

Technical Report

Cumulative Impact Assessment, Resource Efficiency, and Pollution Prevention Guideline

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TECHNICAL REPORT

Cumulative Impact Assessment, Resource Efficiency, and Pollution Prevention Guideline

Issue and Revision

Rev	Date	Prepared by	Checked by	Approved by	SEZD Review
R1	10.05.2020	CTEC			
R2	20.07.2020	CTEC			
R3	18.10.2020	CTEC			

Abbreviations

AF	Associated Facilities
BAT	Best Available Technology
BTEX	Benzene Toluene Ethyl-benzene Xylene
CEMP	Construction Environmental Management Plan
CIA	Cumulative Impact Assessment
СО	Carbon Monoxide
CO2/CO2e	Carbon di Oxide/Carbon di Oxide equivalent
CTEC	Civil Technology Engineering Consultancy
dB	Decibels
DG	Diesel Generator
DLBB	Duqm Liquid Bulk Berth
DPTC	Duqm Petroleum Terminal Complex
E&S	Environment and Social
EIA/ESIA	Environmental Impact Assessment/Environmental and Social Impact Assessment
EIP	Eco-Industrial Park
EP	Equator Principles
EPC	Engineering Procurement and Contracting
ESAP	Environmental and Social Action Plan
ESDD	Environmental and Social Due Diligence
ESG	Environment Social Governance
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management Plan
GHG	Green House Gases
GIIP	Good International Industrial Practices
GRI	Global Reporting Initiative
H_2S	Hydrogen Sulphide
На	Hectares
IFC	International Finance Corporation
IPCC	Intergovernmental Panel for Climate Change
IREP3	Integrated Resource Efficiency and Pollution Prevention Programme

ISID	Inclusive and Sustainable Industrial Development
ISO	International Organisation for Standardisation
Km/Km ²	Kilometre/Kilometre Square
KPIs	Key Performance Indices
MHC	Ministry of Heritage and Culture
MIGA	Multilateral Investment Guarantee Agency
NH ₃	Ammonia
NO	Nitrogen Oxide
O ₃	Ozone
PEIA	Preliminary Environmental Impact Assessment
PM	Particulate matter
PS	Performance Standards
RAECO	Rural Areas Electricity Companies SAOC Oman
RD/MD	Royal Decree/Ministerial Decision
RECP	Resource Efficient and Cleaner Production
SDG	Sustainable Development Goals
SEP	Stakeholder Engagement Plan
SEZ/SEZD	Special Economic Zone/Special Economic Zone at Duqm
SEZAD	Special Economic Zone Authority at Duqm
SO_2	Sulphur di Oxide
SPR	Source-Pathway-Receptor
TPD	Tonnes Per Day
UNIDO	United Nations Industrial Development Organisation
VEC	Valued Environmental and Social Components
VOC	Volatile Organic Compounds
WB	The World Bank
WHO	World Health Organisation
ZOI	Zone of Influence

SEZD Duqm

Executive Summary

OPAZ/SEZD manages, regulates, and oversees the development of all economic activities in the SEZ at Duqm. It is executing the construction of seven sub-projects that form enabling infrastructure to the Port, the Refinery, and the wider SEZ area. OPAZ/SEZD is being supported by MIGA to secure the financing of the seven sub-projects. In August 2020, the Government of Oman issued RD 105/2020 establishing the Public Authority for Special Economic Zones and Free Zones (OPAZ) which transferred the allocations, origins, rights, obligations, and assets of SEZAD, which was the name of the earlier authority for SEZD, to this new Authority. In this report, all references to SEZAD should be construed as referring to OPAZ.

As part of the Lender's requirements, SEZD has carried out this Cumulative Impact Assessment, Resource Recovery and Pollution Prevention study. This CIA study identifies mitigation and enhancements that should be put in place by SEZD as part of their development to prevent or reduce adverse cumulative impacts.

In view of the complex and long-term nature of the Government-led strategic development of the economic area of Duqm, it also identifies mitigation and enhancement measures which fall outside of SEZD immediate influence and responsibility. These measures include those that should be implemented by organizations such as SEZD and/or other proponents involved in the development and operation of facilities, initiatives and programmes of work in Duqm.

The scope entailed review of available information pertaining to the study area including ESIA studies, baseline studies and other relevant environmental reports for the SEZ. The assessment was conducted in accordance with IFC/WB guidelines for CIA and also concepts of UNIDO's Eco-Industrial Park were considered in preparation of the study. The man steps are described briefly below:

- Step 1: Phase 1 scoping this entailed identifying the various VECs of the project and establishing spatial and temporal boundaries. This stage included collecting existing information such as physical environment, biodiversity, ecosystem services, social and cultural aspects; and differentiating the land-use at the SEZ into light, heavy, tourism, township, logistics, fisheries, etc. Subsequently, a ZOI with respect to the VECs were defined for the assessment.
- Step 2: Phase 2 scoping this entailed establishing other activities and environmental drivers. VECs were screened in terms of the natural and social influences of the SEZ area.
- Step 3: Baseline of VECs once the VECs were identified and defined, the baseline status of the same were determined. This predominantly entailed review of existing information and reports available with SEZD with limited field visits to validate the existing information.

- Step 4: Cumulative impacts of VECs this step takes into consideration all the VECs (e.g., natural resources, physical environment, topography, biodiversity, culture/heritage and community health) and uses the IFC/WB guidelines on CIA to conduct the impact assessment of the projects on these VECs during the construction and operations phases taking into account the ZOIs.
- Step 5: Significance of cumulative impacts this entailed rating the impacts as low, moderate or high as per the impact assessment matrix. The summary is presented in the table below.

VEC	VEC Receptor	Sensitivity/ Value	Magnitude - Construction	Magnitude - Operation	Significance - Construction	Significance - Operation
Ecosystems	Natural capital	Low/High	Low	Low	Negligible	Negligible
Natural resources	Land use	Low/Low	N/A	N/A	Minor	Minor
Physical	Air quality	High/Low	Medium	Low	Minor	Minor
Environment	GHGs	High/High	Very Low	Very Low	Negligible	Negligible
	Noise	Medium/ Low	Low	N/A	Negligible	Negligible
	Groundwater	High/ Low	Very Low	Very Low	Negligible	Negligible
	Soil	Very Low / Very Low	N/A	N/A	Negligible	Negligible
	Surface water quality freshwater/ marine)	High / Medium	Very Low	Very Low	Negligible	Negligible
	Topography / Landscape	Low / Medium	Low	Low to Medium	Negligible to Low	Negligible
Biodiversity	Marine habitats, flora and fauna	Appendix I	Appendix K	Appendix L	Appendix K	Appendix L
	Terrestrial habitats, flora and fauna	Appendix I	Appendix K	Appendix L	Appendix K	Appendix L
Socio- economics	Resident population	High / Medium	Medium	Medium	Minor	Minor
	Local business / economy	Low / High	Medium	Low	Minor (Positive)	Minor (Positive)
	Road traffic / transport	Low / Medium	Medium	Negligible	Minor	Minor
	Local infrastructure	Medium / Medium	Medium	Negligible	Minor	Minor

Minor

Minor

Negligible

Minor

Minor

Negligible

VEC	VEC Receptor	Sensitivity/ Value	Magnitude - Construction	Magnitude - Operation	Significance - Construction	Significance - Operation
Community and Health	Air Quality – community	High / High	Medium	Medium	Minor	Minor
	Noise – community	Medium / Low	Low	N/A	Negligible	Negligible
	Traffic – community	Low / Medium	Medium	Medium	Minor	Minor

N/A

Medium

Medium

Low /

High /

Medium

Archaeology and High / High

Medium

•	Step 6: Management of cumulative impacts - this entailed recommending
	mitigation measures for potential impacts of VECs rated moderate/medium or
	higher and also discusses the residual impacts.

N/A

Low

Low

- Step 7: Resource efficiency and pollution prevention this includes a • discussion on Good International Industrial Practices for ensuring minimizing waste and efficient use of resources for SEZD and its tenants. The section also provides an implementation framework for achieving resource efficiency and pollution prevention goals.
- Step 8: Implementation model this section discusses the timeline for roll out of the implementation model for bringing along the key drivers of CIA which manifest specifically in terms of Integrated Resource Efficiency and Pollution Prevention Programs (IREP3) and continuous improvement through 3Rs reduce, reuse, and recycle strategies. The discussion further presents an approach for mapping international sustainability standards and KPIs into IREP3 for large industrial facilities and commercial/hospitality developments with SEZD providing overall governance to enable the sustainability concepts of industrial ecology and built environments embedded are and institutionalized in the management systems.

Appendices F through L present the details of the VEC sensitivities, impact significance and recommendations for identified impacts.

Cultural

Heritage

Visual amenity

cultural heritage

Culture

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1 INTRODUCTION

On August 18, 2020, the Government of Oman issued Royal Decree No. 105/2020 establishing the Public Authority for Special Economic Zones and Free Zones (OPAZ). This Royal Decree (RD) transferred the allocations, origins, rights, obligations, and assets of the Special Economic Zone Authority at Duqm (SEZAD)¹ to this new Authority. Accordingly, the Special Economic Zone at Duqm (SEZD) becomes part of the Public Authority for Special Economic Zones and Free Zones.

The SEZD manages, regulates, and develops all economic activities in Duqm. With a land area of 2,000 km2 and 90 km of coastline along the Arabian Sea, the Duqm SEZ is the largest in the Middle East and North Africa region and ranks amongst the largest in the world

OPAZ/SEZD is executing the construction of a Project consisting of seven Sub-Projects listed below, which form enabling infrastructure to the Port, the Refinery and the wider Special Economic Zone at Duqm. These Sub-Projects are at different stages of execution with an average 77% level of completion as of January 2019.

As part of Project financing, the Lenders' Independent Environmental Consultant has provided environmental and social action plan. This plan has identified a number of areas in various EIA and ESIA reports for discussed 7 MIGA project which requires, additional documentation that will supplement and/or enhance the reports and have a Cumulative Impact Assessment (CIA) report which will bring them up to Lender standards, including the need to provide this report as CIA.

Data and Information for this CIA has been collated from previous Environmental Impact assessments (EIA)s prepared for Funded Projects in line with Omani national requirements and from individual EIA/ESIAs for the associated facilities. Furthermore, the CIA is supplemented with the data related to third party projects that are being planned and/or underway but for which no publicly-available reports are yet available.

OPAZ/SEZD is being supported by the Multilateral Investment Guarantee Agency ("MIGA"), to secure the financing of the seven (7) Sub-projects, through the Ministry of Finance. The list of seven sub-projects and their current stage of execution is summarized in Chapter 2 of this report.

As part of the Lender's requirements, SEZD had carried out environmental and social due diligence (ESDD) of this Project and a detailed ESDD report and associated environmental and social action plan (ESAP) has been developed to be implemented by SEZAD in relation to the seven Sub- Projects and the zone-wide environmental responsibilities of SEZD.

¹ SEZAD was established by the Government of the Sultanate of Oman through Royal Decree No. 19/2011 as an authority to manage, regulate and oversees the development of all economic activities in the Special Economic Zone at Duqm. This RD has been superseded by RD 105/2020 with the establishment of OPAZ which takes over the role of regulating and managing all the free zones in the Sultanate.

SEZD through tendering has appointed Civil Technology Engineering Consultancy (CTEC) vide contract no. C116/2019 to assist in fulfilling certain requirements under ESAP in accordance with the relevant IFC Performance Standards on Environment and Social Sustainability and Omani regulations, whichever is more stringent, and to the satisfaction of SEZD and the external auditor acting on behalf of MIGA and lending institutions. CIA has information comprising environmental and social assessment documentation in order to provide a holistic summary of all 7 MIGA funded projects. This CIA is supplemented with technical reports/guidelines including updated and new Management Plans and this CIA.

1.1 Objective of the Report

Based on the scope specified by SEZD in the tender document (reference T-13/2019), the main objectives as part of the scope of work include preparation of the following:

- Cumulative Impact Assessment (CIA) for the SEZD area and developing a management framework for OPAZ/SEZD for future projects;
- Resource efficiency and Good International Industry Practice (GIIP) guideline; and
- Pollution Prevention guideline.

Based on IFC guideline and the scope presented following are the objectives to be achieved for the reporting requirements to show compliance to Lenders consultants:

- Assess the potential impacts and risks of a proposed development over time, in the context of potential effects from other developments and natural environmental and social external drivers on a chosen VEC;
- Verify that the proposed development's cumulative social and environmental impacts and risks will not exceed a threshold that could compromise the sustainability or viability of selected VECs;
- Confirm that the proposed development's value and feasibility are not limited by cumulative social and environmental effects;
- Support the development of governance structures for making decisions and managing cumulative impacts at the appropriate geographic scale (e.g., airshed, catchment, town, regional landscape);
- Ensure that the concerns of affected communities about the cumulative impacts of a proposed development are identified, documented, and addressed; and
- Manage potential reputation risks.

Furthermore, a framework guideline will be developed for SEZD in accordance with IFC/World Bank performance standards that will be utilized for implementation within SEZD for its business operations.

This CIA report mainly focusses on the cumulative effects of & MIGA funded projects and associated facilities for which EIAs are available.

1.2 Previous EIA/ESIA reports

Following are main sources of information for drafting this CIA included the 7 projects that have been commissioned/ will be commissioned:

- Preliminary Environmental Impact Assessment Study (PEIA). Commercial, Governmental Berths and Pre-Gate and Inspection Zone. K&A Consultants S.A.E. March 2015
- Construction Environmental Management Plan (CEMP). Construction of Roads, Infrastructure and Buildings at the Commercial Pre-Gate, Gates and Inspection Zone –IP3. Contract C50/2015. Five Oceans Environmental Services. Oct 2016. 2nd revision Feb 2017
- Environmental Impact Assessment Report. Duqm Liquid Bulk Berths Project. WorleyParsons Oman Engineering LLC. Sep 2015
- Duqm Liquid Bulk Berths Project. Addendum to Initial Environmental Permit (IEP) for Onshore Disposal. Boskalis Duqm LLC. June 2017
- Construction Environmental Management Plan. Duqm Liquid Bulk Berths Project. Boskalis Duqm LLC. May 2017
- Design of Road Nos. 1 and 5 and Drainage Systems, Duqm. EIA Report. HMR Environmental Engineering Consultants. April 2017
- Duqm Development Drainage Network and Protection Schemes Phase 1. EIA for Saay Dam, Saay Channel, Jurf Channel and Channel Junction. Renardet S.A and Partners Consulting Engineers LLC. July 2015
- Duqm Development Drainage Network and Protection Schemes Phase 1. ESIA for Jurf Dam. Renardet S.A and Partners Consulting Engineers LLC. June 2015
- EIA report for Service Corridor, Duqm. HMR environmental engineering consultants. July 2015
- Port of Duqm Phase 1 Operational Environmental Impact Assessment. Three Volumes. Haskoning DHV UK Ltd. Oct. 2016
- Port of Duqm Oil Spill Contingency Plan. Oman Pesco LLC, March 2017
- Medium Industrial Zone Environmental Impact Assessment. Volume I: Non-Technical Summary. Haskoning DHV UK Ltd. Mar 2017
- Duqm Refinery Project Oman. Environmental and Social Impact Assessment nontechnical summary. WSP. Dec 2017
- Duqm Refinery Project Oman. Consolidated Impact Assessment and Mitigation Report with appendices. WSP. Dec 2017
- Duqm Refinery Project Oman. Cumulative Impact Assessment. WSP. Dec 2017
- Duqm Refinery Grievance Management Procedure. Sep 2017

1.3 Content of CIA

This CIA has utilized both information, including baseline data, contained in the portfolio of earlier prepared Project EIAs and knowledge gained from literature review, surveys, observations and assessments as part of meeting and site visits conducted by CTEC. As per project understanding and in consultation with SEZD, CTEC has validated the data present in various EIA projects and other available reports, and it was decided not to conduct any primary environmental baseline data collection. Available information provides necessary data and features of the Project to be accounted for and ensure the appropriate mitigation recommendations are made.

This CIA study identifies mitigation and enhancements that should be put in place by SEZD as part of their development to prevent or reduce adverse cumulative impacts. In view of the complex and long-term nature of the Government-led strategic development of the economic area of Duqm, it also identifies mitigation and enhancement measures which fall outside of SEZD immediate influence and responsibility. These measures include those that should be implemented by organizations such as SEZD and/or other proponents involved in the development and operation of facilities, initiatives and programmes of work in Duqm.

1.4 Structure of ESIA

This Report includes a summary of the previous EIAs work and all new activities that together constitute a robust baseline. The work documented in this Report focusses on the assessment of the identified environmental and socio-economic impacts associated with the Projects.

Chapter	Chapter Name	
Chapter 1	Introduction	
Chapter 2	Projects and its Description	
Chapter 3	CIA and Guidelines Methodology	
Chapter 4	Step 1 - Scoping Phase I	
Chapter 5	Step 2 - Scoping Phase II	
Chapter 6	Step 3 - Establish VEC Baseline Information	
Chapter 7	Step 4 - Cumulative Impacts on VECS	
Chapter 8	Step 5 - Assessment of Predicted Cumulative Impacts on VECS	
Chapter 9	Step 6 - Management of Cumulative Impacts	
Chapter 10	Conclusions and Recommendations	
Chapter 11	Guideline for resource efficiency and pollution preventions	

Table 1-1: Structure of the Report

Chapter Chapter Name

Appendices

References

2 PROJECT DESCRIPTION

2.1 Introduction

The SEZ at Duqm is located on the south eastern coast of Oman and is managed by the SEZD. The Duqm SEZ covers an area of approximately 40,000 hectares (Ha). The masterplan sets out the preferred approach for land use and infrastructure planning for the Duqm SEZ. The proposals include the development of an airport, port and related facilities (established and operational), tourism area, industrial zone (see red and light pink shading in figure below) and a commercial and residential area. A schematic of the Duqm SEZ showing broad development categories is shown in Figure 2-1 below while an interactive map, showing each development type and the entire SEZ boundary, can be found at the website of OPAZ/SEZD (http://www.duqm.gov.om/duqm-sez/interactive-map).



Figure 2-1: Schematic of Duqm SEZ

The development of the overall area will be undertaken in phases. It is proposed that Phase 1 development will take place within the next one to five years. The first phase of work will include the development of the following aspects:

- Key major utilities and infrastructure;
- Anchor industries, such as oil refinery and petrochemicals, cement industry, glass industry, soda ash and basalt;
- Logistics and warehouses and business park in the Free Trade Zone;
- Fisheries and Aquaculture related industries;
- Residential areas; and
- Non-industrial land uses.

These developments may not be fully developed in this phase and will be expanded during the following phases. The subsequent Phases 2 and 3 will also see the development of further industries in the area, including clean technology, food and beverage, metal, automotive, industrial logistics and life sciences. The timeframe proposed for the construction of Phases 2 and 3 is between six and 15 years from the commencement of development in the area.

The Duqm SEZ forms part of a wider master planning exercise, with the long-term intention to establish a sustainable economic hub at Duqm. This includes aims to develop a petroleum refining and petrochemical base, representing the first major industrial development in the area.

2.2 MIGA funded Projects

This CIA report mainly focuses on the MIGA funded projects and its associated facilities. The main MIGA funded projects for OPAZ/SEZD comprise of the projects mentioned in the Table 2-1.

Project #	Contract No.	Project Description
1	IP3 - Contract C50/ 2015	Construction of roads, buildings and additional infrastructure at the commercial pre-gate, gates and inspection zone of Port of Duqm.
2	IP7 - Contract C78/2017	Design, procurement and construction of the marine structures and associated berths, dredging works and permanent reclamation areas of liquid bulk berths in the Port of Duqm.
3	Contract C81/2017	Construction of Road No. 1 and Road No. 5 to link the Liquid Berth Terminal at Duqm Port to the Heavy Industrial Zone and drainage systems along the two roads.
4	Contract C65/2016	Construction of Jurf and Saay flood protection channels in Duqm.
5	Contract C76/2016	Construction of Jurf and Saay flood protection dams in Duqm.
6	Contract C80/2017	Engineering, procurement and construction of Duqm Refinery service corridor to liquid jetty.

 Table 2-1: MIGA Funded Project

7	Contract C73/2016	Construction of interface roadway projects in Duqm (Road Section 4).

Figure 2-2 shows the locations of the funded project, which are discussed in subsequent section of the CIA report.



Figure 2-2: Location of MIGA Funded Projects

2.3 Associated Facilities

As most of the mentioned projects are infrastructure projects and mainly are standalone projects like roads, Dams and flood protection channels. There are minor associated facilities (AFs) have been identified as third-party facilities that will further supplement to IP7 projects i.e., Duqm Liquid Bulk Berth (DLBB) project. According to the IFC guidance, such amenities – while not funded as part of the Project – would not be constructed or expanded without the Project, and without which the Project would not be viable. It should be noted that that DLBB project itself is MIGA funded project and will not be considered as associated facility.

2.4 Seven MIGA Funded Projects

Following section of this CIA report provides brief description of each projects that is part of MIGA funding (this information is based on the respective EIA report of the project). Most of these projects are planned in the early stage of the Duqm SEZ development and almost all these projects are complete. Due to requirement of the infrastructure project sites undergone site preparation, construction and subsequent operations – cutting/blasting, levelling, compacting, dewatering, backfilling, excavation and construction for the 7 projects were carried independently by assigned contractors. Marine works entailed dredging, backfilling, dewatering, offshore disposal of sediments, erection of quay walls, breakwaters, casting of berths, portside infra, etc. Within 15,000 where these 7 projects are substantially completed, describe what has been lost - cumulatively, MIGA projects have directly/indirectly impacted 253 Ha of Birding Area, 169 Ha of Wadi Habitat, and 1,631 Ha of Sabka Wetlands.

Out of SEZD area of 177,688 Ha, master-planned (MP) area is about 23% or 40,838 ha. So, from a cumulative impact assessment standpoint, there are 4 parts:

- Part A the 7 MIGA funded port, road & drainage (PRD) infra projects sit on 10,000 ha or 25% of the master-planned area
- Part B the industrial area sits on 15,000 ha or 36% of which heavy industrial (HI) is 6,540 ha, medium industrial is 5,245 ha and light industrial (LI) is 3,156 ha. Presently, only DRPIC in HI is under construction on 900 Ha or 2.2% of the MP area. Similarly, MI and LI may have <5% of area under construction or development.
- Part C The remaining master-planned area of 15,000 Ha is for residential, tourism, commercial, buffer, airport, fisheries, etc., which are de minimis impacts.
- Part D Rest of SEZD area that is not master-planned and will be mostly left 'as-is' – this is about 136,000+ HA and is 3/4th of the allocated area, which has most of the sparse settlements of Al Wusta that supports native Omani tribes and their traditional livelihood.

Brief project description on these MIGA funded projects is provided in Appendix A. It should be noted that the associated facilities and the third-party project that are considered in the CIA is discussed in Appendix D to Appendix F.

3 METHODOLOGY CIA

While the impacts of an individual project may be judged to be acceptable, there is also a need to consider the potential for a project's impacts to interact with impacts associated with other developments - so called 'cumulative' impacts.

This chapter presents a cumulative impact assessment (CIA) of the Projects. The sections herein present details of applicable CIA guidance, the adopted CIA methodology, CIA scoping, and impact assessment. The CIA takes account of planned and reasonably defined developments in the vicinity of the Project.

3.1 Definitions

International Finance Corporation (IFC) Performance Standard (PS) 1, defines cumulative impacts as:

"Impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted".

The impacts of the Projects thus need to be considered in conjunction with the potential impacts from other future developments or activities that are planned and reasonably defined and are located within a geographical scope where potential environmental and social interactions could act together with the Projects to create a more (or less) significant overall impact.

3.2 CIA Guidance

3.2.1 International Finance Corporation (IFC) Guidance

IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts (Ref. 14.1) recognizes that in some instances, developers need to consider cumulative impacts in their environmental and social impact and risk identification and management process.

PS1 states that the impact and risk identification process:

"...will take into account the findings and conclusions of related and applicable plans, studies, or assessments prepared by relevant government authorities or other parties that are directly related to the project and its area of influence" including, "master economic development plans, country or regional plans, feasibility studies, alternatives analyses, and cumulative, regional, sectoral, or strategic environmental assessments where relevant".

Furthermore, it goes on to state that:

"The client can take these into account by focusing on the project's incremental contribution to selected impacts generally recognized as important on the basis of

scientific concern or concerns from the Affected Communities within the area addressed by these larger scope regional studies or cumulative assessments".

In order to provide guidance on undertaking a CIA, IFC released a guidance note in August 2013 titled Cumulative Impact Assessment and Management – Guidance for the Private Sector in Emerging Markets (Ref. 14.2). This guidance note uses the concept of Valued Environmental and Social Components (VECs), these being environmental and social attributes that are considered to be important in assessing risks, which can include:

- Physical features;
- Wildlife populations;
- Environmental processes;
- Ecosystem conditions (e.g. biodiversity);
- Social conditions (e.g. health, economics); and
- Cultural aspects.

The methodology in this CIA has been based on the principles of the IFC guidance, which sets out a six-step structure (i.e. the foundation) for conducting a comprehensive CIA, with the objectives from each step presented in Figure 3-2. IFC guidance document has been followed where applicable. The IFC methodology has been adapted to accommodate project / regionally specific items Where there are deviations from the guidance – because of the particular specifications of the Project and associated facilities – or lack of information about third party other projects/initiatives in the Duqm area, then the reasons are stated. The assessment was adapted and modified throughout the course of compiling the CIA.

The Report's sections which follow, present the findings of the six steps for the assessment of the cumulative impacts upon the relevant VECs of the Project The guidance note provides a six-step process for assessing the potential for cumulative impacts upon VECs as follows:

- Scoping Phase I identifying VECs, spatial and temporal boundaries;
- Scoping Phase II other activities and environmental drivers;
- Establish information on the baseline status of VECs;
- Assess cumulative impacts on VECs;
- Assess significance of predicted cumulative impacts; and
- Management of cumulative impacts design and implementation.

This CIA has used the guidance note as a framework for assessing potential cumulative impacts associated with the Project and from other 'reasonably defined developments.

3.2.2 The Equator Principles (EP)

The Equator Principles (EP) (version III, June 2013) is a recognized framework which promotes developments to be socially responsible and incorporate comprehensive environmental practices. The EPs refer to the IFC Sustainability Framework and its Performance Standards. The EP further highlights the value of conducting a CIA, referencing cumulative impacts of the proposed, existing and anticipated projects to be considered; especially those that are of scientific concern or that affect the communities within the area under influence.

3.2.3 UNIDO Eco Industrial Guidelines

he United Nations Industrial Development Organization (UNIDO) has published the International Guidelines for Industrial Parks providing step-by-step advice on the planning, development and operation of industrial parks for different stakeholders, including industrial park regulators, developers, operators, tenants, partners (such as multilateral development agencies) and financial institutions. The Guidelines are relevant to both existing and new industrial parks in various international contexts, with a focus on the needs and challenges that developing countries and middleincome economies face.

The publication was launched during the side-event on industrial parks, which took place on 6 November 2019, in Abu Dhabi, on the sidelines of eighteenth session of UNIDO's General Conference. It builds on UNIDO's extensive experience in promoting the establishment of industrial parks, export processing zones, special economic zones and eco-industrial parks around the world to support sustainable growth through industrial development. The Guidelines were developed to help countries benefit from UNIDO's expertise in capacity-building and technical assistance different industrial park development. at stages of (https://www.unido.org/news/unido-publishes-international-guidelines-industrialparks)

3.3 CIA Methodology as per IFC Guidelines

The CIA methodology adopted has been defined taking into account the six-step process as detailed in the IFC guidance note referred to above, and has comprised the following:

- Scoping Phase I: This will entail defining which VECs need to be included within the CIA taking into account the characteristics of the Project and the prevailing environmental and social conditions within areas that are potentially impacted by the Project. The VEC identification process will be assisted through the completion of engagement activities with applicable stakeholders. This phase of the assessment has also required setting temporal and spatial boundaries of the CIA for specific VECs;
- Scoping Phase II: This will require the identification of other projects or human activities that could potentially impact upon defined VECs that could result in

cumulative impacts. An analysis will be undertaken which aims to define those development projects that are scoped into the CIA given their potential ability to generate a cumulative impact associated with the Project (due to temporal or spatial interactions with the Project);

- *Establish Information on the Baseline Status of VECs:* Defining the baseline characteristics of VECs is an important stage in the CIA process, as this identifies their sensitivity to change. Note that relevant baseline information will be collated from the ESIA reports of the 7 project and associated facilities;
- Assess Cumulative Impacts Upon VECs: Taking into account the Project's predicted impacts upon identified VECs, an assessment will be undertaken to evaluate the ability of the Projects to interact with other planned or reasonably defined developments in such a manner that gives rise to a cumulative impact (where the temporal and spatial influences may coincide). Note that the assessment will only considers the residual impacts arising from the Projects (i.e. impacts following the application of mitigation measures as detailed in this ESIA Reports). It follows that the chapter only considers those VECs that will experience any degree of residual impact associated with the Projects.;
- Assess Significance of Predicted Cumulative Impacts: Significant cumulative impacts will be evaluated as far as possible using the significance matrix (discussed in detail later in the report). Note that this will only be possible where the magnitude of impacts is capable of definition, for example, through readily accessible documents (e.g. other EIA or ESIA reports or project documentation). Where such information is not available, the assessment of potential cumulative impacts has been qualitative, and has relied on professional opinion using the impact significance definitions. The assessment has not considered unplanned events; and
- Management of Cumulative Impacts Design and Implementation: Should the CIA indicate that there is a potential cumulative impact which is of moderate or high significance, the need for additional mitigation or management actions (or monitoring) beyond those which are targeted at Project-induced impacts as reported within the respective ESIA Reports, will be specified.

Figure 3-1 illustrates the CIA logical framework, which is an iterative six-step process: scoping (Steps 1 and 2), VEC baseline determination (Step 3), assessment of the contribution of the development under evaluation to the predicted cumulative impacts (Step 4), evaluation of the significance of predicted cumulative impacts to the viability or sustainability of the affected VECs (Step 5), and design and implementation of mitigation measures to manage the development's contribution to the cumulative impacts and risks (Step 6).





Figure 3-1: CIA Framework

Steps that will be followed in the CIA and objectives that will be achieved through each step is provided in the Figure 3-2. It should be noted that the CIA methodology is based on the IFC guideline "*Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets*".



Figure 3-2: IFC (2013) CIA Guidance Process

4 SCOPING PHASE I: VECS, SPATIAL AND TEMPORAL BOUNDARIES

As mentioned earlier the CIA is based on the IFC guidelines and the initial phases are critical to the CIA, as it establishes the scope of the cumulative impact analysis and allows the context to be appropriately classified.

This phase of CIA establishes the dimensions (VECs of concern, spatial and temporal assessment scales) of the cumulative impact study, in addition to outlining an appropriate strategy for identifying the pressures from activities other than the proposed development. The outcome of such an early considerate analysis can mitigate the consequences of uncertainty and subsequently allow the cumulative impact management process to anticipate different future scenarios.

4.1 VEC Identification

The ESIA Reports considers the potential Project impacts across a range of VECs. These VECs have been defined by taking into account the prevailing environmental and social conditions in the Project Area, and the ability of the Project to impact upon these resources (during all Phases of the Project, decommissioning impacts will be similar to the construction impacts so it is not discussed separately in the report). Consultation with SEZAD paved path for understanding the environmental and social resources— stakeholder engagement activities are detailed in stakeholder engagement plan. (Document Ref. **SEZAD-SEP-PLN-001-01**)

VECs that have been considered for CIA comprise the following:

- Physical features (i.e. non-living environmental components, including air quality and marine sediments and geology);
- Wildlife populations;
- Environmental processes;
- Ecosystem conditions (e.g. biodiversity);
- Social conditions (e.g. health, economics); and
- Cultural aspects.

Identification of the VECs for which cumulative impacts was assessed and managed, and the spatial and temporal boundaries for the assessment are demarcated. The tasks carried out at this stage are to identify:

- The VECs to be included in the CIA;
- The spatial boundaries of the CIA; and
- The temporal extent of the CIA

The VECs in CIA is collated from information within the original EIAs for the MIGA Projects as well subsequent information available from the preparation of the ESDD.

Specialists contributing to the CIA had also visited Duqm as part of collating the enhanced baseline data sets and extensive visual observations. Opportunities to talk to a wide range of DRPIC staff and meet with SEZD staff were also taken.

Priority was given to those VECs that are likely to be at the greatest risk from the development's contribution to cumulative impacts. CIA considered those VECs that will be impacted by the Project with any degree of residual impact thus VECs for which there is an impact that is deemed to be not significant is scoped out of this CIA.

CTEC also identified all masterplanning and landuse studies conducted by SEZD during the planning stages to develop an inherently sustainable economic zone. The individual development zones of heavy, light, logistics, tourism, township, fisheries, etc have been planned with setbacks and buffers which ensure that any adverse impacts are minimized and localized within the footprint with buffer areas serving as further safeguards. Where the Project residual impact significance is defined to be **Low, Moderate** or **High**, the applicable VEC's are scoped into the CIA.

The collated VECs are presented in Appendix A of this report. These VECs and their justification for inclusion is presented in Appendix A of this report. Detailed Biodiversity Assessment undertaken by CTEC in 2020 to fill in the gaps in the previous baseline studies has identified VECs that will need to be considered under multiple sensitivity levels and may require a diverse range of mitigation.

4.2 Temporal and Spatial Boundaries

The temporal boundary of the CIA includes the Project Construction and Pre-Commissioning Phase and into the Operational Phase. However, the degree of uncertainty increases the further into the future the assessment extends. Potential cumulative impacts during the Decommissioning Phase will be similar to that of the construction phase and has not been discussed separately in the report. Remediation post decommissioning would be the difference and would require development of specific programmes, which need to be prepared at the later stage of the projects.

The spatial or geographic boundaries of the CIA will be defined taking into account the Project characteristics and the assessment areas applied to defined VECs as included within the various technical assessments within respective ESIA Report. A flexible approach has been maintained, such that the boundaries of the assessment vary depending upon the characteristics of the potentially impacted VEC. The geographic boundary thus varies from the space occupied by a small VEC feature (e.g. a discrete feature of cultural heritage value) to a large geographic region or habitat within which a particular VEC occurs (e.g. habitat occupied by a protected species). The spatial extent of relevant VECs will be detailed in the CIA Report.

A determination of the 'study area' or Zone of Influence (ZOI) will be undertaken for each of the identified VECs in order to identify the spatial boundary within which other projects and their potential cumulative impacts will be considered. This will be produced by carrying out a "Source- Pathway-Receptor" screening (SPR) to ascertain the likely spatial extent over which they may interact in order to provide a geographical constraint to selection of 'other' projects.

The ZOI differs topic by topic, and can be highly variable for receptors depending on their spatial location. The proposed ZOI for the various VECs are presented in Appendix C.

Specific ZOIs are not stated in the guidance; therefore, justification has been provided over the assigned ZOIs where appropriate. The proposed ZOI justifications are presented in Appendix C of this report. The maximum assigned ZOI for various parameters i.e., air, marine, groundwater, noise, soil, surface water, topography/landscape, archaeology, community/asset, noise community, resident population, transport and terrestrial flora, are presented diagrammatically in Figures 4-1 through 4-13 respectively.

The design operational life period for the all projects is 40 years, with predicted full operation commencing at the end of 2022 and activity continuing until 2062.

CTEC has provided the impacts assessment beyond that is mentioned in CIA guideline by providing a way forward to cope up and provide realistic qualitative assessment as the projects developed wide Duqm SEZ area. This assessment is conducted with certain assumptions and based on information available and pure judgement of consultant and are subject to change. And similarly, for such instances a high-level mitigation is suggested in Section 9.3 of this report. Based on the experience and conducting various EIA and baseline in the region CTEC has proposed 2 scenarios:

<u>Current Scenario:</u> This is for the known and projects in the pipeline, where cumulative impact is assessed based on the all 7 MIGA funded projects + Third party Projects and future projects in pipeline + external impacts – climate change, extreme weather, economy, etc.

Midway Scenario ~ 2040: This is for the known projects and future unknown developments in the SEZ, where cumulative impacts will be assessed for All project stated in current scenario + Additional development after 2025 within SEZ as well as external impacts – climate change, extreme weather, economy, etc.



Figure 4-1: Air Quality ZOI



Figure 4-2: Marine ZOI



Figure 4-3: Groundwater ZOI



Figure 4-4: Noise ZOI



Figure 4-5: Soil ZOI



Figure 4-6: Surface water ZOI


Figure 4-7: Topography/Landscape ZOI



Figure 4-8: Archaeology and Cultural Heritage ZOI



Figure 4-9: Local Community/ Asset ZOI



Figure 4-10: Noise Community ZOI



Figure 4-11: Resident Population ZOI



Figure 4-12: Transport Network ZOI



Figure 4-13: Terrestrial Flora Fauna ZOI

5 SCOPING PHASE II: OTHER ACTIVITIES AND ENVIRONMENTAL DRIVERS

The tasks that were conducted and presented in this scoping phase II are as follows:

- Identification of long list of other developments in the region;
- Obtaining available information on third party developments and plans;
- Identifying distances of third-party developments from the MIGA project components; and
- Screening projects out of the CIA, if they are outside the various assigned ZOIs.

This section defines the planned and reasonably defined developments in the vicinity of the Projects. If the Projects are able to interact with such developments (temporally and/or spatially), the Projects may be able to exert a potential cumulative impact. Information has been obtained particularly from local, regional and national governmental organizations and from a review of open literature.

Detailed identification of other projects, activities, or actions that are likely to have significant impacts and can play an important role in the management of cumulative impacts is appropriate. In addition to other human activities, natural drivers that exert an influence on VEC condition will be identified and characterized. Natural environmental processes—for example, drought or flooding—have significant impacts on a variety of environmental and social components. Following data will be screened and scoped for the CIA.

5.1.1 Development of Long List of Other Projects

Based on the information provided by SEZD and through the available documentation and reports a list of third-party projects has been identified. CTEC had discussions with SEZD and other relevant authorities and its team members to identify a long list of third-party developments within the study area. The inclusion of third-party developments has been based on the following criteria:

- Built and operational projects;
- Approved but uncompleted projects;
- Projects under construction;
- Projects for which an application has been made till 1st of April 2020, that are under consideration by the SEZD and for which refined information and robust assessment outcomes are available; and
- Projects which are reasonably foreseeable, i.e., projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information and robust assessment outcomes are available at the date of any appropriate assessment in order to assess the likelihood of cumulative impacts.

Information has been sought from SEZD regarding third party projects, in particular whether any EIA and other related documentation is available. It was identified however that in general limited information was available for the majority of the long list of third-party projects.

The long list of projects for consideration and a summary of third-party project information is presented in Appendix D and Appendix E of this Report, respectively.

5.1.2 Screening of long list of Projects

The locations of third-party developments are currently unknown but a conservative estimate of distance will be estimated to provide context. The closest distance in relation to each development will be taken as a precautionary approach. These distances are compared to the ZOIs developed in Step 1. This enables to identify those developments that spatially overlap with the various ZOIs for the VECs, potentially resulting in additive or synergistic cumulative impacts. If no spatial overlap was recognized, then the third-party project can be screened out and is not considered any further in this assessment. The maximum ZOIs identified were 10 km and 250 km for terrestrial and marine related impacts, respectively. Based on the ZOI and available data additional projects list is provided in Appendix D.

The distances of the identified projects in relation to the MIGA projects and components are presented in Appendix F The locations of some third-party developments are currently unknown but CTEC has provided a conservative estimate of distance to provide context. As a precautionary approach closest distance in relation to each development has been taken.

Due to the absence of available information on the third-party projects (Appendix D), a very detailed and quantified assessment of cumulative impacts for the wider Duqm SEZ, and other regional development, is not possible. Such a study or longer-term programme of ongoing work on cumulative impacts would be best conducted by SEZAD once further detailed information becomes available for the various developments that will be planned and built within the Duqm SEZ.

CTEC in consultation with SEZD has evaluated third party projects to ascertain the relevancy and scale of the various developments and plans with an indication (using a matrix of the key receptors) to whether there is a potential for them to result in impacts of a similar nature to the MIGA Projects.

This report**Error! Reference source not found.** presents the relevant impacts that were considered in the screening and that will ensue over time. Therefore, this CIA continues to focus mainly on the cumulative impacts of the MIGA Projects and the associated facilities for which EIAs are available. The third-party projects were evaluated to ascertain the relevancy and scale of the various developments and plans with an indication (using a matrix of the key receptors) to whether there is a potential for them to result in impacts of a similar nature to the MIGA Projects. Figure 5-1 provides high level projects and environmental drivers in the region.



Figure 5-1: High Level Project and Environmental Drivers in Region

5.2 Natural and Social External Influences

According to the fifth assessment report of the International Panel on Climate Change (IPCC, 2014), the stressor of warming of the climate is a clear and unequivocal global challenge. Considering the current high level of water stress in Oman, the main climate change issues that have been highlighted at a national scale are projected temperature increases and precipitation decreases. Detailed assessment for climate change has been conducted by CTEC and the methodology, scale, modelling and results are discussed in the report. The finding of which has been utilized for to get signification of the climate change in CIA context. This report discusses the detailed assessment on the climate change, sea rise, flooding and heat island effect at wider Duqm SEZ area.

Dust blows off the coast of the Gulf of Oman especially in winter, when dust storms are associated chiefly with the passage of westerly depressions in the Arabian Gulf. Sometimes called a "Shamal" (an Arabic word for "north") in the Gulf, such winds can reach 25 knots or more in an almost always north-westerly direction and thus produces the most widespread hazardous weather (including high seas) in the region. Associated with this is persistent dust and sandstorms. Shamal and heavy weather events are dealt with by smart design in buildings and infrastructure, and institutional (e.g. policy) and behavioral measures (e.g. staying indoors to keep

safe). The Projects' design has therefore taken into account extreme events such as floods, cyclones, storms and tsunamis.

Provisions that also need to be made in other projects and third-party development to reduce the risk of damage against natural hazards and climate stressors are not known at this stage. It would be prudent for OPAZ/SEZD to engage with other proponents and Ministries to develop a coordinated approach to countering the longterm impacts of these aspects and it is believed that this will be forthcoming from SEZD in the form of monitoring visits, checking and annual reporting. SEZD has invested significantly in civil works' improvements in and around wadis to enhance flood protection (broadly, from the 1-in-1,000 years' storm to 1-in-100) as two of the project for flood protection are part of the MIGA projects namely Jurf Dam and Saay dam with all channels for wadi Jurf, wadi Saay and streams of Dangeret, so it is assumed in this CIA that the authority is dealing with such strategic solutions, and will continue to do so in order to attract other operators and developers to Duqm.

6 STEP 3: ESTABLISH INFORMATION ON BASELINE STATUS OF VECS

Following are the tasks that are conducted during this phase of the CIA:

- Identification and description of the baseline in relation to all VECs based on existing documents;
- Identification of the sensitivity and value of the VECs; and
- Identification of any missing baseline information like site-specific, contextual, spatial, condition etc.

Availability of relevant data is critical for the success of a CIA, and the methodology to be used to determine VEC baseline conditions should be defined as early as possible. Existing information available from various project reports is used to complete assessment of cumulative impacts. During the scoping phases it is determined that the existing information contains no significant gaps that prevent the performance of an adequate assessment of cumulative impacts.

The VECs baseline environment is established based on the extraction of data as available from the major projects from MIGA seven projects and projects in vicinity. Information from the other developments is also used to enhance or provide more contexts for the relevant VECs (in terms of presence and absence). The VECs environment baseline was established based on the collating data from various existing EIAs for MIGA Project's and various other documentation provided by SEZD.

The collated baseline will be produced based on the EIA/ ESIA conducted and will utilize the information (as available) provided in the list of projects summarized in Appendix M. The collated baseline is presented in Appendix G.

Information from the other developments has also been used by CTEC to enhance or provide more contexts for the relevant VECs (in terms of presence and absence) and the condition of those VECs where available. Where information on quantities or condition of the VECs is unknown, this has been identified and any assumptions made have been provided. Furthermore, the baseline area beyond the Projects components, i.e., in the vicinity of third-party projects and, indeed, the Duqm SEZ is usefully summarized in Table format as Appendix H.

In determining and describing the baseline, CTEC have identified following:

- Spatial location and extent of the VECs both at the site specific (e.g. settlement) scale and regional (e.g. population and demographic) scale;
- Description of the VECs and their character;
- Context of the VECs in terms of rarity, function, and population at the local, regional and national level; Sensitivity, i.e. vulnerability, resilience (adaptability and tolerance) and recoverability; and
- Value/importance.

To gain a more complete understanding of the VEC baseline conditions, a further table containing information on the baseline has been established which considers the wider Duqm

The VEC/receptor sensitivities will be characterized using the qualitative guide for representative 'levels' of sensitivity presented in Table 6-1. The sensitivity (and value) of the various VECs is presented in Appendix I of this report. The respective sensitivities of the biodiversity VECs identified in Appendix B are presented in bio diversity report. For biodiversity, the values originally assigned have been taken as their sensitivity for the purpose of this CIA.

Sensitivity	Guide Definition for "Sensitivity" of Feature/Receptor
Very High	Has no capacity to accommodate physical or chemical changes or influences.
High	Has a very low capacity to accommodate physical or chemical changes or influences.
Medium	Has a low capacity to accommodate physical or chemical changes or influences.
Low	Has a moderate capacity to accommodate physical or chemical changes or influences.
Very Low	Generally tolerant of and can accommodate physical or chemical changes or influences.

Table 6-1: Guide for Classification of Sensitivity

The value of the VECs has been determined based on a geographical hierarchy where relevant and is presented in Table 6-2.

Table 6-2	Guide fo	r Classification	of Value
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Value	Guide Definition for "Value" of Feature/Receptor
Very High	International
High	National (Oman)
Medium	Governorate (i.e. Al Wusta)
Low	Wilayat (i.e. Ad Duqm)
Very Low	Within zone of influence (which might be the development site or a larger area)

7 STEP 4: ASSESS CUMULATIVE IMPACTS ON VECS

CTEC has conducted following task for assessing cumulative impacts on VECs:

- Identify potential environmental and social impacts and risks;
- Identify any potential additive, countervailing, masking, and/or synergistic effects, of the considered third party developments that can act cumulatively with the MIGA funded projects.
- Identify the magnitude of effect for all VECs from existing EIAs and relevant documents; and
- Identifying impacts where insufficient information/quantification is available;

Analysis of cumulative impacts on VECs will be estimated for future state of the VECs that may result from the impacts they experience from various past, present, and predictable future development. The objective is to estimate the state of VECs as it results from the aggregated stresses that affect them.

Where the projects will have a potential to impact on a VEC, the magnitude of the effects (from sources of impact) will be collated, quantified and described. The cumulative magnitudes were defined using the following four factors:

- Extent The area over which an effect occurs;
- Duration The time for which the effect occurs;
- Frequency How often the effect occurs; and
- Severity The degree of change relative to the baseline level.

The magnitude of the impact has been linked to either quantified thresholds or qualitative descriptions depending on the nature of the impact and the receptor. Table 7-1 represents the guide for the qualitative scale of magnitude that has been used where quantified information or magnitudes are uncertain or unknown.

Magnitude	Guide Definition
Very High	Loss of VEC and/or integrity of the VEC; severe damage to key characteristics, features or elements (Negative). Permanent / irreplaceable change, which is certain to occur.
	Large scale improvement of resource or attribute quality; extensive restoration or enhancement (Beneficial).
High	Loss of VEC, but not affecting integrity of the resource; partial loss of or damage to key characteristics, features or elements (Negative). Permanent / irreplaceable change, which is likely to occur.
	Improvement to, or addition of, key characteristics, features or elements of the VEC; improvement of attribute quality (Beneficial).
Medium	Minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; measurable change in attributes, quality or vulnerability (Negative). Long-

Table 7-1: Guide for C	Classification of Mag	nitude
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Magnitude	Guide Definition				
	term though reversible change, which is likely to occur.				
	Minor improvement to, or addition of, one (maybe more) key characteristics, features or elements of the VEC; minor improvement to attribute quality (Beneficial).				
Low	Very minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; noticeable change in attributes, quality or vulnerability (Negative). Short- to medium-term though reversible change, which could possibly occur.				
	Very minor improvement to, or addition of, one (maybe more) key characteristic, feature or element; very minor improvement to attribute quality (Beneficial).				
Very Low	Temporary or intermittent very minor loss of, or alteration to, one (maybe more characteristic, feature or element; possible change in attributes, quality or vulnerability (Negative). Short-term, intermittent and reversible change, which unlikely to occur.				
	Possible very minor improvement to, or addition of, one (maybe more) characteristic, feature or element; possible improvement to attribute quality (Beneficial).				

Based on the proposed OPAZ/SEZD masterplan for Duqm, the construction impact duration for the SEZD is considered to be long term (in the region of 15 years plus). The construction impact duration for the MIGA Projects is however considered in this assessment as medium-term (generally 2 - 3 years). It should be noted that most of the MIGA funded projects are almost completed or on verge of the completion. Operational impacts for the MIGA Projects and the wider SEZD development are judged to be long-term.

In absence of information available on third party projects has not allowed the assessment to quantify their influence on cumulative impact within the SEZD. Some qualitative assessment is made, where possible. The CIA focuses on the cumulative impacts of the MIGA Projects and its associated facilities.

The cumulative impacts will be under each VEC topic area below. The assessment also considers the probability/likelihood and duration of the impacts.

- Ecosystem Services/Natural Resources
 - Natural resources
 - Land use
- Physical Environment
 - Air Quality;
 - Greenhouse Gas (GHG) Emissions
 - Noise;
 - Groundwater;
 - Soil;
 - Surface Water Quality; and
 - Topography/Landscape.
- Biodiversity
 - Marine habitats, flora and fauna; and
 - Terrestrial habitats, flora and fauna.

7.1 Ecosystem Services/Natural Resources

The cumulative impacts that have been assessed for the natural resources' VECs identified in Appendix B are as follows:

7.1.1 Natural Resources

7.1.1.1 Construction Phase

Based on the available information MIGA Projects utilized some of the same natural resources as the third-party developments in the SEZD area. This is also the case for commercial development activities in the region beyond the boundary of SEZD's responsibility. Cumulative impacts on natural resources impacted sourcing of wood, metal, cement, rock, aggregates, fuel, water and foodstuffs. It was driven by influences such as transportation costs and ease of access, the resources was sourced locally and/or regionally from reputable suppliers. Where there was poor availability or insufficient quantity and/or quality, procurement of such resources was extended to wider Oman, but besides national, there were some international sourcing of specialist materials and components.

Thus, the cumulative impacts of natural resources in construction were considered to be regional to national and of medium-term duration but of **Low** magnitude given that it is likely that there are sufficient natural resources nationally and internationally to supply the development of the MIGA Projects.

Best practice principles were adopted by SEZD across all the proposed Projects elements in terms of strategies to avoid and minimize the use of natural resources and to adopt efficiency savings and reuse/recycling where possible. Examples of this include integration of the internationally renowned waste minimization hierarchy to be adopted by all contracted EPC Contractors and initiatives for different Contractors to source water and reuse wastewater, where at all feasible and possible as well as the requirement for overall resource efficiency measures.

7.1.1.2 Operation Phase

The main natural resources that will be directly consumed by the MIGA Projects and other OPAZ/SEZD projects is fuel (diesel and petrol will be needed for the vehicles that will be used for transportation of workforce and materials), raw materials for maintenance works.

Desalinated water, provided by the dedicated Marafiq and RAECO, for the workforce for operations and maintenance, based on the requirements and thus not draw on third party sources of water provision.

Materials such as wood, metals, plastic and sand and cement will be required for the ongoing maintenance of the MIGA Projects, other third-party developments.

As all MIGA funded projects will not require much of the fuel during operations. Diesel and petrol are available in the local market. Impacts associated with natural resource requirements for operational phase and maintenance activities are considered to be local, regional and national and of a long-term duration. Cumulative impact is likely to be of **Low** magnitude given there will be sufficient natural resources nationally to support the MIGA Projects and the longer-term development of the SEZD.

Principles of best practice in operations will need to be adopted across all of the Projects components to meet with lenders' requirement, particularly around the sustainable use of resources and materials, avoidance of waste and proactive approach to energy conservation/efficiency.

7.1.2 Land Use

The MIGA Projects and its components are located on large areas and newly developed plots of land within the industrial zone identified by OPAZ/SEZD, most of the projects and its components are required infrastructure in the SEZD area. The extensive geographical areas of land were allocated following Government study and planning and on the basis of the erstwhile Royal Decree 119/2011 which stipulated the creation of the SEZAD. Some villages which were identified as being affected by the overall development under SEZD are being relocated by the Government to alternative residential sites (e.g. 150 Residential Units) while the land for all Projects area is not being used for any other material purposes (e.g. large-scale agriculture).

On this basis, there is potential minor land use conflict where the relocation process was started in 2011 for the wider area development, prior to the construction of the MIGA funded projects. The alternative land plots were also identified back in 2011 and the process follows the national legal process of land acquisition. Based on this legal process in 2011, relocation of the fishing communities and their fish landing sites was finalized and implemented. Through its management system, SEZD implemented mitigation measures, especially around stakeholder engagement, though these are not directly related to the Projects. Therefore, it is predicted that there will be no cumulative impact arising for land use.

7.2 Physical Environment

The cumulative impacts that have been assessed for the Physical Environment VECs identified in Appendix B (and refined) are as follows and described in more detail in subsections below.

- Air Quality;
- Greenhouse Gas (GHG) Emissions
- Noise;
- Groundwater;
- Soil;
- Surface Water Quality; and

• Topography/Landscape.

7.2.1 Air Quality

Air quality impacts and their magnitude are included in the Section on Community and Health below.

7.2.2 Green House Gas Emissions

7.2.2.1 Construction Phase

Greenhouse Gas (GHG) emissions from the 48-month construction phase of the MIGA funded Projects, mainly from construction activities DG sets and vehicles which will contribute to the carbon footprint of the Projects, and thus the GHG emissions contributed (by Oman) on an annual basis, to the global-scale problem of global warming from anthropogenic sources. An estimate of construction GHG emissions is shown in Table 7-2 below, which shows the relatively larger proportion than it compared with the operations of all MIGA funded projects and its associated facilities.

Projects Type	Selected Project Components and Scopes	Construction (TCO2e) – Sum of Stationary, Mobile & Fugitive	Operation (TCO2e) – Annual	Total GHG Emissions (Tonnes TCO2e) – Construction + Single Year Operation
GHG emi	ssions (e.g. from fossil fu	iels)		
MIGA	DLBB Project	Not Available	Not Available	Not Available
Funded Projects	Road 1 and 5	2,410	0	2,410
	CUC, Service corridor	5,460	0	5,460
	Wadi Jurf Dam	2,946	0	2,946
	Wadi Saay Dam and Channels	2,946	0	2,946
	IP3	Not Available	Not Available	Not Available
	Road 4	Not Available	Not Available	Not Available
Major Third- Party Projects	Duqm Refinery's Project Components (Refinery, Crude Pipeline, Export Terminal and Ras Markaz Crude Oil Tanks)	203,782	3,142,119	3,345,901
	Duqm Refinery's Associated Facilities (Crude Oil Storage, Service Corridor, DIPWP)	492,358	53,655	546,013

Table 7-2: Breakdown of GHG Emissions

Projects Type	Selected Project Components and Scopes	Construction (TCO2e) — Sum of Stationary, Mobile & Fugitive	Operation (TCO2e) – Annual	Total GHG Emissions (Tonnes TCO2e) – Construction + Single Year Operation
	Duqm Port	Not Available	7,938	7,938
	Oman Dry Dock	Not Available	Not Available	Not Available
Total (MIG Third Part emissions	A Funded Projects+ Major Projects) of Scope 1 GHG	709,902	3,203,712	3,913,614
Scope 2 C	GHG emissions (i.e. from	electricity and st	team)	
MIGA	DLBB Project	Not Available	Not Available	Not Available
Funded Projects	Road 1 and 5	Not Available	Not Available	Not Available
	CUC, Service corridor	Not Available	Not Available	Not Available
	Wadi Jurf Dam	Not Available	Not Available	Not Available
	Wadi Saay Dam and Channels	Not Available	Not Available	Not Available
	IP3	Not Available	Not Available	Not Available
	Road 4	Not Available	Not Available	Not Available
Major Third-	Duqm Refinery and Project components	Not Available	506,359	506,359
Projects	Duqm Refinery's Associated Facilities (Crude Oil Storage, Service Corridor, DIPWP)	Not Available	Not Available	Not Available
	Duqm Port	Not Available	166,931	166,931
	Oman Dry Dock	Not Available	Not Available	Not Available
Total (MIG Third Part emissions	A Funded Projects+ Major Projects) of Scope 2 GHG	Not Available	673,290	673,290

The nature of the cumulative impact is temporary (in duration) and the overall impact on climate change at the global scale is considered to be **Very Low.** Based on a baseline of 2010, the average 'annual' contribution of GHG emissions during construction (approximately 13,800 tons of CO_2 a year) for MIGA Projects components is only a tiny fraction of the total CO_2 emissions in Oman.

Despite the fact that a number of industrial third party projects are being progressed at the same time within Duqm SEZ, construction best practice principles will be adopted by SEZD, via its EPC Contractors, to minimize the use of fossil fuels, where possible, and adopt – and monitor/manage, in order to reduce – techniques to avoid unnecessary GHG emissions. Examples include switching off plant and equipment to avoid idling engines when not in use, and minimizing site trips and deliveries through resource efficiency.

7.2.2.2 Operation Phase

MIGA funded projects operations will not contribute significantly in overall increase of increase in overall emissions (including both GHG emissions and other pollutants to air). Much longer-term electrification and automation trends in industry and public life (e.g. electric vehicles that will required charging), encompassing one to two decades, will reduce the overall combined contribution of scope 1 GHG emissions (i.e. from fossil fuels) but with the population set to increase (and hence an increased contribution to carbon footprint) the long- term strategic impact remains of **Low** magnitude.

It is expected that as environmental permitting and reporting procedures mature in the next few years, especially in respect of Oman's response to international initiatives, individual industries will need to establish comprehensive calculations on their GHG emissions, while OPAZ/SEZD collate the GHG emissions of the companies within its boundaries for reporting accurate figures into national data collection initiatives by MECA. At the global scale such contributions are still considered to be **Very Low**.

OPAZ/SEZD will support the Government of Oman in achieving national initiatives for awareness around GHG emissions and air quality at large, education initiative and a response to reducing them in order to support collaborative efforts on mitigation of climate risks.

7.2.3 Noise

The impact and magnitude associated with noise is covered in the Section on Community and Health below.

7.2.4 Groundwater

Groundwater resources in this area are limited and the groundwater is saline in nature, exceeding both the WHO and Omani Standard for drinking water for a number of parameters. This deems the local groundwater resources unfit for human consumption without treatment. Therefore, it is not thought to be a resource anyone is currently reliant on, so obtaining freshwater this way is not a viable option.

Furthermore, all water used by the MIGA funded projects was obtained by their respective contractors during construction and was sourced from the existing operational desalination plants in region or approved local water supplier.

OPAZ/SEZD will have proactive control measures in place to prevent groundwater pollution from accidental spillages and contaminated discharges and the management plans for implementation by EPC Contractors procedures have requirements for clean-up (e.g. of spills) to prevent pollutants entering groundwater. During the construction phase, the respective contractors utilized approved permanent accommodation camps for the workers.

Only if major spillages or incidents occurred at Projects facilities which is considered to be exceptionally unlikely, would there be any visible effects on groundwater quality due to the Projects. Should a significant accidental spill occur, appropriate spill control measures will be put in place by the EPC Contractor/s. Groundwater quality could be affected for a short duration whilst clean-up is underway.

During operation, water will be supplied by Marafiq to SEZ. It shall be noted that very small quantities of water is required for the operation of MIGA funded projects. Mostly, the water during operations will be for domestic use during regular maintained and respective offices. Moreover, intermittently the water will be required for maintenance of these infrastructure projects.

Thus, the magnitude for cumulative impacts on groundwater is predicted to be **Very Low** for both construction and operation.

7.2.5 Surface Water

7.2.5.1 Construction Phase

Both projects (both funded by the MIGA) i.e., Jurf dam and Saay dam with the channels comprehensive flood protection system, designed to secure the zone's future investments at SEZD.

These works to divert and manage surface waters safely are being progressed by SEZD as part of the overall development of the Duqm SEZ. The aims of the diversions are to protect the area from future flood events and convey any surface waters safely to sea via excavated channels within the natural terrain of the wadis.

The channels follow the natural wadi watercourses and collect secondary channels. Stretches of wadi have, and are being, protected further with gabion boxes and levees reinforced through of the existing Jurf and Saay channels have a combined outlet to sea at the approximate location of the current wadi deltas. As a result, the risk of flooding from the wadis has been greatly reduced, rainwaters are collected and released to the marine environment while new coastal areas, outside the wadis, are not affected.

These both MIGA funded projects for flood protection dams/reservoirs are built upstream of the Jurf and Saay wadis to protect from potential flood events that could affect (future) occupants downstream. Mostly project in Duqm SEZ are beneficiary of the flood protection system and there will be a very limited risk of the presence of any surface waters in the vicinity of the Projects. As rainfall in the area is very low (yearly average is around 36mm), it is recognized that with good practice in design and subsequent operations, the likely impact upon surface water quality due to run-off is estimated to be very low. OPAZ/SEZD will have in place control measures in place during construction to prevent pollution from surface water and runoff. As such, the magnitude for cumulative impacts associated with surface water is **Very Low**.

7.2.5.2 Operation Phase

The low rainfall (above) and good practice in design/operations mean that any negative impacts upon surface water quality due to runoff is estimated to be very low.

All MIGA funded projects are infrastructure projects for development of Duqm SEZ, only minor spillages or incidents can occur and would there be any discernible effects on surface water quality from the Projects. Should this occur, appropriate spill control measures will be actioned by OPAZ/SEZD. Surface water quality could be compromised for a short duration before clean-up.

As such, operation impacts associated with surface water are predicted to be localized, low occurrence and reversible, therefore any cumulative impact is likely to be of a **Very Low** magnitude.

7.2.6 Soil

As is the case for Land use, the sites of Project locations are situated on land which is either purpose-built (i.e. prepared) or of low quality to sustain other uses such as grazing or agriculture. Therefore, it is predicted that there will be no cumulative impacts arising from land use and thus 'soil' has been screened out as a topic from further consideration in the CIA.

7.3 Topography/Landscape

Low landscape and visual impacts are anticipated during the construction and operation all mentioned 7 project and associated facilities in isolation. However, the Duqm SEZ has been formally designated for industrial development as a whole and thus the Projects has been allocated plots and various locations and these projects are considered to essential as these are the projects required for sustainable development of the SEZ. As further facilities, features and commerce develop incrementally within the Duqm SEZ, the landscape will become increasingly developed.

In terms of the region, industrial and commercial development will be concentrated in the Duqm SEZ rather than zones and plots of land being developed along the west coast of the Al Wusta region in a more haphazard manner, therefore avoiding a large (geographical) scale impact.

7.4 Biodiversity (from Bio diversity Report)

SEZD has a dedicated study for bio-diversity assessment based on which the cumulative impacts that have been assessed for the Biodiversity VECs identified in Appendix B (and refined) are:

- Marine habitats, flora and fauna; and
- Terrestrial habitats, flora and fauna.

Appendix B has VEC descriptions provided in the ZOI justifications. Appendix K and Appendix L present a construction and operation phase cumulative impact assessment for all the identified biodiversity VECs.

7.4.1 Marine Habitats, Flora and Fauna

Appendix K and Appendix L state the magnitude of the potential construction and operation phase cumulative impacts for the marine VECs.

7.4.2 Terrestrial Habitats, Flora and Fauna

Appendix K and Appendix L state the magnitude of the potential construction and operation phase cumulative impacts for the terrestrial VECs.

7.5 Socio-economics

Following cumulative impacts, are assessed for the socio-economic VECs identified in Appendix B (and refined), are:

- Resident population/community health;
- Community safety and security;
- Livelihood activities involving ecosystem services;
- Road traffic/transport;
- Influx of workers potential integration and cultural assimilation issues
- Local business/economy (includes competition for jobs possibly causing pressure on wages, increase in diversity for skills and tax contributions); and
- Local infrastructure.

The socio-economic and social impacts considered in this CIA report are mainly associated with impacts on local communities, jobs, community health, as well as local infrastructure and traffic during the construction and operational phases.

7.5.1 Construction Phase

The presence of approximately 6,000-7,000² migrant workers during the three and a half years of the MIGA funded projects construction phase is one of the most

² Estimated numbers at the time of preparation of this report.

important socio-economic impacts, which could include a potential increase of prices for basic commodities and services, potential impacts on local communities and also their health, safety and security, as well as local infrastructure and services.

Based on discussion with SEZAD, it is estimated that the overall number of migrant workers shared between all developments in the SEZAD area for the next five years will not exceed 22,000 people (this also includes the construction of Duqm Refinery), including the number of workers required for the development of the MIGA funded projects. However, this is only an estimate, as the information on other development projects that are currently being planned by OPAZ/SEZD is subject to change and the socio-economic/social content of all EIAs are limited to basic facts around demographics (e.g. increasing population) and Census data.

Tourism services in the area currently consist of the two elements:

- Accommodation/hotels and other related services (food services, catering, etc.) which bring the main share of the overall earnings in the tourism sector in the project area; and
- Activities involving sub-aqua diving/snorkeling and sightseeing which often involves private arrangements between individuals (diving) or a by-product of the accommodation product (sea-view from a hotel room or an excursion to the wider project area by a car) and do not constitute to a significant input into the local tourism earnings.

These two elements are likely to be affected differently by the SEZD area development. The accommodation and other related services are likely to thrive and experience increased earnings (positive impact), further boosted by the parallel development on the wider SEZD territory. Slight positive impact will continue throughout into the operations phase of the MIGA funded Projects. At the same time, although the diving and general tourism activities will not disappear because of the Projects or wider development, the territory that is currently available to use for such activities could be reduced and very likely to be confined to the territories managed by the local hotels (minor negative impact on diving and sightseeing).

As part of mitigation measures, all MIGA funded projects has developed an Environmental and Social Management System, which includes a number of management plans relating to socio-economics and social aspects to be implemented by the appointed EPC Contractors. Provisions in these will help to reduce the impact of migrant workers upon the local community and infrastructure, look after their health and security. The management plans to be developed include:

- Workers Influx Management Plan;
- Community HSE Management Plan;
- Stakeholder Engagement Plan, and
- Grievance Procedure.

In addition, OPAZ/SEZD, on all Project-related labor and community issues, which will help contribute to early identification of potential issues before they arise and assist

SEZD

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with prompt response and optimization of the above socio-economic/social management plans.

Assuming the above management plans and close coordination with OPAZ/SEZD will be implemented, it is anticipated that cumulative (negative) impact from approximately 22,000 workers presence in the Duqm SEZ area will be minimized and managed and that their influx will support the wider strategic development goals of the Government to stimulate significant economic development in the region.

As the construction phase will last for three to 4 years, the impacts will be temporary, but also potentially positive in terms of the economic benefits that local employment and spending in the economy will bring. On the other hand, the potential strain on existing infrastructure, increased traffic, safety and security risks and the potential for the spread of communicable diseases will still be potentially negative. In turn, OPAZ/SEZD is investing (e.g. infrastructure, facilities) to make provision for this influx. Any additional influx of workers for third party development is likely to be staggered and has the potential to increase the pressures and problems mentioned above. The development and provision of public facilities – including entertainment (e.g. retail, leisure) needs to keep pace with such in-migration.

As for potential increase of basic commodities' and services' prices, this aspect will be somewhat mitigated by increased wages both for local workers and migrant workers, and by a new flow of investments, which will improve the quality of basic services. As a result, it is expected that the potential increase in prices will be counterbalanced by improved services and increased wages in the area.

The influx of workers is considered to have a medium severity due to the significant volume of migrant workers relative to the current population of Duqm (estimated to be around 7,000). Therefore, for the construction phase, the employment and local economy impacts are predicted to be of **Medium** (positive) magnitude and potential strain on local infrastructure, traffic, safety and security and potential communicable diseases spread are predicted to be of **Medium** (negative) magnitude – until the injection of new investment to improve the services, when this strain on the existing infrastructure will mostly be neutralized or turn to positive.

7.5.2 Operation Phase

The assessment of impacts on local employment and economy, as well as community health and local infrastructure during the operational phase has predicted that most impacts will be negligible, with the exception of Community Health and potential price inflation for basic commodities and services which would be Minor negative (without any mitigation). However, the majority of workers engaged on the in-construction project will leave the area after the construction phase. With regards to health, OPAZ/SEZD is expanding healthcare facilities and other infrastructure in the wider Duqm area.

Despite the majority of workers leaving the project area after construction is completed, all MIGA's funded projects operation phase will continue to provide a **Low** (positive) magnitude on local employment and economy. The MIGA projects

are providing connectivity via roads to support economic development and growth within the SEZ. There will be only intermittent contractual employment during the maintenance and repair works of the MIGA funded projects.

Little information is available for the third-party projects but it is assumed that, based on the standards that are evidently being adopted by Omani authorities, that all these projects will be required to meet Oman's planning, environmental and social legislation. Another important mitigating factor to consider is that SEZD has finished planning significant parts of the development area, particularly that which is closer to the coastline – and there is physically little space available after the large developments are completed. Once these third party projects and MIGA funded projects are developed, there will be more cumulative impact especially around the areas which are industrial or large emitters, such as DR and the Petrochemical industry, there will be increase in waste, wastewater, vehicle traffic etc. and moreover, with increased workers and residents there is also potential for increased spread of communicable diseases as the population of the SEZ grows.

Therefore, the cumulative impact on local security, traffic and infrastructure is predicted to be of a **Medium** magnitude for the operational phase. However, due to a preserving risk from the spread of communicable diseases, the impact on community health is considered to remain at a **Medium** (negative) magnitude.

7.6 Community and Health

CTEC has assessed following cumulative impacts for the Community and Health for the VECs identified in Appendix B:

- Air Quality Community;
- Noise Community;
- Access Community;
- Traffic Community; and
- Visual Amenity.

7.6.1 Air Quality - Community

IFC guidance (IFC, 2007) requires projects with significant sources of air emissions, and the potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.

This project has assessed air quality impacts using the Omani Air Quality Standards, and in their absence the IFC air quality guidelines.

Air Quality regulations in Oman were stated in Ministerial Decision No. 118/04 for in stack concentration and MD 41/2017 Regulations on Ambient Air Quality and redefined threshold limits and stated average periods of measuring pollutants. These are shown in Table 7-3 below:

Pollutant	New Omani Air Quality Standard (MD 41/2017)	Average Period
Sulfur Dioxide SO2	350	1 hour
	150	24 hours
Hydrogen Sulfide H2S	30	1 hour
Nitrogen dioxide NO2	250	1 hour
	130	24 hours
Ozone (O3)	120	8 hours
Particulate matter, PM10	150	24 hours
PM2.5	65	24 hours
Carbon Monoxide (CO)	30,000	1 hour
	10,000	8 hours
Non-methane Hydrocarbons	160	3 hours
Lead (Pb)	1.5	3 months
Ammonia (NH3)	200	24 hours

Table 7-3: Oman Air Quality Standards, µg/m3

The new threshold for $PM_{2.5}$ is higher compared to IFC/WHO standards, the latter of which is not to exceed 25 μ g/m³ over an annual period.

From, provided EIA reports the baseline air quality survey concentrations of Ozone, PM_{10} and $PM_{2.5}$ within the study area were observed to be elevated, and at times in exceedance of the provisional Omani and WHO/IFC ambient air standards. All other monitored pollutant concentrations were considered to be very low, and well below both the provisional Omani and WHO/IFC ambient air standards.

7.6.1.1 Air Quality Cumulative Impacts

The process of CIA seeks to determine whether the proposed developments of SEZD will contribute to cumulative impacts on air quality impacts. A ZOI for each air quality impact was assigned around the Projects Components in order to identify the spatial boundary within which other projects and their potential cumulative impacts

will be considered. Specific ZOIs are not stated in the guidance; therefore, justification has been provided over the assigned ZOIs and are presented below:

- A 5km ZOI has been used for air quality impacts around all MIGA funded projects sites. Operational activities will release critical pollutants (NOx, CO, SO₂, and PM₁₀ and VOC from a multitude of on-site sources that will potentially deteriorate local ambient air quality within a 5km radius.
- A 1km ZOI has been used for the air quality and impacts from roads, dams and channels and port works. This boundary has been defined based on the construction dust and related localized exhaust emissions.

A 500m ZOI has been assigned to the effects on air quality from road traffic. Within this area, it is envisaged that the enhanced traffic exhaust emissions may have direct impacts up to 200m, but indirectly effect VEC receptors up to 500m, such as deposition on ecological receptors. Emissions from additional activities associated with other developments and industries in the area surrounding the all the MIGA funded projects are likely to result in emissions of pollutants thereby degrading local air quality. The relative locations third-party projects were compared to the ZOIs developed. This enabled the identification of developments that spatially overlap with the various ZOIs for the VECs, potentially resulting in additive or synergistic cumulative impacts. If no spatial overlap was recognized, then the third-party project was screened out and not considered.

The absence of information available on third party projects has not allowed the assessment to quantify their influence on cumulative impact, however some qualitative assessment is made where relevant.

Construction Phase

Air quality effects arising as a result of impacts from the associated facilities outlined in Appendix E of this report are highly likely during the construction phase of the various projects, as it is mentioned earlier that construction of most of the MIGA funded projects are already complete and soon will complete for remaining projects.

Future developments will also have cumulative impacts during construction activities in and around the Industrial Zone of the Duqm SEZ but more importantly the dusty and dry nature of the locality, increasing the potential for windblown dust from construction and further elevation of particulate matter concentrations locally. Other cumulative effects, due to emissions of NO_2 , SO_2 and NMHCs from construction traffic and on-site plant, have been assessed as resulting in a minor risk of adverse impacts upon sensitive receptors, as the baseline concentration of these pollutants is currently very low, and their standards are unlikely to be affected by any cumulative emissions. However, construction impacts will always be temporary.

Air quality has been assessed within a number of the EIAs previously reported (Appendix D). Where air quality was assessed, there was a limited amount of information on emission sources and/or the contributions from each project to ambient air concentrations was inconsistent between each of the reports, but often

lacking. The individual contributions to air from construction phase from each of the components within the contributing projects are outlined below Table 7-4.

Several emission components have been predicted to occur at several projects coincidentally, resulting in a large aggregate emission across the area of Duqm. In particular, emissions of PM, PM2.5, NO_x and VOCs have been predicted to occur from several components, at multiple projects sites across both the construction and operational phases.

Emission Source	Air Pollutants	Contribution Projects
Construction Machinery	NO _x , SO ₂ , CO, PMs, VOCs	Saay Dam and Channels
· · · · · · · · · · · · · · · · · · ·	, , , -,	• Jurf Dam
		• DLBB
		Road 1 and 5
		• CUC
		Roads 4
		Construction of Port Gate
Diesel Generators	NO _x , SO ₂ , CO, PMs, VOCs	Duqm Liquid Bulk Berth Project
		Road 1 and 5
		• CUC
		Roads 4
		Construction of Port Gate
Transport vehicles	NO _x , SO₂, CO, PMs, VOCs	Duqm Liquid Bulk Berth Project
		Road 1 and 5
		• CUC
		• Roads 4
		Construction of Port Gate
Fugitive Emissions from Fuel Storage Tanks	VOCs	Duqm Liquid Bulk Berth Project
Traffic on Graded Roads &	Dust	Saay Dam and Channels
earth works		• Jurf Dam
		Duqm Liquid Bulk Berth Project
		Road 1 and 5
		• CUC
		Roads 4
Marine Vessels and Barges	NO _x , SO ₂ , CO, PMs, VOCs	Duqm Liquid Bulk Berth Project

 Table 7-4: Cumulative Emissions to Air During Construction

In order to reduce the risk of adverse PM_{10} and $PM_{2.5}$ impacts at sensitive receptors; dust control measures should be incorporated into the environmental and construction plan of the MIGA funded projects and its associated facilities. It is recommended that these measures should include control of particulate emissions and dust re-entrainment in areas close to boundaries of the project sites. Provision for the avoidance, minimization and mitigation (e.g. use of water spraying) are

included in the ESMP for use by EPC Contractors. The ESMP includes management measures such as:

- As part of EPC, a resource efficiency assessment shall be undertaken by Contractors to assess resources required during construction activities, potential sources and resource use reduction measures to be undertaken;
- Contractors shall monitor ambient air quality parameters (e.g. Sulphur Dioxide, Oxides of Nitrogen and Particulate Matter) from plant and equipment to ensure compliance with Project Standards; and
- Emissions inventories shall be developed and updated as needed. The discharge of pollutants is to be avoided at all locations in order to protect sensitivities in both the terrestrial and nearby marine environment in and around Duqm.

Where other construction sites may overlap the ZOI of the MIGA Projects components, the ZOI of traffic routes, amalgamated effects of large-scale construction activities could result in construction associated dust clouds occurring over extended periods. With these dust clouds, elevated $PM_{2.5}$ and PM_{10} concentrations could also occur.

Elevated particulate concentration impacts identified as associated with cumulative impacts of construction activities are likely to occur at locations in close proximity to site boundaries and key traffic routes. These air quality impacts would be negative, are likely to prevail for the whole construction period and have been predicted to be of **Medium** magnitude for the construction phase.

Operation Phase

From the assessment of air quality impact associated with all MIGA funded projects and third party facilities upon sensitive receptors within the study area during the operational phase, air quality standards were predicted to meet both Omani and IFC/WHO limits for all pollutants, with exception to Ozone, $PM_{2.5}$ and PM_{10} as the baseline for these parameters are at times exceeding the Omani Standards.. Mostly all other project is infrastructure project and will not have much contribution with regards to impact on ambient air quality.

These minor incremental contributions to air pollutant concentrations from MIGA funded projects are well below the permittable allowable standards of pollutants for all pollutants.

Qualitative assessment of one out of 7 MIGA funded project was conducted i.e. IP7 which has an associated facility DLBB project. Air emissions from the operation of the DLBB Project terminal are expected to be fugitive VOC, fugitive dust and combustion emissions. Fugitive VOC emissions will be from the storage tanks, flanges, pumps etc., while fugitive dust will result from handling and storage of Pet Coke and Sulphur Stockpiles. Combustion emissions will result from periodic operation of DGs/pumps and the emergency flare.

VOCs will be emitted during the storage of various crude oil products at the facility. Emissions of VOCs may result from evaporative losses during storage (typically referred to as "breathing, storage, or flash losses"), from operational activities such as filling, withdrawal, and loading / unloading of transport links (referred to as "working losses"), and due to leaks from seals, flanges, and other types of equipment connections (known as "fugitive losses"). In order to minimize the VOC emissions from the Project, Duqm Petroleum Terminal Company (DPTC) has adopted a number of BAT measures. The key measures adopted to reduce VOC emissions include:

- Tank color reflecting about 70 % of the light
- Internal floating roof
- Dedicated systems (products stored in dedicated tanks)

The closest receptors to the DLBB Project are the fish landing area located 4 km to the north of the Lee Break Water (LBW) and Say village located approximately 5.5 km to the South-West of the LBW.

The cumulative impact of the maximum predicted operational emissions to air from MIGA funded projects, emissions to air and baseline concentrations does not appear at risk of resulting in an exceedance of the Omani air quality standards form NO_2 , SO_2 or CO. However due to the elevated baseline concentration of PM_{10} and $PM_{2.5}$ in the study area, maximum PM_{10} and $PM_{2.5}$ concentrations were predicted to exceed the Omani air quality standards.

However, adverse air quality effects arising as a result of impacts from the other third-party projects (outlined in Appendix D) are highly likely during the operational phase of the Project. This is in part due to the scale of activities in and around the Industrial Zone of the Duqm SEZ and, once again, the dusty and dry nature of the locality, increasing the potential for windblown dust from vehicular movements and further elevation of particulate matter concentrations locally. Other cumulative effects have been identified as emissions of NO₂ directly emitted from operational traffic. In addition, emissions of SO₂ and NMHCs from on-site plant. All of the above have been assessed as resulting in a minor risk of adverse impacts upon sensitive receptors, as the baseline concentration of these pollutants is currently very low, and their standards are unlikely to be affected by any cumulative emissions.

Several emission components have been predicted to occur at several projects coincidentally, resulting in aggregate emission across the area of Duqm. In particular emission of PM, NO_x and VOCs have been predicted to occur from several components, at multiple projects sites during the operational phase as per Table 7-5. It should be noted that only major projects in vicinity have been considered for the assessment. Most of the MIGA funded project will not have wider area of impact on air emissions as they are infrastructure projects.

	Table 7-5: Cumulative	emissions to air	during operation	from Major Projects
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Source	Air Pollutants	Contributing Projects	Co-Incidence with MIGA funded
			projects Emissions

Source	Air Pollutants	Contributing Projects	Co-Incidence with MIGA funded projects Emissions
Machinery	NOx, SO2, CO, PMs, VOCs	Duqm DIPWP	Yes
		Duqm Refinery and associated facilities	Yes
Diesel Generators	NOx, SO2, CO, PMs, VOCs	DUQM Camp	Yes
		Duqm DIPWP	Yes
		Duqm Refinery and associated facilities	Yes
Transport vehicles	NOx, SO2, CO, PMs, VOCs	DUQM Camp	Yes
		Duqm DIPWP	Yes
		Duqm Refinery and associated facilities	Yes
Fuel Storage Tanks	VOCs	DUQM Construction Camp	No
		Duqm DIPWP	Yes
		Duqm Refinery and associated facilities	Yes
Movement and storage of construction materials, aggregate or pet coke	Dust	Duqm Refinery and associated facilities	Yes
Marine vessels, barges and tug boats (construction only)	NOx, SO2, CO, PMs, VOCs	Duqm Refinery and associated facilities	Yes

Raz Markaz Crude Oil Park construction effects scoped out due to the large distance between that facility and the sensitive receptors

During the operational phase, cumulative emissions of NO_x , SO_2 and VOCs may increase, though emissions of PM are likely to significantly reduce in magnitude at all project's sites, from their concentrations during the construction phase.

Though the contribution of air pollution from the MIGA funded projects has been assessed as negligible, there will be emissions from main port berth activities which is an associated facility. Other third-party non-AFs will contribute by way of creeping (i.e. incremental cumulative increases) pollutant concentrations in the area as parts of the Duqm SEZ are completed and become operational. This can lead to longer-term air quality impacts, which SEZD will need to monitor over time. Therefore, the overall impact from cumulative impacts upon air quality is predicted to be of a **low** magnitude for the operational phase.

Future Cumulative Baseline

Emissions to air arising from construction activities and operations at other project sites within the Duqm area are likely to have a detrimental impact upon the future air quality baseline. The magnitude of pollutant emissions from these projects has not been quantified due to the lack of information presented within the available EIAs.

The generation and emission of dust during the construction phase of other projects within the Duqm area, is a certainty, and due to the character of the soils and landscape surrounding Duqm, cumulative emissions of dust during the early construction phases of each of the projects are likely to be high. Therefore, baseline dust concentrations used within the assessment of construction dust for the MIGA funded projects were assumed to be high. However, dust has a 'drop-out' rate sufficient to effectively remove it from ambient air within 200m of its source. As the allocated areas for residential development are at a considerable distance (greater than 5km) of the construction will be remote.

The generation and emission of both NO_x and SO_x during the construction phase of other projects within the Duqm area, has been identified, though specific NO₂ and SO₂ emission data was not available for all of the assessed project assessments. Emissions of NO₂ are likely to increase, and possibly SO₂, across the study area as industrial development increases within of the Duqm SEZ and its associated increase in residential population which eventually will have increased traffic in the SEZ. However, due to the low density of industrial development, distances between other known projects and the MIGA funded Project sites, there is a significant opportunity for both NO₂ and SO₂ emissions to disperse. In addition, areas in Duqm allocated for residential development are removed from the principal industrial zones, therefore exposure of sensitive receptors to pollutants associated with industrial emissions will be limited. Therefore, MIGA funded projects contributions of NO₂ and SO₂ to the future baseline have been assumed to be negligible for both the construction and operation phases of other projects within the Duqm area.

7.6.2 Noise – Community

7.6.2.1 Construction Phase

Noise in Oman is governed by two regulations, MD 79/94 and MD 80/94. MD 79/94 provides noise limits from industrial noise and traffic noise for which the criteria for the boundary of an industrial site is no greater than 70dBA. MD 80/94 provides noise limits for workers exposed to noise and stipulates that where noise levels are 85dB and higher, workers must be provided with adequate hearing protection.

There is minimal information available for the third party projects mentioned in Appendix E, but it is assumed that, based on the EIA information available, the boundary noise level will be maintained at less than 70dBA, and workers are provided with adequate hearing protection where there is exposure to noise levels of 85dBA and higher. Also, every effort should be made to reduce noise levels to below 85dBA and locate noisy equipment away from the site boundary.

Assuming the above is implemented in these projects, it is anticipated that there would be no cumulative impact for workers within the sites as they will already be exposed to machines generating high noise levels. Therefore, contributions from other distant sites will have no significant effect on overall noise exposure. However, it has been identified that on-site activities could lead to exposure of maximum levels exceeding 110 dB L_{AFmax}.

Article 2 of MD 79/94 does not refer to noise from temporary construction activities; it is therefore assumed the limits do not apply to such sources, and the IFC Guidelines are instead applicable. For the MIGA projects, noise levels at identified high sensitivity receptors are expected to be below the IFC Guideline day and night-time noise limits during all peak activity periods. However, in areas where projects have an overlapping ZOI, the combined effect of multiple boundary noise levels at 70dB can be enhanced through the cumulative action of onsite and long-range audible activities such as rock drilling, breaking, crushing, foundation piling and blasting activities.

Even when considering the worst-case scenario, the construction noise impacts identified would only act locally and in the short-term. However, the construction noise impacts would still be negative and are considered to have a low to medium severity. Therefore, the impact from ambient noise is predicted to be of **Low** magnitude for the construction phase.

7.6.2.2 Operation Phase

The assessment of operational noise levels from MIGA funded projects at identified receptors are predicted to meet the industrial noise limits set out in MD 79/94 for all periods. All of the cumulative impacts associated are considered to be negligible, which is detailed below.

An increase in road traffic on Road 1,5 and 4 as a result of the export during the operational phase is anticipated. Existing local receptors may be affected by noise from the increased traffic flows, but the nearest receptor is approx. 3.5 km away from the source. The combined predicted noise levels from increased traffic would still be below IFC and Omani limits and would therefore present a negligible impact.

Within their respective EIAs, DLBB and IP3 suggests the noise level at the project line will be 70 dB. Similarly, the Duqm Refinery EIA states that an 85 dB on-site limit will be upheld. If this level is maintained, the cumulative impact will be negligible at the Saay and Nafun village (closest receptors).

Little information is available for the third-party projects but it is assumed that, based on experience, all new projects will be required to meet the Omani limits. These are generally more stringent than the IFC guidelines and it may be reasonable to assume these will be achieved. Another important mitigating factor to consider is that with more third-party development, there will be more physical obstacles between the MIGA funded projects/components and sensitive areas. Such a scenario is not accounted for within the noise modelling as such features do not yet exists, so the noise levels reaching receptors from the Projects components are likely to be lower than originally estimated.

In consideration of the baseline noise environment, the predicted levels are expected to be imperceptible at all locations with the exception of the area around the north of Saay Village and the Renaissance Workcamp. At all receptors the predicted levels are below the applicable guideline criteria, and the impact severity is therefore considered very low. Therefore, the impact from ambient noise is predicted to be of a **Negligible** magnitude for the operational phase.

7.6.3 Visual Amenity

Please refer to physical Environment (Landscape) section above for the considered visual amenity magnitude.

7.7 Cultural Heritage

The cumulative impacts at have been assessed for the Cultural Heritage VECs identified in Appendix B (and refined) are:

- Archaeological sites; and
- Cultural

7.7.1 Archaeological Sites

7.7.1.1 Construction Phase

There are several projects within the area of SEZD which are in various stages of their lifecycle and within 20km of the MIGA funded projects of SEZD. Studies in the region show that the character of the archaeological remains within the vicinity can be divided into up-standing visible remains, surface remains and graves. Cumulative impacts (e.g. damage) to archaeological remains during the construction phase are most likely during intrusive temporary works such as the construction of haul roads and compounds or permanent works such as underground pipes and foundations. In addition, the setting of up-standing remains may be affected during the construction phase although this is considered to be of low magnitude. In order to protect the heritage assets, appropriate mitigation strategies was put in place by SEZD during all construction works within the area once full details of temporary and permanent construction are available. Measures to implement these are integrated into the ESMP. The following generic recommendations should be adhered to:

- Clear marking of all listed significant cultural heritage assets in the area of works (including temporary) with marked with bunting/flags and inclusion of an adequate buffer zone ~40 m;
- Cultural heritage assets should be avoided, by design, either during the construction or operational phase of the development;
- 'Safe routes' for vehicles to be included in the Contractors' ESMP;

- Consultation on any foreseeable and unavoidable impact on a cultural heritage asset to be held with the Ministry of Heritage and Culture (MHC) and SEZD;
- All necessary archaeological works to be carried out by a suitably qualified archaeologist in consultation with the MHC and OPAZ/SEZD.

All the measures committed to by SEZD, in combination with assurances that strategic protection of identified (i.e. known) and non-identified (unknown) cultural heritage assets will be part of their ongoing monitoring and management of the entire Duqm SEZ, will go a long way to ensure the Duqm region does not suffer damage of archaeological resources. Please also refer to the guideline provided by SEZD on the cultural heritage protection on their website.

The construction phase will see an increase in noise, air pollution and lighting due to a rise in traffic and human presence. If these proposed developments are completed the Duqm SEZ and surrounding area will be in a construction phase for a long period of time. It is understood that SEZD maintains information on GIS and utilises this during assessment of submitted EIA/ESIA reports, so there is a system for this update.

It is thought that the general impacts during the construction phase will be short term and are estimated to be of a moderate severity. Even in the event of the surrounding SEZ undergoing permanent works, it is predicted that the level of impact severity is unlikely to change.

All works should be subjected to a mitigation strategy which would be agreed by the Ministry for Heritage and Culture. Any cumulative impact is anticipated to be of a **Medium** magnitude.

7.7.1.2 Operation Phase

The operational phase of the considered developments will be long term, increasing human activity in the area and therefore noise, lighting and pollution. Increases in noise and light will alter the setting of up-standing heritage assets and these may also be impacted by increased local activity and public visitation. It is reported, that certain sites are regularly visited by local inhabitants and in instances, offerings have been made at heritage assets. This activity could increase causing possible impacts to the asset's surroundings and (if applicable) structural integrity.

In order to limit damage to the heritage assets, a mitigation strategy should also be implemented during the operational phase of these developments. This strategy would highlight opportunities to enhance heritage assets for recreational purposes (recreational tourism) and indicate negative impacts associated with new developments. If significant heritage assets could be incorporated into the masterplan of proposed developments within the area, their value as recreational tourism assets could provide a positive impact.

The impacts during the operational phase will be long term and are likely to be of minor severity. The impacts are likely to be localized and it is therefore considered that these impacts will be of **Low** magnitude.
7.7.2 Cultural

The Socio-economic and Health section above provided details and the magnitude of cultural (safety and security) aspects. SEZD is putting measures in place to manage the potential clash of cultural values between local communities and migrant workers. These include:

- At Construction Camps located away from local communities and self-sufficient (e.g. provision of food, recreation/entertainment) to minimize interaction with the community and to be secure; this is the case at the recently established Renaissance Camp which has integrated facilities in modern accommodation buildings;
- Camp rules, protocols and regulations (e.g. zero tolerance of alcohol and drugs) and shared with the nearest residents in a relevant language and media;
- Provision of a Grievance Mechanism for workers;
- Ongoing monitoring (including meetings and discussions with stakeholders such as local authorities and the Governate) of in-migration levels to better understand patterns and trends, so that action can be taken;
- Contractors to have Communications' Plan for effective stakeholder engagement;
- Recruitment policy and ongoing management to prioritize employment of those considered local, and formal application procedures to avoid the presence of those to site seeking work on a casual basis;
- During operations, the recruitment and training-up of locals (i.e. Omani nationals) will clearly assist in developing enhanced communications and relationships between the workers from different cultures and between employees and local communities.

SEZD will provide guidelines to adopt the same style and types of mitigation for third party projects. The effectiveness of these measures and their management will determine the impacts associated with in-migration experienced in the Duqm area. Despite these measures and recommendations, the potential for breakouts of cultural conflict exists. The impact of such incidences might range from small to significant but the overall is considered to be low to medium.

8 STEP 5: ASSESS SIGNIFICANCE OF PREDICTED CUMULATIVE IMPACTS

The tasks carried out at this stage were to:

- Identify the significance of the impact for all VECs (including relevant individual receptors); and
- Discuss the thresholds relating to 'significant' or 'insignificant' impacts.

Any potential cumulative impact that warrants additional mitigation and/or monitoring beyond that identified in the ESIA should be considered significant.

The significance of a cumulative impact will be evaluated in terms of the potential resulting impact to the vulnerability and/or risk to the sustainability of the VECs assessed. This means evaluating cumulative impacts in the context of ecological thresholds. To be able to determine the significance of cumulative impacts, some limits of acceptable change in VEC condition will be used to which incremental effects can be compared. If the cumulative impacts of all combined developments on a VEC do not exceed a limit or threshold, the development would be considered acceptable. Thresholds are limits beyond which changes resulting from cumulative impacts become of concern; they are typically expressed in terms of carrying capacity, goals, targets, and/or limits of acceptable change.

When the magnitude of the effect for each VEC is known (Step 4), the sensitivity of the receptor (identified in Step 3) was considered and along with a determination of the probability of the effect occurring, the significance of the impact assessed.

To enable a transparent and repeatable assessment, we have used the generic criteria for levels of magnitude, sensitivity, and value (identified in the earlier steps) to determine the significance of the impact using a matrix (see Table 8-1). However, given the role of professional judgement in the assessment process, there may be some variation between subject areas in the significance rating process and the matrix in Table 8-2. In addition, the relevance of these criteria to a quantifiable threshold or level of acceptability of change has been clarified where necessary.

Receptor	Magnitude of Effect					
Sensitivity/value	Very High	High	Medium	Low	Very Low	
Very High	Major	Major	Moderate	Minor	Minor	
High	Major	Moderate	Minor	Minor	Negligible	
Medium	Moderate	Minor	Minor	Negligible	Negligible	
Low	Minor	Minor	Negligible	Negligible	Negligible	
Very Low	Minor	Negligible	Negligible	Negligible	Negligible	

Table 8-1: Matrix for Assessing Impact Significance

The definition of the significance ratings for the impacts are provided in Table 8-2. These provide both the definition of impacts determined through the matrix approach above or that using professional judgement.

Significance	Description
Major	Very large or large change in environmental or socio-economic conditions. Effects, both negative and beneficial, which are likely to be important considerations at a national to regional level because they contribute to achieving national / regional objectives, or, which are likely to result in exceedance of statutory objectives and/or breaches of legislation.
Moderate	Intermediate change in environmental or socio-economic conditions. Effects that are likely to be important considerations at a regional and local level.
Minor	Small change in environmental or socio-economic conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision-making process.
Negligible	No discernible change in environmental or socio-economic conditions. An effect that is likely to have a negligible or neutral influence, irrespective of other effects.

 Table 8-2: Generic Description of Significance Ratings

Where impact significance could not be determined, this has been noted. The assessment of significance has also taken into account the significance determination in CIA, and has been undertaken on the basis that the updated mitigation measures will be successfully implemented, and similar mitigation measures would be expected to be implemented for the other projects.

8.1 Significance of The Cumulative Impacts

The significance of the cumulative impacts is considered below on the basis of the assessment of the magnitude of the effects in Section 7, and in relation to the sensitivity/value of the likely VECs as provided in Appendix D to Appendix J **Error! Reference source not found.**. The collated VEC cumulative impact significance is provided in Table 8-1.

8.1.1 Ecosystem Services/Natural Resources

8.1.1.1 Natural Capital

Cumulative impacts on natural resources are assessed to be Very Low in magnitude during construction and operation. Receptor sensitivity is Low though of High value. Consequently, the cumulative impact is considered to be of **Negligible** significance during construction and operation of the MIGA projects.

8.1.1.2 Land Use

With the sensitivity of receptors judged to be medium, but the potential magnitude to be low to high, there is **Minor** negative cumulative impact predicted in relation to land use.

8.1.2 Physical Environment

8.1.2.1 Air Quality

See Community and Health section below for cumulative air quality significance.

8.1.2.2 Green House Gas Emissions

Cumulative impacts from the Projects and its components' contribution of GHG emissions are assessed to be Very Low in magnitude during construction with respect to the global challenge of climate change. During operation of the MIGA funded projects there will be no to minor GHG emissions, however, the major contribution is from third party projects but cumulatively the emissions are of low magnitude. Receptor sensitivity is High and of High value. Consequently, the cumulative impact is considered to be of **Negligible** significance during construction and operation. The overall contribution of GHG emissions from the development of the wider Duqm SEZ, once operational, will make a significant contribution to the carbon footprint of Oman and the Government will need to manage its balance of contributors in line with its international treaty and convention commitments.

8.1.2.3 Noise

See Community and Health section below for cumulative noise significance.

8.1.2.4 Groundwater

Cumulative impacts on groundwater are assessed to be Very Low in magnitude during construction and operation. Receptor sensitivity is Medium though of Low value. Consequently, the cumulative impact is considered to be of **Negligible** significance during construction and operation of the MIGA project.

8.1.2.5 Soil

There are no cumulative impacts predicted in relation to land use.

8.1.2.6 Surface Water

Cumulative effects on surface water are assessed to be Very Low in magnitude during construction and operation. Receptor sensitivity is High though of Medium value. Consequently, the cumulative impact is considered to be of **Negligible** significance during construction and operation of the MIGA project.

Without mitigation and consistency (e.g. in the location, layout and screening/planting of plots) of mitigation within the Duqm SEZ, **Negligible** negative impacts could occur in respect of the impact of new development adjacent to MIGA funded Projects and other third-party projects.

If SEZD is able to adopt on landscape and visual intrusion, cumulative impact can be minimized and opportunities taken to enhance the landscape – in what is a long-term and planned industrial /commercial zone. There are no significant cumulative impacts predicted in relation to landscape.

8.1.4 Biodiversity Marine Ecology

Appendix K and Appendix L state the significance of the potential construction and operation phase cumulative impacts for the marine VECs.

8.1.5 Terrestrial Ecology

Appendix K and Appendix L state the significance of the potential construction and operation phase cumulative impacts for the marine VECs.

8.1.6 Socio-economic

8.1.6.1 Construction Phase

Cumulative effects on local communities, local employment (including livelihood) and economy (including tourism and other potential economic impacts such as inflation of local commodities/services and wages) and local infrastructure are assessed to be of Medium magnitude during construction. Receptor sensitivity is considered to be High for the construction phase. Consequently, the cumulative impact of the construction phase on the local community, local employment and economy, as well as their health and local infrastructure is considered to be of **Minor** significance (negative). The cumulative impact of the construction phase on local employment and economy is considered to be also of **Minor** significance (positive).

8.1.6.2 Operation Phase

Cumulative effects on local communities, local employment (including livelihood) and economy (including tourism and other potential economic impacts such as inflation of local commodities/services and wages) and local infrastructure are assessed to be of medium magnitude during operation. Receptor sensitivity is considered to be High for the operation phase. Consequently, the cumulative impact of the operation phase on most social receptors is considered to be **Minor**. However, for the local economy and community health the magnitude was considered to be Medium and the receptor sensitivity High, resulting in **Minor** (positive) and **Minor** (negative) significance, respectively.

8.1.7 Community and Health

8.1.7.1 Air Quality - Community

Construction Phase

Cumulative effects on air quality are assessed to be Medium in magnitude during construction. Receptor sensitivity is considered to be High and the receptor value is considered to be **Minor**. Consequently, the cumulative impact of the construction phase is considered to be of Minor significance.

Operation Phase

Cumulative effects on air quality are assessed to be Medium in magnitude during operation. Receptor sensitivity and value are considered to be High and Low respectively. Consequently, the cumulative impact of the operational phase is considered to be of **Minor** significance.

8.1.7.2 Noise - Community

Construction Phase

Cumulative effects on noise are assessed to be Low in magnitude during construction. Receptor sensitivity and value are considered to be Medium and Low respectively. Consequently, the cumulative impact of the construction phase is deemed to be of **Negligible** significance.

Operation Phase

There are no cumulative impacts predicted in relation to noise during the operational phase.

8.1.8 Visual Amenity

Please refer physical Environment section above for the considered visual amenity magnitude.

8.1.9 Cultural Heritage

8.1.9.1 Archaeological Sites

Construction Phase

Cumulative effects on cultural heritage are assessed to be Medium in magnitude during construction. Receptor sensitivity is considered to be High and of High value. Therefore, the cumulative impact of the construction phase is considered to be of **Minor** significance in the context of successfully implementing the mitigation measures outlined in Section 7.

Operation Phase

Cumulative effects on cultural heritage are assessed to be Low in magnitude during construction. Receptor sensitivity is considered to be High and of High value. Therefore, the cumulative impact of the operation phase is considered to be of **Minor** significance.

8.1.9.2 Cultural

Please refer to Socio-Economic section above for cumulative cultural significance.

8.2 Thresholds of Significance

This section of the report discusses the relevant thresholds of significant or potentially significant impacts on the relevant VEC/Receptor Group, particularly where thresholds may be encroached or where there is uncertainty.

8.2.1 Ecosystem Services/Natural Resources

8.2.1.1 Natural Capital

Whilst any use of natural resources could be considered a threshold of significance, such a threshold is exceeded on a daily basis. The key threshold is whether the consumption of natural resources is exceeded to the point where the region can no longer support the requirements of the project. It is anticipated that this threshold will not be been exceeded.

8.2.1.2 Land Use

Minor negative cumulative impacts on land use and land ownership are anticipated based on the likely sensitivity of receptors (medium) and magnitude of effect (medium) Therefore, the VEC resilience to change is considered high and is expected to be able cope with cumulative changes. Moreover, based on discussions at SEZD, land acquisition will be limited to the currently ongoing resettlement process and no more households will be resettled.

8.2.2 Physical Environment

8.2.2.1 Air Quality

This has been discussed in Community and Health Section (Section 8.2.5) below for the threshold considered for air quality.

8.2.2.2 Green House Gas Emissions

The threshold of significance on the atmosphere from GHGs emitted from the developments considered in the CIA is not likely to be exceeded, based on the low contribution compared to national and international GHG emissions emitted every year. The climate change report has been prepared by CTEC and also explains the threshold of significance for the climate change.

8.2.2.3 Noise

The Section 8.2.5 on Community and Health of this report has described the thresholds considered for noise.

8.2.2.4 Groundwater

Any change to groundwater as a result of construction or operational activities could be considered a threshold of significance. Monitoring of the scheme and adoption of best practice principles will ensure any significant threshold is not likely to be exceeded.

8.2.2.5 Soil

No cumulative impacts on soil are anticipated. Therefore, the VEC resilience to change is considered high and is expected to be able cope with cumulative changes.

8.2.2.6 Surface Water

The capacity of the surface water drainage network is used to determine the threshold of significance of the MIGA funded projects and third-party projects, cumulatively with other projects which will be constructed more or less at the same time, or when operational. The threshold of significance considered for the surface water is not likely to be exceeded, based on the minimal cumulative influence identified.

8.2.2.7 Landscape

Any change of landscape could be deemed an exceedance of the threshold. The projects are located in an area of development (SEZ). As such, exceedance of significance is only applicable to where the project operates outside these areas. Hence any significance threshold is not likely to be exceeded.

8.2.3 Biodiversity

8.2.3.1 Terrestrial Ecology and Marine Ecology

Any damage to uncommon or rare terrestrial and marine habitats or species as a result of construction or operational activities could be considered a threshold of significance. Monitoring of the scheme and adoption of best practice principles will ensure any significant threshold is not likely to be exceeded.

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8.2.4 Socio-economic

8.2.4.1 Residential Population/Community – General

Any negative significant and/or permanent impact on local communities as a result of construction or operational activities could be considered a threshold of significance. Monitoring of the social management plans implementation and continuous consultations and dialogue with local communities and SEZD (as the main stakeholder in the area and project developer) will ensure any significant threshold is not likely to be exceeded.

8.2.4.2 Local Business/Economy

Some impacts on local employment and economy are predicted to be minor positive and some are minor negative, but both are not considered a threshold of significance. In addition, OPAZ/SEZD will be closely monitoring their EPC Contractors' In-Country Value strategy implementation which could present an opportunity to further optimize local employment in the area (thus optimizing positive impacts).

8.2.4.3 Local Infrastructure

Any negative significant and/or permanent impact on local infrastructure as a result of construction or operational activities could be considered a threshold of significance. The preparation of a traffic management plan by EPC Contractors and further dialogue and consultation with local communities and third parties on traffic management by SEZD will ensure any significant threshold is not likely to be exceeded.

8.2.5 Community and Health

8.2.5.1 Communicable Diseases – Community

Any negative significant and/or permanent impact on local communities' health as a result of an outbreak or spread of communicable diseases caused by the influx of workers (particularly during the construction phase) constitutes a threshold of significance. The Workers' Influx Management Plan and Community Health and Safety Management Plan implementation by EPC Contractors as well as regular training and refresher courses for workers on communicable diseases will help to ensure that this significant threshold is not exceeded.

8.2.5.2 Air Quality – Community

The relevant thresholds of significance with regard to air quality (the air quality objectives) were considered in the determination of the significance of impacts detailed in Section 7.

8.2.5.3 Noise – Community

The relevant thresholds of significance with regard to noise (the Oman and IFC objectives) were considered in the determination of the significance of impacts detailed in Section 7.

8.2.5.4 Visual Amenity

Please refer to Physical Environment (Landscape) section above for the threshold considered for visual amenity.

8.2.6 Cultural Heritage

8.2.6.1 Archaeological Sites

Cumulative impacts on archaeological sites are most likely to occur in the construction phase. Cultural heritage assets (i.e. the receptor in this case) has a resilience to damage or loss that is Low. Assets are not expected be able to cope with the cumulative risks of damage or loss, i.e., this physical change constitutes the thresholds for significance.

8.2.6.2 Cultural

Please refer to Residential Population/Community section above for the threshold considered for cultural mentioned in section 8.2.4.1.

Following are the tasks completed in this section:

- Design management strategies to address significant cumulative impacts on selected VECs; and
- Propose mitigation and monitoring programs;

The management measures needed to prevent cumulative impacts will depend on both the context in which the development impacts occur (i.e., the impacts from other projects and natural drivers that affect the VECs) and the characteristics of the development's impacts. Since cumulative impacts typically result from the actions of multiple stakeholders, the responsibility for their management is collective, requiring individual actions to eliminate or minimize individual development's contributions. Where cumulative impacts already exist, management actions by other projects may be needed to prevent unacceptable cumulative impacts. Management of cumulative impacts therefore, does not rest solely with developments that come later in the development sequence. Ignoring possible cumulative impacts during project development carries the risk of having unanticipated constraints imposed at a later time.

The analysis phase of the project CIA may indicate the need and/or potential for additional mitigation measures beyond those identified in the project EIA. The design of such additional mitigation measures for the development, if needed, is an early part of the work in this step of managing cumulative impacts. Iteration of the analysis (Step 4), significance evaluation (Step 5), and management (mitigation) design (this step) may be needed. If specific project mitigation that will prevent unacceptable cumulative impacts can be identified and implemented, then the developer may not need to initiate collaborative engagement of others in impact management. When prevention of unacceptable cumulative impacts by project mitigation alone is not possible, collaborative engagement in regional management strategies will be necessary.

As with the process of ESIA, the CIA approach to managing cumulative impacts revolves around the development of mitigation measures (either changes in design or construction/operational methods, or external measures (e.g. local outside the site boundary, regionally) such as offsets, creation, or compensation). Where significant cumulative impacts or potentially significant impacts remain, additional mitigation measures may need to be developed. The principles of mitigation should follow the hierarchy of mitigation which comprises the following in order:

- **Prevention**: changes to projects design (or potential location/orientation) to avoid negative effects on a VEC;
- **Reduction**: where prevention is not possible, negative effects should be reduced through sensitive treatments/design;

• **Remediation**: where negative effects are unavoidable, management measures can be introduced to limit their influence.

Where potential impacts will be highlighted, recommendations will be made as to whether further detailed monitoring or additional mitigation measures should be considered.

9.1 Recommended Measures

The following additional recommendations are made in order to prevent, reduce, or offset the potential significance of significant negative cumulative impacts where that impact is certain. Where uncertainty arises, monitoring is the appropriate approach to determining whether the impact is occurring and measures would need to be undertaken to ameliorate the scale of the impact to acceptable levels.

9.1.1 Air Quality

In order to reduce the risk of adverse impacts from above threshold ozone, PM_{10} and $PM_{2.5}$ at sensitive receptors during the construction phase, measures should include abatement and suppression of particulate emissions and dust re-entrainment in areas close to boundaries of the MIGA funded projects sites. This will assist in containing excessive dust, curbing potential dust nuisance and reduce incidence of elevated PM_{10} and $PM_{2.5}$.In addition, near real time fence line monitoring of both PM_{10} and $PM_{2.5}$ will provide early warning of any potential dust nuisance complaints, and allow site managers to be able to intervene in order to either relocate or cease dusty works.

9.1.2 Landscape

EPC Contractors on Project Facilities are responsible for landscape measures such as screening at Projects sites. SEZD will adopt the same standards of landscape initiative throughout the Duqm SEZ so that there is consistency in the style of mitigation and consistency in species (e.g. planting flora) for new tenants. These measures would include standard mitigation, for instance:

- Encourage laydown and support areas, under construction, to take up the minimum footprint in order to avoid unnecessary disturbance of existing landform and vegetation;
- Minimize lighting levels, duration of use, eliminating unnecessary lighting etc.;

- Minimize the use of reflective materials in construction, encourage the use of local stone and aggregate and muted color schemes to avoid glare and maximizing the best possible integration into the local environment; and
- Inclusion of native and xerophytic species in planting mixes.

These mitigation measures have been incorporated into all MIGA funded projects by SEZD.

9.1.3 Biodiversity

Appendix K and Appendix L contain mitigation recommendations to address potentially significant cumulative impacts. These measures are taken from the mitigation measures presented in the biodiversity assessment – basically they entail specific areas that can be taken up for conservation as biodiversity offsites or as natural open spaces or as areas landscaped with local vegetation. The principles behind these recommendations are equally as applicable to all future development projects in Duqm SEZ.

9.1.4 Socio-Economic

The minor (negative) impacts on local communities, their health and infrastructure during the construction phase will be remedied through the implementation of the ESMP and ongoing engagement and consultation with local communities and SEZD, as well as a robust Grievance Procedure developed by SEZD and which will be implemented by all EPC Contractors and their management personnel. Socio-economic impacts for MIGA funded project construction was considered to be positive. During operation phase of these projects as they are infrastructure projects the positive impacts shall be considered as negligible.

9.1.5 Cultural Heritage

The risks of cumulative impacts on archaeological sites during the construction and operational phase can be minimized through the application of the ESMP and ongoing engagement and consultation with local communities and SEZD.

9.2 Residual Cumulative Impacts

Where significant negative impacts were identified and mitigation measures recommended, the subsequent reduction in the magnitude and significance of the impact is discussed below.

9.2.1 Air Quality

Elevated concentrations of Ozone, $PM_{2.5}$ and PM_{10} are likely to occur over more during construction phase and less during operational phase of the MIGA funded projects and third-party projects. In order to reduce the likely harm to health of construction site staff and operational staff, specific occupational exposure mitigation measures need to be designed and put in place to limit site staff exposure to elevated particulate matter and ozone. In order to ensure occupational exposure mitigations are implemented during periods of elevated particulate matter and/or ambient ozone concentrations, it is recommended that continuous ambient air monitoring is undertaken during both the construction and operational phases of the MIGA funded projects. This needs to be designed to provide information that can inform management decision on the working environment, treatment and measures to remain within legal limits, hours of exposure etc. Therefore, occupational exposure mitigations can be put in place should elevated particulate matter and/or ambient ozone concentrations be detected on-site.

It is noted that SEZD plans to develop and implement a comprehensive airshed management system. As a result, OPAZ/SEZD is ramping up its existing policies, governance, systems, procedures and guidelines, including air quality monitoring and mapping to prevent significant deterioration of the regional airshed whilst carefully allowing incremental impacts from emissions of new industries. As decisions for permitting increments can only be based on established trends from airshed mapping, the modelling capabilities of the regional airshed become an important aspect of monitoring as shown below:



9.2.2 Landscape

For the Project, EPC Contractors will implement a variety of measures (e.g. planting native trees) that will address landscape and visual impact. SEZD will liaise on the development of third-party plots to ensure that development occurring on adjacent/neighboring plots and those taking place within the wider Duqm SEZ progresses on a consistent basis (e.g. third parties maintain continuous engagement with each other, local communities and SEZD); then, all moderate negative impacts will be reduced to the minor level.

EPC Contractors on Projects are responsible for landscape measures such as screening at Project sites. SEZD to adopt the same standards of landscape initiative throughout the Duqm SEZ (as part of Biodiversity Management) so that there is

consistency in the style of mitigation and consistency in species (e.g. landscape planting using native/endemic tree species). The same approaches need to be adopted during the operation phase because of the scale and extent of third-party development. If these initiatives are successful, then cumulative impacts will be

9.2.3 Biodiversity

reduced to negligible/low.

Appendix K and Appendix L state the residual impacts for each VEC. Provided the mitigation measures are implemented, most adverse impacts are reduced to a minor level. A major impact would still remain in the event of a major oil spill on all marine VECs. However, the recommended mitigation actions would markedly reduce the risk of occurrence of such a catastrophic event and enhance the chances of successful clean-up.

9.2.4 Socio-Economic

Provided all social management plans are implemented and OPAZ/SEZD and their EPC Contractors and operators to maintain continuous consultation/engagement with local communities, all moderate negative impacts will be reduced to the minor level.

9.2.5 Cultural Heritage

Provided the ESMP is implemented and SEZD and their EPC Contractors maintain continuous engagement with local communities and SEZD, all moderate negative impacts will be reduced to the minor level.

9.3 Summary & Implementation Framework

The Duqm SEZ is a strategic development by the Government of Oman based on a technical, commercial and planning studies carried out over the last two decades. The key ambition is to stimulate economic growth in order to attract industry, create employment, and market growth. This is being targeted for urban development in a dedicated area of land with responsibility for managing this with SEZD. There is therefore an opportunity to ensure that the growth of the SEZ takes place with robust principles of environmental, social and sustainability management in place.

By following the policies, sustainability framework, tenets, elements and principles of the suite of international environmental and social standards, SEZD with all these 7-infrastructure project (MIGA funded) – sets a good precedent for development. If other, consequent and subsequent third-party development follows these standards, and indeed new requirements that will become more developed under SEZD, the potential impacts of cumulative impact across the SEZ can be managed with control and oversight.

This assessment identified that whilst many negligible, negative and positive cumulative impacts could occur, only a small number of potential cumulative impacts

have been identified on the basis of the conservative assessment. A summary of all the assessed VEC cumulative impacts significance before mitigation is provided below in **Error! Reference source not found.** Table 10-1.

VEC	VEC Receptor	Sensitivity/ Value	Magnitude - Construction	Magnitude - Operation	Significance - Construction	Significance - Operation
Ecosystems	Natural capital	Low/High	Low	Low	Negligible	Negligible
Natural resources	Land use	Low/Low	N/A	N/A	Minor	Minor
Physical Environment	Air quality	High/Low	Medium	Low	Minor	Minor
Environment	GHGs	High/High	Very Low	Very Low	Negligible	Negligible
	Noise	Medium/ Low	Low	N/A	Negligible	Negligible
	Groundwater	High/ Low	Very Low	Very Low	Negligible	Negligible
	Soil	Very Low / Very Low	N/A	N/A	Negligible	Negligible
	Surface water quality freshwater/ marine)	High / Medium	Very Low	Very Low	Negligible	Negligible
	Topography / Landscape	Low / Medium	Low	Low to Medium	Negligible to Low	Negligible
Biodiversity	Marine habitats, flora and fauna	Appendix I	Appendix K	Appendix L	Appendix K	Appendix L
	Terrestrial habitats, flora and fauna	Appendix I	Appendix K	Appendix L	Appendix K	Appendix L
Socio- economics	Resident population	High / Medium	Medium	Medium	Minor	Minor
	Local business / economy	Low / High	Medium	Low	Minor (Positive)	Minor (Positive)
	Road traffic / transport	Low / Medium	Medium	Negligible	Minor	Minor
	Local infrastructure	Medium / Medium	Medium	Negligible	Minor	Minor

Table 9-1: Summary of VEC Cumulative Impact Significance

VEC	VEC Receptor	Sensitivity/ Value	Magnitude - Construction	Magnitude - Operation	Significance - Construction	Significance - Operation
Community and Health	Air Quality – community	High / High	Medium	Medium	Minor	Minor
	Noise – community	Medium / Low	Low	N/A	Negligible	Negligible
	Traffic – community	Low / Medium	Medium	Medium	Minor	Minor
	Visual amenity	Low / Medium	N/A	N/A	Negligible	Negligible
Cultural Heritage	Archaeology and cultural heritage	High / High	Medium	Low	Minor	Minor
	Culture	High / Medium	Medium	Low	Minor	Minor

It is important to note that the above impact ratings and significance of cumulative impact assessment applies to the existing scenario wherein SEZD is still in the early development stages of implementing the requisite common infrastructure of the industrial area, urban center, tourism zone and overall logistics and transportation scenario related to port, fisheries, oil and the built environment.

As more anchor and supporting industrial facilities and other commercial and tourism enterprises get setup and operational, there is bound to be greater degree of cumulative impacts and hence higher level of engagement with all stakeholders in supporting the overall development of the SEZ whilst minimizing impacts and developing it stylized on Eco-Industrial Park (EIP) of UNIDO's sustainability guidelines (or similar international guidelines), performance indicators and overall guidelines on management system.

At the time of preparation of this report, internal stakeholder consultations with various departments within SEZD were being conducted on the implementation framework and its rollout process with regards to ESMS, especially how it ties in with other programs such as:

- Overall framework manual on ESMS **SEZD-ESMS-MAN-001-01**;
- Stakeholder Engagement Plan **SEZD-SEP-PLN-001-01**;
- Cumulative Impact Assessment linkage with Resource Efficiency and Pollution Prevention Program discussed in the subsequent chapter of this report;
- Biodiversity and Ecological Services **SEZD-BDM-PLN-001-0**1; and
- Climate Change and Greenhouse Gas Management SEZD-CCGHG-PLN-001-01.

Since the above programs are all linked and form a part of the overall E&S policy and risk management framework, it is important to assimilate and embed them into

SEZD corporate governance system. In this regard, please refer to the technical memorandum at the end of this report which proposes a staged approach towards implementing various provisions in a sustained manner

10 RESOURCE EFFICIENCY AND POLLUTION PREVENTION

After Step 6 of the CIA, CTEC has prepared a guideline on resource efficiency & pollution prevention and set minimum standards (e.g. Good International Industry Practice (GIIP) for resource efficiency measures into projects within the SEZ on best effort basis. The Resource Efficiency and pollution prevention Guideline also includes resource efficiency measures to be integrated into operational and maintenance plans, and the management plans of future tenants' projects.

Guideline for resource efficiency and pollution prevention is based on IFC Performance Standards (PS) i.e. PS -3 and the IFC "Environment, Health and Safety Guideline" requirements. This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices.

Following are the objectives of this performance standard:

- To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities;
- To promote more sustainable use of resources, including energy and water; and
- To reduce project-related GHG emissions.

In addition to PS-3, to draft the guidleins for resource efficency and pollution prevention, CTEC proposes UNIDO's eco-industrial park concept that covers resource recovery and pollution prevention concepts within the framework of industrial ecology.

10.1 Resource Efficiency & Good International Industry Practice (GIIP)

This guideline focuses mainly on energy, waste, water and landuse with a concept of industrial ecology i.e.one's waste is other's feed. This guidelines will provided methodlogy and framework for conductiong stuides for - energy audits, solid waste resource recovery, wastewater recycling and efficient landuse practices with pockets of biodiversity in landscaped areas. Based on the category of the projects the requirement of submitting Resource Efficiency Plans will be mandated. High level concept plan is provided in Figure 10-1. Following key points will be considered but not limited to:

 Reducing energy consumption for the same level of production or services; or increasing productivity and creating more products/services output with the same level of energy consumption;

- Establish energy management programs (regular measurement and reporting of principal energy flows, definition and regular review of energy performance targets);
- Provide adequate energy efficiency measures (e.g. ensure adequate insulation, properly design work layouts and processes, use of efficient transport (e.g. electric and hybrid), use renewable energy (solar, wind), increase co-generation, waste heat recovery, and combustion efficiency); and
- Implement principles of Cleaner Production etc.



Figure 10-1: High Level Concept for Resource Efficiency

10.2 Pollution Prevention

The main focus of the pollution prevention guideline is to on the adoption of cleaner technologies and techniques, and which shall be applicable to a wide range of sectors (i.e., industry, infrastructure, housing, and hospitality services) and

organization sizes (from a large petrochemical plant to a small industrial enterprise). A strategy that reduces and avoids pollution and waste throughout the entire production cycle, starting with product design, and then moving to manufacturing issues such as efficient use of raw materials, energy, and water will be applied to formulate guideline. It also acts as effective measure for climate change mitigation because of its potential to reduce GHG emissions. The process that shall be followed is 7 steps for pollution prevention as per World Bank as illustrated in Figure 10-2.



Figure 10-2: 7 Steps for Pollution Prevention

Following points will be considered for pollution prevention guideline but not limited to:

- Avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release by all tenants in SEZD. This should apply to release of pollutants to air, water, and land due to routine, non-routine, and accidental circumstances with the potential for local, regional, and transboundary impacts;
- Where historical pollution such as land or ground water contamination exists, the Consultant has to determine who is responsible for the mitigation measures, SEZD or tenants. The guidance on how the liabilities will be resolved in accordance with Omani law, or where this is silent, with GIIP, has to be included in the study;

- Address potential adverse project impacts on existing ambient conditions. Relevant factors, like (i) existing ambient conditions; (ii) the finite assimilative capacity of the environment; (iii) existing and future land use; (iv) the project's proximity to areas of importance to biodiversity; and (v) the potential for cumulative impacts with uncertain and/or irreversible consequences will be considered; and
- In addition to applying resource efficiency and pollution control measures as required in this Performance Standard, when the project has the potential to constitute a significant source of emissions in an already degraded area, additional strategies and measures that avoid or reduce negative effects has to be provided. These strategies will include, but not be limited to, evaluation of project location alternatives and emissions offsets.

10.3 Recommended Framework for SEZD, Industries and Tenants

It is to be noted that both Resource Efficiency and Pollution Prevention programs can be integrated into SEZD's ESMS stylized on the Implementation Handbook for Eco-Industrial Parks (EIP) published by United Nations Industrial Development Organization (UNIDO) in CY 2017 to promote Inclusive and Sustainable Industrial Development (ISID). The EIP incorporates industrial ecology in its planning, design and operations to encourage sharing of resources between industrial plants and zones so that bi-products, waste streams, off-spec items, reject heat, wastewater, etc. emitted from some units can serve as raw materials or feed streams for other units in the EIP. This process of Resource Efficient and Cleaner Production (RECP) enables sustainable consumption and production. For instance, in case of waste management, the RECP process entails concept presented in Figure 10-3, which integrates pollution prevention and resource efficiency processes.



Figure 10-3: Waste Management RECP Process

The RECP also results in building resilient infrastructure and foster innovation. Most importantly, EIPs serve to catalyze all UN SDGs (to various extents), but most explicitly to one presented in Figure 10-4.



Figure 10-4: RECP, Building Resilient Infrastructure

In the UNIDO publication of November 2019, a cross-disciplinary team on industrial parks assessed and benchmarked over 15 industrial parks in Asia and Africa to conclude that EIPs deliver various benefits such as: reducing operating costs and improving productivity; greening supply and value chains; mitigating climate change; and improving resource efficiencies of materials, water, and energy. As presented in the figure below, UNIDO's continuous improvement program module in the EIP framework entails performance indicators for 3 core categories – such as economy (61 KPIs), social (81 KPIs) and environmental (59 KPIs) as provided in Figure 10-5.



Figure 10-5: UNIDO's Continuous Improvement

Whilst most pollution prevention and resource efficiency programs are fixated on the conventional environmental, energy, ecology and industrial processes, RECP covers a wider scope that includes social and economic performance parameters as well. The ESMS and KPIs together serve as risk management strategies as presented Figure 10-6.





Figure 10-6: Risk Management Strategies

Whilst SEZD develops the framework and implements select KPIs based on EIP for the SEZ, the industries and other economic sectors in SEZD, especially large industries, would follow the standardized Global Reporting Initiative (GRI) G4 style standards which cover all major industrial and economic sectors.

As the earliest champion of sustainability reporting, GRI started back in CY 2000 as an independent body collaborating with UNEP to develop robust framework and sector standards which have gone through many revisions. These standards are detailed and provide guidance at the generic corporate and sector-specific level – they are ideally suited for Oman and most countries that do not have sector-specific guidelines on pollution prevention, resource recovery, sustainability, etc.

Over the last few years, the GRI G4 standards have been revamped to align with UN's SDGs as well as ESG reporting guidelines used for reviewing sustainability performance of businesses and benchmarking them against best-in-class standards to assess their overall performance and management's commitment to minimize impacts – as a result, several new modules on governance and climate change topics and KPIs have been added to GRI standards as shown in Figure 10-7.

The approach for implementing Cumulative Impact Assessment, Pollution Prevention and Resource Efficiency provisions therefore entails:

- UNIDO's KPIs and EIP systems for implementing continuous improvement programs across SEZ, especially for assets and areas operated by SEZD; and
- GRI G4 sustainability reporting for industries and tenants located in SEZD so that they are able to implement continuous improvement programs and track sector-specific KPIs.



Figure 10-7: GRI G4 Reporting

It is important to note that the above provisions (customized to SEZD) will be written into SEZD's ESMS along with the Stakeholder Engagement Plan after internal consultation workshops are conducted over the coming months.

10.4 Integrated implementation

As opposed to borrowing heavily from USEAP provisions on Pollution Prevention Plans and Resource Efficiency which are in turn based on Federal Regulations of EPCRA 1986 and SARA Title III list of chemicals, SEZD proposes a more customized approach that is suited to the SEZ since such regulations and requirements do not specifically exist in the current Royal Decrees and Ministerial Decrees. Please refer to the last chapter on the combined implementation of Integrated Resource Efficiency and Pollution Prevention Program (IREP3) along with cumulative impact assessment.

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11 STAKEHOLDER DISCUSSIONS ON THE IMPLEMENTATION MODEL

This concluding chapter focusses on the implementation model for bringing along the key drivers of CIA which manifest specifically in terms of Integrated Resource Efficiency and Pollution Prevention Programs (IREP3). Risk mitigation and continuous improvement through 3Rs – reduce, reuse, and recycle strategies – are the most important components of IREP3. These are typically conducted at sourcelevel and also at higher levels between clusters of industrial plants or commercialresidential-tourism areas that share certain common themes.

The discussion below presents an approach for mapping international sustainability standards and KPIs into IREP3 for large industrial facilities and commercial/hospitality developments with SEZD providing overall governance to enable the sustainability concepts of industrial ecology and built environments are embedded and institutionalized in the management systems.

11.1 Industrial Facilities

The large industries are definite candidate for IREP3 and are typically funded by lenders as they form anchor industries of the SEZ. The small chemical plants, manufacturing, fabrication and assembly units are usually less emissive and resource intensive – however, their applicability to IREP3 is subject to ESMS reviews and the following SEZD-specific screening thresholds, the exceedance of which may make the relevant parameter material for consideration in the IREP3 program.

#	Resource	Threshold V ³ alues	Requirements to be covered in the IREP3
1	GHG Emissions	> 0.1 Mtpy CO2 Eq	GHG & Energy Management + KPI
2	Seawater Cooling	> 10,000 m3/hour	Marine Biodiversity Offset + KPI
3	Flaring	>15,000 m3/day	Flare Gas Management + KPI
4	Water Usage	> 500 m3/day	Water Management + KPI
5	Marine Spill	> 100m3/day	Marine Spill Management + KPI
6	Land Spill	>10 m3/day	Land Spill Management + KPI
7	Industrial Waste	>10 tons/day	Storage on site <200 tons & management KPI
8	Emissions	> 1,000 TPY VOC, > 100 TPY NOx	Contribute to Ambient Air Quality Network Upkeep and Emissions Reduction + KPI

Tabla 11_1.	Scrooning	Critoria for IRED3	Applicability	to Industrias
	Screening		Applicabilit	y to muustries

³ These value are based on literature review and the bandwidth that typically applies to Oman based on industrial capacities and their potential to consume, emit and impact on the cumulative environment.

#	Resource	Threshold V ³ alues	Requirements to be covered in the IREP3
9	Chemical Usage in Process	> 100 TPD - Toxic, Corrosive, Hazardous	Leak Detection Repair & Maintenance (LDAR) Program KPIs + Process Safety Improvements
10	Land Take	>50 Ha	Offset Equivalent Biodiversity Area & Develop Stormwater Management Plan
11	Sewage	>100 m3/day	Contribute to the conservation of Natural Open Spaces and Landscaped Areas of SEZD
12	Category A facility per IFC/WB	ESIA submissions per Equator Principles	 Quality Certified to ISO 9001 Environmental certified to ISO 14001 H&S certified to OSHAS 18001 GRI G4 Reporting relevant to their sector
13	Industrial Ecology & Value Creation	Amongst similar sector industries	Joint efforts/budget projects to be ongoing to discover synergies and pool in resources.

Hence Environmental Assessment (EA) of operations (such as blending, surface coating, etc) and activities (such as purging, flaring, etc) are conducted to identify specific constituents (such as GHG, BTEX, heavy metals, etc) and aspects (such as energy, water, etc) whose release or usage can be minimized through initial desktop and detailed feasibility studies of shortlisted alternatives.

These may include process changes, material substitutes, alternative technologies, operational modifications, physical transformations, etc. Typically, for the selected mitigation alternative, other aspects such as post-EA, Hazard Assessment, Monitoring, Management and Institutional Capacity components are studied to ensure that the pre and post EA process truly result in resource recovery and/or pollution prevention.

Usually, the baseline pollution rate for the selected year is identified along with certain reduction percentage to be achieved by a specific year. For instance, if X tons of VOC/ton of product is the baseline pollution value for solvent based formulation and the IREP3 process identifies 30% reduction in this factor by changing over to low-VOC coating formulations over a 2-year cycle, then the technical, financial, operational and training aspects are figured out within the plant with various departments and product/technology vendors and these are financed internally or through external funding.

For the most part, IREP3 initiatives having payback of less than 1 to 2 years are funded out of the plant's repair and maintenance budgets, whilst those requiring significant investments and having payback of 3 to 5 years are planned as CAPEX projects. Another example maybe spent-metal shot from surface preparation – these could be deemed hazardous due to de minimis quantities of heavy metals that are removed from chipping of paints. Since such wastes are generated in copious quantities, they can be processed on site and part-recycled back to the process whilst the rest can be premixed with cement and batched as interlocks for paving

parking lots, etc. Likewise, hazardous sludge, waste solvents, still bottoms, etc. having calorific content can be fired up at rotary kiln incinerators with waste-heat boilers to recovery steam/energy. The above are both CAPEX type IREP3 examples and may entail 5 to 7-year payback.

In most instances, IREP3 projects are taken up internally by the plant's planners and engineers as a multidisciplinary effort to minimize wastages, generate savings, avoid frequent repairs and shutdowns, or even embed advanced materials, technologies, etc that improve the quality, processing time or minimize energy inputs. The above initiatives translate into visible improvements to KPIs reported in GRI G4 performance reporting to the lenders and stakeholders – please refer below to the KPIs reportable under GRI framework for oil & gas industry, especially for the Environmental category.



Figure 11-1: Sample KPIs of GRI G4 KPIs applicable to Oil & Gas Industry

The World Bank's Pollution Prevention and Abatement Handbook of 1998 covers 38 Industrial Sectors including Aluminium, Base Metal, Chlor Alkali, Coke, Dye, Glass, Steel, Fertilizer, Oil/Gas, Refining, Power, Textiles, etc., each having pollution prevention and control guidelines, treatment technologies, emission guidelines and monitoring/reporting. The industries can refer to GRI or WB or EU BAT or industryspecific guidelines to develop their IREP3 framework and specific reportable KPIs.

The Environmental Social Governance (ESG) standards preferred by the institutional investors and index funds for rating and ranking corporates and sectors use KPIs that are quite similar to GRI G4 standards. The US based ESG funds use SASB standards whilst the European ones use EFAAS standards. All these standards are available on the internet – however, both GRI and ESG standards map into Sustainable Development Goals (SDGs) of the UN and these are being increasingly being relied upon by the lending and investing communities as indicators of sustainability performance.

The enforcement of IREP3 framework on Category A industries and other manufacturing facilities that trigger any of the 13 screening criteria enumerated in Table 11-1 is primarily through the issuance and renewal of environmental permits, review monthly monitoring records, plant inspections, enforcing mitigation consent orders per timelines for standards that are exceeded, and insisting on IREP3 plan for the baseline year and updates for subsequent years along with KPIs that show the status of continuous environmental improvement programs vis-à-vis the planned improvements.

The industrial developments at SEZD are still in their initial stages with most of them under planning, design and construction stages. With significant headwinds in the economy, depressed oil prices, and virtual lockdown due to the ongoing viral pandemic in the first half of 2020, these effects may last until the end of 2021. It is likely that liquidity and investor confidence may return in a significant way to take the investments forward by 2022 and by 2025 after DRPIC is commissioned and stabilized other developments may start to materialize.

Therefore, the rollout of IREP3 could be targeted for CY 2022 and active implementation by 2025. However, in the interim, the IREP3 provisions may be mandated on existing facilities such as the port, drydock, power, water and other infrastructure facilities that have been in operation for quite some time and come to stability.

11.2 Commercial & Hospitality Developments

The SEZD masterplan includes detailed planning of urban and tourism zones that entails purposefully built environments that offer suite of mixed land use, quality of life and hospitality options such as retail, entertainment, office parks, hotels, and residential areas with proper transport, drainage, civic amenities, and landscape along the lines of sustainability.

Although these typologies are not polluting or as energy intensive as the industries, there are specific guidelines and KPIs for the real estate sector which cover the following parameters that can be incorporated in the IREP3 framework and driven through continuous improvement programs.

#	Resource	Threshold	Requirements to be covered in the IREP3
1	Energy Usage	> 10 MWHr/month	Energy Management KPIs, Green Building Standards, Renewables, Solar Lights, etc
2	Water Usage	> 200 m3/day	Water Minimization and KPIs
3	Municipal Waste	> 30 tons/day	3R program and KPI
4	Land Take	> 20 HA	Offset Equivalent Biodiversity Area

Table 11-2: Screening Criteria for IREP3 Applicability to Commercial &Hospitality Tenants

5	Wadis Drainage	> 250m length	Setback from Wadi and Enabling Native Vegetation to Prevent Wadi Erosion
6	Synergies amongst Like Sectors	Especially tourism and mixed land use	Pool resources for preserving and monitoring dunes, ecology, wadis & seawater quality

The Atkins masterplan for the Duqm Urban City outlines specific sustainability requirements and indicators for various development typologies and their locations within the masterplan. The GIS, urban design and planning group at SEZD has a detailed development control planning framework (DCPF) for approving masterplans with specific conditions on site preparation, drainage, landscaping, sustainability, etc which are part of the building permit without which developers cannot authorize contractors to undertake site works.

The implementation of IREP3 would be through developer's agreements, building permits and environmental permits that apply to largescale developments. In addition, during permit renewals and by reviewing monitoring records and site inspections, SEZD can insist on submissions of IREP3 for the baseline year and updates for subsequent years along with KPIs that show the status of continuous environmental improvement programs for the resources identified in Table 11-2 above. However, as stated above, these programs can be rolled for active implementation by CY 2025. In the interim, the IREP3 provisions can be rolled out for existing properties such as Renaissance Accommodations, SEZD properties, etc.

11.3 IREP3 Enablers at SEZD

Other than OPAZ/SEZD owning, operating and managing the assets of the common infrastructure, it is also the governing body and authority for setting the agenda of development, creating investor-friendly policies and enabling ecosystem that align the recommendations coming from environmental & social action plan (ESAP) besides those coming from this study, climate change, biodiversity, stakeholder engagement plan, etc.

The whistleblowing mechanism afforded by the monitoring and mitigation apparatus in the previously described cumulative impact assessment methodology needs to be built into IREP3. These enable tracking, review, course correction and transforming environmental challenges into growth opportunities in low-carbon green economy. By layering in these aspects along with IREP3 through working forums, sustainability funds, etc, there will be deeper engagements and joint workings to create new products and services using the combined enterprise, resources, co-products and waste streams within SEZD, Oman and the region. This will create the scale required for creating localized low-cost innovative solutions and building unique expertise that will transform SEZD SEZ into an industrial knowledge and technology hub.

As highlighted in the previous discussions, the Eco-Industrial Park (EIP) model of UNIDO is ideally suited for SEZs such as SEZD. However, many aspects of EIP risk

management and performance evaluation need to be modified to suit Omani legislative framework, market conditions and local culture and tradition. Clearly, some of the economic, environmental and social performance indicators and scoring methodology do not apply to SEZD and a customized framework needs to be created. This entails conducting several consultations and workshops with senior leadership to articulate a suitable way forward in anticipation of the SEZ coming to maturity by 2025 when there is critical capacity of operating industries, commercial/hospitality and service sectors.

In the current economy and ongoing recovery from the pandemic-inflicted disruption, these discussions are premature. Therefore, it makes sense to propose the following initiatives at the corporate level to onboard the IREP3 framework.

#	Initiative	Requirement
1	ISO certifications – 9001, 14001 & 18001	Quality, Environment & Social Accountability
2	Enable Innovation & Training Centre	Green Meetings to discuss IREP3 workings
3	Matching, twinning & supplier-buyer linkages	Developing Value Chain of Industrial Ecology
4	Common Air Quality Network	Network of 3 stations that can be expanded
5	Marine Quality & Met-ocean Monitoring	Expand capabilities of Port of Duqm
6	Hazardous Waste Clearing and Disposal	Facility for Reception of Waste and Fees
7	Municipal Waste Treatment and Disposal	Facility for Recycling and Resource Recovery
8	Bilge and Ballast Water Reception at Port	Ship to shore reception and pre-treatment
9	Offshore disposal location for dredge spoil	Including innocuous material near coast
10	Composting of sludge to create top soil	Capable of accepting stabilized sludge
11	Renewable energy and storage options	Solar, wind and renewable project mix
12	Energy and Environmental Service Hub	To provide audits and sustainability services
13	Biodiversity and Ecological Service Areas	Offset areas, open spaces and landscapes
14	Sustainable life styles and smart city	LEED certifications and Smart Transport
15	1 st Change-mapping effort since CY 2012 to Assess Residual Cumulative Impacts	Sampling and ecological surveys Land, Marine, Coast, Air, Noise, & Groundwater

 Table 11-3: Onboarding the IREP3 Framework

It is important that some of the above initiatives be prioritized and identified in SEZD's Corporate IREP3 framework for rollout and implementation roadmap. Although some of the provisions may seem to be an overreach of capabilities with the limited resources in the current environment, these have to be nonetheless discussed internally during consultative meetings and workshops.

SEZD Duqm

11.4 Concluding Remarks

The findings and recommendations of CIA and IREP3 will need significant internal discussions and consultation on prioritization, rollout, resourcing and capacity building before SEZD is able to commit to specific actions and timelines. Due to the nature of force majeure events and dull economic projections all around, these programs will have to be on standby as the senior leadership of OPAZ/SEZD and indeed the Sultanate of Oman is engaged on more challenging matters. However, as a starting point for internal discussions, the following staged implementation process is being discussed:

- A 3-stage process of implementation is being discussed Start-up (2020 to 2024); Growth Phase (2025 to 2040); and Maturity Phase (2041 to 2060).
- The focus on the ESMS, IREP3 and other E&S programs are geared towards the Start-up Phase, which culminates with the key anchor industry of DRPIC being fully commissioned to stable operations. The theme of this phase is 'Rollout, Monitoring, and Training' to create the capacities and building the expertise required within the core ESMS governance functions before launching into the Growth Phase of CY 2025. The implementation proposal being considered for now is that all E&S programs will be resourced for 'Start-up Phase' in RMT mode. The detailed mechanics of implementation will come out in the ensuing months and will be adopted by the end of this year in a phased manner. In the interim, an internal 'Step-Out' mechanism will be adopted for implementation of ESMS governance besides internal consultations with the leadership, OPAZ/SEZD will engage with the lenders and agree on an action plan for the RMT phase' of 2025 to 2040.
- A budget may need to be set aside for the 15-year duration against the USD 1.7 billion loan amount. At a modest 2%, this works out to RO 13.08 million or about USD 34 million. This will be proposed to the Ministry of Finance and the lenders so that the amounts are ring-fenced as 'Environmental Funds' against which local banks are able to provide debt arrangements to approve large CAPEX projects for co-financing the IREP3 projects being implemented by tenants. These funds will also enable SEZD to privatize sustainability projects such as Biodiversity Offsets, Centralized Waste Treatment, etc through low-cost green bonds.

The above 3 points are at initial stages of discussions and need greater consultations which are beyond the scope of the current timelines. However, the 3rd point above on creating budgets is extremely important for the viability of applicable E&S programs and overall compliance with equator principles to reduce and manage such risks. Assuming that a negotiated understanding can be reached on the budgets, the process of instituting them within SEZD as 'Environmental Funds' for co-financing IREP3 projects and issuance of green bonds are likely to take time and need to be factored in as well.

12 ASSUMPTIONS AND LIMITATIONS

This CIA is undertaken based on the available information contained within the EIA/ESIA Reports made available by SEZD (As listed in Appendix K). Key assumptions and limitations are detailed below:

- Only Qualitative assessment for CIA is conducted, high level of modelling is considered for climate change;
- The CIA is restricted to Omani VECs and only concerns potential cumulative impacts associated with the Projects (i.e. within Oman);
- The assessment only considered residual impacts after the implementation of mitigation measures as detailed in this EIA/ESIA Report;
- The assessment has not considered any unplanned events;
- The details regarding the new development are limited and it is unclear whether these activities have been subject to any formal environmental impact assessment process. This is limitation on the CIA to only consider potential cumulative impacts on a qualitative basis in some cases; and
- The CIA excludes potential cumulative impacts during the Decommissioning Phase given that the decommissioning programme is uncertain and to be developed during the Operational Phase of the Projects, whilst other developments that may be taking place at the same time are also unknown.

Appendix A: Project Description of MIGA Funded Projects

Construction of Road No. 1 and Road No. 5 to link the Liquid Berth Terminal

This road Project 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.

The construction of Road No. 1 from its junction with Road No. 7 to its junction with the Duqm-Mahoot Public Road (National Route 32) was suspended during construction due to weak subsoil conditions ("sabkha") that were encountered. The construction of Road No. 5 was also similarly suspended. The current design has been prepared taking in to account the presence of sabkha along with the ground treatment and/or ground improvement proposed to enable construction in that area.

As shown figure below, the Project (Road Nos. 1 and 5) is located in Duqm, south of the Duqm Refinery, and bound on the west by the Duqm – Mahoot Road (National Highway No. 32) and on the east by the Duqm Port.



Road 1 and 5 Layout Plan

Conceptual Design Roadways

The roadways have been designed in conformance with the following standards:

- Sultanate of Oman Highway Design Standards (Vol. 1 & 2 June 2010 Edition);
- Sultanate of Oman Standard Specifications for Road & Bridge Construction (Vol. 3 June 2010 Edition); and
- All relevant and applicable American Association of State Highway and Transportation Officials (AASHTO) Design Standards.

Road No. 1 is approximately 3.93 km in length and Road No. 5 is approximately 3.3 km in length. The right of way for both the roads is 200 m. They are being 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 has been designed to accommodate extraordinary long vehicles called "Self-Propelled Modular Transport" (SPMT) for transporting the refinery equipment from Duqm Port to Duqm Refinery. Two long equipment (Vacuum Distillation Column and Crude Distillation Column) will be transported from Duqm Port to Duqm Refinery using Road No. 1. However, no hazardous material transported between Duqm Refinery and Duqm Port will be sent through this road, but through a service road that will come up later.

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.

Conceptual Design Peripheral Infrastructure

Drainage channels outside of the utility corridors are designed in order to provide the services directly to the plots without crossing the drainage channels. Since the existing ground within the utility corridor is unstable with shallow groundwater table, the ground conditions make it impossible to construct the utilities directly on the existing unstable ground. Therefore, it is proposed to fill the proposed utility corridor with approved suitable borrow material up to 3 m minimum and compacted in 25 cm embankment layers. The embankment fill material will be reinforced with the two geo-grid layers approximately 40 to 60 cm below the bottom of utilities to avoid the differential settlement.

The utility corridor and drainage channel plan illustrate the infrastructure that will be developed as part of the Project which will comprise of the actual roads, utility corridor, and the drainage channel.

Dugm Liquid Bulk Berths Projects

The present phase of the Duqm Liquid Bulk Berths Project (DLBB) Project only involves developing along half of the length of the current LBW; the rest of the LBW

is set aside for future development. Below figure highlights the area set aside for development as part of the present phase and the area earmarked for future development.



Phases of the project

Below figure presents the layout for the DLBB Project facility. Salient features of the project, construction and operation, which are covered in this EIA, are:

- Dredging of the liquid bulk berth basin
- Reclamation to the south of the existing LBW including ground improvement and foundation to support equipment, buildings, tanks, pipeline, and other equipment (as required)
- Construction of the following berths:
- Liquid product export berths (4 Nos)
- Bulk solids export berth (1 No)
- Spare berth (2 Nos)




Layout plan of DLBB Project

Installation of the following items on the berths:

- Ship loading equipment
- Pipelines
- Tanks
- Flare
- Auxiliary equipment
- Utilities
- Equipment for control of loading and shipping operations
- Access Road.
- Housing up to 5,000 personnel in an existing construction camp for the peak construction

Associated facilities such as access roads, pipelines, external drainage and power lines will be developed by third parties and will extend until the battery limit at the root of the LBW.

Marine Structures

As part of the Project, an area 150 to 350 m wide area will be reclaimed along the LBW and the area south of the reclamation will be dredged to -18 m CD. As part of the project, seven berths will be constructed. Below Table provides a summary of the berths.

Summary of Berths

Berth	Use	Proposed Structure
900	Dry Bulk Material Export Berth – Spare	Continuous Quay (Blockwork wall)
901	Dry Bulk Material Export Berth for Pet Coke and Sulphur	Continuous Quay (Blockwork wall)
902	Multi-purpose /Small Vessel Refined Product Export	Continuous Quay (Blockwork wall)
903 and 904	Liquid Refined Product Export Berth for Jet- A1 and Diesel	Double-sided Island Jetties (Concrete deck on steel piles)
905	Liquid Refined Product Export Berth for Naphtha and PLPG	Double-sided Island Jetties (Concrete deck on steel piles)
906	Liquid Refined Product Export Berth - Spare	Double-sided Island Jetties (Concrete deck on steel piles)

Topside Facilities

The DLBB Project will export refined products namely Naphtha, Jet A-1, Diesel, HSFO, PLPG, Pet Coke and Sulphur.

Refined liquids, such as Naphtha, Jet A-1 and Diesel shall be pumped from the refinery to the Terminal Storage Tanks, through the pipeline network from refinery. HSFO and PLPG will be pumped from the refinery by pipeline directly to the ships. Duqm refinery will be responsible for the construction and operation of the pipelines from the refinery to the DLBB Project terminal battery limit. The Pet Coke and Sulphur will be transported from the refinery to the DLBB Project by trucks owned and operated by the refinery. Export of product from the facility will be in 4 modes as listed below:

- Storing of product in tanks at the terminal (i.e. Naphtha, Jet A-1 and Diesel)
- Loading of stored products to vessels (i.e. Naphtha, Jet A-1, and Diesel)
- Loading products directly from the refinery to ships (HSFO and PLPG)
- Loading Diesel and Jet A-1 from storage tanks to road trucks
- Loading of bulk material by conveyor system on to vessels (Pet Coke and Sulphur)
- Miscellaneous Quay Furniture

Following Table presents a summary of miscellaneous quay that will be installed on the continuous quay and island jetties.

Miscellaneous Quay Furniture

Furniture	Comments
Rope Rails and Stainless-Steel Formers	Rope Rails and Stainless-Steel Formers will be used to prevent damage to the mooring lines. The island jetties will use rope rails, while the continuous quay will use stainless steel formers
Marine monitoring systems	The marine mooring systems will consist of the following sub-systems such as:
	Central control and monitoring equipment in control room
	Berthing/Dock Aid System laser based
	Mooring load Monitoring system
Oil spill containment equipment (Oil Boom)	The oil spill containment equipment will as a minimum meet the following requirements:
	Containment of spilled products
	Spilled product recovery
	Transportation and storage of recovered products
Kerbs and traffic barriers	Continuous kerbs will be provided around the loading platform to contain spills and reduce the risk of vehicles driving off the edge of the quay. Kerbs will also be provided along the edge of the quay wall with breaks at the bollard locations for the bulk berths. Traffic barriers will also be erected to direct traffic.
Access Gangway	Access gangways for light vehicles will be provided between the loading platforms and breasting dolphins. Only pedestrian access gangways will be provided to berthing and mooring dolphins.
Handrails	Handrails will be provided along the pedestrian access ways on any edge which is open to the water, excluding the port side edge and where they will interfere with normal operations of the berth such as berthing, un-berthing, mooring and ship loader/loading arm operations
Emergency ladder	A minimum of two emergency ladders will be provided for each loading platform and a minimum of one ladder on each breasting and mooring dolphin. For the continuous quay and access trestles, ladders will be provided at a maximum spacing of 30 m in accordance with BS 6349-2:2010.
Lifesaving equipment	Life-saving equipment such as life buoys, life jackets, etc. will be provided at all ladder locations
Jetty/Quay Service	The jetty will also offer various services such as low voltage, information technology, firefighting, compressed air, etc.
Utility trenches	Utility trenches and/or utility trays will be provided at locations to facilitate the functions of the berths and to avoid the obstructions at the platform due to the utility lines if installed above deck level.
Walkway services	Cable tray supports (cantilever structural members) at both sides of the walkway will be provided for an adequate number of cable trays considering the current requirements and spares for future use.

Buildings

Following Table presents details of buildings onsite.

Buildings at site

Building	Comments
Admin Building/ Control Room/Amenities	 3 storey RCC framed structure with blockwork infill Plan area of about 1,200 m² in each floor, i.e., 3,600 m² 50 users of admin building 25 operators in control room
Parking area	 Open area, for admin building. /control room Additional parking facility in front of workshop (if required) Tarmac pavement will be provided
Substations / Local Equipment Room	2 storey, RCC structureNumber of substations 6Number of operators 10
Workshop	Single floorSteel framed structureNumber of users 20
Guard house	Guard House complex will be a single-story building in protected air- conditioned environment consisting of
	 Approach road Main gates Security gates Time office Speed breakers Traffic barriers and Parking/waiting space –
Warehouse	Warehouse for storage of miscellaneous material
Firewater Pump House	Pump house for storage of fire water
Product Pump Rooms	Rooms housing pumps for transferring products. Details not available in current stage of the Project.
Bulk Storage Buildings	Sheds for storage of Pet Coke and Sulphur
Fire and First Aid Building	Buildings housing firefighting and response tools and equipment. Details not available in current stage of the Project.

Associated Facilities

Going by this IFC definition associated facilities to the DLBB Project are:

- Laying water line to the DLBB Project and the subsequent supply of water;
- Laying power supply power lines to the DLBB Project and will subsequently supply power;
- Developing the road for transport of Pet Coke and Sulphur from the refinery to the DLBB Project

- Laying the pipelines to transfer product from the Duqm Refinery to the DLBB Project
- Vessels used to export refined products from the DLBB Project
- Construction of Road No. 5

While, using the same definition the DLBB Project could be considered as an associated facility to the Duqm SEZ, Duqm Port and Duqm Refinery.

Associated Facilities - Utility Corridor

CUC will be responsible for the construction of the utility corridor within which Duqm Refinery will lay pipelines to transfer product from the refinery to the DLBB Project. CUC will also construct the road between the refinery and the DLBB Project. The Duqm Refinery will use trucks to transport Pet Coke and Sulphur from the refinery to the DLBB Project. The trucks will use the road constructed by CUC to transfer product. Following Table provides details of the same.

Product/ Utility	Mode	Construction by	Operation by	Expected Specifications
Diesel	Pipeline	Duqm Refinery	Duqm Refinery	16-inch pipeline
Jet-A1	Pipeline	Duqm Refinery	Duqm Refinery	10-inch pipeline
Naphtha	Pipeline	Duqm Refinery	Duqm Refinery	12-inch pipeline
HSFO	Pipeline	Duqm Refinery	Duqm Refinery	16-inch pipeline with insulation
PLPG	Pipeline	Duqm Refinery	Duqm Refinery	12-inch pipeline
Sulphur	Truck	Duqm Refinery	Duqm Refinery	25-ton tipping trucks
Pet Coke	Truck	Duqm Refinery	Duqm Refinery	25-ton tipping trucks
Power Lines	-	CUC	CUC	Requirement will be 15 to 20 MW approximate
Utility corridor	-	CUC	CUC	The utility corridor will contain all the above utilities

Associated Facilities – Utility Corridor

It should be noted that this mentioned this service corridor is also MIGA funded project, so this project is not treated as associated facility and complete description of this project is provided in this CIA report and treated as main project.

Associated Facilities – Vessel

It is expected that about 800 vessels will visit the DLBB Project every year. The vessels will be owned by independent shipping companies and their navigation within and around the port as well as the wider bay of Masirah will be directed by PDC. In addition to the movement of ships loading at DLBB Project, the ship movement in the area is expected to substantially increase. The activities leading to

an increase in shipping will be attributed to the development of SEZD industrial area, the Port and the Ras Markaz Crude Oil storage area.

As per the Royal Haskoning 2013 Master Plan, the traffic visiting the Port of Duqm excluding the LBW is expected to increase gradually, starting with 650 vessels in 2015 and increasing to 2800 by 2040.

PDC as port authority has assumed the responsibility for managing MARPOL waste generated by vessels visiting the port and at the DLBB Project. Following Table identifies the MARPOL waste streams and the proposed management strategy.

Waste Stream	MARPOL Waste Type	Management Strategy
Ballast water	Annex I	Offshore de-ballasting in accordance with MD 159/2005, MARPOL 73/78 and PDC's Port Rules and Regulations (under review)
Oily bilge water oily waste, oily mixtures, slops, sludge, oily tank washings, oily cargo residues,	Annex I	Collection by a contractor appointed by PDC using vacuum truck and subsequent treatment at a MARPOL facility
Domestic Waste	Annex V	The domestic waste shall be shifted from vessel by crew to a covered skip placed at a designated location on the jetty. PDC will appoint a contractor to collect this waste from this designated location for disposal at the municipal dumpsite or engineered landfill when it becomes available.
Sewage	Annex IV	The ships will have on-board facilities for the treatment and discharge of sewage
Bulk HW	Annex II	To be shifted by the vessel crew to a designated area on the jetty. PDC will appoint a contractor to collect this waste from the designed area.

Management of MARPOL Waste

All records of MARPOL waste discharged by ships (coming to DLBB Project terminal) to PDC's port reception facilities or marine environment will be submitted to DPTC. All Ship Operators will be required to comply with the requirements of MD 159/2005, MARPOL 73/78 and PDC's Port Rules and Regulations.

Associated Facilities – Road No. 5

The Road No. 5 will be, theoretically, the permanent access route to the liquid bulk berths. As such it represents another physical interface with the Project. A contract will shortly be let by SEZD to a design consultancy to re-visit the design of Road No. 5 together with Road No. 1. The road itself will be constructed on an elevated embankment which will ultimately provide flood protection, in conjunction with wadi channel diversion works. Prior to the completion of the Road No. 5 embankment and/or wadi channel improvements, the Project works, particularly the dredged areas, will be vulnerable to the effects of wadi flooding. Temporary flood embankments constructed by SEZD contractors from unsuitable material are considered inadequate without further reinforcement/erosion protection. This project is MIGA funded project and will be treated as main project under CIA consideration.

Infrastructure at the commercial pre-gate, gates and inspection zone of Port of Dugm (IP3)

The new Port of Duqm is developed on behalf of the Ministry of Transport and Communications (MOTC) to provide facilities for commercial, navy and coastguard vessels at a site approximately 450km south of Muscat in the Sultanate of Oman. The operation of the port will be managed by the Port of Duqm Company S.A.O.C, a 50: 50 joint venture between the Omani Government and the Consortium Antwerp Port (CAP). The Port's operations will include a variety of port activities (some of which are already taking place), principally comprising activities associated with operations at a dry dock area (for ship repair and maintenance), a commercial quay (for a container terminal, dry bulk terminal and multi-purpose terminal), government berths, a fast ferry terminal, liquid berths, a variety of storage areas, port gates and offices, utilities etc.

The Port of Duqm is developed in phases, with the first phase being the development and operation of the navigable areas within and outside the port, the commercial quay on the main breakwater (multi-use, container and bulk terminals), government berths, fast ferry terminal, finger pier, dry storage areas and all associated landside supporting infrastructure (e.g. gates, entry, buildings, offices, utilities, etc.). The second phase will see the development of the and operation of the liquid berth and liquid storage areas on the lee breakwater, whilst the third phase is envisaged to involve the increase mineral export, and the fourth phase will be when the commercial quay is fully operational as container terminal.

The Proposed infrastructure packages

First Part of the Commercial Berths in terms of three packages as follows:

- Package (IP2): Construction, commissioning and maintenance of the Construction of Roads, Infrastructure & Buildings at the Commercial Terminal & Operational Zone Areas, Port of Duqm.
- Package (IP3): Construction, commissioning and maintenance of the Construction of Roads, Infrastructure and Buildings at the Commercial Pre-Gate, Gates and Inspection Zone, Port of Duqm.
- Package (IP4): Construction, commissioning and maintenance of the Construction of Roads, Infrastructure and Building Works at the Government Berth Area, Port of Ductal.

Package 3 (IP3) Pre-Gate, Gates & Inspection Zone

The Scope of Works to be executed under this Contract for the Pre-Gate, Gates & Inspection Zone, Port of Duqm shall include, but not be limited to, the construction, installation, testing, commissioning and remedying of defects of the following:

Road and Paving Works	Construction of 8.00 Km roads with varied cross sections including the junctions on these roads. The roads are ROAD 02-2, ROAD 02-3, ROAD 02-4, ROAD 02 -5, ROAD 02 -6, ROAD 02-7, ROAD 02 -8, ROAD 02 -9, ROAD 02-11. Construction of all internal roads as access to buildings and Parking			
	areas.			
	 Construction of Parking areas to serve all activities. Supply and Installation of Traffic Signals. The Contractor shall carry- out the design, supply, installation and commissioning of Traffic Signals, complete, including all signal heads, loop detectors, ducting/cabling, controllers and power supply. Traffic Signal design shall be as per site requirements. 			
	• Construction of 2 Nos. of Helipad with an approximate area of 2,200			
	m2 in Zone 2 - Inspection Zone.			
Infrastructure Works	Potable Water Network and Fire Fighting Network Steven Water During as and Couverage Network			
	Storm Water Drainage and Sewerage Network Dump Stations and Electrical works			
	Telecommunications			
	Street Lighting and Yard Lighting			
	Share Ducts and Fencing and Gate works			
Duilding Works C 1 CO	 Block 1 A - Gate House & In Gate - Out Gate Booths 			
Gate and Pre-Gate	 Block 1 B - One Stop Station - Transaction Building 			
Area (Zone - 1)	Block 1 C - Pass Office Building			
	 Block 1 E - Mosque 			
	Block 1 G - Electrical Service Building (Type-1)			
	Block 1 G - General			
	 Block 1 H - Electrical Service Building (Type-2) 			
	Block 1 J - Fire Fighting Water Tank			
Building Works C.2	Block 2A - Custom - MoH Administration & Inspection Building			
Inspection Zone (Zone	Block 2B - MAF Inspection Building			
- 2)	Block 2C - MoH Clinic			
	Block 2D - Gate House			
	Block 2E - Electrical Service Building (Type-1)			
	Block 2F - Electrical Service Building (Type-2)			
	Block 2G - Fire Fighting Water Tank			
	Block 2G – General			
	Block 2K - Custom Inspection Staff Building			

Block 2L -Ammunition Building



Location of Package 3 (IP3) Pre-Gate, Gates & Inspection Zone



Layout of Package 3 (IP3) Pre-Gate, Gates & Inspection Zone

Saay Dam and Flood Protection Channels

Duqm SEZ is developed in accordance with this Masterplan with industrial, commercial and residential areas demarcated and joined with arterial roads. Masterplan foresaw at least two dams and three channels over the studied area to provide safe conveyance of stormwater and to protect area in terms of flooding.

The project comprehends the Saay dam and 3 channels (Saay channel, Jurf Channel and the junction of both channels till the sea outlet) positioned in the three main wadis, Wadi Saay, Wadi Jurf and Dangert. The aim of the project is to provide a significant degree of flood protection to the free zone area under development. The construction of attenuation dams and flood conveyance channels is likely to form the principal components of such flood protection measures. Dams will be situated upstream of the target area and channels shall be designed to convey the remaining water safely through the development area. The following figure shows the approximate location of the project.



Location of Saay Dam and Channel

The upstream dams are to be designed to ensure the attenuation of the peak discharge from the 1000 yrs natural discharge to a reduced value corresponding to the 100 yrs natural peak discharge.

Consequently, both channels are designed to withstand the 100yrs natural flood which is equivalent to the 1000 yrs event with the upstream dam implemented.

<u>Jurf Dam</u>

The aim of the project is to provide a significant degree of flood protection to the free zone area under development. The construction of attenuation dams and flood conveyance channels is likely to form the principal components of such flood protection measures. The Jurf dam will be situated upstream of the target area and convey the remaining water safely through the development area. The following figure shows the approximate location of the project.



Location of the Jurf Dam

General Design Criteria

International, American and European standards shall be used as well as the Oman Highway Design Manual and Sultanate of Oman General Specification for Roads.

As far as civil and building works are concerned, the American Codes, Standards and Recommendations shall be used for the design of the structures, except as otherwise mentioned. An inconsistent mixing of various standards on the same structures must be avoided because of the different safety factors in the critical load combinations for stability analysis and dimensioning. Nevertheless, where American Codes do not provide pertinent information, other codes could be followed as reference.

Main applicable organizations, codes, standards and recommendations are listed in the subsequent sections.

Dugm Refinery Service Corridor to Liquid Jetty

The proposed Project intends to provide centralized utilities and pipeline corridor for the proposed Duqm Refinery and several heavy/petrochemical industries coming within the proposed heavy industrial zone in SEZD for the planning horizon: 2017 – 2045.

The location of the Duqm Service Corridor (DSC) is shown in following figure, south of the proposed Duqm Refinery. The route of the DSC with the DSC alignment crossing a wadi (Wadi- Saay), approximately 3.5 km south of the Duqm Refinery before adjoining the Duqm Petroleum Terminal Company (DPTC).



Location of Service Corridor

The corridor plan shows the services infrastructure extending between the Duqm Refinery site and the DPTC Port fence. The major items in the service corridor will consist of pipelines of various sizes ranging from 12" to 36" dia., heavy haul traffic

road, service access road, pipe bridges, and buried power cables. In addition, the corridor would also include suitable provisions to accommodate utility requirements of various industries slated to come up in the heavy industrial zone within SEZD.

The service infrastructure corridor is proposed to be approximately 200 meters wide and 6 kilometers in length. The service corridor infrastructure will include pipelines, pipe supports, pipe sleepers, pipe bridges, service roads, etc.

The service corridor will include:

- Sleepers;
- Pipe Bridges above ground at Wadi Saay;
- Service roads including finished surface grading including lighting, power cables, barriers, bollards and road painting;
- Bunds for Pet Coke/ Sulphur roads;
- Patrol road made good excluding the black top asphalt;
- Fences and security system;
- Corridor drainage;
- Vertical pipe loops bridges (3 nos.);
- Completion of Corridor at refinery and at the Port (buried section, excluding pipelines and cables);
- Horizontal sleeper bends (6 nos.);
- Road junction profiling;
- Pipeline bedding, haunching & final covering, RC cable troughs, and road crossings at the Refinery South Road; and
- Power Cable trough below ground and C&I cable tray above ground.

VEC	Impact Source	VEC Receptor – Secondary Receptor	
Natural resources/ Ecosystem Services	Stress on water resources through consumption of potable water for construction / operation / decommissioning	Natural capital (freshwater and groundwater resources) – resident population / land use / local economy	
	Consumption of fossil fuels for vehicles, equipment, as feedstock, and as pilot gas for combustion devices.	Natural capital (oil, diesel, petrol and natural gas) – resident population / land use / local economy	
	Consumption of natural resources (mineral, wood and metal) for construction materials	Natural capital (wood, metal ores, rocks, geological deposits and aggregates) - resident population / land use / local economy	
	Alteration of land use for installation of project facilities and storage of construction and waste materials	Natural capital (Land use) – land owners / resident population	
	Release of air pollutants from various emission sources during construction / operation / decommissioning activities	Air quality – health and nuisance - resident population / employees / Terrestrial habitats, flora and fauna	
	Release of dust, PM10 and PM2.5 from construction / operation / decommissioning activities and road traffic		
	Lower atmosphere – climate (global population)	Temporary or constant greenhouse gas emissions (GHG) during construction / operation / decommissioning.	
	Increase in ambient noise levels from construction / operation / decommissioning activities, plant equipment and vehicles	Noise – health and nuisance – resident population / employees / Terrestrial fauna	
	Release of process and sanitary wastewater management (improper collection, storage, treatment and/or	Groundwater and Soil - resident population / employees / land use / local economy	
	uisposai)	Surface water (freshwater / marine) - biodiversity (flora and fauna) / land use / local economy	
	Release of non-hazardous (industrial and domestic) and hazardous substances during storage, handling and waste	Groundwater and Soil - resident population / employees / land use / local economy	
	папауеттет	Surface water (freshwater / marine) - biodiversity (flora and fauna) / land use / local economy	

Appendix B: Valued Environmental and Social Components

VEC	Impact Source	VEC Receptor – Secondary Receptor	
	Accidental release of oil / effluent into the marine and terrestrial environment during transportation, handling and processing	\Surface water (freshwater / marine) quality - biodiversity (flora and fauna) / land use / local economy	
	Dredging, reclamation and disposal activities at Export Terminal port basin, offshore borrow area and offshore dredge disposal area	Marine water quality - biodiversity (flora and fauna) / local economy.	
	Physical environment Land take for installation of project facilities and storage of construction and waste materials	Soil and Topography - resident population/ biodiversity (flora and fauna)	
Biodiversity	Temporary or permanent alteration to physical environment during construction / operation / decommissioning (indirect impact from above)	Terrestrial / Marine habitats, flora and fauna	
	Temporary or permanent disturbance during construction / operation / decommissioning	Terrestrial / Marine habitats, flora and fauna	
Increase in lighting / noise from operation		Terrestrial / Marine habitats, flora and fauna	
	Accidental release of oil / effluent into the marine and terrestrial environment during transportation, handling and processing	Terrestrial / Marine habitats, flora and fauna	
	Dredging, reclamation and disposal activities at \export Terminal port basin, offshore borrow area and offshore dredge disposal area	Marine habitats, flora and fauna.	
	Land take for site preparation / installation of project facilities and storage of construction and disposal of waste materials	Terrestrial habitats, flora and fauna	
	Release of air pollutants from various emission sources during construction / operation / decommissioning activities	Terrestrial habitats, flora and fauna	
Socio- economic	Employment of local people and expatriates for MIGA funded projects/ Refinery construction / operation (direct and indirect employment) and in local markets (e.g. fisheries)	Employment – Resident population / Local economy	
	Increased strain on road traffic from transportation of equipment, machinery, raw materials and wastes	Road traffic (congestion) - resident population / local economy	
	Increased utilisation and strain on local	Local infrastructure - resident population /	

VEC	Impact Source	VEC Receptor – Secondary Receptor	
	infrastructure facilities	workers	
	Temporary influx of a peak of 20,000 workers into the area during construction.	Community Safety & Security / relationship between local communities and workers	
Community and health	Release of air pollutants from various emission sources at MIGA funded projects and third-party projects	Air quality – health and nuisance - resident population / employees	
	Release of dust and PM ₁₀ from construction / operation / decom. activities and road traffic		
	Increase in ambient noise levels from construction / operation / decommissioning activities, plant equipment and vehicles	Noise – health and nuisance – resident population / employees	
	Employment of local people and expatriates for MIGA funded projects and third-party projects construction / operation (direct and indirect employment)	Relationship between workers and local communities/Local Economy	
	Increased traffic from transportation of equipment, machinery, raw materials and wastes	Road traffic – resident population / workers	
Cultural heritage	Temporary or permanent disturbance to archaeological resources during construction / operation / decommissioning.	Archaeological sites or sites of cultural and / or religious significance	
	Restricted access to cultural heritage sites		
	Cultural conflict of employment of local people and expatriates for MIGA funded projects and third-party projects construction / operation	Resident population / employees	

VEC	VEC Receptor	ZOI	
Natural resources	Natural capital	National large-scale projects.	
	Land use	1km boundary around the MIGA Project sites.	
Physical environment	Air quality	5km boundary around the MIGA Projects1km boundary around the Pipeline route and Roads.500m boundary either side of the key transport routes.	
	Noise	10km boundary around projects.1km boundary around the Pipeline route and Roads.600m boundary either side of the key transport routes.	
	Groundwater	10km boundary around the MIGA Projects.	
	Soil	1km boundary around the MIGA Projects.	
	Surface water quality (freshwater/ marine)	10 km boundary around the MIGA Projects.10 km boundary around designated dredging areas and navigation routes.	
	Topography / Landscape	1km boundary around the MIGA Projects.	
Biodiversity	Marine habitats, flora and fauna	250 km boundary around the port sites to account for oil spill, potential discharge locations and designated dredging routes.	
	Terrestrial habitats, flora and fauna	10km boundary around the discharge location.	
Socio-economic	Resident population	5km boundary around the MIGA Project components.	
	Local Communities / Assets	5km boundary around the Pipelines and Roads.	
	Road Traffic	10km boundary around the Project sites.	
	Transport networks		
	Local infrastructure	Regional / large scale projects.	
Community and Health	Air Quality and Odor– community	5km boundary around the projects.1km boundary around the Pipeline route and roads.500m boundary either side of the key transport routes.	
	Noise – community	500m boundary around the Project component sites. 200m boundary either side of the key transport routes.	
	Traffic – community	10km boundary around the Project sites.	
	Visual amenity	1km boundary around the Project sites.	

Appendix C: Zone of Influence

VEC	VEC Receptor	ZOI
Cultural heritage	Archaeology and cultural heritage sites	1km boundary around the Project sites.

ZOI JUSTIFICATION

LAND USE AND TOPOGRAPHY

A **1km** ZOI has been used for land use and topography as it is the distance over which noise and deposition of gaseous emissions are likely to have reduced to levels that would not be discernible above background levels. These aspects would result in an indirect impact on land use and topography, whereas the direct disturbance impacts would only be attributed to the footprint of a project (including working area).

It is also noted that the changes in land use would impact upon visual amenity. However, this distance is deemed appropriate as the development is set in an area that has already been designated as an industrial zone.

AMBIENT AIR QUALITY AND ODOUR

A **5km** ZOI has been used for air quality impacts around the MIGA funded Projects and the project component sites. Operational activities will release critical pollutants (NOx, CO, SO₂, and PM₁₀) and Volatile Organic Compounds (VOCs) from a multitude of on-site sources that will potentially deteriorate local ambient air quality and odour conditions within a 5km radius.

A **1km** ZOI has been used for the air quality and odour impacts from the Crude Pipeline construction works. This boundary has been defined based on the construction dust and related localized exhaust emissions. Furthermore, anticipated future leaks during pipeline operation may result in negatively influencing local air quality and odour conditions.

A **500m** ZOI has been assigned to the effects on air quality from road traffic. Within this area, it is envisaged that the enhanced traffic exhaust emissions may have direct impacts up to 200m, but indirectly effect VEC receptors up to 500m, such as deposition on ecological receptors.

NOISE

Due to the complexity of the construction and operational phases it is difficult to define the noise levels during these activities. Such industrial activities tend to propagate low frequency noise levels that commence at high intensities. Since noise is attenuated by distance, a **10km** ZOI has been used for the impacts in relation to noise around the DRPIC Project sites during construction and operation.

A **1km** ZOI has been used for the noise impacts from the Crude Pipeline construction works. This boundary has been imposed due to the reduced scale of onsite construction activities and the predicted minimal operational noise levels.

An additional distance of **600m** ZOI has be assigned for noise, surrounding the proposed major road networks in order to account for the anticipated enhanced traffic levels.

SURFACE WATER AND GROUNDWATER RESOURCES

Accidental spills of non-hazardous and hazardous substances and releases of wastewater will cause contaminated run-off. Improper management of hazardous wastewater streams and wastes may potentially lead to the pollution of surrounding surface water and groundwater sources.

In addition, project works could potentially damage existing surface drainage channels and subsequently modify groundwater flow, providing alternative pathways for contamination. Such influences can have a much wider indirect impact upon the local surrounding environment.

Therefore, a **10km** ZOI has been designated, as beyond this area processes such as attenuation, dilution and degradation will reduce pollution levels to an indiscernible level.

SOIL

Direct impacts on soil from releases of non-hazardous (industrial and domestic) and hazardous substances would only take effect within the project footprint. However, in order to provide a conservative and robust assessment, a **1km** ZOI has been assigned. This is to account for the deposition of gaseous emissions that could influence and alter the surrounding soils composition. It is deemed at this distance; levels of the gaseous emissions output would no longer be noticeable above current background levels.

MARINE ECOLOGY

Marine Ecology has been allocated a **250km** ZOI. This is the maximum judged distance to which releases to the marine environment would no longer have a negative influence over the notably diverse surrounding marine flora and fauna (plankton, fish, benthos, marine mammals and turtles etc.). This distance has been developed for the absence of a fully developed impact scenario assessment and accounts for noise, wildlife strikes and spills from ships.

The direct impact of the marine construction works such as dredging and harbor construction would only be attributed to the footprint of the project.

TERRESTRIAL ECOLOGY

Although the direct impact of the Project works would only be attributed to the footprint of the project, in reality a ZOI is hard to define as it varies for different effects. In consultation with air quality and acoustic specialists, an area extending

0.25km from the Project footprint is likely to capture the majority of potentially significant impacts on ecological features. However, this distance does not account for local terrestrial mammal movements.

Therefore, a pragmatic approach has been adopted and a **10km** ZOI for terrestrial ecology has been allocated. This distance also represents when the deposition of gaseous emissions is likely to have reduced to levels that would not be discernible above background levels and would not impact on flora and habitats to any measurable degree.

Furthermore, this distance is judged to be suitable to which dust, artificial lighting, noise and vibration levels would be unlikely to be discernible to fauna.

LOCAL RESIDENTIAL, INFRASTRUCTURE, COMMUNITY, BUSINESS AND ECONOMY

Project components will carry a significant influence over the local community including existing infrastructure, employment, enhanced local business and intrusion on fishing regions. Due to the wide prominent effect the project is anticipated to have on the local residents and communities, a **10km** ZOI has been allocated for the impacts on related to socio- economic effects.

A separate **5km** ZOI has been used for the Ras Markaz Pipeline in order to represent a distance appropriate to the health and safety risks from oil and gas pipelines. The Pipeline will also influence the socio-economic VECs identified, but to a reduced degree and mainly during the construction phase.

TRAFFIC AND TRANSPORT

A 10km ZOI has been used for the impacts on transport and traffic. Due to the large scale of the project and its requirements, effects on the access for local residents and communities are anticipated.

ARCHAEOLOGY

A 1km ZOI has been used for impacts on archaeological sites to consider both the direct impact disturbance impacts within site areas, but also the appreciation of an archaeological site's setting which could be affected by increased noise or visual disturbance from construction or operational activities.

Appendix D: List of Third-Party Projects in Duqm SEZ and Region

#	Development	Source	Development Stage	EIA report
1	Construction of roads, buildings and additional infrastructure at the commercial pre-gate, gates and inspection zone of Port of Duqm.	SEZD	Construction work Going on	EIA report for commercial, Government, pre-gate and Inspection Zone by K & A Consultants SAE
2	Design, procurement and construction of the marine structures and associated berths, dredging works and permanent reclamation areas of liquid bulk berths in the Port of Duqm.	SEZD	Construction work Going on	Worley Parsons EIA report for DLBB project
3	Construction of Road No. 1 and Road No. 5 to link the Liquid Berth Terminal at Duqm Port to the Heavy Industrial Zone and drainage systems along the two roads.	SEZD	Ongoing construction	EIA report by HMR, Design of Road Nos. 1 and 5 and Drainage Systems, Duqm
4	Construction of Jurf and Saay flood protection channels in Duqm.	SEZD	Completed	EIA of Saay Dam and Channels, Renardet SA and Partners
5	Construction of Jurf and Saay flood protection dams in Duqm.	SEZD	Completed	EIA of Jurf Dam, Renardet SA and Partners
6	Engineering, procurement and construction of Duqm Refinery service corridor to liquid jetty.	SEZD	Ongoing construction	EIA by HMR for Service Corridor, Duqm
7	Construction of interface roadway projects in Duqm (Road Section 4).	SEZD	Completed	-
8	Duqm Refinery	Project Information;	Construction Started	Duqm Refinery EIA

#	Development	Source	Development Stage	EIA report	
		SEZD Masterplan and website		Report	
		Data Room			
9	Crude Oil Storage at Ras Markaz (DRPIC Crude Oil Storage)	SEZD	Not started	Ras Markaz Crude Oil Park ESIA	
10	Crude Oil Import Pipeline (Ras Markaz to Refinery)	SEZD	Not started	Ras Markaz Oil pipeline Concept Study & FEED EIA in Data Room	
11	Export Terminal	SEZD	Topsides not started	Duqm Liquid Bulk Berths Project EIA	
12	Duqm Export Terminal (DLBB) jetty marine scope including dredging, reclamation/ground improvement and berth construction.	Ramboll Report, Export Terminal EIA	Marine scope (dredging and reclamation) started.	SEZD	
13	Natural gas spur line from gas supply station to Refinery	SEZD	Tender awarded	With Sezad Archives	
14	Marafiq Duqm Integrated Power and Water Plant (DIPWP)	SEZD	Tendering	Ramboll Report; IDZ ESIA, DIPWP ESIA	
16	Seawater supply network	SEZD	Project Cancelled	SWIP EIA Report, Ramboll	
17	Waste water discharge/ common outfall	SEZD	Not started	SWIP EIA Report, Ramboll	
18	Ras Markaz Crude Oil Park (Phase 1.2 and 1.3 Marine Scope/ Infrastructure)	SEZD	Tendering	Ras Markaz Crude Oil Park ESIA	
19	Haul road / lane for solid product from Refinery to Duqm Export Terminal	Ramboll Report	Road 1 and 5 being developed	With SEZD Archives	
20	150 Villas (Housing Units)	SEZD Masterplan / Consultation	Under Construction (nearly finished)	With SEZD Archives	

#	Development	Source	Development Stage	EIA report	
		notes / SEZD Website			
21	Renaissance Village Duqm	Observation s on site	Complete. In operation	With SEZD Archives	
22	RAECO Diesel Power Plant	SEZD	In Operation	With SEZD Archives	
23	Port of Duqm - Dock off-loading facility (i.e. Commercial quay)	Ramboll Report, SEZD Website	In Operation and under expansion	With SEZD Archives	
24	Port of Duqm		In Operation and under expansion	EIA on SEZD Website	
25	Sebacic Acid production plant	SEZD	Operation	With SEZD Archives	
26	Fishery Harbor	SEZD Masterplan / SEZD Website	Tender Evaluation; Omani civil works contractor appointed. Road commenced	With SEZD Archives	
27	Fishery Industrial Complex	SEZD Masterplan / SEZD Website	As above	With SEZD Archives	
28	Royal Oman Police services Complex	SEZD Masterplan	Under Construction	With SEZD Archives	
29	Sewage Treatment Plant (STP)	IDZ ESIA / SEZD Website	Power supply is under construction	With SEZD Archives	
30	Road Transportation Network	IDZ ESIA	Under Construction	With SEZD Archives	
31	Natural Gas Pipeline to Duqm	SEZD	Under Construction	With SEZD Archives	
32	Natural gas supply station (GSS) at Duqm	SEZD	Under Construction	With SEZD Archives	
33	Be'ah Integrated waste facility	Ramboll Report	Construction commenced	ESIA Requested from OGC	
34	Ras Markaz Future phases	Ramboll Report	Not known	With SEZD Archives	
35	Construction of water network supply to	SEZD Website	Tender Evaluation	With SEZD Archives	

#	Development	Source	Development Stage	EIA report	
	Port of Duqm				
36	Master Planning for the Development of Al Duqm Town	SEZD Website	Tender Preparation	With SEZD Archives	
37	Airport Substation (Construction of Airport Project Phase 3 – Buildings)	SEZD Masterplan / SEZD Website	Under Tendering	With SEZD Archives	
38	Airport Air traffic Control Tower		Not known	With SEZD Archives	
39	Design of residential water, waste, Communication and electricity network (residential/ Industrial)	SEZD Masterplan / SEZD Website	Tender Preparation	With SEZD Archives	
40	Telecommunications Infrastructure (estimated 87,000 wired lines)	SEZD Masterplan	Not known	With SEZD Archives	
41	Renewable Energy Park (Wind / Solar)	SEZD Masterplan	Assume considered in SEZAD Masterplan above	With SEZD Archives	
42	SEZAD staff Accommodation & Recreation	SEAD Masterplan / SEZD Website	Under Tendering	With SEZD Archives	
43	Rail Corridor/High Speed Rail	IDZ ESIA	Not known	With SEZD Archives	
44	WANFANG swathe	SEZD website	Not known	With SEZD Archives	
45	Duqm Petrochemical Complex	-	Feasibility Studies	With SEZD Archives	
46	Road NR32 three phases		No information available	No information available	
47	Internal roads of the rock garden district		No information available	No information available	
#	Development	Source	Development Stage	EIA report	
1	Construction of roads, buildings and	SEZD	Construction work Going on	EIA report for commercial,	

#	Development	Source	Development Stage	EIA report
	additional infrastructure at the commercial pre-gate, gates and inspection zone of Port of Duqm.			Government, pre-gate and Inspection Zone by K & A Consultants SAE
2	Design, procurement and construction of the marine structures and associated berths, dredging works and permanent reclamation areas of liquid bulk berths in the Port of Duqm.	SEZD	Construction work Going on	Worley Parsons EIA report for DLBB project
3	Construction of Road No. 1 and Road No. 5 to link the Liquid Berth Terminal at Duqm Port to the Heavy Industrial Zone and drainage systems along the two roads.	SEZD	Ongoing construction	EIA report by HMR, Design of Road Nos. 1 and 5 and Drainage Systems, Duqm
4	Construction of Jurf and Saay flood protection channels in Duqm.	SEZD	Completed	EIA of Saay Dam and Channels, Renardet SA and Partners
5	Construction of Jurf and Saay flood protection dams in Duqm.	SEAD	Completed	EIA of Jurf Dam, Renardet SA and Partners
6	Engineering, procurement and construction of Duqm Refinery service corridor to liquid jetty.	SEZD	Ongoing construction	EIA by HMR for Service Corridor, Duqm
7	Construction of interface roadway projects in Duqm (Road Section 4).	SEZD	Completed	-
8	Duqm Refinery	Project Information ; SEZD Masterplan and website	Platform constructed and site fenced off	Duqm Refinery EIA Report

#	Development	Source	Development Stage	EIA report	
		Data Room			
9	Crude Oil Storage at Ras Markaz (DRPIC Crude Oil Storage)	SEZD	Not started	Ras Markaz Crude Oil Park ESIA	
10	Crude Oil Import Pipeline (Ras Markaz to Refinery)	SEZD	Not started	Ras Markaz Oil pipeline Concept Study & FEED EIA in Data Room	
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19	Haul road / lane for solid product from Refinery to Duqm Export Terminal	Ramboll Report	Road 1 and 5 being developed	Not available	
20	150 Villas (Housing Units)	SEZD Masterplan / Consultatio n notes / SEZD	Under Construction (nearly finished)	Not available	

#	Development	Source	Development Stage	EIA report	
		Website			
21	Renaissance Village Duqm	Observatio ns on site	Complete. In operation	Not available	
22	RAECO Diesel Power Plant	SEZD	In Operation	Not available	
23	Port of Duqm - Dock off-loading facility (i.e. Commercial quay)	Ramboll Report, SEZD Website	In Operation and under expansion	Not available	
24	Port of Duqm		In Operation and under expansion	EIA on SEZD Website	
25	Sebacic Acid production plant	SEAD	Operation	Not available	
26	Fishery Harbor	SEZD Masterplan / SEZD Website	Tender Evaluation; Omani civil works contractor appointed. Road commenced	Not available	
27	Fishery Industrial Complex	SEZD Masterplan / SEZD Website	As above	Not available	
28	Royal Oman Police services Complex	SEZD Masterplan	Under Construction	Not available	
29	Sewage Treatment Plant (STP)	IDZ ESIA / SEZD Website	Power supply is under construction	Not available	
30	Road Transportation Network	IDZ ESIA	Under Construction	Not available	
31	Flood Protection Dams	SEZD	Under Construction	Not available	
32	Natural Gas Pipeline to Duqm	SEZD	Under Construction	Not available	
33	Natural gas supply station (GSS) at Duqm	SEZD	Under Construction	Not available	
34	Be'ah Integrated waste facility	Ramboll Report	Construction commenced	ESIA Requested from OGC	
35	Ras Markaz Future phases	Ramboll Report	Not known	Not available	
36	Construction of water network supply to	SEZD Website	Tender Evaluation	Not available	

#	Development	Source	Development Stage	EIA report	
	Port of Duqm				
37	Master Planning for the Development of Al Duam Town	SEZD Website	Tender Preparation	Not available	
38	Airport Substation (Construction of Airport Project Phase 3 – Buildings)	SEZD Masterplan / SEZD Website	Under Tendering	Not available	
39	Airport Air traffic Control Tower		Not known	Not available	
40	Design of residential water, waste, Communication and electricity network (residential/ Industrial)	SEZD Masterplan / SEZD Website	Tender Preparation	Not available	
41	Telecommunications Infrastructure (estimated 87,000 wired lines)	SEZD Masterplan	Not known	Not available	
42	Renewable Energy Park (Wind / Solar)	SEZD Masterplan	Assume considered in SEZAD Masterplan above	Not available	
43	SEZAD staff Accommodation & Recreation	SEZD Masterplan / SEZD Website	Under Tendering	Not available	
44	Rail Corridor/High Speed Rail	IDZ ESIA	Not known	Not available	
45	WANFANG swathe	SEZD website	Not known	Not available	
46	Malls	-	Not known	Not available	
47	Hotels	-	Not known	Not available	
48	Marine Farm	-	Not known	Not available	
49	Duqm Petrochemical Complex	-	Feasibility Studies	Not available	

150 VILLAS (HOUSING UNITS) - **Completed**. A resettlement process which started in late 2016, with the Government commissioning a new development of modern houses, located approximately 15km from the Duqm Airport. This development is called "150 Villas". Affected families will receive a new replacement house (villa) each containing six bedrooms some with ensuite bathrooms.

RENAISSANCE VILLAGE DUQM - **Completed**. This involves the expansion of the Duqm Renaissance Village to encompass an additional area of 71,805 m. Through expanding its Village in Duqm, the Renaissance Services Company seeks to keep pace with growth in both the SEZAD population and the increased pace of its projects. The project includes the construction of various rooms, restaurants and many other services.

RAECO DIESEL POWER PLANT- **In Operation**. The system serving Duqm and the surrounding areas is supplied by the Duqm power station, a 66 MW diesel-fired power plant, which is owned and operated by RAECO.

PORT OF DUQM DOCK OFF-LOADING FACILITY (I.E. COMMERCIAL QUAY) -In Operation and **under expansion**. The Port of Duqm has officially commenced its commercial activities. The ports facilitate (Storage Area, Commercial Berth Zone 1, 2, 3 and 4 and Government Berth) of the Port are due to undergo expansion and are currently going through various tendering stages.

SEBACIC ACID PRODUCTION PLANT - **Operation**. Work on the facility, which represents the first overseas industrial investment in the Special Economic Zone. The 30,000 tons per annum capacity Sebacic Acid Plant represents the first phase of Sebacic Oman's long-term vision to establish a world-scale bio-refinery integrated with a biopolymer refinery at Duqm.

FISHERY HARBOUR- Tender Evaluated; Omani civil works contractor appointed. Construction commenced (from visual observation in March) and well progressed. The Fishing Harbor will be able to accommodate small and medium size fishing boats. Dredging will likely be required.

FISHERY INDUSTRIAL COMPLEX- Tender Evaluated; Omani civil works contractor appointed. Construction commenced (from visual observation in March) and well progressed. This development, together with the Fishery Harbor, will form the fish industry area in Duqm. The complex will include a retail, wholesale and export markets; designated areas to house fish processing, canning, fish oil and animal feed industries; fish and shrimp farming; a training center and extension services; a marine research center and an international standards quality assurance center for fresh and processed fish exports.

ROYAL OMAN POLICE SERVICES COMPLEX - Under Construction. Royal Oman police is constructing a police station and complex at Al Duqm in the Al Wusta Governorate. This will consist of numerous accompanying facilities and will include up to 30 buildings.

SEWAGE TREATMENT PLANT (STP)- Power supply is under construction. Galfar has been awarded a contract by Duqm Special Economic Zone Authority, for the operation and maintenance of a 2,000 m3/day sewage treatment plant. The contract value is OMR 365,170 (\$950,000).

ROAD TRANSPORTATION NETWORK- Under Construction. A high-standard arterial road network has been planned and is under implementation to link Duqm to all the major towns and cities within Oman. Construction has already begun on two main roads within Duqm; the first is a 17 km. primary dual-carriageway with three lanes in each direction. This road will connect the port, airport, and tourist areas with local residential and social amenities. The second is a 22.5 km, 4-lane road beltway around the city that will connect the residential areas within the city with the beach. In addition, another 37km. of roads are under construction in and around the port, dry dock, and government quay; these will connect the port with the airport, the city, and the main roads linking Duqm to other cities in Oman.

FLOOD PROTECTION DAMS- Construction completed and operational. Flood protection dams will be built upstream of the Jurf and Saay wadis to stave off potential flood events that could imperil industrial schemes, most notably the Duqm Refinery Project, which will be located downstream of these wadis.

WADI SAI CHANNEL- Completed. The project, tendered out in separate contracts, entails the construction of an elaborate network of flood channels that will drain runoff from the Jurf and Saay wadis currently crisscrossing the SEZ, safety into the Arabian Sea. The Wadi Sai channel will be up to 90-320 m wide and 10 km long up to the meeting point with Wadi Jurf Channel.

WADI JURF CHANNEL- Completed. The Wadi Jurf Channel will act as one of the two drainage networks. The Wadi Jurf Channel will be about 12 km long and 340-650 m wide at the discharge point at the sea.

NATURAL GAS PIPELINE TO DUQM – Under Construction, EPC Awarded and construction started. The 221km long pipeline will carry natural gas from central Oman to the new Duqm Special Economic Zone (SEZ) on the Wusta coast. A corridor for the construction of the pipeline, linking the Saih Nihayda gas field with Duqm, has been delineated.

NATURAL GAS SUPPLY STATION (GSS) AT DUQM- EPC awarded. Oman Gas Company will supply Duqm with clean natural gas from gas fields in the Al Wusta region. The GSS will initially have a capacity of 15MMSCMD, expandable to a capacity of 25MMSCMD. The company has selected the optimal gas route and gas supply stations. Natural gas is a clean-burning energy source; it will power the economy of Duqm while maintaining a healthy quality of life for its residents.

BE'AH INTEGRATED WASTE FACILITY - Nearing completion/completed. The joint venture of well- known Omani contracting firm Hasan Juma Backer Trading & Contracting Co LLC (HJB) and India's Tatva Global Environment, one of the largest providers of waste management services in the subcontinent, has been awarded a contract valued at around \$20 million for the design and construction of an

Integrated Waste Treatment Storage and Disposal Facility in Duqm Special Economic Zone (SEZ) on the Sultanate's Wusta coast. An integral component of this infrastructure is a modern landfill that will receive for treatment and disposal the massive amounts of waste streams expected to be generated by industries operating within the hub.

RAS MARKAZ FUTURE PHASES - Development stage unknown. Ras Markaz terminal is being developed in five phases. Phase one will have a capacity of 26 million barrels and is expected to be commissioned by the end of 2018. The second phase of development is to be carried out with a total investment of roughly \$925m, including construction of the terminal tanks with an investment of

\$700m, and \$225m for the construction of basic infrastructure facilities. The tanks for the remaining three phases of the terminal development will be built with an investment of approximately \$700m, while basic infrastructure facilities will be completed at an estimated cost of \$381m per phase.

CONSTRUCTION OF WATER NETWORK SUPPLY TO PORT OF DUQM - Tender Evaluation. A major water supply network project is being undertaken to serve the fast-developing Duqm Wilayat in central Oman is nearing completion. The water supply network will cater to the needs of various projects which are currently underway in Duqm, such as the Duqm Port.

MASTER PLANNING FOR THE DEVELOPMENT OF DUQM TOWN- Tender Preparation. An area of 23km2 has been designated for the new frontier town at Duqm. This will be the backbone of the development area and initially will accommodate up to 67,000 people with further provisions to extend it to 111,000 residents. Duqm's new town will be a sustainable community, a model of contemporary urban planning with due consideration given to Omani culture and the local environment and the catalyst for the envisioned urbanization and commercialization of the Wusta region.

AIRPORT SUBSTATION (AIRPORT PROJECT PHASE 3 – BUILDINGS) -Under Tendering. This third package phase includes the passenger terminal spread over 5,600sq m with an annual capacity of half a million passengers. The ground floor of the terminal will have passenger facilities like retail outlets, restaurants and utilities. The passenger terminal will also have four aerobridges. The statement by the ministry also pointed out that the project includes construction of an air navigation complex. This complex will include a 38m air traffic control tower, buildings for navigation and meteorology, services, maintenance, firefighting and gate-keeping.

AIRPORT AIR TRAFFIC CONTROL TOWER - Development stage unknown. Phase 3 of the airport project includes an air traffic control tower. The development is anticipated to be completed by the year-end.

DESIGN OF RESIDENTIAL WATER, WASTE, COMMUNICATION AND ELECTRICITY NETWORK (RESIDENTIAL / INDUSTRIAL)- Tender Preparation. No information available.

TELECOMMUNICATIONS INFRASTRUCTURE - Development stage unknown. The development of the IDZ area will require a new telecommunications infrastructure to serve the needs of the area. Based on the proposed land use and projected population, an estimated 87,000 wired lines will be required.

RENEWABLE ENERGY PARK (SOLAR) - Development stage unknown. Ningxia Zhongke Jiaye New Energy and Technology Management Co. have signed an agreement with the Oman-based investment firm for the development of a large-scale solar power project in Duqm. The project shall be developed in two phases, with the first one having a capacity of 400 megawatts. The first phase will eventually be expanded to 1,000 megawatts capacity. The intention of the project is to set Oman's economy and energy mix on the road to diversification and create a new and sustainable model for economic growth.

SEZAD STAFF ACCOMMODATION & RECREATION - Under Tendering. No Information available.

RAIL CORRIDOR/HIGH SPEED RAIL - Development stage unknown. A single alignment has been considered for a rail link from a main line that is proposed to the west of the IDZ to the port area. This rail alignment generally runs across the central part of the IDZ from west to east. There will be single rail route for both passenger and freight transport. Rail Station locations will have direct access to future locations for residential/commercial use.

WANFANG SWATHE - Development stage unknown. The WANFANG proposal is a \$10 billion investment consisting of numerous proposed developments including, a heavy industrial zone, light industrial zone and mixed-use areas including a tourism sector.

MALLS - Development stage unknown.

HOTELS - Development stage unknown.

BIRD NESTING - Development stage unknown.

MARINE FARM - Design Phase. The development would represent Oman's biggest marine farm project. The Marine Farm planning is in the design phase of coastal development.

DUQM PETROCHEMICAL COMPLEX – Feasibility Stage. The Petrochemical Complex represents the second phase in a two phase DRPIC project. This considers the Duqm Refinery Project as the first phase. Studies are being performed to integrate the petrochemical complex at the same site. The adjacent facility is expected to incorporate a mixed feedstock cracker, a polypropylene plant, an aromatics facility and a styrene plant.

	Distance									
Development	IP7	Contract C81/2017	IP3	Contract C65/2016	Contract C81/2017	Contract C80/2017	Contract C73/2016			
Associated Develo	opment	s								
DLBB jetty marine scope	0.5Km	3.6Km	1 Km	17Km	15.7Km	3.3Km	5.5Km			
Third Party Projec	Third Party Projects									
Duqm Oil Refinery	4Km	4.3Km	6.3Km	8.9Km	15.5Km	0.4 Km	0.3Km			
Ras Markaz Crude Oil Park	46Km	45Km	49Km	55Km	37Km	50Km	52Km			
Ras Markaz Oil Pipeline	46Km	45Km	49Km	55Km	37Km	50Km	52Km			
Natural Gas Spur Line	10.9K m	8.4Km	6.2Km	8.4Km	15.7Km	2.7Km	1.5Km			
DIPWP	8.2Km	6.5Km	5.8Km	10.2Km	15Km		1Km			
Ras Markaz Crude Oil Park (Phase 1.2 and 1.3)	46Km	45Km	49Km	55Km	37Km	50Km	52Km			
Haul road / lane for solid product	11.2K m	8.9Km	7Km	9.2Km	16.7Km	3.3Km	1.78Km			
Third Party Proje	cts (Cor	npleted)								
150 Villas (Housing Units)	16Km	12.4Km	16.8Km	21 Km	3.2Km	17.5Km	18.2Km			
Renaissance Village Duqm	10.2K m	5.7Km	9.1Km	19Km	6.3Km	9.1Km	12.6Km			
RAECO Diesel Power Plant	7.5Km	7.6Km	4 Km	12.1Km	17.3 Km	2.6Km	2.1Km			
Third Party Project	cts (Rec	ently Progresse	ed)							
Port of Duqm - Dock off-loading facility (i.e. Commercial quay)	0.4kM	6.2kM	4.3Km	18.4Km	15.5Km	7.7Km	8.5Km			
Port of Duqm	2.3Km	2.9Km	0.4Km	16.3Km	14.3Km	2.4Km	5.5Km			
Sebacic Acid	6.6Km	6.4Km	3.4Km	11.3Km	15.8Km	1.8Km	1.8Km			

Appendix F: Associated Facilities and Third-Party Projects Distances

	Distance									
Development	IP7	Contract C81/2017	IP3	Contract C65/2016	Contract C81/2017	Contract C80/2017	Contract C73/2016			
production plant										
Fishery Harbour	22Km	18.5Km	22Km	33.2Km	16Km	23Km	27Km			
Fishery Industria I Complex	23.1K m	22.5Km	25.3Km	35Km	17.2Km	25.2Km	29.2Km			
Royal Oman Police services Complex	18.2K m	14Km	7.3Km	23.2Km	4.7Km	16.8Km	20Km			
Sewage Treatme nt Plant (STP)	16.2K m	14.8Km	11.7Km	10.2Km	23Km	7.8Km	7.7Km			
Road Transportation Network	5.8Km		4.7Km	14.6Km	10.2Km	5.3Km	7.04Km			
Flood Protectio n Dams	18.6K m	14.7Km	15.6Km		17.6Km	10.5Km	10.2Km			
Wadi Sai Channel	14.5K m	10 Km	14 Km	17.6Km		13 Km	15.5Km			
Wadi Jarf Channel	14.8K m	13.2 Km	17.3 Km	0.5Km	18.9Km	11 Km	10Km			
Natural Gas Pipeline to Duqm	10Km	7.3Km	6.7Km	9Km	15.2Km	2 Km	1.5Km			
Natural gas supply station (GSS) at Duqm	16Km	15.6Km	12Km	12.3Km	24.3KM	10.3Km	8.4Km			
Be'ah Integrat ed waste facility	18.8K m	19Km	20Km	15.2Km	30Km	16.5Km	15Km			
Third Party Proje	cts (Pos	sible)								
Ras Markaz Future phases	56.3K m	54.4Km	57.8Km	65.7Km	47.5Km	60.7Km	61.6Km			
Construction of water network supply to Port of Duqm		5.8Km	3.9Km	19Km	14.5Km	8.2Km	9.2Km			

	Distance									
Development	IP7	Contract C81/2017		IP3		Contract C65/2016		Contract C81/2017	Contract C80/201	Contract 7 C73/2016
Master Planning for the Development of Al Duqm Town	7.2 Km	2.2Km		5Km	12.6Km		10.9Km		3.7Km	5.2Km
Airport Substati on	16.7K m	12.5Km		17Km	.7Km 24.2Km			5.8Km	17Km	20.3Km
(Construction of Airport Project Phase 3 – Buildings)	16 Km	14.5Km		19Km	19Km 25.5Km			7.5Km	19Km	21.5Km
Airport Air traffic Control Tower	16 Km	14.5Km	ίm		ו	25.5Km		7.5Km	19Km	21.5Km
SEZD staff Accommodation & Recreation	8.9Km	3.2Km			n	11.5Km		9.4Km	3.3Km	6.2Km
Rail Corridor/High Speed Rail	12.2K m	6.8Km		9.4Kr	n	9.3Km		8.7Km	6.8Km	7.7Km
WANFANG swathe (\$10 billion investment	10.5K m	10.8Km		7.1Km		10.7Km		20.2Km	5.2Km	5.2Km
Hotels	10.6K m	5.5Km		9.7Km		15.3Km		4.2Km	11Km	11.2Km
	Distar	ice								
⁴ Development	IP7	Contract C81/2017	IP3	8	Co C6	ontract 55/2016	Coi C81	ntract 1/2017	Contrac t C80/20 17	Contract C73/2016
Associated Developments										
DLBB jetty marine scope										

⁴ Information for the distances for these developments were not available at the time of finalisation of this report
	Distance								
Development	IP7	Contract C81/2017	IP3	Contrac C65/20	t Contract 16 C81/2017	Contract C80/2017	Contract C73/2016		
Third Party Projects									
Duqm Oil Refinery									
Ras Markaz Crude Oil Park									
Ras Markaz Oil Pipeline									
Natural Gas Spur Line									
Export Pipeline Corridor									
DIPWP									
Waste water Discharge / Common Outfall									
Ras Markaz Crude Oil Park (Phase 1.2 and 1.3)									
Haul road / lane for solid product									
Third Party Projects (Completed)									
150 Villas (Housing Units)									
Renaissance Village Duqm									
RAECO Diesel Power Plant									
Third Party Projects (Recently Progressed)									
Port of Duqm - Dock off-loading facility (i.e.									

	Distance							
Development	IP7	Contract C81/2017	IP3	Contract C65/201	t Contract L6 C81/2017	Contract 7 C80/2017	Contract C73/2016	
Commercial quay)								
Port of Duqm								
Sebacic Acid production plant								
Fishery Harbor								
Fishery Industria I Complex								
Royal Oman Police								
services Complex								
Treatme nt Plant (STP)								
Road Transportation Network								
Flood Protectio n Dams								
Wadi Sai Channe	I							
Wadi Jurf Channel								
Natural Gas Pipeline to Duqm								
Natural gas supply station (GSS) at Duqm								
Be'ah Integrate d waste facility	2							
Third Party Projects (Possible)								
Ras Markaz								

	Distance								
Development	IP7	Contract C81/2017	IP3	Contract C65/201	Contract 6 C81/2017	Contract C80/2017	Contract C73/2016		
Future phases									
Construction of water network supply to Port of Duqm									
Master Planning for the Development of Al Duqm Town									
Airport Substatic n)								
(Construction of Airport Project Phase 3 – Buildings)									
Airport Air traffic Control Tower									
Design of residential water, waste, Communication and electricity network (residential / Industrial)									
Telecommunicati ons Infrastructure estimated 87,000 wired lines)									
Renewable Energy Park (Solar)									
SEZAD staff Accommodation & Recreation									
Rail Corridor/High									

	Distance								
Development	IP7	Contract C81/2017	IP3	Contract C65/2016	Contract C81/2017	Contract C80/2017	Contract C73/2016		
Speed Rail					_				
WANFANG swathe (\$10 billion investment	t								
Malls									
Hotels									
Bird Nesting									
Marine Farm									

Appendix	G:	VEC	Baseline
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RECEPTOR	ESIA BASELINE								
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm					
Materials / natural resources	Materials and natural resources are purchased from third	party suppliers, and location of resources can vary fro	m local, regional and national.						
Land Use/ Topography	The DLBB Project is located in the Port of Duqm on the eastern coast of Oman approximately 7 km to the east of the Say village (also known as Al Duqm). The DLBB Project involves development of the LBW. The area immediately around the root of the LBW is sabkha (salt flats). The sabkha comprised of several infra- littoral mud areas, intertidal sand and mud habitats, tidal and non- tidal lagoons, vegetated and non-vegetated dunes, and supra- littoral sand bars. North of the LBW are a series of non-tidal lagoons ('khawrs'), whereby the wate has seeped underground to produce highly saline lagoons. The lagoons are surrounded by a variation of sand and mudflats. On the whole the site topography is generally low lying and very flat, with the nearshore area fronting the port generally between 1 and 2 m above sea level.	Not Available	 CUC area has an elevation of between 2 and 20 meters above mean sea level. The project site consists of flat sandy strips parallel to the coastline, and also includes coastal dunes, belts of scrubs and sparse trees. Observations were that the dune area is mixed with zones of flat khabrah type depressions, where surface water may accumulate periodically" (HMR, 2013a). The khabrah depressions are natural holes or hollows, typically small in size that in rainy season contain water. The topography in the vicinity of the Duqm SWIP area is more or less flat terrain, ranging from low- lying coastal and alluvium plains up to 20 m above mean sea level (HMR, 2015). From the environmental baseline study for SEZAD (HMR, 2013b; HMR, 2013c; and HMR 2012) the following observations of the topography are summarized: low-lying coastal and coastal alluvium plains are confined to the Eastern side of the SEZAD area and the North West - Western side comprises alluvium plain; ground surface features undeveloped area along the coast, with limited coasta dunes extending up to 10 to 20 m distance from the shoreline; and featureless sabkah formation covers the coastal area located south of the study area. 	The top classifie and lim The situ southen with nu The DR 20m at 20m at dunes, The are					
Air Quality	In 2015 a diffusion tube monitoring method was used to record the air quality conditions around the DLBB project site. The following minimum and maximum pollutant concentrations were recorded: NO (3.26 to 4.57 ug/m3), NO2 (1.18 to 2.18 ug/m3), NOX (4.44 to 6.65 ug/m3), O3 (59 to 78 ug/m3), SO2 (0.57 to 3.02 ug/m3), PM2.5 (2 to 20 ug/m3), PM10 (4 to 80 ug/m3). The air quality parameters are within the USEPA National Ambient Air Quality Standards (NAAQS), excluding O3 at one location, where the ozone level is marginally above the USEPA NAAQS limit.	HMR consultants deployed continuous ambient air quality monitoring station (CAAQMS) at three locations across the AI Duqm wider masterplan area. The first available results from CAAQMS- 1 for the period November 14th - 28th 2012 are presented in the table below. The maximum concentrations of all pollutants for the various averaging periods are within applicable limits for all three standards considered. Results at CAAQMS-2 during February – March 2013 indicate that NO2, PM10 and O ₃ data are higher in the month of March than in February 2013. The higher values can be attributed to increased vehicular movement due to an increase in port activity in the month of March, when the commercial	Duqm Refinery ambient air quality data was used for this project	The am the Om An ons followir concen CO (17 NO2 (3 O3 (54 PM10 inherer which p Measur air qua compon					

- pography of the Refinery site is generally fied as low - lying coastal plain (to the east) that losed to the north, west and south by sandstone mestone hills.
- te lies between two wadis, Wadi Jurf on the ern side and a small wadi on northern side along numerous braided natural drainage channels.
- RPIC site has an elevation varying between 2 above mean sea level.
- roject site also consists of flat sandy strips el to the coastline and also includes coastal
- , belts of scrubs and sparse trees.
- rea has no prior established land use pattern

mbient air quality was found to be compliant with mani (Provisional) Ambient Air Quality Standards.

site monitoring location recorded the ing24-hr minimum and maximum pollutant ntrations in October 2013 and June – July 2014: 75 to 229 ug/m3), NO (5.7 to 13.3 ug/m3), 37.2 to 68.4 ug/m3), NOx (56.8 to 72.8 ug/m3), 54 to 129 ug/m3), SO2 (15.3 to 25.0 ug/m3), (63 to 80 ug/m3). The Duqm area has ently high dust levels due to the windy conditions prevail in the region and its openness to the sea.

ured odour baseline sampling results shows the ality in the concerned area has no odorous bunds

RECEPTOR	ESIA BASELINE			
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm
		quay was inaugurated for operations. As a result, there are instances of exceedance in concentrations of O_3 , SO_2 and PM_{10} in comparison with the standards while all other pollutants are well within limits.		
		Due to the absence of vegetation dust can be seen when winds blow in that area. It is assumed that current air quality conditions in the Project Area satisfy a "Moderate" air quality classification according to World Bank criteria.		
Noise	A noise survey was undertaken at nine monitoring locations and at Say village (near the main road) to measure the equivalent continuous (L A-eq)	HMR consultants carried out noise monitoring within the proximity of future sensitive receptors in October-November 2012, including the Al Duqm Town Zone. Three locations are very near to the wadi Saay dam and channels and the readings are 45.3 (#1), 55.1 (#2) and 62.7(#3) dB(A) for Month of October and 45.5 (#1), 52.4 (#2) and 44.6 (#3) for month of November 2012 The project area is relatively close to the monitoring location N0. 2. The measurements in this point reveal that this area near the channel wadi Say is slightly disturb due the anthropogenic activities and wind conditions. The noise assessment wasn't performed in any point near the Wadi Say Dam, Say Channel or the two- wadi junction channel, so it's not possible to present precise conclusions. Nevertheless, during site visits, some anthropogenic activities mostly related with construction were observed along the Wadi Say Channel. It's possible to identify several anthropogenic contributions, since the surroundings of the wadi are highly populated	For the Refinery Environmental Baseline Study (HMR, 2013a), noise levels were measured at 12 monitoring locations, in September 2013. The Refinery Baseline noise monitoring surveys were conducted at 9 locations across the refinery site, and at 3 'background' locations. Baseline noise monitoring results indicate that the noise levels at several locations were higher than the threshold values and exceed limits specified in MD 79/94. Inherently higher noise levels can be attributed to strong winds, which are a common feature in the Duqm region, and also from the noise of wave breaks considering the proximity to the ocean. In addition, some extraneous factors also contributed such as traffic from quarrying, dog barking, etc. With respect to the CUC Project site, the area can be characterized by its open nature and relative absence of high noise sources typically associated with industrial activities, with most potential noise likely derived from sources such as roads and 'environmental noise' from the ocean waves and avifauna.	The site and will As this have be suburba measur locatior for diffe Workda evening (51.0 to tracks, unit and In comp measur low win locatior than re
Surface Water	The major wadis in the vicinity of the DLBB Project are Wadi Jurf and Wadi Say. Runoff in these wadis is limited to that generated by local precipitation which may cause temporary ponding in depressions. Wadis comprise unconfined aguifers of poorly consolidated to lose gravels	provide the residential area. Duqm, while subject to very minimal annual rainfall, is subject to larger intermittent storms with the potential to create strong regional flows. The coastline is subject to several factors that may influence development, including tidal fluctuation.	However, review of the existing hydrology information for the Project area shows the drainage system is influenced by the fluvial flow of sediments and rock debris during heavy rain, as Wadi Jurf has upper tributaries with	More th km2 wit depths the area flow to
	with a sandy matrix and there is no base flow within the wadis. The marine water quality around the Project Area had elevated turbidity levels and remained high in the nearshore areas adjacent to the Port. Chemical water quality was good throughout the study area, with only very minor exceedances of some adopted guideline values for conner and zinc outside of the Port	storm surges, tectonic uplift, sea level rise, and wave-run-up that accompanies major cyclones. Wadis Duqm is traversed by a rigorous network of natural tributaries and stormwater wadis. Preserving these largely in their original form will harness them as effective stormwater conveyance corridors as well as	numerous braided natural drainage channels. The CUC alignment crosses Wadi Jurf, after the junction of Wadi Saay and Wadi Jurf. Previous consultation with MRMWR reveals absence of wadi flow gauge systems located within the area. It is also acknowledged that wadi flow measurements in Al Wusta	become
		leveraging the landscape assets that will help protect their value to the site as a character and value-	Governorate are difficult due to wilderness, high sediment loads, perennial flow and an increased possibility for wadi flow to change	

te is within a dedicated special economic zone ill have commercial developments in the future. s is not a dedicated industrial estate, noise levels been compared with those stipulated for ban residential area in MD 79/94. The urements indicate that noise levels at certain ons exceed the limits (highlighted bold) specified ferent time intervals:

lays daytime (57.0 to 73.2dB Leq), Workdays ng (48.8 to 62.0dB Leq), and Holidays and nights to 62.6dB Leq).

noise levels have been attributed to nearby dirt , Road 32, the nearby power and desalination nd environmental disturbances.

nparison with the previous survey work, the urements taken indicate that during periods of inds (ie < 5m-1), noise levels at comparable ons around Duqm are generally somewhat lower eported during higher wind conditions.

than 20 wadis with catchments greater than 4 within Duqm with visible and known widths and s as they reach the sea. The shallow nature of ea results in an increased possibility for the wadis o change direction especially if the wadi channels he subject to construction.

RECEPTOR	ESIA BASELINE								
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm					
		adding amenity.	direction (HMR, 2014a).						
		Coastline							
		Duqm's coast is defined by a diverse mix of beaches, cliffs, rocky areas, and khawars. These provide a range of conditions that offer different levels of suitability to development as well as result in different zones that will be susceptible to coastal environmental hazards.	,						
Groundwater / Hydrogeology	The Project lies within the Huqf hydrologic area which is undertrained by rocks which are bowed upwards as part of a major structural arch. In the AI Wusta region groundwater discharge is in the dune fields of Ar Rub al Khali in the west and Huqf in the east, where highly fractured pre –Tertiary basement outcrops borders the Arabian Sea. The main regional aquifer in the area is the Umm ar Raduma (UAR) formation. Generally, the salinity of groundwater gradually increases as groundwater migrates to the Huqf hydrological area and all regional groundwater is brackish to saline. The groundwater is saline in nature exceeds both the WHO and Omani Standard for a number of parameters and hence is deemed unfit for human consumption, without treatment.	Ground water table was encountered in all borings of except BH-02, BH-05, BH-06, BH-09 and BH-10. The ground water level varied from 1.5 to 5.6 m below the existing ground surface as recorded during the field exploration. Repeated measurement of ground water in BH-10 shows that it is dry hole, therefore, the ground water depth reported in BH-10 appears to be from water introduced during drilling. Groundwater levels in the piezometers are summarized in. Based upon evaluation of ground water measurement, it appeared that ground water, at the time of field exploration, was flowing toward the southeast direction. Groundwater level measurements and sampling were obtained in the monitoring wells installed in boreholes BH-01, Bh-03, BH-05, BH-07, and BH-13. The water levels ranged from about 1.47 to 3.47 meters below the ground surface. The chemical analyses of ground water samples indicate the highest total dissolved solids (TDS) of 101180 mg/l in BH-03 and least TDS of 8290 mg/l in BH-05. Similarly, the highest in chloride, sodium, calcium, total hardness and conductivities are found in BH-03 and the least in BH-05. These results for BH-03 appear to be consistent since BH-03 is in close proximity of the coastal line where sea water intrusion is present as evidences by Sabkha ground. While BH -05 is located on higher terrain, it is also close to the coast therefore the ground water chemistry may be affected by the introduction of drilling water since drilling was problematic at this location. Generally, the TDS and other indicators for salinity are high in all the GW samples.	Hydrogeology of the SEZAD area consists of Precambrian and Paleozoic rocks including sandstone, which could yield water to wells. There is periodic fresh water perched water tables available in the study area as a result of cyclonic events and heavy rainfall due to aquitard (shammed and Nahar Umr formations) and Aquiclude (shale) occurrences. An average has been calculated for the 12 groundwater samples with analysis results of a near neutral pH of 7.5, Chloride concentration of 72838 mg/L, TDS of 123273 mg/L, and TSS of 74.16 mg/L. The average sulphate concentration was 3429 mg/L and a concentration of 0.01 mg/L was for sulphide. Fluoride concentration data ranged within a narrow band between 1.25 and 2.42 mg/L, with a calculated average of 1.922 mg/L. The metals and metalloid chemistry data for the Service Corridor groundwater survey is presented in Table 5-2. This data shows that the metal concentrations of arsenic, chromium, vanadium, and mercury were not detected greater than the method limit of detection. Results were consistently low with only a few detections greater than the method limit for cadmium, copper, cobalt, and lead. Analysis results greater than the laboratory detection limit were reported for six of the 15 tested metals. All groundwater samples displayed a high natural abundance of three metals in particular, with an average magnesium concentration of 2459 mg/L, average boron concentration of 10.96 mg/L, and an average zinc concentration of 3.44 mg/L. Average results for the remaining metals are: 0.597 mg/L of barium, 0.736 mg/L of iron, 0.619 mg/L of manganese, and 0.021 mg/L of nickel. For the CUC groundwater survey, of the 132 analysis results for hydrocarbon and	The situ the Had er Radh regiona below o aquifer ground flow din Mounta region. Therefo Sulphat Omani					
			and 0.021 mg/L of nickel. For the CUC groundwater survey, of the 132 analysis results for hydrocarbon and bacteriological parameters only one result was reported greater than the method limit of						

te is underlain mainly by Tertiary sediments of adhramaut group. The main aquifer is the Umm dhuma (UER) formation. Recharge occurs through al aquifer system and it is approximately 200 m ground level. It constitutes the main regional r in the Najd (Southern Oman), with dwater becoming gradually more saline in downirection, from fresh in the area of the Dhofar rains to saline in the Al Wusta that is our project

fore, in this study area the groundwater is not le for drinking. Further, parameters such as ate, Sulphide, Nitrite and Fluoride are above i drinking water standard.

RECEPTOR	ESIA BASELINE			
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm
			detection as presented in Table 5-3. In the sample from BH-17 at a depth of 1.55 a result of 119 µg/L was reported for Extractable Petroleum Hydrocarbons (EPH) (C10 –C40) was detected.	
Soil	The surface geology of the study area is characterized by sabkha. It is a type of soil type that forms over low-lying coastal area that are filled overtime, by windblown fine sand and silt with concentration of salt deposits derived from evaporation of seawater that inundates the area at high tide. Eventually the deposits build up above the tidal range leaving a dry crust that conceals a soft mud with a high concentration below the surface. The high salt concentration in sabkha soil is a challenge for construction as it would cause damage to concrete and steel. The General Soil Map prepared by the Ministry of Agriculture and Fisheries and Food and Agriculture Organization of the United Nations identifies the DLBB Project area is mostly composed of tidal flats, with poor soil unsuitable for agriculture.	Total of forty grab (40) soil samples were collected and submitted to the laboratory for particle size distribution analyses to better define soil type and contents. Nine (9) out of the forty soil samples, where silt and clay percentage exceed 15%, were selected for Atterberg Limits test to determine the plasticity degree. Additionally, soil samples from the borehole drilling program were selected for laboratory testing as follows: 14 samples for particle size distribution, eight samples for Atterberg Limits, four samples for moisture density relationship, six samples for unconfined compression strength, two samples for swell pressure, four samples for point load test, two samples for gypsum content, and six samples for chemical analytical testing to determine corrosivity potential.	Oman rainfall is very limited and soils are very dry most of the time. Hence, soil formation is very slow and weak. The General Soil Map prepared by the Ministry of Agriculture and Fisheries and Food and Agriculture Organization of the United Nations identifies the soil in the project area as poor and unsuitable for agriculture. Soils in Oman are usually thin, and thin soils do not provide much attenuation from pollution, and the most vulnerable strata are the uncemented coarse wadi gravels in active wadi channels and fractured limestone. In the absence of any published Omani soil data, or local data from the SEZAD area for which to compare the baseline soil chemistry data, the analysis results for the 12 soil samples have been averaged to characterize the baseline soil chemistry results across the CUC project area. The nutrient analysis results, of the zero survey soil samples show that for the 12 samples the pH results range from 8 – 9.2 which is alkaline soil and having an average pH value of 8.2. Largest proportion of Total Nitrogen is comprised of organic nitrogen (as TKN). Chemistry results for the analyzed nutrient salts – chloride, sulphide and sulphate – are low in the 12 samples collected from the sabkha soils. Concentrations of Total phosphorus as phosphate range from 351 to 3210 mg/kg, with an average of 706.2 mg/kg. The source of phosphate across the CUC site is likely attributed to natural phosphate concentrations, such as particles binding to the clay particles, rather than derivation from anthropogenic sources. The metals and metalloid chemistry data for the Service Corridor soil survey. This data shows that the soils of Duqm are naturally low, and consistently low, with results less than the laboratory detection limit for the following five metals: arsenic, cadmium, cobalt, lead, and mercury. All soil samples displayed a high natural abundance of two metals in particular.	The stur patches mud/mu clays ar of fossil carbona as Calci Soil sam and the except f

tudy area consists of the coastal alluvium and es of calcium carbonate (Marl) or lime-rich nudstone which contain variable amounts of and silt. The sediment grains consist of fragments sils, limestones and dolomites, and other nate grains, or some combination of these known cirudite.

imples were collected from the site and analyzed in values were found to be within the limits t for natural leaching of certain metals

RECEPTOR	ESIA BASELINE			
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm
			with an average iron concentration of 4063 mg/kg and an average magnesium concentration of 11515 mg/kg. Average results for the remaining metals are: 130.6 mg/kg of barium, 23.49 mg/kg of boron, 11.7 mg/kg of chromium, 181.45 mg/kg of manganese, 6.13 mg/kg of nickel, 14.25 mg/kg of vanadium, and 8.42 mg/kg of zinc. For the CUC soil survey, of the 84 analysis results for hydrocarbons only one result was reported greater than the laboratory detection limit as presented in Table 4-4. In the sample from TP-12 at a depth of 0.00 – 1.20 m 0.08 mg/kg of Volatile Petroleum Hydrocarbons (C5	
			-C10) was detected.	
Marine Ecology	No protected areas are located in close proximity to the Project Area. The closest protected area, Ras Madrakah, is located 70 km to the southeast. There is evidence that turtles feed and nest on beaches along the coast immediately surrounding the Duqm area, such as green and loggerhead turtles. The area around Duqm is considered a critical feeding and breeding habitat for certain turtle species, as well as being on a migratory pathway. The most commonly recorded nearshore species in Duqm area are Arabian Sea Humpback Whales and various species of the Delphinidae family, such as dolphins, pilot whales and killer whales. The majority of the benthic habitat within the Port was found to be unconsolidated sediments of fine sand with nc epifauna or flora cover. Outside the Port, the benthic habitat was homogenous unconsolidated sand with no epifauna or flora.	Not Applicable	Not Available	The off marine the pro Day (Gl the Duo The sar of anim crustac Large s in almo product A numb by IUC region. observe Sensitiv
Local Infrastructure	At present, there is no engineered landfill operating in Duqm. Non-hazardous waste generated in Duqm is disposed at dumpsite, which is approximately 15 ha and about 12 km NW from the DLBB Project. SEZAD and be'ah have proposed an Integrated Waste Treatment, Storage and Disposal Facility in Duqm, which will include a new engineered NHW landfill. The integrated facility will be located in an area adjoining the existing dumpsite. A new Sewage Treatment Plant (STP) has been constructed in Duqm. The STP is located close to the existing landfill and has a capacity of 2,000 m3/day. Additionally, two 5,000 m3/d wastewater treatment facilities have been proposed by SEZAD. A high-standard arterial road network has been planned and is under implementation to link Duqm to all the major towns and cities within Oman.	A reverse osmosis (RO) water desalination plant, with an initial daily capacity of 10,000 m3, has been completed. Based on current levels of water consumption in Oman, this amount would be sufficient for a city with a population of 35,000 inhabitants. Two large reservoirs were completed and a third is in the design stage. The government of Oman is committed to meet the expected demand for potable water with the construction of the third reservoir. An entire electricity supply of 67 MW project was completed, most of the houses in the Study Area are served with electricity. Electric supply is also used for lifting water from tanks to water storage towers. Based on current levels of water consumption in Oman, this amount would be sufficient for a city with a population of 35,000. Further expansion of the RO	Not Available	Main so include 1.48 m total 23 domest distribu tankers Current solid no inadequ inappro are unr There a manago new fao solid ha

ffshore region does not have any significant e species which could be affected as a result of oject.

roject site is located near to the long crenulated Shubbat Quwayrat bay) in the northern area of uqm port.

andy intertidal shoreline is inhabited by a number mals includes many burrowing polychaetes, ceans, gastropods, bivalves and amphipods.

shoals of pelagic and demersal fish were sighted ost all the areas of the bay, which indicates high ctivity of the water column in the study area.

ber of humpback whales (population endangered CN) and dolphins were reported from the offshore . Marine green turtles (IUCN Red Listed) were ved at the survey areas of the project site.

ive habitats like seagrass and corals were not ved in the subtidal area.

sources of water supply in Al Wusta Governorate e a number of desalination plants that produced nillion m3 potable water during 2012. There are 23 wells in the Governorate supplying water for stic uses. The network system for water ution is very limited and is mostly supplied by rs.

nt waste management facilities for the liquid and non - hazardous waste for the study area are quate and waste is being stored and treated ropriately. The only waste management facilities managed landfills and scattered tipping areas.

are no long-standing facilities for the gement of hazardous waste at Duqm. However, acilities have been constructed for the storage of nazardous waste for the Dry Dock facility.

RECEPTOR	ESIA BASELINE							
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm				
	Construction on two main roads within Duqm; the first is a 17 km primary dual-carriageway with three lanes in each direction, is complete. This road will connect the port, airport, and tourist areas with local residential and social amenities. Power is generated in Duqm by a temporary diesel power station at Jaluni with a total installed capacity of 67 MW. Power is generated at 11 kV and stepped up to 33 kV using three step-up transformers for transmission. Power is distributed throughout Duqm via an underground cable network. Seven substations have been built to serve the port, airport, city north, city south, light industry and the hotel complex areas. At present a reverse osmosis (RO) water desalination plant, with an initial daily capacity of 6,000 m3, provides water in Duqm. Further expansion of the RO plant along with the water distribution network is underway to meet the expected rise in demand. The villages have varied type of housing units, depicting the economic and social status of each individual. An area of 23 km2 has been designated for the new frontier town at Duqm. This will be the backbone of the development area and initially will accommodate up to 67,000 people with further provisions to extend it to 111,000 residents. There is a 12-bed local hospital in Say village, with health centres at Heytam and Ra's al Madrakah. The hospital is currently being expanded to include a dental clinic. Most households have cars to fulfil their transportation needs. Local transport is also available in the form of a taxi service. Additionally, bus services to Muscat and Salalah are available.	a plant along with the water distribution network is underway to meet the rising demand. Two large reservoirs completed and a third is in the design stage. The two major objectives of the educational institutions will be to: (1) provide local manpower with the skills required to qualify for jobs in future industries and services and (2) provide engineering and troubleshooting services to local industries. An advanced Marine Research Center is planned that wil conduct cutting-edge studies and provide technical support for the local fishing industry. The seventh Five-Year Health Development Plan (2006-2010) has envisaged one health center for every 10,000 of the population in the urban and heavily populated areas and seeks to provide easily accessible health centers for scattered population localities. The following table summarizes of the Sultanate of Oman the available information from the Ministry of Health concerning the health facilities, these are almost free for Omani residents.		Rural A is a clos under t Oman, Govern general distribu As per units w 678 hot area. H apartm Duqm a catering There a educati				

Areas Electricity Company SAOC (RAECO) which osed Omani Joint Stock Company incorporated the Commercial Companies Law No. 4/74 of , is the main power provider to Al Wusta norate. RAECO is primarily undertaking electricity ation, water desalination and electricity ution activities in its authorized areas.

Census 2010, there are around 6,387 housing with 63.1% occupancy in Al Wusta, of which only busing units were part of the project influence Housing units are typically classified as villas, nents, Arabic houses, rural houses or other type.

and Mahout Wilayat have four health institutions ng to the needs of the local residents.

are currently 22 basic education and 1 general tion schools in Al- Wusta.

RECEPTOR	ESIA BASELINE			
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm
Terrestrial Ecology	The flora in the study area is dominated by halophyte plant community. The plant species identified during the survey includes Suaeda moschata, Suaeda verniculata, Zygophyllum qatarense, Arthrocnemum macrostachyum, Halopeplis perfoliata, Limonium stockcii and grasses such as Halopyrum macrostachyum. Most of the study area is barren and the flora in the study area is not rare or endemic to the region. All birds, except one, observed at the site are listed as Least Concern by IUCN, which means that these bird species are widespread and abundant, and are at lowest risk. The Eurasian Curlew is listed as Near Threatened, which means that this bird species is likely to become endangered in the near future. Flamingos were also noted 2 km southwest of the LBW. The animals that were identified from indirect evidence are all listed as Least Concern by IUCN (Red Fox, Cheesman's Gerbil, Camel and Domestic Dog). A total of 39 species of herpetofauna are available in the region, including 8 species with doubtful occurrence. The rarest group representation in this region are amphibian, on account of the arid nature of the region. Reptiles are well represented in the area with high abundance and distribution, which includes lizards. A total of 26 lizard species have been documented out of which many have rare occurrence, and few have high abundance.	 The two most important areas near to the town are the sabkha and coastal habitat to the north in the area of the new port development and the Arabian Oryx reserve to the west. Although these are both outside the boundaries of the Duqms' master plan and both already have the potential to be impacted by other development and activities, the proposed Al Duqm New Town will place additional pressure on these sites. Vegetation is fed by the summer monsoon rains and by dew from coastal fog, meaning that the coastal zone is relatively well vegetated, compared with the arid desert regions further inland. The highly saline coastal environment also contributes to the nature of habitats present. The habitats present in and around the Al Duqm town area can be broadly grouped into three main types: Coastal habitats and Sabkha (salt flats): these areas contain a mixture of wetlands (e.g. lagoons), very saline areas with little vegetation. These habitats support internationally important species and, of the three main habitats, are the least common in the region Wadis and gravel plains: the water provided by wadis supports a diverse range of vegetation, typified locally by open acacia woodlands, low shrubs and ephemeral grasses. Wadis act as wildlife corridors, along which mammals and birds travel; and Hills, slopes and escarpments: these habitat types support the least vegetation and wildlife, although where water is retained in fissures and depressions, there is likely to be a higher density of vegetation. Other habitat types in the local area include small alto use shifts present; these tend to have reduced vegetation and be less bio diverse. 	A total of 16 species of plants representing 14 families were observed across the survey area, however the taxonomy of most of these species has not yet been assessed for the International Union for the Conservation of Nature (IUCN) red list with the exception of a few species which are in the "least concern" category. During this survey, one endemic and regional endemic species was recorded. In this present survey, the most dominant species in the gravel plains/ sandy area were Crotalaria aegyptiaca, Tetreana quatarensis, Cyperus conglomerates, Limonium sacrophyllum, Echiochilon kotschyi and Pulicaria glutinosa. The dominant species in the Sabkah habitats mainly comprise of Halopeplis perfoliata, Arthrocnemum macrostachyum, Suaeda moschata, Halopyrum mucronatum and Cistanche tubulosa. The complete species list including the family name, IUCN status, species assemblage and relative abundance are known. Collectively, the plant community of the study area is mainly comprised common and highly adaptable species, including the one regional endemic (REN) and one endemic (END) species, which are usually found in the coastal environment of gravel plains and sabkah. Pugmark of Feral dog's, grazing camels and wild donkeys have been observed on the sabkha and coastal lagoon areas. Six species of lizards were observed across the study area. The most abundant species recorded were sand lizard <i>Mesalina adramitana</i> and Carter's Rock Gecko <i>Pristurus carteri</i> . Other observed species were Bosk's fringe-toed lizard <i>Acanthodactylus boskianus</i> , Snake-tailed fringe-toed lizard <i>Acanthodactylus opheodurus</i> and Desert agama <i>Trapelus</i> sp. One Spiny tailed lizard <i>Uromastyx leptieni</i> was sighted at location TS6 and their large burrows were also sighted at the gravel-plains and sandy patches. <i>Uromastyx</i> species are mostly found on firm soil or on rock surfaces that provide shelter in the form of cracks and crevices.	To the s which is ecosyst Duqm F classifie Interna site for This are propose None of in the 2 Conserv populat reserve project the refin of lizard The coa winterir
Local business / economy	The port and shipyard are expected to enhance the Omani economy in terms of diversification and creation of job opportunities for Omani citizens. In addition to the sea port, the area will be developed to include an industrial area, new town, fishing harbor, tourist zone, a logistics center and an education and training zone, all of which are supported by a multimodal	Apart from fishing and livestock rearing the local population are also benefits from outside employment. In Ad Duqm Wilayat - Duqm port, dry- dock and other construction companies are major recruiters of the local population in the form of low- grade jobs such as drivers. Moreover, some service industry growth is also	No information.	The ecc charact constitu Sultana occupat

e south of the Refinery site is a sabkah area is also an important birding area and a sensitive stem. The area just near the Lee breakwater of Port is an ecologically sensitive zone and is ied as an Important Birding Area by Bird Life national. This is yet to be declared as an official or conservation under the Ramsar Convention. rea lies in the project influence area, and the sed coastal pipeline corridor passes through it. of the plant species recorded in the site is listed 2011 Red List of the International Union for revation of Nature and Natural Resources (IUCN).

ryx sanctuary (2,828 km2)has a breeding ation of about 430 Arabian Oryx, and an ated number of 200 Arabian Gazelle. These ations are located in a confined area within the re and is approximately 60 km north-west of the t location. The fauna in the area of influence of finery project within the Oryx reserve comprises rd Pristurus robustris, camels, goats and sheep. bastal habitat is important migratory ground for ring birds.

conomy of the Al Wusta Governorate is cterized by its oil and fisheries resources, which tute the two major export commodities of the nate. Fishing and animal husbandry are the main ation of the Al Wusta population.

RECEPTOR	ESIA BASELINE						
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm			
	transport system that connects Duqm to other economic hubs.	apparent in the region. General stores and coffee houses, water transportation and other small businesses are evident within the region providing income opportunities.		The Al new re presen the on- corresp paced industr			
Local Residential / Community	Among all the villages in Duqm Wilayat, Saay village is the largest with a population of 6,183 followed by As Sadanat and Al Hawiyah (Census of Oman 2010). The rest of the villages within the study area are sparsely or seasonally populated. The expatriate population in Say village is approximately 10 times the size of the Omani population. Due to the upcoming economic development in SEZ it is	The Al Wusta Governorate, situated in between Al Dhahirah and Ad Dakhliyah Governorates (North) and Dhofar Governorate (South) with mainly four Wilayats (Ad Duqm, Hayma Mahout and Al Jazer) accounting together an area of about 77,853km2 had a population of 22,983 as of 2003 census.	Secondary information on socio-economic profile and existing infrastructure of the Duqm area and its surroundings has been primarily obtained through desktop review of data available from HMR archive, census reports, and published information from various government agencies.	The Pr are par settlen which popula			
	expected that the number of expatriate working force will increase over time peak and then gradually decline.		During social consultations with stakeholders for the Duqm SWIP Project (HMR, 2015) consultants were informed that due to the present and future planned development in the Special Economic Zone and around Duqm most of the people / households from the surrounding localities / settlements, except Nafun, have been shifted and relocated by the Government to Wadi Say. Further the relocated households have been provided houses and land in Wadi Say. And the Government is planning to shift the people from Wadi Say to the newly upcoming township of approximately 150 houses near to the Duqm Airport.	e			
			The Al Wusta Governorate has mainly four Wilayats (Ad Duqm, Hayma, Mahawt, and Al Jazer) together accounting for an area of about 77,853 km2 and with a population of 22,983 as of 2003 Census. By the 2010 Census the total population of Al Wusta governorate had almost doubled to 42, with a high growth rate of 11.88% per annum, and accounting for 1.5% of the Sultanate's population.	t s			
Traffic and Transport	No Information	No Information	No Information	Public This ro tracks the DS dock, v Constru			

I Wusta communities are slowly adjusting to the eality and emerging livelihood strategies which nt new challenges and opportunities as a result of n-going development of SEZAD and the sponding changes from a traditional to fastercontemporary way of life associated with trial and infrastructure development.

roject Influence Area covers 11 settlements that art of Ad Duqm Wilayat. The majority of the ments are located along or near the shoreline, of 6 are unpopulated as per 2010 Census. The total ation of the 5 populated settlements is 7,051.

Highway 32 acts as the DSEZ main arterial road. oad, with additional current informal access have been developed across the central part of SEZ area to provide access to the port and dry which are currently under construction. ruction of Road 5 has already commenced.

RECEPTOR	ESIA BASELINE						
	IP7 - Contract C78/2017	Contract C65/2016	Contract C80/2017	Duqm			
Cultural Heritage	An area of particular cultural importance is the Rock Garden located about 3.5 km southwest from the DLBB Project. The Rock Garden is made up of limestone and sandstone rocks that were formed in an underground freshwater aquifer more than 46 million years ago.	Archaeological sites in region exhibit the historic remains of the earlier locations and systems of settlements. These include archaeological sites as well as other exposed or underground sites comprising historic caves, remains of castle, graves, fragments of structures etc.	Not Available	Among be extr discove of the p The Ro			
		Oman, can boast of largest collection of archaeological sites including highly revered ones by Muslims, Christians and Jews alike, and ancient historical sites. Many of the heritage sites are included in the UNESCO World Heritage list.		sandsto freshwa it has b natural protect with th			
		Duqm's unique topography is complemented by several areas of geological significance that contribute to the heritage value of Oman. Natural processes and historic human settlements have left behind artifacts and rock formations that will give the development some of its most salient tourism value and local meaning.		Moreov and erc their ov observe			
		The development location has a rich archaeological legacy with a number of findings on or within the vicinity of the site including burial mounds, shell midden sites, ceramic artifacts that hint at Bronze Age settlements, burial structures and pre-historic tombs.					
		Among the COPS identified archeological sites, some remain in right flank zone and others in an area upstream of the Wadi Say Dam, along the wadi Say Channel. During the site visits, no archeological particulars, such ceramic					
		artifacts, burial structures or tombs, were identified.					

gst the numerous studies, Duqm was observed to remely rich in archaeology sites and a number of

eries were made in area adjacent to the location proposed master plan for Duqm.

ock Garden is a 3 km2 area of limestone and tone rocks which formed in an underground vater aquifer over 46 million years ago. With time been shaped by wind, water, frost and other al forces. This has been earmarked for formal tion as a dedicated tourist site and to integrate it he tourism master plan.

ver, despite extensive exposure to weathering rosion, these sites have been well preserved on own accord as erosion at many sites was ved to be extremely slow.

Appendix H: Duqm SEZ VEC Baseline

ESIA Baseline Receptor The Dugm SEZ (DSEZ) Area ("Site") Materials and natural resources are purchased from third party suppliers, and location of resources can vary from local, regional and national. Materials / natural resources Parts of the extensive DSEZ are traversed by a network of vehicle, goat and camel tracks. This allows small sections of the DSEZ to be used as an open thoroughfare for the local population, to access the beach at the eastern edge of the SEZ. Fish landing sites and fish drying shacks Land Use that are sporadically spread across the area in the west of the port area. However, most of the expansive Dugm SEZ is undeveloped and desert. Topography A land use of note in the Dugm area is the Arabian Oryx Sanctuary that lies outside of the DSEZ project area, adjacent to the western boundary. This area has been designated to preserve undisturbed habitat for the benefit of the future of the species. The wide range of contrasting landscapes that characterize the site represent a valuable natural heritage. Over centuries, the people of Oman have developed a culture inextricably linked to the landscape and natural environment of their country. In general, the site can be classified by low-lying coastal and alluvium plains that are enclosed to the north, west and south by sandstone and limestone hills that lie at the foot of the Hugf escarpment. To the east the site meets the Gulf of Oman, with sandy beaches backed by dunes and non-tidal lagoons (khawrs). The area is incised by wadis that flow from the escarpment to the sea. This landscape arrangement is typical of the landscape along the eastern coast of Oman. The MIGA funded project site has an elevation varying between 2 - 40m above mean sea level, although the greater surrounding topography is very variable and ranges up to 190 m above sea level. Even in areas of similar topography land levels are very variable and undulating, mainly resulting from fluvial flash flood erosion and deposition processes. It is observed that some areas consist of extreme gravely, sandy, deep soils. Dunes and rock outcropping with shallow crusted, sandy soils are also present in the DSEZ. The landform of the area, with its predominantly flat plains surrounded by high escarpments, would make a development the size and type of Dugm DSEZ visible from all areas whose aspect faces the project site, including the coastal zones and marine environment. The landscape character of the overall DSEZ is typical of mature marine fringe environments in the Al Wusta region, which is generally characterized by an open coastline backed by sand and alluvium plains and hills. Air Quality The previous data collected for the DSEZ baseline Air Quality was identified to be deficient. More recent and updated information regarding the DSEZ areas Air Quality baseline is given in Appendix G. This data has been extracted from available EIA report and SEZAD baseline conducted in 2013 by HMR.

ESIA Baseline				
Receptor	The Duqm SEZ (DSEZ) Area ("Site")			
Noise	A noise survey was undertaken to inform the understanding of baseline conditions within the DSEZ. A distribution of sampling locations was to obtain a general overview of existing baseline conditions throughout the DSEZ, as related to different geographic areas and the position of existing and future sensitive receivers.			
	The results show that, at the time of the baseline sampling, the equivalent noise levels determined exceeded the MD79-94 threshold for rural residential areas during all samples but one. Similarly, more than half of the samples recorded indicate that the threshold for noise originating from an industrial source would have been exceeded despite the absence of any significant anthropogenic sources of noise within the Duqm development site at the time of sampling. The primary source of noise was invariably noted as coming from strong wind, a phenomenon affecting the Duqm development site as a whole; given the open nature of the site it is subject to the vagaries of the coastal weather systems that operate there. Low surf noise was detectable at some of the sample sites more proximate to the coast. It must be noted that the DSEZ masterplan wide baseline surveys were reported in 2011 and more recently, further surveys have been undertaken with greater relevance to MIGA funded Projects, with the results summarized in Appendix G			
Surface Water	There is no permanent surface water on land as is typical for this region. Although wadis will flow during storms, water will only be present for a short time until it percolates to groundwater, drains to the sea or evaporates. In addition, any pools will evaporate quickly, which is supported by the development of sabkha in extensive areas across the DSEZ. The key long-term surface water resources are associated with the marine zone, which lies immediately adjacent to the DSEZ and is connected via wadi flows that discharge to sea.			
	Marine baseline water quality surveys have been completed as part of monitoring studies to support the port. These surveys have comprised of nearshore surveys in the port area and offshore surveys for the disposal area and borrow area. It must also be noted that these surveys were completed prior to any development occurring in this area and it is likely that conditions may have changed following construction. The survey was also undertaken in relatively nearshore areas within and adjacent to the port area. However, the information gathered in 2008 does provide information on natural baseline conditions and are of some relevance to the waters that front the wider DSEZ.			
	The results of surveys show that the waters off Duqm are naturally rich in nutrients that support abundant wildlife. Water quality is generally very good. However, very high levels of nutrients were recorded that are linked to the movement of deeper colder waters flowing to the coast. The recorded ranges for temperature ($26.6 - 27.8$ C), salinity ($34.9 - 36.9$ ppt), dissolved oxygen ($4.4 - 9.4$ mg/l) and pH ($8.1 - 8.5$) were recorded, which are consistent with conditions expected at the time of survey. Higher dissolved oxygen levels are noted in nearshore surf zones as would be expected. Turbidity values varied from 0.3 to 6.3 NTU with the lower values noted in surface layers.			
Groundwater Hydrogeolog	/In general, regional groundwater flows slowly inland from higher rainfall and recharge zones in north Oman Mountains in the Al Batinah region and southern mountain areas in Dhofar. As the rain water penetrates the soil to the north and the south of Oman, it reaches deep soil horizons beneath the central part of Oman (including the Al Wusta region), commonly over 100 m below the ground surface. This ground water is transported to the west (towards Saudi Arabia) and east (towards the coast). This groundwater is highly saline.			
	In the Duqm area, fresh groundwater lenses will likely occur after periods of strong rainfall which lead to run-off and infiltration to recharge			

	ESIA Baseline				
Receptor	^{)r} The Duqm SEZ (DSEZ) Area ("Site")				
	lenses. The freshwater will therefore only be periodically available, although no fresh groundwater lenses were identified in the 2017 surveys the area. Due to the erratic rainfall and its short duration, this localized rainfall is not expected to recharge deep groundwater wells.				
	A number of wadi channels traverse the IDZ, Wadis generally run from higher ground to the rear of the DSEZ and flow downhill across the DSEZ area where they finally discharge to sea. Runoff is channeled via smaller tributaries that feed the larger wadis. However, in some instances smaller channels do not converge and they discharge directly to the sea. All wadis are generally deeply incised until they reach very flat areas and have wide discharge areas, particularly the larger wadis; this is representative of the extreme nature of flows and their erosional capacity due to the sediment type and geology of the area and the bed load or suspended load in wadis following erosion across the catchment area.				
Soil	The genesis of soils in the DSEZ largely comes from the surrounding limestone geology. Most of the soil is classified as loamy to sandy soils and some of them are skeletal. The soil in the DSEZ can range from moderately to strongly saline soil. Some gypsum pans are present in the DSEZ which can be found in strongly dissected high alluvial terraces and fans. It is noted that some areas consist of extremely gravelly, sandy, deep soils. Dunes and rock outcrops with shallow crusted sandy soils are also present in the DSEZ.				
	It is clear that soils of the DSEZ are largely derived from historic and recent natural alluvium deposition. The periodic flash floods lead to flooding across the DSEZ. When rainfall events occur, surface runoff water moves according to the elevation gradient across the DSEZ. This surface water transports rock and sediment, which is deposited in low lying areas and depressions to form the alluvium plains that are spread across the DSEZ. As would be expected, these deposits lie on the flat plains of the DSEZ and intersect hilly outcrops running alongside existing and historic wadis. In depressions water also accumulates, forming ponds that are exposed to high evaporation processes that leave salt behind. In addition to alluvium deposits, marine deposits are located along the coast, which consist of mudflats in low lying areas and coastal dunes.				

	ESIA Baseline				
Receptor	The Duqm SEZ (DSEZ) Area ("Site")				
Marine Ecology	Due to the high level of productivity in the water column, the marine environment at Duqm is subject to highly turbid conditions, which limit the development of any significant expanses of coral in the area. Certain macroalgae occur in unusually large quantities for the Arabian region in terms of relative biomass. In particular, dense beds of the brown algae grow in specific areas within the shallow sublittoral to a depth of about 9 m, contributing substantially to overall productivity and supporting a range of marine life, although no substantial areas of macroalgae were identified during historic baseline surveys.				
	Overall, infauna communities were noted as being of moderate diversity and abundance in the port area and low diversity and abundance at the disposal and borrow areas. There is clear correlation that infauna species abundance and diversity decrease significantly further offshore.				
	Due to the highly productive waters and, until recently, a history of relatively low fishing pressure, coastal areas of Al Wusta have supported an active fishery. Fish landings include large pelagics such as yellowfin tuna, longtail tuna, kingfish, queenfish; small pelagics such as sardines, mackerel; demersal fish like emperor, sea bream, grouper, crocker, catfish; crustaceans include lobster, shrimp, cuttlefish, abalone; and sharks and rays. This gives some indication as to which species of fish can be found offshore from Duqm. However, it must be noted that the precise location of fishing for landed fish is not known and this therefore only provides an indication of fish that may be present in the area.				
	Cetaceans and turtles are distributed across nearshore and offshore habitats according to their needs for feeding, breeding, migration, and related behavior at different times of the year. Among the habitats that they use, some are more critical than others.				
	Marine mammals in Oman include about 21 species of whales and dolphins, which are top predators feeding in both deep and shallow waters on a wide range of prey. More common species include spinner dolphins, Arabian long-beaked common dolphins, false killer whales, bottlenose dolphins and Risso"s dolphins. Less commonly occurring species include the spotted dolphin, killer whale, pygmy killer whale and Cuvier"s beaked whale. The majority of species are known to be breeding residents of Oman. Of the larger whales, the Bryde"s whale and humpback whales are the most frequently recorded in the area, both of which are known to feed and breed here. Little is known about the rare blue whales, but there appears to be some seasonality to the sighting records, which suggests a migratory route through the area in winter months.				

	ESIA Baseline					
Receptor	The Duqm SEZ (DSEZ) Area ("Site")					
Terrestrial Ecology	The central section of Oman falls within the Arabian regional subzone phytochorion. In general, the vegetation of the central desert is sparse with low species richness. Indeed, despite covering nearly three quarters of Oman's land mass, it is estimated that only about 200 floral species, approximately 20% of the total species in Oman, occur within the central desert. Despite this, the limestone plateau of the central region is classified as a center of local endemism with twelve endemic species and five threatened species occurring there. An increase in vegetation cover and richness occurs from the western to the eastern sections of the central desert as a result of the increasing effect of the heavy fogs and dews in the east. This moisture is crucial to sustaining perennial vegetation species and other wildlife during periods of drought in the hyper arid areas.					
	The central region of Oman is dominated by a limestone plateau and gravel plains and includes the Arabian Oryx Sanctuary (AOS). The sanctuary was formerly listed as an UNESCO world heritage site, but it has since lost this status. The area is noted for its various plant and animal species such as the Arabian Oryx, Nubian Ibex, Caracal, Arabian Gazelle, Houbara Bustard and other animals. The site is also noted for its desert ecosystem biodiversity, including the Jiddat al Harasees; Huqf escarpment and depression; pools of Wadi Ash Shinan and the surrounding sabkha, woodlands and pastures.					
	The DSEZ comprises a mosaic of seven main habitat types consisting of: a coastal zone (comprised of khawrs, intertidal mudflats and beaches); sabkha; wadi courses; gravel and sand plains; low rocky outcrops and gravel hills; Piedmont and foothills and finally Rocky Mountains and escarpments. The coastal zone habitat type is the smallest within the DSEZ, covering approximately 0.24% of the site. In the wider Duqm area it can be subdivided into three sub-categories: beach and back beach, khawrs and intertidal mudflats. Mudflats are present elsewhere in the Duqm area (e.g. near the port), but were not recorded within the DSEZ site.					
	The sabkha in the DSEZ stretches from the coastal zone further inland, principally between areas of gravel and sand plains habitats. Tracks have been graded through the sabkha which has caused some fragmentation and litter has accumulated in areas close to the road. Sabkha only constitutes a relatively small proportion (7.46 %) of the DSEZ.					
	The Duqm area was categorized as an IBA principally because of the importance of the shallow, sandy bay of the Ghubbat Quwayrat, which includes intertidal mudflats and a few small coastal khawrs (lagoons). This area lies to the east of the DSEZ in the area designated for Port Development in the overall Duqm Masterplan. southern end of the IBA has already been lost due to the development of the port.					
	This area is a significant stopover point in a chain of sites along the Oman coast for migratory bird species (gulls and waders) on their journey between Asia and Africa. A total of 120 bird species are recorded for the Duqm area by the OBRC and 115 in the IBA list, due to five species recorded by OBRC since the publication of the IBA document. The great majority of these species are marine or shoreline species (62%) and/or migratory (54%). Some species can be included in both categories. The species in greatest numbers (several thousand each winter) are the gulls and terns, that depend upon fish as a food source and are undoubtedly attracted by the fishing activities and associated waste.					
	As is the case with most areas in Oman with low productivity and prey base, the mammalian fauna of the study area is likely to be constrained, particularly in terms of the larger species.					

	ESIA Baseline					
Receptor	The Duqm SEZ (DSEZ) Area ("Site")					
	At least 15 species of mammal have been recorded in the AOS (MECA, 2008), although it is unlikely that all of those will occur in the study area due to their habitat preferences, and in some cases low population numbers. Examples of species present in the AOS but unlikely to inhabit the site include the Arabian Oryx (Oryx leucoryx - regionally endemic and endangered), which are almost exclusively restricted to fenced enclosures in the Sanctuary and will not be released until the AOS boundary is fenced. Other species unlikely to venture into the DSEZ site include Sand Gazelle (Gazella subgutturosa - Vulnerable), which are scarce and are reported to favour the northern and western sections of the Sanctuary, and the Ruppell"s fox (Vulpes rueppellii) and sand cat (Felis margarita), both of which prefer low-lying sandy areas and dunes. Species such as Striped Hyaena (Hyaena - Critically Endangered in Oman), Caracal (Felis caracal –Endangered in Oman), and Arabian Wolf (Canis lupus - Endangered in Oman) which used to occur along the Huqf escarpment have not been formally recorded there for many years and may no longer occur in the AOS. It is therefore unlikely that they inhabit the DSEZ.					
	Of the total 39 species recorded, 12 are snakes, 26 are lizards, and one is an amphibian. Thirty-one of the species have been confirmed as occurring in the area, and a further eight are considered likely to be present. A diverse reptile fauna exists in the Duqm area, apparently concentrated in sandy and gravel habitats supporting reasonable vegetation cover. The foothill areas exhibited the greatest diversity, due undoubtedly, to a great variety of niches in the form of shelter, along with scattered					
	areas of reasonable vegetation cover. This would provide the richest food resources, as well as shade and suitable cover for nocturnal species during the day. Habitats with limited vegetation cover had seemingly limited reptile niche availability – the sabkha and mountain areas of almost bare rock.					
business / economy	Duqm town. This plant has been decommissioned (when the Port of Duqm was built) and current facilities are temporary and informal along discrete areas of coast. New facilities are to be located at the New Fishing Harbor south of the Port of Duqm.					
	The Al-Wusta region, including the northern part of Dhofar, is said to account for about 70% of all the artisan fish landings as identified by the Ministry of Fisheries Wealth statistics. The fishery is mixed (i.e. targets different stocks including pelagics, demersal, sharks and rays, crustaceans, cuttlefish and squid) and is governed to a great extent by seasonality. Although fisheries represent the major source of income to most households, some supplemental income is also generated through livestock farming (goats, camels). Meat, milk, oil and cheese, as well as some handicraft products, are all important in the communities. Camels, goats and donkeys are grazed in areas surrounding the villages, including those within the DSEZ.					
Local Residential / Community	Despite Duqm's distance from other strongholds of national economy, the region has seen significant recent growth; the population of the Al Wusta region increased from 25,499 in 2006 to 40,936 in 2014, an increase of 60.5% compared to the population increase of Oman which was 54.9%.					
	The Al Wusta Governorate is spread over 79,700 km2 and consists of four Wilayats: Hayma, Muhut, Ad Duqm and Al Jazir, with the total population in the Governorate of 40,936 people (or 1% of the total population) and a population density of only 0.5 ppl/km2. The total					

ESIA Baseline					
Receptor	The Duqm SEZ (DSEZ) Area ("Site")				
	population in the Al Wusta Governorate is split: 54% Omanis and 46% foreign workers or expats. The population of the Ad Duqm area shows the same trend, where the total population of 8,559 people (or 0.2% of the total population) is split: 52% Omani and 48% foreign citizens.				
	Al Tayari, Nafun and Antoot are located within the study area. Within these areas, camel and goat rearing is an essential livelihood activity which can have a large influence over local households' incomes.				
Traffic and Transport	Parts of the DSEZ are traversed by a network of vehicle, goat and camel tracks. This allows sections of the DSEZ to be used as an open thoroughfare for the local population, to access the beach at the eastern edge of the DSEZ.				
	A public highway (Public Highway 32) acts as the DSEZ main arterial road. This road, with additional current informal access tracks have been developed across the central part of the DSEZ area to provide access to the port and dry dock, which are currently under expansion. Additions to the current road network are already under construction, including Road 5.				
	Furthermore, the Duqm regional Airport has been established and is designed to accommodate all types of aircraft, including those handling large passenger numbers and air cargo loads with in-flight catering facilities. It is comprised of a passenger terminal with a capacity of 500,000 travelers per year, a 4 km runway, a cargo terminal with an initial 50,000-ton capacity and duty-free shops. Additional expansion and modifications to the airport are currently being developed.				
Cultural Heritage	A number of archaeological studies have been carried out in the proximity of the masterplan area. Preliminary evaluation of archaeological sites in the Duqm area suggested that very little other than graves date from the Islamic era, but there is a wide spectrum of evidence of human occupation from late pre-Islamic times back to the Early Stone Age. In Oman, generally, burial sites of all eras are found on higher ground, normally where there is rocky material to place over the grave. This, as elsewhere in Arabia, is to prevent scavenging by hyaenas. Burial on higher ground also helps to ensure that graves are not disturbed by flood. It has also been suggested that burial on high ground may have had religious significance in the past. Islamic burial sites, identifiable from the presence of one or two vertical stones, are especially sensitive and any development that might disturb them has to be referred to the Ministry of Awqaf and Islamic Affairs.				
	Previous archaeological walk-over surveys recorded 174 archaeological sites in the Duqm SEZ. In addition, one geological site and seven archaeological sites were identified outside of the DSEZ. Of these sites in the SEZ, 12 had previously been recorded. In addition, available data from the Reto Jagher survey has identified a further four sites that were not investigated as part of our survey. This therefore means that there are 178 archaeological sites in the Duqm SEZ. Archaeological features found mainly consist of triliths, burial sites and flints.				
	Towards the mouth of Wadi Sidrah there is a cluster of important archaeology, which as a group is considered to be worthy of protection. The archaeology in this area comprises graves, cemeteries and shell middens. The trilith site on the Sidrah road (archaeological site 146 just outside the IDZ boundary) where new buyut shaabiyah are being built has been damaged by the movement of heavy machinery. This site is a visible feature adjacent to the main access to Sidrah from the northwest, so is relevant to the amenity resources of the DSEZ.				
	The central area of the site has a swathe of archaeological locations along the southern edge of the foothills. The features are generally limited to burial grounds, with the majority being single graves. There is also a well-known traditional sacrificial site, known as Ayn Maqfaad", near the				

	ESIA Baseline				
Receptor	The Duqm SEZ (DSEZ) Area ("Site")				
	road in this area. The area around in the south of the site includes a variety of archaeological sites, including triliths, burial mounds and flint scatters. The site is also of geological value. This area also forms a connective band of archaeology with sites outside of the DSEZ that Shinan Pools sites sit outside of the DSEZ to the west it is a major natural feature with potential for use by visitors in sustainable numbers. As a source of drinking water for the Nubian Ibex, it must be managed to ensure that they remain protected with minimum disturbance. Nearby is a group of trilith sites, some woodland and a further smaller trilith site, within the IDZ boundary, where there are also Islamic graves and a current beduin settlement.				

Receptor Group	Sensitivity	Justification (Examples)	Value	Justification (Examples)
Natural capital	Low	Resources can be obtained from national and extra- national sources	High	Envisaged that resources will be sourced locally. Where there is poor availability or insufficient quantity and/or quality, procurement of such resources will extend to wider Oman.
Land Use	Low	The land throughout the Duqm SEZ is typical of the Al Wusta region and consider to be of low significance.	Low	Extent of land affected is expected to remain localized to the Duqm SEZ.
Air Quality and Odour	High	Air pollutants may affect human health and there could be permanent or irreplaceable change.	Low	The contribution from the Project's emissions will impact baseline pollutant concentrations in the Duqm SEZ.
GHGs	High	GHG emissions released to the atmosphere would be difficult to reverse and amend.	High	The Project contributions of GHG emissions will add to national contributions and Oman's annual GHG emission output.
Noise	Medium	Noise can cause nuisance to individuals, but the effects are considering less severe and potentially act over a shorter period in comparison to other VECs influencing human health (air quality).	Low	The contribution from the Project Nosie emissions will impact baseline concentrations in the Duqm SEZ.
Groundwater / Hydrogeology	High	Any major spillages or incidents, which is considered to be unlikely, would affect the quality of groundwater systems, and contribute to a contaminated resource, including soil.	Low	The impact (if any) is predicted to be limited to the Duqm SEZ.
Soil	Medium	The soil is situated on either purpose-built land (i.e. prepared) or of low quality to sustain other uses such as grazing or agriculture.	Very Low	Impacts on soil quality are likely to be localized (i.e. in the immediate footprint of the Project) and of short duration.

Appendix I: VEC Sensitivity and Value

Receptor Group	Sensitivity	Justification (Examples)	Value	Justification (Examples)
Surface water quality (freshwater / marine)	High	Valued surface water courses are susceptible to changes in water chemistry through run-off or spill.	Medium	Although impacts are likely to be more evident in the Duqm SEZ, surface water quality and associated flow/run off could have an impact on a wider and regional geographical scale.
Topography / Landscape	Low	The areas landscape arrangement is not highly valued (i.e. not protected), due to it being typical of the landscape along the eastern coast of Oman	Medium	The area of development will be concentrated in the Duqm SEZ. However, it is possible that the Project will change the landscape of a part of the Al Wusta region.
Marine habitats, flora and fauna	Appendix K and Appendix L for Biodiversity			
Terrestrial habitats, flora and fauna	Appendix K and Appendix L for Biodiversity			
Resident population	High	The impact to human health could be permanent or have an irreplaceable change.	Medium	Although direct health impacts are likely to be more evident in the Duqm area (air quality), there could be impacts that act on a wider regional geographical scale (contamination).
Local business / economy	Low	Current business in the area is only on a small and local scale. However, there is a large potential to accommodate change.	High	The Project has the potential to enhance economic value on a national scale in Oman.
Local Communities/ Assets	High	Alterations to the local communities in and around the Duqm area will alter due to a spike in population and influx of foreign workers.	Medium	Impact on the Duqm SEZ is inevitable. However, population increase and community alterations through national and international migration may occur in the wider Al Wusta region.
Road Traffic / Transport	Low	The current transport network mostly consists of dirt tracks. The area is used as an open thoroughfare for the local population and there is a large capacity to	Medium	Improvement of roads and enhanced traffic will occur in the Duqm area. Enhanced road traffic is also likely to occur within the Al Wusta region via connecting link

Receptor Group	Sensitivity	Justification (Examples)	Value	Justification (Examples)	
		accommodate change.		roads.	
Local infrastructure	Medium	There is currently a little amount of local infrastructure, but it has been recently enhanced by an international port. There is still capacity for further infrastructure development in the DSEZ.	Medium	Although infrastructure will be being built directly in the Duqm area, it can provide a catalyst and base to support future growth in the Al Wusta region.	
Culture Heritage	Medium	Risk of accidental damage to archaeological sites is considered to be significant and potentially irreversible, although very unlikely.	High	Cultural heritage and archeological sites will hold significant Omani value and will be of national importance.	

Appendix J: Biodiversity VEC Sensitivity

Biodiversity VEC	Sensitivity			
Designated Sites				
Duqm Important Bird Area (IBA)	Very High			
Jidat Al Harrasis IBA	Very High			
Terrestrial - Natural Habitats				
Intertidal mudflats, sand and lagoon areas (in Duqm IBA)	High			
Endangered, endemic plant species (Salsola omanensis, Ochradenus harsusiticus)	High			
Endangered carnivores (striped hyena, Arabian wolf, Ruppell's Sand Fox)	High			
Mountain areas	Medium			
Wadis	Medium			
Ibex and Gazelle	Medium			
Marine – Natural Habitats				
Shallow coastal habitats (0-20m)	Medium			
Marine – Species				
Arabian Sea Humpback Whale	Very High			
Indian Ocean Humpback Dolphin	High			
Turtles (Green, Loggerhead and Hawksbill).	High			
Other whales and dolphins	Medium			

Appendix K: Biodiversity Construction Magnitude,	Significance and Recommendations
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VEC (Sensitivity)	Cumulative Impact Assessment	Significance Of Cumulative Impacts	Recommendations	Residual Impact
Duqm Important Bird Area (IBA) (Very High)	12 ha (approximately 1%) of the IBA comprising shallow, sandy bay, intertidal mudflats and small coastal khawrs (lagoons) was permanently removed to construct the Export Terminal which is an AF of the Port and Road Number 5. The Port of Duqm Authority aims to expand Duqm Port in the future; further permanent loss of coastal habitats in the IBA will occur in the future – area yet to be defined. Construction disturbance will be temporary (for approximately a year).	Moderate significant.	None required. (already Constructed)	Minor non-significant.
	The IBA is unlikely to be able to support the numbers of wetland bird species for which it was designated as a consequence of habitat loss and disturbance. It may also be the case that certain micro-habitats have been removed by construction and thus the suitability of the IBA for certain bird species may be reduced (the species affected cannot be predicted without detailed topographic survey data and bird habitat suitability modelling). This effect has been predicted to be of very high magnitude in the construction phase.	t		
Jidat al Harrasis IBA (Very High)	No significant adverse construction phase impact was predicted for the Projects and there is little potential for an adverse cumulative construction phase impact.	Not applicable.	None required.	Not applicable.
DSEZ Nature Reserve (High)	A slight adverse impact resulting from minor habitat loss caused by construction of the DRPIC Crude Oil Pipeline was predicted. No detailed plans for further encroachment in the DSEZ Nature Reserve are known and thus cumulative construction phase impacts are unlikely.	Not applicable.	None required.	Not applicable.
Al Wusta Wildlife Reserve (Very High)	No significant adverse construction phase impact was predicted for the Project and there is little potential for an adverse cumulative construction phase impact.	Not applicable.	None required.	Not applicable.
Wadis in close association with mountains & Wadis in open terrain (High)	Significant amount of area of this habitat could be directly removed/disturbed to facilitate Road 5, Service corridor and Dams and Channels. Further areas (area unknown at this stage) of this habitat will be removed when further development is progressed in the SEZAD Heavy Industry Zone. In the Duqm region, this habitat type is relatively abundant. However, wadis are the key habitat type supporting trees which are relatively rare or survive as minor components outside wadi systems. Because they support more vegetation which is otherwise scarce on the desert plain and, in some cases also springs or other permanent water, they are of high value for species such as ibex and gazelle. Cumulative impacts of high magnitude are predicted resulting from habitat loss.	Moderate significant.	 Mitigation proposed in the biodiversity chapter relating to the Project alone is as follows: Minimise footprint a wadi crossings. Reinstate wadi crossings to ensure natural passage of seasonal floor flows. Compensatory landscape planting using native/endemic tree species. In addition to the above measures which will occur in the Project Footprint - recommendations in the biodiversity offsetting framework to comply with the IFC PS 6 requirement to achieve no net loss of natura habitat associated with the Project should be progressed. Cumulative habitat loss impacts should be addressed by application of Performance Standard 6 offsetting targets to other projects and Associated Facilities. This will require SEZAD policy support to ensure inter-project application of no net loss principles relating to natura habitat. 	Minor significant.
Rocky mountain & escarpment (High)	No significant adverse construction phase impact was predicted for the Project and there is little potential for an adverse cumulative construction phase impact.	Not applicable.	None required.	Not applicable.
Shallow coastal habitats 0-20 m - (Medium)	MIGA project IP7 during construction has impacts No significant adverse impact during construction phase was observed. Although habitat loss will be caused by dredging associated nut was for very limited time	Minor significant	Construction Completed	Not applicable.

VEC (Sensitivity)	Cumulative Impact Assessment	Significance Of Cumulative Impacts	Recommendations	Residual Impact
Endangered, endemic plant species (Salsola omanensis, Ochradenus harsusiticus) (High)	There are multiple locations where the Project Footprint overlaps an area which may constitute critical habitat for two endemic plant species. Further development in the SEZAD Heavy Industry Zone and road and infrastructure construction may further remove habitat for the two endemic plant species. On the basis that habitat which may support these species will remain widespread in the Duqm region but with the knowledge that the population distribution and statues of these species is poorly known (as little academic research has been undertaken), on a precautionary basis the cumulative impact of habitat loss is predicted to be of medium magnitude.	Moderate significant	 Preconstruction survey of instances where critical habitat intersects the Project Footprint . Translocate affected populations of endemic plant species for propagation and eventual use in introduction schemes in the SEZAD area. Contribution toward native plant propagation and introduction scheme. In addition to the above measures which will occur in the Project Footprint - recommendations in the biodiversity offsetting framework to comply with the International Financial Corporation PS 6 requirement to achieve a net gain of critical habitat associated with the Project should be progressed. Cumulative habitat loss impacts should be addressed by application or PS6 offsetting targets to other projects and Associated Facilities. This will require SEZAD policy support to ensure inter-project application or net gain principles relating to critical habitat. 	Minor non-significant.
Green, Loggerhead and Hawksbill Turtles (High)	A slight adverse impact resulting from construction lighting and disturbance from personnel and vehicles was predicted. Further development in the AoI is unlikely to threaten key turtle nesting beaches.	Not applicable.	None required.	Not applicable.
Arabian Sea Humpback Whale (ASHW) (Very High)	There is little construction in close proximity to the marine environment proposed as part of the Projects as the construction of IP7 is complete and any impact is very unlikely. Construction due to other development and construction phase of other third party projects might have significant adverse impact on ASHW associated with the Project alone is unlikely. However, construction of the Export Terminal will both introduce a risk of ship strike mortality or injury, underwater noise and changes in prey distribution and abundance arising from disturbance and dispersion of sediments during dredging. Cumulatively, with the low magnitude effects attributable directly to the Project, these effects are likely to result in a Very High impact given the rarity of ASHW (mortality of a single individual may compromise its population status	Major significant.	 Measures to be secured via Strategic Initiative Approach: Formation of an 'advisory panel' that guides mitigation and monitoring through linking industry together government, conservation and research interests. SEZD should request assurance of mitigation strategies implemented for Product Export Terminal. This should include seeking assurance that available technologies are fitted to ships to minimise acoustid disturbance (e.g. low noise vessel technology engine mountings and low cavitation props). SEZD should work within the Strategic Initiative to implement a code of conduct for avoidance of marine mammal and turtle collisions and minimum safety standards relating to pollution for all vessels importing and exporting oil products to/from the Refinery. The Strategic Initiative including SEZD, Omani Government bodies and industrial bodies should produce and publish an oil spill response plar identifying the most sensitive biodiversity areas. The Strategic Initiative including SEZD, Omani Government bodies and industrial bodies should produce and publish an oil spill response plar identifying the most sensitive biodiversity areas. The Strategic Initiative, SEZD and Omani Government bodies should work towards implementation of an offsetting approach to address cumulative impacts on marine species. Such an approach could be linked to a government lead region-wide/Gulf of Masirah wide zoning strategy with designated zones where different activities are prohibited or permitted. 	Until Strategic Initiative Approach formulated and enacted it is not possible to conclude.

Appendix L: Biodiversity Operations Magnitude, Significance and Recommendations

VEC (Sensitivity)	Impact Summary	Significance of Cumulative Impacts	Recommendations	Residual Impact
Duqm IBA (Very High)	From operation of the MIGA funded project there is no significant adverse impact as these projects are infrastructure project. A significant adverse impact is predicted for the third party project from vehicles, personnel and maintenance operations at the Export Terminal Topsides (Project related). Additional disturbance of birds may arise from the same sources operating in the Port of Duqm. This is predicted to result in an adverse impact of medium magnitude.	Major significant.	 Following measures should be applied: Implement a mandatory code of conduct applying to all topside operations in the Export Terminal. This should include suitable controls to limit bird disturbance such as: Ensuring Export Terminal fencing prevents visual disturbance to birds using the IBA. Using 'soft start' protocols for maintenance operations involving loud percussive noise and vibration impacts. Provision of designated staff recreation areas which birds are able to habituate to the presence of people in – evidence shows that birds are able to habituate to predictable/regular movements of people and vehicles bur less so to sporadic and unpredictable events which caused disturbance or bird feeding and roosting. Include bird conservation issues in the site induction delivered to all staff. 	Minor non-significant.
Mountain areas and escarpment (High)	Given the lack of emissions from the 7 projects once operational that there will be no to negligible impact on ambient air quality in these areas. Currently, it is not possible to conclude on potential magnitude of such a cumulative impact. However, it is possible that it could be significantly adverse.	Not possible to conclude unti dispersion modelling complete.	 Ambient air monitoring and wet/dry deposition monitoring close to sensitive habitat features (lichen and plant communities) to ascertain potentia negative effects. Mitigation at source and compliance with air emissions standards. Monitoring of ambient air quality (if required / as informed by monitoring). SEZAD will need to impose appropriate mitigation on third party industrial operators to ensure cumulative air quality impacts are addressed. 	Not possible to conclude until cumulative dispersion modelling complete and mitigation approach defined (if required).
Shallow coastal waters (Medium)	MIGA funded 7 projects does not have any adverse impact. Third party project might have introduction of invasive species from Project supply chain shipping operations and impingement/entrainment of fish or marine macro invertebrates from water intake systems may result in a high magnitude adverse impact.	Minor significant	 SEZD should seek assurance from its supply chain and conduct regular audits to ensure environmentally benign anti-fouling technologies are being adopted at water intake/output points and that measures are in place to minimize entrainment/impingement of marine fauna. SEZD should seek assurance from the Duqm Port Authority and within its own supply chain to verify that stringent environmental controls are in place to address invasive species introduction. 	Minor non-significant.
Wide ranging species such as large carnivores, gazelle and ibex	Wide ranging species such as large carnivores, gazelle and ibex (all of which are high value IEFs) rely on a combination of resources that are also widespread such as food resources (prey, carrion, forage and grazing species, neighboring populations). Because they rely on such a large proportion of the landscape they are sensitive to a range of 'urbanizing effects' which may occur during the operational phase of the Projects in SEZ. However, the MIGA funded project will not have any interactions as they are infrastructure projects and they are inert during operations The magnitude of urbanizing effects associated with the Project is likely to be low and not significant. This is because although the Project Footprint is large, the Refinery and Crude storage facility at the RM Crude Oil Terminal are relatively localized (in comparison to the extremely wide home ranges of large mammals); and the pipeline will be buried when operational and thus will not form a barrier. Considering the Project alongside third-party project s and wider infrastructure development in the Duqm SEZ, the cumulative impact magnitude may be increased to medium as the severity ofurbanising effects is driven by the cumulative level of human use of the landscape.	Minor significant	 Measures to be secured via Strategic Initiative Approach. Contribute to an integrated Biodiversity Management Plan working collaboratively with other anchor tenants in the industrial area. An initia focus of the biodiversity management plan should be to obtain more accurate distribution, abundance and movement data for target species to inform mitigation planning. Integrated BMP incorporates measures to avoid development in wadis and flood prone areas; protection of movement routes of large mammals; and protection of suitable forage, browse and cover. 	Minor non-significant.

VEC (Sensitivity)	Impact Summary	Significance of Cumulative Impacts	Recommendations	Residual Impact
Green, Loggerheac and Hawksbill Turtles (High)	Non-significant slight adverse impacts resulting from operational lighting and disturbance from personnel and vehicles were predicted for the MIGA funded Projects. It shall be noted that during further development and operation of the other third-party project there might be adverse effects related to collisions with ships or entrainment in water intake systems or shipping operations which are not part of the Project.	Moderate to minor significant.	As per ASHW	As per ASHW.
Cetaceans including ASHW (Very High) and Indian Ocean humpback dolphin (High)	The Projects does not comprise marine operations. Third party project operations like from the Export Terminal which occupies a small part of the marine environment. The sensitivity of the ASHW is very high to any incremental mortality rate, and the overall population size is currently critically small, so operational impacts are considered to range from low to very high magnitude. The sensitivity of the Indian Ocean humpback dolphin is also assumed to be very high because of the fragmented nature of its population distribution.	Major significant.	As per ASHW	As per ASHW.

Appendix M: Projects List for VEC Baseline

- 1. Project Sagittarius Independent Environmental and Social Due Diligence Report (draft) (confidential). WSP, February 2019
- Assessment of Coastal Hazards, Vulnerability, and Risk for the Coast of Oman (2015)
- 3. Preliminary Environmental Impact Assessment Study (PEIA). Commercial, Governmental Berths and Pre-Gate and Inspection Zone. K&A Consultants S.A.E. March 2015
- Construction Environmental Management Plan (CEMP). Construction of Roads, Infrastructure and Buildings at the Commercial Pre-Gate, Gates and Inspection Zone –IP3. Contract C50/2015. Five Oceans Environmental Services. Oct 2016. 2nd revision Feb 2017
- 5. Environmental Impact Assessment Report. Duqm Liquid Bulk Berths Project. WorleyParsons Oman Engineering LLC. Sep 2015
- 6. Duqm Liquid Bulk Berths Project. Addendum to Initial Environmental Permit (IEP) for Onshore Disposal. Boskalis Duqm LLC. June 2017
- 7. Construction Environmental Management Plan. Duqm Liquid Bulk Berths Project. Boskalis Duqm LLC. May 2017
- 8. Design of Road Nos. 1 and 5 and Drainage Systems, Duqm. EIA Report. HMR Environmental Engineering Consultants. April 2017
- Duqm Development Drainage Network and Protection Schemes Phase 1. EIA for Saay Dam, Saay Channel, Jurf Channel and Channel Junction. Renardet S.A and Partners Consulting Engineers LLC. July 2015
- 10. Duqm Development Drainage Network and Protection Schemes Phase 1. ESIA for Jurf Dam. Renardet S.A and Partners Consulting Engineers LLC. June 2015
- 11.EIA report for Service Corridor, Duqm. HMR environmental engineering consultants. July 2015
- 12. Port of Duqm Phase 1 Operational Environmental Impact Assessment. Three Volumes. Haskoning DHV UK Ltd. Oct. 2016
- 13. Port of Duqm Oil Spill Contingency Plan. Oman Pesco LLC, March 2017
- 14. Medium Industrial Zone Environmental Impact Assessment. Volume I: Non-Technical Summary. Haskoning DHV UK Ltd. Mar 2017
- 15. Duqm Refinery Project Oman. Environmental and Social Impact Assessment non-technical summary. WSP. Dec 2017

- 16.16. Duqm Refinery Project Oman. Consolidated Impact Assessment and Mitigation Report with appendices. WSP. Dec 2017
- 17. Duqm Refinery Project Oman. Cumulative Impact Assessment. WSP. Dec 2017
- 18. Duqm Refinery Grievance Management Procedure. Sep 2017
- 19. Duqm Refinery Stakeholder Engagement Plan. Aug 2017
- 20. Duqm Refinery ESDD Phase 2 report. Ramboll Environ. Dec. 2017
- 21. Duqm Refinery ESDD Phase 3 report. Ramboll. July 2018
- 22. Port of Duqm Safety Rules for Contractors
- 23.Port of Duqm Company SAOC. Port of Duqm Environmental Guidance Notes:
 1) Omani Environmental Regulations International Legislations References; 2)
 Environmental Standards and Limits; 3) Environmental Review and Permitting;
 4) Environmental Performance and reporting; 5) Construction Environmental
 Management Plan (CEMP); 6) Chemical substances; 7) Waste management; 8)
 Air emissions management plan. Feb 2017
- 24. Port of Duqm Company SAOC. Port of Duqm Early Operations Environmental Performance Report. Haskoning DHV UK Ltd. Sep 2016
- 25. Port of Duqm Company SAOC. Port of Duqm Environmental Guidance Note. Feb 2017
- 26. Stage 4 Report: Final Master Plan and Development Framework, Schematic Engineering Design and Governance Strategy – Chapter 7 Environment, Biodiversity and Cultural Heritage. Atkins. May 2018
- 27. Tatweer Company Profile
- 28. Tatweer HSE roles and responsibilities. Excerpts from the documents. May 2016
- 29. Tatweer Brief Introduction Presentation
- 30.SEZAD Infrastructure Projects- E&S initial findings memo. WSP Middle East-Dubai. Dec 2018
- 31. Findings of the Independent Environmental and Social Consultant (IESC) site visit conducted during Nov 23-28, 2018. WSP. Nov 2018
- 32. Independent Env & Social Consultant (IESC) #1 Compliance of 7 subprojects w.r.t E&S Standards
- 33. Independent Env & Social Consultant #2 for the Refinery Project wrt IFC standards.

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