

Non-Technical Summary – Sub-Project - 3

Construction of Road No 1 And Road No 5 And Drainage Systems at Duqm Port

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ACRONYMS

AAQMS	Ambient Air Quality Monitoring Station
ALARP	As Low As Reasonable Practice
BAT	Best Available Technique
BEES	Battelle's Environmental Evaluation System
CO	Carbon Monoxide
CO2	Carbon Di Oxide
CSR	Corporate Social Responsibility
DG	Diesel Generator
DGEA	Directorate General of Environmental Affairs
EIA	Environmental Impact Assessment
EIPPCB	European Integrated Pollution Prevention and Control Bureau
EMP	Environmental Management Plan
GHG	Greenhouse Gas
GM	Grievance Mechanism
IUCN	International Union for the Conservation of Nature and Natural Resources
KAS	Khalid Bin Ahmed & Sons
MD	Ministerial Decisions
MECA	Ministry of Environment and Climate Affairs
NOx	Oxides of Nitrogen
NTS	Non-Technical Summary
PDD	Partnership and Development Department
PM	Particulate Matter
PMC	Project Management Contractor
RD	Royal Decrees
ROP	Royal Omani Police
SEZAD	Special Economic Zone Authority
SEZD	Duqm Special Economic Zone
SO2	Sulphur Di Oxide
SPMT	Self-Propelled Modular Transport
VOC	Volatile Organic Compounds

1 INTRODUCTION

With a land area of 2,000 km² and 70 km of coastline along the Arabian Sea, the Duqm Special Economic Zone (SEZD) is the largest in the Middle East and North Africa region and ranks among the largest in the world. The Duqm SEZ is a model of an integrated economic development composed of zones: a sea port, industrial area, new town, fishing harbour, tourist zone, a logistics centre and an education and training zone, all of which are supported by a multimodal transport system that connects it with nearby regions (e.g., the Arabian Gulf countries, Middle East, East Africa and Southeast Asia). The Port of Duqm is seen as a catalyst for the development of the Al Wusta region, in particular, the Special Economic Zone at Duqm. The Port and the dry docks are being developed to increase cargo transshipments, ship repairs, manufacturing industry and tourism.

The Special Economic Zone is administered, regulated and developed by the Duqm Special Economic Zone Authority (SEZAD), a financially and administratively independent government entity. SEZAD was established as per the provision of the Royal Decree (RD) 119/2011 and is responsible for the management, regulation, and development of all economic activity in the SEZD.

1.1 PROJECT BACKGROUND – ROAD 1 & 5

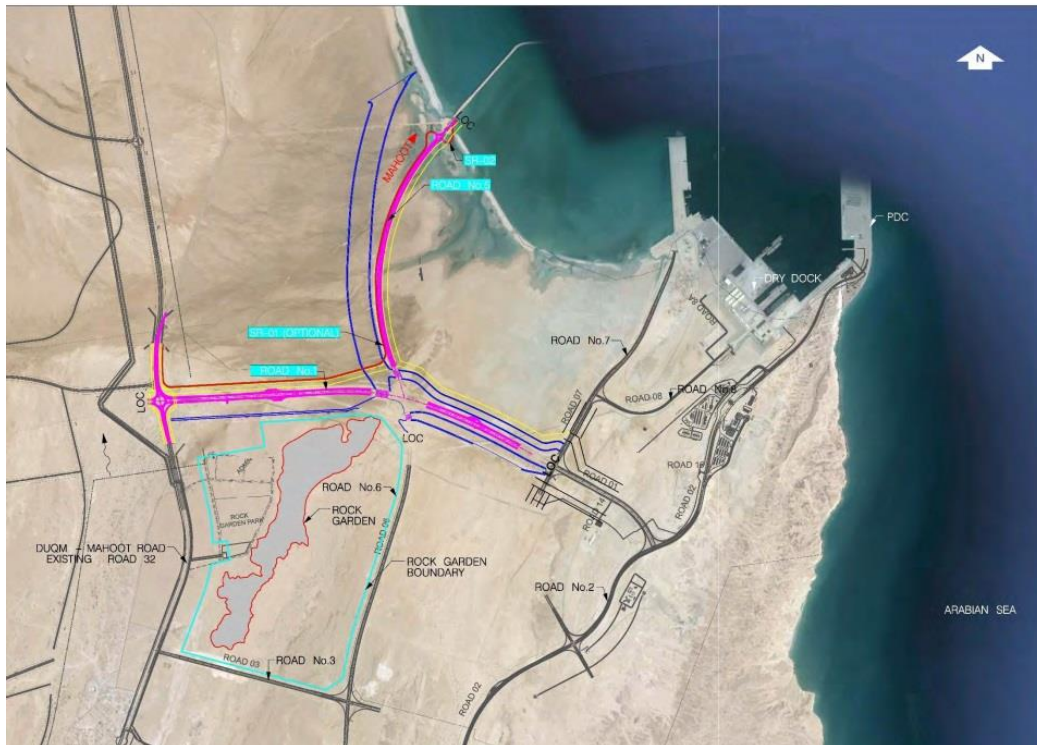
Background of this project involves the construction of two roads which connects the Liquid Berth Terminal at Duqm Port to the Heavy Industrial Zone via National Road No. 32.

The proposed Project 1&5 intends to provide and improve access to the Duqm Port and the Liquid Jetty. Road No. 1 connects the National Road No. 32 (Duqm – Mahoot) with the Port Road No. 2 and enables easier access to the Duqm Port. Road No. 5 connects the Road No. 1 to the Liquid Jetty. The Liquid Jetty will serve the Duqm Refinery and several heavy/ petrochemical industries coming within the proposed heavy industrial zone in SEZD.

Port Road No.1 is a dual carriageway road with 2 lanes on each carriageway. The length of Road 1 is 3.93 km. Port Road No. 5 is also a dual carriageway but with 2 lanes on each carriageway. It connects Road 1 to the Liquid and Bulk Berth at the Duqm Port. The length of Road 5 is 3.30 km.

The project timeline of Road 1& 5 Project shown below:

PROJECT	CONTRACT NO	ORIGINAL PROJECT EXECUTION PROGRAMME	CONTRACTOR	EXPECTED DATE OF COMPLETION
Road 1 & 5 Project	C81/2017	24 Months	Khalid Bin Ahmed & Sons LLC	Q4 2019



Layout for the proposed Road 1 & 5 Project

1.2 REGULATORY CONTEXT AND STANDARDS

1.2.1 Omani Legislation and Guidance

No stakeholder consultation was conducted as part of the EIA report. While the SEZAD is the responsible authority for the Duqm SEZ, the Project was implemented in compliance with the “Guidelines on Environmental Impact Assessment” issued by the Omani Directorate General of Environmental Affairs (DGEA) at the Ministry of Environment and Climate Affairs (MECA).

Omani environmental law has two main legal instruments, viz., Royal Decrees (RDs) and Ministerial Decisions (MDs). Typically, an RD provides a general framework relating to a particular area in need of statutory control, while MDs provide specific regulation using the framework provided in the RD. Where Omani environmental regulations and standards were not available, acceptable international environmental regulations and standards has been referenced. Additionally, the applicable Best Available Technique (BAT) Reference, the so called BREF documents published by the European Integrated Pollution Prevention and Control Bureau (EIPPCB) has been referred.

The Road 1 & 5 project will work within with the range of applicable laws and legislation in Oman.

1.3 ENVIRONMENTAL AND SOCIAL CONTEXT

An Environmental Impact Assessment Study (EIA) has been conducted as part of the SEZAD permitting process for the Road 1 & 5 project by MECA Approved Environmental Consultant - HMR Environmental Engineering Consultants in 2017. Parsons International & Co LLC was awarded for project Design and Supervision of Road 1 & 5 Project, while Khalid Bin Ahmed & Sons LLC (KAS) has been awarded as main contractor for construction of Road 1 & 5 Project. No stakeholder consultation was conducted as part of the EIA report.

SEZAD Corporate Social Responsibility (CSR) section of the Partnership and Development Department (PDD), provides access for communities to provide any grievance (written and in person) through the Grievance Mechanism (GM) form. The GM form is available on SEZAD website at <https://www.duqm.gov.om/sezad/csr/grievance-form>.

The ways grievance can be registered are as follows-

1. **Via Phone** - The Partnership & Development Department (PDD) can be contacted between the hours of operation (8am – 3 pm) Sunday to Wednesday on 24507216.
2. **Via Official Letter** - The Official letter can be directed to the Manager of the Partnership and Development Department and can be dropped of either directly to any one of our offices in DUQM or Muscat
3. **Via Email** - An Email can be sent to the Partnership & Development Department to CSR@duqm.gov.om
4. **Website Portal** - All information regarding the process of the grievance system is available as well as a form that can be filled online and sent directly to the Partnership and Development Department though <https://www.duqm.gov.om/sezad/csr/grievance-form>

All Grievance issues are handled by the Partnership and Development Department (CSR Section). In the event the department is unable to assist or respond, it will be raised to the Deputy CEO of SEZAD where responses will be answered within a 7 days from the date of the letter/ grievance received, however can change depending on the complexity of the grievance.

1.4 DOCUMENTATION

The environmental reports available for Road 1 & 5 project are as follows-

- Environmental Impact Assessment Report (EIA) (Doc Ref: HMR/4077-EIA-1, April 2017, HMR Environmental Engineering Consultant)

All the reports mentioned above are available with SEZAD Environment Regulatory Department and can be accessed on email request to ERD Manager Mr. Ahmed Harib Al Balushi at EMIPS@duqm.gov.om.

1.5 THE PURPOSE AND CONTENT OF NON-TECHNICAL SUMMARY (NTS)

This NTS provides an overview, in layman's terms, of the main environmental findings from the EIA of the Project. Content of the NTS is summarised below.

- Section 1 introduces about the project background, legal or laws and regulations, environmental and social context.
- Section 2 briefs about the project description
- Section 3 summarises the baseline conditions of the project.
- Section 4 summarises summary of environmental impact assessment and management plan for both the phases i.e. construction & operation
- Section 5 provides the findings and conclusions of the EIA.

It is important to note that this NTS does not, and is not intended to, convey all of the information relating to the aspects and impacts of the Project. Its intention is to present key information, describe the main findings and conclusions, enabling the reader to understand the significant environmental and social effects of the Project without needing to refer to the detailed assessments.

2 PROJECT DESCRIPTION

2.1 PROJECT COMPONENTS

This Project involves the construction of two roads: Port Road No. 1 and 5 to connect the Liquid and Bulk Berth at Duqm Port to the Heavy Industrial Zone via National Road No. 32.

Port Road No. 1 is a dual-carriageway road with 2 lanes in each direction. Road No. 1 connects the National Road No. 32 (Duqm – Mahoot) with the Port Road No. 2 and enables easier access to the Duqm Port. The length of Road 1 is 3.93 km, with 3.75 m wide lanes and a 40.9 m median. The embankment height of the Road is generally 2 m to 3 m at drainage culvert locations. The Road has to traverse through soft ground where ground improvement is required. A 63 m wide utility corridor will be provided on both sides of the Road. The right of way for Road 1 varies from 430 m to more than 800 m, which includes the utilities corridors on both sides, main carriageway and two channels on either side of the road (75 m and 110 m wide). Street lighting using LED lamps and drainage systems are also included in the scope of works.

Port Road No. 5 is also a dual-carriageway road but with 2 lanes in each direction starting. It starts from the new Liquid and Bulk Berth and connects to Port Road No.1. The length of Road No. 5 is 3.3 km, with 3.75m wide lanes and an 18.4 m median. The Road will traverse through unstable ground near the sea in which ground improvement is required. A 63 m wide utility corridor is provided on one side of the Road to allow space for the laying of utilities. A service road of 6.77 km length is also to be provided along Road No. 5, as well as a 250 m wide drainage channel to convey storm water from the upstream of Road 1. The right of way of Road 5 averages 400 m, which includes utilities corridor, main carriageway and drainage channel. The Road will have street lighting using LED lamps.

The following are the detailed scope of works for construction of Road 1 & 5 project including the associated drainage systems as part of the road infrastructure development works in the SEZD area.:

- Topographic surveying and setting-out
- Site clearance
- Relocation of 11/33 kV underground cables
- Earthworks fill and excavation.
- Establishment of borrow pits for imported fill
- Establishment of quarries for aggregate requirements
- Pavement construction courses include sub-base, aggregate base, bituminous base and wearing
- Lay-bys
- Concrete barriers and steel safety barriers
- Channel fill slope protection with gabions
- Concrete side ditch
- Loose stone riprap
- Construction of floodway
- Gantry and cantilever road signs
- Road signs, pavement markings and road studs

- LED street lighting
- Ducts for future services
- Right-in/ right-out junction
- Interface with existing road as per dual carriageway requirements
- Basal reinforcement
- Geotextile
- Rock Fill
- Relocation and protection of existing utilities

Road 1&5 are designed for a design speed of 80 kilometres per hour (kph) with a posted speed level of 60 kph. Road No. 1 is a 2x2 dual carriageway expandable to 6x6 lanes, while Road No. 5 is a 2x2 dual carriageway. Road No. 1 are designed to accommodate extraordinary long vehicles called "Self Propelled Modular Transport" (SPMT) for transporting the refinery equipment from Duqm Port to Duqm Refinery. Road no. 1 Provision is also being provided for future railway networks, bus service, and in this regard, approximately 40 m wide corridor adjacent to the outer shoulder is reserved for future road facilities including bus stops, taxi bays, and future pedestrian overpass as whenever this becomes a need.

3 BASELINE CONDITION

3.1 INTRODUCTION

The Road 1 & 5 Project is located in the Al Wusta Region of the Sultanate of Oman. Al Wusta Governorate makes up 25.8 % of the land area of Oman, however only represents about 1 % of the population in the Sultanate with population density of 0.5 persons per square kilometre. The ecology in Al Wusta is diverse with many birds passing the Al Wusta region, and stopping over at Duqm coast for roosting and feeding, during their annual migration. On land, the climate, influenced by the annual autumn season in Dhofar, helps the growth of a variety of plants and rare mammals such as the Arabian Oryx and the Nubian Ibex. The waters off Al Wusta are home to marine cetaceans of conservation concern.

3.2 BASELINE ASSESSMENT SUMMARIES

Summary of the baseline study outlined below for the following parameters was based on the secondary data, desktop assessment and review of the information available from previous studies that has been conducted in SEZD area.

3.2.1 Climate and Meteorology

The climate of Duqm is mainly influenced by the summer and winter monsoons. While the winter winds are relatively gentle, the summer winds are quite vigorous especially during the month of June & July. The historical records for ambient air temperatures at Duqm Port show that the lowest temperatures occur in January with a mean of 20.7°C and steadily increase to a peak of 31.1°C in May. From June with the arrival of the summer monsoon, the temperatures begin a steady decline until December. The average relative humidity is approximately 64% in most months.

Rainfall in Duqm area is low, with the region classified as between arid and hyper arid. However, high intensity storms, capable of producing significant run-off and recharge, occur infrequently at irregular times of the year. Historical rainfall records, for 1983 to 2010, at Duqm Port show that the historical monthly averages illustrate that the highest Mean Rainfall is in the month of December with 2.2 mm and the highest total Maximum Rainfall is 191.0 mm reported for the month of April.

3.2.2 Topography

The general topography of the project site is similar to the other undeveloped areas along the Duqm coastal area. The surface features of undeveloped areas along the coast near the Project site consist of coastal dunes and belts of scrub starting approximately 500 m inland. Further inland from the shoreline, featureless sabkha with sparse vegetation is observed in the northern area of the proposed site. The topography of the project area is more or less flat terrain, ranging from low-lying coastal and alluvium plains. The low-lying coastal and coastal alluvium plains are confined to the Eastern side of the study area and the North West – Western side comprises with alluvium plain. The ground surface features of undeveloped area along the coast, near to the project site consist of limited coastal dunes extend up to 10 to 20 m from the shoreline.

3.2.3 Geology

The geology information for the Project area intersects several different geological formations. The central portion of the Project area consists of coastal (Qm), sabkha (Qb), and alluvium (Qf) deposits. These deposits are of Quaternary age and the sediment grains consist of fragments of fossils, limestone's and dolomites, and other carbonate grains or some combination of these. The limestone formation is predominantly composed of detrital (transported) sand, corals, shells, pellets, and other carbonate grains. The surface geology of the

site is made up of recent to ancient piedmont deposits and sabkha with the Lower Ecocene Sirab Formation exposed in places. This is composed largely of marl and chalky limestone.

3.2.4 Soil Quality

Composite soil samples were collected and analysed as part of baseline study to capture primary information on subsurface conditions within the geotechnical investigations that were carried out. Analytical results for the soils showed no indication of contamination and in particular no evidence of hydrocarbons.

3.2.5 Hydrology

The Project area is underlain mainly by Tertiary sediments of the Hadramout group. The main aquifer is the UER formation. Recharge occurs through the regional aquifer system and it is approximately 200 m below ground level. It constitutes the main regional aquifer in the Najd (Southern Oman), with groundwater salinity increasing from fresh in the area of Dhofar Mountains to saline with proximity to the ocean in the Al Wusta region. In this project area the groundwater is saline in nature and not suitable for drinking.

3.2.6 Ambient Air Quality

Secondary data from previous EIA reports was sourced for comparing the ambient air quality around the project site. A number of ambient air quality monitoring surveys (AAQMS) has been conducted across the SEZD area.

Ambient air quality studies undertaken found that parameters are within the Omani Provisional Standards Limits, excluding O₃ at one location and SO₂ at two locations. Measurements of dust also showed compliance with the Omani Provisional Standards Limits.

3.2.7 Noise

Secondary data from previous EIA reports was sourced for comparing the noise quality around the project site. Noise levels were within applicable limits prescribed in MD 79/94 for industrial areas.

3.2.8 Terrestrial Ecology

During the baseline study, the maximum avifaunal diversity was observed in the coastal region where over-wintering shore birds dominate the beaches. The most prevalent avifauna in the region is the Siberian Gull and the Caspian Gull, comprising about 95% of the total avifauna on the coast. Total of 39 species (Gardner, 1990) of herpetofauna are available in the industrial development zone, including 8 species with doubtful occurrence. The most abundant species recorded were *Mesalina adramitana* (Hadramaut Sand Lizard), *Acanthodactylus boskianus* (Bosk's Fringe-fingered Lizard), and *Acanthodactylus opheodurus* (Snake-tailed Fringe-toed Lizard). Sabkha habitats mainly comprise of *Halopeplis perfoliata* (string of beads), *Arthrocnemum macrostachyum* (glaucous glasswort), *Tamarix aucheriana*, *Tetraena qatarensis* (Bean caper), *Cressa cretica* and *Limonium sarcophyllum*.

3.2.9 Marine Baseline

The lagoons are important nursery areas for various fish species, are feeding grounds of large variety of migratory wading birds, and are rearing areas for cephalopods, crustaceans and invertebrates. This lagoon in the Project area supports a large number of fishes (especially juvenile, fry and fingerlings), shrimps, crabs and molluscs. The tidal mud flat in the lagoon hosts many fiddler crabs, sand bubbler crabs (*Dotilla sp.*), Ghost crabs (*Ocyropode sp.*) and clams.

Fiddler crabs are one of the most important taxa among the macro fauna commonly found in muddy tidal lagoons. There are two species of fiddler crabs found in Oman (*Uca lactea annulipes* and *Uca tetragonon*). In the recent ecological survey for the Duqm Service Corridor project, *Uca lactea annulipes* is the predominant crab species found across the Project site. The average density was 21 crab burrows/m² in the intertidal area indicates the healthy population this species in the lagoon. They are also important to the food web, as they

are food for coastal birds and large crustaceans. The common Rock crabs (*Grapsus sp.*) were noticed in the existing tidal inlets. Smaller patches of sabka vegetation are also found on the northern side on a sandy / muddy bottom. Fish survey was conducted at three locations along the length of the estuarine intersection (tidal inlets) during high tide. Many Juveniles, fry and fingerlings of different fish species were observed, predominantly in lagoon survey areas and intertidal area.

3.2.10 Socio Economic

Secondary data from previous studies was sourced for the Socio Economic study for Road 1 & 5 Project. The project site is located close to the Duqm Port and the nearest inhabited village is the Say village located on the banks of Wadi Say which is approximately 3 km from the sub project. As part of the Road 1 & 5 Project there will be insignificant or no-land use conflict with the local communities during both construction and operation phase of the Project. The nearby Duqm settlement will not be impacted by site preparation activities and movement of vehicles, especially the heavy vehicles during the construction phase. In addition, there will be no relocation or displacement of the local population.

Oman is a hierarchical system where the local population reports its demands and complaints to the local Sheikhs. These issues are then passed on to the Wali who in turn express them to the Governor / government. During consultation with Wali of Duqm, Sheikhs, and local people some of the important and interesting information on the targeted issues was received.

Fishing and livestock rearing were found to be the traditional occupations that exist in Wilayat to a certain extent. People traditionally practice the raising of Camel, Goats and Sheep's and keep them in temporary shelter.

It was observed that due to development planned in and around Duqm, most of settlements, except Nafun, have been shifted and relocated by the Government of Oman to Wadi Say. In future, the Government is planning to shift these settlements from Wadi Say to an upcoming township (150 houses) near to the Duqm Airport in South.

3.2.11 Archaeology

Rock Garden is located to the south of the intersection of Road Nos. 1 and 5. Precautionary measures will be implemented to protect these sites and preserve the archaeological legacy. During construction of roads, excavation etc. if any object of cultural / archaeological significance is encountered such area will be immediately cordoned off and the construction contractors will inform the Ministry of Heritage and Culture accordingly to obtain further advice from the Ministry.

4 SUMMARY OF ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT PLAN OUTCOMES

4.1 INTRODUCTION

The assessment of potential impacts was done using Impact Assessment Matrix method. The impacts are rated as 'low', 'medium' or 'high' depending on the severity of the impact and the likelihood of the impact. An impact assessment matrix as presented in **Figure 1** below has been used for combining the two assessment criteria, i.e., severity of impact and likelihood of aspect occurrence. The matrix is a variant to internationally accepted Leopold's matrix and Battelle's Environmental Evaluation System (BEES), and is developed taking into consideration components mentioned in the World Bank's EIA methodology¹.

Likelihood \ Severity	Very Unlikely	Unlikely	Likely	Very Likely	Certain
Insignificant					
Minor	LOW IMPACT				
Localised			MEDIUM IMPACT		
Major				HIGH IMPACT	
Catastrophic					

Figure 1: Impact Assessment Matrix

4.2 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Environment Management Plan (EMP) describes both generic good practice measures and site-specific measures, the implementation of which is aimed at mitigating potential impacts associated with the proposed project operations. The EMP is prepared with a view to facilitate effective environmental management of the project, and implementation of the mitigation measures. The environmental management plan presents mitigation measures ensure that negative impacts are reduced to ALARP (As Low As Reasonably Practicable), and meet relevant Omani national laws and regulations, and internationally acceptable standards. The proposed EMP for the construction and the operation of the project includes specific mitigation actions for each adverse impact identified, monitoring program and resource allocation.

4.2.1 CLIMATE AFFAIRS

During the construction phase the major source of GHG (Greenhouse Gas) emissions will be attributed to the movement and operation of the various construction or heavy equipment's. During the operation phase, there will be vehicles using the roads that will generate GHG emission. The release of GHGs into the atmosphere contributes to global warming and consequently increasing the sea level, it is an on-going phenomenon globally, and historic rates are generally estimated to be in the range of 3.2 mm / year (or 0.16 m over 50 years). According to the study by the Arab Forum for Environment and Development, it is expected that only a fraction of the overall land area of the Sultanate of Oman will be impacted due to a 1 m rise in sea levels. It is anticipated, that the project will not be substantially impacted by these threats. The climate change adaptation has been highlighted in the EIA report.

¹ www.worldbank.org

4.3 ENVIRONMENTAL MONITORING PLAN

In order to ensure that the quality of the environment within the work sites complies with the Omani regulations, periodic environmental monitoring will be carried out through a third party environmental consultant. All the monitoring data will be documented by the HSE Manager to demonstrate compliance. The proposed monitoring and auditing plan for the construction phase is presented in Table 1 below.

Table 1: Environmental Monitoring Plan

Environmental Aspects	Scope of Monitoring/Auditing	Method/Requirement	Frequency of Monitoring
Construction Phase			
Air Quality	Ambient PM10 concentrations at several locations within work sites	Using on-site analyzers	Monthly
Noise Levels	Sound pressure levels at several locations within work sites	Using sound pressure level meter	Monthly
Sewage	Quantity of raw sewage disposed from work sites	Volume calculated based on tanker capacity Waste consignment note issued for each transfer	Monthly records to be maintained
Wastes	Quantity of each category of waste disposed from work sites	Volume / weight calculated based on tanker capacity	Monthly records to be maintained
Water	Quantity of potable and non-potable water received at the work site	Volume calculated based on tanker capacity	Monthly
Operation Phase			
Air Quality	Toxic gasses and aerosols in selected points along the road.	Using on-site analyzers	Quarterly
Noise Levels	Sound pressure levels at several locations along the road.	Using sound pressure level meter	Quarterly
Safety System	Road safety system shall be executed within the road 1 and 5	Safety Procedures	Bi-Annual

4.4 POTENTIAL ENVIRONMENTAL IMPACTS DURING CONSTRUCTION AND OPERATION PHASE

The impact ratings along with mitigation measures during the project construction and operation phases are presented in Table-2 and Table-3, respectively. The taxonomy of most of terrestrial ecology species has not yet been assessed for the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List with the exception of a few species which are in the “Least Concern” category. Although the environmental issues arising from the Project activities during construction and operation phase will be less substantive and can be quite minimal. Environmental impacts can be minimised by implementing the suggested environmental management plan. It is recommended that, the sabkha land, drainage pattern, especially near to sea, should be maintained undisturbed both construction and operation periods, to protect conjunction of the lagoon into the sea.

Table 2: Potential Environmental Impacts and Mitigation during Construction Phase

#	Environmental Element	Environmental Aspects	Potential Environmental Impacts	Severity	Likelihood	Impact	Mitigation Measures
1	Natural resources	Consumption of large quantities of construction materials and fuel.	• Depletion of natural resources	Major	Likely	Medium	• Optimizing use of resources through reduction, reuse and or recycle of materials
2	Groundwater / Surface water resources	Spillage / leakages of hazardous material and wastes. Abstraction of groundwater for construction purposes.	• Ground and surface water contamination from accidental spills. • Depletion of water resources.	Major	Likely	Medium	• For hazardous materials and wastes, with spill containment • Avoid storing and disposal in the wadis. • Appropriate storage facilities
3	Land	Improper handling and disposal of hazardous materials and wastes. Ground stabilising works for route passing through sabkha land.	• Land and Sabkha land will get disturbed. • Land contamination from accidental spills.	Major	Likely	Medium	• Spill prevention plan and routine inspection of storage facilities. • If sourcing of water is required for construction, water must be sourced from legal sources with relevant permits. • Minimizing water consumption, and implementing water conservation measures where possible. • Necessary precautions will be taken to protect sabkha lands falling in the routes of road 1 & 5.

#	Environmental Element	Environmental Aspects	Potential Environmental Impacts	Severity	Likelihood	Impact	Mitigation Measures
4	Air quality	Dust emissions from earthworks. Emissions (of NOx, SO2, CO, VOCs, and PM – Particulate Matter) from construction vehicles and equipment, and DG (Diesel Generator) sets. Fugitive VOC emissions from fuel storage tanks	• Deterioration of visibility. • Additional increase to background ambient air quality. • Adverse health effects	Major	Likely	Medium	• Equipment and vehicles required to be properly maintained to control the emissions. • Water spraying for dust suppression during dry weather conditions. • Controlling vehicle speeds within the construction sites and graded roads.
5	Ambient noise	Generation of noise construction vehicles and equipment, and DG sets.	• Increase of ambient noise levels may cause annoyance to local habitats, fauna, and sensitive species	Minor	Certain	Low	• Equipment and vehicles to be properly maintained. • No night time operation of high noise generating construction machinery. • Controlling vehicle speeds. • High noise equipment to be oriented away from receptors. • Ear muffs or ear plugs to be used by all personnel working in the vicinity of noise generating sources.
6	Local infrastructure	Utilization of existing roads, water suppliers, etc.	• Minor stress on current infrastructure	Minor	Likely	Low	• Optimize use of the available infrastructure
7	Public health and safety	Movement of heavy vehicles carrying heavy cargo by road to and from the project site. Improper handling and disposal of hazardous chemicals, wastes and operation of hazardous processes.	• Adverse impacts in case of accidental failures	Major	Likely	Medium	• Prepare and implement a transport / traffic management plan. • Emergency response procedures to be established, response team to be identified and trained. • Appropriate training for the staff on safe handling of hazardous materials and wastes.

#	Environmental Element	Environmental Aspects	Potential Environmental Impacts	Severity	Likelihood	Impact	Mitigation Measures
							Defensive driving methods to be adopted and staff trained on the same.
8	Cultural heritage	Presence and movement of equipment, heavy vehicles, work crew	Damage to the archaeological artifacts	Major	Likely	Medium	- Work crew to be informed of the cultural heritage areas and the need to avoid any damage. - Response procedure in case of accidental damage.
9	Socio-economic	Requirement for construction staff by the EPC contractor and subcontractors. Requirement for local contractors and service providers. Influx of expatriate construction workers.	- Employment opportunities for local people and business opportunities for local contractors and service providers – positive impact. - Impact on the local culture and lifestyles – negative impact.	Minor	Likely	Low	- Engage/ consult with local community/ village heads and conduct project appraisal. - The expatriate construction staff are to be managed appropriately to prevent impact on local culture and lifestyles.
10	Terrestrial/ marine ecology	Site preparation and grading	- Disturbance to terrestrial/marine ecology, or habitat loss to terrestrial/marine ecology. Mainly in sabkha land and lagoon area. - Impact on flora fauna, especially on avifauna in sabkha	Major	Likely	Medium	- Minimize the impact by clearing vegetation only wherever required along working strip (especially Road 1 area). - Minimize extraneous noise sources and use adequate noise attenuation on engines. - Minimize disturbance to the coastal avifauna; minimize the impact on surrounding tidal flat. - Vehicles and machinery used outside of project area shall be cleaned prior

#	Environmental Element	Environmental Aspects	Potential Environmental Impacts	Severity	Likelihood	Impact	Mitigation Measures
			Disturbance to marine fauna in tidal flat/lagoon area				to commencement of work so as to avoid introduction of non-native species into the project area; and Night time driving and off road driving will be restricted to emergencies only.

Table 3: Potential Environmental Impacts and Mitigation during Operation Phase

#	Environmental Element	Environmental Aspects	Potential Environmental Impacts	Severity	Likelihood	Impact	Mitigation measures
1	Air quality	Vehicle and equipment exhausts	Emissions of CO, CO ₂ , NO _x , unburnt HC, and PM	Major	Certain	High	- Sign, and enforce road speed limits where possible. - Regular maintenance of the road.
2	Ambient noise	Generation from vehicular movement	Potential impacts on neighboring residents and sensitive receptors	Major	Certain	High	- Sign, and enforce road speed limits where ever possible. - Regular maintenance of the roads
3	Ecology and wildlife	Air, lighting, and noise pollution	Impact to local flora and fauna	Localized	Very Likely	Medium	- Disturbance to the domestic animals (camels in particular) moving around or grazing will be kept to a minimum. - Accidental injuries or fatalities to these animals will be reported to SEZAD / MECA / ROP / or relevant authorities. - Incoming of animals on to the road will be protected by providing vegetative fencing to divert the animals.
4	Climate	Release of greenhouse gases (GHG) from increased vehicle use	Climate change impacts such as global warming and depletion of ozone layer and consequent changes in wind	Localized	Very Likely	Medium	- Identifying opportunities for enhancing energy efficiency. - Regular maintenance of the roads to prevent idling of vehicles which results in increased generation of GHG.

			patterns, sea level changes, changes to rainfall, floods, etc.				
5	Water Resources	Surface run-off during monsoons. Accidental spills of hazardous chemicals /wastes etc.,	Contamination of water resources	Major	Likely	Medium	• Silt traps shall reduce entering of silt into natural drainage. • Mobile vehicles, shall be provided, equipped with tools to handle hazardous materials whenever accidental spills are happened.
6	Land	Accidental spills of hazardous chemicals /wastes etc.,	Contamination of land(including sabkha land)	Major	Likely	Medium	• Contaminated soil will be collected and sent to hazardous landfill sites.

5 FINDINGS AND CONCLUSIONS

The Project involves the design and construction of Road No. 1 and 5 and the associated drainage systems along these proposed roads, which is a part of developing the road infrastructure works in the SEZD area.

It is evident that road construction project usually changes existing drainage pattern, however Parsons, as design and Project Management Contractor (PMC), will ensure that existing drainage will be maintained in their designing and be checked during PMC.

The proposed Project site is located near to the long crenulated bay (Ghubbat Quwayrat bay) in the northern area of the Duqm port (lee breakwater). Intertidal lagoon at the liquid jetty end of the Road No. 5 in project site is the most important area to protect existing environment. The proposed Road 5 alignment will block the tidal flux in the lagoon area and will affect the faunal distribution in this tidal flat area.

There will be insignificant or no-land use conflict with the local communities during both construction and operation phase of the Project. The nearby Duqm settlement will not be impacted by site preparation activities and movement of vehicles, especially the heavy vehicles during the construction phase. In addition, there will be no relocation or displacement of the local population. T

he Project is unlikely to have a major impact on the floral conservation and distribution of the region. However, the Ministry through the enactment of Royal Decree on environmental conservation and pollution prevention (RD 114/2001) emphasizes the need to conserve soil and combat desertification (Article 21) and does not allow cutting down or uprooting trees, shrubs or grass until a valid permit is obtained. Considering the overall SEZAD region, the Project area is a small fraction of the overall area and does not pose a risk to any of the plant species as part of the development of the roads Project.

Environmental impacts can be minimized by implementing the suggested environmental management plan. It is recommended that, the sabkha land, drainage pattern, especially near to sea, should be maintained undisturbed both construction and operation periods, to protect conjunction of the lagoon into the sea. The environmental issues arising from the Project activities during the operation phase will be less substantive and can be quite minimal.

The proposed EMP for the construction and the operation of the project includes specific mitigation actions for each adverse impact identified, monitoring program and resource allocation. Efforts have been made to provide mitigation measures commensurate with assessed level of risk e.g. low, medium and high. This EMP aims to feed directly into an HSE management system to be implemented by the construction contractor (KAS) as well as Parsons (PMC).