activities to support all activities from segregation to final disposal, in compliance with applicable standards
- Construction planning, to be completed before construction:
  - Groundwater risks will be assessed upon completion of the EPC contractor's geotechnical survey and confirmation of groundwater usage during construction
  - Prepare a Terrestrial Construction Works Management Plan that will be included in the construction and installation contractor specification. The plan will confirm:
    - The controls for the avoidance/reduction of impacts to biodiversity and soil erosion
    - Topsoil/surface material storage and preservation
    - Micro habitat disturbance management

- Defined terrestrial habitat restoration goals, including erosion controls and habitat enhancement initiatives to support the BAP
- Adaptive management requirements to respond to temporary construction works such as dewatering, temporary storage of material, burrow pit for construction material, temporary access road routing and usage. A fit-for-purpose biodiversity risk assessment protocol will be developed to assess the temporary construction works, considering the Biodiversity Sensitivities and Constraints Assessment
- Monitoring and inspection protocols, including frequency of inspection
- KPIs to define compliance and performance monitoring and reporting requirements

9.4 Air Quality and Dust

9.4.1 Scoping

Construction activities are detailed in Chapter 5 and will include:

- Use of construction plant and equipment to undertake the site preparation, excavation, civil and mechanical works to construct the Intake Pumping Station (IPS), Desalination Plant, Conveyance System Above Ground Installations (AGIs), Renewable Facility and Overhead Transmission Lines (OHTLs)
- Use of construction plant and equipment to install the intake and outfall transfer pipelines and the Conveyance Pipeline, including trenching (using standard and piling techniques), pipe lay, welding and backfill
- Earthworks and soil movements at the Intake Pumping Station (IPS), Desalination Plant, Conveyance System AGIs and Renewable Facility and along the Overhead Transmission Lines (OHTLs) and Conveyance Pipeline
- Offsite traffic movements on the public highway associated with Project related logistics

To support the construction phase, the Project will also establish temporary laydown areas, access roads and spoil storage and handling areas within up to 10 km of the pipeline route and up to five construction camps (either establishing new facilities or utilising existing suitable facilities where available).

9.4.2 Existing Controls

Existing construction controls, that are assumed to be effective relating to generation of air emissions from use of construction plant and equipment, include:

- All machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum. Lorry engines will be switched off when vehicles are stationary
- Equipment and vehicles shall be used and maintained so that generated atmospheric emissions are not in excess of the threshold emission values set out in applicable standards in Chapter 2
- The fleet of vehicles or equipment emitting combustion gases shall be maintained at the intervals and according to the methods specified by the manufacturer
- The maintenance records for the fleet of vehicles, machinery, and equipment shall be recorded.
- Fixed combustion equipment selected for use for construction activities (including temporary diesel generators at camps where required) shall met relevant emission source limits as stipulated within national legislation

9.4.3 Air Quality and Dust Impacts

This assessment focuses on air quality and dust impacts associated with:

- Use of construction plant and equipment to undertake construction activities across the Project Facility sites based on indicative plant and equipment types and numbers (refer to Chapter 5 appendices)
- Project related construction traffic using the main Highway

- Construction camp operation
- Generation of dust associated with trenching, earthworks and spoil movement across the Project Facilities sites
- Use of emergency generators during the operations phase

9.4.3.1 Magnitude of Effect

A screening assessment was undertaken using modelling to estimate predicted increases in key pollutants arising from the indicative plant and equipment associated with the planned construction activities at all Project Facilities (Intake Pumping Station (IPS), Desalination Plant, AGIs, Renewable Facility) and along the Conveyance Pipeline and Overhead Transmission Line (OHTL). The assessment also assessed changes to air quality associated with anticipated Project construction traffic on the highway.

The approach for assessing the potential magnitude of potential effects was developed based on United Kingdom Institute of Air Quality Management (IAQM) Planning for Air Quality Guidance, which sets out the industry best practice criteria for the assessment of Air Quality impacts from development projects.

The guidance suggests expressing the magnitude of incremental change in concentrations as a proportion of an Air Quality Assessment Level, i.e. based on applicable air quality limits. The magnitude of the effect is then identified based on the change relative to the limit values and the absolute change in pollutant concentrations resulting from the Project. Applicable national and international air quality limits are described within Chapter 2 of this ESIA, and baseline concentrations recorded at representative air quality stations within Jordan are presented in Chapter 6. The results for monitoring stations within urban and rural settings[4] indicate that for all pollutants of concern (i.e. for which air quality limits are determined), applicable air quality limits were met at all monitoring locations for all pollutants with the exception of:

- $PM_{2.5}$, which was found to be exceeding the national air quality limit values at 12 of the 14 monitored locations in 2024. The only exceptions were the monitoring stations within the Tafiela Governorate and daily $PM_{2.5}$ monitoring at Aqaba where exceedances were not recorded
- $PM_{10,}$ which was found to be exceeding limit values in a number of locations on multiple occasions, primarily considered to be due to natural frequent dust events
- H_2S, for which slight exceedances were recorded at the two stations in the Ma'an Governorate where this parameter is measured
- Ozone, which is recorded only at the Aqaba monitoring station and where some slight exceedances above the limit value were recorded

Concentrations of SO_2 and NO_2 recorded were consistently significantly below limit values at all urban and rural monitoring stations. As such, in accordance with best-practice guidance, $PM_{2.5}$ was conservatively selected as the basis for assessing the magnitude of change.

The predicted distances from the construction activities at which air quality effects of different magnitudes were determined based on the indicative plant and equipment assumed to be in use for the construction and installation of each Project component (assuming an area source with plant evenly distributed). These estimates are presented within Chapter 5 appendices. For the Governorates of Aqaba, Ma'an, Tafiela and Karak the air quality modelling results indicated the following:

[4] It should be noted that exceedances of NO_2 were recorded at the Sahab monitoring station which is located within the highly industrialised King Abdullah II Industrial City

- Construction activities at the AGIs (within the Aqaba and Ma'an Governorates) and the Renewable Energy facility and along the OHTL (within the Aqaba Governorate) are predicted to result in moderate air quality effects within 1m, reducing to negligible effects within 15m of the activities
- Construction activities associated with the Conveyance Pipeline, including trenching, pipe installation and welding, and backfill and road maintenance, are predicted to result in moderate air quality effects within 1-5m, reducing to negligible effects within 15-30m
- The use of crushing and screening equipment as part of the Conveyance Pipeline construction activities (to enable re-use of excavated materials for backfill where suitable) is predicted to result in moderate air quality effects within 10m, reducing to negligible effects within 45m of the equipment
- The construction activities associated with Intake Pumping Station (IPS) and Desalination Plant (within the Aqaba Governorate) are predicted to result in moderate air quality effects within 5-10m, reducing to negligible effects within 25m of the construction sources

Within the Amman governorate, the assessment predicted moderate to substantial effects within 5-30m of the construction activities associated with the Conveyance Pipeline, the OHTLs and the AGIs. Moderate to substantial effects ranging from 25 to 45m were also predicted due to use of crushing and screening equipment. The higher level of effect within the Amman governorate is primarily due to the higher existing baseline air quality concentrations recorded in this area (see Chapter 6).

With respect to road traffic, a screening assessment was undertaken based on available existing traffic flows for Highway 15[5] and the number of traffic movements anticipated during Conveyance Pipeline construction based on indicative estimates provided by the Project team and assuming all Project traffic will use this Highway. The screening assessment indicated that Project related traffic is predicted to result in slight to moderate effects within distances of 5m to 15m of the Highway within the Governorates of Aqaba, Ma'an, Talilah and Karak and substantial to moderate impacts within 5m to 15m within the Amman Governorate, again based on the higher baseline levels recorded in this Governorate.

In general, the air quality assessment shows that effects on air quality due to construction activities are predicted to occur within a short range of each activity (no more than approximately 45m) and these effects are typically classified as moderate to negligible with more significant effects predicted in Amman where air quality concentrations of $PM_{2.5}$ are already routinely reported above limit values.

With respect to NO_2 the estimated increases in concentrations are not predicted to be significant and forecast concentrations are anticipated to remain well below applicable limit values. With respect to PM_{10} operation of the plant and equipment is not expected to result in any additional exceedances i.e. no exceedances beyond those already recorded as part of the baseline.

With respect to temporary areas to be used by the Project, e.g. for laydown and storage, these have not yet been defined; however there will be a requirement to undertake earthworks in these areas similar to those associated with the Project AGIs as described above, with the effects to air quality from the use of construction plant and equipment expected to be of a similar scale.

With respect to construction camps, up to five camps may be located along the pipeline route to provide facilities for the Project workforce (see Chapter 5). The majority of the workforce is expected to be located within facilities to be established at Aqaba and Amman, with smaller workforce facilities strategically located along the route (areas to the south of the RGT3 location, near to Jafr and near to

[5] Based on toll booth transit numbers provided by the Jordanian Ministry of Public Works & Housing at the Swaqa Prison Toll Plaza

Hasa are being evaluated in the Governorates of Aqaba, Ma'an and Tafiela). Where there is a requirement to establish new camps, impacts to air quality may arise from construction plant and equipment used to establish the camps (including earthworks and civil works), which are expected to be of a similar scale to those impacts identified from the construction activities associated with the Project AGIs, and from temporary diesel generators providing power for the camps. Air emission modelling has not been undertaken to assess the impacts from these generators as there is insufficient Project information available, however taking a qualitative approach, the key pollutants arising from generator use include NO_2 and SO_2 (varying depending on diesel quality) as well as PM_{10} and $PM_{2.5}$. As discussed above, concentrations of NO_2 and SO_2 have been recorded significantly below limit values across all air quality monitoring stations, and the addition of the temporary generator sources, based on the camp size and the typical power demand for a camp of this size, would not be expected to result in exceedances. The contribution of PM_{10} and $PM_{2.5}$ concentrations from generator use may be more significant given existing exceedances recorded at monitoring stations as described above however contributions are expected to be marginal given the likely size of the generators (providing power for the camp operations only).

During the operations phase, power will be routinely provided to the Project facilities from the Project renewable facility and via the grid. Emission sources during operations are limited to emergency generators providing power for critical systems only. Emissions of key pollutants including PM_{10} and $PM_{2.5}$ from Project operations not expected to be discernible at receptors and air quality impacts are expected to be negligible. Mitigation is, however, specified to ensure compliance with appropriate emission standards and manage potential complaints should they arise.

Dust refers to both suspended and deposited particulate matter up to 75 micros (µm) in diameter and has the potential to create a public nuisance, through deposition. PM_{10} and $PM_{2.5}$ are defined as particulate matter with an aerodynamic diameter of less than 10 and 2.5 microns (µm) respectively and are the result of a combination of man-made (construction work) and natural processes such as natural entrainment of particles by the wind periods of extended dry weather. While limit values exist for both PM_{10} and $PM_{2.5}$ there are no national or international standards or objectives for dust. As such industry best practice guidance is adopted to assess potential for dust risks, taking into account the potential for health impacts associated with PM_{10} and $PM_{2.5}$ and nuisance due to dust soiling.

The Project will involve site preparation and stripping, trenching, excavations and soil movements at all Project Facilities and in temporary areas. On this basis, and given the inherently dusty nature of the environment, it is considered that all stages of construction work are likely to pose an elevated risk of dust emissions. This is further supported by the baseline air quality data presented in Chapter 6 for PM_{10} and $PM_{2.5,}$ as well as by reported observations of frequent dust storms across Jordan.

Overall, based on the screening assessments undertaken and the discussion above the magnitude of impact to air quality as a result of construction activities is assessed as **Minor Adverse**, and the magnitude of impact associated with dust is **Moderate Adverse,** with the following justification:

- Construction activities in any one location along the Conveyance Pipeline route will be temporary in nature and lasting from days to weeks. The potential for access track usage has not been assessed due to the lack of available detail at this stage of the project
- Construction activities at the AGIs will be ongoing for periods of years, with the most intense activities for periods of months
- Construction activities associated with temporary Project areas e.g. camps, laydown areas, storage areas will occur over periods of weeks to months
- No exceedances of air quality limits for NO_2 or SO_2 are predicted at any locations as a result of the use of construction plant and equipment or temporary generators at camps

- With respect to $PM_{2.5}$ where baseline exceedances of limit values are routinely recorded, no significant long term further deterioration in air quality is predicted as a result of use of construction plant and equipment or from temporary generators at camps
- With respect to dust there is potential for short to medium term increases in dust deposition and PM_{10} and $PM_{2.5}$ concentrations at all locations adjacent to the construction activities lasting for the duration of the construction activities

9.4.3.2 Receptor Sensitivity

The key receptors sensitive to changes in air quality and generation of dust due to the Project construction activities comprise the communities located in the immediate vicinity of the works, as well as individual businesses, community facilities and mixed-use areas. The closest towns and villages to the Project Facilities within the Aqaba, Ma'an, Karak, Tafiela and Amman governorates are provided within Chapter 7. With respect to the IPS, Desalination Plant and associated intake and outfall transfer lines, these facilities are located within the Aqaba Industrial Zone, and the nearest communities are located more than 3km away from the planned construction activities. The towns and villages located within 1km of Conveyance Pipeline route ,AGIs and locations being considered for temporary camp facilities include (refer to Figure 9-5 and Figure 9-6 for locations):

- Diesah, Sallheiah, Mezfer, Um El-Basatien, Twaiseh, Taweel, Rashdyah and Shakriyyeh within Aqaba Governorate
- Hasa within Tafiela Governorate
- Qatraneh and Al--Sultani within Karak Governorate

Properties in these locations vary in distance from the anticipated edge of the working width for the pipeline construction activities with the re-routes adopted within Diesah, Hasa and Qatraneh allowing the route to bypass many of the properties previously closest to the route. Within these governorates, as described above, baseline monitoring results indicate that while limit values for NO_2 and SO_2 are routinely met, there are frequent exceedances of PM_{10} and $PM_{2.5}$ limit values with spikes recorded during sandstorms which can occur over several days affecting entire regions. The lowest concentration of PM_{10} and $PM_{2.5}$ have been recorded at the two monitoring stations within the Tafiela Governorate including a rural station located at Hasa, where recorded annual average concentrations in 2024 met the applicable PM_{10} and $PM_{2.5}$ limit values.

Within Amman Governorate the route of the Conveyance Pipeline will pass through the suburbs of Amman City and in close proximity to numerous residences, commercial properties, industrial areas and businesses. For context, Figure 9-7 shows the routing and locations of receptors (primarily residential areas) sensitive to noise. These receptors are also sensitive to air quality and dust impacts. Baseline air quality in the city is considered poorer than elsewhere along the route due to the urbanised environment and numerous industrial sources. The results from the Sahab air quality monitoring station indicate air quality was classified as "good" for only 35 days in 2024 with 59 days recorded as 'Unhealthy for Sensitive Groups'.

Dust is a key area of concern within the communities consulted as part of the stakeholder consultation process (refer to Chapter 8), particularly with respect to the potential to contribute to health issues as well as create nuisance.

The sensitivity of receptors to changes in air quality and nuisance associated with dust is assessed as **Medium** with the following justification:

- Vulnerability and presence:

  - Potential for minor deterioration in air quality and moderate potential for nuisance at receptors (particularly residential properties within approximately 50m of construction activities)

- Value
  - Slight to moderate changes in air quality predicted at receptors within close proximity at construction works for the period of the construction activities, with potential for greater effects within Amman city where receptors are more dense and air quality is poorer
- Resilience
  - Increases in pollutants and creation of dust will be temporary in nature, short to medium term and reversible; the effect on the receptors will not continue once construction works have ceased

9.4.3.3 Impact Significance, Mitigation and Residual Impacts

The impact significance of air quality is considered to be **Minor** and the impact significance of dust is considered **Moderate.**

Mitigation to reduce the potential impact significance associated with air quality and dust impacts are defined below:

- Construction planning, to be completed prior to construction:
  - Incorporate the following dust management measures within the Pollution Prevention Management Plan prior to the commencement of works:
    - Identification of dust generating construction activities and identification and classification of potentially affected sensitive receptors
    - Review and evaluate dust management practices for minimising dust impacts to residents, occupants and animals and minimise potential for sedimentation of watercourses/water bodies due to dust. Practices may include, but not limited to:
      - Using windbreaks, netting screens or semi-permeable fences
      - Controlling vehicle speeds to reduce traffic-induced dust dispersion and resuspension by setting and enforcing speed limits
      - Ensuring trucks hauling sand, dirt or other loose materials are covered (sheeting trucks)
      - Suspending topsoil stripping and replacement during strong winds
      - Using a dust collection system for bulk materials unloading
      - Where wet suppression techniques are considered, an evaluation will be required to provide suitable justification including the proposed source of water (with preference for reclaimed water use)
    - Protocols for engagement with residents and occupants to provide advance warning of works taking place where relevant, including the duration and likely dust impacts. In the case of work required in response to an emergency, the local residents and occupants shall be advised as soon as reasonably practicable that emergency work is taking place
    - Dust monitoring program to include:

- Location, frequency and approach for undertaking onsite and offsite visual inspections during construction activities to confirm the effectiveness of dust control measures and the need, if required, for additional dust reduction measures and management practices to adequately control dust emissions
- Records of inspections and findings to be kept and maintained
- Triggers for increasing the frequency of site inspections e.g. when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions
- Reporting process related to dust visual monitoring results
- Communication/disclosure lines related to dust visual monitoring results, with the affected households and the applicable government entities

- Ensure the Project Grievance Mechanism includes the process for handling and responding to dust complaints including requirements associated with conducting reviews of dust management practices and dust monitoring in response to complaints
- Incorporate consideration of dust and air quality impacts in the detailed planning for the construction camps and temporary project facilities to inform siting, layout, equipment selection and dust abatement measures (where required)

- Construction Phase:
  - When storage, transport and handling of bulk materials is made in the open air and exposed to the wind, the necessary dust abatement measures shall be implemented
  - All dust generating materials transported to and from the construction worksites shall be covered by sheeting
  - The following shall be implemented to the extent possible/practicable:
    - Minimise storage time of spoil stockpiles
    - Align stockpiles to prevailing wind to minimise surface area exposed to wind erosion
    - Minimise stockpile height and use gentle slopes and compact stockpile surfaces
    - Store materials away from the site boundary and downwind of sensitive receptors
    - Minimise the height and fall of excavation materials during handling
  - Plan construction layouts so that machinery and dust-causing activities are located away from receptors, as far as is possible
  - Consider the feasibility of erecting solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
  - Where possible / practicable, fully enclose site or specific operations where there is a high potential for dust production and the site is expected to be active for a prolonged period with adjacent receptors
  - Keep site fencing, barriers and scaffolding clean using wet methods (where feasible to do so)
  - Remove materials that have the potential to produce dust from site as soon as possible unless being re-used on site
  - Cover, seed or fence stockpiles to prevent wind whipping
  - Prohibit bonfires and burning of waste materials

  - Where applicable, re-vegetate earthworks and exposed areas / soil stockpiles to stabilise surfaces as soon as practicable. Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable
  - Only remove the cover in small areas during work and not all at once
  - Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place
  - Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery
  - For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust
  - Use dust sweepers on the access and local roads (water-assisted where feasible to do so)
  - Avoid dry sweeping of large areas
- At the detailed design stage, relevant emission source limits will be defined within equipment specifications to ensure that relevant point source emission standards and air quality limits in Chapter 2 are met
- Operations Phase Pollution Prevention will be developed and will include measures to ensure air quality impacts during operations are minimised, including the need to operate and maintain equipment pursuant to the manufacturer's specifications, managing complaints and conducting air quality monitoring (where necessary) in response to complaints

With the application of the mitigation incorporated into a Project ESMS with verification and reporting, the residual impact is considered **Minor.** The justification for the reduction in impact significance is due to:

- Reduction in magnitude of impact due to the use of dust management practices and controls

9.5 Noise, Vibration and Glare

9.5.1 Scoping

Construction activities are detailed in Chapter 5 and will include:

- Use of construction plant and equipment to undertake the site preparation, excavation, civil and mechanical works to construct the Intake Pumping Station (IPS), Desalination Plant, Conveyance System AGIs, Renewable Facility and Overhead Transmission Lines (OHTLs)
- Use of construction plant and equipment to install the intake and outfall transfer pipelines and the conveyance pipeline, including trenching (using standard and piling techniques), pipe lay, welding and backfill
- Offsite traffic movements on the public highway associated with Project related logistics
- To support the construction phase, the Project will also establish temporary laydown areas, access roads and spoil storage and handling areas within up to 10 km of the pipeline route and up to five construction camps (either establishing new facilities or utilising existing suitable facilities where available)
- Installation of the Conveyance pipeline will be primarily undertaken using trenched techniques however trenchless methods are planned to be used for wadi crossings and for major highways and highway interchanges with augur boring techniques assumed to be used

9.5.2 Existing Controls

Existing construction controls that are assumed to be effective relating to generation of noise from use of construction plant and equipment include:

- Equipment shall be used and construction and transport methods adopted in order not to generate noise levels in excess of values set out in applicable standards in Chapter 2
- To the extent possible, heavy vehicles shall not be used at night between 22:00 and 06:00
- Standard noise abatement equipment shall be fitted to equipment used and maintained in accordance with manufacturers' instructions, e.g., all vehicles and mechanical plant will be fitted with effective exhaust silencers and be maintained in good efficient order
- All machines in intermittent use shall be shut down in the intervening periods between work or throttled down to a minimum. Lorry engines will be switched off when vehicles are stationary
- Normal working hours in or close to residential areas shall be respected, and in general, night-time working shall be kept to a minimum near those areas. Materials for night-time working shall be delivered during normal hours of working and be placed as close as possible to the work area for which they are required
- Construction camp specifications for plant and equipment to be procured to support camp operation shall include relevant noise source specifications as stipulated within national legislation. The procured plant and equipment shall be operated and maintained in accordance with manufacturers' instructions and shall be fitted with appropriate noise abatement as required

9.5.3 Noise, Vibration and Glare Impacts

This assessment focuses on the construction phase and impacts associated with:

- Use of construction plant and equipment to undertake site preparation, excavation and civil works along the conveyance pipeline route and at the AGIs based on indicative plant and equipment types and numbers (refer to Chapter 5 appendices)
- Operation of construction camps
- Offsite traffic movements on the public highway associated with Project related logistics
- Use of augur boring methods and equipment for trenchless crossings
- Vibratory piling along the conveyance route (in urban areas) and vibratory compaction of finished road surfaces

In addition, operational noise impacts associated with the Project facility operations including operational logistics and the potential for glint and glare impacts associated with operation of the Renewable Facility are assessed

9.5.3.1 Magnitude of Effect

A screening assessment was undertaken using modelling to estimate noise levels arising from the indicative construction plant and equipment associated with each activity along the conveyance route and at the AGIs. The assessment focused on these facilities given the potential for impacts to communities; the Intake Pumping Station (IPS), Desalination Plant, BPS1 and Renewable Facility are all located more than 3km from the nearest community receptor and hence there is limited potential for discernible impact to receptors from construction noise at these locations.

The assessment was undertaken in accordance with guidance provided within industry best practice guidance specifically BS5228:2009. Noise limits for the project activities were derived from the following:

- Jordanian Instruction for the Prevention and Elimination of Noise (2003). Noise levels from noise emitting projects are required to meet a number of specified night and daytime limits based on the area category where the development activity is located
- IFC EHS Guidelines 1.7 Noise, which provides daytime and nighttime noise limits for two receptor types: residential, institutional and educational receptors and industrial / commercial receptors

On the basis that the Project does not plan to undertake nighttime working and, taking into account the most stringent noise limits for each receptor type/category, the following noise limits were adopted for the assessment:

- All residential areas except villages (55 dB(A) daytime limit)
- Residential areas in villages (including areas with some but low numbers of residences) (50 dB(A) daytime limit)
- Places of education, hospitals and places of worship (45 dB(A) daytime limit)

The estimated number and type of plant and equipment anticipated to be used for the construction and installation of a generic AGI and for each phase of the conveyance pipeline installation (including conventional trenching and sheet pile trenching) and the associated sound pressure levels were used to predict the anticipated noise levels at increasing distance from the source. The predicted noise levels

were compared to the limit values presented above to derive the distance at which these limit values would be reached i.e. the distance beyond which the noise criteria will be met (Table 9-11).

Table 9-11: Predicted Distances from Project Construction Activities Beyond Which Applicable Noise Criteria will be Met

Receptor type/area	Construction Activity	Noise Criterion, dB(A)	Distance beyond which Noise Criterion is met, m
All residential areas except villages	Construction and Installation of AGI	55	210
	Conventional Trenching, Backfill and Road Maintenance, Crushing and Screening		300
	Sheet Pile Trenching		360
	Pipe Installation and Welding		200
Residential areas in villages	Construction and Installation of AGI	50	325
	Trenching, Backfill and Road Maintenance, Crushing and Screening		460
	Pipe Installation and Welding		310
Places of education, hospitals and places of worship	Construction and Installation of AGI	45	525
	Conventional Trenching, Backfill and Road Maintenance, Crushing and Screening		750
	Sheet Pile Trenching		925
	Pipe Installation and Welding		500

The noise predictions assumed the application of the existing controls (refer to Section 9.5.2) and the following conservative assumptions:

- All plant assumed to be operational simultaneously
- No reduction in noise due to barrier effects through existing buildings and structures
- No reduction in noise as a result of topographical screening

The results show that the distances predicted range from 200m to 925m, with the greatest distances, and hence the highest noise levels predicted, associated with sheet pile trenching; an activity anticipated to be undertaken as an alternative to conventional trenching in constrained areas specifically within urban and built-up areas.

With regard to trenchless crossings, augur boring methods are anticipated to be used at 53 separate locations covering a total length of approximately 2km with each crossing, typically taking days to complete. The locations of the crossings and specific equipment to be used have not been confirmed but is expected to include augur boring activities in rural and populated areas. Assuming a typical equipment spread from similar pipeline projects for the equivalent activity (TAP, 2013), noise levels generated were

predicted to be of a similar scale to pipe installation and welding, albeit occurring over much shorter timeframes.

As discussed in Section 9.4.3.1 above up to five construction camps may be located along the pipeline route to provide facilities for the Project workforce with the major workforce facilities located in Amman and Aqaba. Where there is a requirement to establish new camps, noise impacts may arise from construction plant and equipment used to establish the camps (including earthworks and civil works) which are expected to be of a similar scale to those impacts identified from the construction activities associated with the Project AGIs

Noise may also arise from Project traffic using the main Highway. A noise screening assessment was undertaken based on conservative estimates of heavy goods vehicle numbers associated with the Project using the highway, available baseline noise data and existing traffic flow estimates along Highway 15 (see Appendix 9.B1). The assessment indicated that the estimated increases in traffic flows on the highway (Highway 15) were predicted to result in small increases in noise levels (between 0.9 and 1.5dB) at receptors adjacent to the Highway. Noise levels at receptors adjacent to the Highway are generally high (above 75dB) and the increase is not expected to be significant as such limited discernible impact to receptors is expected due to noise from construction traffic.

The construction and installation of the AGIs will occur over periods of between 6 months and 2 years, with the shortest duration associated with the Break Pressure Tank (BPT) facility and the longest at the pumping stations. The most intense periods of work with the greatest plant on-site will be during site preparation and excavation works, lasting several months. The construction and installation of the conveyance pipeline will take place over 2 years, with activities progressing in 5 sequential spreads along the route. Based on the anticipated rate of progress, pipeline installation activities are expected to occur in locations along the route for days to weeks as the spreads progress, with activities in constrained areas taking longer due to the potential need for alternative construction techniques. Where piling is required for trenching and augur boring for trenchless crossings, these activities are expected to take place over a period of days.

The methodology adopted for the screening assessment presented above aligns with other international guidance relating to construction noise, for example, the ABC method in BS5228-1:2009+A1:2014, which sets absolute limits for construction noise based on baseline sound levels. The ABC method, which represents an industry standard for the assessment of construction noise, recognises the specific and temporary nature of construction noise and sets a daytime limit of 65dB, which is significantly higher than the conservative limits adopted for this assessment.

At 65dB(A), noise would be detectable by receptors and may create a temporary disturbance; however, the guidance recognises that during construction activities, some degree of noise disturbance is inevitable for periods of time to allow construction to progress. For comparison, the 65dB(A) criteria would be met for the various AGI and pipeline construction activities within a range of approximately 75-150m (assuming no screening or barrier effects and all plants operating simultaneously). A noise level of 45dB(A), which is the most stringent absolute limit adopted for the assessment, would be representative of noise levels in a quiet rural setting, as demonstrated by the baseline noise levels reported within Chapter 6 of this ESIA.

With respect to the operation of the construction camps, the size and location of the camps are broadly defined as described within Chapter 5 and the camps are not expected to include the types of major plant noise sources that generate potentially significant noise levels (typically rotating equipment such as large compressors, pumps and generators and percussive equipment such as crushers). Equipment expected to be used will be appropriately selected for the size and demand of the camps. This will include temporary generators and temporary facilities for freshwater storage and supply, sewage and

wastewater handling and HVAC systems for worker accommodation. The potential for noise from these sources to generate significant noise impacts beyond the boundary of the camps is uncertain but based on camps of similar size and general specification, operational noise from construction camp plant operation is not expected to be significant. A conservative approach however is adopted to recognise the uncertainty of the potential noise impacts and potential effects are considered to be of moderate adverse significance.

Overall, on the basis of the screening assessment undertaken and the discussion above the impact of terrestrial construction noise is assessed as **Moderate Adverse**, with the following justification:

- Construction activities in any one location along the conveyance pipeline route will be temporary in nature and lasting from days to weeks, with piling activities lasting periods of days
- Construction activities at the AGIs and operation of the construction camps will be ongoing for periods of years, with the most intense activities for periods of months. No piling activities are planned at the AGI locations
- The assessment of construction plant and equipment noise predicts that the most stringent noise limits for the most sensitive receptors (i.e. schools, hospitals, places of worship) will be met between 500m and 925m of the source (with the greatest distances for piling activities), however these distances are likely to be highly conservative estimates given the conservative nature of the screening assessment and the limits adopted

With respect to vibration, a vibration screening assessment (see Appendix 9.B1) was undertaken to consider the potential for effects resulting from vibratory piling along the conveyance route (in urban areas) and vibratory compaction of finished road surfaces. The assessment predicted no potential for vibration nuisance to communities beyond 20m (vibratory compaction) or 25m (vibratory piling) and that worst case cosmetic damage due to vibration was not anticipated beyond 4m (assuming lightweight building structures). As such vibration impacts are expected to be negligible to minor adverse. Mitigation is specified to ensure vibration risk is appropriately managed and minimised including risks to the integrity of sensitive structures.

Noise impacts during operations are expected to be limited. Potentially noisy equipment including pumps will be located within pump houses and enclosures at each facility as specified within the design and designed to ensure applicable noise standards in Chapter 2 are met. Traffic movements to sites in locations near to receptors sensitive to noise (e.g. within communities) expected to be minimal during operations. As such noise from the Project is not expected to be discernible at receptors sensitive to noise. Mitigation is, however, specified to ensure compliance with appropriate noise standards and manage potential complaints should they arise.

Disturbance effects from the solar panels were considered within a screening assessment undertaken to confirm the potential for glint and glare impacts arising from the operation of the Project renewable (RE) facility which comprises a solar PV facility. Based on the location and distance of potentially affected receptors from the RE facility and the design and orientation of the panels, the assessment concluded that no glint and glare impacts were anticipated, and no impacts were predicted (See Appendix 9.B3).

9.5.3.2 Receptor Sensitivity

The key receptors sensitive to noise generated from the construction of the conveyance pipeline and AGIs comprise the residents located in the vicinity of the construction activities, highly sensitive receptors such as the occupants of places of worship, medical facilities and hospitals, places of education and, to a lesser extent, industrial and commercial receptors.

Towns and villages within 1km of the conveyance pipeline route or AGIs include the towns and villages of:

- Diesah, Sallheiah, Mezfer, Um El-Basatien, Twaiseh, Taweel, Rashdyah and Shakriyyeh within Aqaba Governorate
- Hasa within Tafiela Governorate
- Qatraneh and Al-Sultani within Karak Governorate

These are the most sensitive to noise impacts based on their proximity to the works. Within the Amman Governorate, the pipeline passes through numerous communities in the suburbs of Amman city (immediately to the north of the PSADC), splitting at the PSADC for approximately 15-20km to the reservoir endpoints. These areas are mostly classified as high sensitivity, based on the numbers and types of receptors present, i.e., the highest number of residential receptors.

Community facilities, including places of worship, medical centres, and educational institutions, including schools, are located within the towns and villages listed above, with the highest provision in Amman. The closest educational facilities at the southern end of the route include the Aqaba Medical Sciences University and Aqaba University of Technology, which are located within 150 to 200m of the route and within 300-350m of the BPS2 site.

Figure 9-5, Figure 9-6 and Figure 9-7 show the location of those receptors most sensitive to noise mapped for the whole Conveyance route based on the social sensitivity mapping reported in Chapter 7 of this ESIA and the receptor categories as derived from the relevant noise standards in Chapter 2. A conservative approach has been adopted in applying the receptor categories with the highest category applied to the denser, more built-up settlements including Amman City and the lower sensitivity category applied to settlements classified as villages as well as locations identified with sparse populations or where locations of mixed use were identified and there is potential for residential properties. The figures also show the associated distances beyond which the applicable noise limits are conservatively predicted to be met (based on the worst-case sheet piling noise levels) for each receptor category. The figures show that the majority of the route (over 73%) passes through areas that are classified as low or negligible sensitivity. These areas are generally rural and non-populated. Approximately 14% is predicted to fall within the “Residential Areas within villages” category and approximately 13% of the route falls within the highest category (predominantly within Amman city).

Figure 9-5, Figure 9-6 and Figure 9-7 additionally show the known locations of places of worship (comprising mosques), hospitals and clinics and places of education (primarily universities).

The sensitivity of receptors to construction noise is assessed as **Medium** with the following justification:

- Vulnerability and presence:
    - Potential for disturbance due to construction noise to known receptors that are reliably present along the Conveyance route but not highly vulnerable or fragile
- Value
    - Potentially for disturbance due to construction noise to residents within towns, villages and the suburbs of Amman and occupants of places of worship, medical facilities and places of education within 1km of the conveyance pipeline route, AGIs and construction camps
- Resilience
    - Disturbance would be temporary in nature, short to medium term and reversible; the effect on the receptors will not continue once the noise source has moved

Figure 9-5: Noise Sensitivity Mapping within Aqaba Governorate Including Predicted Worst Case Noise Buffer Distances Along the Conveyance Route

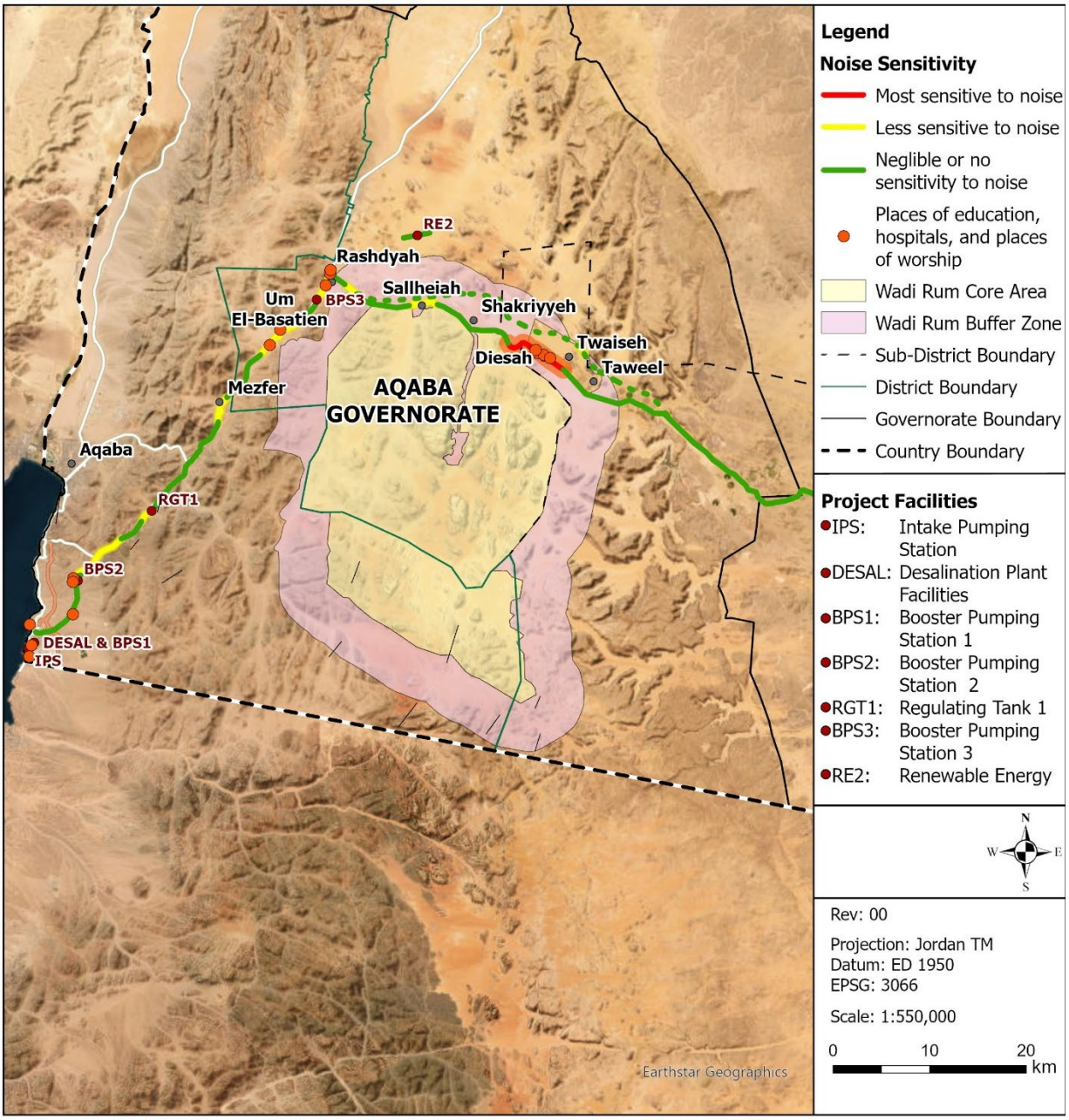


Figure 9-6: Noise Sensitivity Mapping within Ma'an, Tafiela and Karak Governorates Including Predicted Worst Case Noise Buffer Distances Along the Conveyance Route

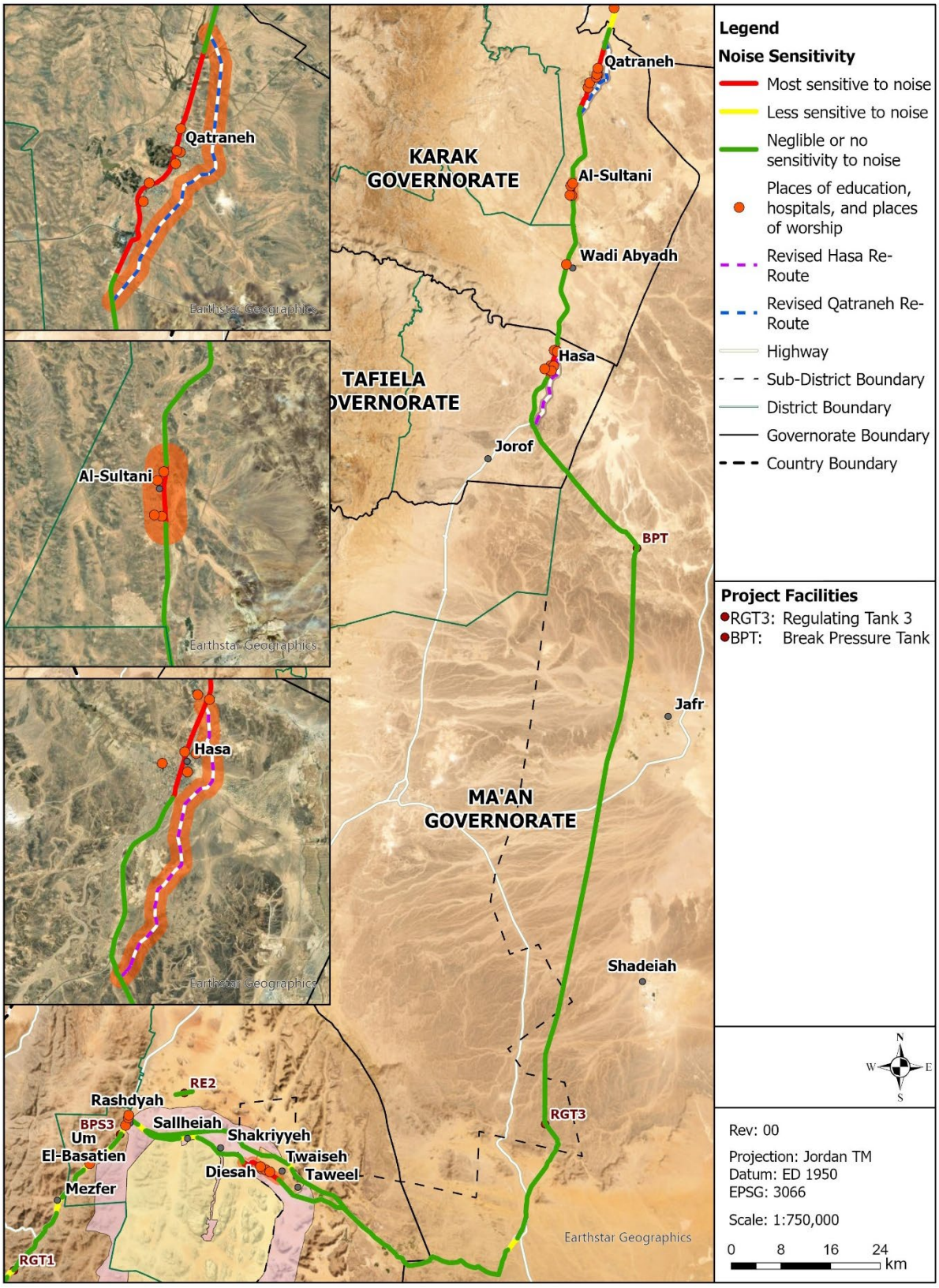
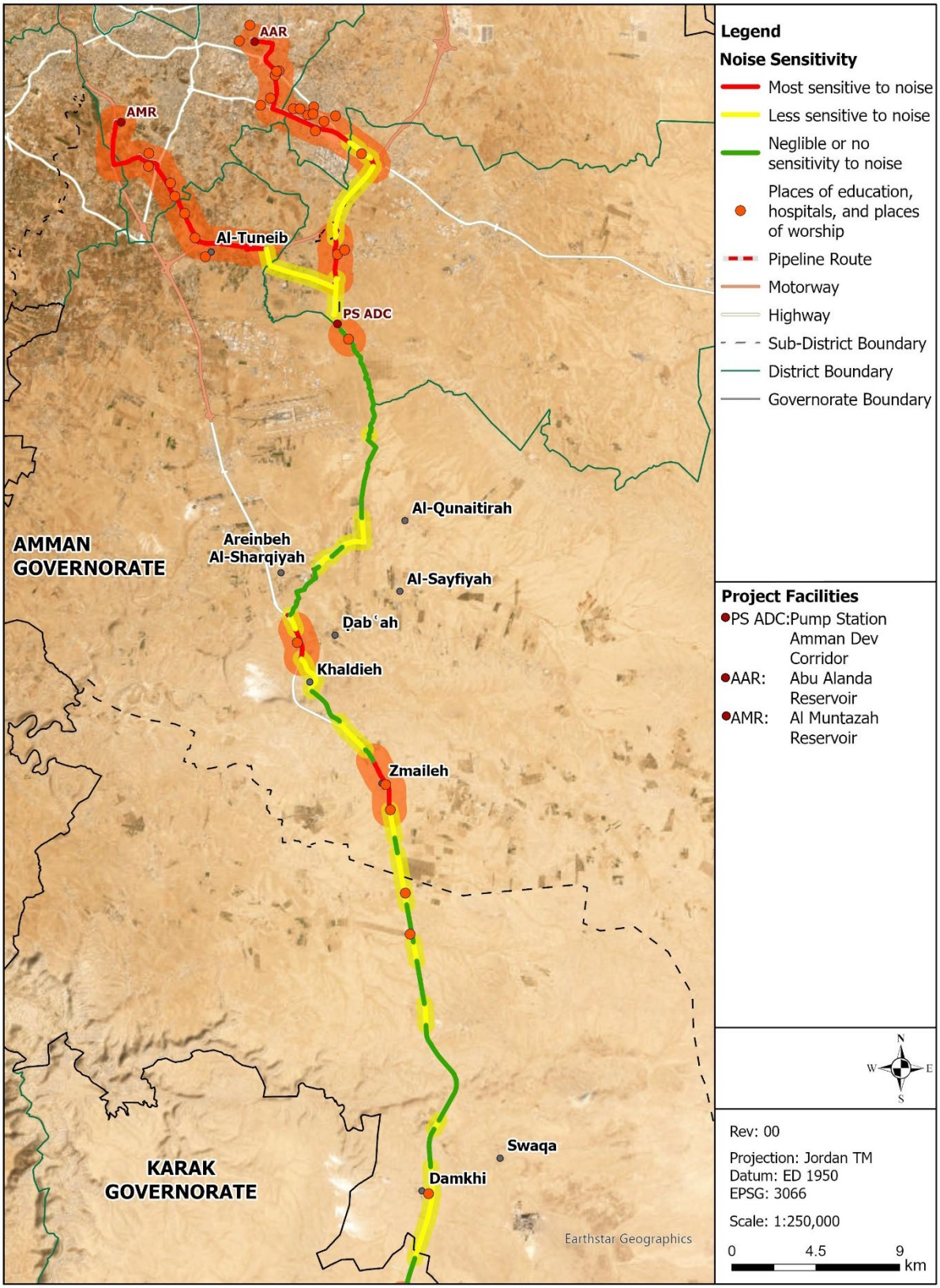


Figure 9-7: Noise Sensitivity Mapping within Amman Governorate Including Predicted Worst Case Noise Buffer Distances Along the Conveyance Route



9.5.3.3 Impact Significance, Mitigation and Residual Impacts

The impact significance of terrestrial noise is considered **Medium**.

Mitigation to reduce the potential impact significance associated with construction noise impacts are defined below:

- Construction planning, to be completed prior to construction:
  - Develop a Construction Noise and Vibration Management Plan aligned to national legislation and international standards in Chapter 2 that includes all feasible and reasonable methods to limit noise emissions and minimise the noise impact on people/properties neighbouring the Project areas/sites. The plan shall include at a minimum:
    - Estimation of the frequencies, duration, days of the week, planned working hours and predicted noise levels anticipated within the vicinity of the Project construction activities at all Project Facilities and along the conveyance pipeline to be completed by a competent noise assessor
    - Protocols for engagement with residents and occupants to provide advance warning of works taking place where relevant, including the duration and likely noise and vibration impacts. In the case of work required in response to an emergency, the local residents and occupants shall be advised as soon as reasonably practicable that emergency work is taking place
  - Ensure the Project Grievance Mechanism includes the process for handling and responding to noise complaints, including requirements associated with conducting noise and vibration monitoring in response to complaints. This should include consideration for an accelerated process to handle and respond to critical construction-related noise grievances.
  - Within the Construction Noise and Vibration Management Plan include a Noise Monitoring Program ahead of the commencement of works, comprising the following elements:
    - Identification of noise/vibration sources and identification and classification of potentially affected sensitive receptors
    - Description of applicable legal requirements related to noise/vibration measuring parameters, measuring locations, frequency of monitoring (intermittent or continuous) and planned monitoring programme for the works, considering the location and sensitivity of the potentially affected receptors
    - Description of arrangements for noise/vibration mitigation during construction in relation to identified noise sources and sensitive receptors, including selection of quieter equipment and scheduling
    - Reporting process related to noise/vibration monitoring results
    - Communication/disclosure lines related to noise/vibration monitoring results with the affected households and the applicable government entities
  - Incorporate consideration of noise impacts in the detailed planning for the construction camps and temporary project facilities to inform siting, layout, equipment selection and noise abatement measures (where required)
  - A review of vibration risk including need to complete a dilapidation survey will be undertaken as part of construction planning

- All pile driving shall be carried out by plant equipped with a noise reducing system or by silent driving systems. Percussive piling shall only be used where no other suitable system is available
- Permanent equipment design to comply with noise limits

- Construction Phase:
  - During construction the contractors shall implement the Construction Noise and Vibration Management Plan and Noise Monitoring Program
  - Temporary noise barriers shall be used to reduce noise levels where appropriate and practicable. Such measures can be particularly appropriate for stationary or near-stationary plant such as pneumatic breakers, piling rigs, and compressors. Barriers shall be located as close to the plant as possible and, in order to provide adequate attenuation, shall have a mass per unit area of at least 7 kg/m^2. The screens may include soil mounds, site offices, site huts, acoustic sheds, or partitions
  - All compressors and generators used during construction activities shall be "sound reduced" models and fitted with properly lined and sealed acoustic covers which shall be kept closed whenever the machines are in use, and all pneumatic percussive tools shall be fitted with mufflers or silencers of the type recommended by the manufacturers
  - High noise generating works (e.g., piling) shall be planned in line with national regulations and respect maximum ambient noise levels at the nearest receptors
  - Stationary equipment (such as temporary generators and compressors) shall be located as far as possible from nearby receptors (e.g., communities). Equipment known to emit noise strongly in one direction, whenever possible, shall be orientated so that the noise is directed away from any sensitive receptors
  - As far as practicable, any activities requiring concrete breaking shall be carried out using equipment that breaks concrete in bending in preference to percussive methods
  - Where reasonably practicable, fixed items of construction plant shall be electrically powered in preference to diesel or petrol driven
  - All ancillary plant such as generators and pumps shall be positioned so as to cause minimum noise disturbance, and, if necessary, acoustic enclosures should be provided
- Operations Phase:
  - Operations Phase Noise and Vibration Plan will be developed as part of the Operational ESMMP and will include measures to ensure noise impacts during operations are minimised including the need to operate and maintain equipment pursuant to the manufacturer's specifications, community relation management, managing complaints and conducting noise and vibration monitoring in response to complaints and specify requirement for dedicated point of contact to manage complaints
  - Operational logistics (e.g. deliveries to Project sites) to be planned to minimise noise impacts to communities
  - Noise survey to be carried out at the boundary of the IPS, Desalination Plant and the Conveyance Pumping Stations in the first year of stable operations to confirm the need for subsequent surveys in the event of grievance and if noise exceedances are recorded

With the application of the mitigation incorporated into a Project ESMS with verification and reporting, the residual impact is considered **Minor.** The justification for the reduction in impact significance is due to:

- Reduction in magnitude of impact due to the use of noise controls including siting of equipment, use of noise barriers and selection of the quietest equipment

9.6 Resettlement, Land, Assets and Livelihoods

9.6.1 Scoping

The AAWDC Project involves linear infrastructure extending across the five Governorates of Aqaba, Ma'an, Karak, Tafiela and Amman, and the eleven districts and seven sub-districts. The construction and operation of the Project will require temporary and permanent land access for construction of all the Project components, including easements and ancillary facilities (e.g. access roads, camps, and laydown areas). Consequently, Project activities may give rise to land, asset, and livelihood-related impacts of varying scale and duration.

Resettlement impacts may be broadly categorised as:

- Physical displacement, involving the loss of residential land, structures, or the need for relocation
- Economic displacement, involving the loss of, or restricted access to, land, assets, or resources that support livelihoods (e.g. crops, irrigation networks, grazing areas, small businesses, or roadside activities), whether or not physical relocation occurs

For the AAWDC Project, no large-scale physical displacement is currently anticipated, as the majority of the pipeline route follows established infrastructure corridors and incorporates a number of re-routes as described within Chapter 4. However, some residential buildings or informal settlements may be affected. The RPF provides a preliminary estimate that 228 residences could be impacted; however the vast majority of the residential buildings counted are not expected to be fully affected in a manner that would lead to physical displacement. Generally, only fences, parking space or access are affected. As such, based on these estimates, physical resettlement is expected to be limited.

Economic displacement is expected to be the predominant impact type, primarily during the construction phase. These impacts may include:

- Temporary loss of access to land or livelihoods due to construction works and restrictions within the right-of-way (RoW)
- Temporary or permanent loss of agricultural income, grazing access, or damage to livestock, crops, trees, fences, or irrigation infrastructure
- Permanent loss of assets (buildings, kiosks) for businesses
- Temporary relocation of business assets during construction
- Temporary disturbance or reduced access to roadside businesses or vendors
- Temporary disturbance to tourism businesses and reduced access to tourism activities
- In limited cases, permanent impacts where land use cannot be safely or practically reinstated following construction

The predominant type of resettlement related impact is the disruption to access to businesses during construction.

Although the majority of these impacts are expected to be temporary, they may still have major short-term effects on affected households, particularly among small-scale businesses, herders, and roadside enterprises whose income or grazing cycles are seasonally dependent.

Engaged Project stakeholders raised the following concerns and requests related to potential economic resettlement impacts, during the September to October 2025 ESIA stakeholder engagement (refer to Chapter 8):

- Impacts on land, houses, farms, and businesses: Business, agricultural and residential owners stakeholders stressed the importance of the Project providing fair, transparent, and timely compensation for all affected assets, including residential houses, businesses, farms, crops and irrigation systems. Stakeholders stressed that compensation should reflect market value, not lower administrative rates, and that eligibility should not depend solely on formal ownership or licence documentation, and should also respect tribal rights in relevant areas
- Livestock owners mentioned the risk of livestock falling into trenches or being hit by construction traffic, as this was an issue that came during the Diesah Pipeline Project, and there was no compensation provided for livestock
- Herders also raised the issue of the potential of construction impeding access to grazing areas or water points
- Tourism business owners around Wadi Rum raised concerns about construction potentially impacting tourism and leading to loss of income or businesses
- Various women stakeholders in the Southern Badia raised concerns about construction leading to the loss of key vegetation for grazing livestock, as well as the loss of medicinal plants they gather

Field observations and conversations also highlighted the following potential resettlement-related impacts:

- The potential displacement of farm labourers living in tents on farmland (Egyptian, generally single men, but also Syrian families in Amman Governorate)
- Potential impacts on Bedouin herders living in tents on state land on or near the RoW

9.6.2 Project Affected People and Contextual Sensitivities

Resettlement related impacts have the potential to affect residents and businesses (owners and workers) of the towns and villages in close proximity to Project construction, as well as land users such as farmers and farm workers and herders.

The adoption of the re-routes, presented in Chapter 4, at the towns of Diesah, Hasa and Qatraneh has significantly reduced the magnitude of potential resettlement impacts. However, there are local residents, land users, and businesses who are still likely to experience the resettlement impacts outlined above, particularly in the densely populated urban areas of Amman Governorate.

Specifically, resettlement related impacts could impact the following groups:

- Residents of the towns, villages and settlements where the pipeline will cross. These potentially currently include: Mezfer, Um El Basatien in Qweirah District, Al Sultani in Qatraneh District, Damkhi in Um Al Rasas Sub-District, Zmaileh and Khaldieh in Jizah District, and then the municipalities of Amman peri-urban and urban areas
- Businesses (owners and workers) of the towns, villages and settlements where the pipeline will cross

- Roadside businesses (owners and workers) and industries along the Desert Highway in Aqaba, Tafiela, Karak and Amman Governorates
- Tourism businesses in the areas around Wadi Rum, particularly camps located to the north of the road that alongside the Wadi Rum UNESCO buffer zone
- Farmers and farm workers located where the pipeline will cross, the OHTL will cross and the RE facilitiy will be located, particularly in Qweirah District, Diesah Sub-District, Jafr Sub-District, along and near to the Desert Highway corridor in Hasa, Qatraneh and Jizah Districts, and where the pipeline corridor splits in Mowaqqar District. These farms are comprised of a mixture of small-scale family farms to medium and larger commercial operations. Farm workers are mainly migrant labourers, including Egyptian workers employed, Syrian workers (particularly in Amman and central Jordan), and a long-established community of Pakistani farmers concentrated in Amman Governorate. Some Syrian workers live on the farms with their families, in makeshift tents
- Herders, including:
    - Settled herders/pastoralism: Settled herders or pastoralism associated with settled Bedouin households, across the ESIA Study Area in the Southern and Central Badia, particularly in the urban and peri-urban areas, and include households that reside permanently in the villages or towns listed in Table 7.1, across Aqaba, Ma'an, Tafiela, Karak and Amman Governorates. You can also find small numbers of settled herders residing in tents and living informally on state or private land, across all five Governorates of the ESIA Study Area
    - Semi-nomadic and nomadic herders, particularly around Hasa and Qatraneh, and Jafr Municipality
    - Both herders and livestock from settled, semi-nomadic or nomadic households may move across or near the corridor at certain times of the year in response to rainfall, grazing availability, and access to water points or grazing corridors. These movements are typically seasonal and adaptive in nature and will be further examined through detailed land-use and access assessments as part of the RAP process

Within this overall context, vulnerable groups to these types of impacts include the following:

- Women, who face structural barriers to representation in public decision-making. Women's limited participation in mixed-gender spaces may also constrain their ability to raise concerns through conventional consultation or grievance channels
- Youth, especially in Badia areas where unemployment is extremely high and where economic opportunities are scarce, making them more vulnerable to project-related expectations, frustrations, and potential livelihood disruptions
- Households living in informal and unregistered residential areas. These include any households living on state land without formal tenure security, such as herders residing in tents or mixed tent-household structures on state- or privately-owned land, or agricultural labourers living in tents on or near farms. This also includes unplanned settlements that lack basic municipal services, including regular water supply, electricity, waste management, and infrastructure and who may rely on self-installed service connections, which increases exposure to health and safety risks and leaves residents vulnerable to any construction-related disturbance or access restrictions

- Casual, seasonal, and informal labourers, particularly in agriculture (including Syrian refugees), who have low and unstable incomes and limited protection against temporary livelihood disruption
- Informal businesses who could be overlooked for any potential compensation measures due to their lack of formal status
- Small scale tourism businesses in and around the Wadi Rum area, that are only just beginning to recover from recent prolonged economic strain, following the dual shocks of the COVID-19 pandemic and regional instability. These businesses could be particularly sensitive to temporary access restrictions or disturbances during construction should they experience them
- Small-scale herders, who operate under increasingly precarious conditions due to declining rangelands, limited access to water, and high feed prices. These households may be particularly sensitive to temporary access restrictions or disturbances during construction should they experience them
- Economically vulnerable households, including those receiving National Aid Fund (NAF) assistance, who typically have limited buffers against even short-term disruptions to income, mobility, or access to services

9.6.3 Impact Assessment: Magnitude, Sensitivity and Significance

9.6.3.1 Magnitude of Effect

The potential magnitude of resettlement-related impacts is assessed as **Moderate** to **Major Adverse**, depending on the location and duration of construction works. While the Project is being designed to minimise land take and physical and economic displacement, the spatial extent of the pipeline, crossing multiple settlements and land use types, means that a large number of people may be temporarily affected by restrictions or access disruptions. In addition, for those relying on grazing lands and limited water points, small-scale farming, or informal roadside activities, even short-term loss of access can have significant livelihood implications.

9.6.3.2 Receptor Sensitivity

The sensitivity of potentially affected people is assessed as **High**, particularly for rural households in the Badia, where access to land, grazing, and water resources is central to livelihoods and social identity. Vulnerability is further elevated among households with informal or customary land use (e.g. unregistered users of state land, settled herders, and informal residents), as they lack formal tenure security and may not be entitled to compensation under national law without additional measures aligned with lender standards. Vulnerability is also elevated for informal businesses, or those small businesses lacking formal documents as they may not be entitled to compensation under national law without additional measures.

Women, small-scale farmers and herders, and small-scale businesses also constitute sensitive groups due to lower adaptive capacity, potential economic vulnerability and limited access to alternative income, and potential barriers to participating in consultation or compensation processes.

9.6.3.3 Impact Significance

Before mitigation, the overall significance of resettlement related, impacts is assessed as **Major Adverse prior to mitigation**, reflecting both the large spatial extent of the Project and the high sensitivity of affected groups, even where physical displacement is limited.

9.6.4 Mitigation

The Project will implement a Resettlement Policy Framework (RPF) in accordance with EBRD ESR5 and IFC PS5, which will guide the preparation of Project Resettlement Action Plan (RAP) once final design details and land acquisition requirements are confirmed. The RPF and subsequent RAP will ensure that all affected people, whether they hold legal, customary, or informal land rights are treated fairly and compensated in line with international standards.

A targeted land use assessment of potential impacts on herders and livestock, including those associated with settled, nomadic and semi-nomadic households will be included in the RAP, including an assessment of whether the Project could impact grazing areas, water points, or access to these grazing areas, water points or livestock feed centres.

The RPF and RAP will include the following mitigation principles and measures:

- Minimisation of land take/access: Continued optimisation of the Project pipeline route and associated working width to avoid or minimise impacts on private and community lands, agricultural areas, and roadside enterprises
- Compensation for all affected people: Provision of cash or in-kind compensation for loss of land, crops, trees, and other assets, at full replacement cost, prior to land entry
- Livelihood restoration and assistance: Implementation of targeted livelihood restoration support for economically displaced persons, including herders, small-scale farmers, and microbusinesses, to help re-establish income sources and reduce transition impacts
- Targeted support for vulnerable groups: Identification of vulnerable households (e.g. female-headed, low-income, informal settlers) and provision of tailored assistance to ensure equal access to entitlements and consultation processes
- Temporary access and construction planning: Coordination between the EPC Contractor and local municipalities to minimise the duration of access restrictions and provide alternative routes where feasible. This will also involve a process to minimise business access disruption, as follows: 1) Implementation of a field inventory (direct footprint and near footprint); 2) Detailed pre-construction review with the EPC Contractor; 3) Assessment of all cases where impacts to access or parking space can be avoided or minimised by the EPC Contractor during construction, as well as cases where the impact cannot be avoided; 4) In the case where access issues can be avoided or minimised, the EPC Contractor will prepare site-specific access management plans for implementation during construction; 5) In the cases where access issues cannot be avoided, a valuation of losses (business income, structure, employees) will be carried out and included in the RAP
- Stakeholder engagement and disclosure: Continued engagement with potentially affected people, landowners, farmers, farm workers, herders, businesses, local residents and municipal authorities, to ensure transparency of land requirements, timing, and compensation procedures

- Grievance redress: Dedicated grievance channels for land and compensation issues, integrated within the Project's overall Grievance Mechanism but tracked separately to ensure timely resolution and documentation
- Monitoring and post-construction commitments: Monitoring of resettlement and livelihood restoration will form part of the Environmental and Social Management System (ESMS). Key indicators will include:
    - Number of affected households and categories of impact (land, crops, assets, income)
    - % of affected persons compensated prior to land entry
    - Number of livelihood restoration activities completed and outcomes achieved
    - Number and resolution rate of land-related grievances
    - Project affected people's satisfaction with compensation and restoration measures

A post-construction audit will confirm the reinstatement of access, the restoration of livelihoods, and the close-out of all commitments prior to the operational phase.

Table 9-12 presents a preliminary entitlement matrix. This will be elaborated upon in further stages of developing the Resettlement Action Plan and consulting thereupon with project affected people.

Table 9-12: Preliminary Entitlement Matrix

Loss or impact	Eligible entity	Entitlement
Privately held land (agricultural, residential or commercial)	Landowner with registered ownership documentation	Compensation at replacement cost, including the value of any development upon land such as water wells, irrigation or drainage infrastructure, water rights, and any other structures – in cash. If there is a lessee (see line below), the compensation may be shared between the landowner and the lessee according to provisions in Jordanian legislation and per agreement between the two parties. In case of shared ownership, each co-owner will be compensated per the share they hold in the property. This component of compensation (titled land) is under the responsibility of MWI. Titled land plots are already identified and a preliminary valuation has been undertaken.
	Lessee with formalised lease agreement	Share of the compensation due to the landowner for land and developments upon land, per agreement between the two parties. Compensation to formalised lessees will be delivered by MWI. This component of compensation (titled land) is also under the responsibility of MWI as it pertains to titled land plots Lessees will have to be identified as part of the RAP preparation.
Informal agricultural use on State land	Informal agricultural land user	No compensation for land. Compensation for any fixed structures (e.g. greenhouses, irrigation and drainage infrastructure) owned by the informal occupant and livelihood restoration in respect of any loss of income.

Loss or impact	Eligible entity	Entitlement
		Compensation for trees and annual crops at replacement cost, taking the duration of the agricultural cycle into consideration.
Public land and public right-of-way with informal (unregistered occupation) by businesses – disturbance to access to business	Informal land user (business owner or operator)	Compensation for the cost of temporary move if a structure has to be displaced during construction or in-kind support for the move. Compensation of any fixed assets that cannot be moved (such as foundations or slabs). Livelihood support for income loss during the construction period in relation to interruption of business activity or disruption of access to business. Compensation will be based on the monthly net income for similar businesses in the area applied to the anticipated duration of disturbance to access.
State land used for grazing	Individual herders or clans/tribes using land on a collective basis	Support to livelihood restoration where impacts are significant – in kind. Compensation could be delivered at community level in the form of social amenities or projects, subject to consultation with the relevant representatives of Bedouin herders.
Residential structures on private or public land	Owner of structure	Compensation for structures at replacement cost – in cash Support to relocation to an equivalent dwelling with security of tenure.
Non-residential structures on private or public land	Owner of structure	Compensation for structures at replacement cost – in cash.
Trees and crops on agricultural land	Owner of the trees or crops (not necessarily the landowner)	Regardless of occupation status of the land, compensation at replacement cost for annual crops if they cannot be harvested before land take, and compensation at replacement cost for perennial crops (trees) – in cash.
Business activity (in case of temporary or permanent interruption of activity)	Owner (or operator)	Compensation for loss of income in case of temporary suspension of business operation related to the Project – in cash. Support to livelihood restoration.
	Employee	Compensation for loss of income in case of temporary suspension of employment related to the Project – in cash.
Affected vulnerable people	Vulnerable household	Supplemental support and facilitation of access to available State or NGO welfare support.

9.7 Community Health, Safety and Security During Construction

9.7.1 Scoping

Construction of the Project will involve significant civil works, excavation, the movement of heavy machinery, increased traffic on national and local roads, temporary access restrictions, storage of materials, and a large construction workforce. These activities present multiple pathways of potential

impact on community health, safety and security, particularly on community residents, road users, businesses, farmers and herders located in or near to the Project areas.

Potential Project construction impacts on community health, safety and security include:

- Construction Hazards and Disturbances:
    - Open trenches or unprotected excavations are a potential hazard to communities and livestock largely related to the pipeline construction. These hazards are heightened where they intersect with community movements or the presence of livestock, such as herders moving livestock, children playing or travelling to school, or vehicles. In the absence of timely reinstatement, barriers or clear warning signage, there is an increased likelihood of accidental entry, injury or livestock loss
    - Dust: Construction related earthworks and excavations for all Project components have the potential to generate large amounts of dust, which can be hazardous to health when inhaled or can cause a nuisance to communities, residents and land users nearby. The full scope and impacts of construction related dust has been assessed in Section 9.4 above
    - Noise and vibrations: Construction activities for all AAWDC Project components have the potential to generate noise and vibrations, which can create disturbances on communities, residents and land users nearby. The full scope and impacts of construction noise and vibrations has been assessed within Sections 9.5 above
    - Safety hazards related to the storage of materials, is a potential issue largely related to laydown areas and the storage of large pipeline sections and the potential for these to attract stray dogs or to create potential areas for anti-social behaviour near to communities
    - Increased exposure to natural hazards risks such as localised flooding. Project activities in wadi systems and low-lying areas may temporarily alter natural drainage patterns, and construction works such as excavations, temporary access roads and laydown areas may obstruct natural watercourses, both leading to potentially exposing nearby communities, road users and grazing areas to flooding safety risks if not managed properly
- Traffic, access and road safety impacts:
    - Increased heavy-vehicle movements along the Desert Highway and internal local roads could create safety risks for pedestrians, livestock herders, and transport users, as well as increased levels of dust
    - Temporary restriction of movement or access on roads could affect residents, businesses, farmers, herder or other road users
    - Increased movement of heavy vehicles along existing roads-especially in more remote stretches of Aqaba, Ma'an, Tafiela, and Karak Governorates, including areas already affected by sand encroachment and limited road shoulders, could accelerate road deterioration, reduce safety, and affect day-to-day accessibility for residents
- **Worker Influx**: The Project will require a temporary construction workforce that may include both Jordanian and non-Jordanian workers. This could lead to a temporary influx of non-local workers to the different municipalities close to construction work fronts or worker camps. Unless carefully managed, through proactive and sustained intervention, this could lead to potential impacts on community health, safety and security such as an increase in the transmission of communicable diseases, increase in anti-social behaviours, GBVH/SEAH, or tensions between workforce and local communities. Worker presence—especially where construction sites are

near small or conservative rural communities—may also lead to concerns around cultural norms, interaction with women and youth, and perceived security risks

- **Impacts on community infrastructure and services**: Construction activities for the Project may create localised pressures on community infrastructure and essential services, particularly in districts and sub-districts situated close to the desalination plant, pipeline corridor, construction laydown areas, access roads, and worker accommodation sites. In towns and villages close to work fronts, particularly in the more remote Southern and Central Badia areas, a temporary increase in workforce numbers may place additional demand on primary health services, water and sanitation systems, waste management, and emergency response capacity. While water scarcity affects all regions in Jordan, it is particularly acute in some of these more remote Badia communities of the AAWDC Project areas such as Jafr and the towns and villages in and around the Wadi Rum area. Smaller municipalities with limited budgets, such as those found in those areas, may also experience challenges managing increased solid waste, maintaining roads, or responding to traffic incidents if adequate mitigation is not in place
- **Security Arrangements Risks**: The use of public or private security personnel may increase risks to communities near to the Project areas, such as use of excessive force, intimidation, or improper conduct if not managed appropriately. Security personnel may be deployed at key construction sites, laydown areas, and worker accommodation sites. While the Project area is not considered to be a high security threat environment, the presence and activities of security providers—whether public (e.g., PSD, Badia Police) or contracted private security—may pose potential risks to communities if not managed in line with international good practice (e.g., Voluntary Principles on Security and Human Rights). Potential impacts could include misuse of force, intimidation (actual or perceived), inappropriate interactions with local residents, or discriminatory behaviour toward specific groups (including women, youth, or migrant workers). Inadequate communication about security roles and protocols could also lead to community mistrust, or fear of retaliation when raising complaints

Engaged Project stakeholders raised the following concerns and requests related to community health and safety during construction, during the September to October 2025 ESIA stakeholder engagement (refer to Chapter 8):

- Demand for Municipal oversight over all construction contractors and for contractors to coordinate closely with municipalities
- Dust generated by construction could exacerbate the already existing problem of desert sand encroachment affecting households in the Wadi Rum area
- Construction related dust could lead to exacerbation of community health issues (asthma, dry eyes, etc)
- Construction noise at night in residential areas could impact people's sleep
- Pipeline sections left for long periods will attract stray dogs or other types of illicit or anti-social activities in residential areas
- Open trenches are a risk for people, in particular children, as well as to livestock, who risk falling in
- Lack of safe crossings around construction sites in urban areas, particularly in areas where children walk to school and back
- Risk to residents of construction related traffic accidents (demand for speed controls)

- Risk of construction traffic collision with livestock (particularly camels in Qweirah District and Diesah Sub-District)
- Construction workforce putting pressure on already stretched health services in certain areas
- Construction traffic could damage municipal roads
- Construction could create traffic congestion or parking problems in urban areas
- Construction could block access for residents, businesses, farmers and herders
- Construction vibrations could create structural damage to houses
- Construction could disrupt businesses

9.7.2 Project Affected People and Contextual Sensitivities

Community health, safety and security construction related impacts have the potential to affect residents and businesses (owners and workers) of the towns and villages in close proximity to Project construction, local authorities such as municipalities, districts and sub-districts, as well as land users such as farmers and farm workers and herders.

The adoption of the re-routes, presented in Chapter 4, at the towns of Diesah, Hasa and Qatraneh has significantly reduced the magnitude of potential community health and safety impacts. However, the local population of the towns and villages in the Diesah/Qweirah District area, along the Desert Highway in Hasa and Qatraneh Districts and then onwards in Amman Governorate and the Amman urban and peri-urban/suburban areas are still likely to experience the community health, safety and security impacts outlined above. Furthermore, the densely populated urban areas of Amman Governorate are likely to experience higher sensitivities and be more impacted due to their population density.

Specifically, community health, safety and security construction related impacts could impact the following groups:

- Residents of the towns, villages and settlements located close to Project construction activities (these are detailed in Table 7.1 of Chapter 7)
- Businesses (owners and workers) of the towns, villages and settlements located close to Project construction activities
- Roadside businesses (owners and workers) and industries along the Desert Highway in Aqaba, Tafiela, Karak and Amman Governorates
- Tourism businesses in the areas around Wadi Rum, particularly camps located to the north of the road that alongside the Wadi Rum UNESCO buffer zone. Tourism businesses in and around Aqaba are less likely to be impacted by construction hazards but they could be impacted by worker influx in Aqaba, construction traffic and Project security arrangements
- Farmers and farm workers located close to Project construction activities, particularly in Qweirah District, Diesah Sub-District, Jafr Sub-District, along and near to the Desert Highway corridor in Hasa, Qatraneh and Jizah Districts, and where the pipeline corridor splits in Mowaqqar District. These farms are comprised of a mixture of small-scale family farms to medium and larger commercial operations. Farm workers are mainly migrant labourers, including Egyptian workers employed, Syrian workers (particularly in Amman and central Jordan), and a long-established community of Pakistani farmers concentrated in Amman Governorate. Some Syrian workers live on the farms with their families, in makeshift tents

- Herders, including:
    - Settled herders/pastoralism: Settled herders or pastoralism associated with settled Bedouin households, across the ESIA Study Area in the Southern and Central Badia, particularly in the urban and peri-urban areas, and include households that reside permanently in the villages or towns listed in Table 7.1, across Aqaba, Ma'an, Tafiela, Karak and Amman Governorates. You can also find small numbers of settled herders residing in tents and living informally on state or private land, across all five Governorates of the ESIA Study Area. Potential construction impacts could involve the potential for noise or dust to disturb their animals, for livestock to fall into open trenches or to be hit by construction traffic, and for construction to impede the movement of livestock or access to water points, grazing areas or livestock feed centres
    - Semi-nomadic and nomadic herders, particularly around Hasa and Qatraneh, and Jafr Municipality
    - Both herders and livestock from settled, semi-nomadic or nomadic households may move across or near the corridor at certain times of the year in response to rainfall, grazing availability, and access to water points or grazing corridors. These movements are typically seasonal and adaptive in nature and will be further examined through detailed land-use and access assessments as part of the RAP process. See Section 9.6.4 above for Project mitigation measures to further assess this potential impact
- Local authorities, and in particularly municipalities located close to Project construction activities.

Amongst these potentially impacted stakeholder groups, vulnerable groups to these types of impacts include the following:

- Women, who face structural barriers to mobility and access to transport, and representation in public decision-making, as well as heightened risks of experiencing gender-based violence and harassment (GBVH) and sexual exploitation and abuse and harassment (SEAH). Women's limited participation in mixed-gender spaces may also constrain their ability to raise concerns through conventional consultation or grievance channels
- Youth, especially in Badia areas where unemployment is extremely high and where economic opportunities are scarce, making them more vulnerable to project-related expectations, frustrations, and potential livelihood disruptions
- Children, who may be more vulnerable in relation to potential construction community health and safety impacts due to their lack of awareness around construction hazards, or their use of local roads or paths to travel to school
- Households living in informal and unregistered residential areas. These include any households living on state land without formal tenure security, such as herders residing in tents or mixed tent-household structures on state- or privately-owned land, or agricultural labourers living in tents on or near farms. This also includes unplanned settlements that lack basic municipal services, including regular water supply, electricity, waste management, and infrastructure and who may rely on self-installed service connections, which increases exposure to health and safety risks and leaves residents vulnerable to any construction-related disturbance or access restrictions
- Persons with disabilities, particularly disabled youth, who may face additional barriers to accessing employment, transport, services, and consultation processes

- Small scale tourism businesses in and around the Wadi Rum area, that are only just beginning to recover from recent prolonged economic strain, following the dual shocks of the COVID-19 pandemic and regional instability. These businesses could be particularly sensitive to temporary access restrictions or disturbances during construction should they experience them
- Small-scale herders, who operate under increasingly precarious conditions due to declining rangelands, limited access to water, and high feed prices. These households may be particularly sensitive to temporary access restrictions or disturbances during construction should they experience them
- Economically vulnerable households, including those receiving National Aid Fund (NAF) assistance, who typically have limited buffers against even short-term disruptions to income, mobility, or access to services
- Residents of towns and villages who experience respiratory health conditions (e.g. asthma) or existing health conditions relating to the dusty environment (e.g. dry eyes), and who may be more sensitive to potential dust generated during construction

9.7.3 Impact Assessment: Magnitude, Sensitivity and Significance

9.7.3.1 Magnitude of Effect

While the adoption of the re-routes, presented in Chapter 4, at the towns of Diesah, Hasa and Qatraneh has significantly reduced the magnitude of potential community health and safety impacts, the magnitude of the overall potential community health, safety and security impacts is assessed as **Major**. Construction will involve multiple simultaneous activities across a long linear corridor, intersecting or passing near populated areas, settlements, business and commercial activities, agricultural zones, herding activities and public roads. The range of potential risks (including increased heavy vehicle movements, road safety hazards, construction safety hazards, accidental damage to infrastructure or utilities, nuisance from dust and noise, and potential interactions between workers and local residents) means that a large number of people could be directly or indirectly affected.

While the duration of works at any single location will be relatively limited and many impacts (such as noise, dust, or temporary access restrictions) are expected to be short-term and reversible (see Sections 9.4.3 and 9.5.3 above), others carry the potential for serious or lasting consequences. These include traffic-related accidents involving community members, safety incidents linked to unprotected excavations or machinery, and disruption to roadside and tourism businesses whose income may depend on uninterrupted access and local mobility.

Given the geographical extent of the pipeline route, the number of potentially exposed people, and the range of potential health and safety risks, the overall magnitude of the unmitigated magnitude of effect is therefore considered **Major,** even though the duration of most individual disturbances will be temporary.

9.7.3.2 Receptor Sensitivity

The sensitivity of potentially affected people to potential health and safety impacts from construction is assessed as **High**. This reflects both the scale and geographic reach of the Project, as well as the diversity and vulnerability of the populations and activities located along the corridor. The Project crosses multiple governorates and socio-economic contexts, from more rural areas in the Central and Southern Badia, to

densely populated peri-urban and urban neighbourhoods near Amman, and includes important tourism, agricultural, herding and small business economies, as well as multiple residential areas.

Several contextual factors heighten this sensitivity. In the south, a number of the communities around Wadi Rum and Aqaba rely heavily on tourism-related income, a sector that has only recently begun to recover from the dual shocks of the COVID-19 pandemic and recent regional instability. In other areas, households depend on roadside trade, transport services, or small-scale agriculture and herding – livelihoods that are directly exposed to potential construction-related disruption. Across the Project area, there are also high numbers of school-aged children who walk to school or crossroads regularly, and large numbers of livestock and herders who use or cross access routes that may overlap with construction areas, all of which elevate safety risks. Finally, the Desert Highway is a major transport artery linking many of these cities, towns and villages together.

In addition, engaged stakeholders repeatedly referred to the legacy of the previous Diesah Pipeline Project, with many reporting experiencing negative impacts from construction, leading to lasting concerns about the adequacy of contractor oversight and enforcement of health and safety standards. While these concerns do not imply non-compliance on the AAWDC Project, they highlight a pre-existing sensitivity and low tolerance from Project stakeholders to any perceived risks to community health and safety.

Taken together, these factors indicate that the Project socio-economic context and the potentially affected receptors have a **High** sensitivity to potential community health and safety impacts, even where the duration of exposure may be short.

9.7.3.3 Impact Significance

Given the combination of a **Major** impact magnitude and **High** socio-economic contextual sensitivity, the overall significance of potential community health and safety impacts during construction is assessed as **Major Adverse prior to mitigation**. The Project's large spatial footprint, coupled with the diversity of affected settings, from remote pastoral landscapes to densely populated peri-urban areas, means that a wide range of people and assets could be exposed to multiple, interacting risks. Even though many individual disturbances will be temporary and site-specific, the cumulative scale of potential exposure, combined with contextual sensitives and community concerns regarding contractor performance and safety oversight, elevates the overall risk level to major significance in the absence of the implementation of robust preventive and management measures.

9.7.4 Mitigation

In order to prevent and manage potential community health, safety and security impacts during construction, the AAWDC Project will adopt a comprehensive community health, safety and security management approach, premised on strict adherence to Jordanian national occupational health and safety regulations and international good practice (e.g. IFC EHS Guidelines).

Mitigations to reduce the potential impact significance are defined below:

Pre-Construction Planning and Coordination:

- Development of a Project Community Health, Safety and Security Management Plan (CHSSMP) to be prepared by the EPC Contractor, in consultation with all affected municipalities and other relevant local authorities and approved by NCPC prior to mobilisation. Specific mitigation measures detailed in the CHSSMP will include:
    - Measures to address potential construction hazards and disturbance impacts, including:

- Avoidance of construction at night in residential areas, wherever feasible
- Dust suppression measures to be implemented near communities, schools, grazing areas and farms (see Section 9.4 for detailed commitments related to dust)
- Noise and vibration measures to be implemented near communities, schools, grazing areas and farms (see Section 9.5 for detailed commitments related to noise and vibration)
- Safe storage and controlled laydown of pipes/equipment to avoid creating hazards or attracting anti-social use
- Clear site fencing, signage, and lighting around open trenches, machinery yards, and material laydown areas, to prevent accidental access
- Hydrological management measures, such as maintaining natural drainage pathways, installing temporary diversions, where necessary, and avoiding obstruction of wadis

o Measures to address potential impacts associated with worker influx, including:

- Workforce accommodation planning to avoid strain on local services
- Worker camps to have their own medical facilities to avoid putting undue pressure on local health services and facilities in rural and peri-urban Project areas
- Worker code of conduct to be implemented for all Project workers, including contractors and sub-contractors
- Worker GBVH/SEAH Code of Conduct to be implemented for all Project workers, including contractors and sub-contractors, and other GBVH/SEAH prevention measures (see GBVH/SEAH Section 9.10 for further measures associated with GBVH/SEAH)

o Measures to address potential impacts on community infrastructure and services, including:

- Solid waste and wastewater management measures aligned with municipal capacity.
- Coordination with public security and emergency response services to ensure preparedness for accidents or emergencies, including shared response protocols and contact points
- Coordination with municipalities to address any impacts on community utilities

o Measures to address community risks associated with Project security in line with international good practice (e.g., Voluntary Principles on Security and Human Rights), including:

- Engagement with public security forces to ensure alignment and coordination over Project security measures
- Rigorous screening, training, and monitoring of private security providers on behavioural standards, human rights, GBVH/SEAH prevention, and proportional use of force
- Clear protocols for engagement with local communities, including respectful communication and cultural awareness
- Transparent procedures restricting security personnel from engaging in law enforcement beyond their mandate

  - Measures to ensure close coordination during construction with relevant authorities, such as municipalities, districts and sub-districts, ASEZA for the Aqaba section, health directorates, and civil defence
  - Any additional measures necessary to address potential community health, safety and security impacts on the vulnerable groups detailed in Section 9.7.2.
  - Construction and post-construction monitoring and reporting measures
- Development of a Traffic and Road Safety Management Plan, that is based on a detailed forecast of the traffic and transport flows and routes, to be prepared by EPC Contractor, in close coordination with municipalities and the Ministry of Public Works & Housing, and approved by NCPC prior to mobilisation. This Plan should take into consideration community access issues, and safety measures around communities and livestock

Construction Implementation:

Implementation of all measures outlined in the Community Health, Safety and Security Management Plan and the Traffic and Road Safety Management Plan, supported by continuous monitoring, transparent communication, and proactive engagement with local authorities (municipalities and districts/sub-districts) and community representatives, will substantially reduce the likelihood and severity of adverse health, safety and security impacts, lowering the residual significance to Moderate or Low after mitigation.

The EPC Contractor will ensure the following public engagement:

- Early notification of construction schedules to governorates, districts/sub-districts and municipalities listed in the Project SEP
- Advance public awareness and information campaigns before and during construction to alert communities about work schedules, restricted zones, temporary closures, detours, and safety precautions—especially in schools, herding areas, and tourism zones

Construction and Post-Construction Monitoring, Reporting Commitments:

Monitoring of community health, safety and security performance will form an integral part of the AAWDC Project's overall Environmental and Social Management System (ESMS). The EPC Contractor, under supervision of the AAWDC Project ESG team, will maintain a system for continuous observation, recording, and reporting of any community safety incidents, near-misses, or grievances related to construction activities. Key indicators will include the number and type of incidents, response times, grievance resolution rates, and community satisfaction levels.

Weekly and monthly monitoring reports will be compiled during active construction, supported by periodic joint inspections with local municipalities and districts/sub-districts, and ASEZA (in Aqaba Governorate Project areas). Any emerging risks will trigger immediate corrective action and, if necessary, revisions to the CESMP. Monitoring results and safety bulletins will also be shared transparently with local stakeholders, municipalities, and governorate authorities to maintain trust and accountability.

Following construction, the Project will implement a post-construction verification and close-out programme to ensure that all commitments and mitigation measures have been effectively implemented, and that any residual risks or outstanding community concerns are addressed prior to commissioning. This will include:

- Final safety inspections and road reinstatement verification in coordination with the Ministry of Public Works and local municipalities

- Closure of any temporary access routes, storage yards, and borrow pits with appropriate signage, fencing, and rehabilitation
- Post-construction consultations with municipalities and districts/sub-districts, including land users outside of urban areas (e.g. farmers, herders) to confirm satisfaction with reinstatement and to identify any unanticipated impacts
- The results of post-construction monitoring and consultations will be compiled into a Community Health and Safety Close-Out Report, confirming that residual impacts have been effectively mitigated, lessons learned have been incorporated, and that the Project meets both national and lender requirements prior to entering full operational phase

9.8 Local Employment and Local Content

9.8.1 Scoping

Employment and procurement opportunities linked to the construction and operation of the Project are expected to generate positive socio-economic benefits for some, particularly in terms of short-term construction related job creation and contracting opportunities, and the potential opportunity for skills development. However, within the socio-economic context of the Project area, these issues are also highly sensitive and complex. Stakeholders across all Governorates consistently identified local employment and the use of local contractors, as well as the manner in which this is implemented, as their primary expectation and concern during the ESIA engagement.

While local employment and procurement is generally perceived as a positive impact, its implementation can produce uneven or unintended consequences if not managed transparently and in a manner that is deemed fair and equitable. In practice, competition for project-related jobs and contracts can lead to tensions between localities, tribes/clans, or social groups, particularly where expectations are high but employment and contracting opportunities are limited or distributed through perceived bias. The reported experience of previous infrastructure projects in Jordan, including the Diesah Pipeline Project, demonstrates how the absence of transparent and locally perceived fair employment processes can create local resentment, protests, or even social unrest and violence. Similarly, stakeholder engagement feedback also highlighted some positive examples of employment processes in past infrastructure or construction projects, demonstrating that local employment and contracting can be done in a manner that is locally perceived to be transparent and fair.

Accordingly, while the Project's potential for local economic benefit is substantial, it also carries significant social risk if expectations are not managed and if recruitment and procurement processes are not perceived as transparent, fair, and inclusive.

Engaged Project stakeholders raised the following concerns and requests related to local employment and local procurement, during the September to October 2025 ESIA stakeholder engagement (see Chapter 8):

- A consistent view was expressed by all stakeholders that the Project should ensure it engages with community Project stakeholders and allocate local employment and local contracts and other benefits, in a transparent, fair and inclusive way. Engaged women and youth stakeholders stressed the importance of making sure they are not sidelined in any AAWDC Project engagement or benefit allocation
- Strong expectations that local stakeholders should be prioritised for job opportunities and local contracts, through transparent and fair processes, and that youth and women should not be

sidelined from opportunities. Requests for investment in vocational training to prepare youth and women for employment and other contracting opportunities

- All stakeholders across the AAWDC Project areas stressed the importance of the Project coordinating closely with municipalities and district/sub-district governors in managing the allocation of local benefits, such as local employment and local contracts
- Many Bedouin stakeholders highlighted the importance of ensuring that the transparent allocation of Project-related benefits-such as local employment and procurement opportunities-respect local tribal affiliations and customary understandings of tribal lands, to avoid inadvertently creating tensions between different tribal/clan groups. It was also stressed that respecting tribal interfaces and their central role in Bedouin communities is essential, as they hold significant social value

9.8.2 Project Affected People and Contextual Sensitivities

Project employment and procurement opportunities, and the implementation of these potential opportunities, have the potential to affect people and businesses across Jordan, as well as internationally. The expectations related to local employment and local procurement are specific to the communities in close proximity to the works (see Section 9.8.1 above). Within the Central and Southern Badia Project areas, there is an additional layer of tribal/clan expectations to benefit from the Project, in relation to any overlap of the Project on or near to tribal/clan customary land rights.

Within this overall context, vulnerable groups to these types of impacts include the following:

- Women, who face structural barriers to mobility and access to transport, economic participation, and representation in public decision-making, as well as heightened risks of experiencing gender-based violence and harassment (GBVH) and sexual exploitation and abuse and harassment (SEAH). Women's limited participation in mixed-gender spaces may also constrain their ability to raise concerns through conventional consultation or grievance channels
- Youth, especially in Badia areas where unemployment is extremely high and where economic opportunities are scarce, making them more vulnerable to project-related expectations, frustrations, and potential livelihood disruptions
- Persons with disabilities, particularly disabled youth, who may face additional barriers to accessing employment, transport, services, and consultation processes

9.8.3 Impact Assessment: Magnitude, Sensitivity and Significance

9.8.3.1 Magnitude of Effect

The potential magnitude of this impact is assessed as **Major** (positive and adverse), depending on how effectively employment and procurement measures are implemented. The Project will generate a substantial volume of temporary employment and procurement opportunities during the construction phase, given the scale and geographical extent of the works, the number of contractors involved, and the duration of construction activities across multiple Governorates. The Project will, however, only generate a small number of permanent employment opportunities.

If managed effectively, these opportunities could positively contribute to local livelihoods, household income stability, and local business activity. However, the magnitude of potential adverse impacts is also major if expectations are not met or if recruitment and procurement practices are not transparent and

inclusive. Exclusion (real or perceived) of local workers or suppliers, whether due to lack of information, limited skills, or favouritism, could lead to significant dissatisfaction and conflict among Project stakeholders.

The large geographic area of the Project also increases the number of directly and indirectly affected people, magnifying the overall scale of potential impacts. Consequently, the magnitude of this effect, considering both potential positive and adverse dimensions, is assessed as **Major prior to mitigation**.

9.8.3.2 Receptor Sensitivity

The sensitivity of communities in relation to project employment and procurement opportunities and the implementation of these potential opportunities within the Project socio-economic context is assessed as **High**. Unemployment levels in the southern Governorates and Districts are among the highest nationally, particularly in Qweirah District, Diesah Sub-District, and Jafr Sub-District, where limited private investment and public employment opportunities have created sustained economic vulnerability, particularly among women and youth in these areas. Local stakeholder expectations around local employment and local procurement, particularly amongst Bedouin stakeholders in the Central and Southern Badia, are high.

In these Badia tribal/clan areas, perceived unfairness or exclusion in recruitment processes and local contract allocation can have broader implications beyond individuals, triggering grievances at the tribal or clan level. This risk is intensified by social dynamics in which *wasta* (personal influence or mediation) is reported by stakeholders to continue to shape access to opportunities, raising concerns about transparency and accountability in hiring and contracting.

Women and youth are also particularly vulnerable in this context, given their historically low labour force participation and limited access to formal employment. Without deliberate inclusion measures, they risk being excluded from project-related benefits.

Given the combination of high socio-economic dependence, strong local expectations, and existing social tensions, the sensitivity of this impact is therefore assessed as **High**.

9.8.3.3 Impact Significance

Considering the major magnitude of potential benefits and risks, together with High receptor sensitivity, the overall pre-mitigation significance of this impact is assessed as Major (Adverse/Beneficial). The impact has the potential to bring widespread positive benefits to local economies but also carries a serious risk of adverse social tension or reputational harm if not managed equitably and transparently.

Given the combination of a **Major** impact magnitude and **High** socio-economic contextual sensitivity, the overall significance of potential impacts related to local employment and procurement (adverse and positive) is assessed as **Major prior to mitigation**.

9.8.4 Mitigation

Overall, and based on consistent feedback from engaged stakeholders throughout the Project areas, the first and main step towards implementing transparent and fair processes, will be to work in close coordination with local municipalities and districts/sub-district local governors.

Mitigations to reduce the potential impact significance are defined below:

Pre-Construction: Planning, Coordination and Commitments:

- EPC Contractor and NCPC to Register on the Ministry of Labour's (MoL) National Employment Program (NEP), which is a government flagship, performance-based wage-subsidy and placement program to stimulate private-sector hiring of Jordanians, especially youth and women. The program blends (i) temporary wage support, (ii) social security and transport top-ups, and (iii) on-the-job & short classroom training, tied to actual signed work contracts
- Development of a Project Local Employment and Local Procurement Plan, in coordination with the EPC Contractor, and consultation with local districts/sub-districts and municipalities in order to design the most effective, transparent and fair local employment and local procurement processes for each Project locality. This Plan will integrate the Ministry of Labour NEP process. Further consideration will also be given to different ways to ensure transparency and fairness, including the consistent request from engaged stakeholders in the Badia for inclusive Local Advisory Committees (LACs) to be set up through the Districts/sub-districts with oversight from the local governors. Consideration will also be given to learning from positive examples of employment processes in past infrastructure or construction projects, reported by engaged community and local authority stakeholders
- The EPC Contractor will develop local employment and procurement plans in consultation with the NCPC ESG team and local authorities, integrating the approach set out by NEP and the overall AAWDC Local Employment and Procurement Framework. These plans will set realistic targets for local employment and local procurement, prioritising residents of the directly affected districts and sub-districts. These plans will specify the number and the types of roles specifically targeted to local employment (unskilled, semi-skilled, and skilled), and the procedures for verification and record-keeping, as well as the measures to address local procurement
- Capacity Building and Skills Development: NCPC and the EPC Contractor will work with the Ministry of Labour, NEP and relevant vocational training centres to promote skills training and pre-employment preparation, particularly targeting youth (including disabled youth) and women to help them qualify for construction-related jobs and contracts
- Advance Communication with local authorities: The EPC Contractor will share expected criteria for local procurement selection pre-construction through municipalities, districts and sub-districts, so that local businesses can have additional training if required

The NCPC and EPC Local Employment and Local Procurement Framework and Plans will include specifications for:

- Transparent Employment Procedures: All employment opportunities during construction will be announced publicly and in advance through accessible local channels (municipalities, social media, district/sub-district offices). Recruitment criteria will be clear, based on merit and relevant skills. Selection will take place through a diverse selection committee in coordination with local authorities
- Fair Local Procurement: The Project and EPC Contractors will identify and pre-qualify local suppliers and service providers wherever feasible, subject to compliance with health, safety, environmental, and ethical standards. Procurement procedures will prioritise local companies from within the Project districts/sub-districts, particularly SMEs and cooperatives
- Coordination with Local Authorities, Tribal Representatives and local community associations: Recruitment and local contracts will be coordinated through governorate, district/sub-district, and municipal authorities, ensuring alignment with official labour regulations and fairness across tribes/clans and localities (including women and youth). Where relevant, Local Advisory

Committees (LACs), with inclusive representation (women, youth, etc) will be used to facilitate communication, ensure transparency, and defuse potential grievances over hiring or contract distribution

- Inclusive Participation: Targeted outreach through local community-based associations and cooperatives, as well a social media platforms (e.g. Facebook) will be made to under-represented groups, including women, youth, and disabled youth and small businesses, ensuring that employment and procurement opportunities are accessible to all segments of the population, not only to well-connected individuals or families
- Grievance Redress and Oversight: Any grievances related to employment and procurement will be received, documented, and resolved promptly through the Project GRM
- Monitoring and reporting indicators will include:
  - Number and percentage of local hires (by district/sub-district, gender, age, and skill level)
  - Number and value of contracts awarded to local suppliers
  - Number and value of contracts awarded to local women associations/cooperative suppliers
  - Number of grievances related to employment or procurement and their resolution rate
  - Participation levels in training and skills programmes (disaggregated by gender)
  - Community satisfaction levels measured through periodic engagement (disaggregated by gender)
- The Project will produce quarterly monitoring summaries shared with lenders, local authorities, and communities through governorate, district/sub-district, and municipal offices, as part of its transparency commitment
- Prior to the demobilisation of the EPC contractor, implement a post-construction verification and close-out programme to confirm that local employment and procurement commitments have been met, lessons have been learned, and any outstanding community concerns or grievances have been addressed. This will be captured in a Local Employment and Procurement Close-Out Report, summarising achieved benefits, residual issues, and recommendations for enhancing community economic participation and benefits during the operational phase

9.9 Labour Management

9.9.1 Scoping

The Project will employ a significant number of workers during construction, including direct employees and sub-contractors of NCPC, the EPC Contractor and its subcontractors, as well as third-party service providers. While employment creation is a positive outcome, the scale, diversity and complexity of the construction workforce also introduce potential risks related to working conditions, occupational health and safety (OHS), workers' accommodation, equal opportunity, and fair treatment.

Although Jordanian labour legislation provides a strong legal framework governing working conditions, including working hours, wages, occupational health and safety, and social security, there are instances of implementation gaps, particularly in large-scale, multi-contractor construction projects involving migrant labour. The Ministry of Labour operates a national labour inspectorate system and OHS enforcement through regional offices, but these are at times constrained.

Potential risk areas, therefore, include:

- Inconsistent application of OHS standards across contractors and subcontractors
- Excessive working hours, late payment of wages, or unclear contracts
- Workers exposed to natural hazards (e.g. flash floods, sudden sand-storm events, extreme heat and seasonal high-wind conditions)
- Unequal treatment of women workers or insufficient provision for maternity protection and GBVH prevention and redress
- Poor accommodation or living conditions for non-local or foreign workers
- Foreign workers hired under the kafala system lacking access to basic labour rights
- Lack of awareness or accessibility of worker grievance channels
- Lack of ability of workers to organise and negotiate
- Potential for worker unrest or reputational risk if labour issues are mishandled.

9.9.2 Project Affected People and Contextual Sensitivities

Project affected people for any potential impacts related to labour management include all workers associated with the Project, including direct employees and sub-contractors of NCPC, the Project Contractors and subcontractors, as well as third-party service providers.

Within this overall context, vulnerable groups to any potential impacts related to labour management include the following:

- Women, who face structural barriers to access to transport, economic participation, as well as heightened risks of experiencing gender-based violence and harassment (GBVH) and sexual exploitation and abuse and harassment (SEAH). Women's limited participation in mixed-gender spaces may also constrain their ability to raise concerns through conventional consultation or grievance channels

9.9.3 Impact Assessment: Magnitude, Sensitivity and Significance

9.9.3.1 Magnitude of Effect

The magnitude of potential impacts is assessed as **Major**, due to the large size of the construction workforce, expected reliance on multiple subcontractors, and the likelihood of employing both local and migrant workers, increasing the complexity of oversight and the risk of non-compliance. Conversely, the effective implementation of a unified Labour Management System would significantly reduce risks and could generate sustained positive outcomes through fair employment and enhanced worker welfare.

9.9.3.2 Receptor Sensitivity

The sensitivity of the Project labour context is assessed as **High**, given that construction workers are inherently exposed to physical hazards, variable employment conditions, and power imbalances in the workplace. Sensitivity is heightened for foreign workers, who may face language barriers, limited access to grievance mechanisms, and restricted mobility. Women workers also represent a potentially vulnerable group, given low female labour participation rates in the construction sector nationally, and the need for explicit safeguards against harassment and discrimination. Finally, informal and low-skilled

workers are also a potentially vulnerable group, given the common lack of health and safety protections this group often experiences.

9.9.3.3 Impact Significance

The overall significance of labour-related impacts is assessed as **Major Adverse prior to mitigation,** reflecting the combination of potential severity and high sensitivity.

9.9.4 Mitigation

In order to prevent and manage potential labour management impacts during construction, the AAWDC Project will develop and implement a comprehensive Labour and Working Conditions Management Plan, to comply with Jordanian labour law, as well as comply with international best practice, including ILO Core Labour Standards on non-discrimination, freedom of association, prohibition of forced and child labour, and occupational health and safety, and Lender standards (IFC PS2, EBRD ESR2).

Mitigations to reduce the potential impact significance are defined below:

Construction planning, to be completed prior to construction:

- EPC to develop a Labour and Working Conditions Management Plan that makes the following commitments for all workers (including day and non-full-time):
    - Written contract: (Arabic + worker's language) issued for all workers; daily workers registered in a day-labour log with written day-rate terms, scope, hours, overtime rates, rest entitlements, and injury compensation procedure
    - Fair wages & timely payment: equal to or greater than national minimum wage; overtime at legal rates; no unlawful deductions; transparent payslips
    - No fees, no passport retention: workers never pay recruitment/placement fees; identity documents remain with workers
    - Rest and hours: normal hours not to exceed 8h/day, or 48h/week; at least one 24-hour weekly rest; shift work managed so no individual exceeds 11 hours in any 24h (including breaks); overtime only under legal exceptions and paid at 125–150%
    - Injury compensation & medical care: immediate first aid and transport; notification and compensation per law; incident logged within 48 hours to Ministry of Labour
    - Social protection: workers informed of their injury insurance and compensation rights; contractor must evidence coverage (SSC or equivalent accident insurance) for all workers on site, including day labourers, and explain access steps in case of injury
    - Adverse Weather: Employers must protect workers in adverse weather; following any hours that the Minister may set in which work is prohibited, in accordance with Reg. 31/2023 Art. 9; stop-work or reschedule when ministerial heat bans are announced (e.g., noon-to-afternoon bans during heatwaves), and document compliance in the daily log
- The Plan will identify, assess and provide management measures for natural hazard risks such as weather monitoring, early-warning protocols and location specific safe-work procedures such as suspending works in flood-prone areas when rainfall thresholds are reached, and training for workers on recognising natural hazard warning signs, emergency response actions and safe evacuation routes

- The plan will be supported by a:
  - Code of Conduct and Employment Terms: All workers will receive written contracts in a language they understand, outlining employment terms, wages, working hours, and benefits. A Project-wide Code of Conduct will prohibit discrimination, harassment, gender-based violence and harassment (GBVH) of any kind, forced and child labour, and ensure respect for freedom of association. All workers will be required to read and sign a Worker Code of Conduct (provided in the worker's language) which will also be explained verbally
  - Occupational Health and Safety (OHS): EPC Contractors will implement an OHS Management Plan meeting national and international standards, covering training, supervision, incident reporting, and emergency response
  - Worker Accommodation Standards: Where workers are housed in temporary facilities, these will comply with the requirements in Chapter 2 of this ESIA, ensuring adequate space, sanitation, potable water, and access to medical care
  - Grievance Redress Mechanism (GRM): A dedicated worker grievance system will be established, confidential, accessible, and separate from the community grievance mechanism, allowing workers to report issues without retaliation
  - Foreign Worker Protection: The Project will ensure recruitment agencies are licensed and ethical, no recruitment fees are charged to workers, and passports or ID documents are not withheld
  - Women Workers' Inclusion and Protection: Contractors will provide gender-sensitive facilities (e.g. Female changing rooms, toilet facilities, and prayer rooms will be kept separate from men. All such facilities will have lockable doors with adequate numbers provided). The AAWDC Project will enforce zero-tolerance policies for all forms of harassment, including gender-based violence and harassment (GBVH) and sexual exploitation and abuse (SEAH) (see Section 9.10 below), and ensure equal pay and maternity rights as per law
  - Training and Awareness: All workers, supervisors, and managers will undergo training on labour rights, health and safety, grievance use, GBVH/SEAH (See Section 9.10 for further detail), and anti-harassment policies
- Monitoring and Reporting:
  - Contractors will report monthly on metrics that will include workforce numbers, gender, nationality, training, incidents, and grievances
  - The NCPC ESG team will maintain oversight of all contractors through regular labour inspections and compliance audits, supported by documentation review and worker interviews

9.10 Gender-Based Violence, Harassment and Sexual Exploitation and Abuse (GBVH/SEAH)

9.10.1 Scoping

Large-scale construction projects involving significant workforce mobilisation can increase risks of Gender-Based Violence and Harassment (GBVH) and Sexual Exploitation and Abuse and Harassment (SEAH)—particularly if workers are housed near communities, where migrant and local workers mix, or

where women and girls already face constraints on mobility, economic participation, or access to protection networks.

Though studies related to GBVH and SEAH in Jordan remain limited, existing studies indicate that sexual harassment constitutes a significant barrier to women's retention and advancement in the labour market, as well as an issue faced by women on public transport.

Across the AAWDC Project area, stakeholder engagement with women indicated sociocultural sensitivities and unequal gender norms. Women described restrictions on mobility, in certain instances reliance on male permission for engagement in public spaces. Some engaged women expressed concern about the potential of Project workers residing in the area and called for strict monitoring of their presence and adherence to local social customs.

These contextual factors may heighten the risk of GBVH/SEAH during construction, especially in locations close to worker accommodation, or where the construction workforce comes into contact with the local population.

Risks may include:

- Harassment or inappropriate behaviour by workers toward women or girls
- Increased pressure on women's mobility due to perceived safety risks
- Exploitation of vulnerable groups (e.g., informal workers, Syrian refugees)
- SEAH risks linked to unequal power dynamics between workers and community members
- Fear of retaliation or stigma associated with reporting GBVH/SEAH cases

Although the Project will implement Jordanian laws that prohibit harassment and violence, lender standards require additional safeguards to prevent, respond to, and monitor GBVH/SEAH risks

9.10.2 Project Affected People and Contextual Sensitivities

Project affected people for any potential impacts related to GBVH/SEAH include all women and girls living in the Project areas, who may come into contact with Project construction workforce, as well as women employed by the Project, including by contractors.

9.10.3 Impact Assessment: Magnitude, Sensitivity and Significance

9.10.3.1 Magnitude of Effect

The magnitude of potential GBVH/SEAH impacts is assessed as **Moderate to Major**, depending on the scale of the workforce, proximity to communities, and the robustness of contractor management systems. Even a small number of incidents may have serious and long-lasting effects on survivors and can undermine trust in the Project.

9.10.3.2 Receptor Sensitivity

Sensitivity is assessed as **High**, due to local gender dynamics and norms, and a likely low reporting culture.

9.10.3.3 Impact Significance

The overall significance of labour-related impacts is assessed as **Major Adverse prior to mitigation,** reflecting the combination of potential magnitude and high sensitivity.

9.10.4 Mitigation

The Project will adopt a survivor-centred, confidential, and zero-tolerance approach to GBVH/SEAH risk management, to comply with Jordanian labour law, as well as with international best practice.

Mitigations to reduce the potential GBVH/SEAH impact significance are defined below:

- Policies, Codes of Conduct & Contractor Requirements:
  - Establish and enforce a AAWDC Project-wide GBVH/SEAH Code of Conduct for all workers, managers and subcontractors, translated into Arabic (or other languages if necessary). All workers will be required to read and sign this Worker Code of Conduct (provided in the worker's language), which will also be explained verbally
  - Require EPC Contractors and subcontractors to implement robust GBVH/SEAH Prevention & Response Action Plans
  - Mandatory induction and refresher training for all workers on behavioural expectations, boundaries, and consequences of misconduct
- Worker Management & Supervision:
  - Supervision protocols to prevent worker-community misconduct, including restrictions on worker movement where necessary
  - Prohibit alcohol and drug use in worker accommodation or near communities
  - Maintain worker accommodation in compliance with IFC/EBRD Worker Accommodation Guidelines
- Safe, Accessible and Confidential Reporting:
  - Integrate GBVH-sensitive channels into the Project Grievance Mechanism (GRM), ensuring confidentiality, anonymity, and non-retaliation
  - Provide multiple reporting pathways (CLOs, women focal points, hotline, WhatsApp, trusted community intermediaries)
  - Ensure that staff responsible for GRM and CLOs receive specialised GBVH/SEAH training
- Partnerships for Survivor Support
  - Pre-identify and partner with specialised local GBV service providers, including shelters, psychosocial services, and legal assistance, to ensure referral pathways for survivors. Available resources can be mapped with support from the Ministry of Social Development and CBOs
- Inclusive Community Engagement
  - Conduct women-only consultations, where necessary, ensuring women can raise safety concerns freely
  - Provide construction updates and worker presence notifications in all urban locations
- Contractor Accountability
  - Immediate dismissal and legal referral for confirmed GBVH/SEAH violations
  - Contractual penalties and performance monitoring linked to GBVH/SEAH compliance

  - Require subcontractor compliance as a condition of contract award
- Monitoring & Reporting
  - Include GBVH/SEAH indicators in routine monitoring, including training completion, incidents reported, response times, and status of corrective actions
  - Quarterly reporting to NCPC senior management and Lenders
  - Third-party audits as required

Residual Significance (Post-Mitigation):

If mitigation is fully implemented, risks can be reduced to **Moderate** to **Minor**; however, because GBVH/SEAH can never be reduced to zero, it will remain a high-priority, ongoing monitoring area.

9.11 Community Development

NCPC recognises that, beyond managing adverse impacts, it has an important role to play in supporting sustainable and inclusive development in the Project areas. Throughout the ESIA and associated stakeholder engagement activities, communities, local authorities, tribal representatives, women's groups, and youth have consistently expressed expectations for the Project to contribute to local socio-economic development in a fair, transparent, and non-discriminatory manner. While these expectations fall outside the formal scope of impact mitigation, they are materially relevant to maintaining trust, strengthening social licence, and supporting the long-term success and operability of the Project.

To reflect this, NCPC commits to implementing Community Development Plans (CDPs), aligned with the IFC Community Development Guide (2020), and guided by principles of fairness, transparency, and inclusivity. The Plans will set out feasible and proportionate measures to reinforce positive contributions where they align with the Project's objectives, technical feasibility, and timelines.

The CDPs will be designed to achieve the following objectives:

- Earn a local license to operate by fostering trust and positive relationships
- Enhance livelihoods through targeted development programs
- Mitigate social impacts and promote inclusive growth
- Align with national development goals

NCPC will first develop a comprehensive Community Development Framework (CDF) that will serve as a guiding structure for the creation of tailored Community Development Plans (CDPs) at various community levels. Recognising that each community may face distinct challenges and priorities, specific CDPs will be designed to address the unique needs of local stakeholders, including vulnerable groups. Both the overarching CDF and the individual CDPs are intended to be dynamic, evolving documents that will be reviewed and updated as necessary throughout the duration of the Project. This reflects NCPC's long-term commitment to community development, which will be sustained and adapted in response to ongoing impacts and emerging needs.

Development Process of the Community Development Plan:

1. Stakeholder Engagement: to identify the needs, concerns and preoccupations of Project affected communities. Engagement will be participatory and inclusive, using culturally appropriate and inclusive methods. A community development assessment will be conducted to understand community needs and potential impacts, which will inform the design of the community development approach.

2. CDPs Design and Prioritisation: Using data from baseline studies, stakeholder engagement and the community development assessment findings, NCPC will design CDPs aligned with its CDF and focusing on the identified needs of the communities as well as the national and international development goals. Initial efforts will focus on small-scale pilot initiatives to build trust and demonstrate commitment. The implementation schedule of these plans will be synchronised with the project's construction and operational phases.
3. Linking Core Business Activities: CDPs will be designed to integrate core business activities in ways that generate tangible benefits for local communities.
4. Wherever possible, CDPs will prioritise local hiring, foster skills development, and promote inclusive economic participation through partnerships with local businesses and institutions.
5. Partnerships and Governance: NCPC will collaborate with NGOs and community-based organizations to leverage local knowledge. Coordination with government entities will ensure alignment with municipal and national development plans. A governance structure, including a steering committee with community representation, will be established to oversee CDPs implementation (this could be the Local Advisory Committees (LACs) set up for the wider AAWDC Project).
6. Implementation and Monitoring: The CDPs will be managed and financed by NCPC. Financing of the community initiatives may be ensured directly by NCPC or through support to existing organized programs. Dedicated budgets will be allocated, and co-financing opportunities explored. A robust Monitoring & Evaluation (M&E) framework will be developed, including KPIs and feedback mechanisms to assess impact and adapt programs as needed. Key approaches under consideration for the financing of the CDPs include:
    - Creation of a foundation
    - Support to existing NGOs
    - Direct contributions to ongoing initiatives launched by the communities
    - Direct contributions to existing governmental programs with linked funding sources committed to the community initiatives
    - Others

Project beneficiaries:

The beneficiaries of the proposed community projects will be community members directly and indirectly affected by the Project development. The Project will put emphasis on integrating women, youth and vulnerable members of the community who may be disproportionally affected by the externalities of development.

Expected Outcomes:

The implementation of the CDPs is expected to yield the following outcomes:

- Improved access to services and infrastructure for local communities
- Enhanced social license to operate and reduced project risks
- Strengthened community resilience and economic inclusion
- Transparent and accountable development processes

Next Steps:

To ensure timely and effective implementation, NCPC will undertake the following steps in Q1 2026:

- Carry out stakeholder engagement and the community development assessment
- Finalise the design of CDPs

9.12 Overview of Social Residual Impacts and Commitments

The assessment of social impacts has identified a range of potential risks and opportunities associated with the construction and operation of the Project. These span across resettlement, land and livelihood impacts, community health, safety and security, local employment and procurement, labour and working conditions, and GBVH/SEAH. While most adverse impacts are expected to be temporary and associated with the construction phase, their scale and geographic extent necessitate robust management and ongoing dialogue with affected people and authorities.

Management of these of potential risks and opportunities, will be addressed through the following management plans that will be developed or updated pre-construction:

- Resettlement Action Plan
- Community Health, Safety and Security Plan
- Traffic and Road Safety Management Plan
- Local Employment and Procurement Framework and Plan
- Labour and Working Conditions Management Plan
- NCPC Community Development Plan
- NCPC Stakeholder Engagement Plan

Across all social dimensions, several cross-cutting themes have emerged that underpin the Project's social commitments and management approach and respond directly to the feedback received from the ESIA stakeholder engagement in September and October 2025.

- Transparent, inclusive and respectful engagement: The Project's success will depend on its ability to maintain open, timely and culturally appropriate communication with all stakeholders. Stakeholder engagement will be guided by principles of transparency, participation and respect, ensuring that information is shared proactively, in formats accessible by the different local stakeholder groups. Engagement processes will be iterative and continuous — not one-off events — enabling concerns, expectations and feedback to shape the Project's ongoing design of management measures and monitoring activities
- Collaboration with local authorities and community governance structures: Local governance structures — including governorates, districts, sub-districts, municipalities, tribal/clan representatives and community-based organisations — will play a pivotal role in representing community interests and facilitating coordination between the Project and local populations. The Project will coordinate actively with relevant authorities and community governance structures to ensure that community engagement, community health and safety, resettlement-related impact management measures, local employment and procurement, and grievance redress mechanisms are implemented in a way that aligns with local administrative systems and enhances institutional and community ownership. Leveraging existing structures will help ensure local legitimacy, efficiency, and sustainability of social management efforts

- Inclusion: The Project recognises that women, youth, and other potentially vulnerable groups can experience impacts differently and may face barriers to participation in decision-making and benefit-sharing. Commitments have therefore been made to mainstream women empowerment and social inclusion across all Project components — from employment and training opportunities to consultation processes and grievance redress. Specific attention will be given to safe working environments for women, equal pay for equal work, and ensuring that women also benefit from the Project through local employment and procurement, and that women's perspectives are heard and integrated into community engagement activities, including through women-only consultations and collaboration with local associations
- Representation and participation of all community segments: Recognising the social diversity of the Project area — including tribal affiliations, rural and urban populations, tourism-dependent businesses, agricultural workers, and herding communities — as well as the fact that a large part of the AAWDC Project will be located in the Southern and Central Badia, engagement and mitigation measures will aim for broad representation and equitable participation. The Project engage with the different tribal/clan representatives, women's associations, youth associations, and other interest groups' community-based organisations, ensuring that all segments of the population have a voice in decision-making and benefit from Project-related opportunities
- Effective and timely grievance redress: A functioning grievance mechanism will be central to maintaining trust and accountability between the AAWDC Project and stakeholders. The mechanism will provide accessible, confidential and culturally appropriate channels for receiving, documenting and resolving concerns. It will prioritise early resolution at the local level wherever possible, through collaboration with municipal and district/sub-district authorities, community liaison officers (CLOs) and representative committees. Clear procedures, timeframes and feedback loops will be established to ensure that grievances are handled promptly and fairly, and that outcomes are communicated transparently to all parties

Overall, considering that the mitigation is effectively implemented, the residual social impacts are expected to be generally minor, but moderate to minor for GBVH/SEAH related impacts.

9.13 Cultural Heritage

9.13.1 Scoping

The Project involves infrastructure extending across the five Governorates of Aqaba, Ma'an, Karak, Tafiela and Amman, and the eleven districts and seven sub-districts. Geographically the Area of Influence (AOI) extends over a length of approximately 438 km from the Gulf of Aqaba to southern Amman with cultural heritage impacts potentially occurring during construction and operational phases of the Project of varying scale and duration.

Thematically both tangible and intangible cultural heritage (ICH) impacts are considered with reference to UNESCO and ICOMOS standards and especially as they relate to the 2003 convention for the ICH including oral traditions, performing arts, social practices, knowledge of nature, and traditional craftsmanship. For the tangible cultural heritage, UNESCO's HIA Toolkit and understandings of heritage assets have been applied.

9.13.1.1 Tangible Cultural Heritage

The key focus of the tangible CH impact assessment are the project activities that have the potential to impact the tangible cultural heritage associated with the Wadi Rum Protected Area (WRPA) as defined by UNESCO and its buffer zone; these are scoped into CH impact assessment Those Project activities that have the potential to impact tangible cultural heritage in and around the WRPA, and thus scoped into the assessment, are summarised below:

- Ground disturbing construction works within the physical footprint of the Conveyance Pipeline (where it runs through the WRPA buffer zone), the OHTL (where it runs to the northwest of the WRPA buffer zone), the Renewable Energy Facility, and all associated work compounds, stockpiles, access roads, etc
- Increased noise, dust, and pollution, lighting, vibrations, and visual effects (e.g., visible machinery, spoil heaps) associated with construction work
- The operational presence of new, above-ground, permanent infrastructure: the OHTL, the Renewable Energy Facility, and potentially other access roads, maintenance depots, etc
- Increased noise, dust, pollution, lighting, vibrations, and visual effects (e.g., maintenance machinery and works) associated with the Project's operation
- Maintenance and repair works carried out during the Project's operation, some of which may require additional excavations that will exceed the construction excavation footprint

9.13.1.2 Intangible Cultural Heritage

The scope of the ICH assessment is informed by the project activities that may impact ICH in various ways. Potential negative impacts assessed include:

- Construction-related disruptions: Activities like groundbreaking, excavation, transportation, and establishing temporary facilities can cause short-term restrictions on community movement, access to traditional lands, and alter land use patterns
- Visual and spatial changes: Permanent structures such as pylons for overhead transmission lines and above-ground pipeline components can affect viewsheds and visual interactions with the landscape

- Restricted access and accessibility: Increased traffic, machinery movement, and temporary occupation of sites can temporarily limit access to culturally significant areas, including settlements, community spaces, or religious facilities
- Social effects from workforce presence: The temporary presence of a construction workforce can lead to social effects and disruption within local communities
- Disruption of cultural events: Project activities can lead to disturbances or relocation of cultural events, performances, and festivals
- Loss of access to natural resources: Reduced access to ecological areas or materials used for cultural knowledge and traditional craftsmanship can occur
- Economic and livelihood impacts: Disruptions to local markets or gatherings due to construction can indirectly affect craft-based traditions and livelihoods
- Noise and sensory intrusion: Construction activities can generate noise, dust, and visual intrusions near culturally significant sites and places of worship
- Displacement of cultural expression: In severe cases, there can be a permanent loss or silencing of oral traditions, cessation of traditional performances, or displacement of artisans

9.13.2 Impact Assessment: Magnitude, Sensitivity and Significance

9.13.2.1 Cultural Heritage Specific Significance Criteria

The significance of tangible cultural heritage-related impacts are assessed in accordance with the best practice guidance using the matrices shown in Table 9-13 and Table 9-14.

Table 9-13 summarises the assessment matrix used to determine impact significance for UNESCO World Heritage Properties (i.e., the WRPA), while Table 9-14 summarises the assessment matrix used to determine impact significance for all other tangible heritage assets. This is in accordance with the UNESCO HIA Toolkit (UNESCO 2022).

Table 9-13: Impact Significance Assessment Matrix for UNESCO World Heritage Properties

Attributes That Convey OUV	Impact Significance (Either Adverse or Beneficial)			
	None	Negligible Change	Some Change	Large Change
	Magnitude of Impact (Either Adverse or Beneficial)			
	Neutral	Minor	Moderate	Major

Note: OUV = Outstanding Universal Value

Table 9-14: Impact Significance Assessment Matrix for non-UNESCO World Heritage Properties

Significance of Heritage Asset	Impact Significance (Either Adverse or Beneficial)				
	No Change	Negligible Change	Minor Change	Moderate Change	Major Change
Exceptional (Category A)	Neutral	Slight	Moderate/Large	Large/Very Large	Very Large
Considerable (Category A)	Neutral	Slight	Moderate/Slight	Moderate/Large	Large/Very Large
Some (Category B)	Neutral	Neutral/Slight	Slight	Moderate	Moderate/Large
Low (Category C)	Neutral	Neutral/Slight	Neutral/Slight	Slight	Moderate/Slight

9.13.2.2 Intangible Cultural Heritage Assessment Criteria: Magnitude of Impact

The matrix in Table 9-15 provides the qualitative framework for assessing the impact of Project activities on ICH domains (UNESCO 2003) in relation to OUV attributes. It builds on UNESCO's (2022) Guidance and Toolkit for Impact Assessments in a World Heritage Context, aligning the ICH impact assessment with the magnitude scale used for heritage impact evaluation. Each domain is evaluated based on the degree of change to community practices, transmission, participation, and environmental context. The framework is intended for use during scoping and impact assessment phases, guiding consistent evaluation across the OUV-ICH interface.

Table 9-15: Magnitude of Impact on ICH Domains

ICH Domains	None/Neutral	Negligible/Minor	Some/Moderate	Large/Major
Oral Traditions and Expressions	No interruption to storytelling, poetry, oral memory, or language use; community transmission continues undisturbed.	Temporary or localized reduction in opportunities for oral performance (e.g., due to site access limits), but no lasting loss of knowledge or practice.	Noticeable reduction in oral exchange, storytelling spaces, or intergenerational transmission due to social or spatial disruption.	Permanent or irreversible loss of oral traditions, displacement of storytellers, or silencing of oral expression linked to affected landscapes.
Performing Arts	Performances, music, and dance unaffected; venues or occasions remain accessible.	Minor disturbance to performance settings or audiences (e.g., noise, temporary relocation).	Sustained disturbance or loss of cultural events, performance spaces, or intergenerational practice.	Cessation of traditional performance due to displacement, commodification, or loss of practitioners.
Social Practices, Rituals, and Festive Events	Rituals and festivals continue in full form and participation; no interference in timing, meaning, or access.	Slight inconvenience or schedule disruption, but events remain viable.	Disruption of ritual timing, place, or participation; reduced community engagement or authenticity.	Elimination or severe alteration of rituals/festivals; loss of social cohesion or ritual knowledge.

ICH Domains	None/Neutral	Negligible/Minor	Some/Moderate	Large/Major
Knowledge and Practices Concerning Nature and the Universe	Environmental knowledge systems (e.g., navigation, herding, resource management) remain intact and practiced.	Minor environmental or access changes that slightly constrain traditional knowledge application.	Moderate disturbance to the ecological or spatial settings that sustain traditional knowledge systems.	Severe environmental alteration or restricted access leading to loss of traditional ecological knowledge and cultural identity linked to nature.
Traditional Craftsmanship	No effect on production, materials, or intergenerational transfer of skills.	Temporary or localized shortage of materials or workspace access, but recovery likely.	Reduced availability of natural materials, markets, or transmission channels; decline in craftsmanship practice.	Permanent loss of craft traditions, workshops, or knowledge bearers; commodification or displacement of artisans.

9.13.2.3 Intangible Cultural Heritage Assessment Criteria: Receptor Sensitivity

The assessment of receptor sensitivity for ICHA is integrated into an impact evaluation process that uses an attribute-based qualitative matrix. This approach aligns with UNESCO's Guidance and Toolkit for Impact Assessments in a World Heritage Context, adapted for living heritage.

Key criteria for evaluating sensitivity include:

- Continuity of practice and transmission: Potential interference with intergenerational learning, oral transmission, or performance cycles
- Access to key spaces and natural resources: Availability and use of sites, grazing lands, springs, or other environmental features necessary for ICH practice
- Integrity and authenticity of cultural expression: Maintenance of the credibility and community recognition of practices
- Relationship to tangible heritage and landscape: Effects on environmental, architectural, or archaeological settings that anchor ICH meaning

Domains and communities with sensitivity to changes as it concerns ICH include:

- ICH Domains: Social practices and rituals, religious institutions and associated ceremonies, and traditional ecological knowledge related to land use and water sharing are considered highly sensitive. These domains depend strongly on the continuity of practice and unrestricted movement within familiar landscapes
- Vulnerable Communities: Bedouin communities are noted as highly sensitive due to their ICH being deeply connected to the desert environment, relying on continuity of practice and unrestricted movement
- Affected Geographic Areas: Communities along the Desert Highway corridor, particularly near Aqaba, Maʿan, Qatraneh, Hasa, and southern Amman, are identified as most likely to experience temporary disruptions because of their proximity to construction areas and the clustering of mosques, cemeteries, and community gathering spaces

The ICH domains sensitivity can be split into those with a high sensitivity and those with a low sensitivity. Domains with a high sensitivity include social practices, rituals, and festive events (because community

gatherings are central to identity) and knowledge and practices concerning nature and the universe (due to being linked to traditional land use).

ICH domains with a medium sensitivity include oral traditions and performing arts (requiring continuity of social transmission) and traditional craftsmanship (requiring support for continuity). Religious institutions and associated rituals are also identified as medium to high sensitivity, depending on time of year.

9.13.2.4 Tangible Cultural Heritage Impact Assessment

The impact assessment undertaken to determine potential impact to tangible cultural heritage identified that Project activities have the potential to detrimentally impact the significance or Outstanding Universal Value (OUV) of a range of tangible cultural heritage, both designated and undesignated, within and around the WRPA. Some of these tangible heritage assets (e.g., some rock art) contribute to the identity of current communities and the practice and persistence of their living heritage.

Potential tangible heritage impacts were identified and assessed for each Project phase (i.e., construction and operations). Table 9-16 summarises the tangible heritage assets, the specific heritage attributes of each of those assets that could be affected by the Project and describes each potential impact, including whether the impact would be permanent or temporary, reversible or irreversible, and new or cumulative. The table also includes an evaluation of the quality of each impact (e.g., positive, neutral, or negative) and significance of each impact (e.g., minor/slight, moderate, major/large). This assessment was based on extensive evaluation, informed by thorough data-gathering (e.g., desk-based assessment, archaeological survey, review of satellite imagery) and by both quantitative and qualitative assessment methods, including site-based observations, artifact analysis, viewshed analysis, and the production of photomontages. The final determination of impact significance was undertaken using an attribute-based qualitative matrix that combines the Outstanding Universal Value (OUV) of the WRPA, the heritage significance of non-UNESCO sites, and the magnitude and duration of each potential impact in line with the criteria within Table 9-13 and Table 9-14.

The assessment indicated that the Project has the potential for a range of detrimental impacts to the OUV of the WRPA and to the heritage significance of the area's historic landscape character, various undesignated heritage assets, and potential (as yet unknown) heritage assets.

The assessment found that some of the identified impacts would result from construction or operational activities, causing physical damage or loss of tangible heritage assets (e.g., archaeological sites, features, and finds). Such impacts would be permanent and irreversible and could be either direct (e.g., where proposed works overlap with known sites) or indirect (e.g., if vibrations produced by works cause damage to an asset in the vicinity) with a number of these impacts certain to occur if the Project were to proceed in its current form. For instance, the Renewable Energy Facility is currently proposed across a site which overlaps with heritage assets AHS002-AHS005 and AHF003-AHF005 and would thus definitely result in the loss of those assets. In other instances, the assessment found that impacts could occur; whether they did or not would ultimately depend on the final design and placement of infrastructure and works. For instance, the final design of access roads has not been defined but could detrimentally impact the OUV of the WRPA core area if any such access roads were ultimately routed through the WRPA core area.

The assessment found that other identified impacts would result from the introduction of large, modern infrastructure in the proximity of tangible heritage assets, thereby detracting from their historic setting and character. Such impacts would be permanent although technically reversible.

Impacts were also identified as a result of increased noise, dust, pollution, lighting, vibrations, or other visual effects (e.g., visible machinery, spoil heaps) associated with construction or operational activities.

These construction or operational effects could detract from the historic setting of tangible heritage assets and/or the area's historic landscape character. Such impacts, the absence of mitigation, may be temporary and reversible (construction-related effects), permanent and reversible (operation-related effects) or intermittent and reversible (maintenance-related effects).

Table 9-16: Overview of "Scoped In" Project Activities and Potential Tangible Cultural Heritage Impacts (Pre-Mitigation)

Activity	Tangible Cultural Heritage Asset Potentially Impacted	Heritage Attributes Potentially Impacted	Description of Potential Impact	Evaluated Quality and Significance of Impact
Construction: **Ground disturbing works within the physical footprint of the Conveyance Pipeline (where it runs through the WRPA buffer zone), the OHTL (where it runs to the northwest of the WRPA buffer zone), the Renewable Energy Facility, and all associated work compounds, stockpiles, access roads, etc.**	WRPA	Rock art, inscriptions, archaeological sites, finds, and features. The palimpsest of semiarid desert, natural landforms, and cultural features.	Potential for damage or loss of some assets if any construction machinery is moved across or used within the WRPA during the construction phase, or if any associated access roads, stockpile sites, etc. are ultimately placed within the WRPA. Permanent and irreversible impact.	Negative Moderate
	Historic Landscape Character	Heritage sites specifically placed to exploit the area's natural characteristics and illustrating the inseparable relationship between the natural and cultural spheres.	Potential for detrimental impacts if any heritage sites contributing to the historic landscape character (e.g., as yet unknown and unrecorded sites) intersect with the Project's excavation footprint and are thus damaged or lost. Permanent and irreversible impact.	Negative Slight
	Undesignated Heritage Assets	The surviving physical remains and setting of the Aqaba Railway (including associated structures and the Wadi Rum Train Station), sites AHS002-AHS005, and features AHF003-AHF005.	Potential for direct physical damage where the pipeline is proposed to cross the railway (one location) and where it passes close to the route of the railway in a number of other locations. Definite loss of sites AHS002-AHS005 and feature AHF003 (which lie within the proposed footprint of the Renewable Energy Facility) and potential loss or damage to features AHF004 and AHF005 (which lie in proximity to the construction works). Permanent and irreversible impact.	Negative Moderate–Neutral
	Potential Heritage Assets	Potential surface or buried archaeological remains.	Potential for damage or loss of any potential (as yet unknown) sites or features that intersect with the excavation footprint or associated enabling works.	Negative Large–Neutral

Activity	Tangible Cultural Heritage Asset Potentially Impacted	Heritage Attributes Potentially Impacted	Description of Potential Impact	Evaluated Quality and Significance of Impact
			Permanent and irreversible impact.	
Construction: **Increased noise, dust, pollution, lighting, vibrations, and visual effects (e.g., visible machinery, spoil heaps) associated with construction work.**	WRPA	Rock art, inscriptions, archaeological sites, finds, and features. The palimpsest of semiarid desert, natural landforms, and cultural features. The wide variety of natural and spectacular landforms in a protected setting.	Potential for detrimental impacts to some heritage assets (particularly those close to the northern boundary of the WRPA core area) if construction effects (e.g., noise, dust, etc.) result in any physical damage or loss of those assets and/or detract from their largely undeveloped, natural setting. Permanent and irreversible impact (physical impacts); temporary and reversible impact (setting impacts).	Negative Moderate–Minor
	Historic Landscape Character	The large, preserved expanses of natural desert with relatively minor incursions.	Potential to detract from the largely undeveloped and natural historic landscape character of the area. Temporary and reversible impact.	Negative Slight
	Undesignated Heritage Assets	The surviving historic setting of the Aqaba Railway and the following undesignated sites and features: Mersed, NN/Ma'an Desert Survey Site 8, WR-14_19, WR-14_22, AHF004, and AHF005.	Potential to detract from the historic setting of these assets. Temporary and reversible impact.	Negative Slight–Neutral
	Potential Heritage Assets	Potential surface or buried archaeological remains.	Potential to detract from the historic setting of any further potential (as yet unknown) heritage assets that may exist within or around the Project Area. Temporary and reversible impact.	Negative Slight–Neutral

Activity	Tangible Cultural Heritage Asset Potentially Impacted	Heritage Attributes Potentially Impacted	Description of Potential Impact	Evaluated Quality and Significance of Impact
Operations: **Permanent infrastructure that remains visible and above-ground following construction. This includes the OHTL, Renewable Energy Facility, and potentially other access, roads, maintenance depots, etc.**	WRPA	Rock art, inscriptions, archaeological sites, finds, and features. The palimpsest of semiarid desert, natural landforms, and cultural features.	Potential to intrude upon the largely natural, undeveloped setting of these heritage assets, particularly where they lie close to northern border of WRPA and/or on high points in landscape. Permanent, reversible, and cumulative impact.	Neutral
	Historic Landscape Character	Large, preserved expanses of natural desert with relatively minor modern incursions.	Potential to detrimentally impact the generally undeveloped and natural, historic landscape character, through an increase in the amount of modern infrastructure visible within the area. Permanent, reversible, and cumulative impact.	Negative Slight
	Undesignated Heritage Assets	The surviving historic setting of the Aqaba Railway and the following undesignated sites: Mersed and WR-14_19.	Potential to detract from the historic setting of these assets, through the introduction of new, visible, modern infrastructure. Permanent, reversible, and cumulative impact.	Negative Slight–Neutral
	Potential Heritage Assets	Potential surface or buried archaeological remains.	Potential for large, visible infrastructure to detract from the historic setting of any further potential (as yet unknown) heritage assets that may exist within or around the Project Area. Permanent, reversible, and cumulative impact.	Negative Slight–Neutral
Operations: **Increased noise, dust, pollution, lighting, vibrations, and visual effects (e.g., maintenance**	WRPA	Rock art, inscriptions, archaeological sites, finds, and features. The palimpsest of semiarid desert, natural landforms, and cultural features.	Potential for operational effects (e.g., increased noise, dust, etc.) to detract from the historic setting of heritage assets (particularly those along the northern boundary of the WRPA core zone). Permanent, reversible, and cumulative impact.	Negative Minor

Activity	Tangible Cultural Heritage Asset Potentially Impacted	Heritage Attributes Potentially Impacted	Description of Potential Impact	Evaluated Quality and Significance of Impact
machinery and works) associated with the Project's operation.	Historic Landscape Character	Large, preserved expanses of natural desert with relatively minor modern incursions.	Potential to detract from the largely undeveloped and natural historic landscape character. Permanent, reversible, and cumulative impact.	Negative Slight
	Undesignated Heritage Assets	The surviving historic setting of the Aqaba Railway and the following undesignated sites and features: Mersed, NN/Ma'an Desert Survey Site 8, WR-14_19, WR_14_22, AHF004, and AHF005.	Potential to detract from the historic setting of these heritage assets. Permanent, reversible, and cumulative impact.	Negative Slight–Neutral
	Potential Heritage Assets	Potential surface or buried archaeological remains.	Potential to detract from the historic setting of any further potential (as yet unknown) heritage assets that may exist within or around the Project Area. Permanent, reversible, and cumulative impact.	Negative Slight–Neutral
Operations: **Maintenance and repair works carried out during the Project's operation, some of which may require additional excavations that will exceed the construction excavation footprint.**	Undesignated Heritage Assets	The surviving remains of the Aqaba Railway and the following undesignated features: AHF004 and AHF005.	Potential for damage or loss if any excavation is required outside the construction excavation footprint and overlaps with these heritage assets. Permanent and irreversible impact.	Negative Slight–Neutral
	Potential Heritage Assets	Potential surface or buried archaeological remains.	Potential for damage or loss of potential (as yet unknown) assets if they intersect with any new or enlarged excavation footprint. Permanent and irreversible impact.	Negative Slight–Neutral

9.13.2.5 Summary of Tangible Cultural Heritage Impact Assessment: Magnitude of Effect

The assessed magnitude of Project effects upon tangible cultural heritage (i.e., the degree to which the Project would change an asset) was assessed and found to range widely–between **Neutral** and **Major Adverse**–depending on the location, nature, and duration of Project activities. A definite, major impact was identified in just one case: where the construction of the Renewable Energy Facility would result in the loss of sites AHS002-AHS005 and feature AHF003. However, in the majority of cases, identified potential impacts were assessed to have a negligible magnitude of effect.

In some instances, identified potential impacts were, following thorough assessment, found to be neutral in magnitude. For instance, the introduction of permanent above-ground infrastructure was flagged as having the potential to impact the setting of heritage assets within the WRPA. However, following a thorough Landscape and Visual Assessment (LVIA) assessment, this aspect of the Project was ultimately assessed and demonstrated to have no impact upon this aspect of the WRPA, largely due to the intervening distance and topography between the infrastructure and the WRPA.

9.13.2.6 Summary of Tangible Cultural Heritage Impact Assessment: Receptor Sensitivity

Receptor Sensitivity is the assessment of the vulnerability or resilience of an affected person, group, or environmental component to a specific impact. This evaluation determines how easily a receptor might be harmed or how well it can adapt and recover from adverse effects. For cultural heritage, receptor sensitivity is crucial for determining the overall significance of an impact, noting that a highly sensitive receptor could experience significant consequences even from a minor impact, whereas a resilient receptor might only show minor effects from a moderate impact.

The sensitivity of all identified tangible heritage assets was also assessed. In almost all cases, the sensitivity of identified heritage assets was **High**. This was determined to be true for the WRPA and its constituent assets, the area's historic landscape character, the Aqaba Railway Line and associated Wadi Rum Train Station, and all known undesignated heritage assets within the AOI. This determination took into account the international significance of both the WRPA and the surrounding historic landscape character; the national significance of the Aqaba Railway; the well-preserved character of these assets and their surrounds; the vulnerability of their significance and meaning to the potential introduction of modern infrastructure; and the lack of protection that currently exists for all known undesignated heritage assets within the AOI.

9.13.2.7 Intangible Cultural Heritage Impact Assessment

The assessment of potential ICH identified several areas and practices within the AOI where Project activities may result in temporary or sensitive changes to living heritage. The analysis was undertaken using an attribute-based qualitative matrix that combined the value and sensitivity of each heritage element with the magnitude and duration of potential impacts.

The assessment evaluated the degree to which Project activities might affect community identity, social and ritual practices, oral and artistic expressions, and access to culturally significant spaces. Overall, no changes are anticipated in group identity, ceremonial observances, or linguistic and symbolic traditions. The cultural continuity of local and tribal communities is expected to remain intact throughout the Project's lifecycle. However, temporary restrictions or reduced accessibility to certain culturally valued areas may occur during the construction phase. These disruptions would most likely result from increased traffic, movement of machinery and materials, or temporary site occupation near settlements, community spaces, or religious facilities.

Impacts were assessed for each Project phase (e.g., construction and operation) and classified according to whether they were direct, indirect, or cumulative. The construction phase is expected to have the highest interaction with ICH, primarily through noise, access limitations, and the visual or social effects of short-term workforce presence. The operational phase, by contrast, is expected to have minimal ongoing impact, limited to routine maintenance access and the presence of aboveground installations.

The analysis indicates that most ICH within the AOI, such as religious observance, oral traditions, craftsmanship, and ecological knowledge, is resilient to short-term external change if access to key spaces and resources is maintained. The most sensitive domains include social practices and rituals, religious institutions and associated ceremonies, and traditional ecological knowledge related to land use and water sharing. These forms of living heritage depend strongly on continuity of practice and on unrestricted movement within familiar landscapes. Communities along the Desert Highway corridor, particularly near Aqaba, Maʿan, Qatraneh, Hasa, and southern Amman, were identified as those most likely to experience temporary disruptions due to their proximity to construction areas and the clustering of mosques, cemeteries, and community gathering spaces.

Table 9-17 summarises the types of ICH that are potentially affected and the nature of the anticipated interactions. Social practices and rituals, such as *majalis al-sulh* (tribal reconciliation councils), weddings, and religious festivals, may experience temporary scheduling conflicts or limited access to communal spaces during peak construction periods. Religious institutions, including mosques, churches, and cemeteries, may be affected by increased noise, dust, or visual intrusion, particularly where construction activities occur near populated centres. Traditional knowledge and ecological practices, such as camel grazing routes and water-sharing customs, could face indirect pressures where access routes or natural resources are temporarily restricted. Craft-based traditions, including weaving, embroidery, and leatherwork, may encounter indirect social effects if construction activity disrupts local markets or gatherings, though such impacts are expected to be minor and reversible. Oral traditions and performing arts, including Nabati poetry, storytelling, and local music, may be discouraged temporarily by noise or workforce presence, but no long-term impacts on their transmission or practice are anticipated.

Overall, these interactions are expected to be localized, temporary, and reversible, with no permanent alteration to the integrity or authenticity of ICH. The magnitude of most predicted impacts ranges from minor to moderate, depending on proximity and sensitivity, while reversibility remains high across all domains. No loss of cultural value or discontinuation of practice is anticipated under the current Project design and management measures.

Table 9-17: Summary of Assessed Impacts on ICH Domains

ICH Domain	Identified Elements/Examples	Type of Impact*	Description of Potential Impact	Duration (Temp/Perm)	Magnitude of Impact	Sensitivity of ICH	Overall Significance	Reversibility	Notes/Mitigation Reference
Social Practices, Rituals and Festive Events	Majālis al-ṣulḥ, weddings, religious festivals	Direct	Timing conflicts or restricted access to community spaces during peak construction activities.	Temporary	Moderate	High	Moderate–High	Reversible	Coordinate schedules with local leaders; maintain access routes.
Religious Institutions and Associated Rituals	Friday prayers, mosque sermons, church masses, cemetery visits	Direct/ Visual	Temporary noise, dust, or access disruption near active sites; possible disturbance of worship or commemoration.	Temporary	Moderate	High	Moderate–High	Reversible	Implement buffer zones; notify religious leaders in advance.
Oral Traditions and Performing Arts	Nabati poetry, storytelling, dabke, zajal	Indirect	Reduced opportunities for gatherings or performances due to workforce presence or local disruption.	Temporary	Minor	Medium	Minor	Reversible	Support local events; minimize night-time activity near villages.
Traditional Craftsmanship	Sadu weaving, embroidery, leatherwork	Indirect	Temporary effects on markets or access to communal spaces	Temporary	Minor	Medium	Minor	Reversible	Ensure access to local markets; avoid prolonged site occupation.

ICH Domain	Identified Elements/Examples	Type of Impact*	Description of Potential Impact	Duration (Temp/Perm)	Magnitude of Impact	Sensitivity of ICH	Overall Significance	Reversibility	Notes/Mitigation Reference
			for production or sale.						
Knowledge and Practices Concerning Nature and the Universe	Camel herding, grazing routes, water-sharing customs (qanat, sabeel)	Indirect/ Cumulative	Short-term restriction of mobility or access to traditional resources and routes.	Temporary	Moderate	High	Moderate	Reversible	Coordinate with herders; avoid water source obstruction.

* Direct/Indirect/Cumulative/Visual

9.13.2.8 Summary of Impact Significance

Tangible Cultural Heritage

The assessed impact significance, as assessed without the implementation of recommended mitigation, is summarised in Table 9-16 above and was found to range between **Neutral** and **Moderate Adverse** for the WRPA (the UNESCO World Heritage Property) and between **Neutral** and **Large adverse** for other tangible heritage assets.

A potential moderate adverse impact significance on the OUV of the WRPA was identified in just one case: if any construction activities were to take place within the WRPA core area and thus cause damage or loss of heritage assets within it. In the majority of cases, however, impact significance was assessed to be either neutral or slight/minor adverse. This was particularly true in relation to impacts associated with changes to the historic setting of heritage assets. A neutral or slight/minor adverse impact significance was assessed in most of these cases due to the considerable distance between most heritage assets and the new infrastructure, and because of the pre-existing presence, and closer proximity of, other modern infrastructure (OHTL lines and a Renewable Energy Facility) to those heritage assets.

Although impact significance was assessed to range between neutral and large adverse, it is important to note that, with the implementation of mitigation measures, the detrimental impacts of the Project upon tangible cultural heritage would be considerably reduced (refer to Section 9.13.3).

Intangible Cultural Heritage

Most ICH within the AOI is resilient to short-term external change if access to key spaces and resources is maintained. However, for highly sensitive domains, such as social practices, rituals, and religious institutions, and traditional ecological knowledge, even temporary disruptions can lead to moderate-to-high overall significance.

The overall significance for highly sensitive domains with moderate impact is assessed as **Moderate - High**, while for domains with medium sensitivity and minor impact, the significance is **Minor**. It should be noted that incorporating receptor sensitivity into the impact assessment is crucial for developing effective and targeted mitigation strategies, especially given that ICH is considered irreplaceable.

Potential impacts are primarily associated with changes to access, disturbance during construction, and shifts in social and environmental conditions that may affect the continuity of practice and intergenerational transmission. These are deemed to be manageable through careful planning, scheduling, and coordination with community custodians. Where avoidance is not feasible, measures to minimize and safeguard ICH have been proposed as set out in Section 9.13.3.

9.13.3 Mitigation and Residual Impacts

9.13.3.1 Tangible Cultural Heritage

A suite of mitigation measures has been recommended to, wherever possible, avoid or minimise identified impacts to tangible cultural heritage and ensure compliance with all relevant heritage legislation and Lender requirements. These mitigation measures (comprising recommendations to be closed out and Project commitments) are discussed in detail below and summarized in Table 9-18, which also includes an assessment of the Project's residual effects, i.e., the tangible cultural heritage-related impacts that would remain following the implementation of all recommended mitigation. Table 9-18 conclusively demonstrates that, if all mitigation is implemented, the negative impacts of the Project will

be considerably reduced, resulting in a Project which poses **no (i.e., neutral) impacts** to the OUV of the WRPA and **slight adverse impacts** to the heritage significance of other, non-UNESCO heritage assets.

Most identified impacts to tangible cultural heritage can be avoided or further minimised through the development of sensitive provisions. Recommendations for provisions to protect and conserve tangible cultural heritage are provided below. It is, however, important that the developer makes a commitment to adhering to these provisions at all relevant stages of the Project (construction and operation, as applicable) and across the lifetime of the Project. To ensure this compliance, it is therefore recommended that these provisions be formally entered into the Project's Environmental and Social Management System (ESMS) and Cultural Heritage Management Plan (CHMP) as project commitments. This is in compliance with Lender policies which require the development and implementation of an ESMS and CHMP for the Project across its lifetime.

To ensure compliance with all Lender requirements, it is thus recommended that the cultural heritage provisions listed under bullets 1 to 4 below are developed and integrated into both the Project's ESMS and the more detailed and bespoke CHMP. Avoidance is the preferred mitigation method and will be considered along with mitigation measures to ensure that all tangible cultural heritage potentially affected by the Project is managed responsibly, legally, and in a manner that respects its historical, scientific, and social significance. The plan seeks to avoid or minimise harm to tangible cultural heritage wherever feasible, and to ensure that any unavoidable impacts are appropriately mitigated or offset.

Recommendations and Mitigation Measures

Avoidance Recommendation: Aqaba Railway

It is recommended that the Project avoids physical impacts to the known heritage site of the Aqaba Railway, through Project design. The pipeline is proposed to cross the route of the railway in one location. In this location, the Project design should be carefully developed to route the new pipeline through ground that has already been disturbed by the existing road, i.e., areas where the railway has already been truncated and removed.

Avoidance Recommendation: Known Cultural Heritage Sites

It is recommended that the contractor to conspicuously mark and protect all identified cultural heritage sites within 50 m of the Project construction footprint. Both the site and an appropriate surrounding protection buffer should be marked as "no-go" zones. In accordance with the Jordan's Antiquities Law No. 23, the provided buffer should be between 5-25m as appropriate, or greater if deemed necessary by the Minister of Tourism and Antiquities (General Department of Antiquities, 2024). Temporary barriers around sites and buffers might involve a bright coloured plastic or wire mesh fence with highly visible flagging or tape attached to it, in cooperation with the competent authorities (Department of Antiquities [DoA]). The fencing should be removed following the completion of the construction phase and (as applicable) any required maintenance or repair activities during the operational phase. All fencing should be freestanding on the ground surface with no intrusion into the ground; if necessary, sandbags should be used to stabilise and ground the fencing.

Avoidance Recommendation: Unspecified Design Details

It is recommended that all, currently unspecified, aspects of the Project (e.g., access roads, machinery use areas and movement routes, construction camps, stockpiles, future maintenance works, etc.) are designed and designated to avoid intruding into the WRPA core zone or across known heritage sites (as identified in this report). These designated areas and routes should be demarcated if necessary. No vehicle or equipment movement or construction activities may take place outside of these designated areas and routes. Drive-over traffic in wet conditions should also be prohibited. This provision will also

reduce impacts to potential buried archaeology as it will generally restrict and reduce ground disturbance across the AOI.

Avoid, Minimise, Reduce and Offset Recommendations: Archaeological Investigation and Recording

It is recommended that sites AHS002-AHS005 and AHF003; the PV plant site; and the surrounding area are further investigated. Although avoidance of impacts to these identified sites—through relocation of the PV plant site—would typically be the most preferable option, it is possible that this action would only serve to impact similar (or potentially more significant remains) nearby. As such, the most sensitive course of action is considered to be to undertake further evaluation of these sites, the surrounding PV plant site, and immediate surrounding area. This would serve to confirm or revise the significance of AHS002-AHS005 and AHF003 and characterise the potential for and significance of further buried or surface remains within the PV plant and the land around it. This information could then be used to determine whether harm to heritage significance could most efficiently be avoided/minimised by:

Relocating or shifting the PV plant site, such it avoids or minimises impacts to heritage assets; or

Retain the PV plant site in its proposed location, accepts the loss of AHS002-AHS005 and AHF003 (likely low significance), and avoid greater harm to heritage significance elsewhere.

The nature and extent of archaeological evaluation should be designed and conducted under the supervision of and in collaboration with the DoA. Recommended evaluative techniques include magnetometry survey (to identify the potential for buried remains, particularly furnaces, hearths, and slag halos); targeted evaluation trenching (to assess and characterise the nature and significance of identified potential buried remains); and further walkover survey (to characterise the surface archaeological resource outside and around the RE Facility).

Depending on whether the RE Facility is ultimately relocated or not, it may still involve the inevitable removal of some heritage assets within its final footprint. In this case, these assets would need to be fully investigated, excavated, recorded, and published to extract the maximum possible information from these sites before their loss and offset this impact to their heritage significance. The work should be carried out by a professional archaeologist or archaeological team under the supervision of the DoA. A detailed methodology should be submitted to, and approved by, the DoA in advance of the commencement of the work.

Commitment (To Avoid and Minimise): Construction Effects

Measures to be put in place to minimise noise, dust, pollution, and lighting along the length of the pipeline works (the closest works element to the WRPA) during construction specific to cultural heritage will be included within the CHMP and reflected within applicable topic specific management plans comprise the following:

- Contractor to visually monitor dust generation and airborne concentrations in the air during construction and operational maintenance activities. If dust is visible, mitigation measures, will be implemented with the aim of avoiding causing disturbance within the setting of heritage assets or to the quality of the historic landscape character
- Contractor to select equipment and construction methods such as to minimise the potential for cultural heritage impacts including minimising vibration, lighting and dust generation
- Contractor to periodically monitor noise and vibration at cultural heritage sites within the AOI during construction activities. If harmful levels are identified, the works should cease until

suitable mitigation measures have been implemented and the levels reduced to an acceptable level[6].

- In the case that part or all of a cultural heritage site is damaged due to excessive vibration, the relevant authorities will be informed, consulted and building conservators will be called in immediately to repair the structure with conventional conservation techniques
- Contractor to record the condition and structural integrity of heritage sites with above-ground components located within 50 m of the Project footprint prior to construction in cooperation with the competent authorities. The condition and structural integrity of those features will be monitored periodically for signs of degradation caused by vibration and for signs of pollution (most commonly in the form of dust and soot) in cooperation with the competent authorities. If dust from the project damages a CH site, the site will be cleaned by professional conservators and protected from further damage
- Prohibition of employee activities that might interfere with or damage cultural heritage sites to be included into the workers' Code of Conduct
- Contractor to develop and adhere to a sensitive backfilling and site clean-up methodology, such that construction areas are returned to their original condition and appearance (excluding new, permanent above-ground infrastructure) following the completion of the construction phase

During operations measures will be incorporated into the operational ESMMP relating to the need to select equipment and methods for undertaking maintenance activities that does not result in unacceptable impacts in terms of disturbance and visual intrusion to cultural heritage assets or create unacceptable vibration or other physical risks

Commitment (To Reduce and Offset): Chance Finds Procedure and Archaeological Monitoring

The Project will develop a formal Chance Finds Procedure (CFP) in accordance with lender policies that details the process to be followed in case an archaeological find is made during construction or any required operational maintenance works. The management of any finds will be handled in accordance with Jordanian national requirements and IFC and EBRD performance requirements.

The required CFP should include a requirement for the archaeological monitoring of all construction (and, as applicable, maintenance) activities by a professional archaeologist or archaeological team under the supervision of the Department of Antiquities, and a commitment to temporarily stop work in the vicinity of any new archaeological discovery. The chance find procedure will detail the process to be followed in case an archaeological find is made during construction. Construction activities at a chance find will resume after the implementation of government-approved mitigation measures, in accordance with Jordanian Law and IFC and EBRD performance requirements.

If government-approved mitigation measures include a requirement for further evaluation of chance finds or sites, the Project will engage the appropriate Jordanian authorities in this further evaluation and the use of intrusive and non-intrusive methods, according to the Jordanian Law.

If archaeological rescue is required at a chance find or site, the rescue will be conducted according to international and Jordanian standards and with supervision and involvement of the appropriate government institutions.

[6] ASEZA defines harmful levels as noise levels exceeding 45 dB or vibrations lasting more than three minutes if they are strong enough to be felt by humans (ASEZA n.d.).:

A detailed CFP and archaeological monitoring methodology should be submitted to, and approved by, the Jordanian DoA in advance of the commencement of any Project works.

Commitment: Completion of Full Archaeological and Ethnographic Baseline Surveys

The Project commits to completing a full archaeological and cultural heritage baseline prior to construction. This includes a systematic walkover survey of the pipeline alignment and all ancillary areas, supported by specialist analysis of LiDAR, aerial imagery, and any available subsurface datasets. Ground-truthing will be undertaken where anomalies or potential heritage features are identified. The results will establish a verified dataset of heritage constraints and will be used to refine the final design, avoid sensitive areas, and prepare site-specific management measures. No construction will proceed until this baseline is complete and agreed upon with the Department of Antiquities.

Commitment: Early and Ongoing Consultation with the Department of Antiquities, ASEZA, and UNESCO

The Project will maintain continuous consultation with the Department of Antiquities, ASEZA, and, where relevant, UNESCO, to ensure that all archaeological and cultural heritage requirements are fully coordinated and also ensuring compliance with legal and international obligations. All archaeological survey permits, investigations, approvals, and mitigation strategies will be reviewed and endorsed by the DoA. For the WRPA section, requirements identified by ASEZA and the UNESCO representative, including full monitoring of ground-breaking activities, will be fully implemented.

Commitment: Development and Approval of the Detailed Cultural Heritage Management Plan

The Project commits to updating the framework CHMP into a fully detailed, implementable Cultural Heritage Management Plan once the baseline surveys, relevant recommendations made within the ESIA relating to avoidance are evaluated and final construction footprint are complete. This updated CHMP will specify site-specific mitigation measures, monitoring requirements, access controls, and reporting procedures. It will include all DoA feedback and lender requirements and will be submitted for approval before Notice to Proceed. The approved CHMP will be integrated into the Project's ESMS and contractor documentation.

Commitment: Full Archaeological Monitoring of All Ground-Breaking Works

All Project ground-breaking and ground-clearance works, including trenching, grading, foundation excavation, access road formation, laydown areas, and any earthworks within the WRPA, will be monitored by qualified Cultural Heritage Monitors under the supervision of the Cultural Heritage Specialist. This commitment includes daily reporting, GPS-based recording, photographic documentation, and immediate escalation of potential heritage discoveries. Monitoring coverage will be continuous until the DoA confirms that risks are fully addressed.

Commitment: Implementation of the Chance Finds Procedure

The Project will implement a formal Chance Finds Procedure, approved by the DoA, prior to mobilisation. All workers and contractors will be trained to recognise and correctly report potential finds. In the event of a discovery, work will stop immediately within a minimum 50-metre radius, and the area will be secured. The Cultural Heritage Specialist will assess the find, notify the DoA, and implement mitigation required by the authorities. Construction will not resume until written clearance is issued. The procedure applies to all project phases, including construction, and operational maintenance.

Commitment: Avoidance and Minimisation of Impacts to Known Cultural Heritage Sites

Where known heritage sites are identified, the Project will prioritise avoidance through design modifications, micro-siting, buffer zones, and access restrictions. Where avoidance is not feasible, the

Project will agree a mitigation strategy with the DoA, which may include controlled excavation, documentation, or protective engineering measures. The Project will enforce strict protection of known heritage sites from vibration, dust, and visual impacts and will monitor their condition throughout construction.

Commitment: Protection of Intangible Cultural Heritage and Community Use of Heritage Sites

The Project will work with local communities to identify the intangible cultural heritage associated with the Project area, including traditional practices, rituals, pastoral routes, and place-based meanings. Construction planning will incorporate measures to avoid unnecessary disruption to community access or cultural practices. Where access restrictions are unavoidable, the Project will provide agreed alternatives and communicate them clearly through the Community Liaison Officer.

Commitment: Heritage Awareness and Capacity-Building Training

All project personnel engaged in ground-disturbing activities will receive mandatory induction training on heritage identification, reporting procedures, and cultural sensitivity. Supervisors, machinery operators, and contractors will receive enhanced training on the Chance Finds Procedure and on their legal responsibilities under Jordanian law. Training will be repeated periodically and reinforced through toolbox talks.

Commitment: Reporting and Documentation Requirements

The Project will maintain detailed records of all archaeological monitoring, chance finds, mitigation measures, and communications with regulatory authorities. Daily, weekly, and monthly reports will be produced by the Cultural Heritage Specialist, consolidating field observations, finds, and actions taken. All data—including GIS files, photographs, and descriptions—will be archived in the Project's cultural heritage database and submitted to the DoA for permanent record.

Commitment: Independent Auditing and Continuous Improvement

The Project will undertake regular internal reviews and independent audits of CHMP implementation, monitoring performance, and compliance with national and lender requirements. Any non-conformance will trigger corrective action, updated procedures, and retraining of personnel. The CHMP will be revised when significant project changes occur or when monitoring results indicate the need for improved controls.

Commitment: Integration of Cultural Heritage into Final Design and Construction Planning

Before construction begins, the Project will integrate all verified cultural heritage constraints into engineering design and construction planning. This includes repositioning access routes, adjusting pipeline alignment, modifying pylon locations, and adjusting construction methods to reduce risks to heritage. These design measures will be developed in consultation with the DoA and will be documented in the final CHMP.

Table 9-18: Identified Heritage Impacts, Mitigation, and Assessed Residual Impacts

Element of Proposed Action	Impacted Heritage Attributes (of relevant Tangible Heritage Asset)	Impact Significance (Negative unless otherwise defined)	Recommendations and Mitigation	Residual Impact (Negative unless otherwise defined)
Construction of new Infrastructure	Rock art, inscriptions, archaeological sites, finds, and features (WRPA) Palimpsest of semiarid desert, natural landforms, and cultural features (WRPA)	Moderate	Avoid physical impacts to any assets in the WRPA through sensitive design of final development details, such that they avoid intrusion into the WRPA	Neutral
	Heritage sites specifically placed to exploit the natural characteristics of the site and illustrating the inseparable relationship between the natural and cultural spheres (Historic Landscape Character)	Slight	Avoid physical impacts to known assets through demarcation of the assets and a protection buffer Avoid physical impacts to known assets through sensitive design of final development details, such that they avoid overlap with those assets	Neutral
	The well-preserved physical remains of the railway, station, and associated structures (Undesignated Heritage Assets).	Slight	Avoid physical impacts where pipeline crosses railway route through Project design Avoid physical impacts to asset through demarcation of site and protection buffer Avoid physical impacts to asset through sensitive design of final development details, such that they avoid overlap with the asset	Neutral
	The surviving physical remains and setting of AHS002, AHS003, AHS004, AHS005, and AHF003 (Undesignated Heritage Assets).	Moderate/Slight	Undertake evaluation of these sites and their surrounds to determine the most sensitive location for the RE Facility. If the loss of these sites cannot be avoided without causing greater heritage impacts elsewhere, offset their	Neutral/Slight

Element of Proposed Action	Impacted Heritage Attributes (of relevant Tangible Heritage Asset)	Impact Significance (Negative unless otherwise defined)	Recommendations and Mitigation	Residual Impact (Negative unless otherwise defined)
			loss through a comprehensive program of investigation, excavation, recording, and publishing	
	The surviving physical remains and setting of AHF004 and AHF005 (Undesignated Heritage Assets).	Neutral-Slight (depending on Project work's overlap with asset)	Avoid physical impacts where Project Area crosses these assets, through Project design	Neutral
	Potential surface or buried archaeological remains (Potential Heritage Assets)	Neutral-Slight (depending on significance of asset)	Reduce physical impacts to asset through sensitive design of final development details, such that final land take is minimised Develop and implement a CFP and program of archaeological monitoring	Neutral/Slight
Construction Effects	Rock art, inscriptions, archaeological sites, finds, and features (WRPA) Palimpsest of semiarid desert, natural landforms, and cultural features (WRPA)	Moderate (physical impacts) Minor (setting impacts)	Avoid and minimise construction effects (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
	A wide variety of natural and spectacular landforms in a protected setting (WRPA)	Minor	Avoid and minimise construction effects (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
	Large, preserved expanses of natural desert with relatively minor modern incursions (Historic Landscape Character)	Slight	Avoid and minimise construction effects (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral

Element of Proposed Action	Impacted Heritage Attributes (of relevant Tangible Heritage Asset)	Impact Significance (Negative unless otherwise defined)	Recommendations and Mitigation	Residual Impact (Negative unless otherwise defined)
	The setting of the surviving physical remains of Mersed, NN/Ma'an Desery Survey Site 8, WR-14_19, WR-14-22, AHF004, and AHF005 (Undesignated Heritage Assets).	Neutral/Slight	Avoid and minimise construction effects (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
	Potential surface or buried archaeological remains (Potential Heritage Assets)	Neutral-Slight (depending on the significance of the asset)	Avoid and minimise construction effects (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
Permanent Visible Infrastructure	Rock art, inscriptions, archaeological sites, finds, and features (WRPA) Palimpsest of semiarid desert, natural landforms, and cultural features (WRPA)	Neutral	N/A—neutral impacts identified	Neutral
	Large, preserved expanses of natural desert with relatively minor modern incursions (Historic Landscape Character)	Slight	None recommended. The visual impacts of the OHTL and RE Facility is not considered capable of further, sensitive mitigation	Slight
	The setting of the surviving physical remains of Mersed and WR-14_19 (Undesignated Heritage Assets)	Neutral/Slight	None recommended. The visual impacts of the OHTL and RE Facility is not considered capable of further, sensitive mitigation	Neutral/Slight

Element of Proposed Action	Impacted Heritage Attributes (of relevant Tangible Heritage Asset)	Impact Significance (Negative unless otherwise defined)	Recommendations and Mitigation	Residual Impact (Negative unless otherwise defined)
	The well-preserved physical remains of the railway, station, and associated structures (Undesignated Heritage Assets)	Slight	None recommended. The visual impacts of the OHTL and RE Facility is not considered capable of further, sensitive mitigation	Slight
	Potential surface or buried archaeological remains (Potential Heritage Assets)	Neutral-Slight (depending on the significance of the asset)	None recommended. The visual impacts of the OHTL and RE Facility is not considered capable of further, sensitive mitigation	Neutral/Slight
Operational Effects	Rock art, inscriptions, archaeological sites, finds, and features (WRPA) Palimpsest of semiarid desert, natural landforms, and cultural features (WRPA)	Minor	Avoid and minimise effects associated with maintenance or repair works (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
	Large, preserved expanses of natural desert with relatively minor modern incursions (Historic Landscape Character)	Slight	Avoid and minimise effects associated with maintenance or repair works (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
	The setting of the surviving physical remains of Mersed, NN/Ma'an Desert Survey Site 8, WR-14_19, WR-14-22, AHF004, and AHF005 (Undesignated Heritage Assets)	Neutral/Slight	Avoid and minimise effects associated with maintenance or repair works (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral

Element of Proposed Action	Impacted Heritage Attributes (of relevant Tangible Heritage Asset)	Impact Significance (Negative unless otherwise defined)	Recommendations and Mitigation	Residual Impact (Negative unless otherwise defined)
	The well-preserved physical remains of the railway, station, and associated structures (Undesignated Heritage Assets)	Slight	Avoid and minimise effects associated with maintenance or repair works (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
	Potential surface or buried archaeological remains (Potential Heritage Assets)	Neutral-Slight (depending on the significance of the asset)	Avoid and minimise effects associated with maintenance or repair works (e.g., noise, light, pollution, dust, vibrations) through the development and implementation of appropriate provisions	Neutral
Maintenance and Repair Works	The well-preserved physical remains of the railway, station, and associated structures (Undesignated Heritage Assets)	Slight	Avoid physical impacts to the railway through sensitive design of operational maintenance or repair works	Neutral
	The surviving physical remains and setting of AHF004 and AHF005 (Undesignated Heritage Assets).	Neutral-Slight (depending on Project work's overlap with asset)	Avoid physical impacts where Project Area crosses these assets, through sensitive design of operational maintenance or repair works	Neutral
	Potential surface or buried archaeological remains (Potential Heritage Assets)	Neutral-Slight (depending on the significance of the asset)	Reduce physical impacts to potential assets through sensitive design of final development details, such that final land take is minimised and remains within the original construction footprint	Neutral/Slight

9.13.3.2 Intangible Cultural Heritage

Mitigation and management measures are designed to avoid, minimize, or otherwise address potential adverse impacts on ICH identified through the assessment process. They are structured according to the UNESCO Mitigation Hierarchy (avoidance, minimization, rectification/restoration, safeguarding, and enhancement) and aligned with the broader Environmental and Social Management Plan (ESMP) and CHMP.

These measures aim to maintain the viability and transmission of ICH elements while ensuring that Project implementation proceeds in compliance with national legislation, UNESCO conventions, and lender safeguard requirements. The emphasis is placed on preventive and participatory approaches, recognizing that living heritage is non-renewable and that its safeguarding depends on continued community agency and access to cultural spaces and resources.

The objectives of the ICH mitigation and management framework are to:

- Prevent or minimize project-related interference with cultural practices, expressions, and knowledge systems
- Ensure that affected communities retain access to spaces, materials, and opportunities necessary for the continuation of ICH
- Strengthen community capacity for safeguarding, documentation, and transmission of heritage elements
- Integrate ICH considerations into the ESMP, EPC contract clauses, and monitoring frameworks

Mitigation follows a staged approach consistent with UNESCO (2022) and ESIA procedures. Integration within the ESIA ensures consistency across tangible and intangible heritage management. Avoidance and minimization are pursued through design and scheduling, while access and participation are maintained through liaison and co-planning. Safeguarding and enhancement measures reinforce the long-term transmission and vitality of living traditions.

Because ICH represents living, non-renewable cultural expressions, avoidance and minimization remain the preferred mitigation measures, while offsetting is not applicable. Each level of the hierarchy emphasizes the promotion of intergenerational transmission as a core safeguarding principle.

Table 9-19 provides an indicative framework linking the mitigation hierarchy to the main intangible heritage domains.

Table 9-19: Indicative Mitigation Framework by Intangible Cultural Heritage Domain

Domain	Potential Impact	Hierarchy Level	Example of Generic Measure	Notes/Required Input
Oral Traditions and Expressions	Temporary loss of access to performance or storytelling spaces	Avoidance/ Minimization	Adjust work schedules; provide temporary venues for gatherings	To be refined through community engagement identifying groups and sites within the AOI that maintain oral traditions

Domain	Potential Impact	Hierarchy Level	Example of Generic Measure	Notes/Required Input
Performing Arts	Disturbance or relocation of cultural events	Minimization/ Rectification	Manage noise and access; restore or reestablish venues	Site-specific mitigation to be developed once annual or seasonal events are mapped through community liaison
Social Practices, Rituals, and Festive Events	Restricted access to ritual sites or disruption of timing	Avoidance/ Minimization	Coordinate scheduling with community calendars; maintain open access	Coordination required with religious and tribal leaders through ongoing stakeholder engagement
Knowledge and Practices Concerning Nature and the Universe	Reduced access to ecological areas used for cultural knowledge	Safeguarding Support/ Enhancement	Support documentation, intergenerational learning, or co-management of resource areas	Integrate with biodiversity and natural-resource management plans to ensure continuity of traditional use
Traditional Craftsmanship	Disruption to materials or workspace availability	Minimization/ Enhancement	Maintain material supply; support training or marketing for artisans	Coordinate with livelihood restoration and local economic-development components of the ESIA

ICH mitigation and management measures will be implemented through the Project's management systems and coordinated across design, construction, and operation phases.

Responsibilities for implementation will be defined in a CHMP and ESMP, with oversight by the cultural heritage advisor and specialist team. Contractors will incorporate relevant measures into their construction environmental management plans and schedules.

Contractors will be required to integrate all relevant mitigation and monitoring measures into their construction ESMPs and associated work schedules. These requirements will form part of contractual obligations and will be verified through routine supervision, site inspections, and compliance audits.

The community liaison will ensure that mitigation measures remain aligned with local priorities and are adjusted as needed through ongoing consultation. Monitoring indicators for heritage continuity, participation, and safeguarding outcomes will be defined in the CHMP and reported through the overall project monitoring framework.

Detailed institutional roles, reporting frequencies, and coordination mechanisms will be developed as part of the ESMP and CHMP development. All cultural heritage management actions will be consistent with the approved governance framework and international best practice.

Monitoring and evaluation will track the effectiveness of mitigation and safeguarding measures and ensure that ICH considerations remain integrated throughout Project implementation, as required in the CHMP (Table 9-20).

Table 9-20: Indicative Monitoring and Evaluation Framework

Monitoring Objective	Indicator Type	Example Indicators	Frequency	Responsible Party	Notes/Required Input
Verify implementation of agreed avoidance and minimization measures	Process	Number of avoidance measures applied; compliance with work scheduling near cultural sites	Monthly during construction	EPC Contractor, Environmental and Social Team	Site-specific monitoring points and reporting formats will be finalized in the approved ESMP
Assess continuity of cultural practices and access to heritage spaces	Outcome	Evidence of continued gatherings, rituals, or performances; level of community participation	Semi-annual	CHMP Team, Community Representatives	Monitoring will focus on key communities and practices identified in Section 5; methodologies to be confirmed through consultation
Evaluate effectiveness of safeguarding and documentation programs	Outcome	Number of programs completed; participation rates; feedback from practitioners	Annual	Ministry of Culture, Project Safeguarding Team	Data collection plan and indicators will be finalized upon establishment of safeguarding initiatives
Maintain engagement and grievance channels for cultural concerns	Process	Number of consultation meetings held; grievances received/resolved related to heritage	Quarterly	Community Liaison Officer	Linked to the Stakeholder Engagement Plan and community feedback systems
Review integration of ICH measures into ESMP and CHMP	Process	Inclusion of ICH-specific actions in management plans and contractor procedures	Annual	Project Management Unit	Institutional responsibilities and reporting formats to be confirmed upon CHMP approval

9.14 Ecosystem Services

Ecosystem services are defined as the benefits that people, including businesses, derive from ecosystems and can be classified as:

- Provisioning services are the goods or products obtained from ecosystems, such as food, timber, fibre, and freshwater
- Regulating services are the contributions to human well-being arising from an ecosystem's control of natural processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards
- Cultural services are the nonmaterial contributions of ecosystems to human well-being, such as recreation, spiritual values, and aesthetic enjoyment
- Supporting services are the natural processes, such as nutrient cycling and primary production, that maintain the other services

The AAWDC Project has the potential to impact on ecosystem services through the Project construction activities and ongoing operational activities in the marine and terrestrial environments, through direct and indirect impacts. While there is no definitive list of all the elements that constitute ecosystem services, WRI (2013) provides a comprehensive outline of the services which fall under each category listed above. To identify the potential ecosystem services to be "scoped in", a scoping assessment was undertaken against this list. The review was based on the baseline survey and secondary desktop data available as presented within Chapters 6 and 7 of the ESIA and supporting appendices. This includes baseline biodiversity, environmental and cultural heritage surveys, stakeholder consultation and social baseline surveys and desktop studies carried out as part of the 2025 AAWDC Project ESIA. In addition, the outcomes of the topic specific assessments within this ESIA were also considered.

For those services scoped in, a second review was undertaken in line with best practice to determine whether the ecosystem services were deemed to quality as priority ecosystem services. The criteria for this review comprised the following:

- Could the project affect the ability of others to benefit from this ecosystem service?
- Is this ecosystem service important to beneficiaries' livelihoods, health, safety, or culture?
- Do beneficiaries have viable alternatives to this ecosystem service?

On this basis and, considering the impact assessments already undertaken and presented within this ESIA (within this Chapter and within Chapter 12: Climate Vulnerability Risk Assessment) and the associated mitigation, no priority ecosystem services were identified and no significant impacts identified. No further mitigation measures have been identified. The assessment of the ecosystem services aspects is presented in Table 9-21.

Table 9-21: Ecosystem Services Scoping, Impacts and Mitigation

Service Category	Nature of service	Service Identified/Potential for Impact	Scoped In/Out	Section of the ESIA where impacts are assessed and mitigation identified
Provisioning	Food	Fishing: No commercial fishing activity within the Project Area. Fishing largely restricted to small catch for local supply north of the Project Area. No small-scale fishing within 3km of Project Area. No impacts predicted to fish from the Project expected to affect existing small scale fishing activities	Scoped Out	n/a
		Cultivated crops and farming: Restricted access, loss of grazing land and crops is anticipated to occur due to the Project activities, affecting communities, herders and farmers	Scoped In	Refer to Section 9.6 Resettlement, Land, Assets and Livelihoods
	Biological Raw Materials	No services identified	Scoped Out	n/a
	Biomass Fuel	No services identified	Scoped Out	n/a
	Freshwater	Seasonal wadis: Access to freshwater resulting from seasonal rains via wadi system is important for pastoralists. Access may be potentially affected due to the Project and potential for quality effects due to sediment entrainment from construction activities	Scoped In	Refer to Section 9.6 Resettlement, Land, Assets and Livelihoods and Section 9.3.3 Terrestrial Biodiversity Impacts
	Genetic Resources	No services identified	Scoped Out	n/a
	Biochemicals, natural medicines, and pharmaceuticals	No services identified	Scoped Out	n/a
Regulating	Regulation of air quality	Dust: While the Project not considered to result in any discernible impacts to terrestrial ecosystems as a result of changes	Scoped In	Refer to Section 9.7 Community Health, Safety and Security During Construction and

Service Category	Nature of service	Service Identified/Potential for Impact	Scoped In/Out	Section of the ESIA where impacts are assessed and mitigation identified
		to air quality there is potential for ecosystem impacts due to dust		Section 9.4 Air Quality and Dust
	Regulation of climate	Project not considered to affect the climate regulation role of the ecosystems present (e.g. seasonal wadis) and will not affect carbon storage	Scoped Out	n/a
	Regulation of water timing and flows	The Project is not expected to impact on the timing and magnitude of water flows within the wadi systems in proximity to Project activities.	Scoped Out	n/a
	Erosion regulation	The project has the potential to affect soil erosion within the footprint of the Project activities during construction but is not anticipated to adversely affect the integrity of land and property from erosion effects	Scoped Out	n/a
	Regulation of diseases	No services identified. No existing ecosystems contribute to regulation of diseases	Scoped Out	n/a
	Regulation of pests	No services identified. No existing ecosystems contribute to regulation of pests	Scoped Out	n/a
	Pollination	No services identified. Some agricultural areas and flora present contribute to pollination, but the project will not impact pollination process on a broader scale. Impacts to pollination within the Marine Study Area in the marine environment are mitigated through the Project design and will not impact pollination processes on a broader scale.	Scoped Out	n/a
	Regulation of natural hazards	Flooding and landslides: Potential for impacts to communities and associated land and livelihoods as a result of Project activities contributing to natural hazards	Scoped In	Refer to Section 9.7 Community Health, Safety and Security During Construction and Chapter 12: Climate Vulnerability Risk Assessment
Cultural		Diving and tourism: The Project has some potential although limited	Scoped In	Refer to Section 9.2 Marine Environment and

Service Category	Nature of service	Service Identified/Potential for Impact	Scoped In/Out	Section of the ESIA where impacts are assessed and mitigation identified
	Recreation and ecotourism	potential to affect existing recreational facilities on coastal strip north of Project facilities due to Project activities, resulting in marine ecosystem effects. These effects are assessed through potential environmental impacts to the marine environment.		Section 9.6 Resettlement, Land, Assets and Livelihoods
		Ecotourism: Potential for effects on tourism associated with the Wadi Rum Protected Area given the proximity of Project activities are anticipated.	Scoped In	Refer to Section 9.13 Cultural Heritage
	Ethical and spiritual values	The Project has the potential to affect social practices, rituals, and festive events due to disruption and disturbance	Scoped In	Refer to Section 9.13 Cultural Heritage
	Aesthetic Value	The Project has the potential to affect the landscape and visual setting of Wadi Rum Protected Area	Scoped In	Refer to Section 9.13 Cultural Heritage
Supporting	Habitat provision	The Project will result in habitat disturbance; impacts would be largely limited to pastoralists and herders	Scoped In	Refer to Section 9.6 Resettlement, Land, Assets and Livelihoods and Section 9.3 Terrestrial Environment
	Nutrient cycling	The Project is not expected to have a measurable effect on nutrient levels in groundwater, soils or surface water that would affect communities including herders and farmers	Scoped Out	n/a
	Soil formation	The Project is not expected to have a measurable effect on sediment transfer and potential entrainment that would result in changes to surface water flow or landscape changes that would affect communities including herders and farmers	Scoped Out	n/a
	Water cycling	The Project is not expected to have an impact on the role of ecosystems involved in the water cycle (i.e. supporting filtration and evaporation effects)	Scoped Out	n/a

9.15 Biodiversity Residual Impact Summary

The ESIA sections above provided a detailed assessment of mitigation and residual impacts, including critical habitat and priority biodiversity features, including natural habitat. A summary of the potential impacts, mitigation and residual impact, including quantification where practical is provided in the below tables:

- Table 9-22: Marine Environment Residual Impact Summary - Construction impacts from installation work
- Table 9-23: Marine Environment Residual Impact Summary - Construction and operational impacts from underwater sound and disturbance
- Table 9-24: Marine Environment Residual Impact Summary - Operational Phase Discharges from the Desalination Plant
- Table 9-25: Marine Environment Residual Impact Summary - Operational Phase Seawater Abstraction
- Table 9-26: Terrestrial Environment Residual Impact Summary - Temporary construction impacts, permanent habitat change

As part of the disclosure package a Framework BAP has been developed. It is the initial version of the BAP, outlining offset actions that will require further development and stakeholder consultation. As the potential offset actions are assessed in more detail, refined, and supporting actions are added, the BAP will be revised accordingly. To support future revisions of the Framework BAP, the following initiatives will be integrated into the updated document:

- Site-specific pre-construction surveys will be conducted to ensure that the Project undertakes appropriate avoidance, mitigation, adaptive management, and monitoring to achieve No Net Loss and Net Gain goals
- More detailed Project design and construction information will be integrated, as well as habitat enhancement opportunities to reduce residual impacts
- The approach to integrate additional quantification methodologies to support quality habitat metrics and offset multipliers (including time discounts)
- Stakeholder input

Table 9-22: Marine Environment Residual Impact Summary - Construction impacts from installation work

Critical Habitat: Coral, Giant Clam, Seagrass and Teleost Fish		
Impact mechanism	**Proposed mitigation**	**Residual impact and offset summary**

Construction phase trenching, outfall installation, anchor and jetty construction:
• Loss/damage of habitat
• Loss/damage of individual colonies
• Loss/damage by physiological stress
• Behavioural change
• Reduced reproductive/ settlement success
Impacted area:
• 2,646m2 coral habitat, which includes 19% patch reef and shallow seagrass habitat.
	Avoidance:
	• Reduced project physical footprint and micro-siting
	• Coral translocation
	• Consideration of seasonal restrictions during seasonal reproductive periods
	• Use of silt curtains and other turbidity controls
	Management:
	• ESMMP and supporting ESMS
	• Construction management, including pollution prevention, marine construction operational controls
	• Environmental monitoring and reporting program to support adaptive management during construction
	Restoration:
	• Physical reinstatement of impacted areas and creation of suitable seabed substrate
	• Biorestoration via transplanting of coral colonies
		Mitigation quantification:
		• The translocation of coral and giant clams to depths less than 35m
		  ○ Restoration planned of 1,641 m2 (representing 62%) of the impacted seabed, which includes 491m2 of patch reef and shallow seagrass habitat
		  ○ The Jordan Marine Reserve has reported a survival rate of 80% for translocated coral
		• Coral translocation, deeper than 35m, is considered non-viable due to the water depths preventing access by divers
		  ○ No restoration viable for 1,005m2 of the impacted seabed
		• The outfall, the concrete collars, the lagoon seawall and the concrete mattress to protect the outfall to a depth of 10m, will create an estimated 1,500m2 of new suitable substrate for coral, giant clam (will require further study) and fish habitat.
		Residual impact on critical habitat:
		• 1,313 m2 coral and patch reef and shallow seagrass habitat
		• The residual impact will affect 0.35% of the total coral and patch reef and shallow seagrass habitat in the Study Area
		Offset summary
		• Net Gain required to critical habitat: Reef habitat to support coral, giant clam, seagrass and teleost fish

Table 9-23: Marine Environment Residual Impact Summary - Construction and operational impacts from underwater sound and disturbance

Critical Habitat: Turtles, Marine mammals, Elasmobranchs (sharks & rays), Seabirds		
Impact mechanism	**Proposed mitigation**	**Residual impact and offset summary**
Construction and operations phase: • Behavioural changes in response to underwater sound during construction • Temporary physical presence of construction vessels and equipment • No operational phase activities considered significant Impacted area: • No potential for mortality or injury at distances greater than 76m • Potential for temporary disturbance and behavioural changes in fish up to 684m and in cetaceans within 500m	Avoidance: • Marine mammal observation program • Soft start and a stop work protocol in the event that underwater sound receptors are observed Management: • ESMMP and supporting ESMS • Marine Construction Works Management Plan, including an underwater sound adaptive management and reporting system Restoration: • Not required/applicable	Residual impact on priority biodiversity features and natural habitat: • No residual impact predicted Offset summary: • No offset required

Table 9-24: Marine Environment Residual Impact Summary - Operational Phase Discharges from the Desalination Plant

Critical Habitat: Coral and Teleost fish		
Impact mechanism	**Proposed mitigation**	**Residual impact and offset summary**
Operations phase discharge from the desalination plant: • Seawater quality impacts Impacted area: • Water column impacts not considered significant • 9,076m2 of seabed habitat with <15% coral cover impacted by the increase in salinity of 0.82 psu (defined by the 2% threshold)	Avoidance: • Desalination water treatment process controls to neutralise biocide and chlorine to reduce effluent toxicity and suspended solids • Reverse osmosis technology to reduce the increase in effluent temperature • Diffuser design Management: • ESMMP and supporting ESMS • Operations and maintenance (O&M) controls and procedures • Comprehensive discharge monitoring, including continuous online monitoring and regular sampling • Environmental monitoring and reporting system to support adaptive management	Residual impact on critical habitat: • 9,076 m2 of coral habitat • The residual impact will affect 1.2% of the total coral habitat in the Study Area Offset summary: • Net Gain required to critical habitat: Reef habitat to support coral and teleost fish

Table 9-25: Marine Environment Residual Impact Summary - Operational Phase Seawater Abstraction

Critical Habitat: Coral, Giant Clam, Seagrass and Teleost Fish		
Impact mechanism	**Proposed mitigation**	**Residual impact and offset summary**
Operations phase abstraction of seawater: • Reduced reproductive/ settlement success Impacted area: • 3,500m2 of intertidal coral habitat, with 2% coral cover, the lowest within the Study Area	Avoidance: • Abstraction of water from within a lagoon • Fish recovery and return system • Continuous operation of a bubble curtain at the mouth of the lagoon, • Consideration of an additional bubble curtain during periods of intense planktonic larval spawning/reproduction Management: • ESMMP and supporting ESMS • Settlement monitoring from within the lagoon to confirm effectiveness to support adaptive management	Residual impact on critical habitat: • 3,500m2 of intertidal coral habitat • The residual impact will affect 4.2% of the total coral habitat in the Study Area Offset summary: • Net Gain required to critical habitat: Reef habitat to support coral, giant clam, seagrass and teleost fish

Table 9-26: Terrestrial Environment Residual Impact Summary - Temporary construction impacts, permanent habitat change and operational impacts

Natural Habitat: Potential critical habitat and priority biodiversity feature triggering flora, fauna and birds		
Impact mechanism	**Proposed mitigation**	**Residual impact and offset summary**

Construction phase site / ROW preparation (including vegetation removal, topsoil stripping):
• Loss/damage of habitat
• Loss/damage of individual flora, fauna and birds
Operational phase OHTL impacts
Impacted area:
• 1,534 hectares of natural and degraded habitat
• Flora:
  ○ Potential critical habitat plant species: 4
  ○ Potential priority biodiversity feature species: 1
• Fauna:
  ○ Potential priority biodiversity feature species: 1 mammal, 2 reptile species,
• Birds:
  ○ Potential critical habitat species: 3
  ○ Potential priority biodiversity feature species: 10
	Avoidance:
	• Pre-construction surveys to confirm the presence of important biodiversity values to enable:
	  ○ Planning of seed collection and translocation of all tiggering/important flora and fauna before construction
	  ○ Planning of seasonal breeding bird avoidance measures
	  ○ Installation of bird diverters on OHLT and design of wildlife-friendly pylons
	  ○ Reduce and control project's physical footprint and maximise micro-siting of temporary facilities
	Management:
	• ESMMP and supporting ESMS, including Biodiversity Sensitivities and Constraints Assessment
	• Construction management, focusing on erosion control, wildlife interaction, nesting bird avoidance and reinstatement planning
	• Environmental monitoring and reporting program to support adaptive management during construction, including OHTL post fatality monitoring (PCFM)
	Restoration:
	• Physical reinstatement of impacted areas and creation of suitable soil/ground conditions
	• Biorestoration via replanting of vegetation or broadcasting of recovered seed
		Mitigation quantification:
		• Pre-construction avoidance via translocation and seed collection and restoration of the right of way (assuming a 20% residual impact from temporal loss) and restoration of 70% of the renewable energy site will reduce residual impact by 1,166 hectares
		Residual impact on natural habitat:
		• 368 hectares of natural and degraded habitat
		  ○ A total 162 of hectares of natural and degraded habitat will be permanently lost due to the presence of permanent facilities, via habitat conversion
		  ○ A total of 205 hectares of natural and degraded habitat will be impacted, assuming a 20% residual impact from temporal loss, following reinstatement of the pipeline right of way
		Offset summary:
		• No net loss required for potential priority biodiversity features: Desert habitat to support flora, fauna and birds

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Appendices

Appendix 9A.1 Plume dispersion modelling (see separate document)

Appendix 9A.2 Underwater sound modelling

Appendix 9B.1 Noise and vibration screening assessment

Appendix 9B.2 Air quality and dust screening assessment

Appendix 9B.3 Glint and glare review