ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)
FOR
SHOBAK 45 MW WIND POWER PROJECT
IN
MA'AN

Final ESIA

31 August 2017
REV - 2

Project Developer:

شركة الشوبك لطاقة الرياح
AL-SHOBAK WIND ENERGY PSC

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ABBREVIATIONS

BOO	Build, Operate and Transfer
CARC	Civil Aviation Regulatory Commission
CBO	Community Based Organization
CEA	Cumulative Effect Assessment
DLS	Department of Lands and Survey
DoA	Department of Antiquities
DoS	Department of Statistics
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plant
GWh	Gega-Watt Hour
IBA	Important Bird Area
IFC	International Finance Corporation
IFI	International Financing Institutions
IUCN	International Union for Conservation of Nature
JoD	Jordanian Dinar
JRTV	Jordan Radio and Television Corporation
kWh	Kilo-Watt Hour
MCM	Million Cubic Meters
MEMR	Ministry of Energy and Mineral Resources
MoA	Ministry of Agriculture
MoEnv	Ministry of Environment
MoH	Ministry of Health
MoL	Ministry of Labor
MoMA	Ministry of Municipal Affairs
MoT	Ministry of Transport
MW	Mega Watt

MWI	Ministry of Water and Irrigation
NEPCO	National Electric Power Company
NGO	Non-Governmental Organization
NTS	Non-Technical Summary
OHTL	Overhead Transmission Line
PPA	Power Purchase Agreement
PS	Performance Standard
RJAF	Royal Jordanian Air Force
RSCN	Royal Society for the Conservation of Nature
SEP	Stakeholder Engagement Plan
SNH	Scottish Natural Heritage
TRC	Telecommunication Regulatory Commission
VP	Vantage Point
WAJ	Water Authority of Jordan
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY IN ARABIC

ملخص تنفيذي

EXECUTIVE SUMMARY IN ENGLISH

1. INTRODUCTION

1.1 Project Background

His Majesty King Abdullah Ibn Al Hussein II has charged His Royal Highness Prince Hamza Ibn Al Hussein with the presidency of a Royal Commission to review and update the "Master Strategy of Energy Sector in Jordan", in order to meet the energy demands and challenges facing the energy sector in Jordan. In 2007, the Royal Commission updated the Strategy and provided a vision for the development of the energy sector till the year 2020 to become the "Updated Master Strategy of Energy Sector in Jordan for the period (2007-2020)". One of the main outcomes was the need to diversify energy resources and increase the share of renewable energy to 7% in 2015 and 10% in 2020 – with the major share coming from wind and solar power.

To this extent, and in accordance with "Updated Master Strategy", the renewable energy sector in Jordan is gaining momentum since a temporary Renewable Energy and Energy Efficiency Law was approved in March 2010 and officially entered into force in April 2012, known as the "Renewable Energy and Energy Efficiency Law No. (13) of the year 2012 and its amendments No. (33) of the year 2014". With this law, 'Direct Proposal Submission' of renewable energy projects to the Ministry of Energy and Mineral Resources (MEMR) was allowed, where investors (or developers) had the opportunity to develop renewable grid-connected electricity production projects.

Developers responded at the end of July 2011 by submitting Expressions of Interest (EOI) to MEMR. Following the evaluation of such EOI, MEMR invited the shortlisted developers to enter into a Memorandum of Understanding (MoU) with the objective to undertake all due diligence needed in order to submit a proposal for the proposed project. To this extent, Shobak Wind Power Company (hereafter referred to as the 'Developer') has been qualified as an approved project developer by MEMR and signed a Power Purchase Agreement (PPA) in September 2016 for a total capacity of 45 MW.

The project will be implemented on a build, own and operate basis (BOO) with the developers signing a Power Purchase Agreement (PPA) with national power utility NEPCO.

1.2 Project Location and Setting

The Project is located in Ma'an Governorate in the South of Jordan approximately 160km south of the capital city of Amman. The Project is located within the District of Shobak which hosts 11 villages. The closest villages to the Project site include Mdhaibie' (also known as Al-Faisaliyeh and which is located around 1km to south), Zaitooneh (located 1km to the west), Zobeiriyeh, (located around 1.3km to west) and Mothallath Al-Shobak (located around 1km to the west). From a municipality perspective, the Project site is located within Al-Shobak Al Jadeda Municipality but outside of the municipal administrative boundary. The location of the Project site is presented in the figure below.

The Project area is around 14.5km^2 with a maximum length of around 7.2km and a maximum width of 1.5km The Project site is all governmentally owned lands. Figure 1 below presents the location of the Project site within Jordan.

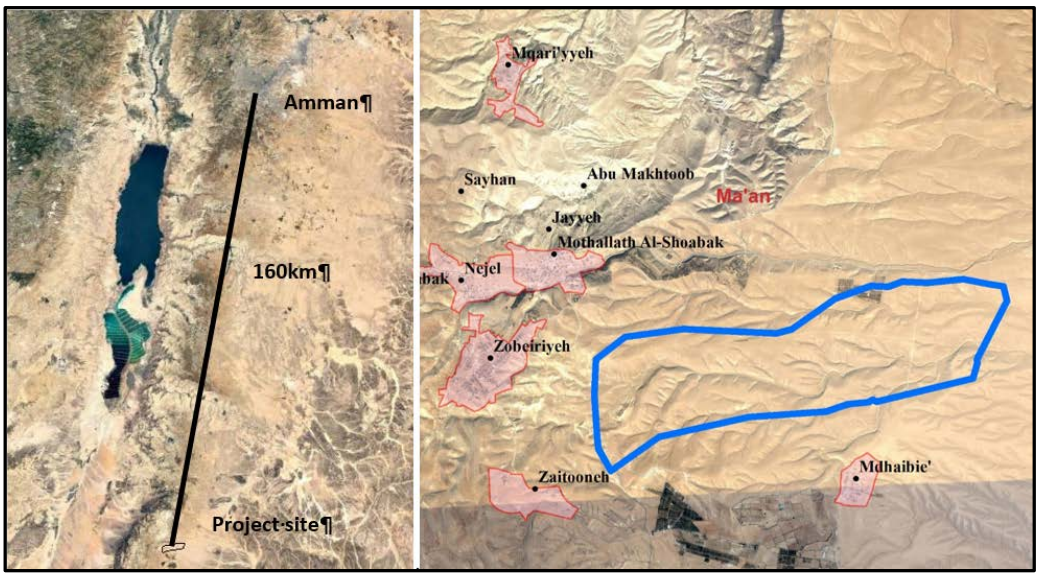

Figure 1: Project Location in Relation to Amman and the Surrounding Human Settlements

The District of Shobak is located within the western parts of Ma'an Governorate near Tafileh and Aqaba Governorates, in an area which is known to be part of Al-Sherah Heights. The Al-Sherah Heights are characterized with their highlands which can reach up to 1,700m ASL (Above Sea Level), and its relatively high rainfall and fertile soil unlike the majority of the Ma'an Governorate and specifically the eastern parts which are characterized by its desert and barren nature.

1.3 The Environmental and Social Impact Assessment (ESIA) Report

The environmental clearance for this Project is governed by the Ministry of Environment (MoEnv), as stipulated by the "Environmental Impact Assessment Regulation No. (37) of 2005". The MoEnv requires the preparation of a comprehensive Environmental Impact Assessment (EIA) for such a Project before an environmental permit is granted, in order to commence with construction and operational activities.

The Developer will be seeking financing for the Project from prospective lenders, including international Financial Institutions (IFIs). Therefore, the Developer wishes to design and manage the project in accordance with good international industry practice and standards. For the purpose of the ESIA this has therefore been developed in accordance with:

- EBRD Environmental and Social Policy (2014) and Performance Requirements (PR)
- IFC Environmental& Social Sustainability Performance Standards (IFC, 2012);
- IFC General Environment, Health, and Safety (EHS) Guidelines (IFC. 2007); and
- Applicable IFC Industry Sector EHS Guidelines – mainly the EHS Guidelines for Wind Energy (IFC, 2015).

ECO Consult was commissioned by Shobak Wind Power Company to prepare the Environmental and Social Impact Assessment (ESIA) for the Project in order to apply for the necessary environmental permit. This report is the ESIA report to be submitted to the MoEnv. This ESIA is undertaken in accordance to the MoEnv's ""Environmental Impact Assessment Regulation No. (37) of 2005" and the IFC Performance Standards and EHS Guidelines and EBRD performance requirements.

1.4 Document Structure

Table 1 provides an overview of the Chapters within this ESIA document.

Table 1: Summary of the ESIA Content

Chapter	Description of Content
Chapter 2 – Project Description	Provides a detailed description of the Project in relation to its location, the key project components and an overview of the proposed activities that are to take place during the various Project phases.
Chapter 3 – Project Alternatives	Provides an analysis of certain alternatives to the Project development in relation to: (i) the Project site selection alternatives, (ii) the Project design, (iii) the chosen technology, and finally investigates (iv) the 'no action alternative'
Chapter 4 – Regulatory and Policy Framework	Provides an overview of the environmental clearance process for the Project as governed by the Ministry of Environment (MoEnv)
Chapter 5 – ESIA Approach and Methodology	Presents the methodology and approach that was adopted for the ESIA study.
Chapter 6 – Stakeholder Consultation and Engagement	Discusses in detail the stakeholder consultation and engagement plans which were undertaken as part of the ESIA process for the Project and provides an overview of the findings. In addition, this Chapter also discusses the future stakeholder engagement and consultation plans which are to take place at a later stage.
Chapter 7 – Overview of Strategic Environmental and Economical Impacts	This Chapter provides an overview of the significant positive environmental and economical impacts that will result from the Project development on the strategic and national level. The Chapter also highlights the site specific negative environmental and social impacts anticipated from the Project throughout its various phases – each of which is discussed in detail in the subsequent chapters.
Chapter 8 – Chapter 19	Presents the environmental and social attributes that will be studied throughout the ESIA. This includes: landscape and visual (chapter 8), land use (chapter 9), geology and hydrology – soil and groundwater (chapter 10), biodiversity (chapter 11), birds – avifauna (chapter 12), bats (chapter 13), archaeology and cultural heritage (chapter 14), air quality (chapter 15), infrastructure and utilities (chapter 16), community health, safety and security (chapter 17), socio-economic conditions (chapter 18), and occupational health and safety (chapter 19). For each attribute and where relevant, the baseline conditions within the Project site and its surroundings was assessed. Each chapter then moves on to identify and assess the potential impacts from the Project on each attribute and for each impact a set of mitigation measures have been identified to eliminate or reduce the impacts to acceptable levels
Chapter 20 – Summary of Anticipated Impacts	Provides a summary of all the identified impacts discussed throughout the previous Chapters which are anticipated throughout the various phases of the Project to include planning and construction phase, operation phase, and decommissioning phase.
Chapter 21 – Assessment of Cumulative Impacts	This Chapter investigates the cumulative impacts which could result from other known existing and/or planned developments in the area, and based on currently available information on such existing/planned developments.
Chapter 22 – Environmental and Social Management Plan (ESMP)	Presents the Environmental and Social Management Plan (ESMP) for the Project; which mainly summaries the impacts identified as well as the mitigation measures and monitoring requirements to be implemented throughout the various Project phases. In addition, this Chapter describes the institutional framework and procedural arrangement for the ESMP implementation.
Chapter 23 – Assessment of Impacts from Associated Facilities	provides an assessment of the anticipated impacts from the associated facilities to the Project and which mainly include the OHTL

1.5 Project Proponent and Key Contributors

Different entities are involved in the planning and implementation of the Project. The responsibilities of each key entity which is of relevance to the ESIA are listed in the text below along with a general description of their roles.

- Shobak Wind Power Company (hereafter referred to as the 'Developer'): owner and lead developer of the Project. The company is owned by Alcazar Energy (70%) and Hecate (30%);
- Engineering, Procurement, and Construction (EPC) Contractor: The EPC Contractor will be responsible for preparing the detailed design and layout of the Project; supply of the material, wind turbines, and equipment; and construction of the internal access roads, crane pads, foundations, operation building and the medium voltage and data interconnection between the individual wind turbines and the wind farm substation. Vestas will be the EPC Contractor for this Project;
- Operation and Maintenance (O&M) Contractor (or referred to as Project Operator): will be responsible for the daily operation of the Project and undertaking all maintenance activities required for the turbines and other utilities. O&M Contractor will also be Vestas;
- National Electric Power Company (NEPCO): is the national electricity company of Jordan with whom Shobak Wind Power Company signed the Power Purchase Agreement (PPA). NEPCO is responsible for the high voltage electric grid in Jordan. For this Project, NEPCO will be responsible for designing and building the high voltage overhead line from the Project substation till its connection to the existing high voltage electric grid;
- The Ministry of Environment (MoEnv): the Regulator and the official governmental entity responsible for the protection of the environment in Jordan. The MoEnv is responsible for the approval of the Environmental Impact Assessment (EIA) Study and making sure it complies with the "EIA Regulation No. (37) of the year 2005" and responsible for granting the environmental clearance for the Project;
- ECO Consult: hereafter referred to as the 'ESIA Team' who is the ESIA Practitioner and the consultant commissioned by Shobak Wind Power Company to prepare the Environmental and Social Impact Assessment (ESIA) for the Project in accordance with the requirements of the Ministry of Environment (MoEnv) and its "EIA Regulation No. (37) of the year 2005". The ESIA will also be prepared in accordance with EBRD Environmental and Social Policy and Performance Requirements (PR) and IFC Performance Standards (PSs) and Environmental, Health and Safety (EHS) Guidelines.

2. PROJECT DESCRIPTION

This Chapter provides a detailed description of the Project in relation to its location, the key project components and an overview of the proposed activities that are to take place during the planning and construction, operation, and decommissioning phase.

2.1 Administrative Setup of Project Location

It is important to highlight the administrative setup as framed by district and municipal boundaries within Ma'an Governorate as those will be referred to many times throughout this document.

The Project is located in Ma'an Governorate in the South of Jordan approximately 160km south of the capital city of Amman. Ma'an Governorate consists of 4 main districts and 4 main sub-districts that belong to the District of Qasabit Ma'an (as highlighted in Table 2 below). From a municipality perspective, the project site is located within Al-Shobak Al Jadeda Municipality but outside of the municipal administrative boundary.

Table 2: Administrative Setup of Ma'an Governorate

Governorate	District/Sub-District	Municipalities
Ma'an	District of Qasabit Ma'an Eel Sub-district Al-Jafr Sub-district Mregha Sub-district Athroh Sub-district District of Petra District of Shobak District of Al-Husseiniyeh	Ma'an Municipality Al-Husseiniyeh Municipality Al-Sherah Al Jadeda Municipality Al-Jafr Municipality Al-Shobak Al Jadeda Municipality Eel Al Jadeda Municipality Al-Asha'ri Municipality Petra Development and Tourism Region Authority (PDTRA)

2.2 Project Location

The Project is located within Ma'an Governorate in the South of Jordan, approximately 160km south of the capital city Amman. More specifically, the Project site is located within Shobak District which hosts several villages. The closest villages to the Project site include Mdhaibie' (also known as Al-Faisaliyeh and which is located around 1km to south), Zaitooneh (located 1km to the west), Zobeiriyeh, (located around 1.3km to west) and Mothallath Al-Shobak (located around 1km to the west). From a municipality perspective, the Project site is located within Al-Shobak Al Jadeda Municipality but outside of the municipal administrative boundary.

The proposed wind farm site is located within a hilly terrain area with altitudes ranging from around 1200 to about 1322m above sea level (a.s.l) as shown in Figure 2 below. The Project site has an area of around 14.5km^2 (14,522 Dunums). The Project site can be accessed through Highway #15 also known as (Desert highway) and which is located 13km east of the Project site. From Highway #15 an exit on the left connects with (AlMolouky Highway) which leads directly to the Project site. As shown in Figure 3.

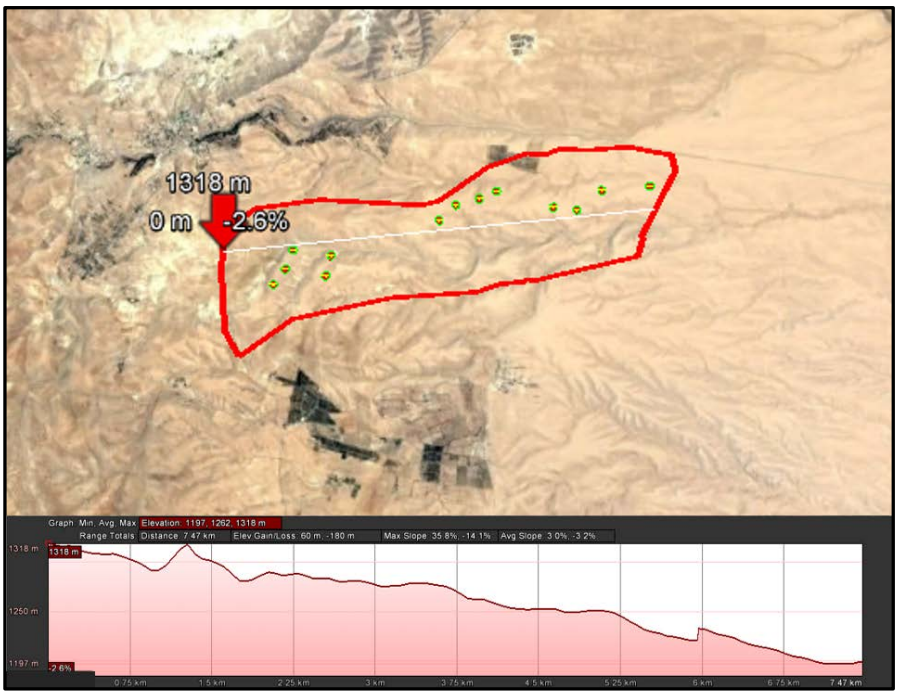

Figure 2: Elevation Profile of the Project Area

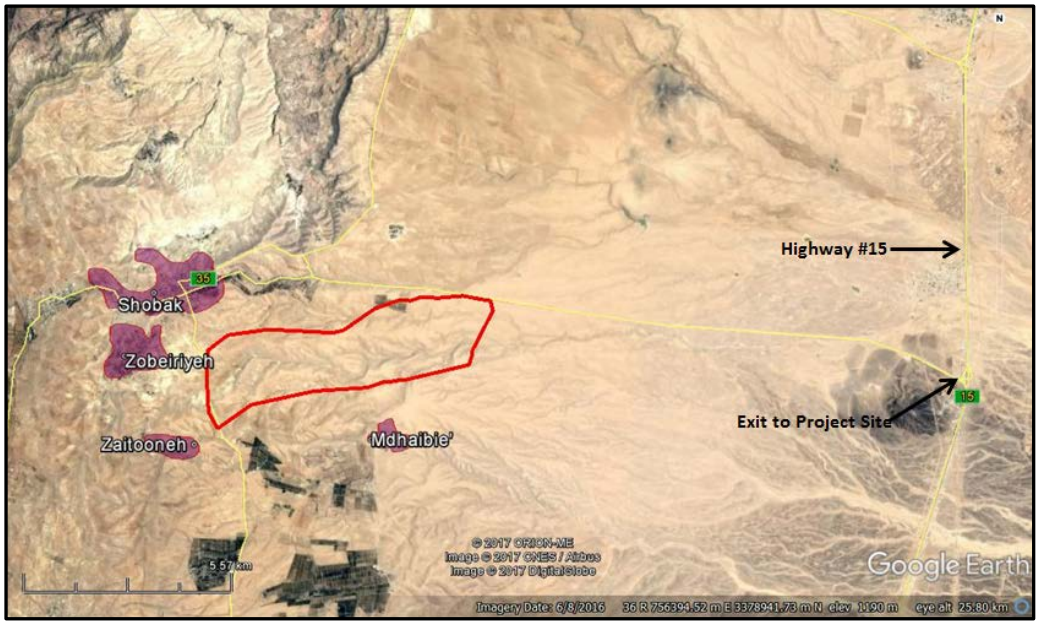

Figure 3: Project Area

The closest 132 kV transmission line is approximately 5 km north of the Project site as shown in Figure 4 below.

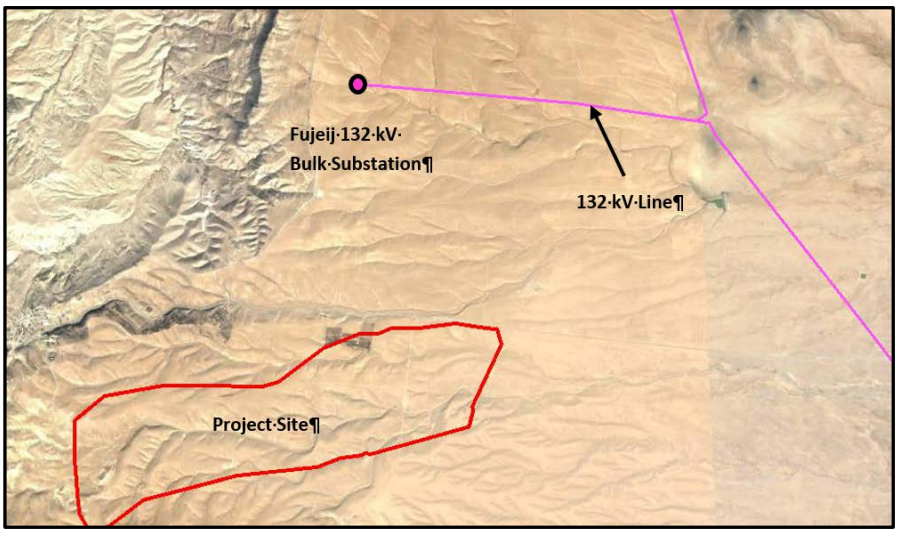

Figure 4: Facilities near the Project Site

2.3 Outline of Wind Turbine Technology

Wind turbine technology relies on harvesting the kinetic energy in wind (i.e. movement of wind) and turning it into mechanical energy which in turn is used for electricity generation. To capture wind, turbines consist of rotor blades which are elevated from the ground using towers to take advantage of faster and less turbulent wind. As wind speed increases, the rotor blade begins to rotate which then spins a shaft that is connected to a generator thereby converting wind energy to electricity.

Wind turbines produce Direct Current (DC) electricity from wind, which can be used for grid connected power generation. However, electricity at the grid is usually in a different form (known as Alternating Current (AC)) and thus inverters are used to convert DC current to AC current. In addition, wind turbines produce electricity at a certain voltage which must be matched to the grid it connects to. Therefore, transformers are used to convert the output to a higher voltage that matches the grid.

2.4 Project Components

Table 3 provides a summary of the key Project components for the Project, along with a detailed description of each of those components below.

Table 3: Summary of Key Project Components

Component	Description
Project Generation Capacity (MW)	44.85
Technology Type	Wind Power
Number of Wind Turbines	Vestas V136 3.45MW model (13 turbines)
Rated Power per Turbine (MW)	3.45
Rotor Diameter (m)	136
Hub Height (m)	112
Tip height (m)	180
Project area to be covered	14.5 km^2
Infrastructure and Utilities	This includes: (i) internal road network; (ii) underground cables; (iii) warehouse and offices; (iii) substation; and (iv) associated facilities.

2.4.1 Wind Turbines

Generally, a wind turbine consists of a foundation, tower, nacelle, rotor blades, a rotor hub, and a transformer, see Figure 5 (a) below). The foundation is used to bolt the tower in place. The tower contains the electrical conduits, supports the nacelle, and provides access to the nacelle for maintenance. Typically, three (3) blades are connected to the hub which then connects with the nacelle; the box-like component that sits atop the tower and which most importantly contains the gear box (which steps up the revolutions per minute to a speed suitable for the electrical generator) and the generator (which converts the kinetic energy into electricity).

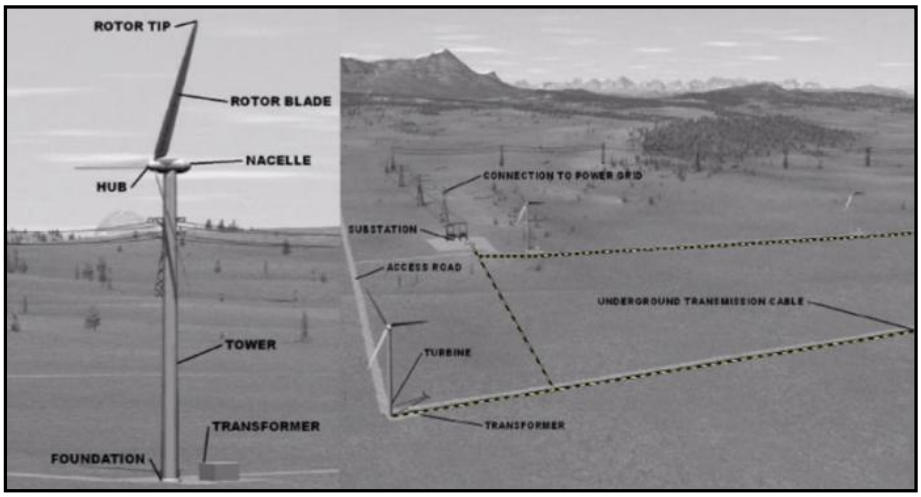

Figure 5: (a) Typical Structural Components of a Wind Turbine, (b) Typical Components of a Wind Farm (Source: EHS Guidelines for Wind Energy, IFC)

The designated EPC Contractor for this Project will be Vestas. The EPC Contractor will be supplying the wind turbines and preparing the detailed design of the Project. Table 4 presents the specifications of the wind turbines that Vestas will be supplying while Figure 6 below presents the layout prepared by Vestas.

Table 4: Turbines Specifications

Company	Technology	Project Size (MW)	Number of Turbines	Turbine Size (MW)	Hub Height (m)	Rotor Diameter (m)	Tip Height (m)
Vestas	V-136 3.45MW	44.85	13	3.45	112	136	180

The project was prepared to show the layout of wind turbines within the Project site, see Figure 6. In addition, the wind farm design has been subject to an intensive process which took into account technical criteria (wind resources in the specific Project site, spacing between the turbines to minimize wake effects which could lead to a decreased wind energy production, accessibility to the turbines, etc.) as well as environmental considerations as presented throughout this ESIA.

As discussed earlier, according to the detailed design there will be 13 turbines spread out throughout the Project site. Foundations will be constructed to bolt the tower of the turbine in place. The EPC Contractor will be constructing 13 foundations (one for each turbine) – no details were available for the specifications for the foundations however they are likely to be around 300m2 in area. In addition, each turbine is equipped with a transformer that converts/steps up the output from the turbine to a higher voltage (from 11kV to 33kV) to meet a specific utility voltage distribution level that is appropriate for connection with a substation (explained in detail below). Each turbine will also be equipped with an inverter that will convert electricity from the turbine from DC current to AC current.

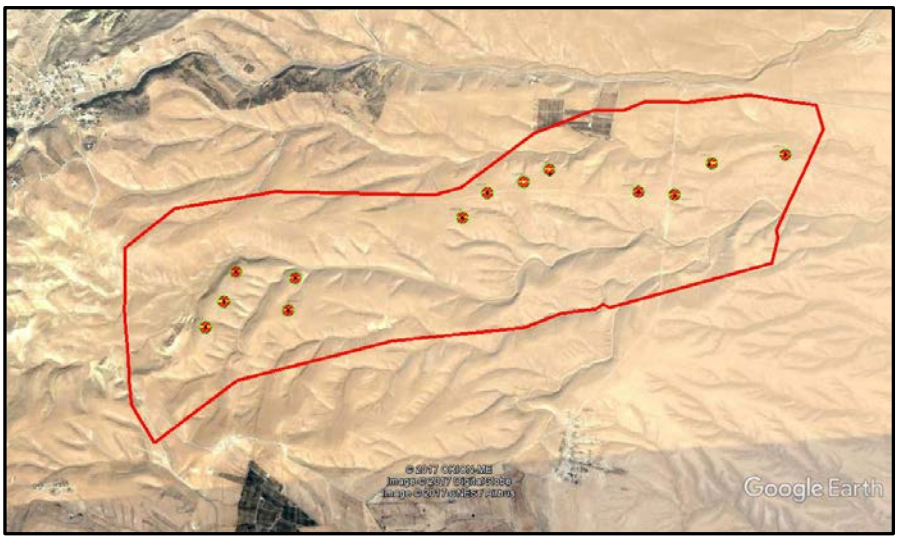

Figure 6: Turbine Layout

2.4.2 Infrastructure and Utilities

The following highlights the infrastructure and utilities requirements of the Project.

- **Medium Voltage Cables:** The wind turbines will be connected through medium voltage cables (33kV) to a substation located within the Project site. It is likely that the connection between the turbines and the substation will be made using underground transmission cables buried in ground by trenches.
- **Substation:** the substation will be located onsite and is a high voltage transformer substation that collects and converts the output from the turbines to a higher voltage (from 33 kV to 132 kV) that is appropriate for connection with the High Voltage National Grid (132 kV), see Figure 7.

  The turbines will be connected to the national grid through a new overhead line (OHL) with a length of approximately 5.0 km is required to transport the power to existing Al Fujeij substation (refer back to Figure 4) which will be under the responsibility of the National Electric Power Company (NEPCO).
- Other infrastructure and utilities in the Project site could include the following:
  - **Building Infrastructure**: onsite building infrastructure could be required for the daily operation of the Project. This could include an administrative building (offices) used for normal daily operational related work and a warehouse for storage of equipment and machinery such as spare parts, oil, fuel, lubricants, etc.
  - **A crane pad** next to each wind turbine to accommodate cranes for the installation of the wind turbines and for maintenance activities during operation. The crane pads will be suitable to support loads required for the erection, assembly an operation and maintenance of the turbines; and
  - **Road network:** a road network will be required for installation of the turbines during the construction process and for ease of access to the turbines for maintenance purposes during operation.

Figure 7: Typical 33/132kV Substation

2.5 Footprint of the Project Components

This section provides an estimate on the footprint of the Project taking into account the components discussed in the previous section. The number and figures have been based on either preliminary information provided by Vestas or based on previous experiences from wind farm developments in Jordan.

As noted in the table below, the total area of disturbance for the project is significantly small and is less than 1% of the Project area (which is 15km^2). As discussed earlier, this number is based on preliminary numbers available at this stage and could be subject to change at a later stage of the project development, see Table 5.

Table 5: Footprint of the Project Components

Component	Footprint	Description
Turbines	0.02km^2	This includes the footprint for the foundation and the crane pad area for each of the 13 turbines. Each crane pad is likely to be around 1,500m^2 in area (38m in width and 40m in length), whereas each foundation is likely to be around 300m^2 in area.
Substation and Warehouse and Storage facilities	0.02 km^2	Includes footprint of the substation area and all building facilities.
Trenches for MV cables and communication cables	0.04 km^2	Trenches are likely to be around 8km in length and a width of around 6m.
Road networks	0.05 km^2	Road network is likely to be around 8.5km in length and a width of around 6m.
Total Project Footprint	**0.13 km^2**	**Project footprint is around 0.9% of the total boundary of the Project area.**
Total Project site Boundary Area	**15km^2**	

2.6 Overview of Project Phases

This section presents the likely activities to take place during the Project development and which will include three distinct phases: (i) planning and construction, (ii) operation and (iii) decommissioning each of which is summarized below.

2.6.1 Planning and Construction Phase

The typical activities that will take place during the planning and construction phase for wind farms include the following:

- Preparation of the detailed design and layout of wind turbines within the Project site in addition to the various other infrastructure/utility elements (buildings, roads, substation, etc.);
- Transportation of wind turbine components to the Project site. The components are expected to be transported to the Port of Aqaba and then transported by road to the Project site;
- Site preparation of the turbine foundation. Such activities are limited to relatively small individual footprints of the foundations and will include excavations and land clearing activities for bolting of the tower to the foundation;
- Installation of turbine components to include tower assembly, hub, rotor, and nacelle lift and rotor assembly which most likely will occur through onsite mobile cranes;
- In addition to the erection of each turbine, there is additional construction work (which could include excavations, land clearing activities, electrical work, etc.) that must be conducted to connect each turbine to the power grid, this could include the installation and laying of transmission and communication cables, and the installation of the substation;
- Internal road network and foundation construction; and
- Other construction works (which could include excavations, land clearing activities, etc.) for the potential access road construction or upgrade and for the building infrastructure (warehouse and offices).

There is additional construction works to be undertaken for the associated facilities by NEPCO discussed earlier, and which include the NEPCO substation and the overhead high voltage transmission line.

2.6.2 Operation Phase

- Commissioning tests of the wind farm which usually involves standard electrical tests for the electrical infrastructure as well as the turbine, and inspection of routine civil engineering quality records. Careful testing at this stage is vital if a good quality wind farm is to be delivered and maintained. Commissioning of an individual turbine can take little more than two days with experienced staff;
- Normal daily operation of the wind farm. The long-term availability of a commercial wind turbine is usually in excess of 97 percent (i.e. 97% of the time, the turbine will be available to work); and
- Maintenance will also take place through a dedicated team. Typical routine maintenance time for a modern wind turbine is 40 hours per year. Non-routine maintenance may be of a similar order. Although minimal, maintenance activities may include turbine and rotor maintenance, lubrication of parts, washing of blades, maintenance of electrical components, full generator overhaul, etc.

2.6.3 Decommissioning Phase

According to the PPA agreement signed between the Developer and NEPCO, MEMR has the option to acquire the Project at the end of the PPA term (set for 20 years) and continue operating it at a mutually agreed price with the Developer. If MEMR and the Developer cannot agree on such a price, then the Project will be completely decommissioned. Therefore, there are two (2) scenarios for the decommissioning phase of the Project as follows:

- MEMR acquisition: the most dominant scenario is that once selected, a well-sited wind farm remains in operation, as well as the tracks, gates, distribution network tie-ins and local maintenance resources; it's cheaper to repower a site than to establish a new site. This means that an out-of-date wind turbine

is replaced with a working turbine of equivalent or even better faceplate generation capacity. As such, wind farms will generally see replacement of old turbines and emplacement of new wind turbines in adjacent areas; or

- Decommissioning: in the case of complete decommissioning of a wind turbine, which is a low-likelihood scenario, the tower and blades of the removed wind turbine will be taken down by crane, disassembled into components, and then the turbine will be refurbished at source and used elsewhere for another Project. The base will typically be left in place and covered by gravel and peat or loam. Tracks used for maintenance vehicles will be restored and can be kept as agricultural routes (given that the road network will be mostly built on the existing agricultural routes). Gates and fences will be removed.

2.6.4 Project Schedule

Construction of the Project is anticipated to commence around the second quarter of 2018, and will require approximately 16 months for construction and commissioning (i.e. October 2019). Operation of the project is therefore anticipated to commence in November 2019 for a period of 20 years as agreed with NEPCO and based on the PPA signed.

2.7 Workforce and Training

According to information provided by the Developer, the Project will require the following workforce throughout the construction and operation phase:

- Around 60 job opportunities during the construction phase for a duration of approximately 16 months. This will mainly include skilled opportunities (to include engineers, technicians, consultants, surveyors.) and unskilled job opportunities (mainly labour force but will also include a number of security of security personnel).
- Around 3 job opportunities during the operation phase for a duration of 20 years. This will include skilled job opportunities (such as technicians) and unskilled job opportunities (such as drivers.). This number does not take into account the security personnel that will be required onsite.

Taking the above into account, the Developer is aiming to hire local community members to the greatest extent possible throughout the construction and operation phase for skilled and unskilled jobs.

2.8 Resource Use Efficiency

The objective of this section is to demonstrate how the Project development has endeavoured to optimize the use of all natural resources (fossil fuels, water, etc.) involved in the Project processes.

- One of the key positive impacts of the Project, as far as resource efficiency, is that it will be utilizing wind energy to produce electricity. The Project is expected to be of an installed capacity of 45MW and will contribute to supplying electricity to the national grid for the use of bulk suppliers and help meet the increasing electricity demands throughout the Kingdom – as opposed to meeting such increasing demands through electricity production from conventional thermal power plants using fossil fuels. The Project is expected to provide 174 Gigawatt Hour (GWh) of electricity per year, which is enough to power over 18,000 average local households in Jordan. This has been based on taking into account that in 2014 (latest statistic) the annual electricity consumption of households in Jordan was 6,580 GWh (MEMR, 2015) while the number of households in 2014 in Jordan was 1,590,762 (DoS, 2015) and thus the average annual electricity consumption can be assumed to be around 4,100 Kilowatt Hour (kWh).
- To this extent, the generation of electricity through a renewable source will offset greenhouse gas emissions as opposed to generating electricity from conventional thermal power plants – which is

currently utilized for producing electricity in Jordan through the burning of natural gas and/or heavy fuel oil. According to the International Energy Association's (IEA) "Carbon Dioxide (CO2) Emissions from Fuel Combustion" (IEA, 2013) the CO_2 emitted per kWh for electricity generation in Jordan in 2011 was estimated at around 0.64kg (latest statistic). The Project is expected to provide around 174 GWh of electricity per year; this will offset more than 111,000 ton of CO2 per year, apart from the reduction of air pollutants emitted from conventional thermal power plants – such as ozone, sulphur dioxide (SO2), Nitrogen Dioxide (NO2), particulate matter, and other gases which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

- The nature of operation of wind farms does not entail the use of significant amounts of water resources during the construction and operation phase. Thus, the water requirements of the Project are minimal and mainly required for the potable use by workers during the construction and operation phase – which are also considered to be relatively small in number.

3. PROJECT ALTERNATIVES

The "Environmental Impact Assessment Regulation No. (37) of 2005" requires that the ESIA shall identify and analyse alternatives, including but not limited to project site location, design, technology, no project alternative (which assumes that the Project development does not take place), and present the main reason for the preferred choice. In addition, the examination of alternatives is also considered to be a key element of the ESIA process under good international practice, including the "IFC Performance Standard 1" (IFC, 2012) and the associated "IFC Guidance Note 1" (IFC, 2012).

This chapter provides an analysis of certain alternatives to the Project development in relation to: (i) the Project site selection alternatives, (ii) the Project design, (iii) the chosen technology, and finally investigates (iv) the 'no action alternative' – which assumes that the Project development does not take place. Based on such alternatives considered, the preferred choice for the Project was chosen and which was presented in "Chapter 2".

Throughout this chapter the application of the environmental and social mitigation hierarchy has been presented (avoid; reduce; mitigate and manage, and compensate and offset), given that environmental and social considerations have been part of the planning of the Project since its inception and a core element of the decision-making process.

3.1 Site Selection Alternatives

MEMR has installed wind measurements stations throughout the Kingdom to undertake wind measurement campaigns. In 2009, MEMR assigned an international consultant to identify priority locations for wind farm developments based on the outcomes of such wind measurement stations. A wind map for Jordan has been created (Figure 8) which presents the priority development areas for wind farms. In general, such assigned areas are located in the south west of Jordan in Tafileh, Ma'an and Aqaba Governorates, in the north east of Jordan in Mafraq Governorate, and in the north of Jordan in Irbid Governorate.

Initially the Project site was chosen within a priority area for wind farm development projects and was located in Ajloun Governorate in northern Jordan. Generally, MEMR allow developers to select their proposed sites and bring land lease agreements from land owners. At the same time, criteria was followed in order to make sure that MEMR are not liable for such selections. A certain buffer zone must be maintained between wind farms to ensure that Project adverse impacts on power production. Projects that have already signed agreements have precedence over proposed projects.

Preliminary mapping of the project site and several turbine layouts were drafted. A series of preliminary ecological assessments were carried out in the proposed site. Based on the findings of the assessments that paralleled consultations with environmental stakeholders, it was decided to move the project site away from the proposed location. The main reasons for this decision could be summarized in the following:

- The project location was in natural forest area and it was expected that some forest cover could be lost during the project development. Taking into consideration that Jordan is a forest-poor country that has less than 1% of its surface area covered in forests, and through consultation with RSCN, the Developer has taken the decision of moving the project away from that part of the country.
- The project location was close to sensitive receptors, especially human settlements. Taking into consideration that the northern part of the country is a much more densely populated area in comparison to the south, it was found while applying several turbine layouts that the issue of close adjacency to human settlements will be a major challenge that will be facing the project at several stages of its development.

Based on the above, an alternative land for the Project development was selected in Ma'an governorate – in Shobak. In order to select the alternative land, the Developer took into account additional factors which are discussed below.

1) ***Distance to Key Sensitive Receptors*:** priority was given for the selection of a site that is located at a reasonable distance from any key potential sensitive receptors such as community settlements. The closest villages to the Project site include Mdhaibie' (also known as Al-Faisaliyeh and which is located around 1km to south), Zaitooneh (located 1km to the west), Zobeiriyeh, (located around 1.3km to west) and Mothallath Al-Shoubak (located around 1km to the west).
2) ***Proximity to Road Network:*** priority was given for the selection of a site that is close to a road network. This substantially reduces the need for access roads to the Project site which in this case is kept to minimum. Besides reduced costs, this would avoid environmental impacts associated with the construction of roads.

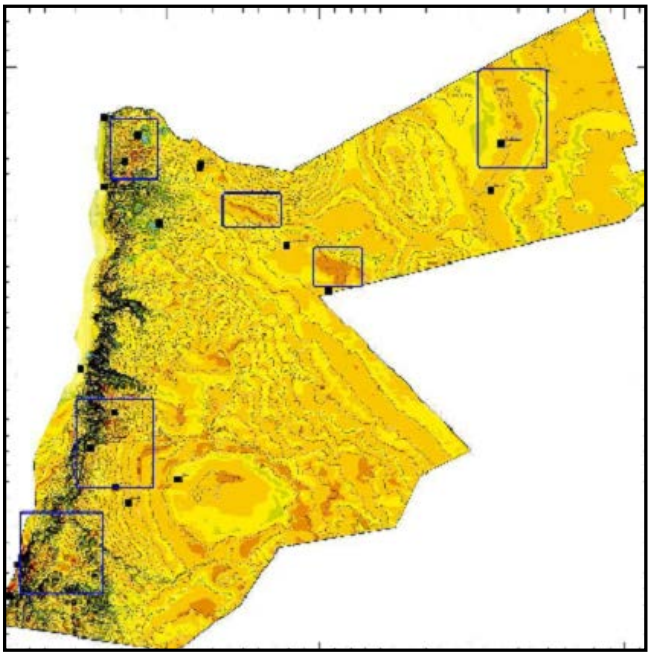

Figure 8: Wind Map of Jordan with Promising Location for Wind Farm Developments

3.2 Design Alternatives

From the onset of the Project development, the Developer approached different turbine providers/EPC contractors for the Project's development. At that time, they provided preliminary designs for the layout of the turbines and technologies selected in accordance with the Project's specifications (available area, Project size, etc.). The technologies that were considered are summarized in Table 6.

Table 6: Wind Turbine Alternatives Considered for the Project Development

Company	Technology	Project Size (MW)	Number of Turbines	Turbine Size (MW)	Hub Height (m)	Rotor Diameter (m)	Tip Height (m)
GAMESA	G114	55	22	2.5	120	114	174
Goldwind	GW121	55	22	2.5	-	121	-
Vestas	V-136 3.45MW	45	13	3.6	112	136	180

At this stage, the Developer has selected Vestas as an EPC Contractor for the Project. Throughout the ESIA, assessment and modelling was conducted for the design and layout selected. Given that the Project site is at a far distance from surrounding residential areas and is located in a vacant area with no key visual receptors or particular structures in the Project site itself, there are no prevailing issues or impacts to be taken into account during the design alternatives.

3.3 Technology Alternatives

This section discusses several alternatives besides the development of a wind farm project. This mainly includes other renewable energy alternatives suitable for Jordan in general (mainly solar power projects), as well as other technological alternatives for power generation such conventional thermal power plants.

3.3.1 Solar Power Projects

Similar to the wind map which was prepared for Jordan, MEMR has also prepared a solar map which also presents the priority development areas for solar projects. Figure 9 below presents the location of the Project site in relation to those areas.

As noted in the figure, in general Jordan has abundant solar energy which is evident from the total annual solar irradiance – considered to be one of the highest in the world. Within Jordan, the southern region has the highest solar isolation in the country and the lowest diffuse irradiance, making it an ideal location for the development of solar projects. This is followed by other areas in the middle, northern and eastern parts which are also considered to have huge potential for development of solar projects.

On the other hand, the white regions in the map are considered to be the lowest; although they still have potential for development of solar projects, but the natural characteristics of those areas are likely to be considered unsuitable for the development of solar projects on a commercial scale as feasible as those in other areas denoted above. The Project site is located in the white areas as presented in the figure below.

In addition, another important point to mention is that the Government of Jordan's "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)", advocates for the diversification of energy resources and increasing the share of renewable energy to 7% in 2015 and 10% in 2020. The Strategy advocates for the development of both solar and wind energy, and not just solar. Therefore, the development of such a Project is in line with the Government of Jordan's "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)".

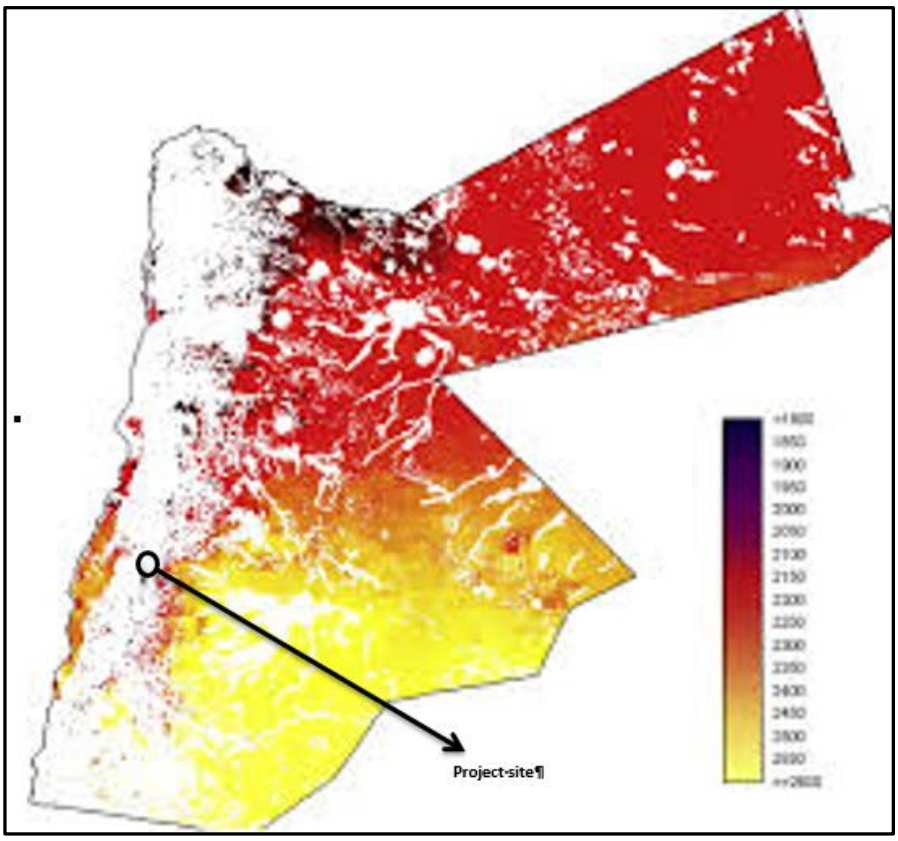

Figure 9: Solar Map of Jordan with Location of Project site

3.3.2 Thermal Power Plants

Other energy generation alternatives suitable to be built in Jordan include conventional thermal power plants which are fuelled with natural gas and/or heavy fuel oil, similar to others already existent in the country.

Despite the advantages that a solution of this kind would entail - such as a potential bigger energy generation capacity or the creation of more jobs during both construction and operation - the disadvantages would be significant; especially those related to environmental impacts. Conventional thermal power plans are well known for their environmental impacts when compared to this Project and could include significantly higher water consumption, generation of air pollutants and greenhouse gas emissions, etc. More importantly, as noted earlier such developments would not be in line with the Government of Jordan's "Updated Master Strategy of the Energy Sector in Jordan for the period (2007-2020)", which in broad terms advocates for the diversification of energy resources and increasing the share of renewable energy to 7% in 2015 and 10% in 2020.

3.4 No Project Alternative

The 'no project' alternative assumes that the 45MW Project will not be developed. Should this be the case, then the Project site area would remain the same. The land area would remain with its current characteristics – an area that is heavily degraded with few rangeland patches of low vegetation cover.

Should the Project not move forward, then the Project-related negative environmental impacts discussed throughout this ESIA would be averted. However, as noted throughout the ESIA, generally such impacts do not pose any key issues of concern and can be adequately controlled and mitigated through the implementation of the Environmental and Social Management Plan (ESMP) discussed in "Chapter 22". Nevertheless, should the Project not move forward, then the significant and crucial positive economic and environmental benefits would not be realized. Such benefits include the following:

- Contribute to increasing energy security through development of local energy resources and reducing dependency on external energy sources;
- Producing clean energy contributes to lowering electricity generation costs compared to the current costs associated with liquid fuels and thus leads to a decrease in the Government of Jordan's fiscal deficit;
- This development allows for more sustainable development and shows the commitment of the Government of Jordan to realizing the energy strategy;
- The clean energy produced from renewable energy resources is expected to reduce consumption of alternative liquid fuels for electricity generation in Jordan, and will thus help in reducing greenhouse gas emissions, as well as air pollutant emissions; and
- Project is expected during the construction and operation phase to generate local employment and commit to other social responsibilities. As such, this is expected, to a certain extent, to subsequently enhance the socio-economic conditions and standards of living of the local communities.

In conclusion, an ESIA must investigate all potential positive and negative impacts from a project development. In the case of this Project, it is important to weigh the significant positive economic and environmental impacts incurred from the Project development, against the negative environment impacts anticipated at the site specific level – in which generally this ESIA concludes to be minor in nature and can be adequately controlled. The comparison in this chapter clearly concludes that the 'no project' alternative is not a preferable option.

4. REGULATORY AND POLICY FRAMEWORK

This chapter first provides an overview of the environmental clearance process for the Project as governed by the Ministry of Environment (MoEnv). The Chapter then discusses the regulatory context, which is directly related to environmental compliance, which must be adhered to by all parties involved in the Project throughout the planning and construction, operation, and decommissioning. The Chapter goes on to summarize the relevant international agreements and conventions to which Jordan is a signatory. Finally, as the Project is seeking financing from prospective lenders, the chapter highlights the environmental and social policies and requirements of the EBRD and IFC, which must be adhered to by the Developer.

4.1 Jordanian Environmental Clearance Process

The process for environmental clearance and obtaining the environmental permit for this Project as required by the MoEnv is stipulated by the "Environmental Protection Law No. (6) of 2017", "Environmental Impact Assessment Regulation No. (37) of 2005", and the "Instructions for Site Selection of Development Projects for the year 2016".

Generally, the environmental clearance process, as governed by the MoEnv, is a two (2) step process. First, the developer of the Project, and prior to commencement of the ESIA study, must apply for a site approval permit in accordance with the "Instructions for Site Selection of Development Projects of 2016". The second step involves undertaking the ESIA study for the Project in accordance with the "Environmental Impact Assessment Regulation No. (37) of 2005".

Both steps are discussed in additional details below.

4.1.1 Location/Site Approval Permit and Environmental Assessment Requirements

- **Location/Site Approval Permit Application:** The Project Owner/Developer applies to the 'Central Licensing Committee' within the MoEnv of the intention to undertake a development project using the application form available at the MoEnv. The 'Central Licensing Committee' includes representatives from the MoEnv as well as other governmental authorities to include: Ministry of Agriculture, Ministry of Health, Ministry of Water and Irrigation, Ministry of Municipal Affairs, Greater Amman Municipality, Energy and Minerals Regulatory Commission, and the Jordan Food and Drug Administration. The application lists the information required by the 'Central Licensing Committee' and which includes:
  - General information on the location of the project supported by a site map;
  - A brief description of the planned project, purpose and nature, capacity, major components, etc.;
  - Implementation schedule for the proposed project at different phases and other.
- **Location/Site Approval Permit Decision:** The 'Central Licensing Committee', upon receipt of the application, evaluates the data submitted and undertakes a site visit to determine the appropriateness of the site for the proposed development. Generally, this is decided based on requirements from the MoEnv stipulated within the "Instructions for Site Selection of Development Projects for the year 2016" stipulated in accordance to Article No. 4 of the "Environmental Protection Law No. 6 for the Year 2017". The 2016 instruction identifies requirements on the setting of development projects and minimum distances that must be respected in relation to nearby sensitive receptors (including renewable energy projects). Based on the findings of the site visit, the Committee either approves the site of the project or rejects the site for the development.

  The Central Licensing Committee approved the site for the development of the Project on the condition that a comprehensive ESIA study is undertaken.
- **Screening Decision/ESIA Requirement:** As part of the same decision process, the 'Central Licensing Committee' determines whether or not the proposed development project is subject to a formal Environmental Assessment procedure. The EIA Regulation lists the projects that require a full EIA or a

Preliminary Environmental Impact Assessment study. Any project which may have a significant impact on the environment is classified into Category 1 which refers to projects in Annex 2 of this regulation. Category 1 projects require the preparation of a comprehensive EIA before permission to operate (or license to begin construction) can be given. Annex 2 of the Regulation requires that any project generating energy/electricity is requested a comprehensive EIA study.

In accordance with the above, the MoEnv has officially requested that the Developer undertake a comprehensive ESIA study for the Project.

4.1.2 EIA Study & Environmental Permit

- ***EIA Technical Committee:*** in the case of a Project where the 'Central Licensing Committee' rule that EIA is required, then the matter is transferred from the 'Central Licensing Committee' at MoEnv to the 'EIA Technical Committee' within the same Ministry and the ESIA Study procedures are officially started. The 'EIA Technical Committee' also includes representatives from the MoEnv as well as other governmental authorities to include: Ministry of Agriculture, Ministry of Health, Ministry of Water and Irrigation, Ministry of Municipal Affairs, Ministry of Public Works and Housing, Ministry of Planning and International Cooperation, Ministry of Energy and Mineral Resources, Ministry of Industry and Trade, and the Environmental Societies Association (which forms the umbrella for the all environmental NGO's in Jordan).

- ***EIA Study Phases:*** In summary, two successive phases of activities are involved in the completion of a comprehensive EIA study in Jordan:
  - Scoping Phase: which includes the submission of a Pre-Scoping Report, undertaking a scoping session, and submission of a Scoping Report/Terms of Reference (ToR) approved by MoEnv for the Study; and
  - Assessment Phase: which includes undertaking the baseline studies, evaluation and assessment of impacts, and the development of an environmental management plan.

- ***Scoping Phase:*** The scoping phase proceeds with the submission of a Pre-scoping report to the Ministry. This provides the MoEnv with all available information about the Project as well as the nature of impacts expected to result from the project and the relevant persons affected in order to initiate the EIA process by calling for a Scoping and Consultation Session. Then a scoping session is undertaken and following this a Scoping Report/ToR is submitted to the MoEnv which will include the issues addressed in the Pre-scoping Report in addition to other valid comments raised by the stakeholders during the scoping session. The report will also include a detailed Terms of Reference (ToR) that will present the methodology that will be adopted for the ESIA study. This report must be approved by MoEnv, prior to undertaking the ESIA study.

  In accordance with the above, the scoping session for the Project was held on 10 January 2017 and the ToR was submitted and approved on 15 February 2017.

- ***Assessment Phase:*** The assessment phase is carried out in accordance with the approved ToR by the MoEnv and involves undertaking the baseline studies, impact assessment and development of management plans for various components that are expected to be impacted by the project and its activities. The ESIA document is the output of the assessment, prepared in accordance with the ToR.

- ***Approval of ESIA:*** Upon submission of the ESIA document, the EIA Technical Committee reviews the report and either approves the study and grants the environmental clearance for the Project or rejects the Project if the study indicates that the implementation of the Project would cause significant impacts on the environment and/or the ESIA fails to identify plans for reducing adverse impacts. In order to issue the environmental permit for the Project environmental clearance is required.

In accordance with the above, this report is the final ESIA report that is to be submitted to the MoEnv for review.

4.2 Summary of Jordanian Environmental and Social Regulatory Context

This section lists those legislations that are directly related to environmental and social compliance that must be adhered to by all parties involved in the Project throughout the planning and construction, operation, and decommissioning phase. These legislations include: (i) those issued by MoEnv (laws, regulations and instruction), and (ii) the relevant national legislations issued by other line ministries (laws, regulations, instructions, standards).

Table 7 below lists the key legislation and regulator/entity relevant to each of the environmental and social parameter being studied and assessed within this ESIA. Throughout the following Chapters, reference to the requirements set out within legislation is provided under each relevant parameter.

Table 7: Legislative Context for each E&S Parameter being Studied and Assessed within this ESIA

Parameter	Responsible Regulator/Entity and Relevant Legislations
Pre-ESIA Compliance Requirements	
Site Selection Process	▪ Ministry of Environment (MoEnv): - Environmental Protection Law No. 6 of 2017 - Instruction for Site Selection of Development Projects for the year 2016
ESIA and Post ESIA Requirements	
Landscape and Visual	▪ Ministry of Environment (MoEnv): - Environmental Protection Law No. 6 of 2017
Land Use	▪ Ministry of Municipal Affairs (MoMA) - Municipalities Law No. Law No. 41 for the year 2015 - Land Use Planning Regulation no. (6) for the Year 2007 ▪ Ministry of Environment (MoEnv): - Environmental Protection Law No. 6 for the year 2017 ▪ Ministry of Agriculture (MoA): - Agriculture Law No. 13 for the year 2015
Geology and Hydrology (soil and groundwater)	▪ Ministry of Environment (MoEnv) - Environmental Protection Law No. 6of 2017 - Solid Waste Management Regulation No. (27) of 2005 - Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005, - Instruction for Management and Handling of Consumed Oils for 2003, - Instruction for Hazardous Waste Management for the year 2003 ▪ Ministry of Water and Irrigation (MWI) - Water Authority Law No. 18 for 1988 and it's amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof - Instructions for the Protection of Water Resources Allocated for Drinking Purposes for 2006 ▪ Ministry of Health (MoH) - Public Health Law No. 47 for 2008 ▪ Jordan Institution for Standards and Metrology (JISM) - Jordanian Standard 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
Biodiversity	▪ Ministry of Environment (MoEnv) - Environmental Protection Law No. 6 of 2017 ▪ Ministry of Agriculture (MoA) - Agriculture Law No. 13 of 2015 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008
Avi-Fauna (Birds and Bats)	▪ Ministry of Environment (MoEnv) - Environmental Protection Law No. 6 of 2017 ▪ Ministry of Agriculture (MoA) - Agriculture Law No. 13 of 2015 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008
Archaeology	▪ Department of Antiquities (DoA) - Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
Air Quality	▪ Ministry of Environment (MoEnv) - Environmental Protection Law No. 6 for the year 2017

Parameter	Responsible Regulator/Entity and Relevant Legislations
	- Air Protection Regulation No. 28 for 2005 ▪ Jordan Institution for Standards and Metrology (JISM) - JS 1140-2006 Ambient Air Quality
Infrastructure and Utilities	▪ Ministry of Water and Irrigation (MWI) - Water Authority Law No. 18 for the year 1988 and it's amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof - Instructions for the Protection of Water Resources Allocated for Drinking Purposes for 2006 ▪ Ministry of Municipal Affairs (MoMA) - Municipalities Law No. Law No. 13 for the year 2011 ▪ Ministry of Environment: - Environmental Protection Law No. 6 for the year 2017 - Instruction for Hazardous Waste Management for the year 2003 ▪ Civil Aviation Regulatory Commission - Civil Aviation Law No. 41 for the year 2007 ▪ Telecommunication Regulatory Commission - Telecommunications Law No.21 for the year 2011 ▪ Jordan Radio and Television Corporation - Jordan Radio and Television Corporation Law No. 35 for the year 2000 ▪ Ministry of Interior - Traffic Law No. 49 for the year 2008 - Regulations for the Registration and Licensing of Vehicles No. 104 for 2008 - Regulation for Maximum Dimensions, Weights and Total Engine Power for Vehicles No. 42 of 2002 - Instructions for Allowable Speed Limits for 2002
Occupational Health and Safety	▪ Ministry of Labor (MoL) - Labor Law No. 8 for the year 1996 and its amendments - Regulation of Protection and Safety from Industrial Tools and Machines and Work Sites No. 43 for 1998 and its amendment thereof - Formation of Committees and Supervisors of Occupational Health and Safety Regulation No. 7 for 1998 - Instructions for the Protection of Workers against the Risks of the Work Environment - Regulation for Preventive and Curative Health Care for Workers in Establishments No. 42 for 1998 and its amendments thereof - Regulation for the Fees of Work Permits for Non-Jordanians No. 67 for 2014 and its amendments thereof - Regulation for Labour Inspectors No. 56 of 1996 - Decision for the Works and Times prohibiting the employment of Women 2010 - Decision for the Hazardous or Exhaustive or Harmful Works on Health for under 18 years of age 2011 ▪ Ministry of Health (MoH) - Public Health Law No. 47 for 2008 - Crafts and industries Law No.16 for the year 1953 and its amendments thereof - Instructions for Prevention of Health Nuisances from Workers Accommodation No. (1) for the year 2013 - Health General Conditions for Crafts and Industries for the Year 2013
Community Health, Safety, and Security	▪ Ministry of Environment (MoEnv) - Environmental Protection Law No. 6 for the year 2017 - Instruction for Reduction and Prevention of Noise for 2003 ▪ Ministry of Health - Public Health Law No. 47 for the year 2008
Socio-economic	▪ National Building Council – Ministry of Public Works and Housing (MPWH) - Regulation for Obligatory Employment of Jordanian Workforce from Surrounding Communities in Development Projects No. (131) for the year 2016

4.3 International Agreements

The Government of Jordan is signatory to a number of important international agreements which relate to the topics addressed in this ESIA, and has already incorporated many of the provisions in national legislation, often indicating that where the national law is inconsistent with international agreements to which Jordan is a signatory, the requirements of the international agreement will prevail. Accordingly, the terms of international agreements to which Jordan is a party are an important part of the legal framework within which the Project operates. Key Treaties and obligations are described below.

4.3.1 *International Agreements on Biodiversity, Flora and Fauna*

These include the following:

- Convention on Biological Diversity (1993) – signed by Jordan in 1993. Under this agreement, signatories are required to develop plans and policies for the protection and monitoring of biodiversity and to integrate these into national plans for development;
- Convention on Migratory Species (1979) – signed by Jordan in 2000. Signatories are required to protect migratory species throughout the migration range by coordinated efforts and research;
- Agreement on the Conservation of African-Eurasian Migratory Water birds (1995) – came into force in 1999 when ratified by a number of at least fourteen Range States, comprising seven from Africa and seven from Eurasia. The Agreement covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973) – objective of this convention is to save many and varied forms of wild fauna and flora by regulating trade in specimens of species of wild fauna and flora;
- International Plant Protection Convention (1970) – the objective of this convention is to prevent the international spread of pests and plant diseases;
- UN Convention to Combat Desertification – the objective is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification through effective action at all levels; and
- Stockholm Convention on Persistent Organic Pollutants (POP) (2004) – the objective of this Convention is to protect human health and the environment from persistent organic pollutants.

4.3.2 *International Agreements on Energy and Climate Change*

These include the following:

- UN Framework Convention on Climate Change (UNFCCC) 1992 – the UNFCCC was established so as to begin to consider what can be done to reduce global warming and to cope with whatever temperature increases are inevitable, aiming to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system;
- Kyoto Protocol to the UN Framework Convention on Climate Change (1997) – establishes a legally binding commitment for the reduction of four greenhouse gases produced by industrialized nations, as well as general commitments for all member countries; and
- UNEP Montreal Protocol on Substances that Deplete the Ozone Layer (1987) – an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion.

4.3.3 *International Agreements on Cultural Heritage*

These include the following:

- Convention Concerning the Protection of the World Cultural and Natural Heritage, (World Heritage Convention, 1972) – the primary mission of the Convention is to identify and protect the world's natural and cultural heritage considered to be of outstanding universal value.

4.3.4 *Other International Agreements Relating to Environmental Protection*

This mainly includes the following:

- Basel Convention on the Trans-boundary Movements of Hazardous Wastes and Their Disposal – designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries.

4.3.5 Obligations Relating to Membership of the International Labor Organization (ILO)

The International Labor Organization sets guidelines and requirements relating to labour relations and workers' rights. Jordan has ratified a range of ILO Conventions that are relevant to the Project. These are set out in the Box below.

List of ILO Conventions ratified by Jordan and relevant to the Project

- C 29 Forced Labor Convention, 1930 (No.29) ratified 06:06:1966
- C 81 Labor Inspection Convention, 1947 (No. 81) ratified 27:03:1969
- C 98 Right to Organize and Collective Bargaining Convention, 1949 (No.98) ratified 12:12:1968
- C100 Equal Remuneration Convention, 1951 (No.100) ratified 22:091966
- C105 Abolition of Forced Labor Convention, 1957 (No.105) ratified 31:03:1958
- C 106 Weekly Rest (Commerce and Offices) Convention, 1957 (No.106) ratified 23:07:1979
- C 116 Final Articles Revision Convention, 1961 (No.116) ratified 04:07:1963
- C 117 Social Policy (Basic Aims and Standards) Convention, 1962 (No. 117) ratified 07:03:1963
- C 118 Equality of Treatment (Social Security) Convention, 1962 (No. 118) ratified 07:03:1963
- C 119 Guarding of Machinery Convention, 1963 (No.119) ratified 04:05:1964
- C 120 Hygiene (Commerce and Offices) Convention, 1964 (No. 120) ratified 11:03:1965
- C 122 Employment Policy Convention, 1964 (No. 122) ratified 10:03:1966
- C 124 Medical Examination of Young Persons Convention, 1965 (No.124) ratified 06:06:1966
- C135 Workers' Representatives Convention, 1971 (No.135) ratified 23:07:1979
- C 142 Human Resources Development Convention, 1975 (No.142) ratified 23:07:1979
- C 144 Tripartite Consultation (International Labor Standards) Convention, 1976 (No. 144) ratified 05:08:2003
- C 147 Merchant Shipping (Minimum Standards) Convention, 1976 (No. 147) ratified 01:04:2004
- C 150 Labor Administration Convention, 1978 (No. 150) ratified 10:07:2003
- C 159 Vocational Rehabilitation and Employment (Disabled Persons) Convention, 1983 (No. 159) ratified 13:05:2003
- C 185 Seafarers Identity Documents Convention (Revised), 2003 (No. 185) ratified 09:08:2004
- C 111 Discrimination (Employment and Occupation) Convention, 1958 (No. 111) ratified 04:07:1963
- C 138 Minimum Age Convention, 1973 (No. 138) species at 16 years ratified 23:03:1998
- C182 Worst Forms of Child Labor Convention, 1999 (No.182) ratified 20:04:2000

4.4 Requirements for Project Financing

In addition to Jordanian requirements, the international standards which are applicable to the Project include the "International Finance Corporation Policy on Social and Environmental Sustainability" (IFC, 2012) including the IFC Performance Standards (PS) and the Environmental, Health & Safety (EHS) Guidelines.

The "IFC Policy on Social and Environmental Sustainability" (IFC, 2012) sets out the environmental, health & safety and community requirements for projects financed by IFC. Through the implementation of the Equator Principles, IFC requirements have become the *de facto* international environmental and social performance benchmark for project financing. IFC requirements are set out in its Performance Standards (PSs) of Social and Environmental Sustainability, which are summarized in Table 8 below. In addition the

table also summarizes the EBRD Environmental and Social Policy (2014) and Performance Requirements (PR).

Table 8: Overview of EBRD PR and IFC PS of Social and Environmental Sustainability

EBRD Performance Requirements	Key Points Relevant to the Project
PR 1: Environmental and Social Appraisal and Management	This PR outlines the process of appraising, managing and monitoring environmental and social issues associated with a project consistent with the European Union environmental impact assessment directive (85/337/EEC as amended). This Project is likely to be categorized by EBRD as a Category A Project.
PR 2: Labour and Working Conditions	This PR assures that human resources policies, procedures and standards will meet the following minimum requirements during the life of the Project with regards to labour and working conditions: ▪ Establish and maintain a sound worker-management relationship and promote the fair treatment, non-discrimination and equal opportunity of workers; ▪ Promote compliance with any collective agreements to which the client is a party, national labour and employment laws, and the fundamental principles and key regulatory standards embodied in the applicable ILO conventions; and ▪ Protect and promote the health of workers, especially by promoting safe and healthy working conditions. In addition, EBRD requires compliance with applicable EU Occupational Health and Safety requirements and, where such requirements do not exist, applicable IFC Occupational Health and Safety guidelines (IFC PS2).
PR 3: Pollution Prevention and Abatement	Pollution prevention and abatement are key ingredients of a sustainable development agenda and EBRD – financed projects must meet good international practice in this regard. The impacts and issues associated with polluting activities need to be considered in all economic activities, and from effluents and emissions at the facility level, to impacts at a regional and global level where appropriate. This performance requirement assures that all aspects of the Project will meet the following objectives: ▪ To avoid or, where avoidance is not possible, to minimise adverse impacts on human health and the environment by avoiding or minimizing pollution directly arising from projects; ▪ To assist clients in identifying project-related opportunities for energy and resource efficiency improvements and waste reduction; and ▪ To promote the reduction of project-related greenhouse gas emissions.
PR 4: Health & Safety	While bringing many positive benefits to local communities, projects can also increase the potential for community exposure to risks and impacts arising from temporary or permanent changes in population; transport of raw and finished materials; construction, operations and decommissioning; accidents, structural failures, and releases of hazardous materials. This performance requirement addresses the project proponent's responsibility to identify and to avoid or minimise the risks and adverse impacts to community health, safety and security.
PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement	Involuntary resettlement refers both to physical and economic displacement as a result of project-related land acquisition. Where involuntary resettlement is unavoidable, appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented.
PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	EBRD recognises the need for the protection and conservation of biodiversity in the context of projects in which it invests. In pursuing these aims, EBRD is guided by and supports the implementation of applicable international law and conventions and applicable EU Directives: ▪ To protect and conserve biodiversity; ▪ To avoid, minimise and mitigate impacts on biodiversity and offset significant residual impacts, where appropriate, with the aim of achieving no net loss or a net gain of biodiversity; ▪ To promote the sustainable management and use of natural resources; ▪ To provide for fair and equitable sharing of the benefits from project development and arising out of the utilisation of genetic resources; ▪ To strengthen companies' licence to operate, reputation and competitive advantage through best practice management of biodiversity as a business risk and opportunity; and ▪ To foster the development of pro-biodiversity business that offers alternative livelihoods in place of

EBRD Performance Requirements	Key Points Relevant to the Project
	unsustainable exploitation of the natural environment.
PR 8: Cultural Heritage	Cultural heritage is important as a source of valuable historical and scientific information, as an asset for economic and social development, and as an integral part of a people's cultural identity, practices, and continuity. EBRD requires the protection of cultural heritage from project activities.
PR 10: Information Disclosure and Stakeholder Engagement	EBRD considers stakeholder engagement as an essential part of good business practice and corporate citizenship. In particular, effective community engagement is central to the successful management of risks and impacts on communities, as well as central to achieving enhanced community benefits. The specific objectives of this PR are: ▪ To identify people or communities that are or could be affected by the Project, as well as other interested parties; ▪ To ensure that such stakeholders are appropriately engaged on environmental and social issues that could potentially affect them through a process of information disclosure and meaningful consultation; and ▪ To maintain a constructive relationship with stake holders on an ongoing basis through meaningful engagement during project implementation.
IFC Performance Standard	**Key Points Relevant to the Project**
PS1: Assessment and Management of Environmental and Social Risks and Impacts	PS1 underscores the importance of managing social and environmental performance throughout the life of a project by using a dynamic social and environmental management system. Specific objectives of this Performance Standard are: ▪ To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence; ▪ To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment; ▪ To ensure that affected communities are appropriately engaged on issues that could potentially affect them; and ▪ To promote improved social and environment performance of companies through the effective use of management systems.
PS2: Labor and Working Conditions	The requirements set out in this PS have been in part guided by a number of international conventions negotiated through the International Labor Organization (ILO) and the United Nations (UN). Specific objectives of this Performance Standard are: ▪ To establish, maintain and improve the worker-management relationship; ▪ To promote the fair treatment, non-discrimination and equal opportunity of workers and compliance with national labour and employment laws; ▪ To protect the workforce by addressing child labour and forced labour; and ▪ To promote safe and healthy working conditions, and to protect and promote the health of workers.
PS 3: Resource Efficiency and Pollution Prevention	This Performance Standard outlines a project approach to pollution prevention and abatement in line with international available technologies and practices. It promotes the private sector's ability to integrate such technologies and practices as far as their use is technically and financially feasible and cost-effective in the context of a project that relies on commercially available skills and resources. Specific objectives of this Performance Standard are: ▪ To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; and ▪ To promote the reduction of emissions that contribute to climate change.
PS 4: Community Health, Safety and Security	This PS recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. However, projects can also increase risks arising from accidents, releases of hazardous materials, exposure to diseases, and the use of security personnel. While acknowledging the public authorities' role in promoting the health, safety and security of the public, this PS addresses the project sponsor's responsibility in respect of community health, safety and security.
PS 5: Land Acquisition and Involuntary Resettlement	Involuntary resettlement refers both to physical and economic displacement as a result of project-related land acquisition. Where involuntary resettlement is unavoidable, appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented.

EBRD Performance Requirements	Key Points Relevant to the Project
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote the use of renewable natural resources in a sustainable manner. This Performance Standard addresses how project sponsors can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources. Specific objectives of this Performance Standard are: ▪ To protect and conserve biodiversity; and ▪ To promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities.
PS 7: Indigenous Peoples	Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies.
PS 8: Cultural Heritage	Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to protect irreplaceable cultural heritage and to guide project sponsors on protecting cultural heritage in the course of their business operations.

In addition, there are also sector-specific EHS guideline document for Wind Energy produced by IFC and followed by EBRD. This EHS guidance document provides detailed management and technical recommendations with regards to Industry-

5. ESIA APPROACH AND METHODOLOGY

This chapter of describes the approach and methodology that was adopted for the ESIA study including the following:

- Approach to screening and scoping phases;
- Approach for the analysis of alternatives;
- Approach to stakeholder engagement;
- Approach to determining the spatial and temporal study area;
- Methodology for assessment of the baseline environmental and social conditions;
- Methodology used to assess the potential environmental and social impacts of the Project – including the approach to determining significance, development of mitigation measures and the assessment of residual effects;
- Approach used for the assessment of cumulative and trans-boundary effects; and
- Approach for development of an Environmental and Social Management Plan (ESMP).

5.1 Screening, Scoping & Assessment

The ESIA process for the Project has followed the environmental clearance process outlined in 'Section 4.1' earlier, as summarized below:

- ***Location/Site Approval Permit & Screening Decision:*** the Central Licensing Committee approved the site for the development of the Project conditional that a comprehensive ESIA study is undertaken before commencement of any construction or operational activities. The Site Approval Permit has been granted on 14 December, 2016
- ***Scoping Phase:*** the scoping session for the Project was held on 10 January 2017. In addition, the Scoping Report/ToR was submitted to the MoEnv and was approved 15 February 2017.
- ***Assessment Phase:*** The assessment phase has been carried out in accordance with the approved ToR by the MoEnv. This ESIA report is the output of this assessment for submission to the MoEnv for approval.

5.2 Analysis of Alternatives

The "Environmental Impact Assessment Regulation No. (37) of 2005" requires that the ESIA shall identify and analyse alternatives, including but not limited to project site location, process and technological alternatives, no project alternative (which assumes that the Project development does not take place), and present the main reason for the preferred choice. The examination of alternatives is also considered to be a key element of the ESIA process under good international practice, including the "IFC Performance Standard 1" (IFC, 2012) and the associated "IFC Guidance Note 1" (IFC, 2012). Environmental and social considerations have been part of the planning of the Project and a core element of the decision-making process.

The analysis of alternatives has already been presented in "Chapter 3". The chapter discussed and compared several alternatives to the Project development in relation to: (i) the Project site, (ii) the chosen technology, (iii) the Project design, and finally investigated the 'no action alternative' – which assumes that the Project development does not take place.

5.3 Stakeholder Engagement

Stakeholder consultation and engagement is an essential part of the ESIA process, and has been carried out in accordance with the regulatory requirements in Jordan and international best practice – to include requirements identified within the "EIA Regulation No. (37) of 2005" as well as "IFC Performance Standard 1" (IFC, 2012) and "EBRD Performance Requirement 10. The previous and future stakeholder consultation and engagement for the Project are summarized below and discussed in detail in "Chapter 6".

The stakeholder consultation and engagement for the Project to date has included both and which are discussed in further details in "Chapter 6": (i) high level consultations and (ii) detailed engagement and consultations. The high level consultation mainly includes the undertaking of a scoping session, and which is considered high level as various stakeholder groups representing various entities are consulted at once. The scoping session that was undertaken included stakeholder groups such as national governmental entities, local governmental entities, non-governmental organizations, academic and research institutions, etc. The detailed engagement and consultation focused on a single stakeholder group at a time in order to take their specific concerns into account throughout the ESIA study. This included: (i) local community and nomads through onsite consultations and/or local community consultation session; (ii) other stakeholders to include governmental and non-governmental organizations consulted and engaged through bi-lateral meetings, e-mail communication, phone communication, and formal letters.

"Chapter 6"also discusses future stakeholder engagement and consultations which are to take place once the ESIA has been approved by the MoEnv. This includes (i) the disclosure of the ESIA to stakeholders with regards to the findings and recommendations proposed within the ESIA study as well as the disclosure of the Non-Technical Summary (NTS) and Stakeholder Engagement Plan (SEP); and (ii) implementation of the Stakeholder Engagement Plan (SEP) by the Developer describes the planned stakeholder consultation activities and engagement process.

5.4 Delineation of Study Boundaries and Scope of Assessment

5.4.1 Definition of Spatial Study Area

The overall Study Area for the ESIA represents the potential area of influence of the Project. This is '*the area over which significant effects of the Project could reasonably occur, either on their own, or in combination with those of other developments and projects'*.

In general terms, the Study Area for the Project ESIA includes the footprint of Project disturbance as demarcated in black in Figure 10 below. However, for the assessment of the individual environmental and social parameters (infrastructure and utilities, socio-economic, etc.), an appropriate thematic Study Area is determined for each theme on a case by case basis. Such a thematic Study Area is clearly identified within the relevant section it relates to throughout this ESIA. In identifying these thematic Study Areas, the type and degree of the potential direct and indirect effects were taken into consideration.

In identifying these thematic study areas, the type and degree of the potential direct and indirect effects were taken into consideration. The core area where direct effects are likely to occur was determined, as well as the wider area of influence where indirect, combined and cumulative effects are likely to occur on the surrounding areas and communities.

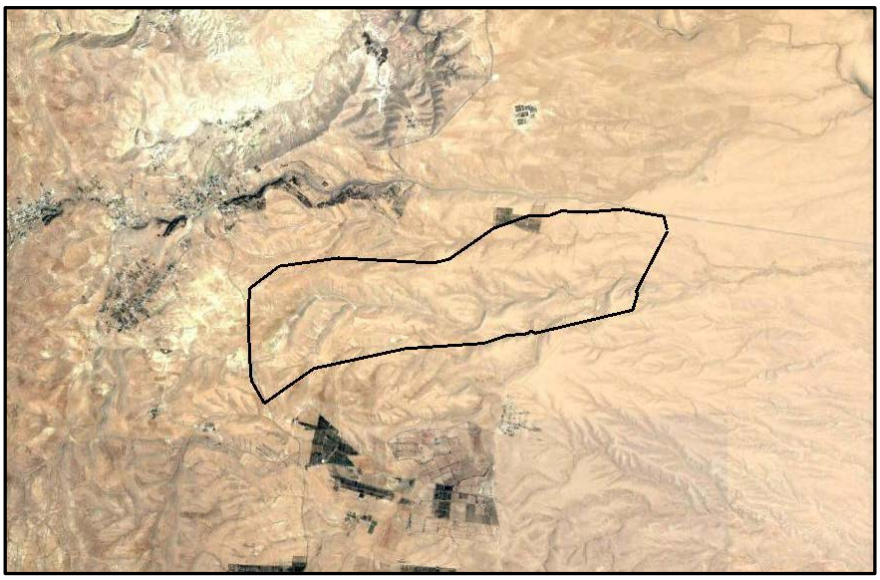

Figure 10: Study Area

5.4.2 Temporal Scope of the Assessment

The Project will be developed in a three phase sequence, as follows:

- Planning & Construction Phase
- Operation Phase
- Decommissioning Phase

It is important to note that the ESIA study does not cover the associated interconnection facilities and the activities that will be undertaken for their construction and operation. Such associated interconnection facilities include the NEPCO receiving substation and the high voltage overhead transmission line. Such activities will be undertaken by NEPCO.

(i) Planning and Construction Phase

This includes construction activities which will be undertaken by the EPC Contractor. This mainly includes preparing the detailed design and layout of the Project, transportation of Project components onsite, as well as site preparation and construction activities for installation of wind turbines, foundations, internal access roads, buildings, etc.

(ii) Operation Phase

This includes activities to be undertaken by the Project Operator. Activities expected to take place mainly include the normal daily operation of the wind turbines and the routine maintenance activities.

(iii) Decommissioning Phase

It has not been determined yet, whether at the end of the PPA term (which is set for 20 years) MEMR would take ownership of the Project and continue operating it, or whether the Project will be completely decommissioned by the Developer.

Nevertheless, should the Project be completely decommissioned, then generally the anticipated impacts throughout the decommissioning phase are similar in nature to impacts assessed during the construction phase – and specifically in impacts related to soil and groundwater (from improper management of waste streams), air quality, and occupational health and safety. Therefore, the assessment of impacts for those

receptors and mitigation identified during the construction phase is assumed to apply to this phase in particular without the need to reiterate or emphasize this throughout this chapter.

5.5 Environment & Social Baseline Conditions

As part of the ESIA process, the baseline environmental and social conditions of the study area were established. Describing the baseline includes identifying and defining the importance and sensitivity of the various environmental and social resources and receptors likely to be impacted, i.e. within the study area. Understanding the value or sensitivity of the resources and receptors to impacts and changes is an important consideration when determining the significance of effects, and allows for better identification of the most appropriate measures that could be employed to avoid impacts, and to mitigate any adverse impacts.

The description of environmental and social baseline conditions has considered a wide range of data and information gathered from various sources, including:

- Desk-based studies and literature reviews;
- Data from statutory and non-statutory stakeholders; and
- Field surveys and site investigations.

These studies have covered all the environmental and social aspects related to the Project. The baseline conditions are treated as those conditions which would prevail in the absence of the Project. Studies of the environment and social baseline are described under each chapter respectively and include the following: landscape and visual; land use; geology and hydrology (soil & groundwater); biodiversity; birds (avi-fauna); bats; archaeology and cultural heritage; infrastructure and utilities; community health, safety and security (to include noise and shadow flicker); and socio-economic conditions. Within each chapter, the methodology which was undertaken for assessment of the each of those baseline conditions is described in detail.

5.6 Impact Assessment Methodology

Given the scale and type of the Project, the ESIA commences with an assessment of the positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Jordan faces- as highlighted in “Chapter 7”.

It then moves forward and within each chapter (from Chapter 8 - 19) the assessment of impacts on environmental and social parameters is undertaken as required under the ToR. The following section provides a description of the approach, methodology and process adopted for the impact assessment presented within this ESIA.

5.6.1 Approach to Assessment of Impacts

The adverse and beneficial environmental and social impacts of the Project have been identified and assessed against the established baseline. A consistent approach to the assessment of impacts was followed to enable environmental and social impacts to be broadly compared across the ESIA. A set of generic criteria were used to determine significance (see below) which were applied across the various social and environmental parameters.

As far as possible, environmental and social impacts were quantified. Where it was not possible to quantify impacts, a qualitative assessment was conducted using professional experience, judgment and available knowledge, and including the consideration of stakeholder views. Where there were limitations to the

data, and/or uncertainties, these have been recorded in the relevant chapters, along with any assumptions that were taken during the assessment.

In order to determine the significance of each impact, two overall factors are considered:

- The importance and/or sensitivity of the environmental and social receiving parameter, as determined during the assessment of baseline conditions; and
- Magnitude and Nature of the impact.

5.6.2 Sensitivity of the Receiving Parameter

Receiving parameter sensitivity was determined using information taken from the baseline description on the importance, significance or value of the social or environmental component under examination. It is important to understand the sensitivity of the receiving parameter, as this is a measure of the adaptability and resilience of an environmental parameter to an identified impact. The following categories of sensitivity were applied to the assessment:

- *High*: The environmental parameter/receptor is fragile and an impact is likely to leave it in an altered state from which recovery would be difficult or impossible.
- *Medium*: The parameter/receptor has a degree of adaptability and resilience and is likely to cope with the changes caused by an impact, although there may be some residual modification as a result; and
- *Low*: The parameter/receptor is adaptable and is resilient to change.

5.6.3 Magnitude and Nature of the Impact

The magnitude of the impact is the scale of change which the impact may cause compared to the baseline and how this change relates to accepted thresholds and standards. The following categories were applied to the assessment:

- *High*: a large change compared to variations in the baseline. Potentially a clear breach of accepted limits;
- *Medium*: change which may be noticeable and may breach accepted limits; and
- *Low*: when compared with the baseline, change which may only just be noticeable. Existing thresholds would not be exceeded.

Furthermore, in determining the magnitude of the impact it is important to take into account and consider several other factors which define the nature of the impact. This includes the following:

Type of Impact

- *Positive*: applies to impacts that have a beneficial environmental or social result, such as enhancement of the existing environmental conditions; and
- *Negative*: applies to impacts that have a harmful aspect associated with them such as loss or degradation of environmental resources.

Type of Effect

- *Direct:* applies to impacts which can be clearly and directly attributed to a particular environmental or social parameter (e.g. generation of dust directly impacts air quality); and
- *Indirect*: applies to impacts which may be associated with or are subsequent to a particular impact on a certain environmental or social parameter (e.g. high levels of dust could entail nuisance and health affects to construction workers onsite).

Duration (how long the stressor or its effect last)

- *Short Term*: applies to impacts whose effects on the environment will disappear within a 1 year period, or once construction activities are completed;
- *Medium Term*: applies to impacts whose effects on the environment will disappear within a 5 year period; and
- *Long Term*: applies to impacts whose effects on the environment will disappear in a period greater than 5 years.

Reversibility

- *Reversible*: applies to impacts whose significance will be reduced and disappeared over time (either naturally or artificially), once the impacting activity ceases; and
- *Irreversible*: applies to impacts whose significance will not be reduced nor disappeared over time (either naturally or artificially), once the impacting activity ceases.

5.6.4 Assessing the Significance of the Impacts

The concept of 'significance' is central to the ESIA process and aids the identification and categorization of environmental and social effects. As noted, in order to determine impact significance, the sensitivity of each environmental and social parameter/receptor is considered in combination with the magnitude of the impact. Table 9 below demonstrates how these parameters are considered in the assessment of significance.

Table 9: Determination of Significance

Magnitude and Nature of Impact / Sensitivity of Receiving Parameter/Receptor	Low	Medium	High
Low	Not significant	Minor	Minor
Medium	Minor	Minor	Moderate
High	Minor	Moderate	Major

While the above matrix provides a framework for the determination of significance, and enables comparison across environmental and social parameters, a degree of professional judgement must be used and some parameter-specific factors to be considered in making the determination of significance. Below provides additional guidance to the degrees of significance used in this ESIA. Note that positive impacts are defined, but are not rated for significance.

- *Major significance*: requires thorough investigation in the ESIA. These impacts have been studied extensively by consulting expertise in the areas of the identified impacts to design needed mitigation and environmental management measures. Moreover, conducting specific studies and assessments to some of the key issues identified;
- *Moderate significance*: requires reasonable investigation in the ESIA. These impacts have been studied by expertise in the areas of the identified impacts to design needed mitigation and environmental management measures.
- *Minor significance*: must be listed, and addressed in some way, but which did not require detailed assessment in the ESIA.
- *Not significant*: for completeness, impacts which have been included in the assessment but determined not to be significant, are rated formally as 'not significant'.

5.6.5 Management Measures

Based on the impact assessment undertaken a set of management measures are identified for each impact which aims to address it. Management measures include the following:

- Additional Requirements: those are generally regulatory requirements which have been identified and which must be taken into account at a later stage.
- Additional Studies: for certain environmental/social receptors additional studies must be undertaken at a later stage. Such studies and their scope, timing, etc. have been highlighted were relevant.
- Mitigation Measures: a vital step in the ESIA process is the identification of measures that can be taken to ensure that impacts are mitigated or reduced to acceptable levels. The ESIA will firstly consider the significance of any impacts caused by the Project and then assigned mitigation options through applying the following hierarchy:
  - Avoiding or 'designing out' impacts wherever possible;
  - Considering alternatives or modifications to the design to reduce the impacts wherever possible;
  - Applying measures to minimize and manage impacts on the receptor; *then*
  - As a last resort, identifying fair compensation, remediation and offsetting measures to address any potentially significant residual effects.

  Some negative impacts can be easily mitigated, whilst others cannot or are too difficult and costly to mitigate. The various potential impacts are described in this ESIA, along with the provision of 'feasible mitigation measures' that can be implemented.
- Recommendations: for positive impacts, it is not possible to identify mitigation measures, but rather recommendations have been identified which aim to enhance the positive impact.

5.6.6 Assessment of Residual Effects

If there are mitigation measures it is then necessary to make an assessment of the 'residual significance' after mitigation has been taken account. A re-assessment of Project impacts is then made, taking into account the effect of the proposed mitigation measures in order to determine the significance of the *residual effects*. Residual effects are discussed for each environmental and social theme in the ESIA chapters.

5.7 Assessment of Cumulative Impacts

For each of the impacts assessed, the ESIA investigates the cumulative impacts which could result from incremental impacts from other known existing and/or planned developments in the area, and based on currently available information on such existing/planned developments. Assessment of cumulative impacts is presented in 'Chapter 21'.

5.8 Development of an Environmental and Social Management (ESMP) Plan

Based on the results of the impact assessment, development of mitigation measures, and development of monitoring plan, an ESMP was compiled into a single table that details all of the above. The ESMP will be a key document and will list the environmental/social requirements and detail the procedures necessary for managing the significant environmental/social issues connected to proposed Project activities. The ESMP will be developed specifically to provide flexibility in the nature and exact location of operations, while ensuring all potential impacts are identified and properly mitigated and monitored throughout the later stages of the Project. This ESMP can be used as a stand-alone document during the different phases of the Project by Developer, EPC Contractor, Project Operator, MoEnv, and other responsible parties. The ESMP is presented in 'Chapter 22'.

6. STAKEHOLDER CONSULTATION AND ENGAGEMENT

This Chapter discusses in detail the stakeholder consultation and engagement plans which were undertaken as part of the ESIA process for the Project and provides an overview of the findings. In addition, this Chapter also discusses the future stakeholder consultation and engagement plans which are to take place at a later stage of the ESIA process as well the Project development.

6.1 Introduction

Stakeholder engagement is an integral part of ESIA good practice and is a statutory requirement of the national EIA legal framework in Jordan and within the IFC Performance Standards and EBRD Performance Requirements. The Developer is committed to a technically and culturally-appropriate approach to consultation and engagement with all stakeholders affected either directly or indirectly by the Project. The consultation program for the Project is based on informed consultation and participation in line with IFC and EBRD requirements with affected people, and is designed to be both fair and inclusive. Consultation activities have been an ongoing process since the commencement of the ESIA study in August 2016.

A stakeholder is defined as any individual or group who is potentially affected by the proposed Project or can themselves affect the proposed Project directly or indirectly. Stakeholder consultation is an inclusive process for sharing information that enables stakeholders to understand the risks, impacts, and opportunities of a development or Project, allowing them to express their views and articulate their perceptions towards it.

6.2 Objectives

The objective of stakeholder consultation is to ensure that a participatory approach takes place, which in turn, documents concerns of all stakeholder groups and makes sure that such concerns are considered, responded to, and incorporated into the decision making process of the development. Stakeholder consultation needs to be a two-way communication process that imparts information to stakeholders, but also obtains additional and on-the-ground information from them. Stakeholder consultation and engagement must take place at the inception phase of the ESIA process and implemented all through the study period.

The specific objectives of this chapter are to:

- Summarize national and international legal & policy requirements for stakeholder engagement;
- Describe and identify the stakeholders affected and/or with an interest in the Project;
- Summarize stakeholder engagement and consultation conducted to date. In addition, describe how the views and issues raised have informed and influenced the development of the Project; and
- Outline the future and approach to stakeholder engagement.

6.3 Requirements and Policy Requirements for Stakeholder Engagement

6.3.1 Jordanian Legal & Policy Standards

The Jordanian legal requirements for consultation and engagement are mainly included within the "EIA Regulation No. (37) of 2005". The requirements of the Regulation are summarized below.

The Regulation requires that for those projects which the MoEnv requires a comprehensive ESIA study (as the case for this Project), a scoping session must be held from the onset of the ESIA for all stakeholders whom may be potentially affected by the Project. The objective of the session is to provide the stakeholder groups with all available information on the Project and the surrounding environment, in order to allow

them to participate in investigating and identifying the potential impacts which may arise from the Project so that their concerns are taken into account throughout the ESIA study.

To this extent, the MoEnv generally requires that the following stakeholder groups be invited to participate in the scoping session: (i) national governmental entities, (ii) local governmental agencies, (iii) Non-Governmental Organizations, (iv) academic and research institutions, and (v) local community representatives.

In addition, the Regulation specifies that the outcomes of the ESIA study is to be announced to stakeholders and the public in a manner that the Ministry deems appropriate, and this is dealt with on a case by case basis – considering the type and nature of the project development. This is usually determined by the MoEnv once the ESIA study is reviewed and approved.

6.3.2 Requirements in IFC Performance Standards on Environmental & Social Sustainability (2012)

The IFC Performance Standards form part of their Sustainability Framework, where the "IFC Performance Standard 1" (IFC, 2012) sets out the following recommendations for stakeholder engagement:

- Stakeholder Engagement is an on-going process that may involve: stakeholder analysis & planning, disclosure & dissemination of information, consultation & participation, grievance mechanism, and on-going reporting to Affected Communities.
- A Stakeholder Engagement Plan (SEP) must be developed and implemented that is scaled to the project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities.
- Affected Communities will be provided with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.
- When Affected Communities are subject to identified risks and adverse impacts from a project, a process of consultation will be undertaken in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them.
- The extent and degree of engagement should be commensurate with the project's risks and adverse impacts and concerns raised by Affected Communities.
- The consultation process will be tailored to language preferences of Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups.
- For projects with potentially significant adverse impacts, the client will conduct an informed consultation and participation.
- A grievance mechanism will be established to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance.
- As it is considered that the Shobak Wind Power project is likely to be categorized as a Category A project under the IFC requirements, it will be disclosed for a minimum of 60 days.

6.3.3 EBRD Requirements

The Developer will be seeking financing for the Project from International Financial Institutions (IFIs) – to include mainly the European Bank for Reconstruction and Development (EBRD), Islamic Bank (ICB) and Europe Arab Bank (EAB). Therefore, the Developer wishes to design and manage the project in accordance with good international industry practice and standards.

The EBRD 2014 Environmental and Social Policy includes a comprehensive set of Performance Requirements (PRs) covering key areas of environmental and social impacts and issues. EBRD's PR10 sets out the following requirements of stakeholder engagement during project preparation:

- The first step in successful stakeholder engagement is for the client to identify the various individuals or groups who (i) are affected of likely to be affected (directly or indirectly) by the project ("affected parties"), or (ii) may have an interest in the project ("other interested parties"). Resources for public information and consultation should focus on affected parties, in the first instance.
- As part of the stakeholder identification process, the client will identify individuals and groups that may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status. The client will also identify how stakeholders may be affected and the extent of the potential (actual or perceived) impacts. Where impacts are perceived, additional communication may be required to provide information and reassurance of the assessed level of impacts. An adequate level of detail must be included in the stakeholder identification and analysis so as to enable the Bank to determine the level of communication that is appropriate for the project under consideration. Employees are always considered stakeholders.
- The Client will inform the EBRD how communication with the identified stakeholders will be handled throughout project preparation and implementation, including the type of grievance procedure envisaged.

6.4 Stakeholder Identification and Analysis

The Project has been identifying potential stakeholders since it began the development of the ESIA program in August 2016. The Project has a wide range of stakeholders ranging from national government and other bodies involved in the permitting and ESIA process, in addition to communities within the area of influence of the Project. As such stakeholders have been identified at all geographic levels, including national, regional and local levels.

The two principal categories of stakeholders are as follows:

- Affected Communities, defined as the local community as well as other people directly affected by the Project and/or those who have been identified as most vulnerable to change and who need to be engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measures.

  In specific, within the affected communities, vulnerable groups must be identified. Vulnerable groups include those expected to be disproportionally affected by the Project, and therefore require special consideration throughout the consultation process. Vulnerable groups are project specific and depend on a range of issues which must be understood such as project location, socio-economic and demographic context, as well as the nature of the development and type of impacts anticipated. The vulnerable groups within this context were identified by the 'ESIA Team'. Such vulnerable groups include the following:

  - Women groups: due to cultural norms in Jordan (and specifically within the context and setting of the Project area), the participation of women groups in the decision-making process is limited which could result in overlooking any specific concerns they might have.
  - Nomadic tribes: those are people that travel in different areas on a seasonal basis with no fixed residence. As they could not be present in an area year round, this could limit their participation in the decision-making process which could result in overlooking any specific concerns they might have.

Other Interested Parties, defined as people and organizations that are interested in the Project and/or could affect the Project in some way. Those generally include governmental and non-governmental organizations.

6.4.1 Affected Communities

The affected communities have been identified based on: (i) detailed understanding of the Project site location, its nature, administrative setup and the nearby surrounding receptors, and (ii) the nature of the anticipated impacts from the Project throughout its various phases. Based on the above, the affected communities include the local communities of the Project area and nomads.

(i) Local Communities

As discussed earlier, the Project site is located within Ma'an Governorate and specifically within Shobak District which host several community settlements. The community settlements that are likely to be affected by the Project development logically includes those located within the vicinity of the Project site and which are therefore anticipated to be impacted the most from the Project's activities (during construction and operation).

This in turn was determined based on the detailed understanding of the nature and extent of the Project's impacts. The main anticipated impacts which could affect the nearby communities (which are discussed in further details in each of the relevant chapter) include: (i) land use impacts from Project development, (ii) visual impacts from the presence of the turbines and, (iii) noise and shadow flicker generated from the operating turbines. In addition, the socio-economic conditions of these local communities are also anticipated to be impacted (mainly in a positive matter) from such a development.

Such communities were determined to include: (i) Mdhaibie' (also known as Al-Faisaliyeh and which is located around 1km to the south), (ii) Zaitooneh (located 1km to the south-west), (iii) Zobeiriyeh, (located around 1.3km to west) and (iv) Mothallath Al-Shobak (located around 1km to the north-west). Those local communities are presented in Figure 11 below.

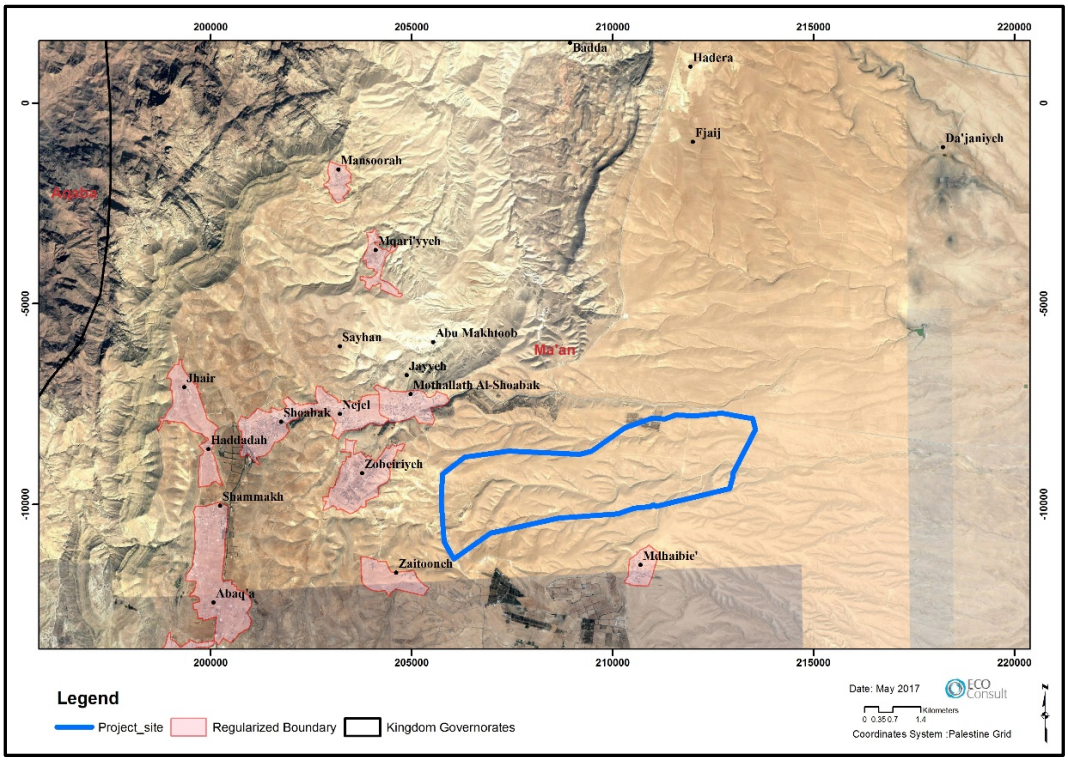

Figure 11: Affected Communities

(ii) Nomads

Based on the understanding of the area in general, it is known that there is some nomadic activity within the Project site and its surrounding areas. Similarly, the main anticipated impacts which could affect the nomads (which are discussed in further details in each of the relevant chapter) include: (i) land use impacts from Project development, (ii) visual impacts from the presence of the turbines and, (iii) noise and shadow flicker generated from the operating turbines.

6.4.2 Other Interested Parties/Stakeholders

Other interested parties and stakeholder groups were identified based on the understanding of the Project location, nature of activities which are to take place, type of development, and the potential environmental and social impacts and how they could potentially affect certain stakeholder groups.

(i) Jordanian Governmental Stakeholders (National and Local)

National and local government stakeholders include Ministries, Directorates, and other agencies that generally have a regulatory role in ensuring the implementation and compliance of projects with the various applicable legislations under the mandate of the relevant legislations. In addition, such entities are involved in the permitting and ESIA process. Thus, such stakeholders have the potential to influence the authorization of the Project and assist in its delivery.

More specifically, it is important to note that most of these governmental entities (mainly ministries) are part of the 'EIA Technical Committee' which will review this ESIA study for approval and granting of environmental clearance.

Table 10 below provides a list of the key national and regional level government stakeholders along with a summary as far as possible of their key areas of interest.

Table 10: List of Key Governmental Stakeholders

Governmental Entity	Interest in/Influence on the Project
National Governmental Entities	
Ministry of Environment (MoEnv)	The governmental body responsible for protection of the environment in Jordan. In addition, the MoEnv is responsible for approval of the ESIA and making sure it complies with the "EIA Regulation No. (37) of 2005" and granting the environmental clearance for the Project.
Ministry of Energy and Mineral Resources (MEMR)	The governmental body responsible for the development of the private sector renewable energy projects in Jordan to include this Project in specific.
Ministry of Agriculture (MoA)	The governmental body responsible for managing rangelands and forest as well as protecting and managing wildlife. For this Project, this includes land use issues related to grazing reserves and forest lands as well as potential impacts related to biodiversity.
Ministry of Municipal Affairs (MoMA)	The governmental body responsible for setting and designating land uses in Jordan which identifies certain activities and projects which are to be allowed. For this Project, this mainly includes issues related to designated land use of the Project site.
Ministry of Health (MoH)	The governmental body responsible for the health sector in Jordan, including public health and safety. For this Project, this mainly includes issues related to the public health of the nearby communities and nuisance prevention from the Project (from issues such as noise, shadow flicker, waste management, wastewater management, etc.).
Ministry of Tourism and Antiquities (MoTA) / Department of Antiquities (DoA)	The governmental body responsible for tourism development and protection of antiquities in Jordan. For this Project, this mainly includes potential impacts related to archaeology and cultural heritage related to the Project.
Ministry of Transport (MoT)	The governmental body responsible for regulating and monitoring the road transport sector and services. For this Project, this mainly includes potential impacts related to infrastructure and utilities – mainly transportation of Project components to the Project site and any impacts on roads capacity and safety.

Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ)	The governmental body responsible for the overall monitoring of the water sector and water supply. For the Project, this mainly includes issues related to the water requirements and supply to the Project.
Ministry of Labor (MoL)	The governmental body responsible for health and safety of workers and labour in Jordan. For this Project, this mainly includes issues related to occupational health and safety.
Civil Aviation Regulatory Commission (CARC)	Governmental body responsible for civil aviation safety, security and regulatory compliance. For this Project, this includes issues related to civil aviation safety from wind turbines.
Royal Jordanian Air Force (RJAF)	Governmental body responsible for military aviation safety and security. For this Project, this includes issues related to military aviation safety from wind turbines.
Telecommunication Regulatory Commission (TRC)	TRC is the official entity for regulating the telecommunications and information technology services in the Kingdom. For this Project in specific, this includes any potential impacts from the wind turbines on telecommunication transmission networks in the area.
Jordan Radio and Television Corporation (JRTV)	JRTV is the state broadcaster of Jordan for radio and television transmission networks. For this Project in specific, this includes any potential impacts from the wind turbines on the radio/television transmission networks in the area.
National Electric Power Company (NEPCO)	Responsible for designing and building the substation, together with high voltage overhead lines and the connection to the existing grid.
Local Governmental Entities	
Ma'an Governorate	The official governmental body responsible for key government services (health, education, security, etc.) as well as coordination for socio-economic development in the region. For this project this mainly includes issues related to socio-economic development on the area from the Project.
Local Municipalities – Shobak Municipality	Jordan has 93 local municipalities, providing local government services such as waste collection, street cleaning, street and road maintenance, public lighting, culture and sports. Municipalities are run by a mayor who answers to a locally elected municipal council. Municipalities vary greatly in size from populations of less than 5,000 people, to greater than 100,000 people, and also vary greatly in capacity. Municipalities report to the central Ministry of Municipal Affairs. The Project site is located within the Shobak Municipality.

(i) Non-Governmental Organizations and Academic Institutions

Other interested parties considered during the ESIA related consultation include those who have the potential to influence the authorization of the Project and assist in its delivery. This mainly includes Non-Government Organizations (NGOs), see Table 11.

Table 11: List of Key NGO and Academic Institutional Stakeholders

Stakeholder	Interest in/influence on the Project
Environmental Societies Association	The Association forms the umbrella for the all environmental NGO's in Jordan and is also a member of the 'EIA Technical Committee' which will review this ESIA study for approval and granting of environmental clearance.
The Royal Society for the Conservation of Nature (RSCN)	The RSCN is an environmental NGO having a mandate for the conservation of Jordan's biodiversity and natural resources. In addition, it is empowered to establish and manage protected environmental reserves as well as Important Bird areas under the supervision of the MoEnv. For this project this includes land use issues related to environmental reserves and important birds areas as well as potential impacts from the project on biodiversity and birds.
BirdLife International – Middle East Regional Office, Jordan	The organization is widely involved in ensuring bird conservation and protection. For this project in specific this includes potential impacts from the project on birds.

6.5 Stakeholder Consultation and Engagement To-Date

Table 12 below highlights the stakeholder groups as identified earlier, and the consultation/engagement method which has been undertaken for each group. As noted in the table below this mainly includes high level consultations as well as detailed engagement and consultations.

The high level consultations mainly include the scoping session representing various entities which are consulted at once (such as national governmental entities, local governmental entities, non-governmental organizations, etc.). The detailed engagement and consultation tends to focus on a single entity within a stakeholder group at a given time, whose concerns need to be taken into account throughout the ESIA study.

Table 12: Methodology for Stakeholder Engagement

No.	Stakeholder Group	Consultations/Engagement to Date	Future Consultations/Engagement
1	**Affected Communities**		
a	Local community	▪ Local Community Consultation Session ▪ Detailed engagement – Onsite consultation	▪ Disclosure Session ▪ Stakeholder Engagement Plan (SEP)
b	Nomads	▪ Detailed engagement – Onsite consultation	▪ Stakeholder Engagement Plan (SEP)
2	**Other Interested Parties/Stakeholders**	▪ High level consultation – Scoping Session ▪ Detailed Engagement – meetings, e-mail communication, official letters, etc.	▪ Disclosure Session ▪ Stakeholder Engagement Plan (SEP)

6.5.1 High Level Consultation – Scoping Session

In accordance with MoEnv's "EIA Regulation No. (37) of 2005", a scoping session must be held for those projects which require a comprehensive EIA study; as the case with this Project. In coordination with the MoEnv, the Scoping Session for the Project was held on 10 January 2017 at the Grand Millennium Hotel in Amman. The list of invitees was identified jointly by the MoEnv and the ESIA team.

The list of invitees mainly included the following stakeholders: (i) national governmental entities (various ministries and other governmental entities), (ii) Local Governmental Agencies (e.g. Ma'an Governorate, Shobak Mutasarrifate), (iii) Non-Governmental Organizations (Environmental Societies Association representing all environmental NGO's in Jordan), and (iv) Academic and Research Institutions.

The ESIA Team documented all records of the scoping session to include transcripts, minutes of meetings, list of participants and attendees, comments and so on. This was presented in detail in the ToR report submitted to the MoEnv. Selected photos from the session are shown in Figure 12 below.

In general, the objectives of the scoping session include the following:

- Introduce the Project and its various components to the stakeholders and provide them with all available information about the Project;
- Present the various anticipated impacts from the Project throughout its various phases and allow stakeholders to participate in the process of scoping environmental impacts of the Project;
- Early consideration of stakeholders concerns and fears regarding the nature, scale and impacts of the Project; and
- Present the suggested methodology for the ESIA and allow stakeholders to comment on the scope of work and methodology.

Throughout the scoping session, the following presentations were given:

- Welcoming Speech by Eng. Izzat Abu Hamra, Director of the Licensing Directorate in the MoEnv.

- A presentation of the Project components by Mr. Samer Bulos from Alcazar Energy Ltd., in which he presented the following topics: (i) introduction to Alcazar Energy Ltd and its line of business, (ii) Shobak Wind Farm background and history, (iii) entities involved in the Project, (iv) Project location and layout, (v) explained the various components and the initial layout for the Shobak Wind Farm Project, (vi) explained the activities to take place during the different Project phases, (iv) project schedule and duration (vii) anticipated job opportunities for the Project and other planned corporate social responsibilities. There was time for questions and answers following this presentation as well as a facilitated discussion, moderated by ECO Consult.
- A presentation by the ESIA Team (ECO Consult) in which the ESIA process was explained as well as the anticipated negative environmental impacts during the various Project phases and the methodology that will be adopted throughout the ESIA study for assessing those impacts on those key sensitive receptors. There was time for questions and answers following this presentation as well as a facilitated discussion, moderated by ECO Consult.

Figure 12: Selected Photos from the Scoping Session of 10 January, 2017

Table 13 below presents the main issues raised by the stakeholders throughout the scoping session and highlights how those comments were taken into account and incorporated throughout the ESIA study.

Table 13: Summary of Comments Raised during Scoping Session and Response

Attribute	Comment	Response
Land Use	A stakeholder inquired whether land use activities onsite would be affected or whether they could continue to take place onsite during the Project development.	It was explained that impacts from wind farms on actual land use activities are generally minor given that the footprint of such projects is generally very limited (usually around 5% from the total project area) and activities can usually continue to take place in other areas within the Project site. In addition, it was also explained that potential impacts on land use will be studied as part of the ESIA and any actual land use onsite will be assessed (e.g. use of area by local communities for grazing or agriculture) and potential impacts from the Project will be studied and appropriate mitigation and monitoring measures will be identified.
Birds	A question was raised by a	Turbine shutdown will only occur if the birds passing

	stakeholder regarding the collision of birds with the wind turbines and whether a turbine shut down would occur if any	through belong to a pre-defined list of priority species. Furthermore, according to IFC guidelines, it is recommended that all operational monitoring should be carried out by qualified observers rather than radars/sensors since radars/sensors are only capable of detecting birds presence regardless of their species, while qualified observers
Community Health, Safety and Security	Several stakeholders asked about the cumulative noise levels of the wind farm and whether it will build up since there are many wind projects in the area.	It was clarified that noise level generated from one turbine is 106 Decibels. The ESIA study will include a noise impact assessment, and a detailed noise study. The manufacturing companies of the wind turbines have brochures for the sound power level of the wind turbines as well as a sound pressure level which measures the noise level at receptor areas.
	Noise – several stakeholders asked about the noise levels that will be generated from the wind turbines.	The noise levels generated from the turbines differ according to the manufacturing company of the turbine. In general, the noise level generated from one turbine is 106 decibels, and which will be dispersed at a distance and absorbed by the surrounding vegetation and topography, thus the noise levels will be minimal. The methodology for assessment of noise impacts from the turbines was explained in detail throughout the session. It was explained that the assessment will be undertaken through computer modelling program which will be based on a worst-case scenario. The program takes into account several factors such as the topography of the area, location of turbines, baseline conditions (in which noise will be monitored onsite), etc. Noise sensors will be located at the adjacent communities of the wind farm.
Occupational Health and Safety	A question was raised whether there will be any guidance and/or instructions for the onsite safety of workers.	It was explained that the Developer and the EPC Contractor will be developing a detailed safety plan. The ESIA study will assess which will take into account the noise impacts on the workers and will identify mitigation and management measures to prevent/reduce such potential impacts.

6.5.2 Detailed Engagement – Affected Community

This section presents the detailed engagements that were undertaken with the affected communities and which include onsite consultations with local communities and nomads as well as a local community consultation session both of which are discussed in further details below.

(i) Local Community Consultation Session

The 'ESIA Team' has undertaken additional consultations with the local community through a consultation session which was held on the 10 May 2017 at Shobak city, headed by Head of Shobak Mutasarrifate. Such consultation session focused on the local community which includes the closest community settlement to the Project site as discussed earlier and who are likely to be affected by the Project development, to include Mdhaibie', Zaitooneh, Zobeiriyeh and Mothallath Al-Shobak.

The representatives were identified jointly by the 'ESIA Team' and Shobak Mutasarrifate to include the following groups:

- Representatives of local community members;
- Community Based Organizations (CBO);
- Elder representatives of tribal groups;
- Local enterprises and businesses;

- Woman Groups; and
- Youth and unemployed.

Generally, such consultations aimed to take into account their thoughts and concerns on the Project development, while allowing the discussion to focus on slightly different angles from more of a first-hand experience/practical, less technical perspective. The 'ESIA Team' documented all records of the consultation session to include transcripts, minutes of meeting, list of participants and attendees, comments and so on. Selected photos from the session are shown in Figure 13 below. In addition, all attendees were provided with a Project handout in Arabic which provides information on the Project, its location and sitting, components, anticipated environmental and social impacts and other as appropriate.

Figure 13: Selected Photos from the Local Community Consultation Session 10th May 2017

In accordance with the above, the consultation session focused on five (5) main themes, each of which is discussed below.

- *Introduction to the Project*

The 'ESIA Team' started the session by first introducing the Project, its location, the various project components and provided the local community with all available information. The objective was to discuss and allow the local community to raise any questions or concerns they might have regarding the Project in general.

Several questions were raised and which are mainly related to issues such as: (i) land selection process for the Project; (ii) investment required to develop such a Project, (iii) amount of electricity produced from the Project and whom will it supply, (iv) Number of job opportunities that will be targeted at the local community, and (v) expected noise levels from the operation of the wind farm.

- *Discussion on Environmental and Social Impacts*

The 'ESIA Team' then discussed the anticipated environmental and social impacts from the Project throughout its various phases in order to address any concerns or fears regarding the nature, scale, and significance of the impacts. In addition, the objective was also to allow the local community to identify any additional impacts which must be taken into account throughout the ESIA study. Generally, the local community inquired about the nature of several of the identified impacts, but did not identify any additional impacts to be considered throughout the ESIA study.

- *Discussion on Land-Use Patterns within the Project Area*

The land use activities for the area in general were discussed in order to understand whether the area surrounding the Project is considered of any value to the local community. This included discussions on agricultural and grazing activities as well nomadic populations which could inhabit the surrounding area. This issue is discussed in further details in 'Section 9.1.3'.

- *Discussion on Socio-economic Conditions*

Within the ESIA, the socio-economic conditions of Ma'an Governorate were established based on review of secondary data available mainly from the Department of Statistics (DoS) and the Local Development Unit (LDU) of Ma'an Governorate. However, statistical data often does not fully represent the situation in reality.

Therefore, one of the objectives of the local community consultation session was to verify/understand the socio-economic conditions of the local communities and the main challenges they face. Such discussions would allow a better understanding and characterization of the current socio-economic conditions – the outcome of such discussions are summarized below and presented in detail in 'Chapter 18'.

- *Discussion on Socio-economic Development from the Project*

At the end of the consultation session, the focus of the discussions was to allow the local community to express their expectations in terms of socio-economic development by the Project, as well as understanding their views on the proposed development and ensure that those views are considered and taken into account throughout the Project development. The main points raised by the local community in relation to their expectations in terms of socio-economic development are discussed in detail in 'Chapter 18.

(ii) Onsite Consultations

Onsite consultations and discussions were undertaken within the Project area based on a site visit carried out on the 11th April 2017 as it is considered the phase which entails the highest onsite land activities by the local community members as well as the period in which nomadic activity is known in the area. Such consultations and discussion entailed visiting each area where activity was noticed, to the greatest extent possible, starting from south to the north of the Project area.

The objective of the consultations included:

- Introduce the Project and its various components;
- Understand, characterize and assess the activities undertaken onsite (the outcomes of such discussions is presented in details in 'Section 9.1.3');
- Understand, characterize and assess their socio-economic conditions and patterns (the outcomes of such discussions are presented in detail in 'Chapter 18); and
- Present and discuss the potential impacts of the Project which could affect their activities onsite in order to take into account their thoughts and concerns on such issues. This mainly includes impacts on land use and impacts from shadow flicker and noise. The outcomes of such consultations are discussed in further details in 'Section 9.1.3' and 'Chapter 18'.

Figure 14 below presents selected photos for onsite consultations undertaken with local communities and nomads. It is important to note that consultations were gender specific – therefore specific consultations were undertaken with women onsite by a female specialist of the 'ESIA Team'. In addition, through the consultations, a handout in Arabic was distributed and explained and which provides information on the Project, its location and sitting, components, anticipated environmental and social impacts and other as appropriate. It is important to note that targeted consultations with women did not identify any specific concerns or requirements other than those undertaken with men. Generally the output of such consultations was similar and is included under the relevant section as identified above.

Figure 14: Selected Photos for Onsite Consultations with Nomads and Local Communities

6.5.3 Detailed Engagement – Other Stakeholder Engagement Activities

Throughout the ESIA process various stakeholders were engaged and consulted. From the onset of the ESIA study, and in accordance with the issues and impacts anticipated from the Project throughout its various phases, the key stakeholder groups that needed to be consulted, involved, and collaborated with on a detailed level were identified.

Such engagement was intended for various purposes and which included to: (i) introduce the project and its overall concept and components, (ii) understand thoughts, views, and concerns from the Project development, (iii) collection of relevant data for assessment of baseline conditions and anticipated impacts from the Project, (iii) discussion on anticipated impacts, (iv) discussion on proposed mitigation measures, etc.

Such stakeholder groups were engaged and consulted through one or more of the following communication protocols: (i) bi-lateral meetings, (ii) e-mail communication, (iii) phone communication, and (iv) formal letters.

Table 14 below presents the entities which were engaged and consulted and the purpose of such engagement. Generally, the outcomes of such consultations are presented and included within the Section that the attribute relates to.

Table 14: List of Other Consultations during the ESIA

Entity	Attribute	Objective of Consultation
Ministry of Environment (MoEnv)	General	Ongoing discussions on the ESIA process as well as general concerns and impacts from Project development.
Ministry of Agriculture (MoA)	Land Use	Collection of secondary data on grazing reserves as well as current and future land use planning in relation to agriculture.
Ministry of Municipal Affairs	Land Use	Current and future land use planning in Project area as set by

Entity	Attribute	Objective of Consultation
(MoMA)		MoMA.
Ministry of Water and Irrigation (MWI)	Geology and Hydrology	Collection of secondary data on site geology and hydrology
	Infrastructure and Utilities	Collection of secondary data on infrastructure and utilities related to water resources and networks, wastewater networks and treatment plants, etc.
Department of Antiquities (DoA)	Archaeology and Cultural Heritage	Collection of any available secondary on archaeological resources on the area. In addition, coordinate with them to undertake archaeological survey and assessment for the Project site.
The Royal Society for the Conservation of Nature (RSCN)	Land Use	Current and future land use planning in relation to areas of critical environmental concern.
Civil Aviation Regulatory Commission (CARC)	Infrastructure and Utilities	Discussion on potential impacts from the Project on civil aviation safety and incorporating their requirements into account as part of the ESIA.
Royal Jordanian Air Force (RJAF)	Infrastructure and Utilities	Discussion on potential impacts from the Project on military aviation safety and incorporating their requirements into account as part of the ESIA.
Telecommunication Regulatory Commission (TRC)	Infrastructure and Utilities	Collection of existing telecommunication networks in the area and discussion on potential impacts from the Project.
Telecommunication company providers (Orange, Zain & Umniah)	Infrastructure and Utilities	Collection of existing telecommunication networks in the area and discussion on potential impacts from the Project.
Jordan Radio and Television Corporation (JRTV)	Infrastructure and Utilities	Collection of existing radio and television networks in the areas and discussion on potential impacts from the Project.
Ma'an Governorate and Shobak Mutasarrifate	Socio-economic	Understand thoughts, views, and concerns from the Project development.
		Collection of secondary data on socio-economic indicators. In addition, meetings were undertaken to characterize and understand the socio-economic conditions in reality of those local communities.
		Socio-economic development and plans for local community engagement.
Shobak District – Joint Service Council	Infrastructure and Utilities	Collection of information on existing infrastructure element in the area such as municipal approved landfills.

6.6 Future Stakeholder Engagement and Consultation

Future stakeholder engagement and consultations will mainly include the following, each of which is discussed in further details below: (i) disclosure session, (ii) disclosure of the ESIA document and (iii) implementation of the Stakeholder Engagement Plan (SEP) by the Developer.

6.6.1 Disclosure Session

Once the Final ESIA has been approved by the MoEnv, a disclosure session will be undertaken in Amman. All stakeholders invited to the scoping session will be invited again to attend the disclosure session, this will include the following groups: (i) national governmental entities (e.g. various Ministries, Civil Aviation Regulatory Commission, etc.), (ii) Local Governmental Agencies (e.g. Ma'an Governorate, Shobak Mutasarrifate, etc.), (iii) Non-Governmental Organizations (environmental and social development), (iv) Academic and Research Institutions. In addition, another session will be held for the local community representatives within the Project area.

In general, the objective of the disclosure session is to present the results and outputs of the ESIA study and which will include the following:

- Discuss in detail the anticipated environmental and social impacts from the Project;
- Discuss in detail the Environmental and Social Management Plan and the identified mitigation and monitoring measures; and

Obtain their thoughts and feedback on any issues of concern they might have. Those will be thoroughly addressed in the Final ESIA study to be submitted.

6.6.2 Disclosure of the ESIA document

The final ESIA, Non-Technical Summary (NTS) and the SEP will be disclosed on the Developer's website. In addition, hard copies of these documents will be available at the following locations:

- Ministry of Environment;
- Ma'an Governorate – Local Development Unit; and
- Shobak Mutasarrifate.

The ESIA will be disclosed for a minimum 60 day disclosure period.

6.6.3 Stakeholder Engagement Plan

Stakeholder Engagement is an on-going process that involves: stakeholder analysis & planning, disclosure & dissemination of information, consultation & participation, grievance mechanism, and on-going reporting to Affected Communities. A Stakeholder Engagement Plan (SEP) is developed and implemented that is scaled to the Project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities and key stakeholders.

The SEP for the Project describes the planned stakeholder consultation activities and engagement process and includes the following:

- Define the Project's approach to future stakeholder engagement;
- Identify stakeholders within the area influenced by the Project;
- Profile identified stakeholders to understand their priorities;
- Propose an action plan for future engagement with identified stakeholders; and
- Set out the grievance/project complaints mechanism.

7. OVERVIEW OF STRATEGIC ENVIRONMENTAL AND ECONOMICAL IMPACTS

It is understood that the Project will results in several site specific environmental and social impacts on various receptors throughout the Project phases to include planning and construction phase and operation phase. Such impacts are discussed in the subsequent chapters for each environmental receptor respectively and which include the following:

- Landscape and Visual;
- Land Use;
- Geology and Hydrology (Soil and Groundwater);
- Biodiversity;
- Birds (Avi-Fauna);
- Bats;
- Archaeology and Cultural Heritage;
- Air Quality;
- Infrastructure and Utilities;
- Occupational Health and Safety;
- Community Health, Safety and Security;
- Socio-economic conditions; and
- Occupational Health and Safety.

Nevertheless, the Project will result in significant and crucial positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Jordan is facing which have serious implications on Jordan's energy security as well as major economic burdens to the Jordanian economy.

Such positive impacts are important to highlight, consider, and take into account before investigating the potential negative environmental impacts anticipated from the Project, as discussed in the following sections.

The anticipated positive environmental and economic impacts on the strategic level are discussed and highlighted below.

7.1 Master Strategy of Energy Sector in Jordan

The energy demand in Jordan is characterized by a rapid increase to cope with the development. The expected demand for primary energy in 2020 will amount to 15 million tons of oil equivalent, compared to 7.6 million tons of oil equivalent in 2007. Similarly, electricity demand in 2020 is 5,770 MW compared to 2,100 MW in 2007; and average increase of 300MW per year (MEMR, 2007).

To meet the energy demand and the challenges of the energy sector a comprehensive energy strategy was approved by the Cabinet in December 2004 revised in 2007 – "Master Strategy of Energy Sector in Jordan". The Strategy is to provide a vision for development of the energy sector over the next ten years. The Strategy studied all options and alternatives for securing all types of energy from the following points of views: (i) the optimal options to cope with the energy demands and its investment cost, (ii) reforming and restructuring the energy sector to open the market for competition, and (iii) expanding on renewable energy projects and implementing energy conservation programs.

To this extent, the future goals of the Strategy can be summarized as follows:

- Reduce the dependence on foreign energy sources (energy independence);
- Security of supply with energy production based on a variety of sources;
- The target for 2015 is for domestic resources to cover 25% of demand reducing imports to 75%;
- The target for 2020 is for domestic resources to cover 39% of demand reducing imports to 61% and achieving energy production from additional energy sources; and
- Promote renewable energy sources to share to 7% in the primary energy mix in 2015, and 10% in 2020. This is to be met through 600-1000 MW from wind energy and 300-600 MW from solar energy.

To promote renewable energy sources and in order to open the way for private sector to effectively participate in the implementation of renewable energy project, the Renewable Energy and Energy Efficiency Law was issued and officially entered into force in April 2012. With this law, and for the first time in Jordan, investors had the opportunity to identify and develop renewable grid-connected electricity production through the Direct Proposal Submission as discussed earlier in "Chapter 1".

In line with the above, this development allows for more sustainable development and shows the commitment of the Government of Jordan to realizing its energy strategy and meeting the set targets for renewable energy sources.

7.2 Energy Security

Recently, most policy makers around the world are grappling with issues related to energy security, energy poverty, and an expected increase in future demand for all energy sources – and Jordan is no exception. Almost certainly, the most spoken words by policy makers and government bodies in Jordan in the last couple of years revolved around 'energy security', which is one of the key goals of the Master Strategy of Energy Sector in Jordan discussed above.

Currently, the Jordanian local energy resources are very limited commercially and Jordan is highly dependent on imported energy, as the total imported energy amounted to 97% of Jordan's total energy needs.

In line with the above, the Project will contribute to increasing energy security through reliance on an indigenous, inexhaustible and mostly import-independent energy resource. The estimated electricity generation from the Project is 174 GWh per year, on average; which will serve the annual electricity needs of around 18,000 local households.

This has been based on taking into account that in 2014 (latest statistic) the annual electricity consumption of households in Jordan was 6,580 GWh (MEMR, 2015) while the number of households in 2014 in Jordan was 1,590,762 (DoS, 2015) and thus the average annual electricity consumption can be assumed to be around 4,100 Kilowatt Hour (kWh).

7.3 Economic Benefits

The reliance on imported energy as discussed earlier above has led to major economic burdens to the Jordanian economy. Over the past couple of years, Egyptian gas supplies through the Jordan Gas Transmission Pipeline (JGTP) have been severely interrupted. To substitute the shortfall in Egyptian gas supply, Jordan had to rely to more expensive alternative fuels (imported fuel oil, diesel, gasoline) for power generation resulting in significant economic implications to the Government of Jordan's energy bill. In 2012, the cost of imported energy amounted to 20% of Jordan's Gross Domestic Product (GDP).

In line with the above, the Project will produce clean energy which will contribute to lowering electricity generation costs compared to the current costs associated with liquid fuels and thus leads to a substantial decrease in the Government of Jordan's fiscal deficit.

7.4 Environmental Benefits

The negative environmental impacts from generating electricity through conventional fossil fuel burning at thermal power plants are very well known. This most importantly includes air pollutant emissions such as ozone, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), particulate matter, and other gases which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

In addition, the burning of fossil fuels results in carbon dioxide emissions; a primary greenhouse gas emitted through human activities which contributes to global warming. The main human activity that emits CO_2 is the combustion of fossil fuels for electricity production and transportation. Concurrently, global climate change has become an issue of concern and so reducing greenhouse gas emissions have also emerged as primary issues to be addressed as the world searches for a sustainable energy future.

Generating electricity through wind power is rather pollution-free during operation. Compared with the current conventional way of producing electricity in Jordan through thermal power plants using heavy fuel oil and/or natural gas, the clean energy produced from renewable energy resources is expected to reduce consumption of fossil fuels, and will thus help in reducing greenhouse gas emissions, as well as air pollutant emissions. The Project will on average displace more than 111,000 metric tons of CO_2 annually. In addition, the project will save more than 1 million m^3 of water per year in comparison to an oil-burning power plant which utilizes water for cooling.

8. LANDSCAPE AND VISUAL

This Chapter first provides an assessment of baseline conditions within the Project site and surroundings in relation to landscape and visual and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

8.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to landscape and visual receptors and presents the outcomes and results.

8.1.1 Baseline Assessment Methodology

A site inspection was conducted on 4 July 2017. Most of the surrounding villages and visual receptors were determined by using ZTV and geographical imagery before the site inspection. All surrounding villages and possible visual receptors were also visited to determine the topography and possible significance on each of the visual receptors. A photo was taken from each of the receptors towards the site and then visual representations of the wind farm from each of these receptors were created using 'SketchUp' and 'Google Earth Pro', to give an indication of what the landscape would look like pre- and post-construction of the wind farm.

Baseline Assessment Significance Rating

Impact assessment must take account of the nature, scale and duration of impacts on the visual receptors whether such impacts are positive or negative. Each impact is also assessed according to the visual receptors, which were determined by using ZTV, and the following project phases:

- Construction;
- Operation; and
- Decommissioning.
- The rating system is applied to the potential impacts on the receiving visual receptors and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, Table 15 below, will be utilised as the baseline impact assessment for each visual receptor and phases of the project.

Table 15: Impact Significance Rating

Nature		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
Geographic Extent		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
Probability		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).

3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
Duration		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
Intensity / Magnitude		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued LVIAbility of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued LVIAbility of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
Reversibility		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
Irreplaceable Loos of Resources		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		

1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
Cumulative Effect		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
Significance		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

Visibility Rating in terms of Proximity by using the Zone of Theoretical Visibility (ZTV) model

The ZTV reflects the visibility rating in terms of proximity of viewers to the wind farm, see Table 16. The distances were calculated using satellite imagery but the impact magnitude was determined by using previous experiences, assumptions and opinions, it is therefore theoretical. The ZTV maps will give a clearer understanding of areas susceptible to line of sight which means; an imaginary line from the eye to a perceived object, in this case the wind turbines. The ZTV assessment did not take into account existing screening such as buildings and vegetation cover but rather the terrain's above mean sea level (AMSL) which indicates line of sight. The receptors which were identified were subject to an impact assessment. The following table was utilised to determine the ZTV Visibility Rating in terms of proximity:

Table 16: ZTV Visibility Rating in terms of proximity

Radius	Visibility rating in terms of proximity
0-5km	Very High
5-10km	High
10-15km	Medium-High
15-20km	Medium
20-25km	Medium-Low

25-30km	Low
30-35km	Very Low

Identified Visual Receptors

This section is intended to highlight possible visual receptors within the landscape which, due to use, could be sensitive to landscape change, see Figure 15. They include:

- Area Receptors includes the Dana Biosphere Reserve.
- Linear Receptors which include:
  - Route 35 / King's Highway;
  - Route 15 / Highway 15; and
  - Route 814.
- Point Receptors which include:
  - Shobak Castle;
  - Dawsaq Castle;
  - Villages within the Shobak Municipality;
  - The town of Al-Qadissyeh;
  - Wadi Musa & Petra; and
  - Ma'an.

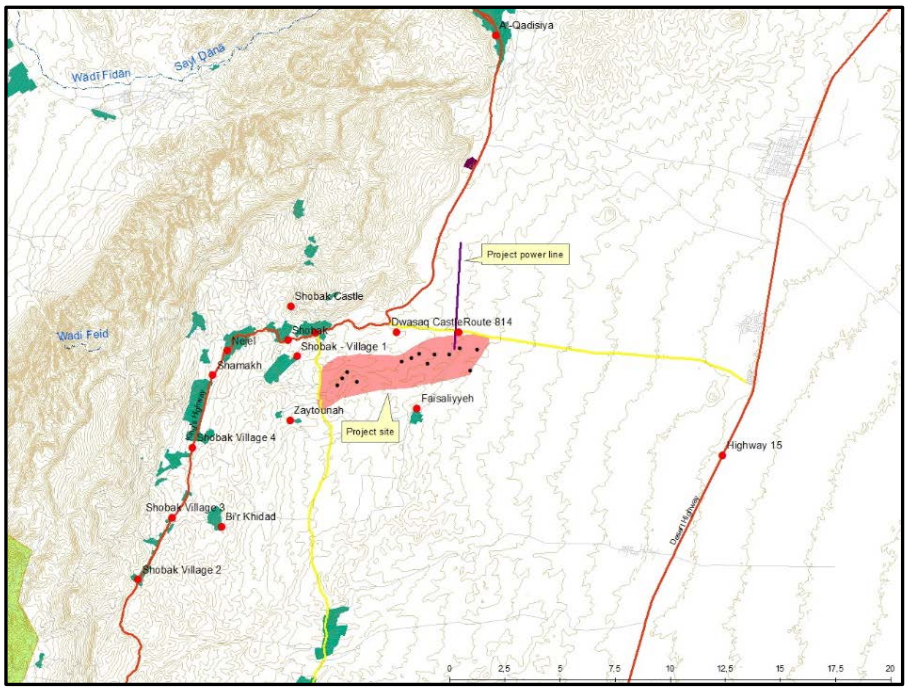

Figure 15: Visual Receptor Map

8.1.2 Results

The proposed wind farm site is located within a moderately hilly terrain area with altitudes ranging from around 1,195m to 1,350m AMSL. The Project area slopes down to the east, towards Highway 15. Surrounding the Project site, mountains, valleys and canyons can be found towards the north, west and south west where as to the east hilly terrain and flat planes dominates the landscape, see Figure 20 and Figure 21.

The landform and drainage described above is unlikely to limit visibility. Certain areas within 35km from the proposed activity might have a clear view without taking existing screening and air quality into account.

Figure 16-19 below were taken from the middle of the site toward the four main directions namely north, east, south and west.

Figure 16: View from site towards the North

Figure 17: View from site towards the east

Figure 18: View from site towards the south

Figure 19: View from site towards the west

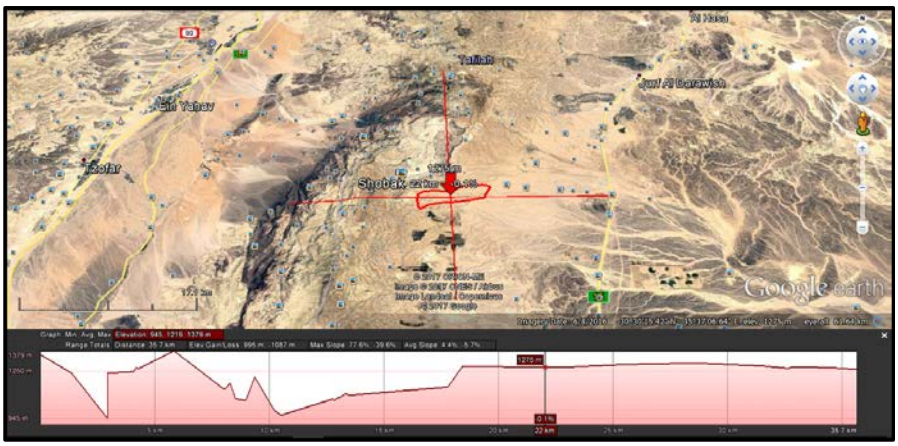

Figure 20: Cross Section Profile taken from north to south

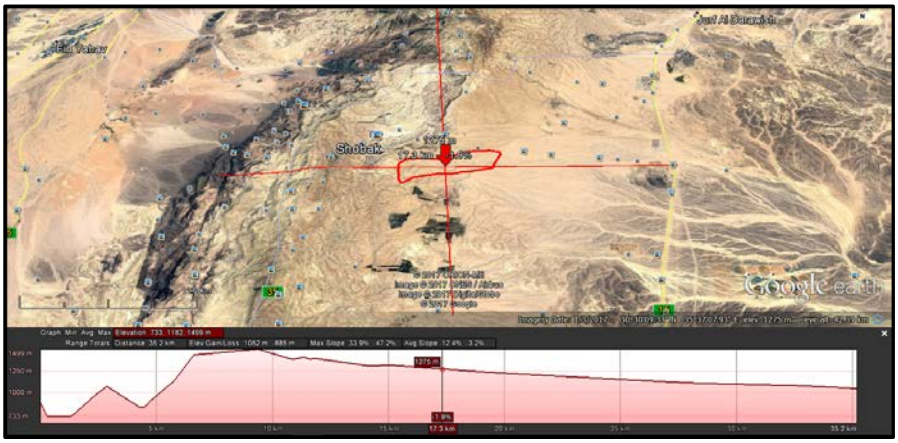

Figure 21: Cross Section Profile taken from west to east

8.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on landscape and visual during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

8.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, levelling, excavation, grading, etc.

Construction activities would create a temporary effect on the visual quality of the site and its surroundings. The visual environment during the construction phase would include the presence of elements typical of a construction site such as equipment and machinery to include cranes, excavators, trucks, front end loaders, compactors and other.

However, as discussed in "Section 8.1", the project site itself is considered an area with no particular structures of interest or any key visual receptors – such as recreational activities, environmental reserves, remarkable/unique historical or cultural sites, or other natural structures normally seen as valuable by the human perception. In addition, any visual impacts to the surrounding landscapes are unlikely, and if so then they will be only temporary affected and will definitely not exceed the impacts anticipated during the operation phase as discussed in "Section 8.2.2" below.

The visual environment created during the construction period would be temporary, of a short-term duration, limited to the construction phase only. For the duration of construction, the visual impacts will be of a negative nature and will be noticeable within the Project site, and therefore of a medium magnitude. As there are no key sensitive visual receptors which would be affected the receiving environmental is determined to be of a low sensitivity. Given all the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- Ensure proper general housekeeping and personnel management measures are implemented which could include:
  - Ensure the construction site is left in an orderly state at the end of each work day.
  - To the greatest extent possible construction machinery, equipment, and vehicles that are not in use should be removed in a timely manner and kept in locations to reduce visual impacts to the area.
  - Ensure proper storage, collection, and disposal of waste streams generated as discussed in detail in "Section 10.2".

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor and which include:

- Inspections of the works should be carried out always to ensure the above measures are implemented.

8.2.2 Potential Impacts during the Operation Phase

Visual impacts associated with wind energy projects typically concern the turbines themselves (e.g. colour, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape and the visual receptor which might be present. Turbines are tall structures that can be seen from several kilometres away and impose a change on the landscape of the area where they are installed. However, visual impacts depend on several factors such as distance, size, visibility, landscape and geography, and the presence of potential sensitive visual receptors.

Discussed below is the methodology that was adopted for the assessment of impacts of the wind turbines on the landscape and visual character of the Project site and its surrounding, and the results and outcomes of the assessment.

(i) Impact Assessment Methodology

Visual Receptors can be defined as: "Individuals, groups or communities who are subject to the visual influence of a particular project."

A Zone of Theoretical Visibility (ZTV) is a Geographic Information System (GIS)-generated tool to identify the likely (or theoretical) extent of visibility of a development. The tool used in this model does not take existing screening in account but only the above mean sea level of the landscape.

Table 17 reflects the visibility rating in terms of proximity on viewers of the wind farm. The distances were calculated according to experience, assumptions and opinion. The ZTV maps will give a clearer understanding of areas susceptible to line of sight.

Table 17: ZTV Visibility Rating in terms of Proximity for the different receptors of the project site

Radius	Visual Receptors	Visibility rating in terms of proximity
0-5km	• Villages within the Shobak Municipality • Shobak Castle • Dawsaq Castle • Route 814 • King's Highway	Very High
5-10km	• Southern villages within the Shobak Municipality	High
10-15km	• Highway 15 • Al-Qadissyeh	Medium-High
15-20km	• Dana Biosphere Reserve	No line of sight
20-25km	• Wadi Musa & Petra	No line of sight
25-30km	None	N/A
30-35km	• Ma'an	Very Low

The ZTV assessment did not take into account existing screening such as buildings and vegetation cover but rather the terrain's above mean sea level (AMSL) which indicates line of sight. Visibility during spring and summer can be restricted to approximately 12km.

a. Visibility Analysis

The theoretical visibility analysis describes the area over which the planned turbine installations might have an influence or an effect upon the visual environment, i.e. the wind turbines can be noticed as elements of the landscape.

The visibility analysis for this Project was conducted by the means of a calculation with WindPRO software (version 2.9; Sep 2014, Module ZVI), based on a Digital Elevation Model (DEM) (SRTM) (USGS, 2000). The SRTM DEM provides elevation information with a spatial resolution of 25m and a vertical accuracy of <16 m.

The view shed calculation was conducted by calculating the view lines from observation points at defined elevation for each turbine (e.g. hub height, rotor tip maximum) looking towards the ground. Visibility was calculated for ground level grid cells with a size of 25x25 m. Where the view line hits a ground cell, visibility between this cell and the respective turbine was counted. As this visible relationship is bi-directional, the result also represents the visibility of the turbine from the subject grid cell. The view shed calculation was conducted for each turbine location. As a result, each grid cell contains the information on which turbines are visible from that cell. The number of turbines in the view from each cell is counted for an impact magnitude classification.

The following assumptions have been made prior to the calculation:

- View shed calculations were limited to an area of 25kmx25km around the planned turbines given that beyond this distance, a visual impact can be considered to be negligible;
- The observation point of the turbine was anticipated at an elevation of 137m above the ground (hub height plus rotor blade length); and

- Screening objects such as trees, buildings or small changes in topography (e.g. road cuttings) reducing the visibility of the Project have not been taken into account.

Given the assumptions and simplifications of the visibility analysis, the results should be regarded as indicative. In general, partly seen objects are accounted for as being completely visible, since the modelling does not differentiate between a partly and a completely seen object; only the general entire object height is the calculation reference for the visibility analysis. Having only a small part of the turbine (e.g. rotor tip or only the uppermost part of the tower) viewable will be a lesser change than the entire turbine. Both, however, are counted equally in the visibility analysis. The assessment of selected viewpoints described in the next section accounts for such effects for the selected views, but on the other side cannot cover all areas where visibility may occur.

The hub at a height can be seen as the major reference for a turbine's visibility. In order to also consider the rotor blade above the hub, the maximum tip height can be taken as a worst case. However, in this case a turbine will be counted even if nothing else but its tip can be seen beyond a ridge. Therefore, it should be noted that the results may show some overestimate in the counts of visible turbines.

b. Photomontage Methodology (Photorealistic Simulation)

Photomontages are used to illustrate the likely view of the visible structures of a proposed project as they would be seen when a photograph is taken from a selected viewpoint. Hence, the photomontage focuses on a singular view and how it will be influenced by a project.

For the Project, several viewpoints were selected in the course of a visit to the area in June 2017. Viewpoints were selected at locations assumed to be highly disadvantageous in terms of the visual impact due to presence of receptors (villages or dwellings). Viewpoints were selected in order to provide exemplary photographic views which show the degree of visual impacts at these viewpoints by means of photomontage – such viewpoints selected are presented in the figure below in red. Thereby an impression can be provided on the wind turbines' visual presence. Moreover, it can be shown, whether the turbines can be seen in total or only partially.

Photographs were taken with a digital single lens reflex (SLR) camera and a 28mm digital lens (35mm equivalent). For each viewpoint, a computer rendered image was generated from a digital model of the wind farm by using WindPRO (Module VISUAL).

For the simulation, the horizontal viewing angle of 60° was chosen, which displays existing objects more realistically than a wide panorama field (in which objects further than 500m from the viewer appear understated).

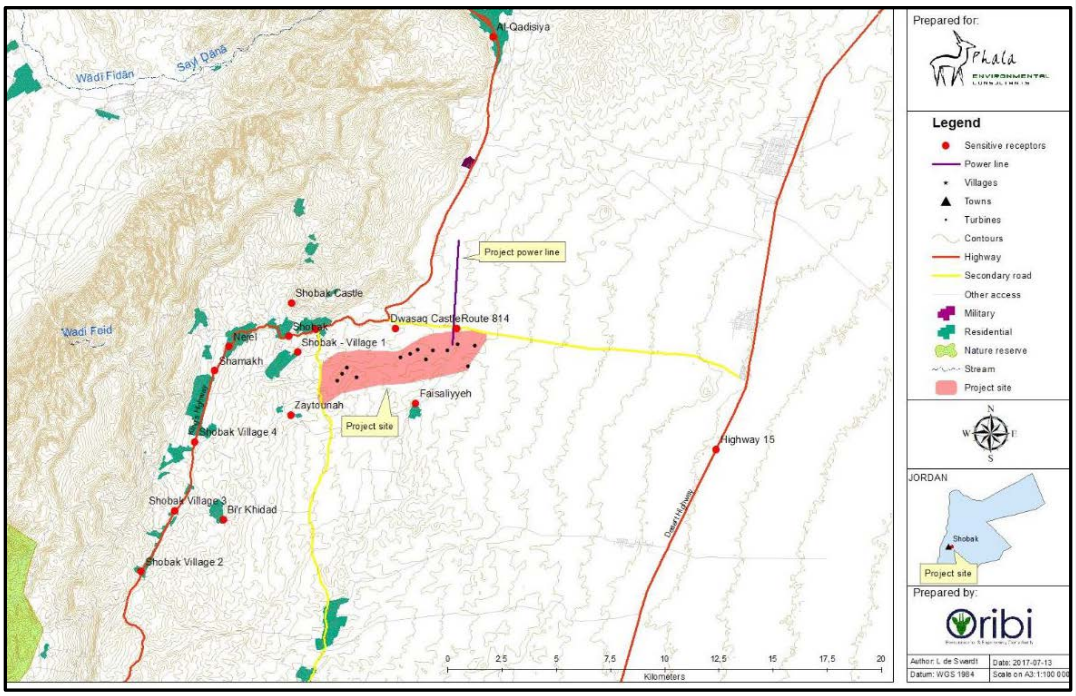

Figure 22: Identified Visual Receptors Map

c. Assessment of the Impacts

As discussed earlier, to assess an impact entails assessing two main criteria – the sensitivity of the receiving parameter of the impact and the magnitude of the impact itself. Throughout this section, the impacts have been assessed for each of the landscape types identified and discussed in "Section 8.1.2" – which also identifies the sensitivity of each of those landscape types which are likely to be impacted. In addition, the magnitude of each impact is determined according to the rationale discussed in Table 14 above.

It is important to note that the impacts discussed throughout this section are not necessarily considered negative. For wind farm projects, the aesthetic perception by viewers is quite different; it can be positive or negative, depending on the individual's attitude to the principle and presence of wind generation. Aesthetic issues are by their nature highly subjective. For some viewers, such turbines could be regarded as manmade structures with visual burdens while to others it represents a positive impact in the sense that they introduce a break in the otherwise dull and monotonous view. Such views could be perceived positively by adding a new interesting scenic feature for the viewer (e.g. 'arid landscape with high-tech') or implementing modern power generation industries by renewable 'clean' energy in the area.

(ii) *Results*

Figures 22-25 below is a summary of the wind farm zone of theoretical visibility from different buffer distances, from 5km up to 35km.

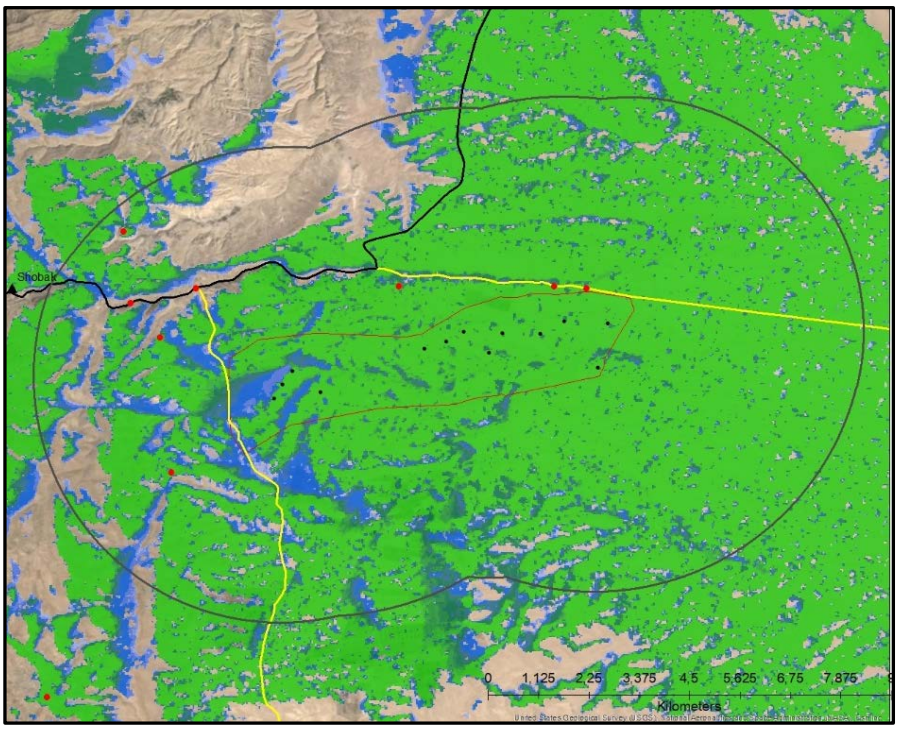

Figure 23: Wind Farm ZTV – 5km buffer

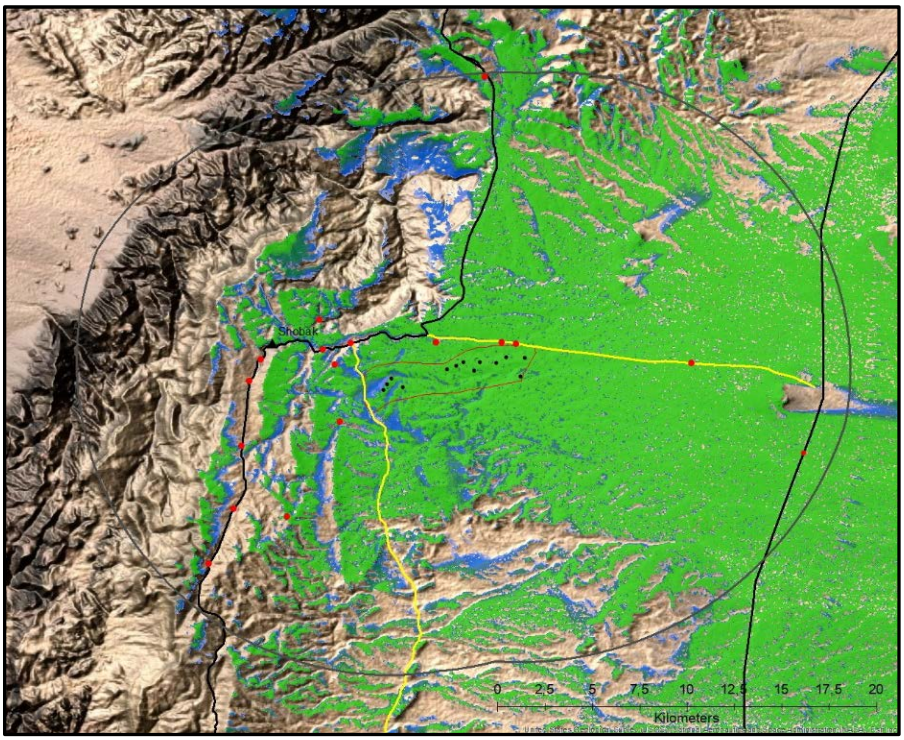

Figure 24: Wind Farm ZTV – 15km buffer

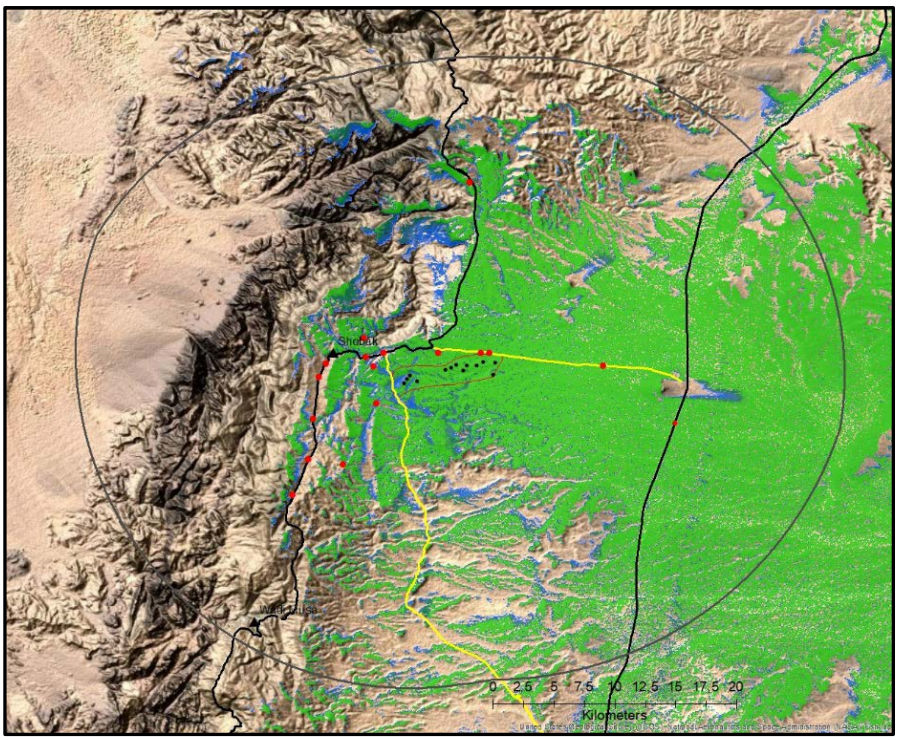

Figure 25: Wind Farm ZTV – 25km buffer

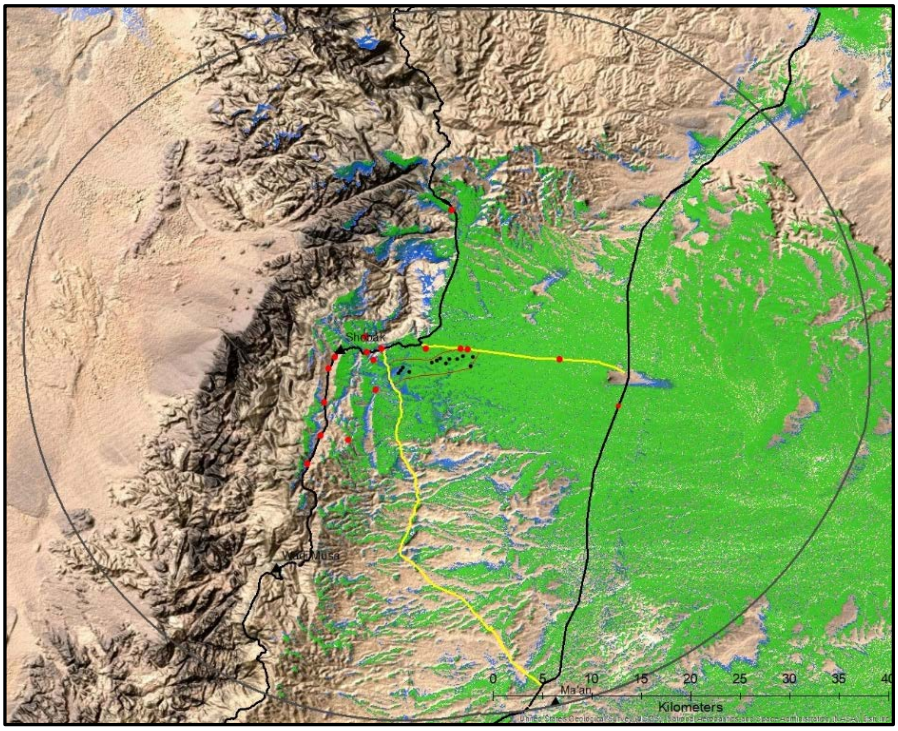

Figure 26: Wind Farm ZTV – 35km buffer

During the visit, it was clear that Wadi Musa and Petra and Dana Biosphere Reserve are completely screened by mountains and landscape features. They will not form part of significance assessment although photos are available on request.

The rating system reflected in Table 15 of this LVIA report will be utilised to determine the significance of the impacts. A photo was taken from each visual receptor towards the proposed development. Visual presentations of the wind farm were created for only eight, and the more significant, receptors. The only cumulative factor that contributed to the cumulative assessment of the wind farm is the Tafila wind farm located 19.8km north from the proposed development.

Table 18: Shobak Castle Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on employees	Pre-Mitigation	2	4	3	2	4	2	2	34
	Post-Mitigation	2	3	3	2	4	2	2	32

Figure 27: View from Shobak Castle towards site

Notes

Elevation: 1367m

Distance and direction from nearest turbine: 4.5 km South East

Shobak Castle is one of the main tourist attractions around Shobak. Shobak Castle is located on top of a hill with a clear view of the proposed development, see Figure 26, however the Lafarge cement factory and existing Tafila wind farm are also visible, except on windy days when dust in the air influences visibility, see Table 18 and Figure 27.

A tour guide was consulted at Shobak Castle and he indicated that the tourists visiting the castle do not have problem with the existing Tafila wind farm project, also visible from Shobak Castle, as it shows local prosperity, by making use of renewable energy sources. The local community is looking forward to the job opportunities that will be created.

Figure 28: Visual Presentation from Shobak Castle

Table 19: Dawsaq Castle Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on employees	Pre-Mitigation	2	4	3	3	4	3	2	54
	Post-Mitigation	2	4	3	2	4	3	2	36

Figure 29: View from Dawsaq Castle towards site

Notes

Elevation: 1283m

Distance and direction from nearest turbine: 1.4 km South-south east

Dawsaq Castle is the closest of all the visual receptors but due to the fact that the caste is in complete ruins, very few tourists go through the trouble of stopping at the site, see Figure 28. The site can however become more popular with tourists, as this would be the best vantage point to view the turbines from, see Table 19 and Figure 29.

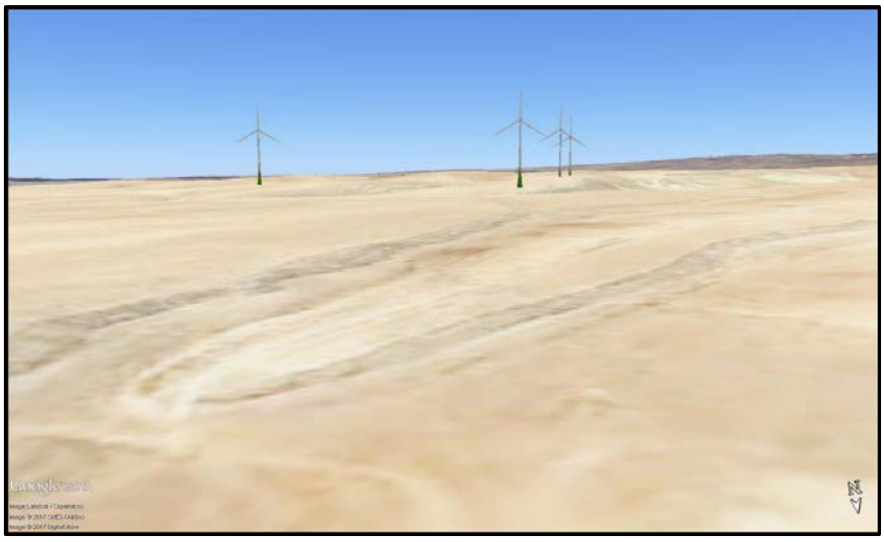

Figure 30: Visual Presentation from Dawsaq Castle

Table 20: Al-Qadissyeh Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	3	3	1	2	2	2	14
	Post-Mitigation	2	2	3	1	2	1	1	11

Figure 31: View from Al-Qadissyeh towards site

Notes

Elevation: 1431m

Distance and direction from nearest turbine: 14.5 km South

Al-Qadissyeh is a town located on the King's Highway, see Figure 30. When driving towards Shobak Village, some of the turbines will be visible in the distance, depending on the turns and topography of the road. The wind farm will be visible to some of the houses in the village which are located on higher ground, but a large majority will be screened by existing buildings in the town, see Table 20 and Figure 31. When driving north on the route, the Lafarge cement factory and existing Tafila wind farm are visible.

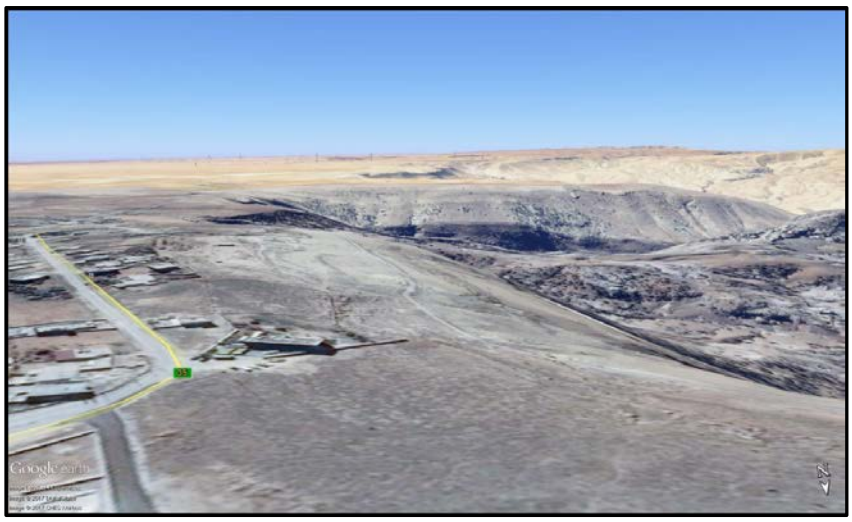

Figure 32: Visual Presentation from Al-Qadissyeh

Table 21: Zaitooneh Village Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	3	4	3	3	57
	Post-Mitigation	2	4	3	2	4	3	3	38

Figure 33: View from Zaitooneh Village towards site

Notes

Elevation: 1380m

Distance and direction from nearest turbine: 2.3 km North East

Zaitooneh is a very small village located south west of the project site, see Figure 32. The town is not located on one of the major routes and the residents of the village would most likely be the only people visual receptors. The village has very few buildings that act as screening, and due to the elevation of the village and distance from the turbines, most of the turbines will be visible, see Table 21 and Figure 33.

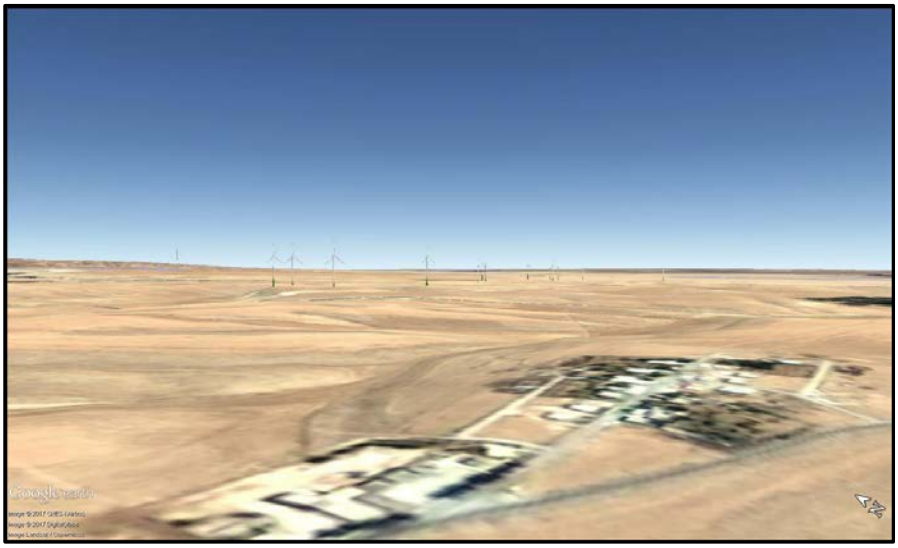

Figure 34: Visual Presentation from Zaitooneh Village

Table 22: Faisaliyeh Village Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	3	4	3	3	57
	Post-Mitigation	2	4	3	2	4	3	3	38

Figure 35: View from Faisaliyeh Village towards site

Notes

Elevation: 1261m

Distance and direction from nearest turbine: 2.2 km North

Faisaliyeh will have a clear view of all the turbines, with no existing screening present, see Table 22 and Figures 34 and 35. During the late afternoon, the turbines located to the north west of the village will be even more visible as the sky is illuminated by the setting sun and the silhouette of the turbines become visible.

Figure 36: Visual Presentation from Faisaliyeh Village

Table 23: Mothallath Al-Shobak Town Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	2	4	2	2	34
	Post-Mitigation	2	3	3	2	3	2	2	30

Figure 37: View from Shobak Town towards site

Notes

Elevation: 1350m

Distance and direction from nearest turbine: 3.3 km south east

The turbines will be visible to a large portion of the town, some sections will be shielded from the wind farm due to the topography and existing infrastructure, however houses that are located on the north western hillside, will have a clear view of the turbines towards the south east, see Figures 36, 37 and Table 23.

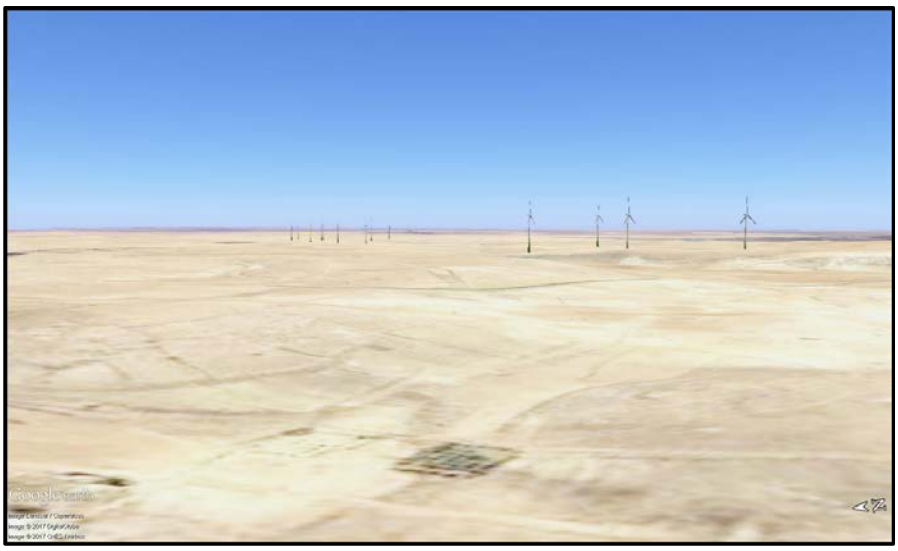

Figure 38: Visual Presentation from Shobak Town

Table 24: Al-Jaya Village Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	2	4	2	2	34
	Post-Mitigation	2	3	3	2	4	2	2	32

Figure 39: View from Al-Jaya Village towards site

Notes

Elevation: 1324m

Distance and direction from nearest turbine: 2.6 km South East

Large sections of the village, and road that runs through the village is screened by trees located adjacent to the road, buildings and topography (hills), see Figure 38. Some turbines might be visible on higher lying areas in the village and were there are dales that expose the turbines whilst driving on Route 35, see Table 24.

Table 25: Nejel Village Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	2	4	2	2	34
	Post-Mitigation	2	3	3	2	4	2	2	32

Figure 40: View from Nejel Village towards site

Notes

Elevation: 1426m

Distance and direction from nearest turbine: 5.8 km South East

A large portion of the village and the King's Highway that runs through the village is screened by buildings, trees and topography, see Figure 39. The turbines can be visible from higher lying areas within Nejel. Telecommunication towers are also visible from the town, see Table 25.

Table 26: Shamakh Village Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	2	3	2	2	32
	Post-Mitigation	2	3	3	2	3	2	2	30

Figure 41: View from Shamakh Village towards site

Notes

Elevation: 1437m

Distance and direction from nearest turbine: 6.1 km East

A large portion of the village and the King's Highway that runs through the village is screened by buildings, trees and topography, see Figure 40. The turbines can be visible from higher lying areas within Shamakh. Telecommunication towers are also visible from the town, see Table 26.

Table 27: Bi'r Khidad Village Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	2	3	2	2	32
	Post-Mitigation	2	4	3	2	2	2	2	30

Figure 42: View from Bi'r Khidad Village towards site

Notes

Elevation: 1557m

Distance and direction from nearest turbine: 8.2 km North East

Bi'r Khidad is a small village located south west of the project. The village has a high elevation and the turbines will be visible from the village, see Figure 41. The village is not located on a main route and therefore the residents will be the main visual receptor. No screening exists on site, see Table 27.

Table 28: Shobak Village 1 Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	4	3	2	3	2	2	32
	Post-Mitigation	2	3	3	2	3	2	2	30

Figure 43: View from Shobak Village 1 towards site

Notes

Elevation: 1385m

Distance and direction from nearest turbine: 2.5 km South East

Very little screening exists for Shobak Village 1, as this part of the village is quite elevated and located within close proximity to the turbine, see Figure 42 and Table 28. The residents will most likely be the only visual receptor for the village.

Table 29: Shobak Village 2 Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	3	3	2	3	2	2	30
	Post-Mitigation	2	3	3	2	2	2	2	28

Figure 44: View from Shobak Village 2 towards site

Notes

Elevation: 1592m

Distance and direction from nearest turbine: 12.2 km North East

Shobak Village 2 is elevated, but the topography of the surrounding area will partially screen the turbines, see Figure 43 and Table 29. The village is also very sparsely populated and would therefore have very few receptors.

Table 30: Shobak Village 3 Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	3	3	2	3	2	2	30
	Post-Mitigation	2	3	3	2	2	2	2	28

Figure 45: View from Shobak Village 3 towards site

Notes

Elevation: 1512m

Distance and direction from nearest turbine: 9.3 km South East

Shobak Village 3 only has a few homesteads located adjacent to the road, which is partially screened from the wind farm by the surrounding topography, see Figure 44 and Table 30.

Table 31: Shobak Village 4 Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on residents	Pre-Mitigation	2	3	3	2	3	2	2	30
	Post-Mitigation	2	3	3	2	2	2	2	28

Figure 46: View from Shobak Village 4 towards site

Notes

Elevation: 1481m

Distance and direction from nearest turbine: 7.1 km South East

The topography offers very little screening of the wind farm from Shobak Village 4, see Table 31. A section of the road that runs through Shobak Village 4 has trees adjacent to the road, which acts as some form of screening, see Figure 45.

Table 32: King's Highway Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on road users	Pre-Mitigation	2	4	1	2	4	2	2	30
	Post-Mitigation	2	4	1	1	4	2	2	15

Figure 47: View form King's Highway towards site

Notes

Elevation: N/A

Distance and direction from nearest turbine: N/A

The wind farm will periodically be visible to road users using the King's Highway, especially the section between Al-Qadissyeh and Shobak Village 3. Screening exists on some sections of road due to infrastructure, vegetation and topography, see Figure 46 and Table 32.

Table 33: Route 814 Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on road users	Pre-Mitigation	2	4	1	2	4	2	2	30
	Post-Mitigation	2	3	1	2	4	2	2	28

Figure 48: View form Route 814 towards site

Notes

Elevation: ~1220m

Distance and direction from nearest turbine: N/A

Route 814 will have a clear view of the turbines while traveling west, however, the route is only ~14km long, and so travellers will only be exposed to the turbines for a short period of time, see Figures 47, 48 and Table 33. During the late afternoon, the turbines located to the west and south west of the route will be even more visible as the sky is illuminated by the setting sun and the silhouette of the turbines become visible.

Figure 49: Visual Presentation from Route 814

Table 34: Highway 15 Significance Rating

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual Impact on road users	Pre-Mitigation	2	3	1	2	3	2	1	24
	Post-Mitigation	2	3	1	1	3	2	1	12

Figure 50: View form Highway 15 towards site

Notes

Elevation: 1048m

Distance and direction from nearest turbine: 13.5 km East

Road users travelling on Highway 15 will have a view of the turbines in the distance, the Tafila wind farm however, is on a higher elevation than the proposed Shobak wind farm and will be visible during a longer duration whilst traveling on Highway 15, see Figures 49, 50 and Table 34.

Figure 51: Visual Presentation from Highway 15

Table 35 below presents the visual impact on tourists using nearby roads and visiting tourists sites, including Shobak Castle during the operation phase whereas the Table 36 presents the average significance rating on all visual receptors during the operation phase.

Table 35: Tourists Significance Rating (during operations)

Nature of Impact		Geographical Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable Loss of Resources	Cumulative Effect	SIGNIFICANCE
Visual impact on tourists using nearby roads and visiting tourist sites	Pre-Mitigation	2	4	1	2	4	2	3	32
	Post-Mitigation	2	4	1	1	4	2	3	16

Table 36: Average Significance Rating on Visual Receptors (during operations)

Visual Receptor	Pre-Mitigation	Post-Mitigation
Shobak Castle	34	32
Dawsaq Castle	54	36
Al-Qadissyeh	14	11
Zaitooneh Village	57	38

Visual Receptor	Pre-Mitigation	Post-Mitigation
Faisaliyeh Village	57	38
Shobak Town	34	30
Al-Jaya Village	34	32
Nejel Village	34	32
Shamakh Village	32	30
Bi'r Khidad Village	32	30
Shobak Village 1	32	30
Shobak Village 2	30	28
Shobak Village 3	30	28
Shobak Village 4	30	28
King's Highway (35)	30	15
Route 814	30	28
Highway 15	24	12
Tourists	32	16
Average	34	27

Mitigation Measures

The following identifies the mitigation measures to be applied by the Developer/EPC Contractor:

- Due to the height of the turbines and extent of the Project, no viable mitigation measures can be implemented to eliminate the visual impact of the turbines, but the subjectivity towards the turbines can be influenced by creating a "Green Energy" awareness campaign. This could be implemented by constructing a visitor's centre on the property allocated for the proposed wind farm which should be open to school fieldtrips, the local community and tourists.
- Avoid including lettering, company insignia, advertising or graphics on the turbines.

As noted throughout the assessment, the majority of the visual impacts are considered minor. There are no mitigation measures per se that can be implemented to eliminate the visual impacts from the turbines. The visual impact, as expected will be higher on the human settlements that are closer to the project. During the consultation process, this is issue was brought up and discussed and the local community has shown a wide acceptance of the Project and none has expressed concern regarding the visual impact of the project. On the contrary, the presence of the turbines was looked at positively but the measures discussed above

are expected to lessen the visual burden – therefore the residual significance is expected to remain minor. However, it is important to note again that there are no key issues of concern in terms of the visual impacts.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase:

- Inspection of the works to ensure the above measures are implemented.

9. LAND USE

This Chapter first provides an assessment of baseline conditions within the Project site and surroundings in relation to land use (to include both formal and informal) and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

9.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to land use (to include both formal and actual) and presents the outcomes and results.

9.1.1 Baseline Assessment Methodology

The baseline assessment of the 'formal' land use was based on collection of secondary data and land use plans set by the relevant governmental authorities – to include Ministry of Municipal Affairs (MoMA), Ministry of Environment (MoEnv), and the Ministry of Agriculture (MoA) etc.

Understanding and characterizing the informal or 'actual' land use of the Project site was mainly based on several site visits undertaken by the 'ESIA Team' to the project site, as well as consultation sessions with the local communities. The objective of such site visits and the consultation sessions was to investigate the actual land use of the site, and determine if it provides any certain value to the affected communities in the areas (e.g. agricultural activities, grazing, etc.).

The site visits were undertaken during May 2017 as it is considered the phase which entails the highest onsite land activities by the local community members. The site visits entailed visiting each area where activity was noticed, to the greatest extent possible, starting from south to the north of the Project area. At each area, detailed discussions were undertaken with members onsite with the objective of (amongst other as stated previously in 'Section 6.5': (i) introduce the project and its various components; (ii) understand, characterize and assess the activities undertaken onsite; (iii) present the potential impacts which could affect their activities onsite and take into account their thoughts and concerns regarding the project development. It is important to note that consultations were gender specific – therefore specific consultations were undertaken with women by a female specialist of the 'ESIA Team'.

In addition, to the above a consultation session was undertaken with local community representatives in May 2017. The objective of the session included (amongst other as stated previously in 'Section 6.5': (i) introduce the project and its various components; (ii) understand, characterize and assess the activities undertaken onsite and verify the outcomes of the site visits undertaken; (iii) present the potential impacts which could affect their activities onsite and take into account their thoughts and concern on the Project development.

9.1.2 Formal Land Use

The formal land use of the Project site was investigated based on available plans set by the relevant governmental authorities. This includes the following: (i) land use planning by MoMA, (ii) planning for areas of critical environmental concern by MoEnv, and (iii) grazing reserves and forest lands planning by MoA.

(i) Land Use Planning by MoMA

The Project might conflict with the allowed land use set for the area by MoMA which designates specific land uses in Jordan where only certain activities are allowed. This issue has been investigated and the results are presented below.

In accordance with the "Law for the Organization of Cities, Villages and Buildings No. 79 for 1966", MoMA designated specific land uses for areas in the Kingdom that are within organized boundaries (urban areas). However, at that time, no land use plans were developed for areas that lay outside of the organizational boundaries and therefore, in 2006 a project to prepare a land use map for such areas began. The output was the National Land Use Master Plan of 2007; which is a recent attempt to produce a harmonized land use plan for those areas that are outside of organized boundaries. Accordingly, the "Land Use Planning Regulation No. 6 of 2007" was issued to regulate land use for those areas outside of organized boundaries and to divide territories by using zoning cryptography as follows:

- Agricultural areas sector, identified by the symbol (A);
- Rural areas sector, identified by the symbol (B);
- Marginal areas sector, identified by the symbol(C);
- Desert areas sector, identified by the symbol (D); and
- Forest areas.

Table 37 below presents the location of the project site and the land use plan set within the National Land Use Master Plan of 2007. The project site is located outside of the regularised boundaries where the closest are Mdhaibie', Zaitooneh, Zobeiriyeh and Mothallath Al-Shobak which are represented in pink in the figure below; where such regularised boundaries have assigned land use categories in the "Law for the Organization of Cities, Villages and Buildings No. 79 for 1966". However, as the Project site is located outside the regularised boundaries of these settlements, it is considered as areas outside planning zones with assigned land use categories set in accordance with the Regulation No. 6 of 2007. According to Figure 51 below and the "Regulation No. 6 of 2007", the Project site is classified as the following:

Table 37: Land Use Classification of the Project Area by MOMA

Classification	Description
Agricultural Area of the 3rd Degree	Roughly 60% of the project site is within this classification, covering the whole western part of the project site and parts of the central part. Article 6[A-3] describes the area as suitable for agro-forestry. Article 6[B] of the Regulation specifically states "In those areas the following land use are allowed: electric power generation facilities, transmission, and distribution networks".
Desert Area of the 2nd Degree	Covering the remaining of the project site including the eastern part of the project site and a smaller part of the central part. Article 9[A-2] defines the area as arid and it can be used for seasonal farming depending on the availability of water.

To this extent, it is evident that the Project site does not conflict with MOMA's land use plan; in fact, the designated land use for the area allows for the development of such a Project.

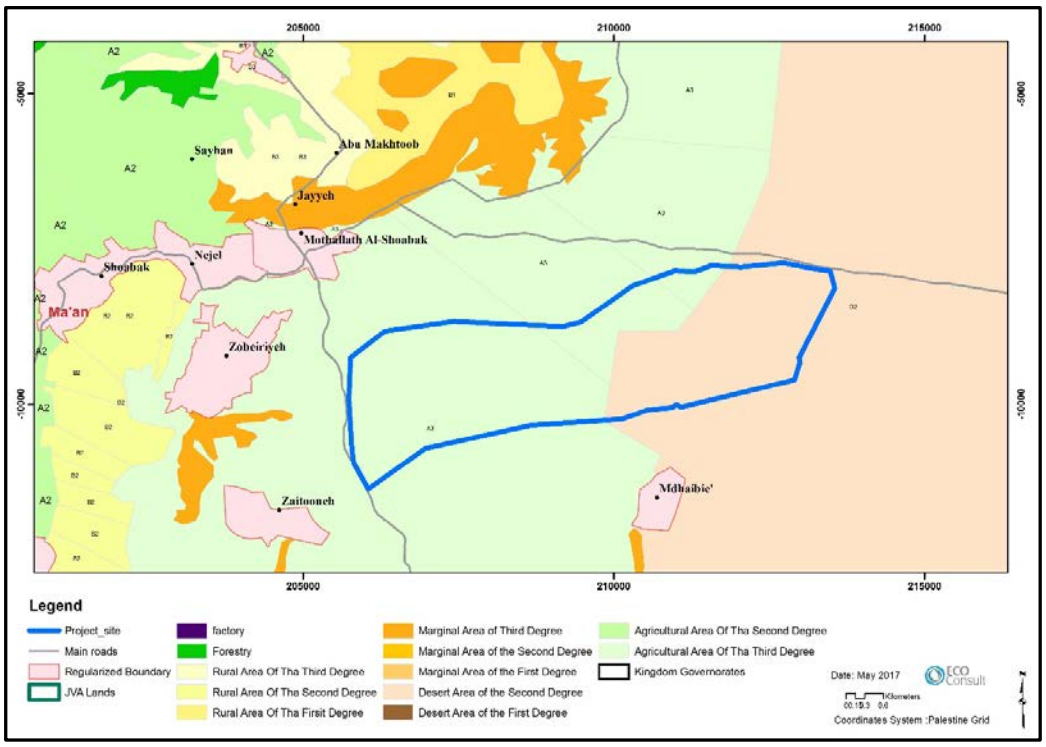

Figure 52: MoMA Land Use Master Plan of the Project Site

(ii) Areas of Critical Environmental Concern Planning by MoEnv

The project could potentially conflict with the use of current or planned nearby specially designated areas such as wilderness areas, areas of critical environmental concern, and/or special recreation management areas. The Ministry of Environment (MoEnv) has the responsibility of establishing nature reserves, national parks, and any site of special environmental significance for protection and management.

However, the MoEnv delegates such responsibilities to the Royal Society for the Conservation of Nature (RSCN). In accordance with the above, the RSCN has designated four (4) categories for areas of environmental concern as highlighted below. Those have been assigned based on detailed reviews prepared by the RSCN and which include: (i) National Network of Protected Areas in Jordan and (ii) Important Bird Areas of the Hashemite Kingdom of Jordan.

- Established Reserves: in accordance with the "National Network of Protected Areas in Jordan" the RSCN has established several reserves which have been announced as protected areas and are currently managed and operated by the RSCN;
- Proposed Reserves: areas proposed within the "National Network of Protected Areas in Jordan" as protected areas but have not been announced as reserves yet and currently are not managed or operated by the RSCN;
- Reserves Under Establishment: areas proposed within the "National Network of Protected Areas in Jordan" as protected areas and are announced as so, but are still underway to be established, operated, and managed by the RSCN; and
- Important Bird Areas (IBAs): areas proposed within "Important Bird Areas of the Hashemite Kingdom of Jordan".

Taking the above into account, the RSCN prepared a comprehensive plan that identifies the location of the reserves and IBAs discussed above. The figure below presents the closest areas in relation to the project site. As noted in the figure, there are no areas of critical environment concern within the project site or its immediate surroundings; there are no established, under establishment, proposed reserves or IBAs. A number of preservation areas exist further away from the project site with the closest delineation being around 5km away which includes the Jerba IBA, which, according to BirdLife International, is an IBA of national significance but not global significance, see Figure 52 and Table 38.

Table 38: Areas of Critical Environmental Concern by MoEnv

Classification	Description
Dana Biosphere Reserve	Located approximately 11km north of the project site, the reserve is the largest nature reserve in the country and is declared by UNESCO as a Man and Biosphere Reserve
Dana IBA	Located approximately 7km north of the project site, the IBA is acknowledged by BirdLife International as an IBA of global significance
Shobak Proposed Protected Area	Located approximately 11km west of the project site, the reserve was proposed by RSCN in 2012 but there are no plans to establish the reserve in the near future
Jerba IBA	Located approximately 5km southwest of the project site, the IBA is classified by RSCN as an IBA of national importance but is not acknowledged by BirdLife International as an IBA of global significance
Petra IBA	Located approximately 16km southwest of the project site, the IBA is acknowledged by BirdLife International as an IBA of global significance

To this extent, it can be concluded that no conflict exists between the Project site and the MoEnv/RSCN planning context. The Project site is not located within established/planned reserves or important bird areas.

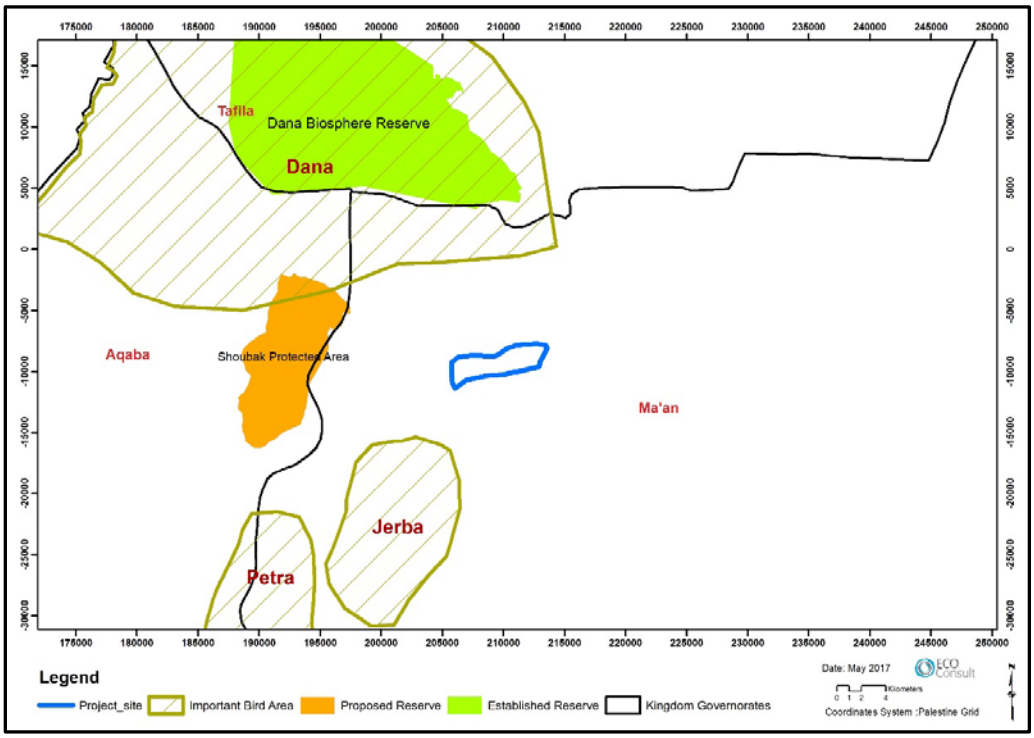

Figure 53: Areas of Critical Environmental Concern in Relation to Project Site

(iii) Grazing Reserves and Forest Area Planning by MoA

The Project might conflict with current or proposed planning policies of the Ministry of Agriculture (MoA) for the general area. The most important planning issues that must be investigated include potential conflict with grazing reserves of the MoA and forest lands.

Grazing Reserves

The MoA is entitled to planning grazing reserves in the Kingdom on rangelands. According to discussions with the Rangeland Directorate, there are currently 34 grazing reserves distributed throughout the Kingdom that cover an area of around 80, 000 Dunums. Such reserves are planned and established for sustainable grazing and prevention of overgrazing which generally reduce the usefulness, productivity, and biodiversity of the land and is one cause of desertification and erosion.

The Project site is not located within any grazing reserves. The closest grazing reserves to the project site are Al Faisaliyeh grazing reserve, which is located in close proximity to the east of the project site, while Fujeij grazing reserve is located approximately 4km north of the project site. Figure 53 below presents the location of the grazing reserves in relation to the Project site.

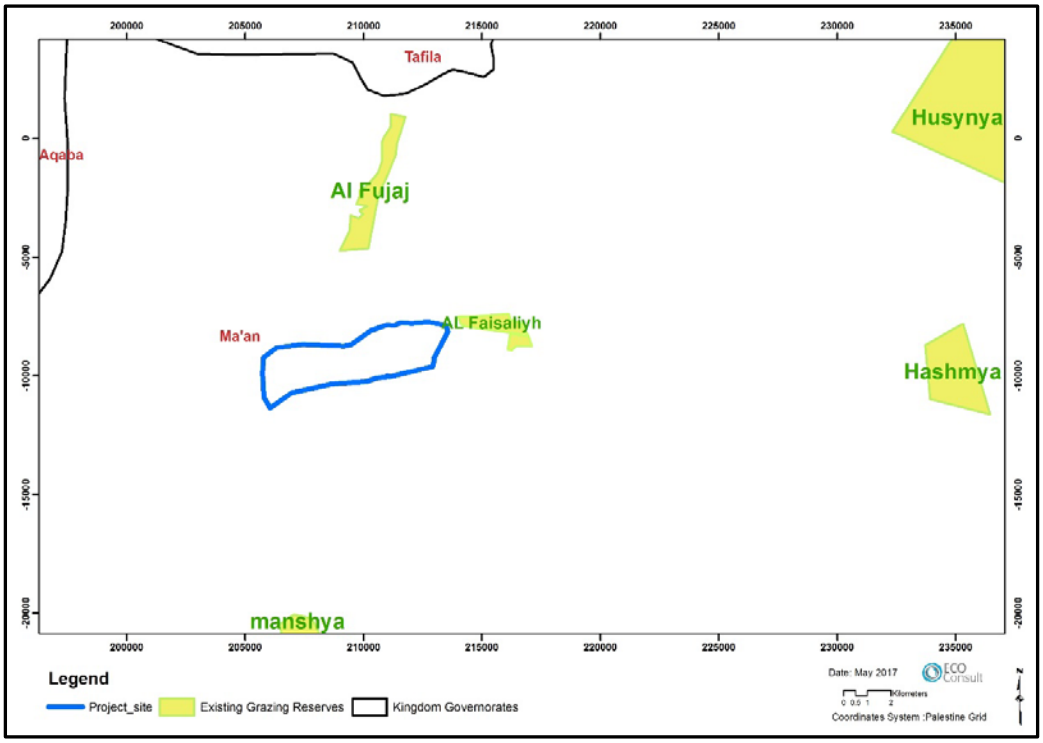

Figure 54: Grazing Reserves in Relation to Project Site

Forest Area Planning

According to the "Agriculture Law No. 13 for the year 2015" Forest Lands are lands of the State that are registered as forests and the lands of the State that are allocated for forestry purposes. The Law states that it shall be prohibited to abuse forest lands whether by erecting permanent or temporary residences, buildings or structures thereon, or digging wells or caves, or installing water, electricity or telephone lines, or opening sewage lines or canals therein, or by cultivation or ploughing, or by grazing therein, without a license.

Figure 54 below shows that there are no forest areas inside the project site. To this extent, it can be concluded that no conflict exists between the Project Site and the Ministry of Agriculture's planning context, specifically for grazing reserves and forest lands.

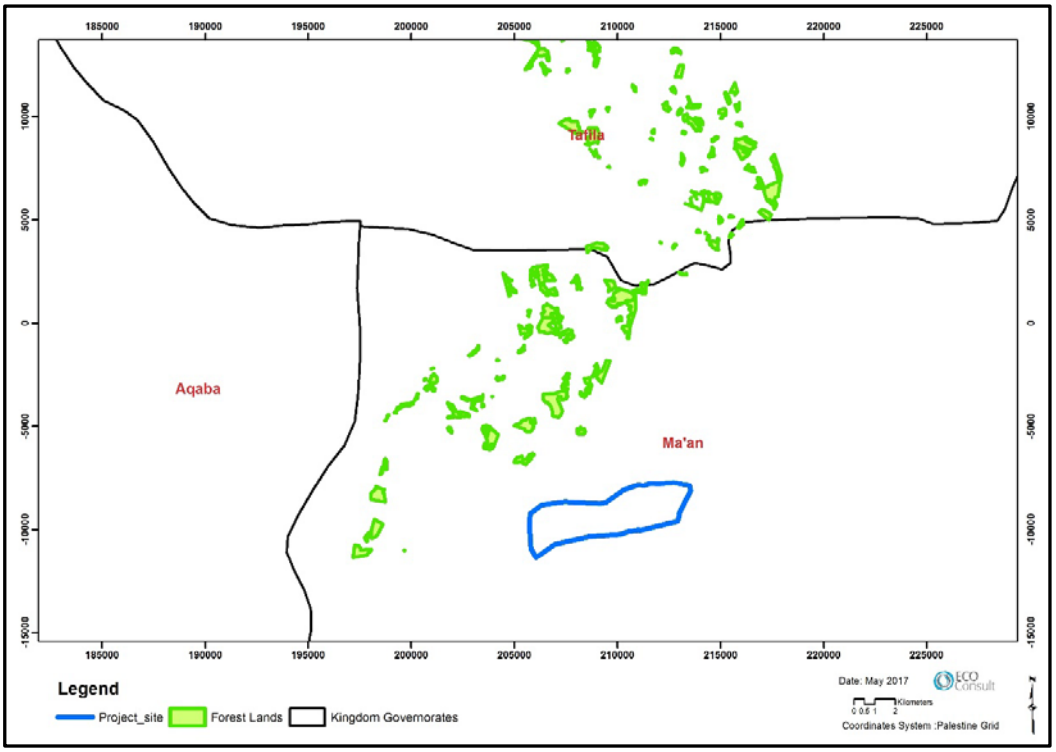

Figure 55: Forest Areas in Relation to Project Site

9.1.3 Actual Land Use

This section presents in detail the actual land use of the project site by the local community and the nomads each of which is discussed in further details below.

(i) Local Community

All project activities are going to take place on governmentally-owned lands and along public access routes that are not privately-owned, see Figure 56.

Summarized below are the main land use patterns for the Project area in general. This has been based on onsite consultations with local communities as well as a local community consultation session (as discussed in detail in Section 6.5.2). Based on such consultations, it was understood that the activities detailed below are restricted to the local community members of the nearby villages.

- *Grazing Activities (March – May):* throughout this season grazing activities take place within the area including the project site. This mainly involves day trips to the area where afterwards the local communities return to their villages. Generally, anyone is allowed to enter the lands for grazing except areas that are seasonally planted. Livestock raising activities are generally undertaken by the local communities for self-sufficiency purposes and less so as a source of income. The project site and its surroundings are not considered of prime value for livestock owners since they have other areas to the west of the project that are considered of higher value for grazing. This is mainly due to the fact that the project site is generally arid and has a relatively low vegetation cover in comparison to richer areas

to the west. During this period of the year, and depending on rainfall amounts, fields that are planted with barley during autumn could be open for grazing for livestock based on predefined arrangements between the members of the local community. For instance, if the rainfall was poor and the barley growth was weak, grazing could be allowed in these fields. In seasons of higher rainfall, barley could be harvested in order to be used later in the year during the dry season of summer (June-August).

- *Harvesting Activities (June – August):* Since there are no farms for perennial crops in the project site, this season is limited to harvesting barley. As mentioned earlier, this highly depends on the rainfall and the availability of options. During poor rainfall years, harvesting of barley does not take place and livestock is allowed to graze directly from the fields, as was the case this year. Harvesting could only take place if the rainfall was good during winter, which would produce good yield that could be harvested to be used during the dry seasons.

- *Planting Season (September – November):* During this period of the year, the area is completely empty from any land users as most of livestock owners would be located east to find warmer areas to protect their livestock from cold wind and rain. Similar to the other seasons, no one inhabits the area in general and livestock owners would depend more on fodder to feed their livestock throughout this period. Some livestock owners would plant barley and wheat for livestock during this period, which would afterwards be either harvested or grazed as mentioned earlier.
- *Dormant Season (December – February)*: The area becomes completely empty of any land users during this period. Most of the livestock owners would keep their livestock indoors and would depend on fodder.

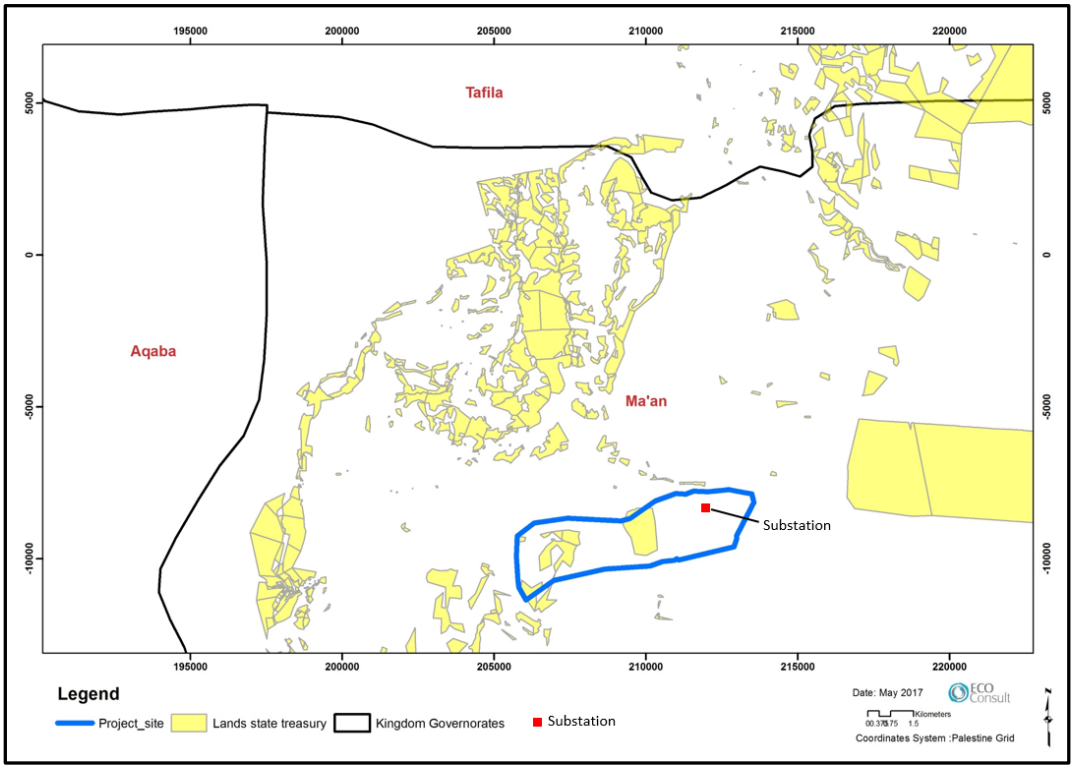

Figure 56: Leased Land Parcels within Project Area

(ii) Nomads

Nomadic groups move around on a seasonal basis. They move to the project site and its surroundings during spring/summer (between May and September), depending on the availability of rangeland in the area itself and other areas in the country. Very limited numbers of nomads inhabit the project site and its surroundings on seasonal basis, see Figure 56. This is mainly due to the fact that the area is too open and windy and the landscape does not provide enough refuge from any extreme weather conditions. Additionally, and as mentioned earlier, the project site has a relatively poor vegetation cover which results in considering the area as a stopover station rather than a seasonal residential area for nomads. By the end of September, as the weather becomes colder, they move back to warmer areas, such as Wadi Araba to the west or Al-Jafr to the east.

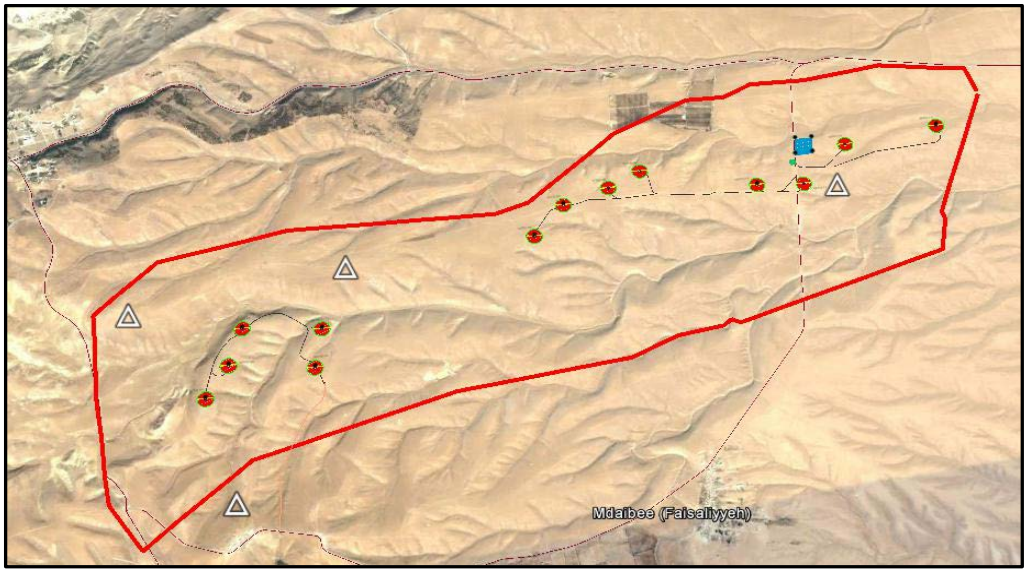

Figure 57: Location of nomad Bedouin tents during the spring of 2017 (ECO Consult, 2017)

9.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the project activities on the formal land use and actual land use. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

Given that the impacts from the Project on land use are similar in nature throughout the various project phases, those have been discussed collectively throughout this section.

9.2.1 Impacts on Formal Land Use during the Planning and Construction Phase

This section identifies and assesses the anticipated impacts from the Project activities on the formal land use. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

As discussed earlier the Project site does not conflict with any of the relevant governmental entities' formal planning context and which includes the following:

- MOMA: the Project site does not conflict with MOMA's land use plan, in fact the designated land use for the area allows for the development of such a Project.
- MoEnv/RSCN: the Project site does not conflict with the MoEnv's/RSCN's planning context as it is not located within established/planned reserves or important bird areas.
- MoA: The Project site does not conflict with the MoA's planning context, specifically for gazing reserves and forest lands.

To this extent, there are no anticipated impacts from the Project on the formal land use plans set for the area.

9.2.2 Impacts on Actual Land Use during the Construction and Operation Phase

Besides potential impacts on the formal land use context set for the area, there are other potential impacts on the actual (or informal) land use of the Project site. Inappropriate selection of a Project site could entail certain impacts on the local community and nomads given that such lands could provide certain value such as agricultural activities, grazing, etc. Taking all of the above into account, the potential impacts on the formal land use , on the potentially affected communities, local community grazers and farmers, as well as the nomads, are discussed in detail below.

- Local Community Grazers: grazing activities are not expected to be affected during construction and operation due to the following: (i) Project footprint areas are very small and have been calculated to be less than 1% of the entire Project site boundary area; (ii) There is no key habitat for grazing that is restricted within the leased lands or the Project site only. The habitat utilized for livestock grazing in the Project area is widespread and can be found extensively throughout the region.
- Local Community Farmers: this includes local community members whom harvest the land. Such activities are unlikely to be affected during construction and operation. This is due to the fact that the Project footprint areas are very small and have been calculated to be less than 1% of the entire Project site boundary area.
- Nomadic groups are unlikely to be affected by the construction and operation activities of the Project, whether it is in terms of settlement or the agricultural and grazing activities that are undertaken during their settlement in the area. This is due to the following: (i) Project footprint areas are very small and have been calculated to be less than 1% of the entire Project site boundary area; (ii) Generally nomadic groups do not settle in the exact specific area each year. Therefore, even if some of the Project components (which as discussed earlier are of a minimal footprint) are within an area in which a nomad is currently settling, in later years (during construction and operation) nomads could simply settle in other nearby areas.

Given all of the above, the potential impacts on actual land use would of a short-term duration during the construction phase and of long term duration during the operation phase. Given that there are grazing and agricultural activities taking place by the local community and nomadic settlers in the area, the receiving environment is considered of medium sensitivity. However, the impacts will be of a negative nature, and low magnitude given the small limited footprint of land use that will be affected from the Project development. Given all of the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the Developer and EPC Contractor during the construction phase and the Project Operator during the operational phase unless stated otherwise:

Land Users – Agricultural Activities

- Prior to construction, consultations will be undertaken with local community land users to develop a baseline in terms of agricultural activities undertaken on leased government lands by the users. The

mapping exercise should aim to identify who undertakes agricultural activities in each leased land, their number, patterns, and type of agricultural crops. The Developer in coordination with the EPC Contractor will assign in detail the exact areas within the leased lands that are expected to be affected by the Project construction and operation – this will include the areas for the project footprint (to include but limited to the turbines, foundations, substation, roads, cables, etc.) and any additional areas required for construction activities such as areas for movement of vehicles and machinery, laydown areas, etc. Developer and EPC Contractor will ensure that such assigned areas are reduced to the greatest extent possible. It is recommended that the Developer allows land users to practice their activities within leased lands outside of construction and operation areas.

- Although highly unlikely, but should any of the agriculture users require assistance in allocating additional lands to undertake agriculture activities, the Developer will help such users to the greatest extent possible through coordination with other land owners in the area and/or on other available public lands.
- Prior to commencement of construction activities, the Developer will disclose to the local communities the information provided below. This will be undertaken through focus group discussions and information sheets in Arabic language at key local platforms where appropriate. This will include (i) the baseline mapping exercise for agricultural activities to verify its outcomes; (ii) announce construction and operation areas and emphasize that agriculture and/or grazing activities cannot take place in such assigned construction and operation areas; (iii) provide construction schedule and duration for which such construction activities will take place; (iv) emphasize that grazing and/or agriculture activities may take place outside of construction and operation areas at all times; (v) provide details on the relocation assistance if required by any agricultural user; and (vi) provide details on the grievance mechanism.

Nomads

- If required (although unlikely) the Developer should provide assistance to nomadic groups in assigning suitable areas outside of construction and operation areas for settlement through coordination with other land owners in the area and/or on other public lands.
- During the period in which nomads begin to settle in the area (April, May and June), Developer will undertake regular site visits to meet with nomadic groups whom arrive onsite. The objective will be to: (i) Announce construction and operation areas and emphasize that settlements as well as agriculture and/or grazing activities cannot take place in such assigned construction and operation areas; (ii) Provide construction schedule and duration for which such construction activities will take place; (iii)Emphasize that settlements as well as grazing and/or agriculture activities may take place outside of construction and operation areas at all times; (iv) Provide details on the relocation assistance if required by any agricultural user; and (v) Provide details on the grievance mechanism.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements which are to be implemented by the Developer and EPC Contractor accordingly.

Land Users – Agricultural Activities

- Produce a comprehensive map which identifies who undertakes agriculture activities, pattern and type for each land parcel and which also assigns construction and operation areas
- If applicable, documentation of relocation assistance with photographs as appropriate to include number of farmers, identified relocated area, etc.
- Prepare disclosure report which includes information on focus group (venue, list of attendees, minutes of meeting, summary of outcomes) and areas where information sheets were posted with photographs as appropriate

Nomads

- Documentation of relocation assistance with photographs as appropriate to include number of nomads, identified relocated area, etc.
- Prepare disclosure report which includes names of nomads met, minutes of meeting, summary of outcomes.

10. GEOLOGY AND HYDROLOGY (SOIL & GROUNDWATER)

This chapter presents the baseline assessment of the Project site in relation geology and hydrology as well as an assessment of potential impacts during the various Project phases. For each impact, a set of mitigation measures and monitoring requirements were identified.

10.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of baseline conditions in relation to geology and hydrology and presents the outcomes and results of the assessment.

10.1.1 Baseline Assessment Methodology

Assessment of baseline conditions in relation to geology and hydrology was based on collection of secondary data from the relevant governmental entities – this mainly includes the Ministry of Water and Irrigation (MWI), Water Authority of Jordan (WAJ), Natural Resources Authority (NRA) and Department of Meteorology (DoM) for the relevant parameters to include climatic data, precipitation, geological and hydrogeological settings, etc.

It should be highlighted that the geology, hydrology (soul and groundwater) assessments were carried out for an older version of the project boundaries, which is wider than the current project boundaries, see Figure 57.

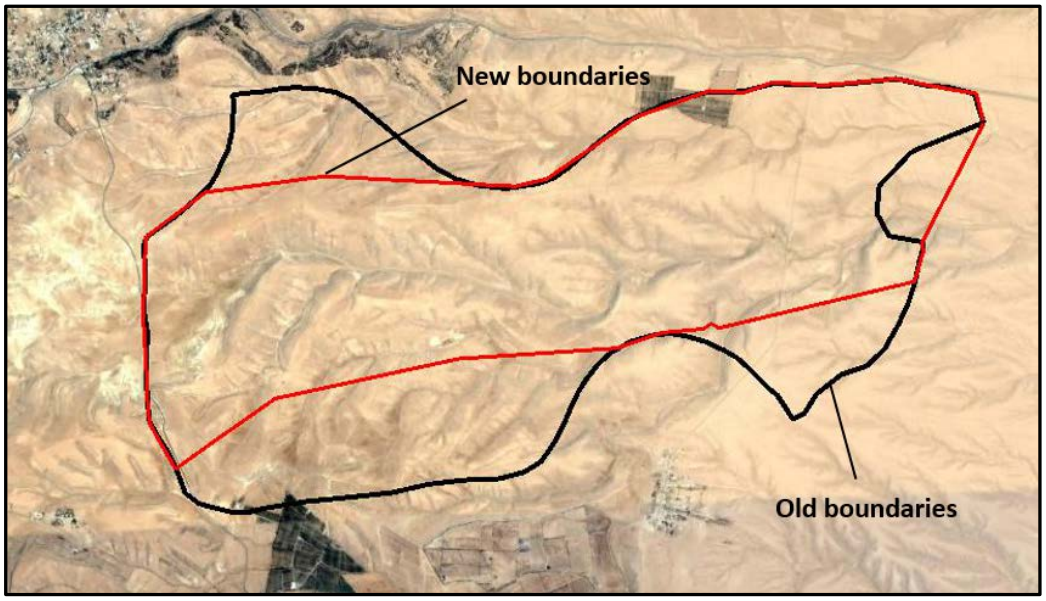

Figure 58: Older boundaries covered by the geology and hydrology assessment (black) and the final project boundaries (red)

10.1.2 Results

Presented below are the outcomes and results in details for geology, hydrology, and hydrogeology.

(i) Geology

The figure below presents the main geological formation in the area. As noted in Figure 58 below, the project site is mainly located with Umm Rijam Formation which consists of limestone (partly phosphatic),

chalky limestone chalk with beds and nodules of brown to black chert. The thickness of this formation is around 40 meters and it outcrops in the south western parts.

In addition, other parts of the site consist of the Fluviatill and Lacustrine Gravels from the quaternary geologic age. This unit is composed due to weathering activities and is dominant along wadi system in the form of unconsolidated material generated from the rocks in the area.

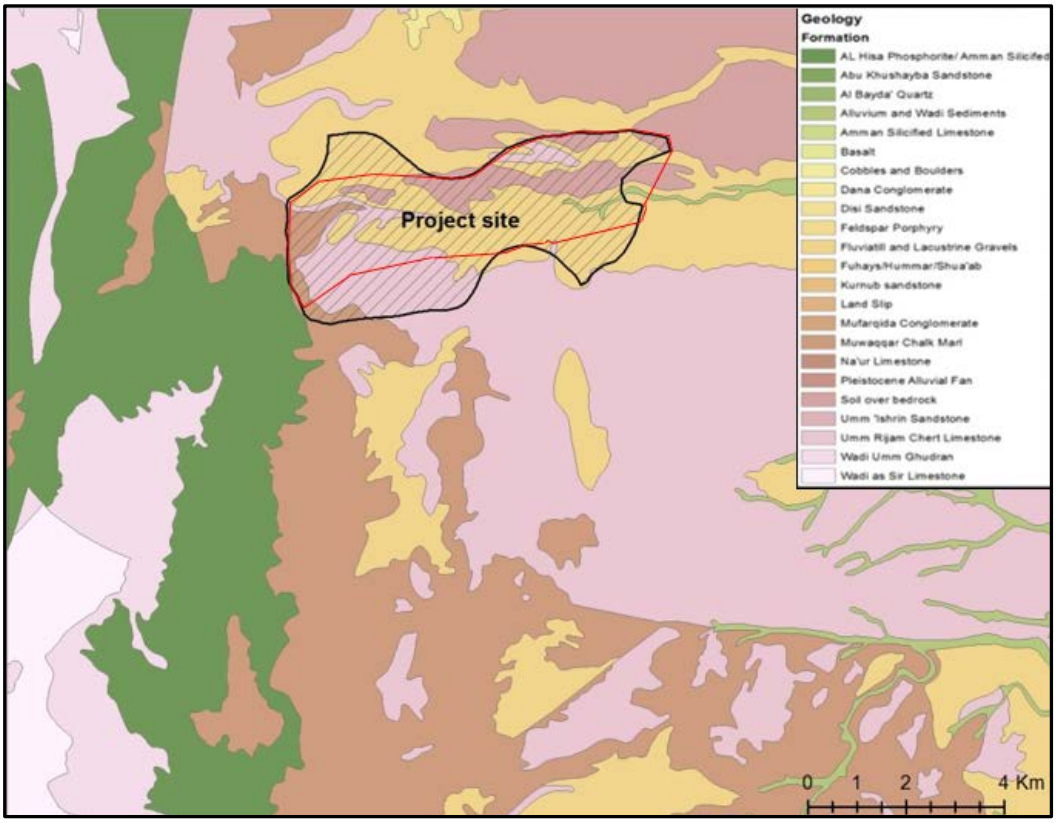

Figure 59: Geological Formations of the Area

(ii) Hydrology

The study area is located within the Jafr surface water basin as noted in Figure 59 below which has a total area of 11,800 km². Average rainfall over the Jafr basin is less than 50 mm/year, the basin is almost flat over big parts and runoff coefficient is very low and the distribution of rainy events as small event does not trigger runoff in most of the cases. The total discharge of the basin is around 15 MCM/year, of which 10 MCM/year flow as floods into the Jafr depression, where they either evaporate or infiltrate into the ground.

Figure 60 that follows also presents the catchment area within which the Project is located (as part of the Jafr Basin). The catchment has an area of around 100km^2 and is considered one of the highest areas of the basin where rainfall is higher and topography is steeper. As noted below, the catchment area includes several interconnected wadi systems. As noted in figure below, a number of wadi systems run within the Project site.

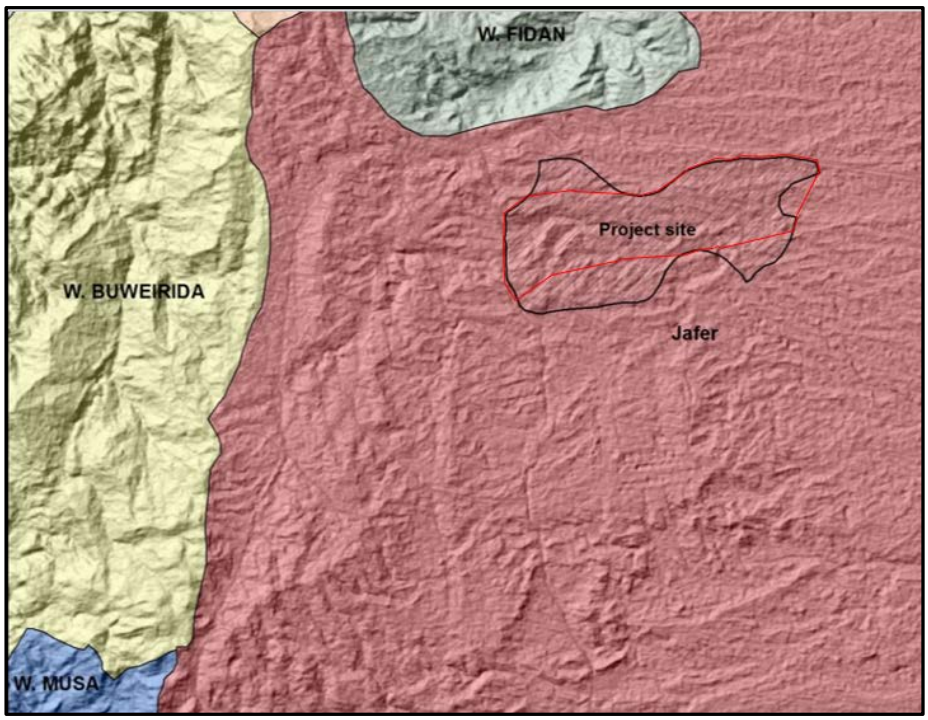

Figure 60: Surface Water Basins of the area

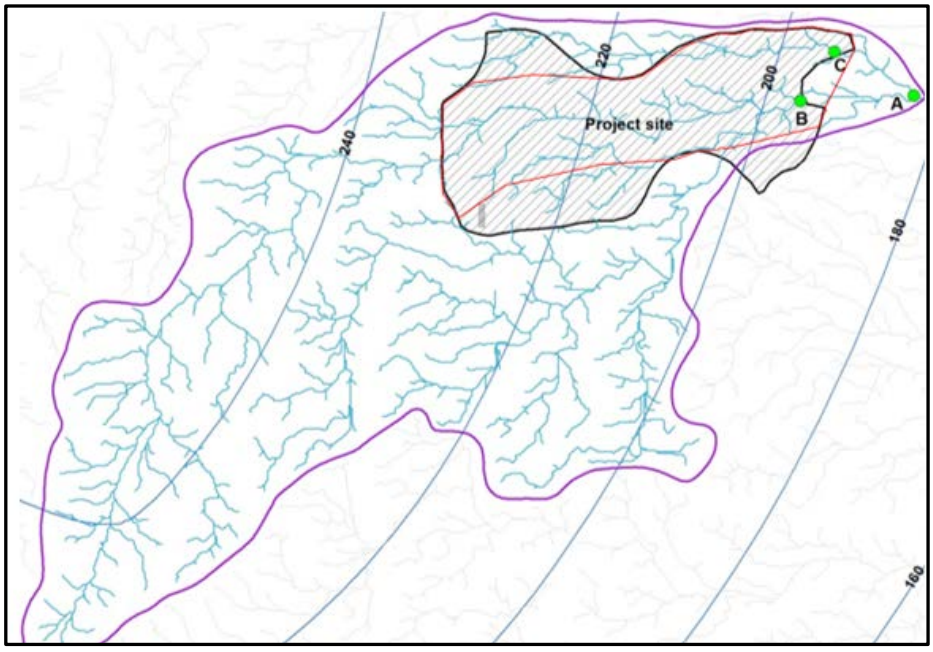

Figure 61: Catchment area for the Project site

(iii) *Hydrogeology*

The Project site is located within the Jafr groundwater basin, which occupies an area of 12,500 km^2 with a boundary similar to the surface water basin discussed earlier. The groundwater flow of the basin is

triggered by high rainfalls on the mountainous areas of Ma'an and Shobak where groundwater flows from high rainfall and recharge areas to the central parts of the basin. According to MWI records there are 2,100 groundwater wells in the basin (but none are located within the Project site) pumping more than 32 MCM/year for both domestic and agricultural supply. The main productive unit in the basin is the upper limestone aquifer which is considered to be moderate to relatively high salinity. The safe yield of the aquifer as calculated by MWI was 25 MCM/year giving a deficit of 7 MCM/year.

10.2 Assessment of Potential Impacts

This section identifies the anticipated impacts on/from geology and hydrology (soil and groundwater) from/on the Project activities during the planning and construction phase as well as the operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements have been identified.

10.2.1 Potential Impacts from Local Flood Hazards during the Planning and Construction Phase

The most important aspect to geology, hydrology and hydrogeology is that of flood risks within the Project site. As discussed earlier several wadi systems run within the Project area and therefore, there is a potential risk of local flood hazard within the site during rainy season and especially during flash flood events. Such risks must be taken into consideration throughout the planning phase of the Project as they could inflict damage to the project and its various components.

To this extent, ECO Consult has undertaken a preliminary flood risk assessment to investigate such risks. The flood risk assessment was based on the study of the catchment area's rainfall, runoff and flood flow. Results are as discussed below.

a. Rainfall

The rainfall in the area was calculated based on data from five climatic stations found within the Project area – this includes DA0001, DA0002, DA0003, DA0004 and DA0005 (Figure 61). These stations were used to obtain the needed data to generate precipitation contours around the Project site. Four stations are located west of the Project site (DA0001, DA0002, DA0003, DA0004) while the fifth is located to the east (Sation DA0005 located 18 km east of the project site with an average rainfall of 95 mm/year and is the closest station to the Project site to the east).

The spatial distribution of rainfall in the area was modelled based on the data from these rainfall stations. The daily rainfall was converted into annual rates. Figure 61 below represents the spatial distribution of annual rainfall in the area. As noted in the figure below, rainfall starts at 120 mm/year in the southeast, the precipitation rates increase towards the northwest to reach about 240 mm/year. The Project site is located in an area where precipitation ranges from 200-230 mm/year.

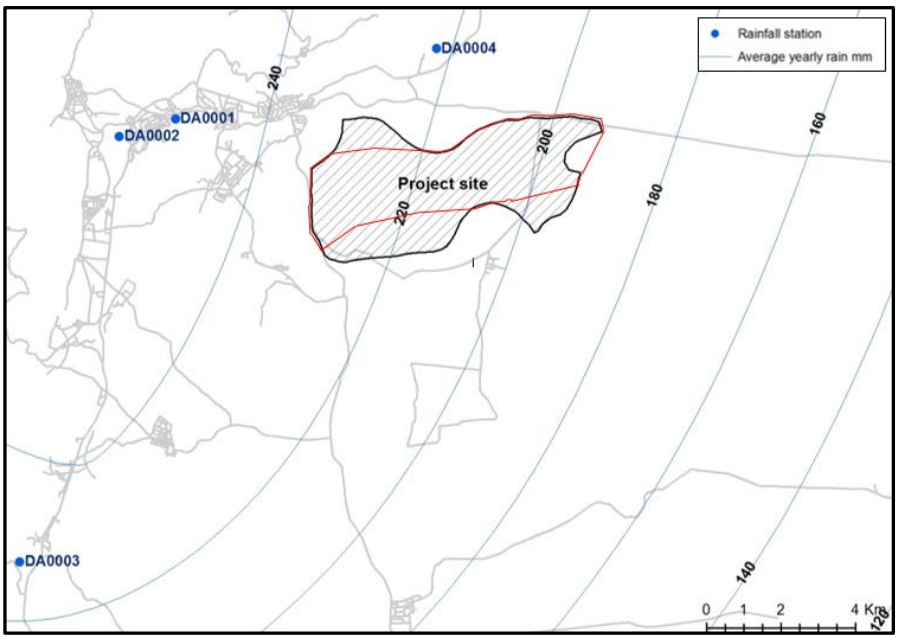

Figure 62: Rainfall Stations around the project site

a. Runoff and Flood Flow

The available information was analysed to study the characteristics of rainfall runoff and derive the flood hydrograph of the area with a 50 year return period. The estimation of the flow was calculated using the United States Soil Conservation Service method (SCS) or the Curve Number method (CN) for the available rainfall data.

The methodology of this approach mainly includes calculating the time of flow from the farthest point on the catchments to the outlet [time of concentration (Tc)], and the time of rise of the unit hydrograph [time to peak (Tp)]. Then, using the values of the synthetic unit hydrograph (in which the discharge is expressed by the ratio of discharge to peak discharge (Q/Qp) and the ratio of time to the time of rise of the unit hydrograph T/Tp), the time lag of unit hydrograph is recalculated along with the peak discharge (Q). Furthermore, the obtained values of new unit hydrograph must be corrected to ensure mass balance of the unit depth of rainfall - which must equal one inch.

Moreover, the effective rainfall for a 50 year return period is calculated from Intensity Duration Curves (IDF) in order to derive the appropriate flood hydrographs for the same periods, depending on the hourly peak discharges values of the corrected unit hydrograph. The frequency floods were also determined by using the storm rainfalls of 50 years return period in the SCS-curvilinear synthetic unit hydrograph method.

The Curve Number (CN) method is used to estimate the hydrologic parameters of the water cycle in the catchments area. This approach is called the Water Budget Method. This method can be estimated by determining the maximum moisture content of the soil (the potential abstraction). The value of the potential abstraction depends on the value of the selected curve number, then, the potential abstraction leads to calculate the value of initial abstraction which is defined as the rainfall value prior to the beginning of direct runoff, to be used in the formula of estimating the discharge flows for each rainfall storm.

The hydrologic characteristics of the drainage area such as; the area of the basin (A), hydraulic length (L) and the elevation difference (H) between the highest point of the main stream and the outlet are calculated from the topographic maps related to the catchment. The calculation of the unit hydrograph (UH) and the derivation of the flood hydrographs of 50 years return period for the catchment were performed and are presented in the table and figure below.

As noted in Figure 62 and Table 39 below the maximum flood flow for the main wadi system outlet (point A in Figure 63) was calculated at 2.4, 4.2 and 5.7 m3/s for average annual flood, 20 and 50 years return period.

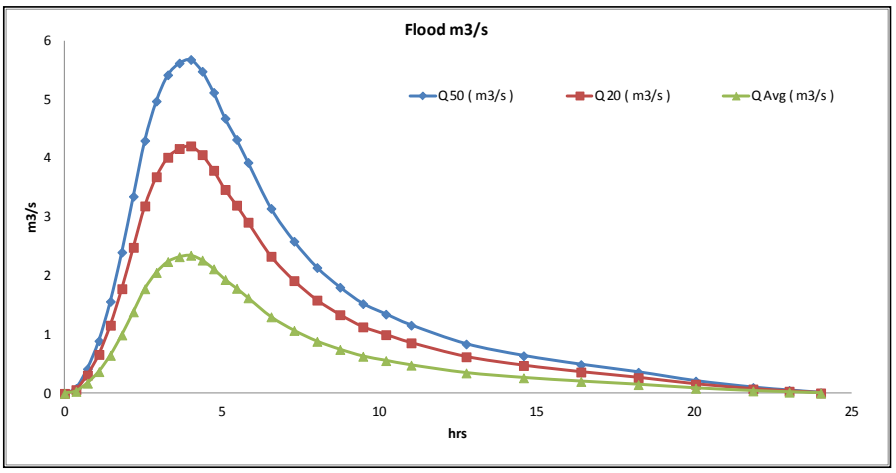

Figure 63: Calculated Unit Hydrograph

Table 39: Calculated Tc, Tp and Qp values

Tc (hours)	Tp (hours)	Qp (m3/s)	Qp20 years (m3/s)	Qp50 years (m3/s)
4.018	0.74	2.35	4.21	5.68

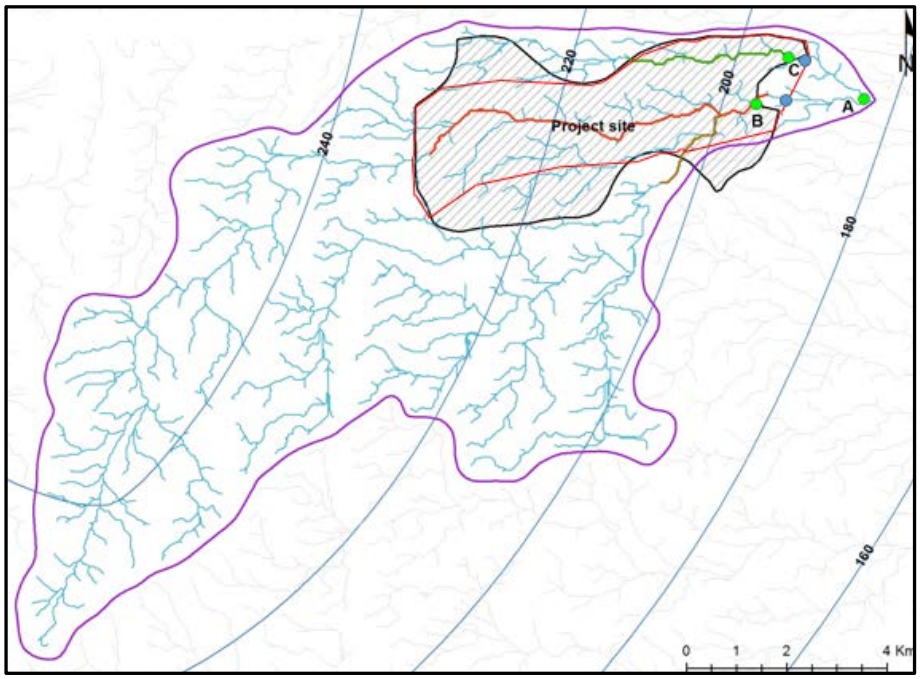

Figure 64: Catchment Area and Drainage System Discharging through the Project Area

Taking the above into account, the preliminary flood risk assessment concludes the following:

- The maximum calculated flood for point A shown on the map (Figure 6) was 2.35, 4.21 and 5.68 m^3/s for average annual flood, 20 years and 50 years.
- The wadi section at point B is expected to discharge more than 95% of the calculated flood. Point B receives flood water from two main wadis marked with red and brown and they are expected to have similar flows (Figure 6). Buffer distance of 20 m is required from wadi B (red and brown).
- Points C represent a low flood risk area with limited base flow less than 5% of the total flood along the wadi section marked with green (Figure 6). Buffer distance of 10 m is needed for wadi C.

Such buffer distance requirements can be easily taken into account as part of the detailed design to be prepared. Taking the above into account, it is evident that there is flood risks within the Project site. Should such risks not be considered, they would result in impacts which are of long-term duration throughout the operation phase of the Project. For the duration of operation, such flood risks will be of a negative nature and of medium magnitude. However, this is considered of high sensitivity given that it could entail damage to the Project. Given all of the above, such an impact is considered to be of moderate significance.

Mitigation Measures

The following identifies the mitigation measures that must be taken into account by the EPC Contractor at a later stage:

- It is recommended that the EPC Contractor, as part of the detailed design prepared for the Project, avoid sitting any of the Project components within the buffer distances specified from the wadi systems to eliminate any risks for flood. Such buffer distance requirements can be easily taken into account.
- Should the Project require sitting any of its infrastructure elements (such as roads) within the wadi system then a detailed hydrological study must be undertaken to identify and determine the required engineering structures to be considered as part of the detailed design for such infrastructure elements (e.g. culverts). It is recommended that the engineering design consider the 50 years return period which was calculated at $5.7m^3/s$.

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the planning phase and which include:

- Review of final detailed design to ensure all flood risk mitigations are considered (e.g. buffer zone from Wadi systems, culvert designs, etc.)

10.2.2 Potential Impacts from Improper Management of Waste Streams during Construction and Operation

Given the generic nature of the impacts for both phases of the Project (construction and operation) those have been identified collectively throughout this section. Generally, this includes potential impacts from improper housekeeping practices (e.g. improper management of waste streams, improper storage of construction material and of hazardous material, etc.).

Improper housekeeping practices during construction and operation (such as illegal disposal of waste to land) could contaminate and pollute soil which in turn could pollute groundwater resources. This could also indirectly affect flora/fauna and the general health and safety of workers (from being exposed to such waste streams). Generally, such impacts can be adequately controlled through the implementation of

general best practice housekeeping measures as highlighted throughout this section, and which are expected to be implemented by the EPC Contractor throughout construction phase and Project Operator during the operation phase.

The potential impacts from improper management of waste streams could be of a long-term duration throughout the construction and operation phase. Such impacts are negative in nature, and are considered of low magnitude they are generally controlled through the implementation of general best practice housekeeping measures. The receiving environment is considered of medium sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Following the implementation of the mitigation measures highlighted throughout this Section, the residual significance can be reduced to not significant.

(i) Solid Waste Generation

Solid waste is expected to be generated from construction and operational activities. Solid waste generated will likely include construction waste (such as debris) and municipal solid waste (during construction and operation such as cardboard, plastic, food waste, etc.). Municipal and construction waste generated will likely be collected and stored onsite and then disposed to the closest municipal approved area for disposal (Shobak Transfer Station).

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase unless stated otherwise:

- Coordinate with New Shobak Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved disposal area (Shobak transfer station);
- Prohibit fly-dumping of any solid waste to the land;
- Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste";
- EPC Contractor only - during construction, distribute a sufficient number of properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. Where possible, the EPC Contractor must seek ways to reduce construction waste by reusing materials (for example through recycling of concrete for road base coarse);
- Implement proper housekeeping practices on the construction site at all times; and
- Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase unless stated otherwise:

- Inspection of waste management practices onsite;
- Review of records and manifests for volume of waste generated to ensure consistency; and
- Regular environmental reporting on implementation of the waste management practices onsite.

(ii) Wastewater Generation

Wastewater is mainly expected to include black water (sewage water from toilets and sanitation facilities), as well as grey water (from sinks, showers, etc.) generated from workers during the construction and operation phase. Wastewater quantities are expected to be minimal. It is expected that wastewater will be collected and stored in fully contained septic tanks and then collected and transported by transportation tankers to be disposed at either Shobak Waste Water Treatment Plant (WWTP) or Mansoorah WWTP.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities, to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise:

- Coordinate with Ma'an Water Directorate to hire a private contractor for the collection of wastewater from the site to Shobak or Mansoorah WWTP;
- Prohibit illegal disposal of wastewater to the land;
- Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas;
- EPC Contractor only - ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil; and
- Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise:

- Inspection of wastewater management practices onsite;
- Review of records and manifests for volume of wastewater generated to ensure consistency; and
- Regular environmental reporting on implementation of the wastewater management practices discussed above.

(iii) Hazardous Waste Generation

Hazardous waste is expected to be generated throughout both the construction and operation phase and this could include simple materials such as consumed oil, chemicals, paint cans, etc. Given the nature of the Project, hazardous waste quantities are expected to be relatively low. Nevertheless, hazardous waste generated will likely be collected and stored onsite and then disposed at the 'Swaqa Hazardous Waste Treatment Facility' which is managed by the MoEnv.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the EPC Contractor during the construction phase the Project Operator during the operational phase, unless stated otherwise.

- Coordinate with the MoEnv and hire a private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility;
- Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv;

- Prohibit illegal disposal of hazardous waste to the land;
- Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing; and
- Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the Swaqa Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise:

- Inspection of hazardous waste management practices onsite;
- Review of records and manifests for volume of hazardous waste generated to ensure consistency; and
- Regular environmental reporting on implementation of the hazardous waste management practices onsite.

(iv) Hazardous Material

The nature of construction and operational activities entail the use of various hazardous materials such as oil, chemicals, and fuel for the various equipment and machinery. Improper management of hazardous material entails a risk of leakage into the surrounding environment either from storage areas or throughout the use of equipment and machinery.

Mitigation Measures

The following identifies the mitigation measures to be applied by all involved entities to include the EPC Contractor during the construction phase the Project Operator during the operational phase, unless stated otherwise.

- Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another. The provisions of the Jordanian Standard (JS) 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials must be adhered to;
- Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must present at all times. Spilled material should be tracked and accounted for;
- Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.);
- Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage (such as refuelling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material;
- Ensure that a minimum of 1,000 litres of general purpose spill absorbent is available at hazardous material storage facility. Appropriate absorbents include elite, clay, peat and other products manufactured for this purpose; and
- If spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by all involved entities to include the EPC Contractor during the construction phase and the Project Operator during the operational phase, unless stated otherwise.

- Inspection for storage of hazardous materials to include inspections for potential spillages or leakages; and
- Report any spills and the measures taken to minimize the impact and prevent from occurring again.

11. BIODIVERSITY

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This Chapter first provides an assessment of baseline conditions within the Project site and its surroundings in relation to biodiversity and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

It is important to note that biodiversity assessed in this Chapter excludes birds (avi-fauna) and bats, which are discussed separately in "Chapter 12" and "Chapter 13" respectively.

11.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to biodiversity and presents the outcomes and results.

11.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on a literature review and a field survey, each of which is discussed in detail below.

(i) Literature Review

This was based on previous studies, data, surveys, and records available in published scientific papers, books, and journals on flora and fauna species recorded within the study region in general.

(ii) Field Survey

A field survey was undertaken at the Project site during the spring of 2017, since the season is the best time for flora and fauna. The biodiversity of the site is considered to be the highest during this period and thus would provide the best representation of the site. The field survey mainly included the following methods:

- Field observations: the site was examined carefully for the presence of active animals, animal signs and tracts, active burrows, remains or any other vital signs that indicate the activity of animals. In addition, the site was surveyed for occurring plant species which were noted and recorded to include number of species, coverage interception per species, etc.;
- Trapping: Sherman rodent traps were used to trap small mammals. The distribution of the traps was opportunistic and were placed in areas where a high activity for small mammals was either observed or predicted.
- Line transects: transects in many areas of the project site of over 100m long were undertaken for the detailed assessment of flora and fauna species. Observed species were recorded and photographed as possible; and
- Interviews with local people: local people of the area were interviewed and asked questions regarding well known fauna species that are likely to be present within the site. A book with illustrations and images of fauna species were shown throughout the process in order to accurately confirm their presence.

(iii) Fauna & Flora Species' status

Floral species recorded onsite generally had no international conservation status as they were not assessed by the International Union for the Conservation of Nature (IUCN). Therefore, the relevant reference in Jordan is the National Red List of Plants of Jordan Vol. 1 (Tafiour *et al*, 2014), which was produced according the to the IUCN regional criteria for threatened species.

The fauna species status was assigned based on their conservation status in the IUCN Red List of Threatened Species (IUCN, 2016) and also based on the regional assessment of threatened species for the Mediterranean region (IUCN, 2016). In Jordan, currently there are no official assigned conservation status for faunal species (to include mammals, reptiles and amphibians).

11.1.2 Results

In accordance with the methodology discussed above, the results below discuss the findings and outcomes for flora and fauna based on the literature review and field survey.

(i) Flora

According to the biogeographical map of Jordan (Albert et al., 2003), the project site is located in the Mediterranean biogeographical region, see Figure 64.

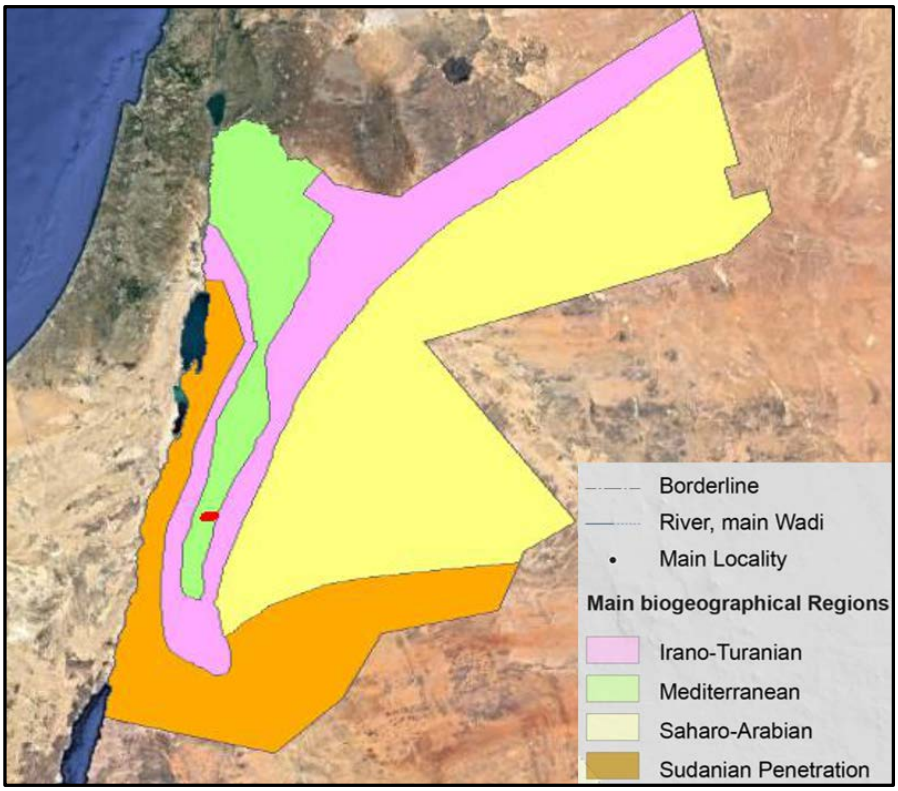

Figure 65: Biogeographical Regions in the Project Site (Albert et al., 2003).

According to Elsawi (1996), the Mediterranean Biogeographical region is characterized by having the highest rainfall in the country, which ranges from 400-600mm/year. It is also known for having the most fertile soil, the highest altitude the least summer temperature and the highest vegetation cover. The region includes almost all mountain ranges in the country along with their directly adjacent plains to the east.

According to vegetation classification types proposed by Albert et al. (2005), the project site is located in the Artemisia herba-alba Steppe vegetation type. As the name implies, this vegetation type is dominated by the perennial species *Artemisia herba-alba*, which is a dwarf shrub species that is most dominant along the eastern plains of the southern highlands of the country. Most importantly, the vegetation type is devoid of any arboreal species and therefore it represents one of the Mediterranean non-forest vegetation types in the country, see Figure 65.

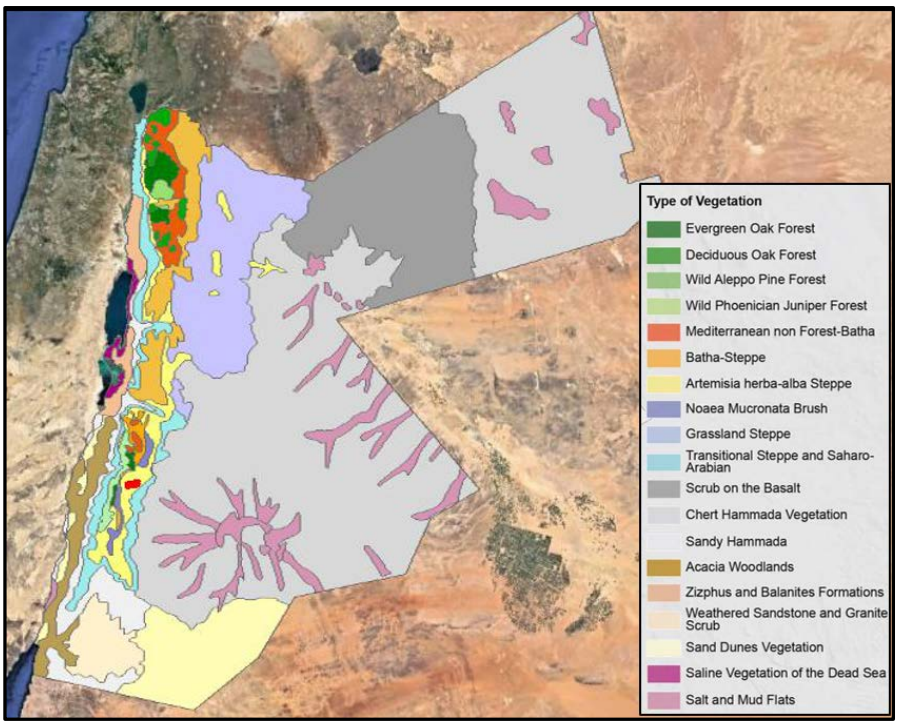

Figure 66: Vegetation type in the project Site (Albert et al., 2003).

Typically, in areas such as the project site, the land is composed of a mosaic of natural vegetation, mainly dominated by shrub vegetation, and transformed agricultural lands. These agricultural lands are seasonally planted by wheat and barley which can be used as fodder for livestock. The coverage of such agricultural lands varies from, year to year and from season to season, depending on the local meteorological conditions and most importantly rainfall.

A total of 71 plant species were recorded on the project site, see Table 40. According to the National Red List of Plants Vol. 1 (Taifour et al, 2014), 58 species have a conservation status on the national level, based on the IUCN Regional Criteria of Threatened Species. 57 of the species are evaluated as Least Concern while one species is evaluated as threatened (Vulnerable). The remaining 13 species have not yet been evaluated on the national level, see Table 40. The nationally threatened species is Cousinia moabitica, which is a species that is restricted to the southern parts of Jordan, see Figure 66. Although it has a relatively limited distribution and its main threat is intensive uncontrolled grazing, the species is protected in several nature reserves in the country including Dana Biosphere Reserve and Mujib Biosphere Reserve.

Figure 67: *Cousinia moabitica*, a nationally threatened species that was recorded in the main wadi by the western part of the project site.

Table 40: Floral Species within the Site

Family	Species	Status in the National Red List of Jordan
Boraginaceae	*Heliotropium rotundifolium*	Not Evaluated
Capparaceae	*Capparis zoharyi*	Not Evaluated
Caryophillaceae	*Paronychia argentea*	Least Concern
	Silene villosa	Not Evaluated
Chenopodiaceae	*Anabasis articulata*	Least Concern
	Anabasis syriaca	Least Concern
	Noaea mucronata	Least Concern
	Salsola vermiculata	Least Concern
Cistaceae	*Helianthemum lippii*	Least Concern
Compositae	*Achillea fragrantissima*	Least Concern
	Achillea santolina	Not Evaluated
	Anthemis pseudocotula	Least Concern
	Artemisia herba-alba	Least Concern
	Atractylis cancellata	Least Concern
	Centaurea hyalolepis	Least Concern
	Chiliadenus iphionoides	Least Concern
	Cousinia moabitica	Vulnerable
	Crepis sancta	Least Concern
	Echinops polyceras	Least Concern

Family	Species	Status in the National Red List of Jordan
	Launaea mucronata	Least Concern
	Notobasis syriaca	Least Concern
	Filago pyramidata	Least Concern
	Onopordum ambiguum	Least Concern
	Ifloga spicata	Least Concern
	Picnomon acarna	Least Concern
	Rhagadiolus stellatus	Least Concern
	Scorzonera papposa	Least Concern
	Senecio flavus	Least Concern
Cruciferae	*Biscutella didyma*	Least Concern
	Diplotaxis erucoides	Least Concern
	Eruca sativa	Least Concern
	Erucaria hispanica	Least Concern
	Matthiola aspera	Not Evaluated
	Sisymbrium erysimoides	Least Concern
Geraniaceae	*Erodium acaule*	Least Concern
	Erodium gruinum	Least Concern
Graminae	*Aegilops biuncialis*	Least Concern
	Avena sterilis	Least Concern
	Bromus rigidus	Not Evaluated
	Bromus tectorum	Least Concern
	Dactylis glomerata	Least Concern
	Hordeum bulbosum	Least Concern
	Hordeum glaucum	Not Evaluated
	Hordeum spontaneum	Least Concern
	Poa bulbosa	Least Concern
	Stipa capensis	Least Concern
Iridaceae	*Iris petrana*	Not Evaluated
Lamiaceae	*Phlomis viscosa*	Least Concern
	Teucrium polium	Least Concern
Liliaceae	*Allium truncatum*	Not Evaluated
Malvaceae	*Alcea acaulis*	Least Concern
	Malva parviflora	Least Concern
Papaveraceae	*Glaucium aleppicum*	Least Concern
Papilionaceae	*Astragalus spinosus*	Least Concern
	Astragalus hamosus	Least Concern
	Astragalus tribuloides	Least Concern
	Colutea istria	Not Evaluated
	Onobrychis crista-galli	Least Concern
	Ononis natrix	Least Concern
	Retama raetam	Least Concern
Plantaginaceae	*Plantago afra*	Least Concern
	Plantago cylindrica	Not Evaluated

Family	Species	Status in the National Red List of Jordan
Ranunculaceae	*Adonis aestivalis*	Least Concern
	Adonis dentata	Least Concern
Resedaceae	*Reseda lutea*	Least Concern
Rutaceae	*Haplophyllum poorei*	Not Evaluated
Scrophulariaceae	*Kickxia aegyptiaca*	Least Concern
	Verbascum sinaiticum	Not Evaluated
Urticaceae	*Urtica pilulifera*	Least Concern
Zygophyllaceae	*Fagonia mollis*	Least Concern
	Peganum harmala	Least Concern

(ii) Fauna

The specific outcomes of the field survey in relation to faunal species are discussed below and which includes mammals and reptiles & amphibians.

a. Mammals

The study site in particular was not studied in detail in previous faunal studies. However, scattered records from the area are scanty, see Table 41. Small mammals and carnivores were recorded from the vicinity of the project site (Amr, 2012).

Table 41: Terrestrial Mammals recorded from the Vicinity of the Study Area

Family	Scientific name	Common name	Global IUCN status	Mediterranean IUCN status
Erinaceidae	*Erinaceus concolor*	Eastern European Hedgehog	Least Concern	Least Concern
Leporidae	*Lepus capensis*	Cape Hare	Least Concern	Least Concern
Muridae	*Gerbillus dasyurus*	Wagner's Gerbil	Least Concern	Least Concern
	Meriones tristrami	Tristram's jird	Least Concern	Least Concern
	Meriones libycus	Libyan jird	Least Concern	Least Concern
Canidae	*Vulpes vulpes*	Red fox	Least Concern	Least Concern
	Canis lupus	Gray Wolf	Least Concern	Least Concern
	Hyaena hyaena	Striped Hyena	Near Threatened	Vulnerable

Trapping yielded only one species of rodents, namely Wagner's Gerbil *Gerbillus dasyurus*, which is one of the most widespread species in the country where it can be found almost in all habitats of the kingdom except pure deserts. Additionally, Red Fox *Vulpes vulpes* was observed on several occasions during the various surveys that were carried out in the project site.

b. Reptiles and Amphibians

Virtually no previous studies on the reptiles and amphibians were conducted within the boundaries of the project site, see Table 42. However, scattered records of snakes and other reptiles can give an idea on the herpetology of the area (El-Oran et al., 1994; Disi et al., 2001; Amr & Disi, 2011). Apart from the IUCN Red List of Threatened Species, there are no relevant conservation assessments that were available for the reptile species. During the surveys, the globally threatened (Vulnerable) Spur-thighed Tortoise Testudo graeca was recorded in several locations in the project site.

Table 42: Reptilian Species Known to Occur within the Study Area

Family	Scientific name	Common name	Global IUCN status
Testudinidae	*Testudo graeca*	Spur-thighed Tortoise	Vulnerable

Gekkonidae	*Ptyodactylus guttatus*	Spotted Fan-footed gecko	Not Evaluated
Agamidae	*Stellagama stellio*	Starred agama	Least Concern
Lacertidae	*Acanthodactylus boskianus*	Bosk's fringe-toad lizard	Not Evaluated
Colubridae	*Dolichophis jugularis*	Large whip snake	Least Concern
	Hemorrhois nummifer	Coin snake	Not Evaluated
	Eirenis rothi	Roth's dwarf snake	Least Concern
	Eirenis coronella	Crowned dwarf snake	Least Concern
	Malpolon insignitus	Montpellier snake	Not Evaluated
	Telescopus nigriceps	Black-headed cat snake	Least Concern

Two lizard species were observed in the study site, see Table 43. The Small spotted desert racer Mesalina guttulata was observed in gravelly areas in the eastern section of the study site, while Ophisops elegans was found more into the western section in milder habitats close to agricultural ploughed fields. The Starred Agama Stellagama stellio was confined to rocky areas around wadi beds.

Table 43: Reptiles Observed in the Study Area

Family	Scientific name	Common name	IUCN status
Agamidae	*Stellagama stellio*	Starred agama	Least Concern
Lacertidae	*Acanthodactylus boskianus*	Bosk's fringe-toad lizard	Not Evaluated

11.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on biodiversity during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

11.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, levelling, excavation, grading, etc.

Such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal. Nevertheless, such activities would likely result in the alteration of the site's habitat and thus potentially disturb existing habitats. Other impacts on the biodiversity of the site are mainly from improper management of the site, which could include improper conduct and housekeeping practices by workers (i.e. hunting of animals, discharge of hazardous waste to land, etc.).

As discussed earlier, the site is generally considered of low ecological significance due to its natural setting; characterized by having low vegetation cover in an arid environment with a low level of diversity. However, a single nationally threatened plant species was recorded in the project site and this species requires special attention in order to avoid any negative impact on its distribution and presence in the project site. *Cousinia moabitica* (nationally Vulnerable) was recorded on several occasions along the main wadi that

passes by the north-western part of the project site, Figure 67. The species was not recorded anywhere else in the project site.

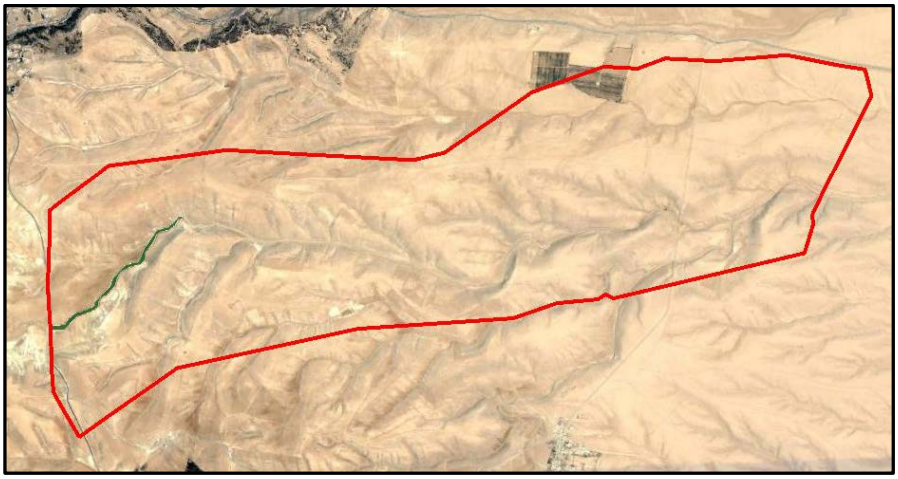

Figure 68: The wadi (in green) by the western part of the project site along which the nationally threatened *Cousinia moabitica* was recorded

Given all of the above, the potential impacts on biodiversity created during the construction phase would of a long-term duration as they would result in a permanent change in the natural biodiversity of the site. Such impacts are considered of negative nature and of a medium magnitude given that the change in the natural biodiversity of the site will be noticeable in limited individual footprints. However, as the site is considered of low ecological significance, the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be of low significance.

Additional Studies/Surveys and Mitigation Measures

The following identifies the additional studies and mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- Based on the final detailed design of the project, all areas where construction activities will take place and that will be disturbed will be identified. Before construction activities commence, the EPC Contractor must undertake a detailed survey (through an ecological expert) to identify the presence of any active tortoises as well as potential hibernation/aestivation sites (during summer and winter) within all assigned areas to be disturbed by construction. Should any tortoises be located, they should be relocated outside of the direct construction active areas. Additionally, the detailed survey should provide a detailed mapping of the main areas where the species is concentrated, so that it can be avoided. Relocation for long distances away from the original location where the individuals were recorded is not encouraged since this could lead to disturbance for breeding and/or disturbance to the species in the receiving location.
- Carry out a survey to identify any locations in the project where the nationally threatened species is located in order to provide instructions during the construction phase to avoid any damage to these threatened species. Spring season from March onwards, would be suitable to locate the species in the project site. A qualified ecologist/botanist who is familiar with the species should carry out the survey. In case of identification of locations of the species, the plants could be either marked and/or fenced so that construction activities would avoid their locations. It is not advised to carry out any relocation of the species since this would lead to damage to the plants, specifically its root system.
- Should any fencing be erected as part of the Project, it must be ensured that it allows for the natural movement of small faunal species within the area. This could include for example a fence with an appropriate gap between the ground level and the first rail or strand (around 30cm);

- Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:
  - Prohibit hunting of any wildlife at any time and under any condition by construction workers onsite;
  - Ensure proper storage, collection, and disposal of waste streams generated as discussed in detail in "Chapter 10";
  - Restrict activities to allocated construction areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances; and
  - Avoid unnecessary elevated noise levels at all times. In addition, apply adequate general noise suppressing measures as detailed in "Chapter 18".

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- A pre-construction flora survey report to be presented prior to construction activities.
- Reporting on outcomes of fauna survey and actions undertaken (e.g. relocation measures to areas outside of construction activities).
- Inspection of the works should be carried out at all times, specifically to ensure that no damage is caused to the threatened plant species.

11.2.2 Potential Impacts during the Operation Phase

The only impacts anticipated during the operation phase are related to improper management of the site as discussed earlier. This could include improper conduct and housekeeping practices by workers (i.e. hunting of animals, discharge of hazardous waste to land, etc.).

The potential impacts on biodiversity would of a long-term duration throughout the operation phase of the Project. Such impacts are of negative nature and of a medium magnitude. However, as the site is considered of medium ecological significance, the receiving environmental is determined to be of medium sensitivity. Given all of the above, such an impact is considered to be of moderate significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the Project Operator during the operation phase and which include:

- Monitoring of the distribution and abundance of the threatened plant species should be carried out for at least five years during the operational phase in order to assess the impact of the project on the three threatened species that were recorded in the project site.
- Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:
  - Prohibit hunting of any wildlife at any time and under any condition by workers onsite;
  - Ensure proper storage, collection, and disposal of waste streams generated as discussed in detail in "Chapter 10 "; and

- Restrict activities to allocated areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances.

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the Project Operator during the operation phase and which include:

- Annual report to include the distribution and abundance of the globally and nationally threatened species present at the project site.
- Inspection of the works should be carried out at all times.

12. BIRDS (AVI-FAUNA)

This Chapter first provides an assessment of baseline conditions within the Project site and surroundings in relation to birds (avi-fauna) and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation and monitoring measures, additional requirements, etc.) have been identified to eliminate or reduce the impact to acceptable levels.

Before discussing the outcomes of the above, it is important to state that the potential impact of wind turbines on birds is considered one of the key issues related to wind farm developments which must be thoroughly addressed within the ESIA.

12.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to birds and presents the outcomes and results.

12.1.1 Baseline Assessment Methodology

Baseline Assessment for in-flight movement of soaring birds

This section is based on the results and findings of the in-flight monitoring that was carried out in over four seasons; autumn, winter, spring and summer which spanned from September 2016 until August 2017. These surveys aimed to observe the numbers and behaviour of migratory and resident soaring birds using the wind farm. These surveys targeted a list of species that are known to use the wind farm and its surroundings, and are presented in Table 44 below.

Table 44: Target Species to be recorded by Flight Activity Surveys

Category A Primary Species	Category B Primary Species	Secondary Species
Egyptian Vulture	Barbary Falcon	Brown-necked Raven
Griffon Vulture	Black Kite	Common Kestrel
Bonelli's Eagle	Black Stork	Eurasian Sparrowhawk
Booted Eagle	Common Crane	Fan-tailed Raven
Eastern Imperial Eagle	Common Raven	Marsh Harrier
Golden Eagle	Crested Honey-buzzard	Rock Dove
Lesser Spotted Eagle	Steppe Buzzard	All bee-eater species
Short-toed Snake-eagle	Eleonora's Falcon	All sandgrouse species
Spotted Eagle	Hen Harrier	All swift species
Steppe Eagle	Hobby	All wader species
Verreaux's Eagle	European Honey-buzzard	All waterbird species
Long-legged Buzzard	Lanner	
	Lesser Kestrel	
	Levant Sparrowhawk	
	Montagu's Harrier	
	Osprey	
	Pallid Harrier	
	Peregrine	
	Red-footed Falcon	
	Saker Falcon	
	Sooty Falcon	
	White Stork	

Observations from fixed vantage points were used to record the number and behavior of diurnal soaring birds over the site, mainly of migratory soaring birds as well as resident soaring birds. Equipment required for this method includes binoculars, telescope, stop watch, GPS and thermometer.

In-flight monitoring assessment were carried out from September 2016 until August 2017. The first assessment was carried out from September 2016 until mid-November 2016 covering the autumn

migration season. It was followed by the winter assessment from mid-November 2016 until February 2017. The spring monitoring assessment was from early March until mid-May while the summer monitoring assessment was from June until mid-August 2017. The level of effort in each assessment varied due to the predicted activity of avifauna during the relevant season, see Table 45.

Table 45: Level of effort of in-flight monitoring assessments per season

Season	Number of hours per vantage point	Total number of hours covered during season (3 vantage points)
Autumn	108	324
Winter	48	144
Spring	144	432
Summer	48	144

Additionally, the autumn migration season was divided into three periods; low activity period from 1 September until 15 September, a high activity period from 16 September until 15 October and low another low activity period from 16 October until 15 November. In winter, the level of effort was divided evenly throughout the season with a total of 16 hours being covered in each month per vantage point. In spring, the season was divided into two periods; low activity period from 1 March until 21 March, a high activity period from 22 March until 15 May. In summer, the level of effort was the same as winter where a total of 16 hours were covered on monthly basis for each vantage point.

In order to identify the vantage points that were going to be used for the assessments, a few assumptions had to be set in order to be able to cover all rotor-swept areas of all turbines that are planned to be erected on the project site. These assumptions are as follows:

- Range of coverage: it was assumed that the range of coverage for birds recorded is 2km, since it is believed that this is probably the maximum period from which a qualified ornithologist would be able to identify the bird observed and would also be able to map its line of movement, and
- Field of coverage: it was assumed that the field of coverage for the three vantage points is 180°, while the aspect of coverage was defined to cover the maximum possible number of turbines. Such an assumption is made given that a 360° field of coverage could entail an observer to cover areas unequally since there would be a tendency to watch areas where it is believed the birds would be passing by more than others. For instance, if the survey is carried out in spring, the observer would normally tend to be watching the southern part of the vantage point's circle much more than the northern part – which could result in missed records in the northern part.

Taking the above assumptions into account and based on the turbine layout that was provided prior to the autumn migration assessment, undertaking a view shed mapping revealed that there is a need to set three vantage points in order to cover all rotor-swept area of all turbines, see Figure 68. These vantage points were used during the autumn assessment until 7 October, 2016. After that, a new turbine layout was provided, based on which, the locations of vantage points had to be reviewed to ensure that the rotor-swept area of all turbines based on the new layout was covered.

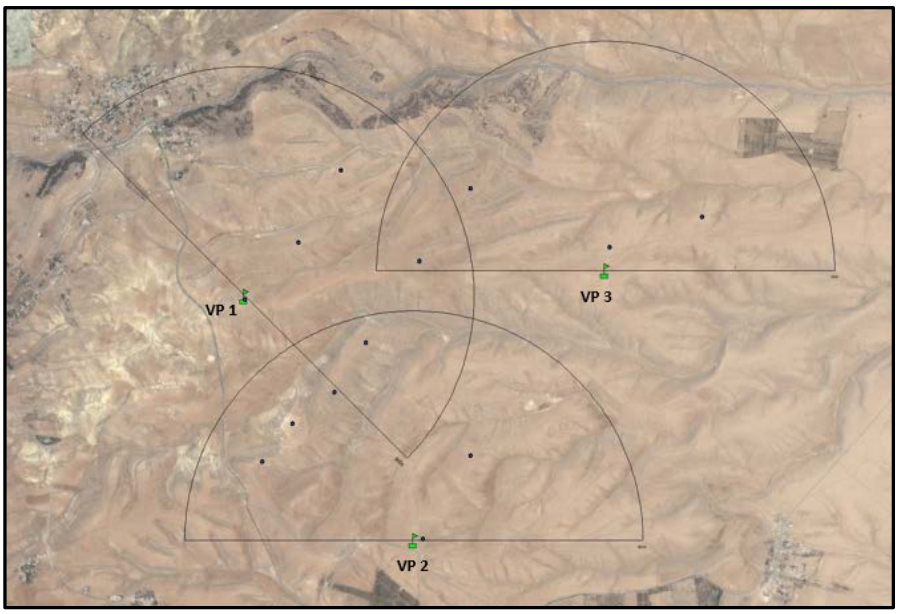

Figure 69: Locations of vantage points and turbine coverage based on the turbine layout provided prior to autumn migration assessment (ECO Consult, 2017)

As a result of this review, VP1 was dropped and was replaced by VP4, which is located in the eastern part of the project site. VP2 and VP3 were kept in the same locations while VP3 view was modified to become centred northeast instead of north, see Figure 69

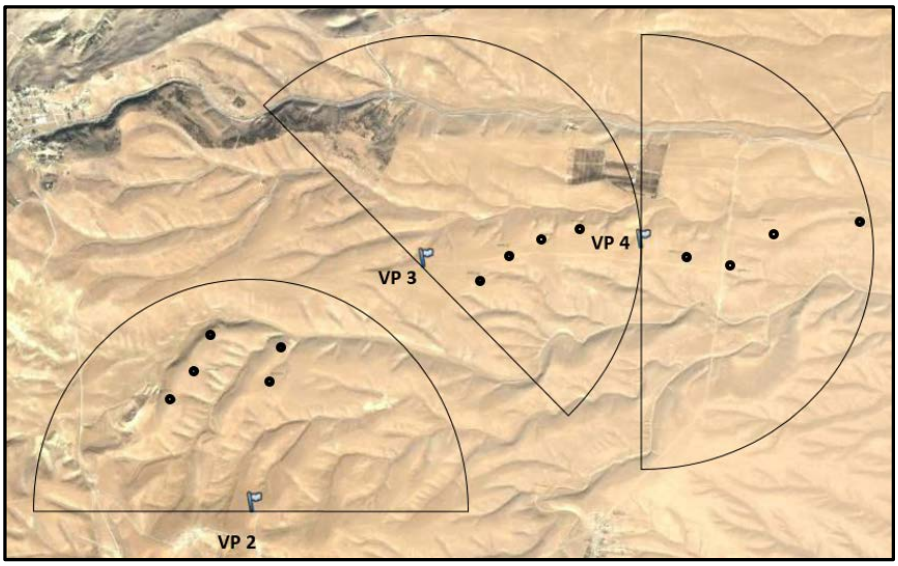

Figure 70: Locations of vantage points and turbine coverage based on the final turbine layout provided during autumn migration assessment (ECO Consult, 2017)

Moreover, the methodology takes into account the target species to be recorded and assigns primary and secondary target species. Observers at VPs positioned themselves to minimize their effects on bird behaviour. A viewing arc not exceeding 180 degrees was scanned using a combination of naked eye and 10x binoculars. A spotting scope was used when required to aid species identification.

For Category A and B primary species flights, focal sampling data are recorded for all flights seen as follows:

- The search area is scanned until a primary target species is detected at which point it is followed until it ceases flying or is lost from view.
- The time the target bird was detected and the flight duration are recorded to the nearest second.
- The flight route is plotted in the field onto 1:25,000 scale maps.
- The bird's flight height above ground level is estimated at the point of first detection and thereafter at 15-second intervals, with the aid of a count-down interval timer with an audible alarm.
- Flight heights are classified as <20m, 20-140m, or >140m above ground level taking into account the turbines specifications of the EPC Contractor.
- The flight lines of Primary target species are recorded in the field on specially designed blank field maps. Each mapped flight line is given a reference number that cross-references to the information recorded for that flight on the corresponding recording form
- Focal observations of primary target species take priority over other species, secondary or other.

If during the course of recording the flight activity for a Category B primary species a Category A primary species (i.e. any vulture or eagle species) is seen, the observer should note the time, cease watching the Category B primary species and immediately switch to observing the Category A primary species. This is because information on Category A primary species is considered to have greater importance for the Project's impact survey.

The observer also separately records if any perched primary or secondary target species are seen. Perched birds are recorded only for the time in which they are first noted, i.e. if the bird remains perched, it is not recorded until it becomes airborne again.

Avifaunal Breeding Survey

The survey was conducted along the four routes during the bird breeding season from March until May 2017. These routes follow four main tracks within the project site. A point count was carried out every 250m along each survey route resulting in between 6 and 12 point counts per route, see Figure 70. Point counts were conducted at each point count location once a month. A total of 31 points were covered along the four routes. The counts were all performed in the morning and each point count lasted for 5 minutes preceded by 2 minutes during which habitat variables were noted and birds were allowed to become accustomed to the presence of the observer. During each 5 minute point count, all birds detected, either visually and/or acoustically were recorded as either within a 50m radius around the point of observation or beyond this 50m radius (sections A and B on Sample Recording Form below). Point counts were carried out in the morning hours between 06:59 and 10:27. Generally, it is preferred to finish point counts before 10 to avoid any warm weather in which birds become less active.

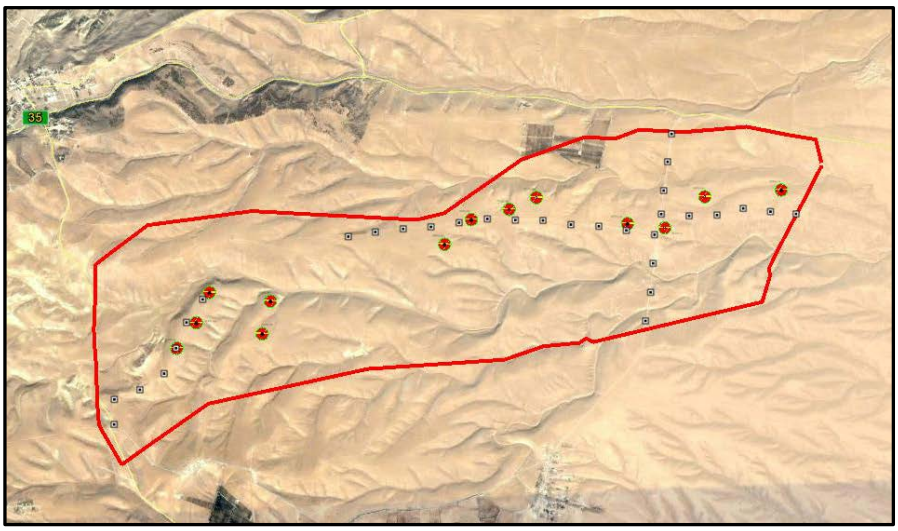

Figure 71: Location of routes and point counts for the breeding bird survey

12.1.2 Results

Baseline Assessment for in-flight movement of soaring birds

Autumn 2016

During the autumn monitoring of 2016, 16 species were recorded, fifteen belonged to primary target species; twelve migratory and three resident species. Five of these fifteen species are globally threatened; Egyptian Vulture *Neophron percnopterus* (Endangered), Saker Falcon *Falco cherrug* (Endangered), Steppe Eagle *Aquila nipalensis* (Endangered) and Eastern Imperial Eagle *Aquila heliaca* (Vulnerable) and Greater Spotted Eagle *Clanga clanga* (Vulnerable), while one species; Pallid Harrier *Circus macrourus*, is Near Threatened (IUCN, 2017).

On the regional level, according to the IUCN regional red list of the breeding of birds of Arabia (Symes *et al*, 2015) which also covers Jordan, the breeding populations of four species that were recorded in the project site are evaluated as threatened regionally; Saker Falcon *Falco cherrug* (Critically Endangered), Griffon Vulture *Gyps fulvus* (Endangered), Egyptian Vulture *Neophron percnopterus* (Vulnerable) and Short-toed Sanek-eagle *Circaetus gallicus* (Vulnerable), while the breeding population of the Western Marsh-harrier *Circus aeruginosus* is evaluated as "Near Threatened", refer to Table 46.

Table 46: Species records and numbers during autumn monitoring, and their status according to IUCN Red List of threatened Species (IUCN, 2016) and the regional Red List of the breeding birds of Arabia (Symes et al, 2015).

Species	Total observations	Total birds	IUCN Red List of Threatened Species	Red List of Threatened Species of the Breeding Birds of Arabia
Egyptian Vulture *Neophron percnopterus*	2	2	Endangered	Vulnerable
Griffon Vulture *Gyps fulvus*	1	1	Least Concern	Endangered
European Honey-buzzard *Pernis*	2	18	Least Concern	Not Evaluated

Species	Total observations	Total birds	IUCN Red List of Threatened Species	Red List of Threatened Species of the Breeding Birds of Arabia
apivorus				
Short-toed Snake-eagle *Circaetus gallicus*	7	7	Least Concern	Vulnerable
Eastern Imperial Eagle *Aquila heliaca*	5	5	Vulnerable	Not Evaluated
Steppe Eagle *Aquila nipalensis*	14	16	Endangered	Not Evaluated
Bonelli's Eagle *Aquila fasciata*	1	1	Least Concern	Least Concern
Greater Spotted Eagle *Clanga clanga*	1	1	Vulnerable	Not Evaluated
Western Marsh-harrier *Circus aeruginosus*	5	5	Least Concern	Near Threatened
Montagu's Harrier *Circus pygargus*	2	2	Least Concern	Not Evaluated
Pallid Harrier *Circus macrourus*	5	5	Near Threatened	Not Evaluated
Hen Harrier *Circus cyaneus*	4	4	Least Concern	Not Evaluated
Black Kite *Milvus migrans*	9	17	Least Concern	Least Concern
Steppe Buzzard *Buteo buteo vulpinus*	8	46	Least Concern	Not Evaluated
Long-legged Buzzard *Buteo rufinus*	63	68	Least Concern	Least Concern
Saker Falcon *Falco cherrug*	1	1	Endangered	Critically Endangered
Unidentified Eagle species *Aquila sp.*	1	1	Not Applicable	Not Applicable
Unidentified Buzzard species *Buteo sp.*	5	8	Not Applicable	Not Applicable
Unidentified Harrier species *Circus sp.*	1	1	Not Applicable	Not Applicable

In total, 209 birds were recorded through 137 observations. The highest recorded species in the survey was the resident Long-legged Buzzard *Buteo rufinus* with 68 birds in 63 observations. The highest number of birds in a single observation was of 30 Steppe Buzzards *Buteo buteo vulpinus* on October 10.

The time spent by all birds recorded of all target species (209 birds) reached a total of 34785 seconds (09h:39m:45s). 7845 seconds (02h:10m:45s) of this time was spent at the band of high collision risk of turbines, which is almost 22.6% of the total time spent by birds in the project site. Out of the total of 209 birds recorded, 160 birds (76.6%) were recorded at risk height even if partially through their presence at the project site. Out of the 16 species recorded, 14 species had more than 50% of the birds flying at risk height even partially during their in-flight passage in the project site. These species include most importantly the globally threatened Egyptian Vulture *Neophron percnopterus* (50%), Eastern Imperial Eagle *Aquila heliaca* (60%), Steppe Eagle *Aquila nipalensis* (75%) and Greater Spotted Eagle *Clanga clanga* (100%), refer to Table 47.

Table 47: Species numbers and percentages of total numbers at collision risk height at the different vantage points in autumn monitoring.

Species	VP1		VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Egyptian Vulture *Neophron percnopterus*			2	1 (50)					**2**	**1 (50)**
Griffon Vulture *Gyps fulvus*			1	0 (0)					**1**	**0 (0)**
European Honey-buzzard *Pernis apivorus*	18	15 (83.3)							**18**	**15 (83.3)**
Short-toed Snake-eagle *Circaetus gallicus*			2	2 (100)	5	4 (80)			**7**	**6 (85.7)**
Eastern Imperial Eagle *Aquila heliaca*	1	1 (100)	2	1 (50)	2	1 (50)			**5**	**3 (60)**
Steppe Eagle *Aquila nipalensis*	2	0 (0)	5	4 (80)	7	7 (100)	2	1 (50)	**16**	**12 (75)**
Bonelli's Eagle *Aquila fasciata*	1	1 (100)							**1**	**1 (100**
Greater Spotted Eagle *Clanga clanga*			1	1 (100)					**1**	**1 (100)**
Western Marsh-harrier *Circus aeruginosus*			4	2 (50)	1	0 (0)			**5**	**2 (40)**
Montagu's Harrier *Circus pygargus*			1	1 (100)	1	1 (100)			**2**	**2 (100)**
Pallid Harrier *Circus macrourus*			3	2 (66.7)	1	0 (0)	1	1 (100)	**5**	**3 (60)**
Hen Harrier *Circus cyaneus*	2	1 (50)	1	1 (100)	1	0 (0)			**4**	**2 (50)**

Species	VP1		VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Black Kite *Milvus migrans*	7	7 (100)	4	4 (100)	6	6 (100)			**17**	**17 (100)**
Steppe Buzzard *Buteo buteo vulpinus*	2	2 (100)	30	30 (100)	8	8 (100)	6	1 (16.7)	**46**	**41 (89.1)**
Long-legged Buzzard *Buteo rufinus*	16	13 (81.3)	13	10 (76.9)	34	23 (67.6)	5	5 (100)	**68**	**51 (75.0)**
Saker Falcon *Falco cherrug*					1	1 (100)			**1**	**1 (100)**
Unidentified Eagle species *Aquila sp.*					1	1 (100)			**1**	**1 (100)**
Unidentified Buzzard species *Buteo sp.*	4	0 (0)	1	0 (0)			3	1 (33.3)	**8**	**1 (12.5)**
Unidentified Harrier species *Circus sp.*					1	0 (0)			**1**	**0 (0)**
Total	53	40 (75.5)	70	59 (84.3)	69	52 (75.4)	17	9 (52.9)	**209**	**160 (76.6)**

Winter 2016-2017

During the winter monitoring of 2016/2017, two species were recorded where both are primary species. Most of the observations belonged to a single species; Long-legged Buzzard *Buteo rufinus*, which is a resident species that is known to be breeding along the rift valley margins, refer to Table 48.

Table 48: Species records and numbers during the winter monitoring, and their status according to IUCN Red List of threatened Species (IUCN, 2016) and the regional Red List of the breeding birds of Arabia (Symes et al, 2015).

Species	Total observations	Total birds	IUCN Red List of Threatened Species	Red List of Threatened Species of the Breeding Birds of Arabia
Steppe Eagle *Aquila niaplensis*	1	1	Endangered	Not Evaluated
Long-legged Buzzard *Buteo rufinus*	45	50	Least Concern	Least Concern

Unidentified Falco *Falco sp.*	1	1	Not Applicable	Not Applicable

Fifty-two birds were recorded in 47 records. The observation was spread out across the period of the survey. Seventeen birds were recorded flying at risk height even if partially through their presence at the wind farm, see Table 49.

Table 49: Species numbers and percentages of total numbers at collision risk height at the different vantage points in winter monitoring.

Species	VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Steppe Eagle *Aquila nipalensis*	1	1 (100)					**1**	**1 (100)**
Long-legged Buzzard *Buteo rufinus*	12	6 (50)	11	2 (18.2)	27	7 (25.9)	**50**	**15 (30)**
Unidentified Falcon species *Falco sp.*					1	1 (100)	**1**	**1 (100)**
Total	13	7 (53.8)	11	2 (18.2)	28	8 (28.6)	**52**	**17 (32.7)**

Spring 2016

During the spring season assessment, 16 species were recorded, of which 14 belonged to primary target species; 13 migratory and one resident species, see Table 50. One species recorded is globally threatened; Steppe Eagle *Aquila nipalensis* (Endangered) (IUCN, 2016) while another species is Near Threatened; Pallid Harrier *Circus macrourus*.

On the regional level, according to the IUCN regional red list of the breeding of birds of Arabia (Symes *et al*, 2015) which also covers Jordan, the breeding populations of two species that were recorded in the project site are evaluated as threatened regionally; Peregrine Falcon *Falco peregrinus* (Endangered) and Short-toed Sanek-eagle *Circaetus gallicus* (Vulnerable), while the breeding population of three species are evaluated as Near Threatened; White Stork *Ciconia ciconia*, Western Marsh-harrier *Circus aeruginosus* and Lesser Kestrel *Falco naumanni*, refer to Table 50.

Table 50: Species records and numbers during the spring monitoring, and their status according to IUCN Red List of threatened Species (IUCN, 2016) and the regional Red List of the breeding birds of Arabia (Symes et al, 2015).

Species	Total observations	Total birds	IUCN Red List of Threatened Species	Red List of Threatened Species of the Breeding Birds of Arabia
White Stork *Ciconia ciconia*	1	1	Least Concern	Near Threatened
Black Stork *Ciconia nigra*	1	7	Least Concern	Not Evaluated
European Honey-buzzard *Pernis apivorus*	17	308	Least Concern	Not Evaluated
Short-toed Snake-eagle	8	8	Least Concern	Vulnerable

Circaetus gallicus				
Steppe Eagle *Aquila nipalensis*	19	133	Endangered	Not Evaluated
Booted Eagle *Hieraaetus pennatus*	3	3	Least Concern	Not Applicable
Western Marsh-harrier *Circus aeruginosus*	3	4	Least Concern	Near Threatened
Pallid Harrier *Circus macrourus*	3	3	Near Threatened	Not Evaluated
Hen Harrier *Circus cyaneus*	1	1	Least Concern	Not Evaluated
Black Kite *Milvus migrans*	53	283	Least Concern	Least Concern
Steppe Buzzard *Buteo buteo vulpinus*	93	2150	Least Concern	Not Evaluated
Long-legged Buzzard *Buteo rufinus*	97	108	Least Concern	Least Concern
Eurasian Sparrowhawk *Accipiter nisus*	2	2	Least Concern	Not Evaluated
Lesser Kestrel *Falco naumanni*	4	12	Least Concern	Near Threatened
Peregrine Falcon *Falco peregrinus*	1	1	Least Concern	Endangered
Eurasian Hobby *Falco subbuteo*	4	4	Least Concern	Not Evaluated
Unidentified Buzzard *Buteo sp.*	5	5	Not Applicable	Not Applicable

The highest recorded species in the survey was the migratory Steppe Buzzard *Buteo buteo vulpinus*, with 2150 birds in 93 records. The highest number of birds in a single record was of 230 Steppe buzzards on March 23.

The time spent by all birds recorded of all target species (3033 birds) reached a total of 300810 seconds (83h:33m:30s), almost ten times the time spent during autumn season. 80580 seconds (22h:23m:00s) of this time was spent at the band of high collision risk of turbines, which is almost 26.8% of the total time spent by birds in the project site. Out of the total of 3033 birds recorded, 812 birds (26.8%) were recorded at risk height even if partially through their presence at the project site. Out of the 16 species recorded, 14 species had more than 50% of the birds flying at risk height even partially during their in-flight passage in the project site. These species include most importantly the globally threatened Egyptian Vulture *Neophron percnopterus* (50%), Eastern Imperial Eagle *Aquila heliaca* (60%), Steppe Eagle *Aquila nipalensis* (75%) and Greater Spotted Eagle *Clanga clanga* (100%), refer to Table 51.

Table 51: Species numbers and percentages of total numbers at collision risk height at the different vantage points during spring monitoring.

Species	VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
White Stork *Ciconia ciconia*					1	1 (100)	**1**	**1 (100)**
Black Stork *Ciconia nigra*					7	7 (100)	**7**	**7 (100)**
European Honey-buzzard *Pernis apivorus*	57	3	243	206	8	3	**308**	**212**

Species	VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
		(5.3)		(84.8)		37.5)		**(68.8)**
Short-toed Snake-eagle *Circaetus gallicus*	5	2 (40.0)	3	3 (100)			**8**	**5 (62.5)**
Steppe Eagle *Aquila nipalensis*	124	9 (7.3)	1	0 (0)	8	2 (25.0)	**133**	**11 (8.3)**
Booted Eagle *Hieraaetus pennatus*			2	2 (100)	1	1 (100)	**3**	3 (100)
Western Marsh-harrier *Circus aeruginosus*	1	1 (100)			3	0 (0)	**4**	**1 (25.0)**
Pallid Harrier *Circus macrourus*			2	0 (0)	1	0 (0)	**3**	**0 (0)**
Hen Harrier *Circus cyaneus*	1	1 (0)					**1**	**0 (0)**
Black Kite *Milvus migrans*	41	34 (82.9)	127	108 (85.0)	115	51 (44.3)	**283**	**193 (68.2)**
Steppe Buzzard *Buteo buteo vulpinus*	92	29 (31.5)	319	110 (34.5)	1739	128 (7.4)	**2150**	**267 (12.4)**
Long-legged Buzzard *Buteo rufinus*	22	17 (77.3)	50	46 (92)	36	33 (91.7)	**108**	**96 (88.9)**
Eurasian Sparrowhawk *Accipiter nisus*			1	1 (100)	1	0 (0)	**2**	**1 (50.0)**
Lesser Kestrel *Falco naumanni*			6	6 (100)	6	6 (100)	**12**	**12 (100)**
Peregrine Falcon *Falco peregrinus*					1	0 (0)	**1**	**0 (0)**
Eurasian Hobby *Falco subbuteo*	3	0 (0)	1	0 (0)			**4**	**0 (0)**

Species	VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Unidentified Buzzard *Buteo sp.*	3	2 (66.7)	1	1 (100)	1	0 (0)	**5**	**3 (60.0)**
Total	349	97 (27.8	756	483 (63.9)	1928	232 (12.0)	**3033**	**812 (26.8)**

Summer 2017

During the summer monitoring of 2017, two species were recorded. Both species belonged to primary target species; Short-toed Snake-eagle *CIrcaetus gallicus* and Long-legged Buzzard *Buteo rufinus,* see Table 52. The former has a summer-breeding population that is known to breed in the forested areas along the rift valley margins while the latter is a resident species that is also known to breed in the rocky areas of the rift valley margins. Neither of the species is globally threatened.

On the regional level, according to the IUCN regional red list of the breeding of birds of Arabia (Symes *et al*, 2015) which also covers Jordan, the breeding population of Short-toed Sanek-eagle *Circaetus gallicus* was evaluated as regionally threatened (Vulnerable), see Table 52.

Table 52: Species records and numbers during summer monitoring, and their status according to IUCN Red List of threatened Species (IUCN, 2016) and the regional Red List of the breeding birds of Arabia (Symes et al, 2015).

Species	Total observations	Total birds	IUCN Red List of Threatened Species	Red List of Threatened Species of the Breeding Birds of Arabia
Short-toed Snake-eagle *Circaetus gallicus*	3	4	Least Concern	Vulnerable
Long-legged Buzzard *Buteo rufinus*	1	1	Least Concern	Least Concern

The highest recorded species in the summer monitoring was Short-toed Snake-eagle *Circaetus gallicus*, with 4 birds in 3 records. The highest number of birds in a single record was of 2 birds on July 23.

The time spent by all birds recorded of all target species (4 birds) reached a total of 1110 seconds (0h:18m:30s). 705 seconds (0h:11m:45s) of this time was spent at the band of high collision risk of turbines, which is almost 63.5% of the total time spent by birds in the project site. see Table 53.

Table 53: Species numbers and percentages of total numbers at collision risk height at the different vantage points during summer monitoring.

Species	VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
Short-toed Snake-eagle *Circaetus*			4	4			**4**	**4**

Species	VP2		VP3		VP4		Total	
	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Species Totals	At risk height (%)
gallicus				(100)				**(100)**
Long-legged Buzzard *Buteo rufinus*			1	1 (100)	0		**1**	**1 (100)**

Taking a general look at the data over the various seasons while taking into consideration the locations of the observations and their height in relation to collision risk, see Figure 71, the spring season had the highest number of bird observations making up 92.1% of total bird observations throughout the year. On the other hand, the autumn season, although having only 6.3% of total bird observations, had the highest percentage of birds flying at collision risk height even if partially (76.6%), see Table 51.

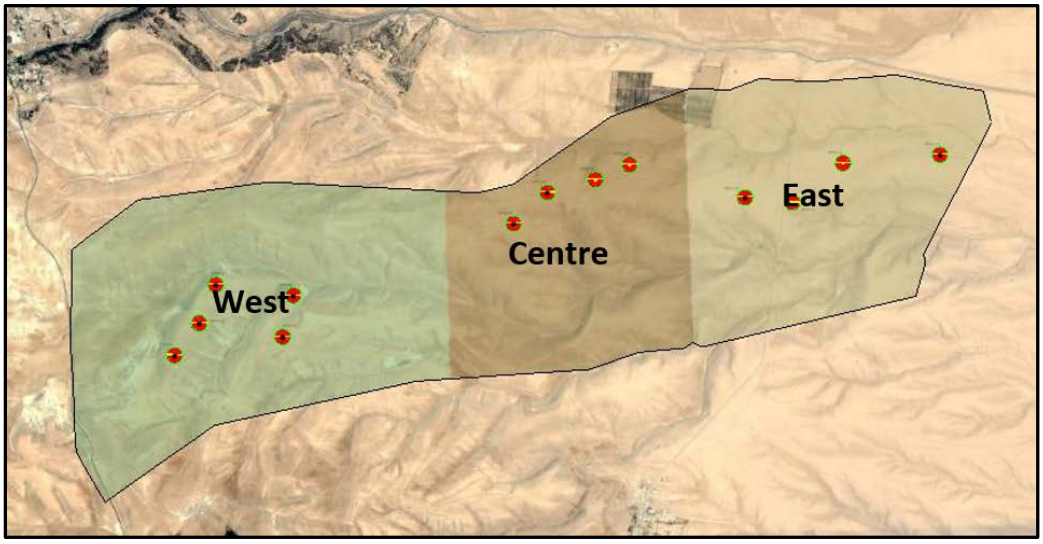

Figure 72: Division of the project site based on coverage of in-flight monitoring (ECO Consult, 2017)

Over all the data collected for the whole year, the eastern part of the project site had the highest number of bird observations (1973 birds) while the western side having the lowest number of observations (483 birds). Over the seasons, the eastern part of the project site had the highest number of observations in winter and spring (28 out of 52 birds and 1928 out of 3033 birds respectively), while the western part had the highest number of observations in autumn (128 birds out of 209).

Regarding bird numbers at flight at collision risk height, the central part of the project site had the highest overall number of birds flying at collision risk height where 537 birds out of 836 birds observed at the central part were recorded flying at collision risk, even if partially. On the seasonal level, in autumn, the western part of the project site had the highest number of birds flying at collision risk height, even if partially. During winter, the western and eastern parts had almost the same number of birds flying at collision risk height, while in spring, the central part of the project had the highest number of bird observations flying at risk height with 483 bird observations in the central part were recorded flying at risk height making up 63.9% of the total birds observed during that season in the central part of the project site., see Table 54.

Table 54: Number of birds flying at risk height in the different seasons of monitoring in the different parts of the project site

Season	Autumn		Winter		Spring		Summer		Total	
Location	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)	Total Birds	At risk height (%)
West	123	99 (80.5)	13	7 (53.8)	349	97 (27.8)	0	0 (0)	485	203 (41.9)
Centre	69	52 (75.4)	11	2 (18.2)	756	483 (63.9)	5	5 (100)	841	542 (64.4)
East	17	9 (52.9)	28	8 (28.6)	1928	232 (12.0)	0	0 (0)	1973	249 (12.6)
Total	**209**	**160 (76.6)**	**52**	**17 (32.7)**	**3033**	**812 (26.8)**	**5**	**5 (100)**	**3294**	**989 (30.0)**

Regarding the total time of birds recorded at collision risk height, the central part of the project site had the highest total time of birds flying at collision risk height where 41.2% of the total time of flight in this part was recorded at collision risk height. On the seasonal level, in autumn and winter, the western part of the project site had the highest total time of birds flying at risk height, while in spring, the central part of the project had the highest total time of flight at collision risk height, see Table 55.

Table 55: Total flight time at collision risk height in the different seasons in the different parts of the project site.

Season	Autumn		Winter		Spring		Summer		Total	
Location	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)
West	21,915	4,275 (19.5)	3,225	1,680 (52.1)	26,100	8,535 (32.7	0	0 (0)	51,240	14,490 (28.3)
Centre	11,370	2,805 (24.7)	2,010	375 (18.7)	112,935	48,810 (43.2)	1110	705 (63.5)	127,425	52,695 (41.4)
East	1,500	765 (51.0%)	1,770	285 (16.1)	161,775	23,235 (14.4)	0	0 (0)	165,045	24,285 (14.7)
Total	**34,785**	**7,845**	**7,005**	**2,340**	**300,810**	**80,580**	**1110**	**705**	**343,710**	**91,470**

Season	Autumn		Winter		Spring		Summer		Total	
Location	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)	Total flight time in seconds	Time of flight at risk height in seconds (%)
		(22.6)		(33.4)		(26.8)		(63.5)		(26.6)

In conclusion regarding the flight at collision risk height, the western part of the project site is the critical site for collision risk during autumn and winter where it is followed in both season by the central part of the project site while the collision risk shifts to the central part in spring season where it is followed by the eastern part while the western part becomes the least part of the project site in regard to collision risk during this season.

Avifaunal Breeding Survey

Throughout the breeding survey from March until May, 2016, 34 species were recorded. Fourteen of the species recorded in the survey are considered as passage migrants and/or winter visitors and are not known to breed in the project area and its vicinity, or even in southern Jordan. Out of the remaining 20 species, nine are confirmed breeding species in the project site while the other 12 species are not confirmed breeders and/or breeding in the vicinity of the project site, see Table 56.

Table 56: Species recorded in the survey

Species	Status during survey	Local status	IUCN Red List of Threatened Species (IUCN, 2016)	IUCN Red List of Breeding Birds of Arabia (Symes et al, 2015)
Steppe Eagle *Aquila nipalensis*	Passage migrant, the most common eagle species that passes over Jordan. It is also one of the most common species that spends winter in Jordan and mostly in the eastern parts of the country. It was recorded as a flyover species during the survey.	Passage migrant, winter visitor	Endangered	Not Evaluated
European Honey-buzzard *Pernis apivorus*	Passage migrant, the second most common species that passes over Jordan. It was recorded as a flyover species during the survey	Passage migrant	Least Concern	Not Evaluated
Steppe Buzzard *Buteo buteo vulpinus*	Passage migrant, considered to be the most common	Passage migrant	Least Concern	Least Concern

Species	Status during survey	Local status	IUCN Red List of Threatened Species (IUCN, 2016)	IUCN Red List of Breeding Birds of Arabia (Symes et al, 2015)
	migratory soaring bird species that passes over Jordan. It was recorded as a flyover species during the survey.			
Long-legged Buzzard *Buteo rufinus*	No breeding recorded in the project site but it would be breeding in adjacent areas since it was recorded on regular basis foraging in the project site.	Resident	Least Concern	Least Concern
Black Kite *Milvus migrans*	Passage migrant, one of the most common migratory soaring bird species in the country. It was recorded mainly as a flyover species during the survey except for a single record of a single bird that was foraging close by a Bedouin tent	Passage migrant	Least Concern	Not Evaluated
Common Kestrel *Falco tinnunculus*	Mainly a resident species. It was not confirmed as a breeder in the project site but it is definitely breeding in the vicinity of the project site by the western side. Most of the records in the survey were of birds foraging briefly in the area, which is an indication that these birds are probably nesting close by.	Resident	Least Concern	Least Concern
Lesser Kestrel *Falco naumanni*	A passage migrant that is known to breed along the rift margins in Jordan. No breeding was confirmed in the project site but a single record of a female foraging briefly in the western part of the project site could imply that the species breeds outside the project site by the western cliffs. It is known to breed in	Passage migrant, summer breeder	Least Concern	Near Threatened

Species	Status during survey	Local status	IUCN Red List of Threatened Species (IUCN, 2016)	IUCN Red List of Breeding Birds of Arabia (Symes et al, 2015)
	Shobak Castle in a few numbers with larger colonies further north in Dana Biosphere Reserve and Mujib Biosphere Reserve			
Collared Dove *Streptopelia decaocto*	No breeding confirmed at project site but is believed to be breeding in adjacent farms	Resident	Least Concern	Least Concern
Rock Dove / Feral Pigeons *Columba livia*	No breeding confirmed at project but is believed to be breeding in adjacent farms and villages	Resident	Least Concern	Least Concern
Little Owl *Athene noctua*	No breeding confirmed but is probably a rare breeder at project site. The species was only recorded once along the road to Faisaliyyeh in the southeastern part of the project site	Resident	Least Concern	Least Concern
European Bee-eater *Merops apiaster*	No breeding confirmed with only a single record of a flock flying over the project site	Passage migrant, summer breeder	Least Concern	Least Concern
Pallid Swift *Apus pallidus*	No breeding, only recorded flying over regularly on passage	Passage migrant, summer breeder	Least Concern	Least Concern
Hoopoe *Upupa epops*	Breeding confirmed in project site	Resident, summer breeder	Least Concern	Least Concern
Calandra Lark *Melanocorypha calandra*	Breeding in small numbers in the central part of the of the project site close to agricultural fields	Resident	Least Concern	Least Concern
Crested Lark *Galerida cristata*	Breeding all across the project area, where it was regularly recorded singing	Resident	Least Concern	Least Concern
Greater Short-toed Lark *Calandrella brachydactyla*	No confirmed breeding. Recorded regularly in barley fields across the project site	Passage migrant, summer breeder	Least Concern	Least Concern
Lesser Sort-toed Lark *Calandrella rufescens*	No confirmed breeding. Very few records of small flocks	Summer breeder, passage migrant	Least Concern	Least Concern

Species	Status during survey	Local status	IUCN Red List of Threatened Species (IUCN, 2016)	IUCN Red List of Breeding Birds of Arabia (Symes et al, 2015)
	in barley fields by the central part of the project stie			
Desert Lark *Ammomanes deserti*	Breeding, where it was recorded singing on a few occasions	Resident	Least Concern	Least Concern
Bar-tailed Lark *Ammomanes cincture*	No confirmed breeding, a single record. Most probably breeding to the east of the project site	Resident	Least Concern	Least Concern
Temminck's Lark *Eremophila bilopha*	Breeding, where it was recorded singing and in display in several occasions, specifically in the eastern part of the project site	Resident	Least Concern	Least Concern
Red-throated Pipit *Anthus cervinus*	Passage migrant that was recorded only twice in the western part of the project site	Passage migrant	Least Concern	Not Evaluated
Northern House Martin *Delichon urbicum*	Recorded on passage	Passage migrant	Least Concern	Least Concern
Barn Swallow *Hirundo rustica*	Recorded regularly on passage	Passage migrant	Least Concern	Least Concern
Collared Sand Martin *Riparia riparia*	Recorded occasionally on passage	Passage migrant	Least Concern	Least Concern
Northern Wheatear *Oenanthe oenanthe*	No breeding, only recorded on passage	Passage migrant	Least Concern	Least Concern
Isabelline Wheatear *Oenanthe isabellina*	Breeding all across the project site where it was recorded singing from perch and showing territorial behaviour	Resident	Least Concern	Least Concern
Black-eared Wheatear *Oenanthe hispanica*	A very rare breeder with a single record of a single male in the western part of the project site.	Passage migrant, summer breeder	Least Concern	Least Concern
Red(Buff)-rumped Wheatear *Oenanthe moesta*	Confirmed breeding – singing and in display. A single record of three individuals (one male and two females) in the southeastern part of the project site	Resident	Least Concern	Endangered
Willow Warbler *Phylloscopus trochilus*	A single record of a passage migrant	Passage migrant	Least Concern	Least Concern
Brown-necked Raven *Corvus ruficollis*	No breeding confirmed with a	Resident	Least Concern	Least Concern

Species	Status during survey	Local status	IUCN Red List of Threatened Species (IUCN, 2016)	IUCN Red List of Breeding Birds of Arabia (Symes et al, 2015)
	single record of a flyover bird. The species is known to be breeding along the rift valley margins			
House Sparrow *Passer domesticus*	No breeding confirmed and was only recorded calling locally in the western part of the project	Resident	Least Concern	Least Concern
Desert Finch *Rhodospiza obsoleta*	No breeding confirmed. Only occasional records of a small flocks and individuals flying over	Summer breeder	Least Concern	Least Concern
Eurasian Linnet *Carduelis cannabina*	Breeding, recorded regularly but with very few singing birds in the western part of the project site	Resident	Least Concern	Least Concern

The most frequently recorded species in the project area was Isabelline Wheatear *Oenanthe isabellina*, followed by two lark species, Crested Lark *Galerida cristata* and Temminck's Lark *Eremophila bilopha,* see Table 57.

Table 57: Total number of observations, relative density (per hectare) and frequency of occurrence as percent of point counts in each block of breeding species.

Species	Total No. of Observations	Total No. of birds recorded	Frequency
Isabelline Wheatear	72	75	55.91
Crested Lark	83	90	53.76
Temminck's Lark	75	99	43.01
Linnet	21	44	20.43
Swallow	21	54	17.20
Short-toed Lark	14	42	12.90
Black Kite	13	28	12.90
Desert Lark	15	25	11.83
Calandra Lark	11	22	10.75
Pallid Swift	9	79	9.68
Hoopoe	12	12	8.60
Steppe Buzzard	8	17	8.60
Rock Dove	6	42	6.45
Kestrel	5	5	5.38
House Sparrow	4	7	3.23
Collared Dove	2	4	2.15
Desert Finch	2	3	2.15
Lesser Short-toed Lark	2	2	2.15
Long-legged Buzzard	3	3	2.15
Northern Wheatear	3	3	2.15

Species	Total No. of Observations	Total No. of birds recorded	Frequency
Steppe Eagle	2	2	2.15
Willow Warbler	2	2	2.15
Bar-tailed Lark	1	1	1.08
Bee-eater	1	16	1.08
Black-eared Wheatear	1	1	1.08
Brown-necked Raven	1	1	1.08
Honey Buzzard	1	1	1.08
House Martin	1	1	1.08
Lesser Kestrel	1	1	1.08
Little Owl	1	1	1.08
Red-rumped Wheatear	1	3	1.08
Red-throated Pipit	2	2	1.08
Sand Martin	1	1	1.08

Apart from Steppe Eagle *Aquila nipalensis*, which was recorded flying over on two occasions while carrying out the point counts, none of the species recorded are globally threatened. However, according to the threatened list of breeding birds of Arabia, which covers Jordan (Symes *et al,* 2015), one species is assessed as Endangered; Red-rumped Wheatear *Oenanthe moesta*. The species was recorded in the south-eastern part of the project site along the main road to Faisaliyyeh, see Figure 72.

Additionally, Lesser Kestrel *Falco naumanni*, which is assessed as Near Threatened on the regional level, was recorded using the site on one occasions. However, no breeding was confirmed for the species in the project site but it is believed that the species breeds outside the project to the west since it is documented that this species is known to breed in Shobak around the Montreal Castle (pers. obs.).

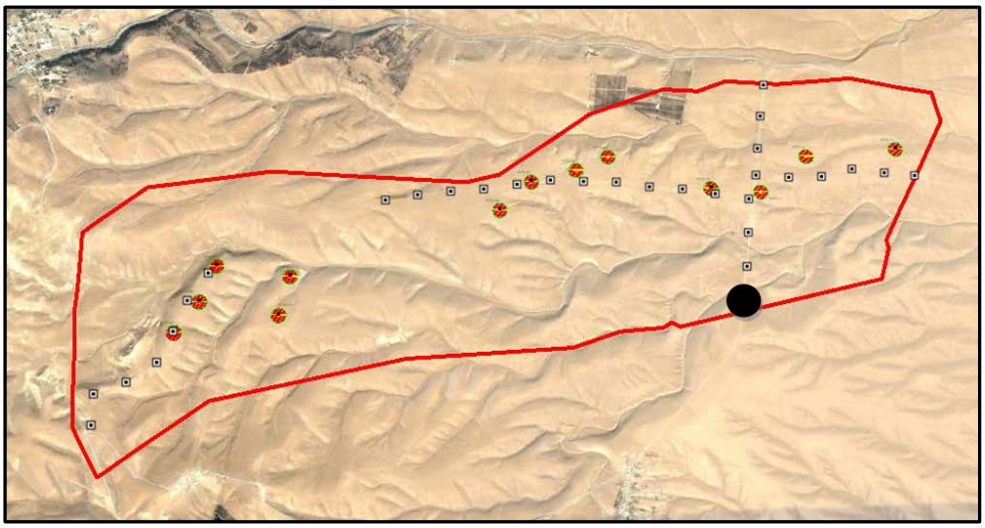

Figure 73: Location of the breeding of the regionally Endangered Red-rumped Wheatear Oenanthe moesta

12.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on birds during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

12.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Such activities in particular could impact avi-fauna which use the site for foraging and as a breeding ground– to include soaring and non-soaring resident and migratory species. As discussed throughout the baseline section, several species of resident and visiting birds were recorded foraging within the site some of which are considered important at the national and regional levels, most specifically Red-rumped Wheatear *Oenanthe moesta*, which is a regionally Endangered species that was confirmed to be breeding inside the project site, and Lesser Kestrel *Falco naumanni*, which is a regionally Near Threatened species that was recorded foraging in the project site.

Nevertheless, such construction activities would not result in any major alteration of the site's habitats and thus would not affect the foraging and feeding area of such species, given that such activities are limited to the relatively small individual footprint of these facilities and where the actual area of disturbance is relatively minimal. In addition, except for Red-rumped Wheatear *Oenanthe moesta*, which was recorded breeding in the south-eastern part of the project site, the project site does not hold any specific or significant value as a feeding habitat for birds. The project site is considered of low ecological significance due to its natural setting; characterized by being heavily degraded.

On the other hand, there are additional potential impacts during the construction phase on breeding birds within the site. Construction activities could disturb existing habitats of birds breeding and within the project site. Such potential impacts are created during the construction phase only and thus are of short-term duration. However, such impacts are considered of negative nature and of a low magnitude given that the construction activities' actual area of disturbance is relatively minimal. In addition, given that breeding activities are likely within the Project site, the receiving environmental is determined to be of a medium sensitivity. Given all of the above, such an impact is considered to be minor significance.

Additional Studies/Survey and Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase and which include:

- To minimize impacts on the recorded regionally Endangered species (Red-Rumped Wheatear), a breeding survey must be undertaken at the project site during the breeding season (which lasts from March till mid-May) and before commencement of any construction activities. The survey must be undertaken by a qualified ornithologist and must be based on point counts that are spread over the entire project site. At each point count all breeding activities must be recorded. The survey must aim to identify any breeding areas of importance within the project site. Based on the outcomes of the survey, should any areas of importance be identified then construction activities must be properly planned to avoid any disturbance to such areas during the breeding season.
- Implementation of proper housekeeping measures to reduce impacts including:
  - Avoid any activities in the sensitive areas for Red-rumped Wheatear *Oenanthe moesta*, mainly in the south-eastern part of the project site, during the breeding season of the species from March until May.
  - Restrict activities to allocated construction areas only with no breeding activities, including movement of workers and vehicles to allocated roads within the site and prohibit off-roading to minimize disturbances.
  - Prohibit hunting of birds at any time and under any condition by construction workers onsite.

- Implement proper measures, which would prevent attraction of birds to the site. This includes measures such as prohibiting illiterate dumping and ensuring waste streams are disposed appropriately in accordance with the measures identified in "Section 9.2".
- Avoid unnecessary elevated noise levels at all times. In addition, apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirement

The following summarizes the monitoring requirements for the Projects which must be undertaken and which include:

- Submission of breeding survey report identifying any breeding areas of importance within the project site.
- EPC Contractor to submit construction schedule and plan and demonstrate that construction is planned to avoid areas of concern during breeding season.

12.2.2 Potential Impacts during the Operation Phase

Wind turbines are associated with impacts on birds from risks of collision and electrocution for both migratory soaring birds (which could pass over the site during the spring and autumn migration seasons) and resident soaring birds in the area. This section provides a qualitative assessment of such impacts. As discussed previously, to determine the significance of an impact it is important to understand the sensitivity of the receiving environment and the magnitude of the impact both of which are discussed in further details below.

(i) Sensitivity of the Project Site

The baseline assessment has recorded relatively low numbers of migratory soaring birds over the Project site. Some of those recorded species have an important status on the international and/or regional/national levels. Comparing these results to other areas reveals that the Project site is not considered to be within an intensive migration route nor within high resident bird activity – especially when compared to areas closer to the rift valley and its margins. Taking all the above into account, the receiving environment is considered of low sensitivity.

(ii) Magnitude of the Impact

Collision of migratory and resident soaring birds with wind turbines is expected. Based on the assessments that were carried for in-flight monitoring of soaring birds, certain species have shown a higher probability of flying at collision-risk height during certain periods of the year. Generally, to determine the magnitude of the impact, three main factors are considered, which are:

1. The numbers of birds of different species recorded within the Project site and the numbers of these species flying at collision risk height;
2. The conservation status of the species (international IUCN status and local status and importance);
3. The avoidance behavior and collision risk of recorded species. There is no data in Jordan on avoidance behavior and collision risks of birds with wind turbines. Therefore, such information was based on experiences from Europe – mainly from Spain. The analysis was a comparative one in order to identify

species that were recorded to have a higher number of collisions and electrocutions and compare them with the species recorded in the project site.

Out of all the species recorded, there are ten species with a high impact magnitude. These include four migratory soaring bird species; Egyptian Vulture *Neophron percnopterus*, Steppe Eagle *Aquila nipalensis*, Eastern Imperial Eagle *Aquila heliaca* and Booted Eagle *Hieraaetus pennatus*, five resident and/or summer breeding species; Griffon Vulture *Gyps fulvus*, Short-toed Snake-eagle *Circaetus gallicus*, Bonelli's Eagle *Aquila faciata*, Long-legged Buzzard *Buteo rufinus* and Lesser Kestrel *Falco naumanni*, and one breeding passerine species; Red-rumped Weatear *Oenanthe moesta*.

Taking a deeper look at the species mentioned above, below is more detailed interpretation of the observations of these species:

- Egyptian Vulture *Neophron percnopterus* is a globally threatened species (Endangered), which also a regionally threatened breeding population (Vulnerable). On the national level, the species is currently a regular passage migrant but with scattered low numbers of passage birds. It is also a former breeder in the country but is still known to breed in Arabia and Israel. Two bird observations were recorded during the assessments, only during the autumn migration season. One of the two observations was at collision risk height. The total duration of the observation in the project site was for 720 seconds where 75 seconds were at collision risk height (10.4%). Both of the observations were in the western part of the project site.
- Steppe Eagle *Aquila nipalensis*, which is an Endangered species and is the most common eagle species migrating over Jordan, had the highest number of birds passing over the project site of all the globally threatened species; 133 birds in spring and 16 birds in autumn. In autumn, 12 of the bird observations were recorded flying, even if partially, at collision risk height (75.0%). The total duration of the species observation in the project site in autumn was for 3570 seconds where 495 seconds were at collision risk height (13.9%). In winter, a single individual was recorded foraging for 540 seconds at collision risk height. In spring, out of the 124 bird observations, 8 birds were flying at collision risk height, even if partially. The total duration of the species observations in the project site in spring was 4485 seconds where 675 seconds were at collision risk height (15.1%). The difference in the species presence and duration of observations is related to the species behaviour in different seasons. The species is known to fly over at higher altitudes and at relatively high speeds above collision risk height during spring migration (133 birds flew for a duration of 4485 seconds), while it is known to be migrating at lower altitudes during autumn migration while foraging for longer periods (16 birds flew for a duration of 3570 seconds). Regarding its distribution, the species was recorded in all parts of the project site. Still, the distribution was different during the different seasons. In autumn, the species was distributed equally in both the western and central parts of the project site (7 birds each). while in spring, most of the observations were in the western part of the project site (124 out of 132 bird observations).
- Eastern Imperial Eagle *Aquila heliaca,* is a globally threatened species (Vulnerable). The species was only recorded during the autumn season. Out of the five bird observations of the species, three were recorded at collision risk height, even if partially. The total duration of the species observation in the project site was for 2070 seconds where 195 seconds were at collision risk height (9.4%). Regarding its distribution, the species was only recorded in the western and central parts of the project site 3 and 3 observations respectively while it was not recorded in the eastern part.
- Booted Eagle *Hieraaetus pennatus*, is a regular passage migrant that is known to pass over Jordan in small numbers. The species was only recorded in the spring where only three bird observations were recorded. All birds were recorded flying at collision risk height, even if partially. The total duration of the species observation in the project was 810 seconds where 390 seconds were at collision risk height (48.1%). Regarding its distribution, the species was only recorded in the central and eastern parts of the project site.
- Griffon Vulture *Gyps fulvus* is resident species that is known to breed in the southern highlands of Jordan along the higher parts of the rift valley margins. The regional breeding population of the species, of which the species population is part, is regionally threatened (Endangered). The species breeding

population in the country has been facing continuous decline over the past 50 years and currently the only records of breeding in the country are in Dana Biosphere Reserve. Recent observations have even indicated that the species does not breed their regularly and it has failed to breed for the past two years. During the assessments at the project site, a single observation was recorded of one bird flying above collision risk height for a total of 900 seconds. The record was in the western part of the project site.

- Short-toed Snake-eagle *Circaetus gallicus* is a passage migrant species that has a breeding population in the country, which is part of the regionally threatened breeding population of Arabia, including Jordan. The species was recorded in autumn and spring but was absent throughout winter. In autumn, seven birds were recorded where 6 of them were recorded at collision risk height (85.7%). The total duration of the observations of the species in the project site was for 1200 seconds where 225 seconds were at collision risk height (18.8%). In spring, a total of eight bird observations were recorded at the project site, out of which 5 were recorded at collision risk height (62.5%). The total duration of the observations of the species in the project site was for 990 seconds out of which 495 seconds were at collision risk height (50%). Taking the scope of the in-flight monitoring assessments into consideration, it is impossible to decide which of these individuals were part of the regionally threatened breeding population, but it is highly probable that some of the individuals that were recorded in spring are part of this population especially that they had a higher percentage of individuals flying at collision risk height while foraging which is an indication for breeding individuals. Regarding its distribution, all individuals of the species recorded throughout the assessments were in the central and western parts of the project site while the species was completely absent from the eastern part of the project. In spring, the highest number of individuals was recorded in the western part of the project site, unlike autumn where the highest numbers were recorded in the central part of the project site. This again supports the theory that a portion of the individuals recorded in the spring season were part of the regionally breeding population since they are located closer to their breeding territories to the west of the project along the rift valley margins.
- Long-legged Buzzard *Buteo rufinus* is a resident species that breeds along the rift valley margins and uses the project for site for foraging. The species was recorded in the project site in autumn, winter and spring seasons. In autumn, the species had the highest number of observations among all species recorded at the project site, including migratory species, making up 32.5% of all birds observed. Out of the 68 bird observations of the species during autumn, 51 of them were recorded at collision risk height (75.0%). The total duration of the species observations in the project site was for 9555 seconds where 3540 seconds were at collision risk height (37.0%). In winter, the species was the most commonly recorded species making up 96.2% of the birds recorded. Out of the 50 bird observations recorded in winter, 15 of them were recorded at collision risk height (30%). The total duration of the species observations in the project site was for 6420 seconds where 1755 seconds were at collision risk height (27.3%). In spring, the species was the most commonly recorded resident species having the fifth highest number of observations among all species recorded at the project site in spring. Out of the 108 birds recorded in spring, 96 of them were recorded flying at collision risk height (88.9%). The total duration of the species observations in the project site as for 21345 seconds where 16725 seconds were at collision risk height (78.4%). Regarding its distribution, the species was recorded from all vantage points at the project site with a marginally higher presence in the central and eastern parts of the project site.
- Lesser Kestrel *Falco naumanni*, which is a migratory summer breeding species that also breeds in the rift valley margins and around Shobak Castle but was also recorded foraging in the project site. The regional breeding population in Arabia, including Jordan, is evaluated as a Near Threatened population. The species was only recorded during the spring assessment, which indicates that the individuals recorded are part of the regional breeding population, especially all species recorded were foraging in the project site and were not on migration. All 12 bird observations of the species were recorded flying, even if partially, at collision risk height. The total duration of the observations of the species in the project site was for 16470 seconds where 4050 seconds were at collision risk height (24.6%). One observation that is worth highlighting is that the remaining duration of the observations for the species (12420 seconds)

was recorded below collision risk height and the species was never recorded above collision risk height. In other words, since all observed were flying at collision risk height, even if partially, and then were only recorded below collision risk height, this indicates that all these individuals are part of the regional breeding population and they were using the project site for foraging. Regarding its distribution, the species was recorded equally in the central and eastern part of the project site where the species was foraging in the flatter parts of the project site.

- Bonelli's Eagle *Aquila fasciata*, is a resident eagle species that has a very small restricted national population along the rift valley margins in Jordan. There was only once record of the species in autumn, The total duration of the observation was for 75 seconds out of which 45 seconds were recorded at collision risk height. The observation was in the western part of the project site.
- Red-rumped Wheatear *Oenanthe moesta*, which is the only regionally threatened species recorded breeding inside the project site. Although there are no studies that could indicate the impact of wind turbines on the species but any direct impacts on the habitat of the breeding area of the species is believed to impact the presence and the breeding success of the species, especially during its breeding season.

In addition, there are additional 6 species with a medium impact magnitude. These are Black Kite *Milvus migrans*, European Honey-buzzard *Pernis apivorus*, Steppe Buzzard *Buteo buteo vulpinus,* Hen Harrier *Circus cyaneus*, Pallid Harrier *Circus macrourus* and Montagu's Harrier *circus pygargus.*

The remainder of the species are considered of low impact magnitude, as that they have no important international or local conservation status, have high avoidance rates, and were recorded in low numbers within the Project site.

In addition to the above, the International Financing Corporation (IFC) has recently publishe the Tafila Region Wind Power Projects Cumulative Effect Assessment. The overall objective of the CEA was to identify the potential cumulative effects of the Wind Power Projects on biodiversity in the study area of Tafila Region and propose mitigation, monitoring and other management measures to address the highest risks. Risks were identified with respect to Valued Social and Environmental Components (VECs). The CEA's scope was on three major biodiversity elements with the major focus being on birds.

Although the project site is outside the area of scope of the CEA, it is only located less than 3km to the south of it, making the CEA highly relevant to the project. The results of the CEA started with an initial list of 171 species populations that were identified as potentially at risk. This list was reduced through the CEA process to 13 species which were defined as priority bird VECs that were assessed to be at highest risk through the CEA process. Out of these 13 species populations, nine were recorded in the project site.

Based on the above, including the IFC's CEA, the species populations that have a potential high magnitude of impact in the project is nine species. Therefore, the magnitude of the impact in general ranges between low – high depending on the species of concern as noted in the Table 58 below.

Table 58: Magnitude of Impacts on Bird Species (ECO Consult, 2017)

Species	Magnitude of Impact	Justification
▪ Egyptian Vulture ▪ Steppe Eagle ▪ Eastern Imperial Eagle ▪ Booted Eagle	High	▪ High collision rates of such species with wind turbines ▪ Globally threatened ▪ Listed as one of the VECs of the IFC's CEA
▪ Griffon Vulture ▪ Short-Toed Snake Eagle ▪ Bonelli's Eagle ▪ Long-Legged Buzzard ▪ Lesser Kestrel	High	▪ High collision rates of such species with wind turbines ▪ Biological significance of a loss is very high due to its important local, national and/or regional status ▪ Listed as one of the VECs of the IFC's CEA
▪ Red-rumped Wheatear	High	▪ Unknown collision rate ▪ A high concentration of a breeding population of a regionally threatened species (Endangered)

▪ Black kite ▪ Steppe Buzzard ▪ European Honey-buzzard ▪ Montagu's Harrier ▪ Hen Harrier	Medium	▪ Migrants in flocks with frequent passes. ▪ Observed collision rates of this species is medium-low ▪ May cause high number of fatalities in a single event
▪ Pallid Harrier	Medium	▪ Observed collision rates of this species is medium-low ▪ Globally Near Threatened
▪ Remaining species	Low	▪ All other species are considered of low impact magnitude, as that they have no important international or local conservation status, have high avoidance rates, and were recorded in low numbers within the Project site.

Given all the above, the potential impacts on birds created during the operation phase would be of a long-term duration as they are as long as the wind turbines are operating. Such impacts are considered of negative nature and range from a low magnitude to a high magnitude (high magnitude has been taken into account as a worst case scenario). However, the receiving environmental is determined to be of a medium sensitivity. Given all of the above, such an impact is considered to be of moderate significance.

Mitigation and Monitoring Measures

The following identifies the mitigation and monitoring measures to be applied during operation phase. This mainly includes the undertaking of: (i) annual breeding survey, (ii) avi-fauna monitoring and turbine shutdown; (iii) onsite avi-fauna carcass search; (iv) onsite carcass search (other than birds); and (v) monitoring of the breeding population of the regionally Endangered Red-rumped Wheatear *Oenanthe moesta.*

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

(i) Annual Breeding Survey

During the first 3 years of operation a follow-up breeding bird survey must be undertaken (one each year) with the objective of comparing and determining the impacts of the construction phase on the Red-Rumped Wheatear. The breeding survey must be undertaken at the Project site during the breeding season (which lasts from March till mid-May). The survey must be undertaken by a qualified ornithologist and must be based on point counts that are spread over the entire Project site. At each point count all breeding activities must be recorded. Based on that an annual report must be prepared during the first 3 years.

(ii) Avi-Fauna Monitoring and On-Demand Turbine Shutdown

Monitoring during the operation of the wind farm must be completed in order to inform the actual impact caused by the wind farm on resident and migratory birds. The monitoring must be undertaken with the primary objective of collision avoidance but also secondary for migration monitoring behavior.

Monitoring must take place during the spring migration season (from early March until mid May) and autumn migration season (from early September till mid-November). Throughout these periods, monitoring must take place continuously on a daily basis. As for the summer and winter seasons, the level of effort of monitoring should be decreased and a single observer could be located in a central vantage point in the wind farm, to be identified later after the construction phase.

Monitoring must be undertaken onsite by qualified ornithologists to observe all migrating and resident birds. It is anticipated that a minimum of 3 vantage points will be required to undertake such monitoring

(however this can be determined and confirmed at a later stage based on onsite conditions when the turbines are in place).

Monitoring must take place to prevent potential collision of birds with the wind turbines, through individual shutdown of turbine(s) which pose an imminent collision risk to birds. Imminent risk is identified as (a) bird(s) flying at risk height and within a buffer distance of 500m from the turbine(s). However, this should be verified and confirmed during the actual operation of the project taking into account the actual turbine shutdown time as well as other onsite conditions.

Individual temporary turbine(s) shut-down will be enacted by the observers calling through to the control room once an imminent risk is identified and until the birds are out of the risk area. This should take place based on two main conditions and which include the following:

a. **Condition 1**: the passage of an individual bird species of global or national significance will require the individual temporary shutdown of the concerned turbine(s). Species under these conditions were previously highlighted in Table 55.
b. **Condition 2**: the passage of ten or more individuals of the species provided below will require the individual temporary shutdown of the concerned turbine(s). Species under these conditions were previously highlighted in Table 55.

Although some of the species listed above were not recorded during the bird monitoring that was carried as part of the ESIA, such as Levant Sparrowhawk *Accipiter brevipes*, but all the species listed above could occur in the project site even if rarely. The objective of the monitoring should be to avoid any potential collision that could occur to any individual of these species with a threshold of zero fatality as highlighted in the CEA of Tafila Region.

Observers must record in a log sheet in details the following: species involved, number/ID of turbines ordered for shutdown, time of dispatch of shutdown call, time of actual shutdown. After the risk situation is over the observer must also record the following: time of dispatch of operation resumption, time of actual operation resumption, outcome of event (collision or avoidance), and the avoidance behavior of bird(s).

In addition, to the above monitoring must also take place during summer and winter (mainly for resident bird activity) through the same methodology discussed above. However, during this time it is likely that a single vantage point will be required to cover the site – however this can be determined and confirmed at a later stage based on onsite conditions when the turbines are in place.

Taking the above into account, a semi-annual report must be prepared with all the findings and outcomes based on all records for that year and shut-down events and their effectiveness. In addition, the report must also determine whether any changes on the frequency of the monitoring are required – to include effectiveness of the vantage points and observation hours.

Moreover, as discussed earlier, the monitoring is also intended for migration monitoring behavior. Therefore, the report must also detail all migratory and resident bird activity and patterns, numbers, etc., similar to pre-construction monitoring.

The above monitoring plan must be undertaken during the first 3 years of operation. After the third year the monitoring plan will be reviewed and re-evaluated. For example, based on the results it could be decided that summer and winter monitoring should be discontinued or its frequency reduced due to low risk of collisions onsite and good avoidance behavior by bird species or it could be recommended to extend the monitoring further during the operation phase.

(iii) Avi-Fauna Carcass Search during Operation

During the operation phase, mortality rate surveys must be undertaken through carcass search surveys covering the entire wind farm. The carcass search will demonstrate the effectiveness of mitigation measures such as turbine shut down and allow an estimation of the annual number of bird deaths caused by the turbine.

a. Carcass Search Surveys

Carcass search surveys shall be carried out by the beginning of the operation phase on a weekly basis during the spring and autumn migration season and twice per month during the summer and winter season. A plot area of 100mX100m would be set around each turbine to search for carcasses. The plot will be covered with search transects 10 m apart, with the searcher looking 5 m on either side.

All found carcasses must be recorded in a log sheet with information to include the following: species, sex, age, condition, cause of death (to the greatest extent possible), coordinates, date, and photos as appropriate, condition (intact, scavenged, feather spots, etc.)

An annual report must be prepared with the results and outcomes to complement the report prepared for the migration monitoring as discussed earlier.

The above carcass search surveys must be undertaken during the first 3 years of operation. After the third year, the carcass search survey will be reviewed and re-evaluated. For example, based on the results it could be decided that autumn surveys should be discontinued or its frequency reduced due to absence of carcasses recorded.

b. Carcass Removal and Searcher Efficiency Bias Trials

Before commencement of the avi-fauna carcass search during the operation phase, a carcass removal and searcher efficiency trial test must be undertaken. The objective of this test is to factor and adjust for carcasses that are removed from the Project site from external factors (such as animals that might feed on such carcasses) as well as for searcher efficiency in locating carcasses.

Also, a carcass removal and searcher efficiency bias trial shall be undertaken for the Wind Farm in order to assess the efficiency of the carcass search team. This trial shall also cover the OHTL route in order to factor and adjust for carcasses that are removed from the Project site from external factors (such as animals that might feed on such carcasses) as well as for searcher efficiency in locating carcasses.

Carcasses will be placed and dispersed over the Wind Farm area as well as the OHTL route, avoiding saturation, which could attract animals to the site. They should be checked every day over fifteen days or until the entire carcasses have been removed if earlier.

At the same time, searchers should not be familiar with carcass location and will perform the carcass search annotating how many of the placed carcasses they find. After the trial of each searcher, the carcasses will be checked again to see if they are still there (and were not recorded by the searcher) or have been removed (by animals). Based on the above, the carcass removal and searcher efficiency rates can be calculated.

(iv) Onsite Carcass Search (other than birds)

The Project Operator must implement a carcass search plan (other than birds) for any carrion which could be present onsite to prevent attraction of birds to the site (such as the Griffon vulture, Egyptian vulture and Steppe Eagle which rely on livestock and medium-large size mammals to feed on). The plan should

cover the entire Project site and surrounding areas and must commence with the operation of the Project. This should be undertaken on a monthly basis but particular attention should be paid during the season when nomads are in the area (from April till September). Nomads raise livestock and carcasses could be in the area throughout such times. Such a plan should be implemented throughout the first 2 years of operation of the Project after which it could be reviewed and revaluated (e.g. if not carcasses are recorded during the first 2 years it can be discontinued).

(v) Monitoring of the breeding population of the regionally Endangered Red-rumped Wheatear *Oenanthe moesta*

According to IUCN Red List of Threatened Species (IUCN, 2016), Red-rumped Wheatear is assessed as Least Concern. On the regional level however, and according to the Conservation Status and Distribution of the Breeding Birds of the Arabian Peninsula (Symes et al, 2015), the species is assessed as Endangered. Based on this, the status of the breeding population of the species in the project site needs to be monitored for the first three years at least to assess its status and the potential impact that the project might have on the species. A breeding survey needs to be carried out in the spring season for the first three years, from March until May of each year.

13. BATS

This Chapter first provides an assessment of baseline conditions within the wind farm and its surroundings in relation to bats and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

13.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to bats and presents the outcomes and results.

13.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on a literature review and a field survey, each of which is discussed in detail below.

(i) Literature Review

This was based on previous studies, data, surveys, and records available in published scientific papers, books, and journals on bats of Jordan. All available data known in the study area and adjacent regions were tabulated.

(ii) Field Survey

Field survey was undertaken at the Project site using bat detectors. The survey is still ongoing as it started in April and is planned to last until August. This is regarded as the most suitable period of the year to assess bat activity as bats become active after the period of hibernation which may last from December to March after which they are active from April till late November. During this period, bats feed and reproduce giving birth in June and thereafter. In addition, the survey was undertaken during night-time as bats usually rest and sleep during the day and are active during night as they search for prey to feed on.

The survey was undertaken using a Titley Scientific ANABAT SD2 Active Bat Detector and recording stations were set along routes in the project site, see Figure 73. Upon detecting bat activity, coordinates would be recorded using Garmin (GPSMAP 62S) global positioning device. In addition, careful inspections were undertaken during the day throughout the Project site to identify potential roosting sites which might be inhabited by bats during the day for rest and sleep and such areas were inspected for bat signs and remains or any other vital signs that indicate bat activity (e.g. faecal remains).

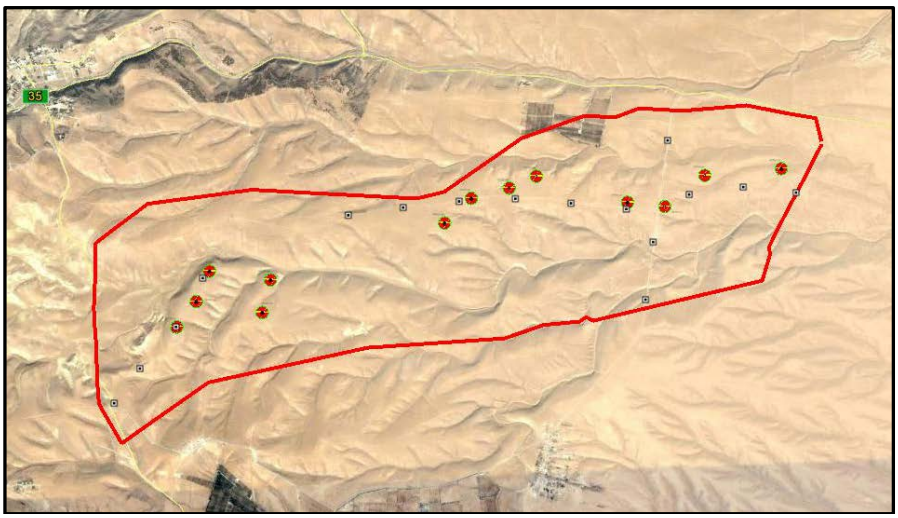

Figure 74: Location of Routes and Point Counts for the Bats and Breeding Bird Assessment

(iii) Bats Species' status

Bats species status was assigned based on their conservation status within the Mediterranean region according to the IUCN Red Data Books: "The Status and Distribution of Mediterranean Mammals" (Temple & Cuttelod, 2009). In addition, their local status was based on an assessment undertaken by the bats expert in collaboration with RSCN – where such an assessment was undertaken in accordance with IUCN criteria. However, the results for this assessment have not been published yet.

13.1.2 Results

A single bat species was recorded during the survey so far. The species was recorded in the western part of the project site near the village of Zaitooneh, see Table 59.

Table 59: Bat Species

Family	Scientific name	Common name	IUCN Red List	Mediterranean IUCN Regional Status
Vespertilionidae	*Pipistrellus kuhlii*	Kuhls' Pipistrelle	Least Concern	Least Concern

13.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on bats during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

13.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, levelling, excavation, grading, etc.

Such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal. Nevertheless, such activities would likely result in the alteration of the site's habitat and thus potentially impacts bats; particularly through loss of hunting habitats for bats as well as roosting sites.

The bat species recorded in the project site is evaluated as Least Concern conservation status according to both IUCN Red List of Threatened Species and the IUCN Mediterranean Regional Assessment. The species is also a common species in Jordan and is not known to face any specific threats. Also, based on the CEA for Tafileh Region, the species recorded in the project site is not identified as a priority species.

Given all the above, the potential impacts on bats created during the construction phase would of a long-term duration as they would result in a permanent change in the natural biodiversity of the site. However, such impacts are considered of negative nature and of a low magnitude given that the site is not used by bats as a feeding ground and no roosting sites were recorded. In addition, given the very limited bat activity, the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be not significant. To this extent, no mitigation measures have been identified.

13.2.2 Potential Impacts during the Operation Phase

The potential impacts from the Project during operation are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines.

Many reports have corroborated the findings of bat collisions with wind turbines; this includes reports in Germany (Dürr 2001; Trapp *et al.* 2002; Dürr & Bach 2004), Sweden (Ahlén, 2002) and Spain (Alcalde, 2003). Evidences that turbines do not only kill bats from local populations but also from populations at far distance were established (Voigt *et al*., 2012). Moreover, there are reports with findings on collisions of bat species similar to that recorded onsite (Kuhl's Pipistrelle) from a wind farm project in Spain (Alcalde, 2003).

The bat species recorded in the project is evaluated globally as Least Concern according to both IUCN Red List of Threatened Species and the IUCN Mediterranean Regional Assessment. The species is also a common species in Jordan and is not known to face any specific threats. Also, based on the CEA for Tafileh Region, the species recorded in the project site is not identified as a priority species.

Given all the above, the potential impacts on bats created during the operation phase would have a long-term duration. Such impacts are considered of negative nature and of a low magnitude given that a risk of collision of the species recorded does not entail any significant impacts (species recorded is very common and considered of least concern). In addition, given the very limited bat activity the receiving environmental is determined to be of a low sensitivity. Given all of the above, such an impact is considered to be not significant.

Additional Studies/Surveys and Mitigation and Monitoring Measures

Before commencement of operational activities, Project Operator is required to implement proper and adequate management measures for those sources which could attract bats to the Project site to the greatest extent possible. These sources could include strong white sources of light water ponds, where both sources could attract insects that are the main component of the diet of bats.

In addition, implement a bat mortality monitoring plan. The plan should include bat collision fatality 'carcass search' surveys informed by bat ecology, and calibration tests for searcher efficiency and bat carcass removal by scavengers. The monitoring program for bats should follow recommendations in the ESIA and the Tafila Wind Power Projects CEA MMP. The program must be undertaken by an expert and must include the following components:

- Bats mortality monitoring program would be carried out as part of the carcass search surveys that will be undertaken for birds, during the first 3 years of operation. After the third year, the carcass search survey, as a whole for birds and bats, will be reviewed and re-evaluated. For example, based

on the results it could be decided that autumn surveys should be discontinued or its frequency reduced due to absence of carcasses recorded. No bat-specific carcass removal and searcher efficiency trials will be carried out and it will be done as part of the birds trials, and

- Based on the outcomes of the mortality monitoring program, should no issues of concern be identified then the mortality monitoring program can be discontinued (this is the most likely scenario to occur). In the highly unlikely event that any issues of concern are identified (high bats mortality recorded) then additional investigations must take place on the sources of attraction of bats to the site (which will most likely be from external sources) and based on that appropriate mitigation measures must be identified.

14. ARCHEOLOGY AND CULTURAL HERITAGE

This Chapter first provides an assessment of baseline conditions within the project site and its surroundings in relation to archaeology and cultural heritage and then assesses the anticipated impacts from the project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

14.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to archaeology and cultural heritage and presents the outcomes and results.

14.1.1 Baseline Assessment Methodology

The baseline assessment of the Project site was based on a literature review and a field survey, each of which is discussed below.

(i) Literature Review

Literature review included a comprehensive review of archives, publications, and studies on previous archaeological work and surveys undertaken in the area, and which are available at the Department of Antiquities' (DoA) database. This also includes the search of the official register and database of all archaeological/cultural sites of Jordan known as the Middle Eastern Geodatabase for Antiquities – Jordan (MEGA Jordan).

(ii) Field Survey

A field survey was undertaken by the DoA – the official governmental entity in Jordan responsible for the protection, conservation, and preservation of antiquities in accordance with the "Antiquities Law No. 21 for 1988 and its amendments No. 23 for 2004".

The objective of the field survey was to ascertain the presence of any archaeological remains within the Project site. The survey was undertaken from 01 September – 08 September 2016 for the entire Project site boundary with a total area of approximately 24 km^2. It should be mentioned that the project boundaries that were covered in the survey, from here onwards is referred to as the survey area, were earlier boundaries, which were modified at a later stage to become with a surface area of 20km2, see Figure 74.

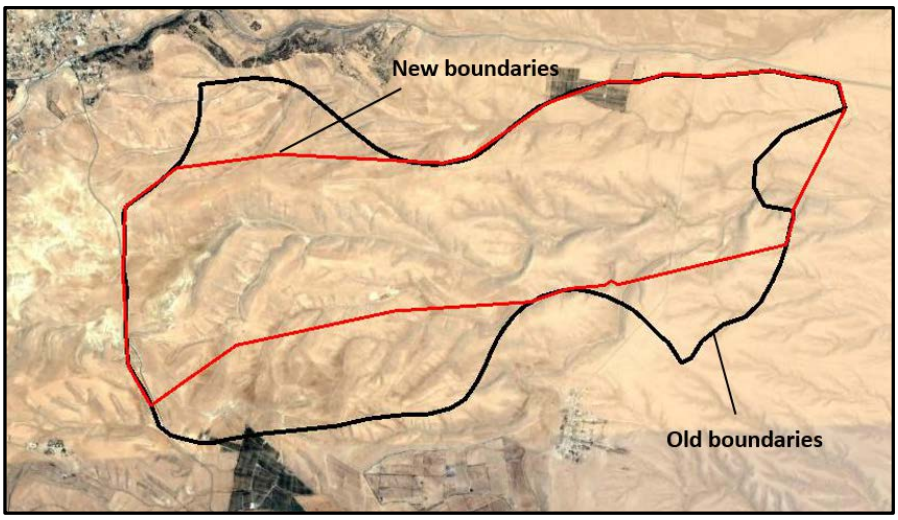

Figure 75: Older boundaries covered by the archaeology and cultural assessment (black) and the final project boundaries (red)

The survey area is, in general, characterized with being mountainous with several wadis that vary in size and depth. In addition, the survey area is approximately 1300 m above sea level. A technical team from DoA has walked along the boundary of the survey area given the exact coordinates provided by ECO Consult in order to inspect the entire ground surface. The ground was divided into 4 parcels, approximately with a surface area of 5 km^2 each, see Figure 75 below), which covered the entire survey area. Any sites of interest were recorded by sketch plans and /or a photograph as appropriate. Whilst walking these parcels, GPS coordinates were taken. The results of the survey were analysed by categorizing the sites and making an assessment of their significance. The result of the survey was a full listing of the archaeological sites, archaeological features, and survey results of the Project area using maps and photographs where appropriate.

14.1.2 Results

In accordance with the methodology discussed above, the results first provide the outcomes of the literature review and the outcomes of the DoA survey in addition to an extended analysis by ECO Consult based on the modifications in the project boundaries.

(i) Literature Review

This section summarizes some of the data collected from previous archaeological surveys and studies undertaken in Jordan, which are registered in the Middle Eastern Geodatabase for Antiquities (MEGA) – Jordan. MEGA-Jordan is a database, prepared by the Getty Conservation Institute in collaboration with Department of Antiquities (DoA) that encompasses and registers all the known archaeological sites in Jordan. Results collected from the MEGA Jordan returned no recorded archaeological sites within the projects' sites area or the area in general.

(ii) Overview of the Archaeological History of the Region

The area, in general, is believed to be rich in archaeological remains and is considered one of the oldest civilizations over the centuries – from the Stone Age up to modern times (this includes Edomite, Nabataean, Roman, Byzantine and Islamic periods). Fujeij, for instance, which is located around 8Km north of the project site, is a living evidence of an old civilization that dates back to the Old Stone Age – the second phase, in which double-sided axes of flint were explored.

In Shobak, specifically in Um Twairat area, Dolmens1 are the clearest archaeological footprint that prevailed from the Bronze Age to the present. In addition, Shobak played a major role in the Edomite Empire given its proximity to the ancient Bsaira, the capital city of the Edomite Empire.

Shobak has been distinguished all over the centuries with its historical Montreal Castle (also known as Shobak Castle). It was constructed in 1115 by King Baldwin I of Jerusalem to secure the trade links between Syria and Egypt, and was the first of a series of similar strongholds in the Latin Kingdom of Jerusalem. Saladin attacked the castle several times, finally capturing it in 1189 after Hittin battle (only 75 years after it was raised), when the Crusaders were losing their grip over the Holy Land. In 1260, it passed on to the Mamluks who restored it in the following century. Since then it was left largely unattended, gradually falling into greater dilapidation.

Moreover, Shobak is situated on Montreal, about 23 km north of Petra. Rebuilt several times, its walls and towers, as seen today, date to the Islamic period, 13th century and later. Earlier this century, the castle itself was occupied by a few local families, and there was a market within its walls which served all the villages, after which the Ministry of Tourism and Antiquities (MoTA) in Jordan represented by DoA designated the site as a preserved archaeological site.

(iii) Archaeological Assessment of the Project Site

Based on the results of the baseline assessment conducted as part of the archaeological survey undertaken by DoA, eleven (11) archaeological sites were identified, all of which – except for Site 1 - lie within the survey area of the Project agreed upon in June 2016 which is shown in Figure 76. However, as mentioned earlier, according to some recent adjustments made by the developer to the project boundaries, sites 4, 5 and 11 have become to be located outside the final boundaries of the project site. Moreover, the change in the boundaries has resulted in producing an area that was not covered by the original survey, see Figure 76. This area was later covered by the DoA and no archaeological sites were found in it.

Regarding all sites recorded in the survey, such sites include settlement sites with features such as watchtowers, remains of pottery pieces, archaeological debris, khirbet (old settlements), building structures, architectural elements, caverns, etc. which generally date back to several periods from the 2nd Stone Age into Roman and then Nabatean periods. Table 60 lists all these sites along with a brief description for each one of them while the Figures 77, 78 and 79 show the photographs that were taken for those archaeological sites during the survey.

[1] https://www.britannica.com/topic/dolmen

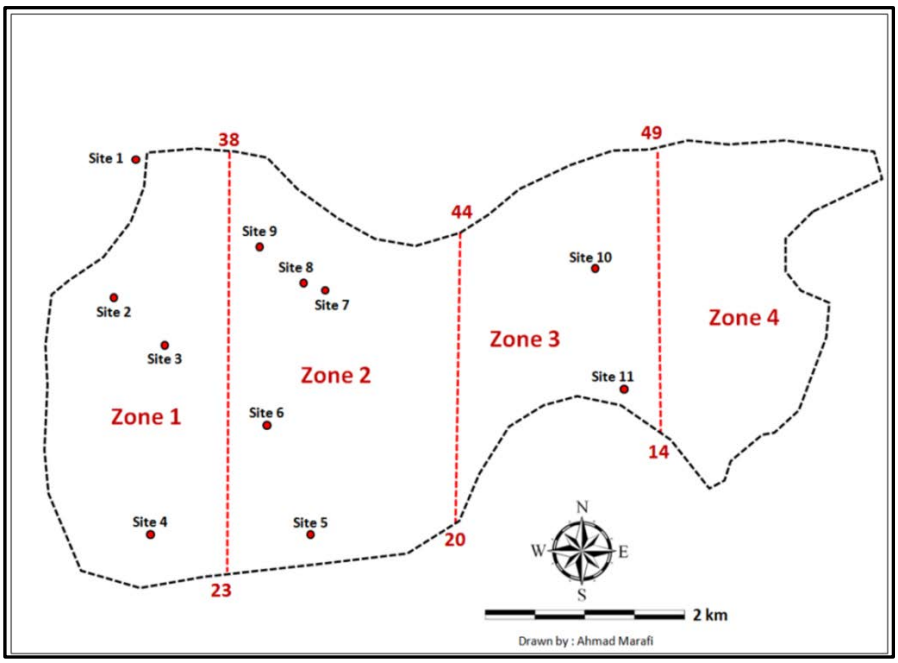

Figure 76: Archaeological Sites Recorded within the survey area (DoA, 2016)

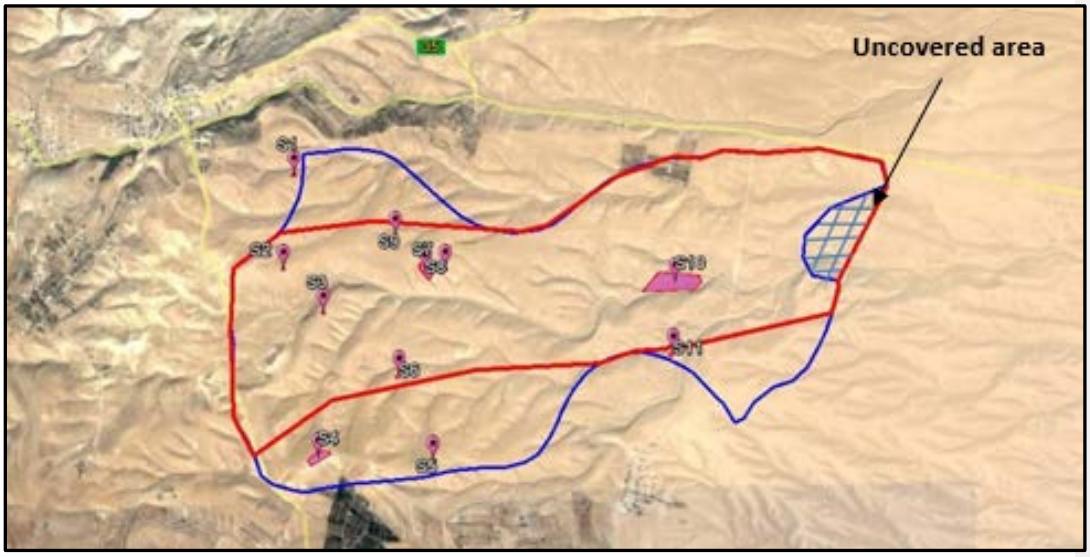

Figure 77: The survey area and the final project boundaries, showing the archaeological sites and the area that was not covered in the first survey of DoA (ECO Consult & DoA, 2017)

Table 60: List of Archaeological Sites Recorded during the DoA survey and their location in relation to the final project boundaries

Site	Period*	Brief Description	Area (m^2)	Location in relation to the final project boundaries
1	Nabatean, Late Roman	A square building structure (4x4) m, which is completely damaged except for the northern and western facets which are one course in height.	484	Outside
2	Nabatean, Late Roman	Remains of a one meter high circular mound 8m in diameter which consists of small-medium sized flint stones, in addition to large scattered stone blocks that exist as an indicator of disturbance to the mound caused by ploughing activities within the vicinity of the site.	958	Inside
3	2nd Stone Age/ Roman	Remains of a 2-courses high elliptical building (14x8) m built from Calcite stones, where the northern side of it seems to be disturbed. The building is thought to be used as a watchtower during the Roman Empire due to its unique elevated location overlooking surrounding area.	1,029	Inside
4	2nd Stone Age/ Roman/ Nabatean	A large archaeological site featuring remains of completely damaged huge building structures - different in shapes – built from large flint stones in addition to a few number of caverns. It is thought that most of the site's stones were hauled off to other places to be utilized for different purposes (i.e. construction).	22,574	Outside
5	2nd Stone Age/ Roman/ Nabatean	Remains of a large archaeological site spread over an area of approximately three Dunums, consisting of indistinguishable remains of completely-damaged building structures as well as a circular mound built from medium-large flint stones. In addition, the site features 11 graves, all of which most likely belong to the Hithban tribe, dating back to 3-4 decades ago.	2,538	Outside
6	2nd Stone Age/ Roman/ Nabatean	Remains of completely-damaged and indistinguishable building structures built from flint stones spread over an area of approximately 5 Dunums.	2,803	Inside
7	2nd Stone Age	Remains of completely-damaged and indistinguishable building structures spread over an area of approximately 2 Dunums which dates back to the Edomite period.	1,217	Inside
8	2nd Stone Age/ Roman/ Nabatean/Byzantine/ Ottoman	A large archaeological site spread over an area of more than 25 Dunums featuring remains of large completely-damaged building structures – different in shapes – in addition to few caverns and a circular pond that Is 20m in diameter with a rocky foundation. Above all, the site is mainly distinguished through a 3-courses rectangular-shaped building (5x7)m built from trimmed medium-sized calcite stone blocks (70cm each) with a 1m wide opening. The rectangular building most likely dates back to the Nabatean period.	16,136	Inside
9	2nd Stone Age	Two elliptical-shaped graves facing (east-to-west) with few randomly scattered Basalt and flint stones, all of which are untrimmed, in addition to very minimal number of archaeological finds.	309	Inside
10	2nd Stone Age	A large graveyard with an area of over 100 Dunums spread over a huge foothill descending towards the north and the east, consisting of tens of graves 1-3m in diameter - similar in shape to circular mounds - which are built from small-medium flint stones and most likely date back to the Edomite period.	113,516	Inside
11	2nd Stone Age/ Roman/ Nabatean	A large archaeological site (8 Dunums) featuring remains of completely-damaged building structures and interconnecting walls surrounding the majority of the site. The site is mainly distinguished by a square building structure (10x10)m built from large trimmed calcite stone located over a hilly ridge (6m above the surroundings). In addition, It is believed that this square building was used as a Nabatean temple.	4,256	Outside

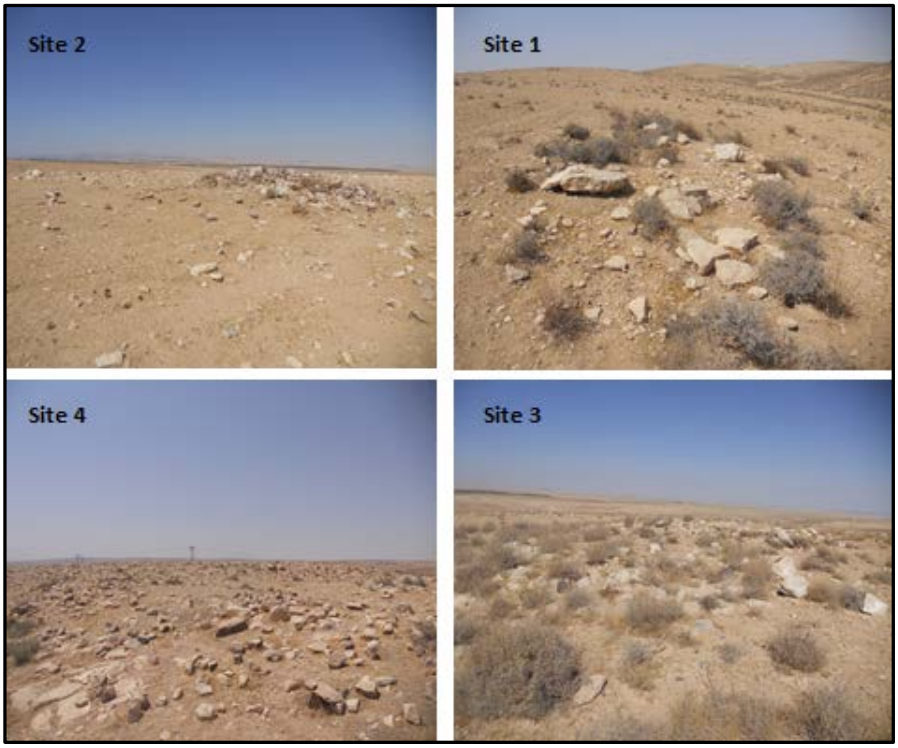

Figure 78: Sites 1 – 4

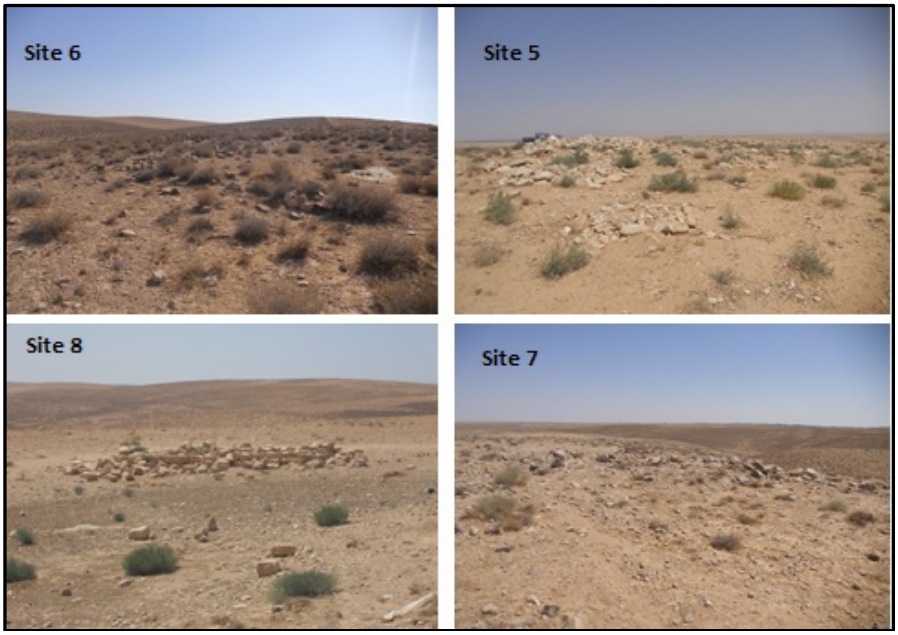

Figure 79: Sites 5 - 8

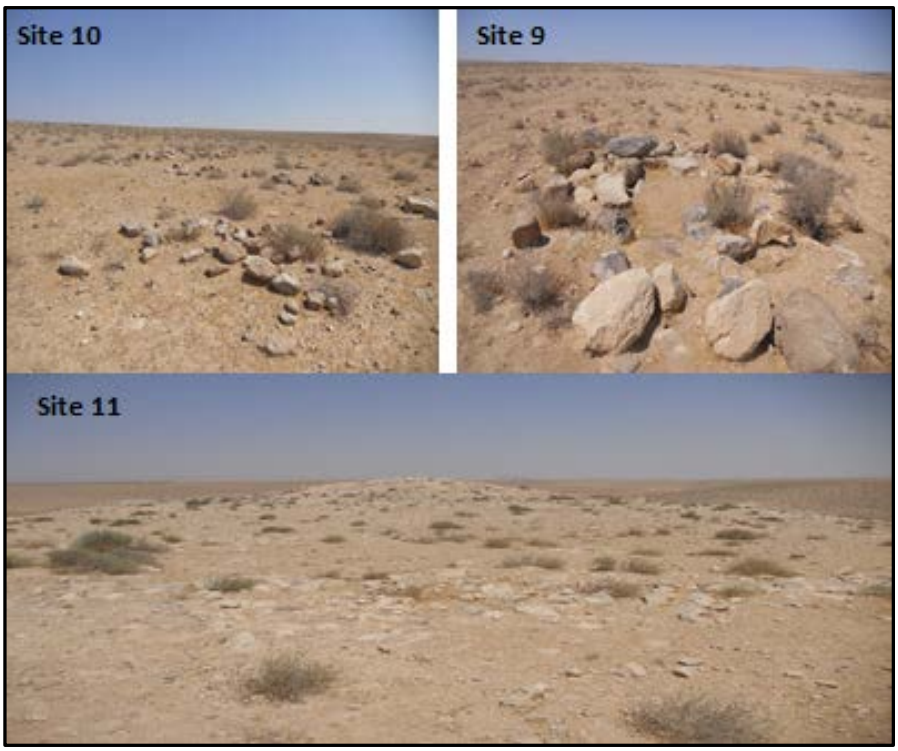

Figure 80: Sites 9 - 11

14.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the project activities on archaeology and cultural heritage during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

14.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, levelling, excavation, grading, etc.

Although such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal, if such activities are improperly managed they could damage or disturb archaeological remains present on the surface of the Project site. As discussed in the baseline section (refer to "Section 14.1"), there were 7 archaeological sites recorded within the project site.

Such sites recorded are considered important given their archaeological and cultural value, and should be protected from potential damage or destruction throughout the various project activities. According to the survey of the DoA, one of the sites (Site 10) is considered of high importance. The other sites are not considered unique nor distinctive archaeological features.

Based on the final layout of the turbines and the other project components, it was found that two of the archaeological sites (Site 3 and site 8), are located in close proximity to planned construction activities, see Figure 80.

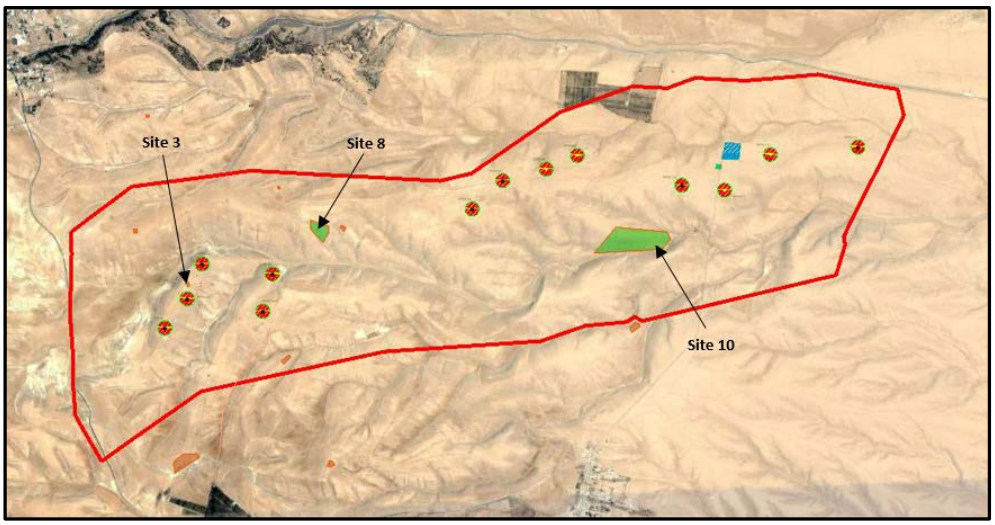

Figure 81: Sites located in close proximity to planned construction activities

In addition, there is a chance that throughout such construction activities, archaeological remains buried in the ground are discovered. Improper management (if such sites are discovered) could potentially disturb or damage such sites which could potentially be of archaeological importance.

Given all of the above, the potential impacts on archaeology created during the construction period would of a short-term duration as they are limited to the construction phase only. The impacts will be of a negative nature, and medium magnitude if improperly managed as it is possible once a site is damaged or disturbed it cannot be restored. In addition, given the presence of archaeological remains in the Project area, the receiving environment is considered of medium sensitivity. Given all of the above, such an impact is considered to be of moderate significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase for all archaeological sites, and which include:

- As part of the disclosure session for the ESIA results with the local communities (as discussed in Section 6.6.1), present the results and outcomes of the archaeology assessment. In particular, this should focus on the identified sites of importance by the DoA and whether the local community require access to such sites (such as the graveyard). Should this be applicable, then appropriate mitigation measures must be identified and implemented to ensure access to such sites is maintained for the local communities.
- The final detailed design prepared by the EPC Contractor should avoid sitting any of the Project components (to include the turbines, roads, transmission lines, warehouses, etc.) within such delineated areas of archaeological importance which takes into account a 70m buffer area from each site as required by the DoA. Exact coordinates of such areas along with the buffer area to be provided in AUTOCAD format for the EPC Contractor to take into account during the detailed design of the Project.
- Submission of final detailed design to the Department of Antiquities to demonstrate that such sites have been avoided.
- Before commencement of any construction activities, the identified sites must be properly demarcated (with fences or flag poles or other as appropriate) with appropriate signage so that the sites are clearly visible to all workers during construction.

- Properly plan construction activities to take into account the identified archaeological locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas during the various construction activities, etc.
- Ensure that the Code of Conduct, awareness raising, and training developed for construction workers and personnel involved in the construction phase of the Project to emphasizes the presence of archaeological locations in the area - this would include providing information on their locations, prohibit any improper conduct which could disturb/ damage those locations, etc.
- Implement appropriate chance find procedures. Throughout the construction phase and as the case with any project development that entails such construction activities there is a chance that potential archaeological remains in the ground are discovered. It is expected that appropriate measures for such chance find procedures are implemented which are standard requirements by the DoA as required by the "Antiquities Law No. 21 for 1988 and its amendments No. 23 for 2004". Those mainly require that construction activities be halted in the specified area of findings and the area fenced, while immediately notifying the DoA. No additional work will be allowed before the Department assesses the found potential archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.

Regarding the three archaeological sites mentioned earlier (sites, 3, 8 and 10), specific mitigation measures have been agreed with DoA in order to ensure the conservation of these sites, which are:

- Fencing around the archaeological sites 8 and 10 including a 100 metre buffer,
- Provide timeline and movement corridors for machinery in the vicinity of these three archaeological sites,
- Add fence around WTG 2 and site 3 after finishing construction of the turbine,
- The EPC Contractor shall inform DoA of the works to be done around sites 3 and 8; so that DoA can allocate a person to be on-site to observe these works and ensure all is well managed

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Submission of proof of coordination for submission of final detailed design to the DoA.
- Inspections of construction activities to ensure that archaeological locations are avoided throughout the construction activities and proper code of conduct is enforced.
- Inspection of actions taken in case of new discoveries, including fencing, limiting access to site, and contacting the DoA. Report should be prepared and submitted to the DoA in such a case which details the above.

14.2.2 Potential Impacts during the Operation Phase

Potential impacts during the operation phase are limited to improper management of operation activities which could potentially disturb or damage the archaeological locations identified as discussed earlier. This could include for example improper movement of vehicles and machinery into/out of the site, improper conduct by operation workers, etc.

Given all of the above, the potential impacts on archaeology are of a long -term duration throughout the Project operation phase. The impacts will be of a negative nature, and medium magnitude if improperly managed as it is possible once a site is damaged or disturbed it cannot be restored. However, operation and maintenance activities are expected to occur at designated areas only (turbine locations, substation, etc.) using access roads established during the construction phase, therefore the receiving environment is considered of low sensitivity. Given all of the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the Project Operator during the operation phase and which include:

- Properly plan operation and maintenance activities to take into account the identified archaeological locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas during the various operation and maintenance activities, etc.
- Ensure that the Code of Conduct, awareness raising, and training developed for workers and personnel involved in the operation phase of the Project to emphasizes the presence of archaeological locations in the area – this could include providing information on their locations, prohibit any improper conduct which could disturb/ damage those locations, etc.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the Project Operator during the operation phase and which include:

- Continuous monitoring of operation activities to ensure that a proper code of conduct is enforced.

15. AIR QUALITY

This Chapter provides an assessment of anticipated impacts on air quality from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

15.1 Assessment of Baseline Conditions

Assessment of baseline conditions is considered unnecessary (i.e. measurements of air pollutants), due to the nature of anticipated impacts from the Project – which are mainly related to dust generation. Such impacts can be adequately controlled through appropriate mitigation and monitoring measures as discussed in further details below.

15.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on air quality during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

15.2.1 Potential Impacts on Air Quality during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the wind turbines and the various Project components to include transmission cables, access roads and internal road network, buildings, etc. are expected to include land clearing activities, levelling, excavation, grading, etc.

Although such activities are limited to the relatively small individual footprints of these facilities and the actual area of disturbance is relatively minimal. Nevertheless, such activities will likely result in an increased level of dust and particulate matter emissions, which in turn will directly and temporarily impact ambient air quality. If improperly managed, there is a risk of nuisance and health effects to construction workers onsite and to a lesser extent to the nearby surrounding receptors from windblown dust (such as grazing reserve facility to the west, highway to the north and south, etc.). In addition, construction activities will likely entail the use of vehicles, machinery and equipment (such as generators, compressors, etc.) which are expected to be a source of other pollutant emissions (such as SO2, NO2, CO, etc.) which would also have minimal direct impacts on ambient air quality.

The above impacts are anticipated to be temporary and of short-term nature as they are limited to the construction period only. Such impacts are of a negative nature, and will be noticeable and therefore of medium magnitude. However, the impacts will be dispersed and are reversible as air quality would revert back to baseline conditions after construction works is completed and thus the receiving environment is considered of low sensitivity. Given the above such an impact is considered of minor significance.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor during the construction phase:

- Based on inspections and visual monitoring undertaken, if dust or pollutant emissions were found to be excessive due to construction activities, the source of such emissions should be identified and adequate control measures must be implemented;
- Comply with the Occupational Safety and Health Administration (OSHA) requirements and the Jordanian Codes to ensure that for activities associated with high dust and noise levels, workers are

equipped with proper Personal Protective Equipment (e.g. masks, eye goggles, breathing masks, ear muffs, etc.);

- Apply basic dust control and suppression measures which could include:
  - Regular watering of roads for dust suppression;
  - Proper planning of dust causing activities to take place simultaneously to reduce the dust incidents over the construction period.
  - Proper management of stockpiles and excavated material (e.g. watering, containment, covering, bundling).
  - Proper covering of trucks transporting aggregates and fine materials (e.g. by tarpaulin).
  - Adhering to a speed limit of 15km/h for trucks on the construction site.
- Develop a regular inspection and scheduled maintenance program for vehicles, machinery, and equipment to be used throughout the construction phase for early detection of issue to avoid unnecessary pollutant emissions.

Following the implementation of these mitigation measures, the significance of the residual impact is categorized as not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Inspection and visual monitoring of the works should be carried out at all times. In addition, periodic inspections should be conducted at nearby sites (e.g. villages) to determine whether harmful levels of dust from construction activities exist; and
- Reporting of any excessive levels of pollutants/dust or noise and the measures taken to minimize the impact and prevent it from occurring again.

16. INFRASTRUCUTRE AND UTILITIES

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to infrastructure and utilities and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

16.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to infrastructure and utilities as well as the outcomes and results.

The components discussed in relation to infrastructure and utilities include the following: (i) water resources; (ii) wastewater services; (iii) solid waste services; (iv) hazardous waste services; (v) aviation, telecommunication and television & radio link; (vi) road safety each of which is discussed separately below.

16.1.1 Baseline Assessment Methodology

The baseline assessment was based on collection of secondary data and plans available as well as discussions and consultations mainly with representatives from various governmental authorities and utility service providers as discussed in detail throughout this section.

16.1.2 Water Resources

The water sector in Jordan is generally governed by the Ministry of Water and Irrigation (MWI) and the Water Authority of Jordan (WAJ). MWI is the official body responsible for the overall monitoring of the water sector, water supply and wastewater system, and the formulation of national water strategies and policies. WAJ assumes all responsibilities related to water and wastewater structures including design, construction, operation, maintenance and administration. Within Shobak District, Shobak Water Directorate is the responsible entity representing WAJ.

According to the "Strategic Master Plan for Municipal Water Infrastructure" (ISSP, 2015), water system within Ma'an Governorate is divided into nine main systems;

1. Ma'an Main Water System: is the main water system that covers the sub district of Ma'an.
2. Wadi Mousa Water System: medium sized water system that covers the Wadi Mousa sub district
3. **Shobak Water System**: medium sized water system that covers the Shobak district.
4. Al-Manshiyya Water System: small water system that covers the Manshiyya locality
5. Al-Muraygha and Wahida Water System: small water system that covers Al-Muraygha locality
6. Al-Muhamadiyya Water System: small water system that covers al-Muhamadiyya locality
7. Al-Husayniyya Water System: water system that covers al-Hussayniyya district
8. Al-Jafr Water System: small water that covers three localities in the al-Jafr sub-district
9. Al-Mudawwara Water System: small water system that covers the al-Mudawwaral locality in the Jafr sub-district
10. The Project area in general is supplied through the Shobak water system which is divided into three separate sub-systems; Nijil, Hamza, and Ad-Dabbaghat. The overview of Shobak water system is presented in Figure 81 below.

The Shobak water system is comprised of 7 operating wells with a maximum combined pumping capacity of 380 m3/hour as presented in Table 61 below. Such wells are divided between the 3 sub-systems discussed above as follows: the Nijil sub-system receives water from Shobak wells 1, 3A, and 4 and the Hamza sub-system receives water from Shobak wells 6 and 6A while Ad-Dabbaghat sub-system receives water from Shobak wells 8 and 10. The Nijil sub-system received the most water, as its supply wells produced 0.64 MCM whereas the Hamza and Ad-Dabbaghat sub-systems produced 0.37 and 0.38 MCM, respectively.

Finally, Figure 82 also presents the water supply network of the Shobak water system. As noted in the figure below, some parts of the water network run within the eastern parts of the Project site. The water network is underground and the water line is around 100mm in diameter.

Table 61: Shobak Well Fields

Groundwater well	Pumpage annual (m3/yr)
Nijil Sub-water System	
Shobak well 1	94,734
Shobak well 3A	168,770
Shobak well 4	381,179
Hamza Sub-water System	
Shobak well 6	122,134
Shobak well 6A	243,035
Ad-Dabbaghat Sub-water System	
Shobak well 8	243,121
Shobak well 10	136,737
Total	**1,389,710**

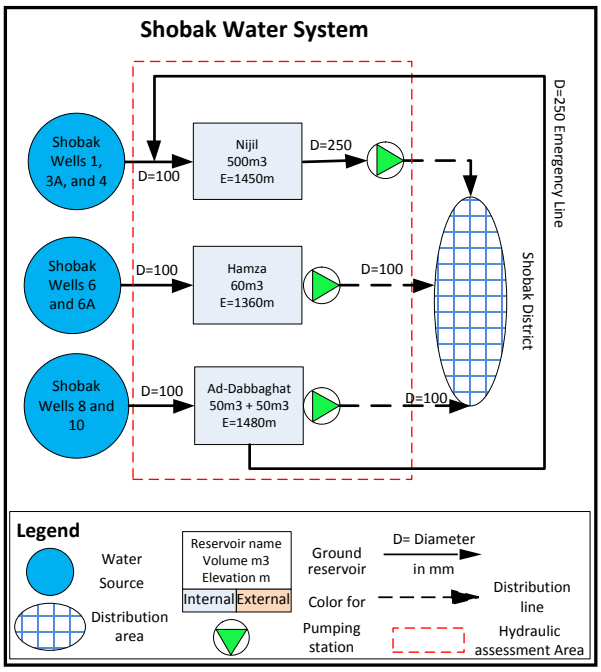

Figure 82: Schematic of Shobak Water System

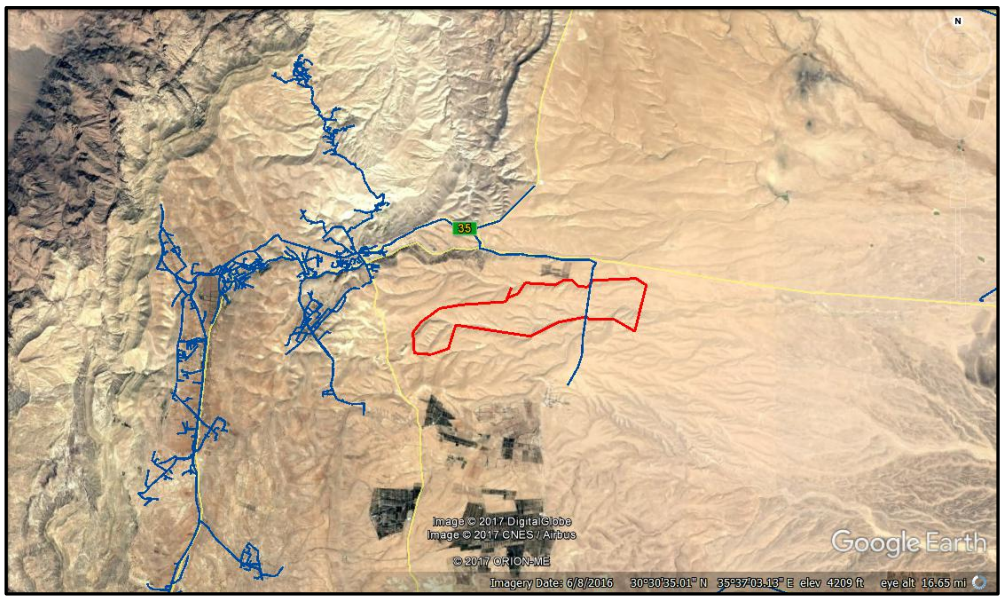

Figure 83: Water Network of Shobak Water System in relation to the Project site.

16.1.3 Wastewater Services

The same entities that govern the water sector are responsible for the wastewater as well. MWI is the official body responsible for the overall monitoring of the water sector, water supply and wastewater system, and the formulation of national water strategies and policies. WAJ assumes all responsibilities related to wastewater structures and within Shobak District, Shobak Water Directorate is the responsible entity representing WAJ.

Within the Shobak District, there are 2 Waste Water Treatment Plants (WWTP) known as Shobak WWTP and Mansoorah WWTP, see Figure 83. Shobak WWTP was constructed in 2010 as a natural treatment plant with a design capacity of 350m3/d and a current load of about 19% of its design capacity. Mansoorah WWTP was constructed in 2010 as a natural treatment plant and has a design capacity of 50m3/d and receives 13 m3/d.

The location of the WWTP in relation to the Project site is presented in the figure below.

It is important to note that the villages within Shobak District are not served with a wastewater network. Wastewater is mostly disposed through septic pits which are emptied by tankers on a regular basis to Shobak and Mansoorah WWTP.

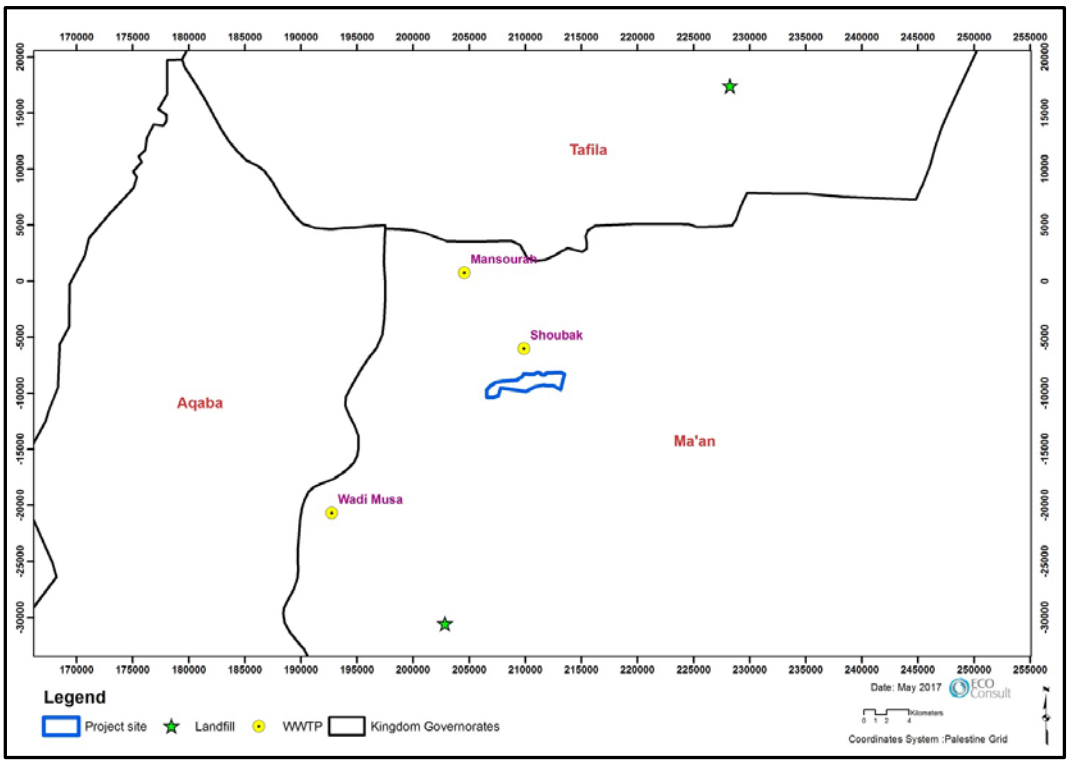

Figure 84: Location of Closest WWTP in Relation to Project Site

16.1.4 Solid Waste Services

In Jordan, solid waste management is undertaken primarily by the public sector. Solid waste is managed through the operation of landfills (or dumpsites). In accordance with the "Municipalities Law Mo.13 of 2007", solid waste management is the responsibility of local municipalities under the umbrella of the Ministry of Municipal Affairs (MoMA) – this includes the collection of municipal solid waste, transportation, and final disposal to landfills.

Within Shobak District, solid waste is collected from relevant municipalities and is transported to the Shobak Transfer Station which was developed in 2005 and was put in operation in 2008. Solid waste is then transferred to Ma'an Landfill located around 60km to the south of the Transfer Station. The Transfer station receives on average around 20-25 tons of solid waste per day and is located at an area of around 10 Dunums. The location of the transfer station in relation to the Project site is presented in Figure 84 below.

As for construction waste, there is only one authorized landfill which can utilized for disposal of construction waste – known as Ma'an Central Landfill site. The landfill is located around 39km to the southeast of the Project site, see Figure 85. The landfill has an area of approximately 500 Dunums and receives around 80 tons of solid waste per day. There are is no specific number on the total capacity which the landfill can handle, however it is expected to remain operational till the year 2045 taking into account the population growth and various developments within the Ma'an area. According to discussions with Greater Ma'an Municipality the landfill can accept construction waste and debris, whereas current practice within Ma'an is disposal through illegal dumping in wadis.

Figure 85: Shobak Transfer Station in Relation to the Project Site

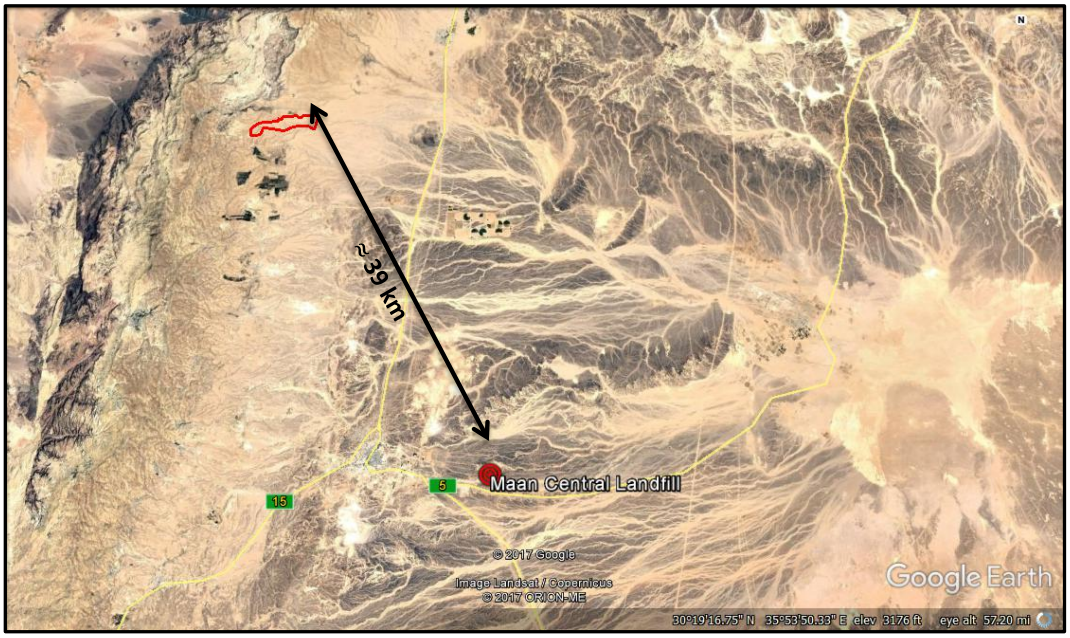

Figure 86: Location of Ma'an Central Landfill in relation to the Project Site

16.1.5 Hazardous Waste Services

In accordance with the "Environmental Protection Law No.(52) of the year 2006" and the "Instruction for Management and Handling of Hazardous Waste of 2003", hazardous waste must be transported and disposed at landfills which are approved by the MoEnv.

In Jordan, there is currently one landfill for disposal of hazardous waste – the Swaqa Hazardous Waste Treatment Facility. The facility is operated and managed by the MoEnv. The facility is located in Al-Karak Governorate, around 70km south of the capital city of Amman and approximately 102km to the northeast of the Project site. Figure 86 below presents the location of Swaqa Hazardous Waste Treatment Facility in relation to the Project site.

According to discussion with the ''Hazardous Substances and Waste Management Directorate" of the MoEnv, the facility is located on an area of around 8,500 Dunums and receives around 8-10 tons per day of hazardous waste. Currently disposal of hazardous waste is undertaken through either land-filling of stabilized and inert hazardous waste in specially lined cells, while for other types of waste which require physical-chemical treatment or incineration they are stored in safe storage spaces. Such storage spaces are temporarily until the second phase of the facility construction is implemented. The second phase mainly involves physical-chemical treatment and incineration facilities which mainly aim to improve handling and management of hazardous waste which requires treatment or incineration. Currently, there are no additional plans by the MoEnv for hazardous waste management in Jordan.

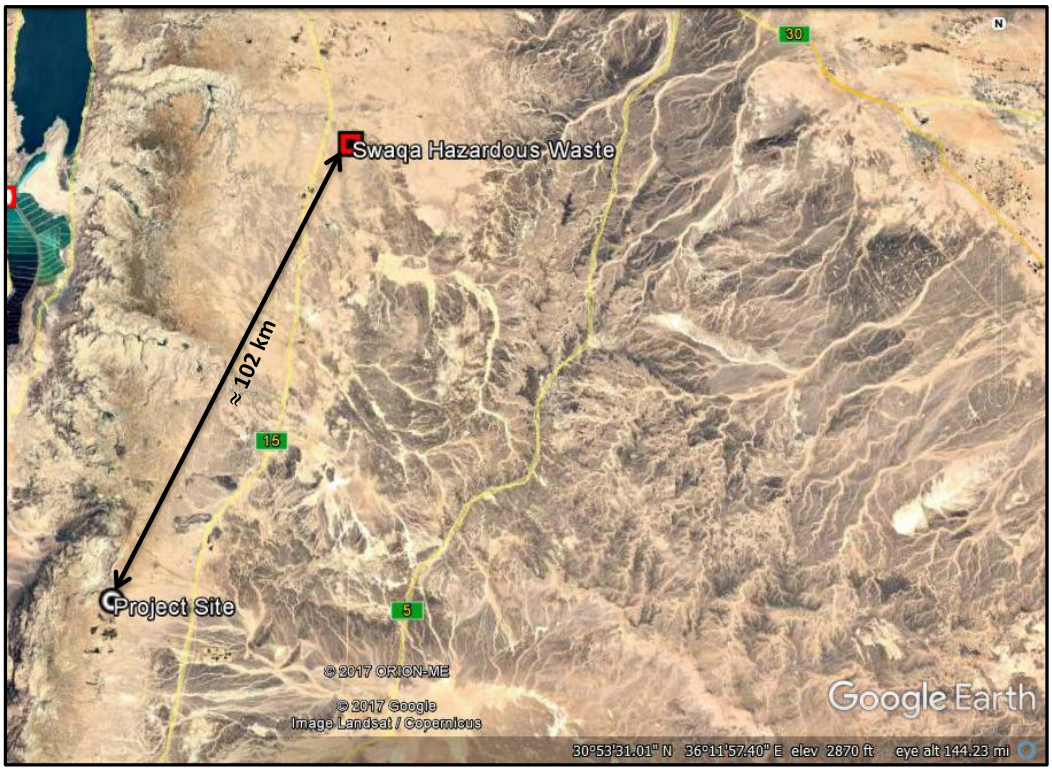

Figure 87: Swaqa Hazardous Waste Treatment Facility in Relation to the Project Site

16.1.6 Aviation, Telecommunication and Television & Radio Links

Official communications were established with the relevant governmental entities that govern the subject matter as presented below.

The objective of such communication was to collect information and understand what infrastructure elements are within the Project area in general, and identify requirements that should be taken into account for the Project development.

- ***Civil Aviation Regulatory Commission (CARC)/ Royal Jordanian Air Force (RJAF):*** CARC is the official governmental authority responsible for the development of civil aviation safety and security and environmental regulatory compliance, whereas RJAF is responsible for all military air bases in Jordan;
- ***Telecommunication Regulatory Commission (TRC):*** the TRC is the official entity for regulating the telecommunications and information technology services in the Kingdom to guarantee the provision of high-standard information and communications technology services to end users; and
- ***Jordan Radio and Television Corporation (JRTV)***: JRTV is the state broadcaster of Jordan for radio and television transmission.

Presented below are the infrastructure elements in the Project area in relation to aviation, telecommunication, and television and radio links respectively.

(i) Aviation (Civil and Military)

The closest civil airport in the area is the King Hussein International Airport located in Aqaba and around 110km southwest of the Project site as presented in Figure 87. Other civil airports in Jordan are located within Amman Governorate and include the Queen Alia International Airport located 135km from the Project site, and the Marka International Airport located 160km from the Project site.

In addition, with regards to military air bases, in the south of Jordan there is only one military airport located within Ma'an Governorate at Al-Jafr area, known as King Feisal Airbase. This air base is located around 50km to the east of the Project site. For security reasons, information on radars in the area was not provided neither by CARC nor RJAF.

Figure 88: Location of project site in relation to nearby civil and military air bases

(ii) Telecommunication Links

Official communication was established by ECO Consult with TRC. ECO Consult provided TRC with all information required for the Project to include Project location, coordinates, location and specifications of turbines and other as appropriate. ECO Consult required the TRC to contact telecommunication companies in Jordan (Zain, Orange and Umniah) and provide information on location of telecommunication towers in the area and line of sight connections.

An official letter was provided by the TRC stating that all three telecommunication companies have responded stating that the Project will have no impact on any of their telecommunication towers or line of sight connections. Official letter provided in Annex I.

(iii) Television and Radio Links

Official communication was established with JRTV by ECO Consult. ECO Consult provided JRTV with all information required for the Project to include Project location, coordinates, location and specifications of turbines and other as appropriate. ECO Consult required the JRTV to provide information on its broadcasting towers in the area.

JRTV responded and indicated that the closest tower is located around 2.2km north of the Project site as indicated in Figure 88 below. The tower is a radio broadcasting tower at 612 kHz. JRTV indicated that in order for the tower not to be impacted, a distance of 490m should be taken into account, and given that the Project is not located within such a distance they have no objection on the development of the Project (letter provided in Annex I).

Figure 89: Location of JRTV Broadcasting Tower

16.1.7 Road Networks

The Ministry of Public Works and Housing (MPWH), operating under the "Regulation of Organization and Management of the MPWH No. 55 of 1996", is the governmental authority responsible for the construction and development of the public road network in Jordan. The Ministry is also responsible for connecting cities, villages, and communities together in addition to maintaining the network in good technical conditions. Within Ma'an Governorate, the Ma'an Public Works Directorate assumes the responsibilities of the MPWH.

The Project site can be accessed from Highway #15 (better known as the 'Desert Highway') which is the major route in Jordan and connects the capital city of Amman with the southern Governorate of Jordan (Aqaba, Ma'an, Karak, Tafileh). This highway is heavily travelled daily by large vehicles (trailers and trucks) transporting materials to/from the capital city of Amman and the Port of Aqaba (as well as other industrial establishments in the southern Governorates of Jordan). The Project site is located about 167 km road distance from the Port of Aqaba northward.

Components for wind energy projects are usually transported by sea from the manufacturing country to the country of installation and are then loaded in existing ports to trucks which manoeuvre their way through existing roads to the installation site.

With regards to the Project, the wind turbine components will arrive to the Port of Aqaba in the south of Jordan. Figure 89 and Figure 90 below presents the transportation route from the Port of Aqaba to the Project site. The transport will follow Highway #15 around 134km after which an exit from Unayza Intersection through road #818 for about 13km west which leads to the northern edge of the Project site.

Figure 90: Southern Section of the Transportation Route

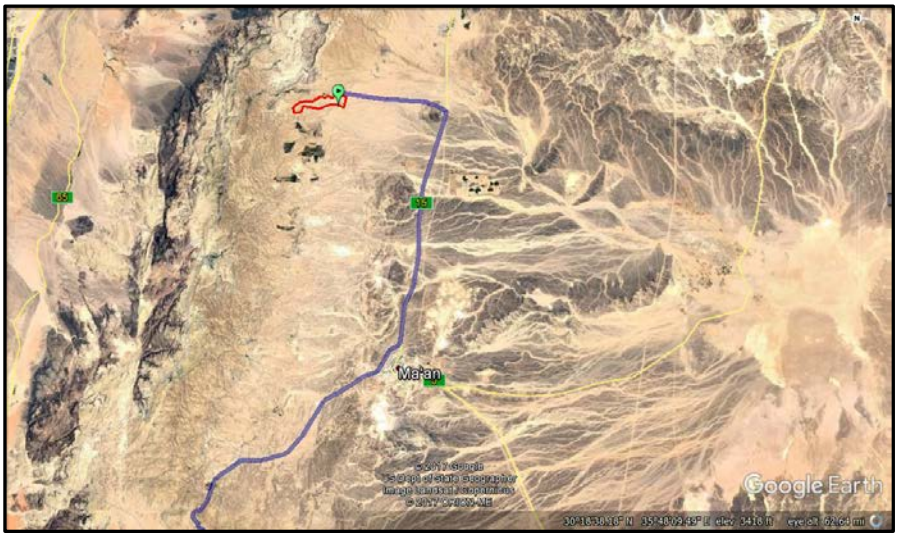

Figure 91: Northern Section of the Transportation Route

16.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on infrastructure and utilities during the various phases to include planning and construction phase and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

16.2.1 Potential Impacts on Water Resources during the Construction and Operation Phase

It is expected that the Project throughout the construction and operation phase will require water for potable usage (drinking, personal cleaning, etc.) and non-potable usage (e.g. cleaning of turbines).

During the construction phase, the potable water requirements for around 60 workers onsite is not expected to exceed 50 litres per capita per day for a duration of 16 months. Thus, the daily water consumption is likely to be around 3,000 litres per day – or $3m^3$ per day. In addition, during the construction phase water for non-potable usage will be required which has been estimated to be around $1.5m^3$/ day. Therefore, the total water requirements during the construction phase are likely to be around $5m^3$/ day. The water requirements throughout the construction phase will be required temporary (for construction period only) and are considered minimal and not significant.

In addition, water will be required during the operation phase and mainly for drinking and other personal use of onsite staff (around 3 personnel). Similarly, potable water requirements for the onsite workers is not expected to exceed 50 litres per capita per day – thus a daily water consumption is likely to be around 150 litres per day – or $0.15m^3$ per day.

During operation, water will also be required for the cleaning of the blades. Based on previous experiences for wind farms in Jordan, it is expected that the cleaning will take place once every 3 – 5 years, thus amounting to 4 – 6 times during the lifetime of the Project. The amount of water required per wash is around $15m^3$ (equivalent to around $1m^3$ per turbine); thus the maximum amount of water required during the lifetime of the Project is around $100m^3$ (assuming 6 washes are undertaken) – amounting to around $0.01m^3$ per day.

Therefore, the total water consumption during operation is likely to be around $0.15m^3$/day for a duration of 20 years (equivalent to around $55m^3$ per year).

Putting things into perspective, the total annual water supplied by the Shobak Water Supply System is 1.39 MCM. Comparing the numbers above clearly reveals that the water requirements of the Project are rather considered to be negligible and are expected to be easily met by the Shobak Water Directorate. In addition, such water requirements will most likely be met through licensed tankers from the Shobak Water Directorate which are likely to provide water with a quality that meets the relevant Jordanian Standards.

Table 62: Anticipated Water Requirements for the Project

Phase	Amount (m^3 per day)
Construction	**5**
Potable	3
Non-Potable	1.5
Operation	**0.15**
Potable	0.15
Non-potable	0.01

Taking all of the above into account, the anticipated impacts on the local water resources and utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude and of low sensitivity given the minimal water requirements of the Project. To this extent, the impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies additional requirements to be taken into account by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with the Shobak Water Directorate to secure the water requirements of the Project. such water requirements will most likely be met through licensed tankers

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.
- Submit monthly water consumption reports.

16.2.2 Potential Impacts on Wastewater Disposal Utilities during the Construction and Operation Phase

The Project is expected to generate wastewater during both the construction and operation phases to include black water (sewage water from toilets and sanitation facilities) and grey water (from sinks, showers, etc.). Wastewater quantities generated are expected to be minimal and not significant at all during both phases of the Project and are likely to be easily handled by either Shobak WWTP or Mansoorah WWTP.

Generally, the approximate estimated wastewater to be generated from the Project can be accounted as follows. Throughout the construction phase, 60 construction workers are anticipated, whereas during the operation phase 3 workers are anticipated. The water requirements per capita during the construction and operation is not expected to exceed 50 litres per day; and taking into account an 80% wastewater generation factor per capita – then the anticipated wastewater to be generated during construction and operation is around 2,400l/d and 120 l/d (2.4m^3/d and 0.12m^3/d) respectively.

The wastewater generated will most likely be collected by tankers from the Project and disposed at either Shobak WWTP or Mansoorah WWTP. Such wastewater generated from the Project during the construction and operation phase reveals that such quantities are negligible.

Taking all of the above into account, the anticipated impacts on wastewater utilities are considered of short-term duration during the Project construction phase and of long-term duration during the Operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude given the minimal wastewater quantities generated, and of low sensitivity as they will be easily handled. Given the above impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies the mitigation measures to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with the Shobak Water Directorate to obtain list of authorized contractors for disposal of wastewater at either Shobak WWTP or Mansoorah WWTP.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.
- Submit monthly report of wastewater disposal.

16.2.3 Potential Impacts on Solid Waste Disposal Utilities during the Construction and Operation Phase

The Project is expected to generate solid waste during both the construction and operation phases to include construction waste (i.e. dirt, rocks, debris, etc.) as well as general municipal waste (such as food, paper, glass, bottles, plastic, etc.). Solid waste quantities generated are expected to be minimal and not significant at all during both phases of the Project and are likely to be easily handled by Shobak Transfer Station (for municipal waste) and Ma'an Central Landfill (for construction debris).

The approximate estimated municipal solid waste to be generated from the Project can be accounted as follows; throughout the construction phase, 60 construction workers are anticipated. The average theoretical municipal solid waste generation in Jordan is 0.85kg/capita/day (SWEEPNET, 2010) (this number is rather high but can be assumed as a worst case scenario). Thus, the anticipated municipal solid waste is estimated to be around 51kg/day. In addition, construction waste is likely to be around 100kg/day to include waste such as cables, metal, wood, etc.

Similarly, during operation solid waste will mainly include municipal waste. Around 3 workers are anticipated and based on the average theoretical municipal solid waste generation in Jordan (0.85kg/capita/day) (SWEEPNET, 2010) the estimated municipal solid waste is 2.5kg/day for duration of 20 years.

Comparing those numbers to the daily amount of solid waste currently handled by Shobak Transfer Station reveals that such quantities are negligible and are expected to be easily handled which receives around 25 tons of solid waste per day. In addition, according to discussions with Greater Ma'an Municipality Ma'an Central Landfill has sufficient capacity to easily handle construction debris generated from the Project.

Taking all of the above into account, the anticipated impacts on solid waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the Operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude given the minimal solid waste quantities generated, and of low sensitivity as they will be easily handled by the landfill. Given the above impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies additional requirements to be taken into account by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with Greater Ma'an Municipality or hire a competent private contractor for the collection of construction waste from the site to the approved landfill (Ma'an Central Landfill).
- Coordinate with Shobak Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill (Shobak Transfer Station).

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.
- Submit monthly report of amounts of water disposed.

16.2.4 Potential Impacts on Hazardous Waste Disposal Utilities during the Construction and Operation

The exact quantities of hazardous waste that will be generated from the Project are not determined, but given the nature of construction and operation they are expected to be minimal and not significant at all during both Project phases. Such hazardous waste streams include simple types of waste such as oil, chemicals, and fuel for the various equipment and machinery. Hazardous waste quantities are likely to be easily handled by the Swaqa Hazardous Waste Treatment Facility; which is the major and only hazardous waste landfill in Jordan.

Taking all of the above into account, the anticipated impacts on hazardous waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the Operation phase. Such impacts are of a negative nature, and are expected to be of low magnitude given the minimal hazardous waste quantities generated, and of low sensitivity as they will be easily handled by the landfill. Given the above impact is considered not significant.

To this extent, there are no mitigation measures to be applied. However, there are additional requirements that must be taken into account as detailed below.

Additional Requirements

The following identifies additional requirements to be taken into account by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Coordinate with MoEnv to hire a competent private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and the Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.
- Submit monthly report of amounts of hazardous waste produced on site.

16.2.5 Potential Impacts on Aviation, Telecommunication and Television & Radio Links during the Planning and Construction Phase

Improper planning and site selection of the Project could impact and affect infrastructure elements related to aviation, telecommunication and television & radio links in the surrounding area. Those are discussed in further details below.

(i) Aviation

Any tall structure could impact aircraft safety if located near airports or known flight paths. In addition, such structures could potentially interfere with certain electromagnetic transmissions associated with air transport, for example primary radar and secondary surveillance radar. Wind turbines have the potential to impact the surveillance systems used to detect and identify aircraft approaching, overlying or leaving Jordanian airspace and for which a Recognized Air Picture (RAP) is produced.

In accordance with the "Civil Aviation Law No. 41 of the year 2007", Article 27(e) requires that any entity which intends to construct a facility of a height greater than 40m obtain the approval of CARC.

With regards to wind farms in specific, the usual process with CARC is that an application should be submitted with the following information:

- Project coordinates to be obtained from the Royal Jordanian Geographic Centre (RJGC);

- Specifications for the navigational lights which is required by CARC to include 1 medium intensity light on the nacelle only; and
- Blade painting specifications for the turbines.

Upon submission of the application, CARC reviews and provides a no objection letter for the Project development. ECO Consult is currently submitting the application to CARC and the no objection permit is expected to be issued in September 2017. A similar process to that discussed above is also followed with RJAF. ECO Consult is also submitting the application to RJAF and the no objection permit is expected to be issued in September 2017.

To this extent, there are no impacts anticipated from the Project on aviation safety. However, there are additional requirements which must be taken into account as highlighted below.

Additional Requirements

Provide official no objection permits by CARC and RJAF (expected in September 2017).

(ii) Telecommunication Links

As discussed earlier, ECO Consult contacted the TRC to obtain information on location of telecommunication towers and line of sigh connections for Zain, Orange and Umniah. An official letter was provided by the TRC stating that all three telecommunication companies have responded stating that the Project will have no impact on any of their telecommunication towers or line of sight connections Official letter provided in Annex I.

To this extent, there are no impacts anticipated from the Project on telecommunication links. There are no additional requirements to be considered.

(iii) Television and Radio Links

As discussed earlier, JRTV has already provided ECO Consult with a no objection letter on the Project development indicating that the Project would not affect its broadcasting tower in the area. To this extent, there are no impacts anticipated from the Project on television and radio links. There are no additional requirements to be taken into account.

16.2.6 Potential Impacts on Road Networks during the Planning and Construction Phase

Wind turbines are manufactured in factories and transported to the installation site where they are assembled. Wind turbine components have big dimensions and weight and their transport poses a challenge to the existing roads and infrastructure. The Project's wind turbine blades have a length of around 70m and are usually transported in one piece. Tower components can have a transport height of up to 5m. Nacelles are also usually transported in one piece and can have a weight of more than 70 tones.

Components for wind energy projects are usually transported by sea from the manufacturing country to the country of installation and are then loaded in existing ports to trucks which manoeuvre their way through existing roads to the installation site.

As discussed earlier in the baseline section, with regards to the Project, the wind turbine components will arrive to the Port of Aqaba in the south of Jordan. Transportation route will follow Highway #15 a distance for around 134km after which an exit from Unayza Intersection through road #818 for about 13km west which leads directly to the northern edge of the Project site.

Given the increasing size, weight, and length of components of the wind turbines, proper transportation and logistical solutions could be required for managing the heavy-load long-haul requirements. If improperly planned and managed, the trucks hauling the various heavy Project components may damage the existing roads, highways and bridges, utility lines (e.g. electricity lines), and could also be a public safety concern for other vehicles on the road.

Taking all of the above into account, the anticipated impacts on road networks are considered of short-term duration during the Project construction phase. Such impacts are of a negative nature, and if such impacts are improperly managed, then they are expected to be of high magnitude and medium sensitivity. Given the above impact is considered of moderate significance.

Mitigation Measures

It is recommended that EPC Contractor develop a Traffic and Transport Plan before commencement of any transportation activities to ensure that the transportation process is properly and adequately managed and does not pose a risk of damage to the existing roads, highways, overpasses whilst ensuring public safety. The Plan must analyse and study the entire route for transportation of the Project components from the port of Aqaba till the Project site. The assessment must take into account worst case scenarios for transportation of Project components for blade lengths, tower sections, etc. The study must investigate any constraints which need to be considered along the highways leading to the Project site such as bridges, overhead utility cables, slants in roads, etc. and identify accommodations which need to be taken into account (bypasses, adjustments to roads, etc.)

The Plan must take into account the following:

- The Plan must be developed in accordance with the following: (i) Traffic Law No. 49 for 2008 (ii) Regulations for the Registration and Licensing of Vehicles No. 104 for 2008 (iii) Regulation for Maximum Dimensions, Weights and Total Engine Power for Vehicles No. 42 of 2002, and (iv) Instructions for Allowable Speed Limits for 2002;
- The plan must consider, to the extent possible, the proper planning of generated trips of trucks to ensure they are spread over the course of a work day and hours of day, and which also take into account peak and non-peak commute hours on the highway;
- As part of the Plan, the EPC Contractor must coordinate with the Traffic Department and the Ministry of Public Works and Housing to: (i) notify them on the timing and schedule of transportation activities, (ii) identify the peak and non-peak commute hours to help avoid congested zones (and times of the day) if required, and (iii) coordinate in advance for any works which will be required as part of the study which could include bypasses required (if any), traffic diversion, etc.
- The Plan must also cover all other onsite and offsite activities. Related to offsite activities, the plan must cover transportation requirements of project components other than turbines (e.g. other materials and components) as well as labour (if relevant). The plan must identify proposed delivery routes to the project site, planning of generated trips of trucks to site, speed limits, number of vehicles movement. Related to onsite activities, the plan must cover the day to day movements of vehicles and machinery and must include measures for proper onsite traffic management, assigned speed limits, allowed movement routes within the site amongst others.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Submission of Traffic and Transport Plan with proof of coordination with the authorities discussed above for works required as part of the Study.

17. COMMUNITY HEALTH, SAFETY AND SECURITY

This Chapter assesses the anticipated impacts from the Project throughout its various phases on community health, safety and security. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

This chapter discusses impacts from the Project on health, safety and security of local communities. Other impacts on local communities are discussed in other chapters, such as socio-economic development (discussed later in Chapter 18) and land use activities (previously discussed in Chapter 9).

17.1 Assessment of Baseline Conditions

Assessment of baseline conditions related to community health, safety and security focused on the local communities surrounding the Project site and which are anticipated to be impacted from the Project development. Those mainly include Mothallath Al-Shobak, Zobeiriyeh, Zaitooneh and Mdhaibie' as noted in the figure below.

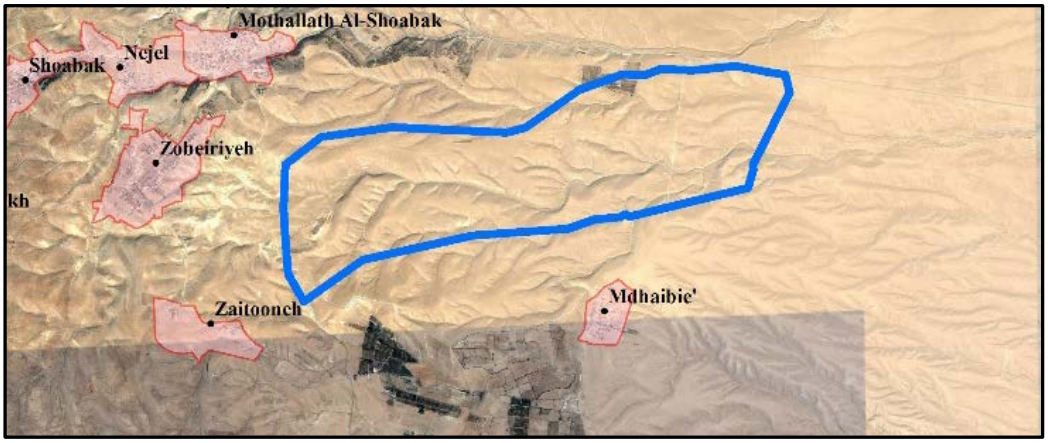

Figure 92: Local Communities Surrounding the Project Site

It is important to reiterate that baseline conditions of such local communities is discussed in other chapters were relevant – this includes socio-economic conditions of such local communities and which is discussed later in Chapter 18 and land use which was previously discussed in Chapter 9.

17.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities on community health, safety and security during the construction and operation phase. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

In particular, the potential impacts on community health and safety which are discussed throughout this section include the following:

- Potential impacts from noise from construction activities during the construction phase;
- Potential impacts from noise of wind turbines during operation;
- Potential impacts from tonal noise, low frequency noise, infrasound and vibration of wind turbines during operation;

- Potential impacts from shadow flicker of wind turbines during operation;
- Potential Impacts from blade and tower glint of wind turbines during operation;
- Potential impacts from blade/ice throws during operation;
- Potential impacts from public access to Projects components during operation;
- Potential impacts from presence of security personnel during construction and operation; and
- Potential impacts from workforce influx during construction.

17.2.1 Potential Impacts from Noise from Construction Activities during the Construction Phase

The construction programme has the following main construction phases:

- Road preparation / construction for transport of turbine to specific sites;
- Transportation of turbine to the Project site;
- Site Preparation for turbine foundation construction, include excavations and land clearing;
- Foundation construction; and,
- Turbine erection and assembly, which includes tower assembly, hub, rotor and nacelle lift and rotor assembly

The above activities are expected to be a source of noise and vibration generation within the Project site and its surroundings. If improperly managed, there is risk of nuisance and health affects to the nearby surrounding receptors (such as the local communities).

The main noise generating activities during the construction phases will be the site excavation and foundation construction. Since the Project site expands over a 14km^2 area most of the turbines are located within remote areas where the construction noise will not be audible at any nearby domestic dwellings due to the distance of the sites from the dwellings (since distance from source is the most influential to noise propagation attenuation).

It is unlikely that all 13 WTG sites would be constructed on simultaneously as this would-be construction resource heavy in terms of equipment and manpower. However, since no construction programme has been issued, the assumption for this noise study is that all the sites will be constructed simultaneously, which is the overly conservative approach and would result in maximum noise levels from the construction activities.

(i) Relevant Legislations and Requirements for Noise Impact Assessment

a. Jordanian Requirements for Noise

The only relevant Jordanian requirement related to noise includes the "Instruction for Reduction and Prevention of Noise for the year 2003". The articles within the Instruction which are relevant for the Project include the following:

- Article (5) states that all construction activities which use noise producing plants and equipment which may cause nuisances may not occur between 20h00 and 06h00 unless a permit is granted by the Minister of Environment.
- Article (6) of the Instruction specifies the maximum allowable noise level for specific times and areas. As per MoEnv classifications, the villages near the Project site are considered to be a 'Residential area in (rural) village' and therefore the development is limited to the following permissible noise limits for day-time and night-time:

- Day-time (07h00 – 18h00): 50 dBA
- Night-time (18h00 – 07h00): 40 dBA

There are no specific International standardised criteria for assessing construction noise impacts; therefore the chosen standard must meet international best practice for working standards.

b. British Standard BS 5228:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise

British Standard BS 5228:2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise* (BS 5228-1) is considered in this regard. Noise levels generated by construction and plant equipment experienced at nearby receptors depend on a several variables, the most significant are as follows:

- The sound power level of the noise generated by the equipment on site;
- The period and duration of equipment operation – known as "on-time";
- The distance between the noise source and the receptor – known as "stand-off";
- The attenuation due to the presence of hard vertical faces such as walls.

BS 5228-1 contains an up-to-date database of noise emissions from individual items of plant / construction equipment and their associated activities and methods of working. Unless provided with specific manufacturer's noise level data the BS 5228-1 database is used when predicting the noise levels associated with construction activities. Due to the nature of construction works, any noise disturbance that may arise from construction of the proposed development, although it may be significant for a temporary since the period of construction is limited.

Calculation of noise levels are performed using tables of typical noise sound power sources for the construction equipment and plant items operating on site. The activities and associated output level along with applicable work duration is summed, with the resultant sound pressure level calculated at the receiver according to ISO 9671 outdoor propagation standard. The resultant sound pressure level is compared to set noise limits in order to judge whether or not the construction activity will significantly impact nearby communities.

The methodology for assessment is based on not exceeding specified limits as per the "ABC" method. The "ABC" method defines in Table E.1 (of BS 5228-1) 'threshold of potential significant effect at dwellings". The table is shown below.

Table 63: Table E.1, BS 5228-1 'ABC' Method Thresholds

Assessment category and threshold value period	Threshold value in decibels (dB) $L_{Aeq,T}$		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23h00 – 07h00)	45	50	55
Evenings and weekends	55	60	65
Daytime (07h00 – 19h00)	65	70	75
Saturdays (07h00 – 13h00)	65	70	75

NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds threshold level for the category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3 Applied to residential receptors only.
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays. Where ambient noise is defined as: *"the noise in a given situation at a given time, usually composed of sound from many sources near and far, but excluding site noise."* Ambient noise plus site noise gives the total noise.

The table above can be used such that for the appropriate period the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the site noise level. If the site level exceeds the appropriate category value, then a potential significant effect is indicated.

The assessment is based on either the Category A, Category B or Category C threshold values. The decision as to which threshold values is based on the following criteria:

- Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
- Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
- Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

Based on the ambient noise levels taken at measurement locations R1, R2 and R3 surrounding the wind farm (discussed in further details below) , the Category A threshold is to be used as defined in the table below.

Table 64: Noise Limits for Construction Noise

Time Duration	Noise Limit at Receptor	Category A Threshold
06h00 – 07h00	55 dBA (Category C)	Night-time (23h00 – 07h00)
07h00 – 19h00	65 dBA (Category A)	Day-time (07h00 – 19h00)
19h00 – 20h00	55 dBA (Category B)	Evening (19h00 – 23h00)

c. International Organisation for Standardisation (ISO) 9613-2 Acoustics – Attenuation of Sound during Propagation Outdoors

ISO 9613 Acoustics – Attenuation of Sound During Propagation Outdoors'(ISO 9613-2) specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (L_{Aeq}) under meteorological conditions favourable to propagation from sources of known sound emission.

(ii) Impact Assessment Methodology

British Standard BS5228:2009:2014 'Noise and Vibration Control on Construction and Open Sites' provides a calculation method, practical information on noise reduction measures, and promotes 'Best Practice Means' approach to control noise emissions during construction. It does not however provide noise limits for construction periods. The noise emission data presented in BS 5228-1 does not reflect the latest advancements in plant noise emissions control. Therefore, whilst the calculations in this assessment have been carried out according to the BS5228 methodology, several of the input data for construction plant noise levels have been taken from the United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) report 'Update of Noise Database for Prediction of Noise on Construction and Open Sites'.

a. Noise Baseline Assessment

A noise baseline survey was undertaken at the identified receptors R1 – R3 (see figure below) for a duration of 24hours at each receptor location. The db 307 Noise Meter was used for the measurement survey. The selected sound level meter automatically logs environmental noise measurement parameters. The methodology followed is summarised in the table below.

Table 65: Summary of Noise Measurements

Item	Specification
Parameters	$L_{Aeq,}$
Equipment	db 307 Noise Level Meter Field Calibrator Wind shield Heavy Duty Tripod
Reference Method	ISO 1996-1:2003
No. Locations	3
Measurement interval	15 minutes
Duration (per location)	24 hours

The average day-time and night-time noise levels for each site are given as per the day-time and night-time rating periods, in the table below. The detailed noise results are presented in Annex II.

Table 66: Summary of Baseline Noise Levels

Measurement Site	Coordinates	Village	Ld, Day-time Average	Ln, Night-time Average
Closest Domestic Dwelling to Project	747761.82 3378702.81	Mothallath Al-Shobak	44.6 dBA	42.9 dBA
Closest Domestic Dwelling to Project	747123.53 3375099.33	Zobeiriyeh	48.1 dBA	46.8 dBA
Could not be places at closest dwelling due to security and logistical reasons. Device was installed at	752580.94 3375288.30	Mdhaibie'	55.4 dBA	44.9 dBA

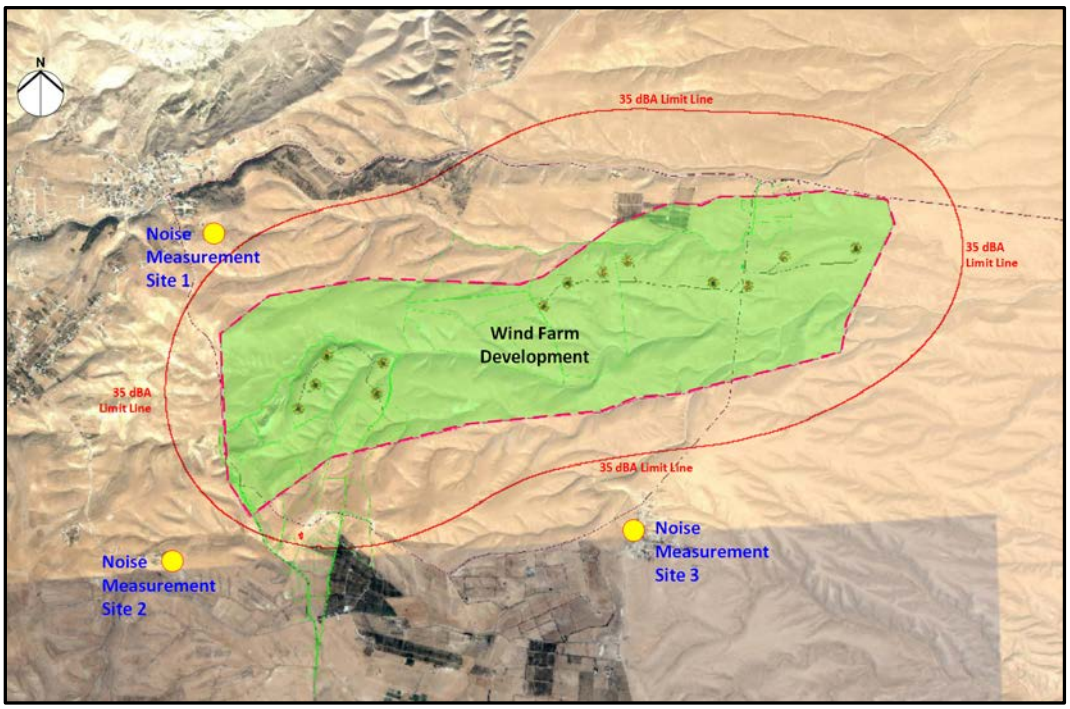

Figure 93: Location of Noise Baseline Survey Receptors (R1, R2 and R3)

b. Modelling the Propagation of Sound

All noise prediction modelling for the construction and road noise has been completed using the international recognised and certified software program SoundPLAN (version 7.4). SoundPLAN is developed by SoundPLAN Gmbh in Germany. The program allows for the calculation of sound pressure levels due to various sources using empirical calculation algorithms of the applicable international standards and regulations.

The propagation methodology adopted for this noise study, and the equations used within the SoundPLAN model are based on the British Standard BS 5228:2009:2014 'Noise and Vibration Control on Construction and Open Sites'. BS 5228-1 is representative of the International Organisation for Standardisation noise propagation standard (ISO) 9613 'Acoustics – Attenuation of Sound during Propagation Outdoors' – Part 2: General Calculation Method (ISO, 1996). The following is a concise summary of the standard and applicable details.

The ISO 9613-2 is a general-purpose standard for outdoor noise propagation, the standard specifies a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (L_{Aeq}) under meteorological conditions favourable to propagation from sources of known sound emission. The standard takes into account the following physical effects on sound:

- Geometrical divergence;
- Atmospheric absorption;
- Ground effect;
- Reflection from surfaces; and,
- Screening by obstacles.

Table 67: SoundPLAN Model Settings

Model Parameter	Parameter Setting / Standard
Calculation Standard	BS 5228-1+A1:2014
Ground Absorption Coefficient	Set according to ground cover type (override of default)
Maximum Order of Reflection	3
Reflection Loss by Obstacles and Barriers	Default: 1 dB
Meteorological Data	Humidity 70% Air Pressure 1013.3 mbar T = 27ºC
Calculation Grid Size	Unit wide calculations: 1 m resolution Site-wide calculations: 15 m resolution

c. Noise Modelling Source Parameters – Noise Inventory

The construction equipment which is to be used for the construction and erection of the turbines has been estimated based on the usual construction equipment configuration which has been used for the noise prediction calculations. The following noise sources were used for the prediction calculations for the various stages of the construction process for each of the turbine sites.

Table 68: Excavation and Foundation Construction Equipment

Equipment Description	Quantity on Turbine Site	BS 5228:2009 Reference
D10 Bulldozer	1	C5.4
H160 Grader	1	C6.31
Dump Truck	3	C9.21
980 Loader	2	C10.6
Dumper	2	C4.6
Vibratory Compactor	1	C5.22
Water Truck	1	C11.2

Table 69: Turbine Assembly Construction Equipment

Equipment Description	Quantity on WTG Site	BS 5228:2009 Reference
Main Crane	2	C4.38
Auxiliary Crane	2	C4.38
Unload Crane (90t)	2	C4.38
Nacelle Unload Crane (300t)	1	C4.38
Forklift	1	-
Truck Crane	1	-

Since no site-specific works programme has been issued, all sites are being constructed simultaneously. This is considered to be overly conservative, usually one to three sites would be worked on simultaneously with varying work occurring per site.

(iii) Results

The construction of the turbines requires various construction phases, the maximum noise levels for each construction phase is investigated as a worst-case scenario. The following assumptions are therefore made for each of the assessed construction phases and the worst-case scenario:

Excavation and Foundation Construction Phase:

- All equipment is working on site simultaneously at peak power output / maximum load.

- Equipment is located within site construction boundary closest to the nearest receptor to each of the turbine construction sites.
- All construction equipment is running at peak power output and all sites have simultaneous construction at the peak power output.

Turbine Assembly Construction Phase:

- All equipment is working on site at simultaneously at peak power output / maximum load.

Noise contour maps for both the site preparation and turbine assembly have been calculated and are presented in the figures below. The map shows contour lines and noise propagation level areas or 'zones' between the contour lines. The significance of the noise contour map is to allow for an overview of noise levels over a geographic area and therefore allows a quick basic analysis of the noise propagation for identification of specific areas of negative impact. The modelling specification for the noise contour map modelling is as per the table below.

Table 70: Noise Contour Map Setup Specification – ISO 9613-2

Parameter Description	Noise Map Parameter
Turbine Operation	Worst Case
Mapping Grid Resolution	10 x 10 m
Mapping Result Range	25 - 100 dB(A)

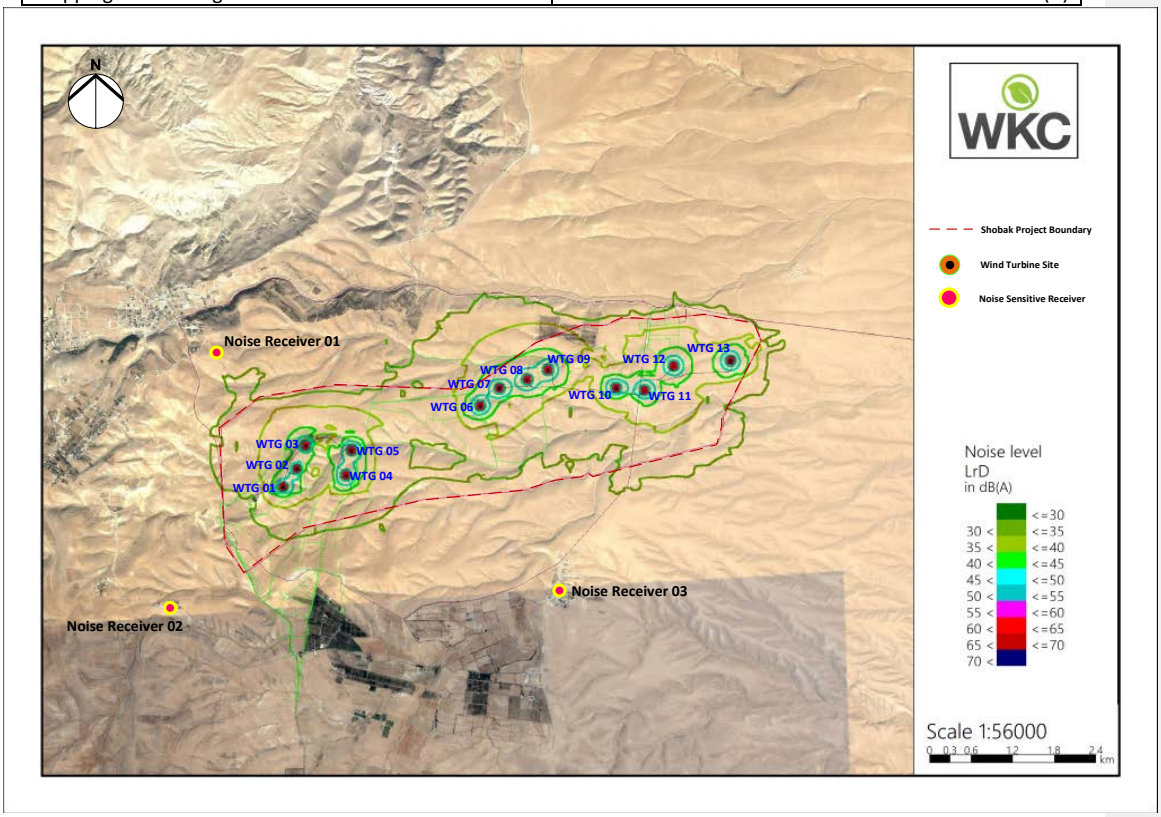

Figure 94: Noise Prediction Map for Site Preparation and Foundation Construction of all Turbines

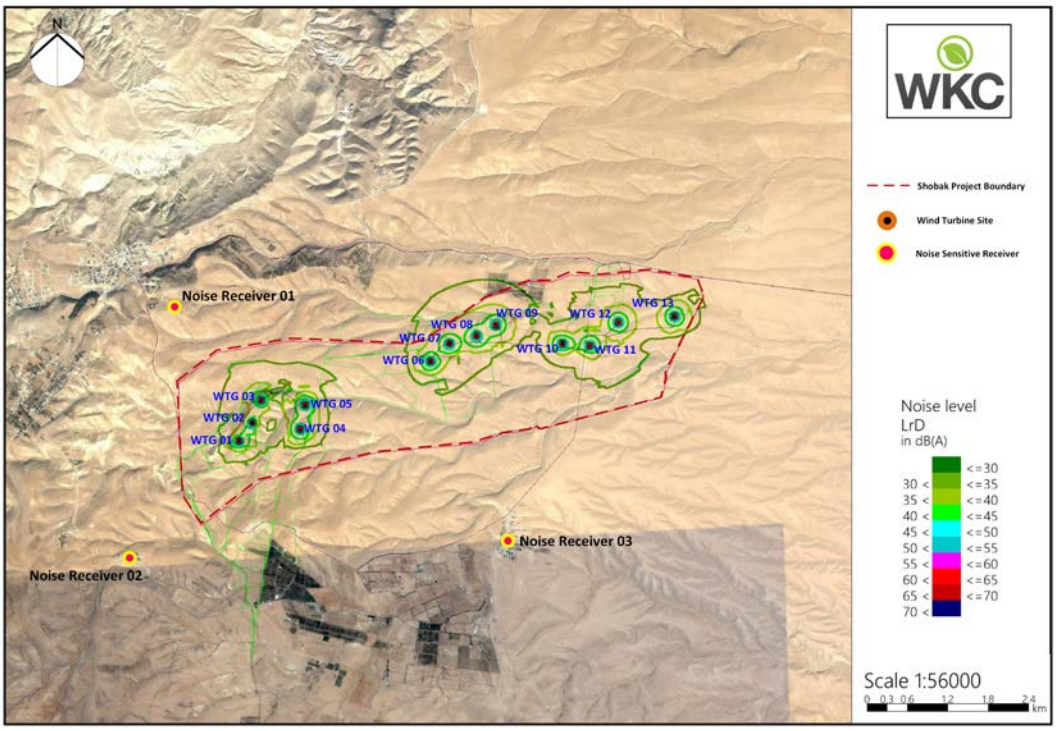

Figure 95: Noise Prediction Map for WTG Construction and Assembly

The following table gives contribution noise levels at the receptors for the site preparation and foundation construction and assembly and construction of the turbines.

Table 71: Predicted Contribution Noise Levels for Construction Activities

Noise Sensitive Receiver	Predicted Contribution Noise Level– dB(A) from site preparation and foundation construction	Predicted Contribution Noise Level– dB(A) from assembly and construction of the turbines
R1	28.5	23.4
R2	20.7	15.8
R3	24.7	19.9

Road construction and WTG haulage has not been calculated in this study, as no haulage routes have been given at this stage, however the calculated output for the haulage would be low with minimal impact as the volume of construction vehicles is low and travelling at low speeds, therefore there would be little or no average effect on existing background noise due to both the low noise power output and the distance of the nearest receptor from the turbine construction sites and therefor associated haulage roads.

The assessment of predicted noise emissions from construction activities at the receptors associated with the various Project construction sites was carried out in accordance with BS 5228-1 according to the following predefined noise limits as shown in the table below.

Table 72: Assessment Periods and Noise Limits

Limit	Limit	Limit
Night-time 06h00 – 07h00	**Day-time 07h00 – 19h00**	**Evening 19h00 – 20h00**
dB(A)	dB(A)	dB(A)
55 (Category C)	65 (Category A)	55 (Category A)

Noise emissions from calculated for construction activities are given in the tables below in accordance with the methodology presented in BS 5228-2. The levels given are contribution noise limits and therefore the total noise level (as per the equation below) which the construction noise is to be comparted to the noise limits as per BS 5228-2.

- Total Noise [dB] = Predicted Construction Noise Level [dB] + Background Noise Level [dB]

The noise contribution due to construction activity of the worst-case scenario has been added to the baseline noise levels to calculate total noise. The construction noise levels have been assessed against the construction noise thresholds as per the table above.

As noted in the table below there is no exceedance of noise limits at any of the receptors for day-time, evening and nigh-time periods.

Table 73: Assessment of Day-time / Evening Excavation and Foundation Construction Noise

Noise Sensitive Receiver	Contribution Noise Level (dBA)	Day-time Baseline Noise Level	Total Noise Level at NSR	Limit Day-time 07h00 – 19h00	Limit Evening 19h00 – 20h00	Exceedance of Day-time construction Noise Limit?
		dB(A)	dB(A)	dB(A)	dB(A)	
R1	28.5	44.6	44.7	65	55	No
R2	20.7	48.1	48.1	65	55	No
R3	24.7	55.4	55.4	65	55	No

.

Table 74: Assessment of Night-time Excavation and Foundation Construction Noise

Noise Sensitive Receiver	Contribution Noise Level (dBA)	Night-time Baseline Noise Level	Total Noise Level at NSR	Limit Night-time 06h00 – 07h00	Exceedance of Day-time construction Noise Limit?
		dB(A)	dB(A)	dB(A)	
R1	28.5	42.9	43.1	55	No
R2	20.7	46.8	46.8	55	No
R3	24.7	44.9	44.9	55	No

Table 75: Assessment of Day-time / Evening WTG Assembly

Noise Sensitive Receiver	Contribution Noise Level (dBA)	Day-time Baseline Noise Level	Total Noise Level at NSR	Limit Day-time 07h00 – 19h00	Limit Evening 19h00 – 20h00	Exceedance of Day-time construction Noise Limit?
		dB(A)	dB(A)	dB(A)	dB(A)	
R1	23.4	44.6	44.6	65	55	No
R2	15.8	48.1	48.1	65	55	No
R3	19.9	55.4	55.4	65	55	No

Table 76: Assessment of Night-time WTG Assembly

Noise Sensitive Receiver	Contribution Noise Level (dBA)	Night-time Baseline Noise Level	Total Noise Level at NSR	Limit Night-time 06h00 – 07h00	Exceedance of Day-time construction Noise Limit?
		dB(A)	dB(A)	dB(A)	
R1	23.4	42.9	42.9	55	No
R2	15.8	46.8	46.8	55	No
R3	19.9	44.9	44.9	55	No

Taking the above into account, the assessment concludes that there are no issues of concern in terms of noise impacts from the Project during construction on the surrounding receptors.

Impacts from construction noise from wind turbines during construction are considered of short-term duration as they are limited to the construction phase of the Project and of a negative nature. The noise impact assessments concluded that noise levels from will not affect the surrounding nearby receptors and will not exceed acceptable limits during daytime and night-time, such an impact is considered of low magnitude and low sensitivity. Given the above, such an impact is considered to be not significant

Mitigation Measures

The EPC Contractor is expected to implement general best practice measures to control sources of noise onsite during the construction phase this include measures including but not limited to the following:

- As per the "Instruction for Reduction and Prevention of Noise for the year 2003" highest noise level construction activities should not be undertaken between 8pm and 6am
- Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.
- Site inductions should cover the importance of noise control and available noise reduction measures
- Maximising the offset distance between noisy equipment items and residential receptors
- Avoiding the coincidence of noisy equipment working simultaneously close together when adjacent to sensitive receptors
- Minimising consecutive works in the same locality
- Orienting equipment away from sensitive receptors
- Carrying out loading and unloading away from noise sensitive areas
- Construction site and haul-road speed limits shall be established and enforced during the construction period
- The use of noise-producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor during the construction phase and which include:

- Inspection and visual monitoring of the works should be carried out at all times to ensure above practices are implemented.
- Reporting of any excessive levels of noise and the measures taken to minimize the impact and prevent it from occurring again.

17.2.2 Potential Impacts from Noise of Wind Turbines during Operation

Perception of noise can result from sound emissions generated from operation of the wind turbines. The sound originates from mechanical and aerodynamic effects, where mechanical sound is generated by the machinery of the nacelle (e.g. generator, gear box) and aerodynamic sound emanates from the movement of air around the turbine blades and tower.

Such sound emissions could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment. Therefore, to assess the anticipated impacts, a noise prediction model was employed.

The section below discusses the methodology that was adopted for the modelling and also presents the outcomes and results.

(i) Relevant Legislations and Requirements for Noise Impact Assessment

a. Jordanian Requirements for Noise

The only relevant Jordanian requirement related to noise includes the "Instruction for Reduction and Prevention of Noise for the year 2003". The articles within the Instruction which are relevant for the Project include the following:

- Article (5) states that all construction activities which use noise producing plants and equipment which may cause nuisances may not occur between 20h00 and 06h00 unless a permit is granted by the Minister of Environment.
- Article (6) of the Instruction specifies the maximum allowable noise level for specific times and areas. As per MoEnv classifications, the villages near the Project site are considered to be a 'Residential area in (rural) village' and therefore the development is limited to the following permissible noise limits for day-time and night-time:
  - Day-time (07h00 – 18h00): 50 dBA
  - Night-time (18h00 – 07h00): 40 dBA

b. World Health Organization (WHO) Guidelines for Community Noise (WHO 2002*)*

This document, which is an update to a 1999 version of the same name, is the outcome of the WHO expert task force's endeavours to derive guidelines for community noise by consolidating actual scientific knowledge on the health impacts of community noise, and providing guidance to environmental health authorities and professionals. The WHO, 2002 provides a summary of the thresholds for noise nuisance in terms of outdoor daytime LAeq in residential districts. It states the following:

- At 55-60 dBA noise creates annoyance
- At 60-65 dBA annoyance increases considerably
- At above 65 dBA constrained behaviour patterns, symptomatic of serious damage caused by noise, arise.

The WHO therefore recommends a maximum outdoor daytime LEeq of 55 dBA in residential areas and schools so as to prevent significant interference with the normal activities of the local community/ies. For night-time, it recommends a maximum of 45 dBA outside dwellings. The WHO 2002 makes no distinction between the sources of noise, i.e. whether it originates from road traffic, production plants or the local restaurant.

c. IFC EHS Guidelines

It is important to note that the EBRD does not include specific requirements for assessment of noise impact levels from wind energy projects, and therefore the IFC requirements have been taken into account. Discussed below are the IFC EHS Guidelines for Wind Energy and the General IFC EHS Guidelines requirements for noise assessment that are relevant for the Project.

The IFC EHS Guidelines on Wind Energy describes the main noise producing mechanism for operating turbines along with a general methodology for conducting a noise impact assessment for the turbines with the following principles:

- *Receptors should be chosen according to their environmental sensitivity (human, livestock, or wildlife).*
- *Preliminary modelling should be carried out to determine whether more detailed investigation is warranted. The preliminary modelling can be as simple as assuming hemispherical propagation (i.e., the radiation of sound, in all directions, from a source point). Preliminary modelling should focus on sensitive receptors within 2,000 meters (m) of any of the turbines in a wind energy facility*
- *If the preliminary model suggests that turbine noise at all sensitive receptors is likely to be below an LA90 of 35 decibels (dBA) at a wind speed of 10 meters/second (wind speed measured at 10 m height) during day and night times, then this preliminary modelling is likely to be sufficient to assess noise impact; otherwise it is recommended that more detailed modelling be carried out, which may include background ambient noise measurements.*
- *All modelling should take account of the cumulative noise from all wind energy facilities in the vicinity having the potential to increase noise levels.*
- *If noise criteria based on ambient noise are to be used, it is necessary to measure the background noise in the absence of any wind turbines. This should be done at one or more noise-sensitive receptors. Often the critical receptors will be those closest to the wind energy facility, but if the nearest receptor is also close to other significant noise sources, an alternative receptor may need to be chosen*.
- *The background noise should be measured at 10m height over a series of 10-minute intervals, using appropriate wind screens. At least five of these 10-minute measurements should be taken for each integer wind speed from cut-in speed to 12 m/s.*

The above principles are referenced from the following key documents: (i) ETSU, Report ETSU-R-97, "The Assessment and Rating of Noise from Wind Farms" (1997); and (ii) Institute of Acoustics (IOA), "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise", 2013.

On the other hand, the IFC EHS General Guideline provides guidance on acceptable noise levels and comprises paragraphs on prevention and control, noise level guidelines and monitoring. For the noise level guidelines, the guidelines refer to those stipulated by the WHO, i.e. for residential areas:

- Day-time (07h00 to 22h00): 55 dBA
- Night-time (22h00 to 07h00): 45 dBA

The guidelines also add another criterion in that the existing background ambient noise level should not rise by more than 3 dBA, presumably also when determined over the period of an hour. It is considered that this criterion was probably introduced in order to address cases where the existing ambient noise level is already at or in excess of the recommended limits.

d. ISO 9613-2:1996 Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation

ETSU-R-97 discussed above, and which is referenced within the IFC EHS Guideline for Wind Energy, states that ISO 9613 is to be used for Wind Turbine noise predictions, with particular stipulations and limitations.

ISO 9613-2:1996 Part 2 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in ISO 1996) under meteorological conditions.

(i) Impact Assessment Methodology

This section presents the impact assessment methodology in relation to the noise prediction model.

a. Wind turbine Generator

The Vestas V136 3.45 MW wind turbine generator is an IEC IIIA and IEC IIB Wind Turbine which delivers high and efficient energy production in low and medium wind conditions, rated capacity of 3.45 megawatts (MW) and 136 m rotor diameter. The turbine operates at variable rotational speeds and resulting power output dependent on the wind speed acting on the turbine rotor and operational settings.

The project specific specifications for the Wind Turbines to be used are presented in Table 62 below.

Table 77: VESTAS V136 3.45 MW Specification

Item	Specification
Rated Power	3,450 kW
Wind Class	IIIA / IIB
Rotor Diameter	136 m
Swept Area	14,527 m^2
Control	Independent Pitch and Variable Speed
Gearbox	3 Stages – two planetary stages & one helical
Frequency	50 Hz / 60 Hz
Blades	
Length	66.7 m
Physical Dimensions	
Tower Height	Site Specific
Hub Height	112 m
Tower Type	Steel

Sound power levels have been provided by Vestas in accordance with IEC 61400-11 *Wind Turbine Generator Systems – Part 11: Acoustic noise measurement techniques.* Modern Wind Turbines such as the V136 have various operations including Noise Reduced Operation (NRO) modes. The data used for this study is aimed to be primarily conservative with NRO modes deemed to be potential mitigation methods where necessary. Therefore, the preferred data for prediction calculations is NRO = 0 which means no NRO is active during operation and the WTG is at maximum noise levels.

The sound power levels during standard operation mode ranges from 93.0 dBA at low revolutions per minute (rpm) to 108.2 dBA at full rated power output (high rpm). In accordance with IEC 61400-14 '*Wind Turbines – Part 14: Declaration of apparent sound power level and tonality values',* Vestas provides a performance guarantee that the maximum sound power output will be 108.2 dBA. The sound power level data presented is sound power level per wind speed as presented in Figure 91 below.

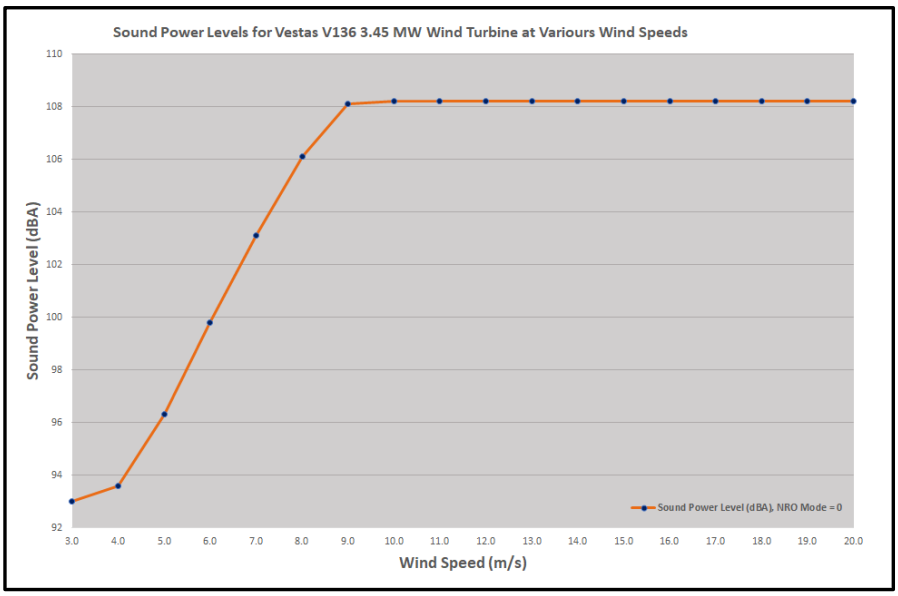

Figure 96: Sound Power Levels for Vestas V136 3.45 MW

Third octave frequency data was provided by Vestas for the noise study. Sound octave data is required for the application of the ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO 9613-2).

b. Noise Modelling Methodology

Sound is a sequence of pressure waves which propagate through fluid medium. In the case of all outdoor propagation of sound in air the following factors affect the propagation and resultant sound levels from the source: (i) type of source (point, line or area); (ii) distance from the source; (iii) atmospheric absorption; (iv) wind; (v) temperature and temperature gradient; (vi) obstacles such as barriers and buildings (barrier effects); (vii) ground absorption; (viii) reflections; and (ix) humidity and precipitation

The noise model that was used for this noise impact study was SoundPLAN 7.4 software. The program allows for the calculation of sound pressure levels due to various sources using empirical calculation algorithms of the applicable International Standards and Regulations.

The propagation methodology adopted for this noise study, and the equations used within the SoundPLAN model are based on the ISO 9613:1996 'Acoustics – Attenuation of Sound during Propagation Outdoors' – Part 2: General Calculation Method (ISO 9613-2) as per the modelling requires of IOA GPG.

The method predicts the equivalent continuous A-weighted sound pressure level (L_{Aeq}) under meteorological conditions favourable to propagation from sources of known sound emission. The standard takes into account the following physical effects on sound:

- Geometrical divergence;
- Atmospheric absorption;
- Ground effect;
- Reflection from surfaces; and,
- Screening by obstacles.

Noise from WTGs is reduced by distance, atmospheric losses, screening effects and other 'miscellaneous' losses. ISO 9613-2 empirical formula calculates the predicted sound pressure level at a specified distance by taking into account the sound power level in octave frequency bands and subtracting a number of attenuating factors as described generally above.

The predicted noise level for each octave band is calculated by the following equation (1) within the modelling software.

The applied equation for the Standard computed is as follows:

$$L_s = [L_W + D_1 + K_0] - [D_S + \sum D] \quad (1)$$

where L_s sound pressure level for a single frequency

L_W sound power

D_1 directivity of the source

K_0 spherical model ($K_0 = 10 \log \left[\frac{4\pi}{\sigma}\right]$ where σ is the spatial angle)

D_S geometrical spreading ($D_S = 10 \log(dist.source, receiver) + 11\ dB(A)$)

$\sum D$ contributing factors – air absorption, ground absorption, meteorological effects, volume type absorption and screening

Summary of the calculation settings and standards are detailed in Table 63 below.

Table 78: Model Calculation and Parameter Settings for ISO 9613-2

Model Parameter	Parameter Setting / Standard							
Calculation Standard	(ISO) 9613 'Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Calculation Method' (ISO, 1996) Application as per IOA GPG							
Wind Speed	10.0 m/s							
Ground Absorption Coefficient	0.0							
Valley Factor Penalty	1.5 dB							
Topographic Screening Reduction	2.0 dB							
Meteorological Coefficient	0.0 dB							
Receiver Height	1.5 m							
Meteorological Data	Humidity 70% Air Pressure 1013.3 mbar T = 21ºC							
Atmospheric Attenuation Coefficients (dB / km)	63 Hz 0.1	125 Hz 0.4	250 Hz 1.0	500 Hz 1.9	1 kHz 3.7	2 kHz 9.7	4 kHz 32.8	8 kHz 117.0

The following assumptions have been made for the modelling assessment, and wherever possible, a conservative approach has been taken. As noted below and as required by the IFC EHS Guideline for Wind Energy the assumptions assume a worst case scenario:

- The modelling was undertaken on the final layout of the wind turbines as provided by the Developer;

- ISO 9613-2 calculates predicted noise levels with the major assumption that sensitive receptors are located downwind of the turbine noise as this is considered to be the most conservative. Therefore, directivity and attenuation due to metrological factors such as wind speed and wind direction upwind from a source are not taken into account;
- Shielding effects from building structures were not taken into account;
- Attenuation effects by vegetation were not taken into account; and
- A single modelling scenario is to be assessed for this study, namely, worst-case scenario of wind speed of 10m/s, which gives the maximum sound power output for the V136. Since the V136 3.45 MW under normal operating conditions (NRO Mode = 0) operates at a constant maximum sound power output of 108.2 dBA between 9.0 m/s and 20.0 m/s, worst-case would be defined as operation within wind speeds which exceed 9.0 m/s.

c. Noise-sensitive Receptors

The noise sensitive receptors which were considered for the assessment, as discussed earlier, mainly include the villages surrounding the Project site (Mothallath Al-Shobak, Zobeiriyeh and Mdhaibie') as presented in Figure 92 and Table 64 below.

Table 79: Receptor details and coordinates

No.	Receptor	Coordinates		Distance from Nearest WTG
		E	N	m (WTG)
R1	Closest Domestic Dwelling to Project	747761.82	3378702.81	1790 (WTG 3)
R2	Closest Domestic Dwelling to Project	747123.53	3375099.33	2321 (WTG 1)
R3	Centre of Village	752580.94	3375288.30	2902 (WTG 6)

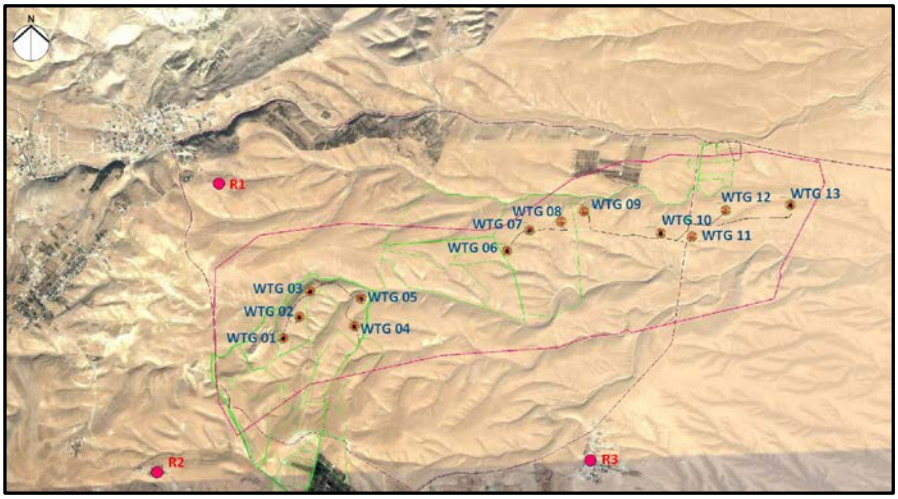

Figure 97: Noise Sensitive Receptors for the Project

(ii) Results

Presented below are the outcomes of the noise impact assessment in accordance with the methodology discussed earlier, to include an assessment without noise baseline conditions and another assessment that takes into account noise baseline levels.

a. Assessment without Noise Baseline Conditions

As discussed earlier, the IFC EHS Guideline for Wind Energy states: "*If the preliminary model suggests that turbine noise at all sensitive receptors is likely to be below an LA90 of 35 decibels dB(A) at a wind speed of 10meters/second (m/s) at 10m height during day and night times, then this preliminary modelling is likely to be sufficient to assess noise impact; otherwise it is recommended that more detailed modelling to be carried out, which may include background ambient noise measurements*".

The figure below presents the 35 dBA limit line from noise prediction calculations for all WTGs operating with peak sound power level (Ws > 9 m/s). As noted in the figure below, no sensitive receptors including nearby villages or domestic dwellings fall within the 35 dBA limit line.

In addition, a noise contour map for the worst-case noise scenario has been calculated and is presented in the figure below. The map shows contour lines and noise propagation level areas or 'zones' between the contour lines. The significance of the noise contour map is to allow for an overview of noise levels over a geographic area and therefore allows a quick basic analysis of the noise propagation for identification of specific noise sensitive receptors. The modelling specification for the noise contour map modelling is as per Table 65 below.

Table 80: Noise contour map setup specification – ISO 9613-2

Parameter Description	Noise Map Parameter
WTG Operation	Worst Case – All WTGs operating
Mapping Grid Resolution	10 x 10 m
Mapping Result Range	25 - 100 dB(A)

Based on the results of the noise contour map and the identification of noise sensitive receptors, Table 66 below shows contribution noise levels at 'R1' to 'R3' for the worst-case scenario for a Ws of 10 m/s.

Table 81: Predicted Contribution Noise Levels (W10)

Noise Sensitive Receiver	Predicted Contribution Noise Level per Wind Speed (W_s) of 10 m/s – dB(A)
R1	32.0
R2	29.5
R3	31.2

Taking the above into account, the assessment concludes that there are no issues of concern in terms of noise impacts from the Project on the surrounding receptors, see Figures 93 and 94. The assessment is considered sufficient to assess impacts in accordance with the IFC EHS Guidelines for Wind Energy. There is no requirement for an additional assessment which takes into account background noise levels.

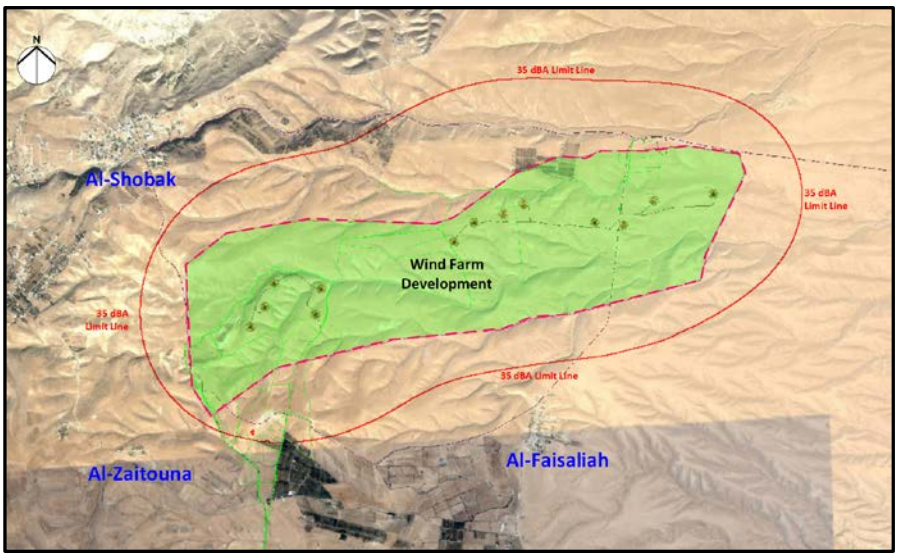

Figure 98: Noise Propagation with the 35 dBA Limit

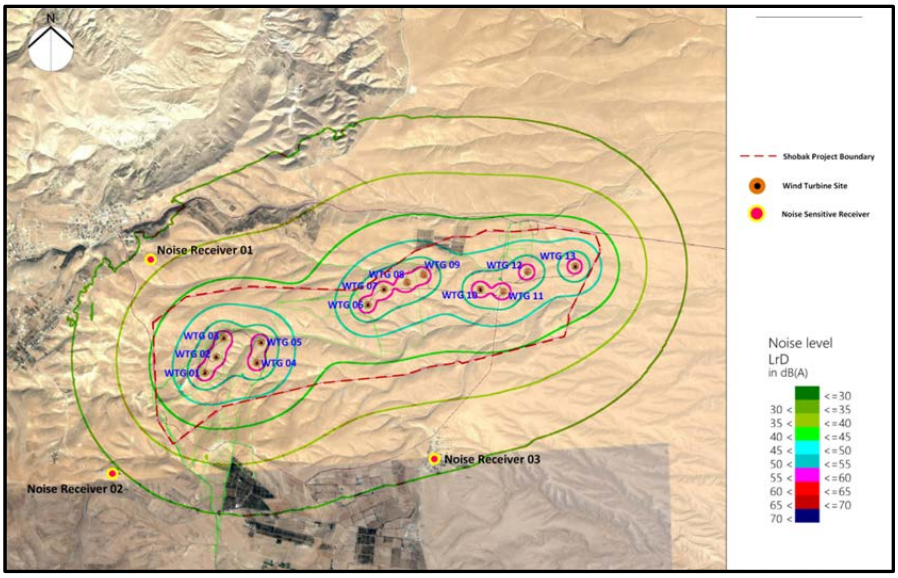

Figure 99: Noise Contour Map for Wind Farm – Worst-case, 10 m/s wind speed with All WTGs operating

b. Assessment with Noise Baseline Conditions

As discussed earlier, the assessment undertaken without a noise baseline conditions is considered sufficient to assess impacts from noise from the turbines on surrounding receptors. Nevertheless, the MoEnv requires that a noise baseline survey is undertaken at the surrounding receptors to be taken into account as part of the assessment. Therefore, in order to comply with the MoEnv requirements a noise baseline survey was undertaken. The noise baseline survey has been previously discussed in Section 17.2.2

Assessment of noise levels per noise limits are presented in Table 84 below.

Table 82: Proposed Noise Limits for WTG Noise Assessment

Item	Worst-case, 10 m/s
Jordanian Regulations Noise Limits, LA90 dB	
Day-time (07h00 – 18h00)	50.0
Night-time Period (18h00 – 07h00)	40.0
IFC EHS Limits – Table 1.7.1 Noise Level Guidelines	
Day-time (07h00 – 22h00)	55.0
Night-time (22h00 – 07h00)	45.0
IFC EHS Limits – Background Level Limit Increase + 3dB Noise Sensitive Receiver 1	
Day-time (07h00 – 22h00)	48.0
Night-time (22h00 – 07h00)	48.0
IFC EHS Limits – Background Level Limit Increase + 3dB Noise Sensitive Receiver 2	
Day-time (07h00 – 22h00)	51.0
Night-time (22h00 – 07h00)	50.0
IFC EHS Limits – Background Level Limit Increase + 3dB Noise Sensitive Receiver 3	
Day-time (07h00 – 22h00)	58.0
Night-time (22h00 – 07h00)	46.0

Tables 70 and 71 below show the assessments for day-time and night-time periods for wind speed of 10 m/s, the worst-case scenario. This assessment compares the calculated noise levels for the worst-case scenario with the Jordanian Limits where the total noise has been calculated assuming the background noise is equal to the Jordanian limit level.

Table; 83: Jordan Regulation Noise Impact Assessment for Day-Time Periods, Worst-Case Scenario

Noise Sensitive Receptor	Predicted Noise Contribution	Total Noise (Contribution + Background)	Jordanian Day-time Limit Level (Rural Areas)	Maximum Exceedance Value
	dBA L_d	dBA L_d	dBA L_d	dB
R1	32.0	50.0	50.0	-
R2	29.5	50.0	50.0	-
R3	31.2	50.0	50.0	-

Table 84: Jordan Regulation Noise Impact Assessment for Night-Time Period, Worst-Case Scenario

Noise Sensitive Receptor	Predicted Noise Contribution	Total Noise (Contribution + Background)	Jordanian Night-time Limit Level (Rural Areas)	Maximum Exceedance Value
	dBA Ln	dBA Ln	dBA Ln	dB
R1	32.0	40.6	40.0	0.6*
R2	29.5	40.4	40.0	0.4*
R3	31.2	40.5	40.0	0.5*

** Exceedance of the night-time limit at all receptors is below 1 dBA and within a 1 dB error tolerance. In order for an increase in noise to be noticeable to a human receiver it should exceed the background level by more than 3 dB. Therefore, though there is a numerical increase from the addition of background and contribution noise levels, the predicted noise levels are significantly lower at the receptors such that they would not be audible or change in background noise levels noticeable.*

Tables 72 and 73 below show the assessments for day-time and night-time periods for wind speed of 10 m/s, the worst-case scenario. This assessment compares the calculated noise levels for the worst-case scenario with the IFC Limits where the total noise has been calculated assuming the background noise is equal to the IFC limit levels.

Table 85: IFC Limit Level Noise Impact Assessment for Day-Time Periods, Worst-Case Scenario

Noise Sensitive	Predicted Noise Contribution	Total Noise (Contribution +	IFC Day-time Limit Table 1.7.1 Residential	Maximum Exceedance Value

Receptor		Background)		
	dBA Ld	dBA Ld	dBA Ld	dB
R1	34.0	55.0	55.0	-
R2	29.5	55.0	55.0	-
R3	31.2	55.0	55.0	-

Table 86: IFC Limit Level Noise Impact Assessment for Night-Time Periods, Worst-Case Scenario

Noise Sensitive Receptor	Predicted Noise Contribution	Total Noise (Contribution + Background)	IFC Night-time Limit Table 1.7.1 Residential	Maximum Exceedance Value
	dBA Ln	dBA Ln	dBA Ln	dB
R1	34.0	45.2	45.0	0.2*
R2	29.5	45.1	45.0	0.1*
R3	31.2	45.2	45.0	0.2*

** Exceedance of the night-time limit at all receptors is below 1 dBA and within a 1 dB error tolerance. In order for an increase in noise to be noticeable to a human receiver it should exceed the background level by more than 3 dB. Therefore, though there is a numerical increase from the addition of background and contribution noise levels, the predicted noise levels are significantly lower at the NSRs such that they would not be audible or change in background noise levels noticeable.*

Tables 74 and 75 show the assessments for day-time and night-time periods for wind speed of 10 m/s, the worst-case scenario. This assessment compares the calculated noise levels for the worst-case scenario with the IFC assessment of background noise level + 3 dB where the total noise has been calculated with the addition of background noise with the predicted contribution noise levels.

Table 87: IFC Background Level + 3dB Noise Impact Assessment for Day-Time Periods, Worst-Case Scenario

Noise Sensitive Receptor	Predicted Noise Contribution	Total Noise (Contribution + Background)	IFC Day-time Limit Background + 3dB	Maximum Exceedance Value
	dBA Ld	dBA Ld	dBA Ld	dB
R1	34.0	45.2	48.0	-
R2	29.5	48.1	51.0	-
R3	31.2	55.0	58.0	-

Table 88: IFC Background Level + 3dB Noise Impact Assessment for Night-Time Periods, Worst-Case Scenario

Noise Sensitive Receptor	Predicted Noise Contribution	Total Noise (Contribution + Background)	IFC Night-time Limit Background + 3dB	Maximum Exceedance Value
	dBA Ln	dBA Ln	dBA Ln	dB
R1	34.0	45.2	48.0	-
R2	29.5	47.1	50.0	-
R3	31.2	43.3	46.0	-

Taking the above into account, the assessment with noise baseline concludes that there are no issues of concern in terms of noise impacts from the Project on the surrounding receptors.

Impacts from noise from wind turbines during operation are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. However, the noise impact assessments concluded that noise levels from the wind turbines will not affect the surrounding nearby receptors and will not exceed acceptable limits during daytime and night-time, such an impact is considered of low magnitude and low sensitivity. Given the above, such an impact is considered to be not significant.

Additional requirements

Based on the results of this noise study no mitigation or curtailment for noise is required. However, there are additional requirements which must be taken into account as discussed below.

Upon completion of the construction of the wind farm, during the commissioning period a detailed long-term noise monitoring programme should be implemented to verify the outcomes and results of the noise assessment undertaken (as presented above). The monitoring programme should be carefully designed with specific planning of equipment, measurement locations and periods.

In addition, a detailed grievance mechanism for the local community must be prepared and implemented (currently being prepared as part of the SEP). The local community must be made aware of the grievance mechanism available to submit complaints regarding nuisances related to noise from the turbines (although unlikely based on the outcomes of the assessment and as to be verified during commissioning monitoring). Should, for any reason, such grievances be submitted, they must be verified and appropriate mitigations should be implemented (such as curtailment of turbines during specific situations or compensation such as provision of noise shielding at receptor locations such as sound reducing windows (double glazed) and planting of trees and shrubs, etc.).

Other Affected Communities

In addition to the villages discussed above, there are other affected communities which could be impacted by the noise generated from the turbines during operation. This mainly includes local communities who undertake agricultural and grazing activities during specific seasons of the year. However, noise from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on those local communities undertaking such activities are considered temporary and not significant, given that those local communities do not reside in the area; once they undertake such activities they return to their villages.

In addition to the above, there are some nomads that occupy the area and whom also undertake agriculture and grazing activities. Noise from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on the nomads are considered not significant. Nomads in general occupy the area on a yearly basis, but do not settle in the exact specific area each year. Therefore, in areas where high noise levels are expected from the turbines, the nomads could simply set up their tents on other nearby less affected areas.

Mitigation Measures and Monitoring Requirements

The Developer must develop informative maps in Arabic of noise propagations from the turbines in accordance with results highlighted throughout this chapter. In addition, the Developer should visit the Project area on a regular basis throughout the active period of nomads (at least once per month during their arrival period) to explain such informative maps and allow nomads to build up their tents in less affected areas.

17.2.3 Potential Impacts from Tonal Noise, Low Frequency Noise, Infrasound and Vibration of Wind Turbines during Operation

In general, modern wind turbines have been designed to keep tonality to a minimum and can be considered in most cases broadband noise sources. No tonal correction for components was added to the predicted noise levels. The standard methodology to determine the presence of tones is to check the level difference between the one-third octave band that contains the tone frequency and the two adjacent one-third octave bands, and determine if the difference exceeds the prescribed limits as per (ISO 1996 – 2). Based on that, calculations with the use of the predicted noise levels indicate that no tonality is present except when it is in exceedance at 1600 Hz and 2000 Hz. However, the resultant A-weighted noise levels at these frequency bands are 16.1 dBA and 8.9 dBA, which would be inaudible and therefore of no concern.

Comprehensive research on low frequency noise (frequency below160 Hz) and infrasound (below 20 Hz) has been published by the UK Department for Environment, Food & Rural Affairs and which concludes that there are no direct health effects at the levels of low frequency noise generated by wind turbines (DEFRA, 2003). It has been repeatedly shown from measurements of low frequency noise and infrasound from wind turbines undertaken over the past decade (in the UK, Denmark, Germany, and the USA), and as agreed by experienced acoustics professionals, that the levels of infrasound emitted from modern wind turbines even within the wind farm sites are at very low levels below the threshold of perception (DELTA, 2010).

A basic assessment of low frequency noise for the closest noise sensitive receptor (R1) was completed using the general Low Frequency Rating Noise (LFNR) Assessment as per ISO 1996 – 2. The assessment indicates that there is as exceedance at 16 Hz. However, this is not the case as the A-weighted level at this receptor is -9.35 dBA, which would be inaudible

Wind turbines are not typically a source of high level vibration. Vibration levels are reduced rapidly with distance to the source. A comprehensive study of vibration measurements in the vicinity of a wind farm undertaken in 1997 found that vibration levels were already at distances of 100 m below 10% of the value recommended as exposure limit for critical buildings such as laboratories housing precision measurement instruments (UK Department of Trade and Industry, 1997). Therefore, no vibration impacts are expected during operation beyond 100m. It can be anticipated that vibration from the Project's wind turbines will not be perceivable at any of the nearby sensitive receptors.

Taking all of the above into account, such impacts are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. However, the impact is considered to be of low magnitude and low sensitivity. Given the above, such an impact is considered to be not significant. To this extent, no mitigation measures are required and no additional requirements have been identified.

17.2.4 Potential Impacts from Shadow Flicker of Wind Turbines during Operation

Shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow several hundred meters away from the turbines location. As the rotor blades rotate, shadows pass over the same point causing an effect known as 'shadow flicker'. Of course, shadow length can change depending on the angle of the sun in the sky, but even if the object is large and the sun is low in the sky, the shadow will only stretch a certain distance – after that, the light bends around the object and the shadow becomes diffuse (weak).

Four conditions must occur simultaneously for a wind turbine to cause shadow flicker:

- The sun must be shining and there is no cloud cover;
- The moving object must be between the observer and the sun;
- The observer has to be close enough to the object to be in its shadow; and
- The blades have to be facing directly toward or away from the sun (so they are moving across the source of the light relative to the observer).

Shadow flicker could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment, see Figure 95. Therefore, to assess the anticipated impacts, a shadow flicker prediction model was employed.

The section below discusses the methodology that was adopted for the modelling and also presents the outcomes and results.

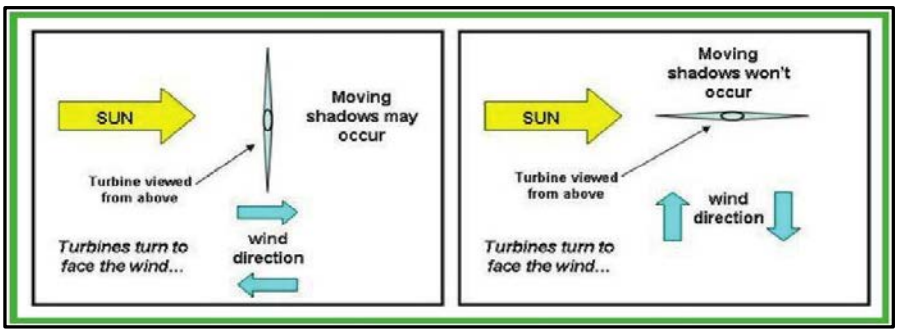

Figure 100: Relation between Position of Sun, Wind Direction and Occurrence of Shadows

(i) Relevant Legislations and Requirements for Shadow Flicker Assessment

There are no specific requirements in Jordan for shadow flicker. The relevant international guideline and best practice for shadow flicker would be the IFC EHS Guidelines for Wind Energy. In specific, with regards to shadow flicker the IFC EHS Guideline for Wind Energy specifies the following:

- *Where there are nearby receptors, commercially available software can be used to model shadow flicker in order to identify the distance to which potential shadow flicker effects may extend. The same software can typically also be used to predict the duration and timing of shadow flicker occurrence under real weather conditions at specific receptors located within the zone of potential shadow flicker impact.*
- *If it is not possible to locate the wind energy facility/turbines such that neighbouring receptors experience no shadow flicker effects, it is recommended that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario.*
- *In order to assess compliance with the recommended limits, shadow flicker should be modelled and predicted based on an astronomical worst-case scenario, which is defined as follows: (i) there is continual sunshine and permanently cloudless skies from sunrise to sunset; (ii) there is sufficient wind for continually rotating turbine blades; (iii) rotor is perpendicular to the incident direction of the sunlight; (iv) sun angles less than 3 degrees above the horizon level are disregarded (due to likelihood for vegetation and building screening); (v) distances between the rotor plane and the tower axis are negligible and (vi) light refraction in the atmosphere is not considered.*

(ii) Impact Assessment Methodology

a. Shadow Flicker Modelling Methodology

Shadow flicker for the Project was modelled in WindPRO Version 3.1. WindPRO is considered to be an industry standard software program for WTG calculations. The software incorporates the WTG sites and surrounds and simulates the path of the sun over the course of the year and assesses at intervals the potential shadow flicker at a given receptor (domestic dwelling).

The software gives a conservative estimate of the number of hours per year that shadows could be cast by the rotation of the turbine blades. The assessment provides a shadow flicker calculation method which considers the following parameters:

- The position of the WTGs – x, y, z coordinates;
- The hub height and rotor diameter;
- The position of the shadow receptor object – x, y, z coordinates;

- The size of the window and its orientation, both directional (relative to South) and tilt (angle of plane to the horizontal);
- The geographic position (latitude and longitude);
- Time zone and daylight-saving time information; and,
- A simulation model, which holds information about the Earth's orbit and rotation relative to the Sun.

The sun is modelled by a single-point source of light, whereas in reality the sun is not defined by a point source and is instead a sphere. Due to the spherical shape of the sun, there are shading areas in which the sunbeams or part of the sunbeams are covered by object. The model further assumes clear sky during 100% of the year (which is not the case in reality). Therefore, the model produces the worst-case scenario in line with a conservative assessment methodology.

The calculation model used within WindPRO uses the following parameters define the shadow propagation angle behind the rotor disk:

- The diameter of the Sun, D: 1,390,000 km;
- The distance to the Sun, d: 150,000,000 km;
- Angle of attack: 0.531 degrees.

The following calculations and assumptions were used for WindPRO calculations:

- Calculations only when more than 20% of the sun is covered by the blade;
- Minimum sun height over the horizon of influence: 3^{o};
- Day step for calculation: 1 day;
- Time step for calculation: 1 minute;
- A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non-visible WTG do not contribute to calculated flicker values;
- A WTG will be visible if it is visible from any part of the receiver window;
- The ZVI calculation is based on the following assumptions:
  - Height contours are used;
  - Eye height: 1.5m;
  - Grid Resolution: 10.0 m;
- The calculated times are "worst-case" given by the following assumptions:
  - The sun is shining continuously during the day, from sunrise to sunset;
  - The rotor plane is always perpendicular to the line from the WTG to the sun; and,
  - The WTG is always operating.

b. Sensitive Receptors

The sensitive receptors which were considered for the assessment, as discussed earlier, mainly include the villages surrounding the Project site as presented in Figure 96 and Table 76 below. The sensitive receptors included the closest dwellings to the Project site.

Table 89: Sensitive Receiver Locations fort Shadow Flicker Assessment

Receptor	Village	Description	Latitude (UTM Easting)	Longitude (UTM Northing)	Closest Distance to WTG (m)
R1	Closest domestic dwelling to Project	Domestic Dwelling	747761.82	3378702.81	1790 (WTG 3)
R2	Closest domestic dwelling to Project	Domestic Dwelling	747123.53	3375099.33	2321 (WTG 1)
R3	Centre of the village	Modaabie Knowledge Station	752580.94	3375288.30	2902 (WTG 6)

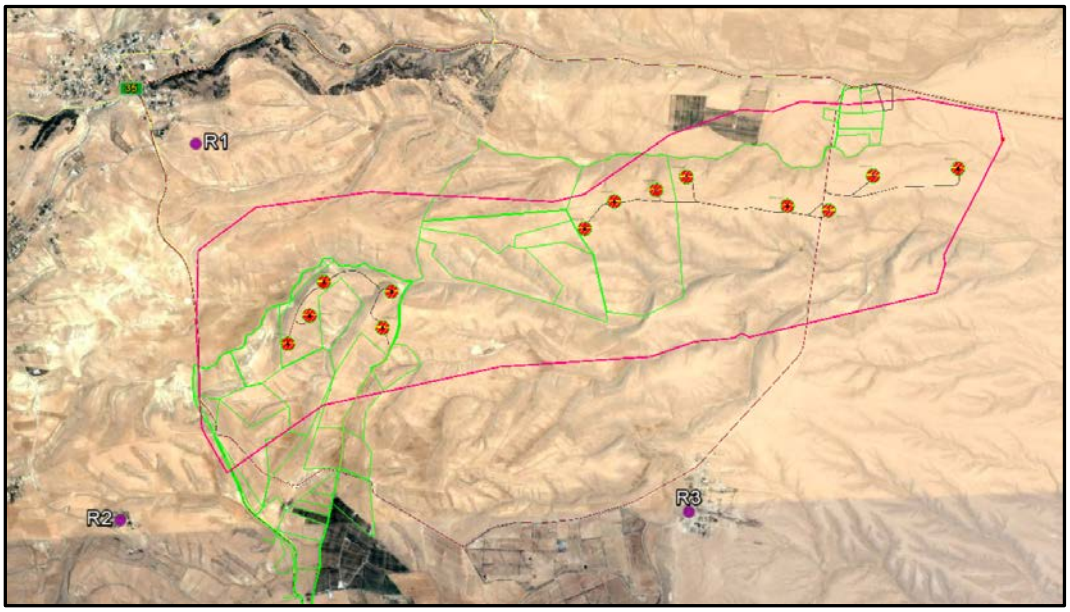

Figure 101: Shadow Flicker Sensitive Receptors for the Project

(ii) Results

Table 77 below shows the calculated astronomical maximum shadow flicker for hours per year and minutes per day for the wind farm. Figure 97 below confirms the results below visually showing the extent of shadow flicker as per the total hours per year.

Table 90: Worst Case Shadow Flicker Values for Identified Sensitive Receivers

Receptor	UTM East	UTM North	Astronomical maximum possible shadow flickering [Hours per year]	Astronomical maximum possible shadow flickering [Minutes per day]
R1	747761.82	3378702.81	00:00	00:00
R2	747123.53	3375099.33	00:00	00:00
R3	752580.94	3375288.30	00:00	00:00

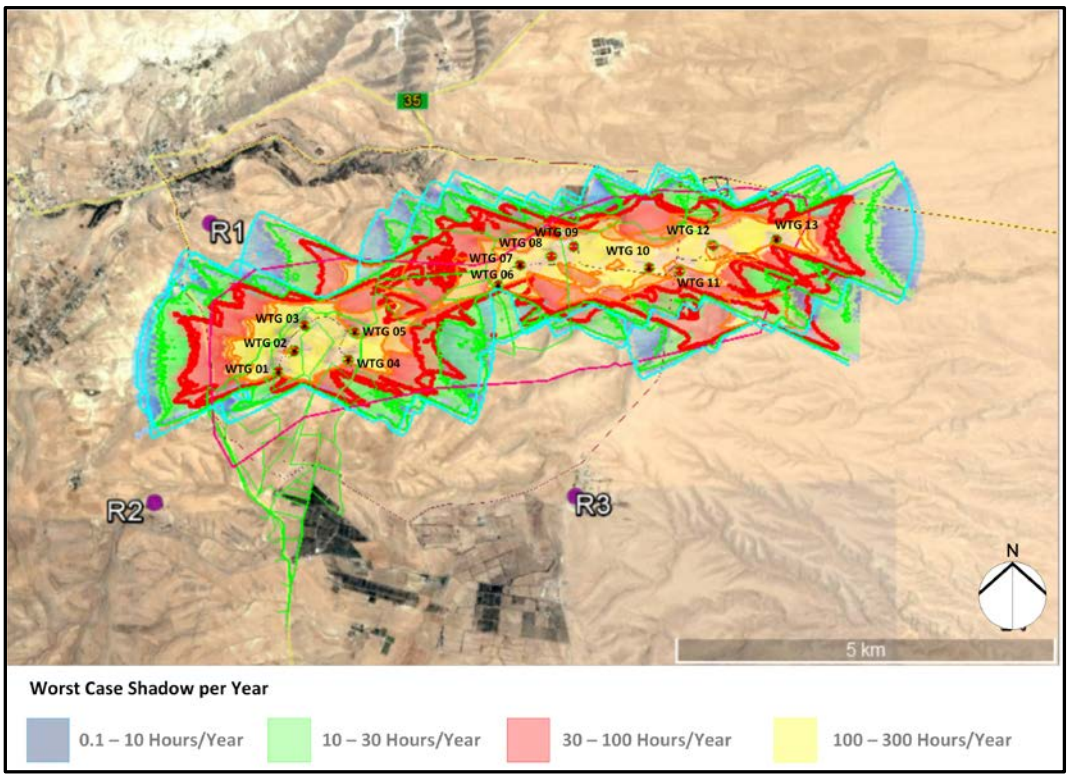

Figure 102: Shadow Flicker Map for Worst Case Shadow for all WTGs Operating

As noted in the table and figure above, all nearby receptors (including nearby villages and closest residential dwellings) will not experience any shadow flicker impacts and therefore results are within allowable limits set within the IFC EHS Guideline for Win Energy of 30 minutes per day and 30 hours per year.

Impacts from shadow flicker from wind turbines during operation are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. However, the shadow flicker impact assessments concluded that shadow flicker levels from the wind turbines will not affect the surrounding nearby receptors and will not exceed acceptable limits, such an impact is considered of low magnitude and low sensitivity. Given the above, such an impact is considered to be not significant.

Additional Requirements

Based on the results of this shadow flicker assessment, no mitigation or curtailment is required. However, there are additional requirements which must be taken into account as discussed below.

A detailed grievance mechanism for the local community must be prepared and implemented (currently being prepared as part of the SEP). The local community must be made aware of the grievance mechanism available to submit complaints regarding nuisances related to shadow flicker from the turbines (although unlikely based on the outcomes of the assessment). Should, for any reason, such grievances be submitted, they must be verified and appropriate mitigation should be implemented (such as curtailment of turbines during specific situations or compensation such introduction of vegetative buffers as a barrier for shadow flicker and/or providing window blinds).

Other Affected Communities

In addition to the villages discussed above, there are other affected communities which could be impacted by the shadow flicker generated from the turbines during operation. This mainly includes local communities undertake agricultural and grazing activities during specific seasons of the year. However, shadow flicker from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on those local communities undertaking such activities are considered temporary and not significant, given that those local communities do not reside in the area; once they undertake such activities they return to their villages.

In addition to the above, there are some nomads that occupy the area and whom also undertake agriculture and grazing activities. Shadow flicker from the turbines would not affect their grazing and agricultural activities. In addition, potential impacts and nuisances from the turbines on the nomads are considered not significant. Nomads in general occupy the area on a yearly basis, but do not settle in the exact specific area each year. Therefore, in areas where high shadow flicker levels are expected from the turbines, the nomads could simply set up their tents on other nearby less affected areas.

Mitigations Measures and Monitoring Requirements

The Developer must develop informative maps in Arabic of shadow flicker propagations from the turbines in accordance with results highlighted throughout this chapter. In addition, the Developer should visit the Project area on a regular basis throughout the active period of nomads (at least once per month during their arrival period) to explain such informative maps and allow nomads to build up their tents in less affected areas.

17.2.5 Potential Impacts from Blade and Tower Glint of Wind Turbines during Operation

Blade or tower glint occurs when the sun strikes a rotor blade or the tower at a particular orientation. This can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences. According to the IFC EHS Guidelines on Wind Energy "*previously, blade or tower glint, was considered to have a potential impact on communities. However, provided that wind turbines are painted with a matt, non-reflective finish, as is typical with modern wind turbines, blade or tower glint is no longer considered to be a significant issue".*

Taking all of the above into account, such impacts are considered of long-term duration as they will occur only throughout the operation phase of the Project and of a negative nature. However, based on the location of the turbines in relation to nearby receptors such an impact is considered of medium magnitude and low sensitivity. Given the above, such an impact is considered of minor significance.

Mitigation Measures

- EPC Contractor to ensure that turbines are painted with a matt, non-reflective finish.

With the implementation of the above mitigation, the residual significance is considered to be not significant.

Monitoring Requirements

- Review of detailed design to ensure such mitigations are taken into account.

17.2.6 Potential Impacts from Blade/Ice Throws during Operation

There are potential impacts from blade throws and ice throws from the wind turbines, where if such incidents occur they could affect the public safety – for example vehicles passing on the highway within the

Project area where some turbines are located, grazers from the local community passing next to turbines, etc.

According to the IFC EHS Guidelines on Wind Energy, a failure in the rotor blade can result in the 'throwing' of a rotor blade – however the overall risk of such an event is extremely low. In addition, if ice accretion occurs in blades, which can happen in certain weather conditions in cold climates, then pieces of ice can be thrown from the rotor during operation, or dropped if the turbine is idling. In the Project site, icing is expected to be a very low frequency occurrence based on the review of the climatic data for the region, and thus overall risk of such incidents is extremely low.

Taking all of the above into account, such impacts are considered of long-term duration as they will occur throughout the operation phase of the Project and of a negative nature. However, given that the overall risk of such events is extremely low such an impact is considered of low magnitude. However, the receiving environment is considered of high sensitivity given that it entails potential public safety. Given the above, such an impact is considered to be of minor significance.

Mitigation Measures

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Ensure that regular maintenance of the wind turbines takes place according to set schedule to prevent any unforeseen events from occurring such as blade throws; and
- Install post signs at least 200 meters from the wind turbine which provide informative in English and Arabic language about risks from such events.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant.*

Monitoring and Reporting Requirements

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Inspections and visual monitoring to ensure that maintenance activities of turbines take place according to set schedule, and to ensure that warning signs and posts are installed on the ground.

17.2.7 Potential Impacts from Public Access during Operation

The final impact related to community health, safety and security is mainly related to public access of unauthorized personnel to the various Project components. Such access could results in safety issues such as unauthorized climbing of the turbine, safety hazards from substations (electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc.) and others.

Such impacts are considered of long-term duration throughout the Project operation phase, of a negative nature, and are expected to be of medium magnitude and high sensitivity given that it entails potential public safety concerns which in extreme cases they could entail permanent impacts (e.g. death or permanent disability). Given the above such an impact is considered of moderate significance.

Mitigation Measures

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Each turbine is fitted with locked doors to prevent unauthorized access to the turbines;
- Substation area to be completely fenced with concrete walls to prevent unauthorized access;

- Onsite guards within the entire Project site at all times to ensure the safety and security of the Project as well a preventing unauthorized access to any of the Project components. However, it must be ensured that all onsite guards are adequately trained to deal with unauthorized trespassing incidents. In addition, guards must refrain from using excessive force, unless situation extremely requires so.
- Post informative signs on the turbines and other Project components (substation) about public safety hazards and emergency contact information.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant.*

Monitoring and Reporting Requirements

The following presents the mitigation measures that are to be implemented by the Project Operator during the operation phase of the Project and which include:

- Inspections and visual monitoring to ensure above measures are in place; and

Reporting of any trespassing incidents and the measures undertaken in such cases to control the situation and prevent it from occurring again.

17.2.8 Potential Impacts from Presence of Security Personnel during Construction and Operation

Onsite security guards will be required for the Project during the construction and operation phase. Inappropriate management and conduct of security personnel towards the local communities could result in potential conflicts, hostilities and resentments.

Taking the above into account, it is specifically important to adhere to EBRD PR4 – Labour and Working Conditions in relation to the security guards employed. PR4 requires that that the standard or practice and behaviour for the security personnel is guided by the Voluntary Principles on Security and Human Rights in terms of hiring, rules of conduct, training, equipping and monitoring of such personnel. It also requires that the Developer to make reasonable inquiries to satisfy itself that those providing security measures are not implicated in past abuses, will ensure they are trained adequately in the use of force (and firearms if applicable) and appropriate conduct towards the workers and the local community. Force should only be used when strictly necessary, and to an extent proportional to the threat.

Such impacts are considered of long-term duration throughout the Project duration, of a negative nature, and are expected to be of low magnitude and high sensitivity as they are generally controlled through the implementation of best practice requirements. Given the above such an impact is considered of minor significance.

Mitigation Measures

Developer is required to submit a security employment plan to be guided by international best practice requirements (such as the Voluntary Principles on Security and Human Rights). The plan must identify number of security workers required for the Project, how they will be recruited and hired (to include measures to ensure they are not implicated in past abuses), training requirements and implementation (to include in particular the use of force and if applicable firearms), equipping and monitoring, and code of conduct to be implemented (towards workers and local communities).

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant.*

Monitoring and Reporting Requirements

- Submission of security employment plan
- Reporting of any trespassing incidents and the measures undertaken in such cases to control the situation and prevent it from occurring again.

- Reporting of any allegations of unlawful or abusive acts of security personnel along with action undertaken to prevent reoccurrence.

17.2.9 Potential Impacts from Workforce Influx during Construction

During construction there will a peak of 60 construction workers for a duration of 16 months. It is expected that such a workforce will include expatriates, locals and Jordanians as well as migrant workers. No breakdown is available at this stage for the workforce in terms of workers from local communities, Jordanians, migrants and expatriates.

Nevertheless, taking the above into account, the construction phase will result in a small population influx to the local Project area. Such population influx (if inappropriately managed) could result in potential impacts towards the local communities such as nuisances, inappropriate conduct, disrespect of local cultures and norms, increased risk of exposure to communicable diseases, and other.

Such impacts are considered of short-term duration as they are limited to the construction phase, of a negative nature, and are expected to be of low magnitude and high sensitivity given the relatively small number of construction workers required. Given the above such an impact is considered of minor significance.

Mitigation Measures

Developer/EPC Contractor is required to prepare submit a community health and safety management plan that addressed impacts from influx of construction workers. The plan should detail proper management measures related to potential impacts on community health and safety to include a proper code of conduct to ensure appropriate management of worker interaction with the local communities and which takes into account local cultures and norms, mitigation measures to avoid/reduce risks of exposure to communicable disease such as proper screening, vaccination, awareness/, and other as appropriate.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to *not significant.*

Monitoring and Reporting Requirements

- Submission of community health and safety management plan
- Reporting of any incidents with local communities and the measures undertaken in such cases to control the situation and prevent it from occurring again.

18. SOCIO-ECONOMIC CONDITIONS

This Chapter first provides an assessment of baseline conditions within the Project site and surrounds in relation to the socio-economic conditions and then assesses the anticipated impacts from the Project throughout its various phases. For each impact, a set of management measures (which could include mitigation measures, additional requirements, recommendations, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

It is important to note that this chapter investigates impacts related to socio-economic development. Other impacts on local communities are discussed in other chapters, such as impacts on community health and safety and security (Chapter 17) and land use activities (Chapter 9).

18.1 Assessment of Baseline Conditions

This section discusses the methodology for the assessment of the baseline conditions in relation to socio-economic conditions as well as the outcomes and results.

18.1.1 Baseline Assessment Methodology

The socio-economic conditions have been established based on the review of secondary data available mainly from the Department of Statistics (DoS) and the Local Development Unit (LDU) of the Ma'an Governorate – mainly the "Economic and Social Situation of Ma'an Governorate Report of 2015" and "National Development Plan of 2016-2018". Available data from DoS and LDU was collected and reviewed for certain indicators in order to characterize and describe the socio-economic situation.

Available data was collected and reviewed for certain indicators in order to characterize and describe the socio-economic conditions. However, it is important to note that the majority of the socio-economic data from DoS is only available at the Governorate level; no data is available at the District level or specifically for the local communities near the Project area. Therefore, where available and relevant, data from DoS was complemented with additional statistical data from the LDU of Ma'an Governorate and a local community consultation session (as discussed previously in 6.5.2) to provide additional insights for the socio-economic situation within Shobak district in general and that of the nearby local communities to the greatest extent possible.

18.1.2 Results

Table 78 below presents relevant socio-economic conditions of the local communities which are closest to the Project site – which includes Mothallath Al-Shobak , Zaitooneh, Zobeiriyeh, and Mdeibie' as presented in Figure 98 below. Those are referred collectively as the local communities.

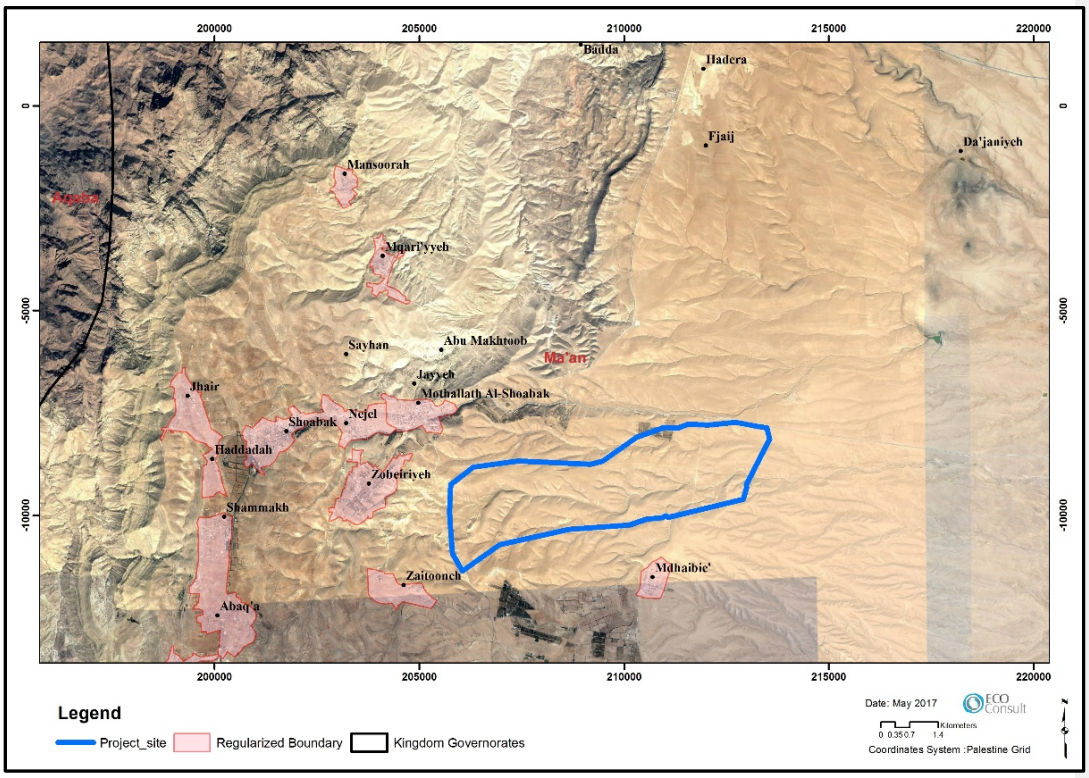

Figure 103: Local Communities to the Project Area

Table 91: Socio-economic Assessment of the Local Communities

Socio-economic Indicator	Local Communities			
	Mothallath Al-Shobak	Mdaibie'	Zaitooneh	Zobeiriyeh
Governorate	Ma'an			
District	Shobak District			
Population	4,275	880	125	1563
Syrian Refugees	663	0	14	103
Distance to Project Site (km)	1km west of the Project site	1km to the South	1km to the west	1.3km to the west
Gender Ratio	1:1 (as per Shobak District)			
Household Size	5.9 (as per Ma'an Governorate)			
Tribal Affiliation	Tribal affiliation in those local communities is represented by several tribes and sub-groups. Namely; ALHabahbeh, AlHedban, AlSaudis, AlRawashdeh, AlRafay'a, AlAzazmeh, AlMalaheem, AlAmareen and AlJbour.			
% of working population in public services	For Ma'an Governorate this was estimated at around 58.6%. However, based on consultations with local community representatives, the percentage is much higher within these communities, as the majority of the working population are in the public sector – the majority of which are in the Jordanian Armed Forces and minority of which are in public administration offices and civilian central government (39.4%) as well as education (19.2%) of the working population (mostly in schools operated and managed by the Ministry of Education) and health centres (operated and managed by the Ministry of Health).			
% of working population in private sector	For Ma'an Governorate this was estimated at 39.4% with an estimated 1482 active economic establishments where the majority engage in retail trade of commodities such as food, beverage, clothing, and household appliances, etc. However, based on consultations with local community representatives, job opportunities in the private sector are very limited and mainly include small scale establishments such as supermarkets, bakeries, restaurants, etc. However, within Shobak city in particular, opportunities in the private sector and especially in such small scale establishments are considered higher when			

Socio-economic Indicator	Local Communities			
	Mothallath Al-Shobak	**Mdaibie'**	**Zaitooneh**	**Zobeiriyeh**
	compared to the rest of the nearby villages.			
% of working population in Agriculture and Livestock	For Ma'an Governorate this was estimated at 2%. Based on consultations with local community representatives, agriculture and livestock/grazing activities are considered very limited practices by the local communities – in general, such activities are mainly undertaken for self-sufficiency purposes and/or as an additional source of income but they do not completely depend them as they are considered unfeasible.			
Annual Income per household (JOD)	For Ma'an Governorate 7,513 JOD, where the main source of income was from employment followed by transfers and income from rental.			
Unemployment rate	For Ma'an Governorate was estimated at 15.4%.			
Poverty Rate	For Ma'an Governorate was estimated at 26.6%. It is important to note that poverty in Ma'an recorded the highest rate across Jordan.			
# of Schools	For Ma'an Governorate was estimated of 193 schools			
Universities and Colleges	Within Ma'an Governorate this includes AlHussein Bin Talal University, Ma'an College, and AlShobak College.			
Health Services	Within Ma'an Governorate this include 2 hospitals, 38 health centres, 19 dentistry centres, 1 communicable diseases centre, 19 maternity and child care centre, and 18 pharmacies			

In addition to the above, based on consultations with the local community representatives as part of local consultation for this ESIA, one of the main socio-economic challenges facing the communities is the relatively high unemployment and poverty levels. This is mainly attributed to the following:

- Local communities mainly work in the public sector and specifically in military jobs which are considered low income professions;
- The investment and development projects/programmes in the area failed to employ local communities and thus positively impact poverty and unemployment levels. The major economic establishments in the area include poultry and agricultural farms as well as industrial establishments. Poultry and agricultural farms mainly employ foreign labour (such as Syrians or Egyptians) whereas industrial establishments mostly employ people from outside of the local communities, although there are limited job opportunities provided for the local communities mainly in unskilled labour;
- Another important factor is the scarcity of economic establishments which triggers the migration of the working population to other governorates seeking better job opportunities;
- Based on such consultations, the local communities were supportive of such wind farm projects. Nevertheless, their expectations from such development projects mainly include providing job opportunities and social development as detailed below.
  - Priority for all job opportunities (skilled and unskilled) should be for the local communities.
  - The local community has several expectations from the Developer in implementing additional social responsibility actions. Generally, it was agreed that such actions should be based on the priority needs of the local communities and must also be coordinated with the relevant municipalities as well as Community Based Organisations (CBOs).
  - There must be a transparent and well-advertised recruitment procedure for the local community members which provides an equal opportunity for all and it was suggested that this is coordinated with the Governorate or municipalities.
  - The Developer must consider additional areas where local community members can benefit or be involved besides job opportunities provided they have the required skills and expertise needed to meet the development standards. For example, during construction the Project shall consider the appointment of local contractors, local sourcing of materials and supplies, etc.

18.2 Assessment of Potential Impacts

Given the generic nature of the impacts on socio-economic development for both phases of the Project (construction and operation) those have been identified collectively throughout this section. During the construction and operation phases, the Project is expected at a minimum to provide job opportunities for local communities. The Project will create the following job opportunities:

- As provided earlier, a maximum of 60 job opportunities will be provided during the construction phase for duration of 16 months. This will include job opportunities for unskilled labour, and professionals for management (to include engineers, technicians, surveyors, etc.). Based on preliminary information, the Developer at this stage has prioritised all job opportunities to the local communities. All unskilled job opportunities will be for local communities, while skilled opportunities will be prioritised to the local communities (with required qualifications and skills) and/or Jordanian residents.
- 3 job opportunities will be provided during the operation phase for duration of 20 years. This will include jobs for skilled labours (electricians and technicians). Based on preliminary information, the Developer at this stage has prioritised all job opportunities to the local communities. Majority of skilled job opportunities will be prioritised to the local communities (with required qualifications and skills) and/or Jordanian residents.

The above could also entail other indirect positive benefits to the local community from increase in demand for local services, supplies, and businesses. This could include for example possible engagements for supplies and services (accommodation services, food, household products, etc.). Such demands could improve the existing local economic activities and impact certain sectors, such as wholesale/retail trade.

Taking all of the above into account, this to some extent could contribute to enhancing the living environment for its inhabitants. The creation of job opportunities in specific is of crucial importance especially because, as discussed earlier, the local community in general suffers from high unemployment rates and lacks governmental and private sector investment projects which can employ labour and thus positively impact unemployment levels.

Proper planning and local community engagement from the start is crucial to understand issues and opportunities which in turn would enable the Project build true sustainable links which will bring maximum benefits to the local communities. Given the above, such impacts are anticipated to be positive.

Recommendations

As the impacts discussed are mainly positive, no mitigation measures have been identified. This section provides recommendations which aim to enhance such positive impacts anticipated from the Project throughout the construction and operation phases to the greatest extent possible.

From the onset of the Project, it is recommended that the Developer adopt and implement a community integration plan. The community integration plan must demonstrate how the local communities will be involved and integrated in the Project in terms of job opportunities and other indirect socio-economic benefits (e.g. accommodation services). The plan must conform to the requirements of the recently issued "Regulation for Obligatory Employment of Jordanian Workforce from Surrounding Communities in Development Projects No. (131) for the year 2016". The Regulation requires the obligatory employment of local communities within development projects to include fresh graduate engineers, technicians, labourers, etc. and specifies requirements for training as well as giving priority for local contractors. The number of job opportunities is specified based on the investment amount of the development projects. In addition, the plan must follow EBRD's Environmental & Social Policy which includes requirements for supply chain management. The Plan must also demonstrate providing priorities to local communities starting at the municipal level, district level, and finally at the Governorate level.

Taking the above into account, it is recommended that the plan include the following:

- Manage expectations so that local communities are realistic about opportunities from the Project;

- Identify the number of skilled and unskilled job opportunities targeted to the local community throughout the construction and operation phases. The Developer is expected to provide in detail the qualifications and skills required for each job opportunities as well as the limitations and constraints of local community members and how and to which extent those could be addressed through training and capacity building;
- Present transparent recruitment procedures for the local community, to be adopted and implemented in the various construction and operation contracting arrangements. Such procedures must provide equal opportunities for all, including females;
- Detail additional areas where local community members can benefit or be involved besides job opportunities provided they have the required skills and expertise needed to meet the development standards. For example, during construction the Project shall consider local sourcing of materials and supplies (if available);
- Ensure timely and continuous communication and dissemination of information between the Developer and the local community members to alleviate potential sense of social marginalization and improve their understanding and perception of the benefits associated with development. Communication should also include information and updates on the projects development, number of employment opportunities, the bidding process for project components, construction plans, etc.
- The plan should also consider allocating funds for social responsibility programs to be implemented for the local communities. The program must be structured and based on the priority needs for the villages along with a structured approach for selection of projects and programs (e.g. through a committee with representatives from local communities, local governmental agencies, CBO's, etc.).

19. OCCUPATIONAL HEALTH AND SAFETY

This Chapter assesses the anticipated impacts from the Project throughout its various phases on occupational health and safety. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

19.1 Assessment of Baseline Conditions

Assessment of baseline conditions related to occupational health and safety is considered irrelevant.

19.2 Assessment of Potential Impacts

This section identifies and assesses the anticipated impacts from the Project activities occupational health and safety. For each impact, a set of management measures (which could include mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels. Throughout this section, the impacts during the construction and operation phase have been discussed collectively due to the similarity in nature of the impacts.

Throughout the construction phase there will be generic occupational health and safety risks to workers, as working on construction sites increases the risk of injury or death due to accidents. The following risks are generally associated to construction sites and apply for the construction of the Project and could include:

- Slips and falls;
- Working at heights;
- Struck-by objects;
- Moving machineries;
- Working in confined spaces and excavations;
- Exposure to chemicals, hazardous or flammable materials;
- Air pollutants and dust generation;
- Noise;
- Particularly for wind power projects, workers are potentially exposed to electric shocks and burns when touching live components; and
- Taking into account the Project site, construction workers are expected to work relatively hot weather conditions (and thus are exposed to certain risks such as dehydration, heat exhaustion, and heat stroke) and very cold weather conditions (and thus are exposed to certain risks such cold stress, slippery roads during frost days, etc.).

Similarly, throughout the operation phase, there are occupational health and safety risks to workers from the various operation and maintenance activities expected to take place for the Project. The following risks are generally associated to such a Project and which could include:

- Working at heights during maintenance activities
- Exposure to a variety of hazards such as electric shock, and thermal burn hazards;
- Exposure to chemicals, hazardous or flammable materials; and
- Taking into account the Project site, maintenance activities are expected to take place in relatively hot weather conditions (and thus workers are exposed to certain risks such as dehydration, heat

exhaustion, and heat stroke) and very cold weather conditions (and thus workers are exposed to certain risks such cold stress, slippery roads during frost days, etc.).

In addition to the above, the nature of construction and operation activities could entail incidents, accidents and emergency situations (such as fire, lightning, earthquakes, OHS risks, etc.) which could result in adverse impacts on workers. Specific incidents related to the Project site include dust/sandstorms, OHS incidents (bites from poisonous fauna such as snakes or scorpions).

Such impacts are considered of short-term duration during the construction phase and of long-term duration throughout the Project operation phase, of a negative nature. A wind farm construction site is associated with an inherently high occupational health and safety risks some of which have considerable consequences (fatality through fall from heights) – but such impacts are generally controlled through the implementation of general best practices; to this extent such impacts are considered of medium magnitude and high sensitivity. Given the above such an impact is considered of moderate significance.

Mitigation Measures

- The EPC Contractor is required to prepare an Occupational Health and Safety Plan (OHSP) regarding the Project's construction and commissioning activities while the Project Operator is required to prepare an OHSP for the operation and maintenance works. The objective of the Plan is to ensure the health and safety of all personnel in order to concur and maintain a smooth and proper progress of work at the site and prevent accident which may injure personnel or damage property of the EPC Contractor, O&M Contractor and all involved sub-contractors.

  The OHSP for the construction and operation phase should be Project and site specific and must take into account the national requirements mainly the "Labour Law No.(8) for the year 1996 and its amendments", including Chapter IX, Occupational Safety & Health. In addition, it must also be compliant with EBRD PR4 – Health and Safety, which recognizes the importance of avoiding or mitigating adverse health and safety impacts on workers and requires the development of a project-specific health and safety plan that in accordance with the relevant EU Occupational Health and Safety (OHS) Standards and Good International Practice (GIP).

  In summary, the OHSP should provide details on the following components.

  - Identification of roles and responsibilities of the personnel involved within the Project to include the EHS manager, Project manager, site manager, health and safety manager, EHS coordinator, subcontractors, workers, etc.;
  - Identifies in details information in relation to communication protocols, first aid instructions and facilities, training programs, occupational health and safety culture, inspection programs, monitoring and reporting requirements, incident management, etc.
  - Identifies in details the activities that are expected for the Project (e.g. civil works, electrical wiring, material transport and unloading, wind turbine mechanical assembly, wind turbine electrical installation, commissioning, maintenance, etc.) and lists the specific jobs which are to be undertaken under each activity and the hazards which may be associated for each (electric hazards, working with machinery, vertical works, etc.);
  - For each of the activities above, the OHSP must identify the preventive equipment and systems that must be in place to eliminate or reduce such risks. This includes: (i) collective protective equipment (safety signs, traffic signs, hand signs, marking and signalling of work in progress, etc.); (ii) personal protective equipment (this includes the compulsory equipment for any worker or visitor onsite and obligatory equipment based on the tasks being carried out) (iii) detailed safety measures on how the task should be implemented in a safe manner to reduce any occupational health and safety risks.

  The EPC Contractor and the Project Operator are expected to adopt and implement the recommendations/provisions of the OHSP throughout the Project construction and operation phase.

- The EPC Contractor and Project Operator are also expected to prepare a project and site specific Emergency Preparedness and Response Plan.

Following the implementation of these mitigation measures, the significance of the residual impact can be reduced to not significant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements that must be adhered to by the EPC Contractor and Project Operator during the construction and operation phase:

- Inspection to ensure the implementation of the provisions of the Occupational Health and Safety Plan and assess compliance with its requirements;
- Submission of an emergency preparedness and response plan; and
- Regular Reporting on the health and safety performance onsite in addition to reporting of any accidents, incidents and/or emergencies and the measures undertaken in such cases to control the situation and prevent it from occurring again.

It is important to note that the contract between the Developer and EPC Contractor and Developer and Project Operator requires that both entities adhere to the requirements of EBRD PR 2 – in relation to preparation of an HR policy, requirements for working conditions and terms of employment, child labour, forced labour, non-discrimination and a labour grievance mechanism.

20. SUMMARY OF ANTICIPATED IMPACTS

Tables 79, 80 and 81 below present a summary of the anticipated impacts during the planning and construction, operation, and decommissioning phase of the Project, respectively. The information in the tables includes:

- Key and generic environmental attributes (e.g. air quality, noise);
- Impact (textual description);
- Nature of impact (negative or positive);
- Duration (long-term or short-term);
- Reversibility (reversible or irreversible);
- Magnitude (high, medium, or low);
- Sensitivity (high, medium, or low);
- Significance (major, moderate, minor, or not significant);
- Management action – generally management actions describe whether an impact can be mitigated or not. Management actions include: (i) mitigation measures; (ii) compensation measures; (iii) additional requirements which must be implemented at a later stage and which could be required by a governmental entity; (iv) for positive impacts recommendations have been provided which aim to enhance the impact; and
- Residual significance after management actions are implemented (major, moderate, minor, or not significant).

Table 92: Summary of Anticipated Impacts during the Planning and Construction Phase

Environmental Attribute	Likely Impact – Planning and Construction Phase	Impact Assessment							
		Nature	Duration	Reversibility	Magnitude	Sensitivity	Significance	Management Action	Residual Significance
Landscape and Visual	Construction activities would create a temporary effect on the visual quality of the site and its surroundings. The visual environment during the construction phase would include the presence of elements typical of a construction site such as equipment and machinery to include cranes, excavators, trucks, front end loaders, compactors and other	Negative	Short-Term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
Land Use	Project could conflict the formal assigned land uses set by the various governmental entities.	There are no anticipated impacts.						No action	Not relevant
	Construction activities could disturb and affect the actual land use of the site as it could provide value to local stakeholders such as local communities and nomads (for agriculture, grazing, etc.).	Negative	Short– Term	Reversible	Low	Medium	Minor	Mitigation available	Not Significant
Geology and Hydrology	There are various wadi systems which run within the Project site. If not taken into account there could be potential for flood risks which could affect the various Project components.	Negative	Long – Term	Could be irreversible	Medium	High	Moderate	Mitigation Available	Not Significant
	Risk of soil and groundwater contamination during the various operational activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater	Negative	Long – Term	Could be irreversible	Low	Medium	Minor	Mitigation available	Not significant
Biodiversity	Construction activities would disturb existing habitats (flora and fauna). In addition, other impacts could be from improper management of the site (e.g. improper conduct and housekeeping practices).	Negative	Long – Term	Could be irreversible	Medium	Low	Minor	Mitigation Available/ Additional Studies	Not Significant
Birds (Avi-Fauna)	Construction activities could disturb existing habitats of birds breeding and/or nesting within the Project site.	Negative	Short – Term	Could be irreversible	Low	Medium	Minor	Mitigation Available/ Additional Studies	Not Significant
Bats	Construction activities would alter the site's habitat and potentially affects bats particularly through loss of hunting habitats as well as removal of roosting sites.	Negative	Long – Term	Could be irreversible	Low	Low	Not Significant	No Mitigation Required	Not Significant
Archaeology and Culture Heritage	Improper management of construction activities could disturb/damage the archaeological locations recorded within the area as well as potential archaeological remains which could be buried in the ground (if any).	Negative	Short – Term	Could be irreversible	Medium	Medium	Moderate	Mitigation Available	Not Significant
Air Quality	Construction activities will likely result in an increased level of dust, particulate matter and pollutant emissions which in turn will directly impact ambient air quality.	Negative	Short - Term	Reversible	Medium	Low	Minor	Mitigation Available	Not Significant
Infrastructure and Utilities	Water Resources – water requirements of the Project could entail constraints on the existing resources users such as the local communities.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project during the construction phase.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project during the construction phase.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project during the construction phase.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Aviation, Telecommunication, and TV & Radio Links – Improper planning and site selection of the Project could impact aircraft safety and/or could potentially interfere with certain electromagnetic transmissions associated with air transport, telecommunications, and radio/television systems	There are no anticipated impacts.						Additional Requirements	Not Significant
	Road Networks – if transportation activities of the various project components to the site are not properly managed beforehand, they could entail risk of damage to the existing roads and could be of public safety concerns to other users on the road.	Negative	Short-Term	Reversible	High	Medium	Moderate	Mitigation Available	Not Significant
Community Health, Safety and Security	Various construction activities expected to be a source of noise and vibration generation within the Project site and its surroundings. If improperly managed, there is risk of nuisance and health affects to the nearby surrounding receptors (such as the local communities).	Negative	Short-Term	Reversible	Low	Low	Not significant	Mitigation available	Not Significant
	Potential Impacts from presence of security personnel relate to inappropriate management and conduct of security personnel towards the local communities.	Negative	Long-Term	Reversible	Low	High	Minor	Mitigation available	Not Significant
	Potential Impacts from Workforce Influx during Construction	Negative	Short-Term	Reversible	Low	High	Minor	Mitigation available	Not Significant
Socio-Economic Conditions	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.	Positive	Not applicable					Recommendations provided	Not applicable
Occupational Health and Safety	There will be some risks to workers health and safety during the operation and maintenance activities of the Project.	Negative	Short – Term	Could be irreversible	Medium	High	Moderate	Mitigation Available	Not Significant

Table 93: Summary of Anticipated Impacts during the Operation Phase

Environmental Attribute / Issue	Likely Impact – Operation Phase	Impact Assessment							
		Nature	Duration	Reversibility	Magnitude	Sensitivity	Significance	Management Action	Residual Significance
Landscape and Visual	Visual impacts concern the turbines themselves (e.g. colour, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape. There were various impacts assessed on various landscape types.	Could be Negative or Positive	Long – Term	Reversible	Low	Medium	Minor	Mitigation Available	Minor
Land Use	Operational activities could disturb and affect the actual land use of the site as it is used by the local community for agriculture and grazing. In addition, nomads settle in the area and undertaken agricultural and grazing activities.	Negative	Long –Term	Reversible	Low	Medium	Minor	Mitigation Available	Not Significant
Geology and Hydrology	Risk of soil and groundwater contamination during the various operational activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater.	Negative	Long – Term	Could be irreversible	Low	Medium	Minor	Mitigation available	Not significant
Biodiversity	Improper management of the site could disturb existing habitats (e.g. improper conduct and housekeeping practices).	Negative	Long –Term	Could be irreversible	Medium	Low	Minor	Mitigation Available	Not Significant
Avi-Fauna (Birds)	Wind turbines are associated with impacts on birds from risks of strikes and collision on both migratory and resident soaring birds. Such impacts depend on several factors but could affect the population levels of certain species especially those with international/national critical conservation status.	Negative	Long – Term	Could be irreversible	Low – High	Medium	Moderate	Mitigation Available	Not Significant
Bats	The potential impacts from the Project during operation are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines.	Negative	Long –Term	Could be irreversible	Low	Low	Not Significant	Mitigation Available / Additional Studies	Not Significant
Archaeology	Improper management of operational activities could disturb/damage the archaeological locations recorded within the Project area.	Negative	Long - Term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not Significant
Infrastructure and Utilities	Water Resources – water requirements of the Project could entail constraints on the existing resources users such as the local communities.	Negative	Short - Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project during the operation phase.	Negative	Long –Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project during the operation phase	Negative	Long –Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project during the operation phase.	Negative	Long –Term	Reversible	Low	Low	Not significant	Additional Requirements	Not Significant
Community Health , Safety and Security	Operating wind turbines will produce noise from mechanical and aerodynamic effects. This could be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment.	Negative	Long – Term	Reversible	Low	Low	Not Significant	Mitigation Available	Not Significant
	Operating wind turbines could produce low frequency noise, infrasound and vibration which could be a source of nuisance to the receptors and residents of the nearby villages.	Negative	Long –Term	Reversible	Low	Low	Not Significant	No additional requirements	Not Significant
	Shadow flicker from the rotating turbines could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages and could create a disturbing indoor environment.	Negative	Long – Term	Reversible	Low	Low	Not Significant	Mitigation Available	Not Significant
	Blade or tower glint can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences.	Negative	Long – Term	Reversible	Medium	Low	Minor	Mitigation Available	Not Significant
	Failure in rotor blade or ice accretion can result in the 'throwing' of the blade. Although overall risk of such events is extremely low, it could affect the public safety of the residents of nearby villages.	Negative	Long – term	Could be Irreversible	Low	High	Minor	Mitigation Available	Not Significant
	Public access of unauthorized personnel to the various Project components (turbines, substation) could results in various public safety hazards to local communities.	Negative	Long – term	Could be Irreversible	Medium	High	Moderate	Mitigation Available	Not Significant
	Potential Impacts from presence of security personnel relate to inappropriate management and conduct of security personnel towards the local communities.	Negative	Long-term	Reversible	Low	High	Minor	Mitigation available	Not Significant
Socio-economic Development	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.	Positive	Not applicable					Recommendations provided	Not applicable
Occupational Health and Safety	There will be some risks to workers health and safety during the operation and maintenance activities of the Project.	Negative	Long – Term	Could be irreversible	Medium	High	Moderate	Mitigation Available	Not Significant

Table 94: Summary of Anticipated Impacts during the Decommissioning Phase

Environmental Attribute / Issue	Likely Impact – Operation Phase	Impact Assessment							
		Nature	Duration	Reversibility	Magnitude	Sensitivity	Significance	Management Action	Residual Significance
Geology and Hydrology	Risk of soil and groundwater contamination during the various decommissioning activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater	Negative	Long – Term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not significant
Air Quality	Decommissioning activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Negative	Short term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
Community Health and Safety	Possible noise emissions to the environment from the decommissioning activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities	Negative	Short term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
Occupational Health and Safety	There will be some generic risks to workers health and safety from working on decommissioning sites, as it increases the risk of injury or death due to accidents.	Negative	Short Term	Could be irreversible	Medium	High	Moderate	Mitigation Available	Not significant

21. ASSESSMENT OF CUMULATIVE IMPACTS

This section investigates the cumulative impacts which could results from incremental impacts from other known existing and/or planned developments in the area based on currently available information.

Based on currently available information, there are no existing and/or planned development projects which could in result in any cumulative impacts, apart from existing and planned wind farm development project as discussed in further details below.

Within the Project area and its surrounding there are two existing wind farms and six planned wind farm development projects, which are at different stages of development. These projects are the following and which are presented in Figure 99 below.

1. Tafileh Wind Farm Project: a 117MW project that is located around 21km north of the Project site. Project is owned by Jordan Wind Power Company (JWPC) and started commercial operation in third quarter of 2015. The wind farm was part of the IFC's CEA;
2. Xenel Wind Farm Project: a 50MW project that is located around 30km north of the Project site. Project is owned by Xenel. This Project is part of the Direct Proposal Projects that have been shortlisted by MEMR, and has been recently approved by the government but it is yet unclear at this stage what is the timeframe for the project development. The wind farm was part of the IFC's CEA;
3. MASS Wind Farm Project: a 100MW project that is located around 28km northeast of the Project site. Project is owned by Mass Group Holding and its construction is expected in late 2017 while operation is not expected before the beginning of 2019;
4. LAMSA Wind Farm Project: a 99MW project that is located around 18km north of the Project site. The project is owned by LAMSA Investments LLC but the status of the project is unknown at this moment. It should be mentioned though that this project was included in the Cumulative Effect Assessment that was carried out by IFC (IFC, 2017), mentioned earlier;
5. Fujeij Wind Farm Project: a 90MW project that is located around 2km north of the Project site. Project is owned by MEMR. Project started construction activities in second quarter of 2017 and operation is expected in late 2018. The wind farm was part of the IFC's CEA;
6. KOSPO Wind Farm Project: a 50MW project that is located around 24km north of the Project site. Project is owned by Korea Southern Power Company and is construction is expected in late 2017 while operation is not expected before the beginning of 2019. The wind farm was part of the IFC's CEA;
7. Ma'an Wind Farm Project: a 75MW project that is located around 26km to the south of the Project site. Project is owned by MEMR and started commercial operation in third quarter of 2015;
8. Rajif Wind Farm Project: an 82MW project that is located around 35km to the south of the Project site. Project is owned by Alcazar Energy. The project is at the construction phase and it is expected to commence operation by the second half of 2018.

The key cumulative impacts that are relevant include: (i) biodiversity, bats and avi-fauna; (ii) shadow flicker; (iii) noise and (iv) landscape and visual. The only impact that is presented below is biodiversity, bats and avi-fauna since it is currently the only impact that has been studied cumulatively and there is available data. As for the other impacts, there is no data available from all adjacent projects and therefore and cumulatie studies would need a approval by the relevant parties to provide data for such analysis.

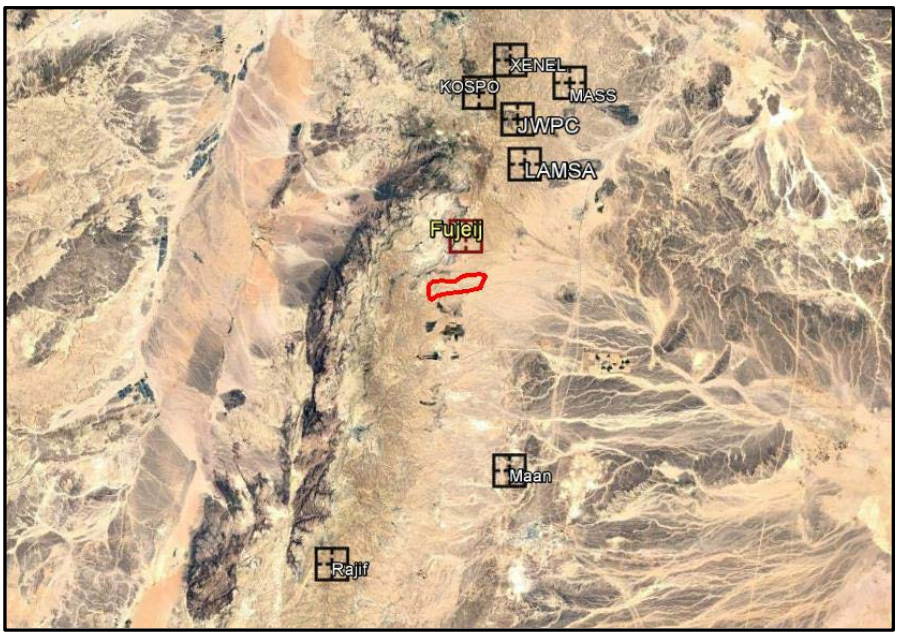

Figure 104: Wind Farm Projects in the Area

(i) Biodiversity, Bats and Avi-Fauna

The International Financing Corporation (IFC) has published recently the Tafila Region Wind Power Projects Cumulative Effect Assessment, covering five projects in the Tafila Region, namely, JWPC, KOSPO, Xenel, LAMSA, and Fujeij.

The overall objective of the CEA was to identify the potential cumulative effects of the Wind Power Projects on birds, bats and habitats in the study area of Tafila Region and propose mitigation, monitoring and other management measures to address the highest risks. Risks were identified with respect to Valued Social and Environmental Components (VECs). The CEA's scope was on three major biodiversity elements; birds, bats and habitats.

The focus of IFC's CEA was on five wind farm projects in the Tafila Region as mentioned earlier. The Project site is located inside the IFC's CEA area and the findings of the assessment are applicable to the Project.

Of particular importance would be the potential cumulative impacts on avi-fauna during the operation phase. The general area of the Project site along with the other adjacent wind farm projects is known to be part of the Red Sea/Rift Valley Migration Flyway, which is known to be the second most important bird migration flyway in the world. The cumulative impacts could occur mainly from strikes and collision of birds with operating wind farms. For example, given the migration route of birds during spring there could be impacts on migratory birds from the Project which could result in fatalities on certain priority species identified in the CEA. As birds continue with their migration route north or south, depending on the migration season, there could be impacts from other projects (such as the existing Tafileh Project and any other project that could be operational in the future).

The results of the CEA started with an initial list of 171 species populations that were identified as potentially at risk. This list was reduced through the CEA process to 13 species which were defined as priority bird VECs that were assessed to be at highest risk through the CEA process. Out of these 13 species populations, nine were recorded in the Project site. Four of these are migratory soaring bird populations; Egyptian Vulture *Neophron percnopterus*, Steppe Eagle *Aquila nipalensis,* Eastern Imperial Eagle *Aquila heliaca* and Booted Eagle *Aquila fasciata*, while the remaining five are resident or summer-breeding bird

populations; Short-toed Snake-eagle *Circaetus gallicus,* Griffon Vulture *Gyps fulvus*, Golden Eagle *Aquila chrysaetos*, Long-legged Buzzard *Buteo rufinus* and Lesser Kestrel *Falco naumanni*. Additionally, it would be impossible at this stage to confirm that additional priority species, other than the ones that were previously recorded in the Project site, will not be recorded during the operational phase of the project.

Regarding bats, the results of the CEA started with an initial list of 18 species populations that were identified as potentially at risk. This list was reduced through the CEA process to 2 species which were defined as priority bat VECs that were assessed to be at highest risk through the CEA process. In the project site, three bat species were recorded but none of them is a priority species, according to the CEA.

It is believed that cumulatively along with the other adjacent projects, avian in-flight monitoring during the operational phase is needed, in order to avoid any negative impacts on the priority species highlighted by the CEA, which has highlighted that the bird-fatality threshold of these species populations is zero. In other words, the projects should work collectively to avoid any fatalities for any individual of the thirteen species populations identified by the CEA. Based on the location of the Project, the results and recommendations of the IFC's CEA should be adopted during the operational phase of the project.

The main outcome of the CEA was management measures to be implemented throughout the construction and operation phase for the area. Such management measures were reflected and included within the impact assessment sections in this ESIA for biodiversity, bats and avi-fauna as well as the ESMP that follows.

The same level of assessment undertaken for the 5 projects covered in the CEA could not be undertaken for remaining wind farm projects (which mainly include Mass, Ma'an and Rajef) due to the following: (i) inconsistent level of data between the other sites; (ii) assessment will require a huge and extensive level of analysis over a long period of time; (iii) unavailable data for some of the sites. Nevertheless, a detailed and project specific baseline and impact assessment has been undertaken for each of the remaining projects not covered in the CEA as part of the project specific ESIA studies and a project specific ESMP has been developed. It is expected that as part of the ESMP a bird monitoring plan for observer-led turbine(s) shutdown on both migratory and resident birds will be required. With the implementation of such measures, the cumulative impacts on avi-fauna are anticipated to be not significant.

22. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

22.1 Institutional Framework and Procedural Arrangement for ESMP Implementation

Generally, two main pillars govern the successful implementation of any Environmental and Social Management Plan (ESMP):

1. Proper identification of roles and responsibilities for the entities involved; and
2. Effective control of the process.

All management practices are interlinked, and this section describes how these two pillar criteria could be fulfilled, which in turn helps ensure that the overall objectives of the ESMP are met.

Defining roles and responsibilities of the involved entities in any ESMP identifies where and when each entity should be engaged, their degree of involvement, and the tasks expected of the entity. This in turn eliminates any overlap of jurisdiction or authority and ensures proper communication and effective management of ESMP components. Control processes mainly include training and awareness for entities involved and control of non-conformances that might occur throughout the process.

The objective is to ensure that the ESMP recommendations are implemented in practice, during construction and operation, and assess how environmental resources are affected. Table 82 below summarizes the overall proposed institutional and procedural arrangement for the implementation of the ESMP, while Table 83 discussed in details the roles and responsibilities of each of the entities involved in implementation of the ESMP.

Generally, a self-compliance approach is advocated, whereby the body responsible for the causative action should ensure that the objectives and requirements stipulated within the ESMP are met – this mainly includes the appointment of a competent HSE Officer by the EPC Contractor during the Construction Phase, while during the Operation Phase this is to be undertaken through the appointment of a competent staff member of the Project Operator Team – there is no need to appoint a separate HSE Officer during operation due to the limited and simple mitigation/monitoring measures detailed within the ESMP (with the exception of the avi-fauna management and monitoring measures which must be undertaken by an expert in this field).

In addition, the Developer is required to review the reporting requirements as per the ESMP and undertake auditing exercises to ensure that the EPC Contractor and Project Operator meets the requirements stipulated within the ESMP. This could be undertaken through the appointment of a competent HSE Officer as part of the Developer Team or through a third party Employer Representative. It is recommended to undertake the auditing exercises on a monthly basis during the construction phase and on a quarterly basis during the operation phase. Finally, in accordance with the "EIA Regulation No. (37) of 2005", the Regulator (being MoEnv), will be responsible for undertaking compliance monitoring to ensure that the responsible entity is adhering to the ESMP requirements.

Table 95: Overall proposed institutional and procedural arrangement for ESMP Implementation

Issue	Self-Compliance	Review/Checks	Compliance Monitoring/ Inspection
Construction Phase			
Compliance with ESMP Requirements	EPC Contractor – HSE Officer	Project Developer – HSE Officer or third party Employer Representative (monthly basis)	MoEnv
Compliance with environmental legislations	EPC Contractor – HSE Officer	Project Developer – HSE Officer or third party Employer Representative (monthly basis)	MoEnv
Operation Phase			
Compliance with ESMP	Project Operator – Project Staff	Project Developer – HSE Officer or third party Employer Representative (on a quarterly basis)	MoEnv

Requirements	Member		
Compliance with environmental legislations	Project Operator - Project Staff Member	Project Developer – HSE Officer or third party Employer Representative (on a quarterly basis)	MoEnv

Table 96: Roles and Responsibilities of Entities Involved in ESMP

Designation	Entity	Project Role	Environmental and Social Responsibilities
Project Developer	Shobak Wind Power Company	Project Owner and Developer	▪ Selection of EPC Contractor and Project Operator; ▪ Implement mitigation and monitoring requirements as detailed in the ESMP; and ▪ Appoint a competent HSE Officer or Third Party Employer representative to review the reporting requirements as per the ESMP and undertake auditing exercises to ensure that the EPC Contractor and Project Operator conform to the requirements of the ESMP. Auditing is to be undertaken on a monthly basis during the construction phase and on a quarterly basis during the operation phase. ▪ Appoint a Community Liason Officer (CLO) to implmenet all community related management meausres identified within the ESIA/ESMP as well as Stakeholder Engagement Plan (SEP), grievance mechanism and other as appropriate. ▪ Appoint HR Manager (or delegate responsibilities to appropriate team staff member) to implmenet all labour and worker related management measures identified within the ESIA/ESMP as well as ensuring EBRD PR 2 requirements are met
Engineering, Procurement, and Construction (EPC) Contractor	Vestas	Undertake detailed design and construction of the project	▪ Appoint a competent HSE officer responsible for implementing the ESMP. ▪ Implement mitigation and monitoring requirements as detailed in the ESMP; ▪ Prepare and submit reporting requirements to Project Developer as detailed in the ESMP; ▪ Implement corrective action measures in case of non-compliance incidents and submit non-conformance report to Project Developer whom in turn will submit to MoEnv.
Project Operator	Vestas	Operation and maintenance of the Project	▪ Due to the limited and simple mitigation/monitoring measures detailed within the ESMP for the Operation Phase, a staff member of the Project Operator Team must be appointed to implement the requirements detailed within the ESMP; ▪ Appoint avi-fauna expert to implement the management and monitoring measures required as per the ESMP. ▪ Prepare and submit reporting requirements to Project Developer as detailed in the ESMP; and ▪ Implement corrective action measures in case of non-compliance incidents and submit non-conformance report to Project Developer whom in turn will submit to MoEnv.
Env. Regulator	MoEnv	Granting environmental clearance to the Project	▪ Undertake compliance monitoring

22.2 Training and Awareness Raising

Effective and efficient implementation of any ESMP requires that all personnel involved in the Project (construction/operation staff across all levels) understand its objectives and requirements. A proper training and awareness program ensures that applying mitigation measures is more of a sense of responsibility rather than an enforcing protocol.

Training and awareness is an ongoing process, but most importantly must take place before the commencement of any activity in any phase of the Project. The EPC Contractor and Project Operator are responsible, each for his own staff, for conducting inductions, training requirements and awareness raising which should include at a minimum the following:

- Ensure that staff understand all requirements, measures, and protocols stipulated within the ESMP;
- Ensuring that all personnel engaged in activities that may have an impact on the environment are competent to carry out their duties, or, where necessary, arrange for suitable training to be undertaken;
- Cultural change towards environmental perception;
- Waste, wastewater, and hazardous waste management practices as identified throughout the ESMP;
- Occupational health and safety; and
- Emergency response procedures.

22.3 Control of Non-Compliances

In case any incidents of non-compliance with the ESMP or relevant environmental legislations were noted by MoEnv, as part of their compliance monitoring, then the responsible entity (EPC Contractor or Project Operator) is responsible for issuing a Non-Compliance Report to be submitted to the MoEnv. The report would identify the nature of the problem, the proposed corrective action, action taken to prevent recurrence of the problem and verification that the agreed actions have been carried out. Normally, a Non-Compliance Report should be submitted within 24 hours of the identification of the non-compliance. However, in cases that demand an immediate response to address the non-compliance incident, the MoEnv should verbally notify the Contractor of the non-compliance. The Contractor should then take all necessary measures to address the non-compliance.

22.4 Compilation of Environmental and Social Management Plan

Tables 84 and 85 below present the ESMP for the planning/construction and operation phase respectively and which include the following:

- The environmental and/or social attribute (e.g. air quality) that is likely to be impacted;
- A summary of the potential impact and/or likely issue;
- The identified management measures that aim to eliminate and/or reduce the potential impact to acceptable levels. Management measures include mitigation actions, further requirements, additional studies, and compensation measures;
- Monitoring actions to ensure that the identified mitigation measures are implemented. Monitoring actions include: inspections, review of reports/plans, reporting, etc.;
- The frequency for implementing the monitoring actions, which include: once , continuously throughout the construction/operation period (depending on the mitigation measure identified this could include daily, weekly, or monthly), or upon occurrence of a certain issue;
- The responsible entity for implementing the mitigation measures and monitoring actions identified; and
- The relevant legislation that must be adhered to and which govern the environmental attribute or likely issue identified.

Table 97: ESMP for the Planning and Construction Phase

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Landscape and Visual	Construction activities would create a temporary effect on the visual quality of the site and its surroundings from presence of elements typical of a construction site such as equipment and machinery.	Ensure proper general housekeeping and personnel management measures are implemented such as: (i) ensure the construction site is left in an orderly state (ii) construction machinery, equipment, and vehicles that are not in use should be removed in a timely manner and kept in locations to reduce visual impacts (iii) ensure proper storage, collection, and disposal of waste streams generated	Mitigation	Inspections	Continuous	EPC Contractor	Environmental Protection Law No. 6 of 2017
Land Use	Construction activities could disturb actual land use of the site as it is used by the local community or nomads.	Land Users – Agriculture. Prior to construction, consultations to be undertaken with local community land users to develop a baseline in terms of agricultural activities undertaken within the Project site. In addition, assign in details the exact areas that are expected to be affected by the Project construction and operation. Ensure that such assigned areas are reduced to the greatest extent possible. It is recommended that the Developer allows land users to practice their activities within leased lands outside of construction and operation areas.	Mitigation	Produce comprehensive map which identifies agriculture activities and which also assigns construction and operation areas	Once; before construction commences	Developer and EPC Contractor	Environmental Protection Law No. 6 of 2017
		Land Users – Agriculture. Although highly unlikely, but should any of the agriculture users require assistance in allocating additional lands to undertake agriculture activities, assist such users to the greatest extent possible through coordination with other land owners in the area and/or on other available public lands.	Mitigation	Documentation of relocation assistance with photographs as appropriate	Upon occurrence	Developer or EPC Contractor	
		Land Users – Agriculture. Prior to commencement of construction activities, the Developer will disclose to the local communities the following through focus group discussions and information sheets : (i) the baseline mapping exercise for agricultural activities; (ii) announce construction areas and emphasize that agriculture and/or grazing activities cannot take place in such assigned construction areas; (iii) provide construction schedule and duration for which such construction activities will take place; (iv) emphasize that grazing and/or agriculture activities may take place outside of construction areas at all times; (v) provide details on the relocation assistance if required by any agricultural user; and (vi) provide details on the grievance mechanism.	Mitigation	Prepare and submit disclosure report with outcomes	Once; before construction commences	Developer and EPC Contractor	
		Nomads. If required (although unlikely) provide assistance to nomadic groups in assigning suitable areas outside of construction areas for settlement through coordination with other land owners in the area and/or on other public lands.	Mitigation	Documentation of relocation assistance with photographs as appropriate	Upon occurrence	Developer or EPC Contractor	
		During the period in which nomads begin to settle in the area (April, May and June), undertake regular site visits to meet with nomadic groups whom arrive onsite. The objective will be to: (i) Announce construction areas and emphasize that settlements as well as agriculture and/or grazing activities cannot take place in such assigned areas; (ii) Provide construction schedule and duration for which such construction activities will take place; (iii)Emphasize that settlements as well as grazing and/or agriculture activities may take place outside of construction areas at all times; (iv) Provide details on the relocation assistance if required by any agricultural user; and (v) Provide details on the grievance mechanism.	Mitigation	Prepare and submit disclosure report with outcomes	Continuously	Developer and EPC Contractor	
Geology and Hydrology	Wadi systems within the Project site could entail flood risks which could affect the Project components.	It is recommended that the EPC Contractor, as part of the design prepared for the Project, avoid sitting any of the Project components within the identified buffer distance from the wadi systems within the Project site.	Mitigation	Review final detailed design	Once – as part of detailed design phase	Developer and EPC Contractor	Environmental Protection Law No. 6 of 2017
		Should the Project require sitting any of its infrastructure elements (such as roads) within the wadi system then a detailed hydrological study must be undertaken which should determine the required engineering flood discharge structures to be considered as part of the detailed design (e.g. culverts) as per the expected flood .	Mitigation	Submission of detailed hydrology study	Once – as part of detailed design phase	Developer and EPC Contractor	
	Improper management of solid waste	Coordinate with Shobak Municipality or hire a competent private contractor for the collection of solid waste from the site to municipal approved landfill	Mitigation	Review contract with contractor	Once; before construction commences	EPC Contractor	Environmental Protection Law No. 6 of 2017 Solid Waste Management Regulation No. (27) of
		Prohibit fly-dumping of any solid waste to the land.	Mitigation	Inspection	Continuous	EPC Contractor	
		Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".	Mitigation	Inspection	Continuous	EPC Contractor	
		Distribute sufficient number of properly contained containers clearly marked as "Construction Waste"	Mitigation	Inspection	Continuous	EPC Contractor	

		for the dumping and disposal of construction waste. Where possible, the EPC Contractor must seek ways to reduce construction waste by reusing materials (for example through recycling of concrete for road base coarse).					2005
		Implement proper housekeeping practices on the construction site at all times.	Mitigation	Inspection	Continuous	EPC Contractor	
		Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of wastewater	Coordinate with Shobak Water Directorate to hire a private contractor for the collection of wastewater from the site to Shobak or Mansoorah WWTP	Mitigation	Review contract with contractor	Once; before construction commences	EPC Contractor	Environmental Protection Law No. 6 of 2017 Public Health Law No. 47 for 2008
		Prohibit illegal disposal of wastewater to the land	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil	Mitigation	Inspection	Once	EPC Contractor	
		Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing	Mitigation	Inspection	Continuous	EPC Contractor	
		Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the Shobak WWTP or Ma'an Central landfill. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of hazardous waste	Coordinate with the MoEnv and hire a private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility	Mitigation	Review contract with contractor	Once; before construction commences	EPC Contractor	Environmental Protection Law No. 6 of 2017 Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005, Instruction for Management and Handling of Consumed Oils for 2003, Instruction for Hazardous Waste Management for the year 2003
		Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv	Mitigation	Inspection	Continuous	EPC Contractor	
		Prohibit illegal disposal of hazardous waste to the land	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing	Mitigation	Inspection	Continuous	EPC Contractor	
		Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the Swaqa Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of hazardous material	Ensure hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of impermeable surface, accessible to authorized personnel only, prevent incompatible materials from coming in contact, etc.	Mitigation	Inspection	Continuous	EPC Contractor	Environmental Protection Law No. 6 of 2017 Jordanian Standard 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
		Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. Spilled material should be tracked and accounted for.	Mitigation	Inspection	Continuous	EPC Contractor	
		Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.).	Mitigation	Inspection	Continuous	EPC Contractor	
		Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material.	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that a minimum of 1,000 litres of general purpose spill absorbent is available at hazardous material storage facility.	Mitigation	Inspection	Continuous	EPC Contractor	
		If spillage occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.	Mitigation	Inspection Reporting of incident and measures taken to minimize impact	Upon occurrence	EPC Contractor	
Biodiversity	Construction activities would disturb existing habitats (flora and fauna). In addition, other impacts could be from improper management of the site (e.g.	Undertake a detailed survey to identify the presence of any active tortoises as well as potential hibernation/aestivation sites within all assigned areas to be disturbed by construction. Should any tortoises be located, they should be relocated to distant areas with similar habitat characteristics to the species to ensure that they would not return to the Project site, taking into account the home range for the species.	Additional Requirement	Submit survey report	Once; before construction commences	EPC Contractor	Environmental Protection Law No. 6 of 2017 Agriculture Law No. 13

	improper conduct and housekeeping practices).	Undertake a survey to identify any locations in the project where the various threatened floral species are located in order to provide instructions during the construction phase to avoid any damage to these threatened species. In case of identification of locations of any of the species, the plants could be either marked and/or fenced so that construction activities would avoid their locations or relocated	Additional Requirement	Submit survey report	Once; before construction commences	EPC Contractor	of 2015 Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
		Should as part of the Project any fencing be erected, it must be ensured that it allows for the natural movement of small faunal species within the area. This could include for example a fence with an appropriate gap between the ground level and the first rail or strand (around 30cm).	Mitigation	Inspection	Once	EPC Contractor	
		Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel (e.g. with respect to prohibiting hunting) and good housekeeping (e.g. keeping the site orderly and clean).	Mitigation	Inspection	Continuous	EPC Contractor	
Birds (avi-fauna)	Construction activities could disturb existing habitats of birds breeding and/or nesting within the Project site.	A breeding bird survey should be carried out before construction. If active breeding attempts of CEA priority birds or any other IUCN globally or regionally threatened species are confirmed, construction activities that could affect their breeding success must be delayed until these have either failed or young birds have fledged. Further annual breeding surveys are recommended if these categories of species are recorded using the site during the pre-construction phase, to inform a bird sensitive approach to operational phase activities.	Additional Requirement	Submit breeding survey report	Once; before construction commences	EPC Contractor	Environmental Protection Law No. 6 of 2017 Agriculture Law No. 13 of 2015 Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
		Implementation of proper housekeeping measures to reduce impacts including avoiding any activities in the sensitive areas for breeding birds, restrict activities to allocated construction areas only, prohibit hunting of birds at any time and avoid unnecessary elevated noise levels at all times.	Mitigation	Inspection	Continuous	EPC Contractor	
Archaeology and Cultural Heritage	Improper management of construction activities could disturb/damage the archaeological locations recorded in the Project area as well as potential archaeological remains which could be buried in the ground (if any).	As part of the disclosure session for the ESIA results with the local communities present the results and outcomes of the archaeology assessment. In particular, this should focus on the identified sites of importance by the DoA and whether the local community require access to such sites (such as the graveyard). Should this be applicable, then appropriate mitigation measures must be identified and implemented to ensure access to such sites is maintained for the local communities	Mitigation	Submission of disclosure outcomes	Once; before construction commences	Developer / Environmental Consultant	Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
		Ensure that the final prepared detailed design avoids sitting any of the Project components (to include the turbines, roads, transmission lines, warehouses, etc.) within such delineated areas of archaeological importance which takes into account a 70m buffer area from each site as required by the DoA.	Mitigation	Inspection on Final Detailed Design	Once; before construction commences	EPC Contractor	
		Provide Department of Antiquities with final detailed design demonstrating that sites with archaeological importance have been avoided.	Mitigation	Submit final detailed design to DoA	Once; before construction commences	EPC Contractor	
		The identified sites must be properly demarcated (with fences or flag poles or other as appropriate) with appropriate signage so that the sites are clearly visible to all workers during construction.	Mitigation	Inspection	Once; before construction commences	EPC Contractor	
		Fencing around the archaeological sites 8 and 10 including a 100 metre buffer and add fence around WTG 2 and site 3 after finishing construction of the turbine	Mitigation	Inspection	Before/During construction	EPC Contractor	
		Inform DoA of the works to be done around sites 3 and 8 so that DoA can allocate a person to be on-site to observe these works and ensure all is well managed	Mitigation	Official communication letter with DoA	During construct ion	EPC Contractor	
		Properly plan construction activities to take into account the identified archaeological locations to ensure they are protected from any potential damage. This could include proper movement of vehicles and machinery into/out of the site to avoid such areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas, etc.	Mitigation	Inspection	Continuous	EPC Contractor	
		Ensure that the Code of Conduct, awareness raising, and training developed for construction workers and personnel to emphasize the presence of archaeological locations in the area.	Mitigation	Inspection	Continuous	EPC Contractor	
		Implement appropriate measures for chance find procedures which mainly require that construction activities be halted and the area fenced, while immediately notifying the DoA. No additional work will be allowed before the Department assesses the found archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply.	Mitigation	Inspection	Upon Occurrence	EPC Contractor	
				Report prepared and submitted to the DoA	Upon occurrence	EPC Contractor	
Air Quality	Construction activities will likely result in an increased level of dust, particulate matter and pollutant emissions which in	If dust or pollutant emissions are found to be excessive due to construction activities, the source of such excessive emissions must be identified and adequate control measures must be implemented.	Mitigation	Inspection and visual monitoring to include periodic inspections at	Continuous	EPC Contractor	Environmental Protection Law No. 6 of 2017

	turn will directly impact ambient air quality.			nearby sites to determine whether harmful levels of dust from construction activities exist.			Air Protection Regulation No. 28 for 2005 JS 1140-2006 Ambient Air Quality
				Reporting of any excessive levels of pollutants and measures taken to minimize impact.	Upon occurrence	EPC Contractor	
		Comply with the OSHA requirements and the Jordanian Codes to ensure that for activities associated with high dust levels, workers are equipped with proper protective equipment (e.g. masks, eye goggles, etc.).	Mitigation	Inspection and Visual Monitoring	Continuous	EPC Contractor	
		Apply basic dust control and suppression measures which could include: regular watering of roads, proper management of stockpiles/excavated material, proper covering of trucks transporting aggregates and fine materials, adhering to a speed limit of 15 km/h for trucks on construction sites, etc.	Mitigation	Inspection and Visual Monitoring	Continuous	EPC Contractor	
		Develop a regular inspection and scheduled maintenance program for vehicles, machinery, and equipment to be used throughout the construction phase for early detection of issue to avoid unnecessary pollutant emissions.	Mitigation	Inspection	Continuous	EPC Contractor	
Infrastructure and Utilities	Water Resources – it is important to ensure that the water requirements of the Predict would not affect the existing users and resources in the area.	Coordinate with the Shobak Water Directorate to secure the water requirements for the Project.	Additional requirement	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	Environmental Protection Law No. 6 of 2017 Instruction for Hazardous Waste Management for the year 2003 Water Authority Law No. 18 for 1988 and it's amendments thereof Groundwater Control Regulation No. 85 for 2002 and its amendments thereof Municipalities Law No. Law No. 13 of year 2011 Traffic Law No. 49 for 2008 Regulations for the Registration and Licensing of Vehicles No. 104 for 2008 Instructions for
				Submit monthly water consumption reports	During construction		
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project.	Coordinate with the Shobak Water Directorate for disposal of wastewater at Shobak or Mansoorah WWTP	Additional requirement	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
				Submit monthly report of wastewater disposal	During construction		
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project.	Coordinate with Shobak Municipality for the collection of solid waste from the site to municipal approved landfill	Additional requirements	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
				Submit monthly report of amounts of water disposed	During construction		
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project.	Coordinate with MoEnv to hire a competent private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.	Additional requirements	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
				Submit monthly report of amounts of hazardous waste produced on site	During construction		

	Road Networks – if transportation activities are not properly managed, they could entail risk of damage to the existing roads and could be of public safety concerns to other users on road.	Develop a Traffic and Transport Plan to ensure that the transportation process is properly and adequately managed and does not pose a risk of damage to the existing roads, highways, overpasses whilst ensuring public safety. The Plan must analyse and study the entire route for transportation of the Project components from the port of Aqaba till the Project site. The study must investigate any constraints which need to be considered along the highways leading to the Project site such as bridges, overhead utility cables, slants in roads, etc. and identify accommodations which need to be taken into account (bypasses, adjustments to roads, etc.) The Plan must also cover all other onsite and offsite activities. Related to offsite activities, the plan must cover transportation requirements of project components other than turbines (e.g. other materials and components) as well as labour (if relevant). The plan must identify proposed delivery routes to the project site, planning of generated trips of trucks to site, speed limits, number of vehicles movement. Related to onsite activities, the plan must cover the day to day movements of vehicles and machinery and must include measures for proper onsite traffic management, assigned speed limits, allowed movement routes within the site amongst others.	Additional Study	Submission of Traffic and Transport Plan	Before commencement of transportation activities	EPC Contractor	Allowable Speed Limits for 2002 Civil Aviation Law No. 41 of the year 2007 Telecommunications Law No.21 for the year 2011
	Aviation, Telecommunication and Television & Radio Links - Improper sitting of the wind farm could impact aviation, telecommunication and radio links in the area.	Follow up with RJAF and CARC to obtain approval letter for the Project	Additional requirement	Submission of RJAF and CARC approval	Once; before construction commences	Developer or EPC Contractor	
Community Health, Safety and Security	Various construction activities expected to be a source of noise and vibration generation within the Project site and its surroundings.	implement general best practice measures to control sources of noise onsite during the construction phase to include but not limited to the following: (i) highest noise level construction activities should not be undertaken between 8pm and 6am (ii) apply adequate general noise suppressing measures (iii) site inductions should cover the importance of noise control and available noise reduction measures (iv) maximising the offset distance between noisy equipment items and residential receptors (v) The use of noise-producing signals, including horns, whistles, alarms, and bells shall be for safety warning purposes only and other as appropriate.	Mitigation	Inspection and visual monitoring	Continuous	EPC Contractor	Environmental Protection Law No. 6 of 2017 Instruction for Reduction and Prevention of Noise for the year 2003
	Potential Impacts from presence of security personnel relate to inappropriate management and conduct of security personnel towards the local communities.	Submit a security employment plan to be guided by international best practice requirements (such as the Voluntary Principles on Security and Human Rights). The plan must identify number of security workers required for the Project, how they will be recruited and hired (to include measures to ensure they are not implicated in past abuses), training requirements and implementation (to include in particular the use of force and if applicable firearms), equipping and monitoring, and code of conduct to be implemented (towards workers and local communities).	Additional Study	Submission of Security Employment Study	Before construction commences	Developer	
	Potential Impacts from Workforce Influx during Construction	Prepare and submit a community health and safety management plan that addressed impacts from influx of construction workers. The plan should detail proper management measures related to potential impacts on community health and safety to include a proper code of conduct to ensure appropriate management of worker interaction with the local communities and which takes into account local cultures and norms, mitigation measures to avoid/reduce risks of exposure to communicable disease such as proper screening, vaccination, awareness/, and other as appropriate.	Additional Study	Submission of community health and safety management plan	Before construction commences	Developer / EPC Contractor	
Socio-economic	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity	It is recommended that the Developer adopt and implement a Community Integration Plan for working with the local community members during the construction phase. The plan must aim to support the local community stating its aims and objectives and should acknowledge the importance of building a strong socio-economic relationship with the local community through a participatory planning program (in which the local community can express their concerns, strengths and limitations) even before the development is in place.	Recommendation	Submission of community integration plan	Continuous	Project Developer and EPC Contractor	Regulation for Obligatory Employment of Jordanian Workforce from Surrounding Communities in Development Projects No.(131) for the year 2016
Occupational Health and Safety	There will be some risks to workers health and safety during the construction activities of the Project.	Prepare an Occupational Health and Safety Plan for the construction works. Plan should be Project and site specific and must take into account the national requirements mainly the "Labour Law No.(8) for the year 1996 and its amendments", including Chapter IX, Occupational Safety & Health. In addition, it must also be compliant with EBRD PR4.	Additional Study	Submission of OHSP	Before construction commences	EPC Contractor	Labour Law No.(8) for the year 1996 and its amendments
		Prepare a project and site specific Emergency Preparedness and Response Plan.	Additional Study	Submission of Emergency Preparedness and			

				Response Plan			

Table 98: ESMP for the Operation Phase

Environmental Attribute	Potential Impact	Management Action (mitigations, additional requirements, additional studies, compensation measures, etc.)	Type of Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Landscape and Visual	Visual impacts concern the turbines themselves and impacts relating to their interaction with the character of the surrounding landscape.	Include a visitor's centre on the property allocated for the proposed wind farm which should be open to school fieldtrips, the local community and tourists	Mitigation	Documentation of activities	Upon occurrence	Developer	Environmental Protection Law No. 6 of 2017
		Avoid including lettering, company insignia, advertising or graphics on the turbines	Mitigation	Visual inspection	Once; before commencement of operation	EPC Contractor	
Land Use	Operational activities could disturb and conflict with actual land use as it could provide value to locals.	Land Users – Agriculture. Although highly unlikely, but should any of the agriculture users require assistance in allocating additional lands to undertake agriculture activities, assist such users to the greatest extent possible through coordination with other land owners in the area and/or on other available public lands.	Mitigation	Documentation of relocation assistance with photographs as appropriate	Upon occurrence	Developer or Operator	Environmental Protection Law No. 6 of 2017
		Land Users – Agriculture. Prior to commencement of operational activities, the Developer will disclose to the local communities the following through focus group discussions and information sheets : (i) the baseline mapping exercise for agricultural activities; (ii) announce operational areas and emphasize that agriculture and/or grazing activities cannot take place in such assigned areas; (iii) emphasize that grazing and/or agriculture activities may take place outside of operational areas at all times; (iv) provide details on the relocation assistance if required by any agricultural user; and (v) provide details on the grievance mechanism.	Mitigation	Prepare and submit disclosure report with outcomes	Once; before operation commences	Developer or Operator	
		Nomads. If required (although unlikely) provide assistance to nomadic groups in assigning suitable areas outside of operational areas for settlement through coordination with other land owners in the area and/or on other public lands.	Mitigation	Documentation of relocation assistance with photographs as appropriate	Upon occurrence	Developer or Operator	
		During the period in which nomads begin to settle in the area (April, May and June), undertake regular site visits to meet with nomadic groups whom arrive onsite. The objective will be to: (i) announce operational areas and emphasize that settlements as well as agriculture and/or grazing activities cannot take place in such assigned areas; (ii) emphasize that settlements as well as grazing and/or agriculture activities may take place outside of operational areas at all times; (iv) provide details on the relocation assistance if required by any agricultural user; and (v) provide details on the grievance mechanism.	Mitigation	Prepare and submit disclosure report with outcomes	Continuously	Developer or Operator	
Geology and Hydrology	Improper management of solid waste	Coordinate with Shobak Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill	Mitigation	Review contract with contractor	Once; before operation commences	Project Operator	Environmental Protection Law No. 6 of 2017 Solid Waste Management Regulation No. (27) of 2005
		Prohibit fly-dumping of any solid waste to the land.	Mitigation	Inspection	Continuous	Project Operator	
		Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".	Mitigation	Inspection	Continuous	Project Operator	
		Implement proper housekeeping practices on the construction site at all times.	Mitigation	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	Project Operator	
	Improper management of wastewater	Coordinate with Shobak Water Directorate to hire a private contractor for the collection of wastewater from the site to the Shobak or Mansoorah WWTP	Mitigation	Review contract with contractor	Once; before operation commences	Project Operator	Environmental Protection Law No. 6 of 2017 Public Health Law No. 47 for 2008
		Prohibit illegal disposal of wastewater to the land	Mitigation	Inspection	Continuous	Project Operator	
		Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing	Mitigation	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of wastewater generated onsite, collected by	Mitigation	Review manifests to	Continuous	Project Operator	

		contractor, and disposed of at the Shobak WWTP or Jurf Al Darwish landfill. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas		ensure consistency			
	Improper management of hazardous waste	Coordinate with the MoEnv and hire a private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility	Mitigation	Review contract with contractor	Once; before operation commences	Project Operator	Environmental Protection Law No. 6 of 2017 Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005, Instruction for Management and Handling of Consumed Oils of 2003, Instruction for Hazardous Waste Management of2003
		Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv	Mitigation	Inspection	Continuous	Project Operator	
		Prohibit illegal disposal of hazardous waste to the land	Mitigation	Inspection	Continuous	Project Operator	
		Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing	Mitigation	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the Swaqa Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas	Mitigation	Review manifests to ensure consistency	Continuous	Project Operator	
	Improper management of hazardous material	Ensure hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of impermeable surface, accessible to authorized personnel only, prevent incompatible materials from coming in contact, etc.	Mitigation	Inspection	Continuous	Project Operator	Environmental Protection Law No. 6 of 2017 JS 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
		Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. Spilled material should be tracked and accounted for.	Mitigation	Inspection	Continuous	Project Operator	
		Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.).	Mitigation	Inspection	Continuous	Project Operator	
		Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material.	Mitigation	Inspection	Continuous	Project Operator	
		Ensure that a minimum of 1,000 litres of general purpose spill absorbent is available at hazardous material storage facility.	Mitigation	Inspection	Continuous	Project Operator	
		If spillage occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.	Mitigation	Inspection Reporting of incident and measures taken to minimize impact	Upon occurrence	Project Operator	
Biodiversity	Improper management of the site could disturb existing habitats (e.g. improper conduct and housekeeping practices).	Monitoring of the distribution and abundance of the threatened plant species should be carried out for at least five years of the operational phase in order to assess the impact of the project on the three threatened species that were recorded in the project site.	Additional Requirement	Submit annual report	Annually	Project Operator	Environmental Protection Law No. 6 of 2017 Agriculture Law No. 44 of 2002 Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
		Implement proper management measures to prevent damage to the biodiversity of the site. This could include establishing a proper code of conduct and awareness raising / training of personnel (e.g. with respect to prohibiting hunting) and good housekeeping (e.g. keeping the site orderly and clean).	Mitigation	Inspection	Continuous	Project Operator	
Birds (avi-fauna)	Wind turbines are associated with impacts on birds from risks of strikes and collision on both migratory soaring birds and resident soaring birds in the area. Generally, such impacts depend on several factors but could affect the population levels of certain species especially those with international/national critical conservation status.	Implement a bird monitoring and mitigation plan focused on avoiding CEA priority birds colliding with turbine rotors. The plan should include methods/protocols for (i) in-flight priority bird monitoring, (ii) observer-led turbine shutdown on demand for priority birds, (iii) bird collision fatality 'carcass search' surveys for all bird species, (iv) calibration tests for carcass search surveys and (v) livestock movement monitoring. The monitoring and mitigation plan should follow recommendations in the ESIA and the Tafila Wind Power Projects CEA MMP.					Environmental Protection Law No. 6 of 2017 Agriculture Law No. 44 of 2002 Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.

Bats	The potential impacts from the Project during operation are mainly related to risk of bat strikes and collisions with rotors of the operating wind turbines.	Implement a bat mortality monitoring plan. The plan should include bat collision fatality 'carcass search' surveys informed by bat ecology, and calibration tests for searcher efficiency and bat carcass removal by scavengers. The monitoring program for bats should follow recommendations in the ESIA and the Tafila Wind Power Projects CEA MMP					Environmental Protection Law No. 6 of 2017
Archaeology	Improper management of operational activities could disturb/damage archaeological locations recorded in the Project area	Properly plan operation and maintenance activities to take into account the identified archaeological locations to ensure they are protected from any potential damage. This could include for example proper movement of vehicles and machinery into/out of the site to avoid those areas, ensure that all vehicles are on established roads and prohibit off-roading, prohibit movement of vehicles near those areas during the various operation and maintenance activities, etc.	Mitigation	Inspection	Continuous	Project Operator	Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
		Ensure that the Code of Conduct, awareness raising, and training developed for operation workers and personnel to emphasize the presence of archaeological locations in the area.	Mitigation	Inspection	Continuous	Project Operator	
Infrastructure and Utilities	Water Resources – it is important to ensure that the water requirements of the Predict would not affect the existing users and resources in the area.	Coordinate with the Shobak Water Directorate to secure the water requirements for the Project.	Additional requirement	Submit report with proof of coordination	Once; before operation commences	Project Operator	Environmental Protection Law No. 6 of 2017 Instruction for Hazardous Waste Management of2003 Water Authority Law No. 18 for 1988 and it's amendments Groundwater Control Regulation No. 85 for 2002 and its amendments Municipalities Law No. Law No. 13 of year 2011
				Submit monthly water consumption reports	During operation		
	Wastewater Utilities – it is important to ensure that existing utilities would be able to handle the amount of wastewater generated from the Project.	Coordinate with the Shobak Water Directorate for disposal of wastewater at Shobak or Mansoorah WWTP	Additional requirements	Submit report with proof of coordination	Once; before operation commences	Project Operator	
				Submit monthly report of wastewater disposal	During operation		
	Solid Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project.	Coordinate with Shobak Municipality for the collection of solid waste from the site to the municipal approved landfill	Additional requirements	Submit report with proof of coordination	Once; before operation commences	Project Operator	
				Submit monthly report of solid waste disposal	During operation		
	Hazardous Waste Utilities – it is important to ensure that existing utilities would be able to handle the amount of hazardous waste generated from the Project.	Coordinate with MoEnv to hire a competent private contractor for the collection of hazardous waste from the site to the Swaqa Hazardous Waste Treatment Facility.	Additional requirements	Submit report with proof of coordination	Once; before operation commences	Project Operator	
				Submit monthly report of hazardous waste disposal	During operation		
Community Health, Safety and Security	Operating wind turbines will produce noise which could be a source of disturbance and nuisance to the receptors and residents of the nearby villages	Upon completion of the construction of the wind farm, during the commissioning period a detailed long-term noise monitoring programme should be implemented to verify the outcomes and results of the noise assessment undertaken. The monitoring programme should be carefully designed with specific planning of equipment, measurement locations and periods.	Additional Study	Submission of noise monitoring report	Before operation commences	Developer	Environmental Protection Law No. 6 of 2017 Instruction for Reduction and Prevention of Noise for the year 2003
		Grievance mechanism for the local community must be prepared and implemented. The local community must be made aware of the grievance mechanism available to submit complaints regarding nuisances related to noise from the turbines (although unlikely based on the outcomes of the assessment and as to be verified during commissioning monitoring). Should, for any reason, such grievances be submitted, they must be verified and appropriate mitigations should be implemented (such as curtailment of turbines during specific situations or compensation such as provision of noise shielding at receptor locations such as sound reducing windows (double glazed) and planting of trees and shrubs, etc.).	Mitigation	Submission of grievances and measures implemented to solve the issue	Upon occurrence	Developer	
		Develop informative maps in Arabic of noise propagations from the turbines in accordance with modelling results. In addition, visit the Project area on a regular basis throughout the active period of nomads to explain such informative maps and allow nomads to build up their tents in less affected areas.	Mitigation	Submission of consultation report with photo documentation	At least once per month during	Developer	

					arrival period of nomads		
	Shadow flicker from the rotating turbines could potentially be a source of disturbance and nuisance to the receptors and residents of the nearby villages	Grievance mechanism for the local community must be prepared and implemented. The local community must be made aware of the grievance mechanism available to submit complaints regarding nuisances related to shadow flicker from the turbines (although unlikely based on the outcomes of the assessment). Should, for any reason, such grievances be submitted, they must be verified and appropriate mitigation should be implemented (such as curtailment of turbines during specific situations or compensation such introduction of vegetative buffers as a barrier for shadow flicker and/or providing window blinds).	Mitigation	Submission of grievances and measures implemented to solve the issue	Upon occurrence	Developer	
		Develop informative maps in Arabic of shadow flicker propagations from the turbines in accordance with modelling results. In addition, visit the Project area on a regular basis throughout the active period of nomads to explain such informative maps and allow nomads to build up their tents in less affected areas.	Mitigation	Submission of consultation report with photo documentation	At least once per month during arrival period of nomads	Developer	
	Blade or tower glint can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences.	Ensure that turbines are painted with a matt, non-reflective finish	Mitigation	Inspection	Before operation commences	EPC Contractor	
	Failure in rotor blade or ice accretion can result in the 'throwing' of the blade. Although overall risk of such events is extremely low, it could affect the public safety	Ensure that regular maintenance of the wind turbines takes place according to set schedule to prevent any unforeseen events from occurring such as blade throws	Mitigation	Inspection	Continuously	Project Operator	
		Install post signs at least 200 meters from the wind turbine which provide informative in English and Arabic language about risks from such events	Mitigation	Visual observations	Before operation commences	Project Operator	
	Public access of unauthorized personnel to the various Project components (turbines, substation) could results in various public safety hazards to local communities.	Each turbine is fitted with locked doors to prevent unauthorized access to the turbines	Mitigation	Inspection	Continuously	Project Operator	
		Substation area to be completely fenced with concrete walls to prevent unauthorized access	Mitigation	Inspection	Continuously	Project Operator	
		Onsite guards within the entire Project site at all times to ensure the safety and security of the Project as well a preventing unauthorized access to any of the Project components. However, it must be ensured that all onsite guards are adequately trained to deal with unauthorized trespassing incidents. In addition, guards must refrain from using excessive force, unless situation extremely requires so	Mitigation	Inspection	Continuously	Project Operator	
		Post informative signs on the turbines and other Project components (substation) about public safety hazards and emergency contact information	Mitigation	Visual observations	Before operation commences	Project Operator	
	Potential Impacts from presence of security personnel relate to inappropriate management and conduct of security personnel towards the local communities.	Submit a security employment plan to be guided by international best practice requirements (such as the Voluntary Principles on Security and Human Rights). The plan must identify number of security workers required for the Project, how they will be recruited and hired (to include measures to ensure they are not implicated in past abuses), training requirements and implementation (to include in particular the use of force and if applicable firearms), equipping and monitoring, and code of conduct to be implemented (towards workers and local communities).	Additional Study	Submission of Security Employment Study	Before operation commences	Developer	
Socio-economic	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity	It is recommended that the Developer adopt and implement a Community Integration Plan for working with the local community members during the operation phase. The plan must aim to support the local community stating its aims and objectives and should acknowledge the importance of building a strong socio-economic relationship with the local community through a participatory planning program (in which the local community can express their concerns, strengths and limitations) even before the development is in place.	Recommendation	Submission of Community Integration Plan	Continuous	Project Developer and Operator	Regulation for Obligatory Employment of Jordanian Workforce from Surrounding Communities in Development Projects No.(131) for the year 2016

Occupational Health and Safety	There will be some risks to workers health and safety during the operation and maintenance activities of the Project.	Prepare an Occupational Health and Safety Plan for the operation and maintenance works. Plan should be Project and site specific and must take into account the national requirements mainly the "Labour Law No.(8) for the year 1996 and its amendments", including Chapter IX, Occupational Safety & Health. In addition, it must also be compliant with EBRD PR4.	Additional Study	Submission of OHSP	Before operation commences	Project Operator	Labour Law No.(8) for the year 1996 and its amendments
		Prepare a project and site specific Emergency Preparedness and Response Plan.	Additional Study	Submission of Emergency Preparedness and Response Plan			

23. ASEESSMENT OF IMPACTS FROM ASSOCIATED FACILITIES

As discussed earlier in 'Section 2.2', the Project will connect with the existing Fujeij substation (33kV/132kV). For this Wind Farm NEPCO is planning to establish the connection through an Overhead Transmission Line (OHTL) of approximately 5km length, which will run from the wind farm Project site to the Fujeij substation. The route of the OHTL is shown in Figure 100 below.

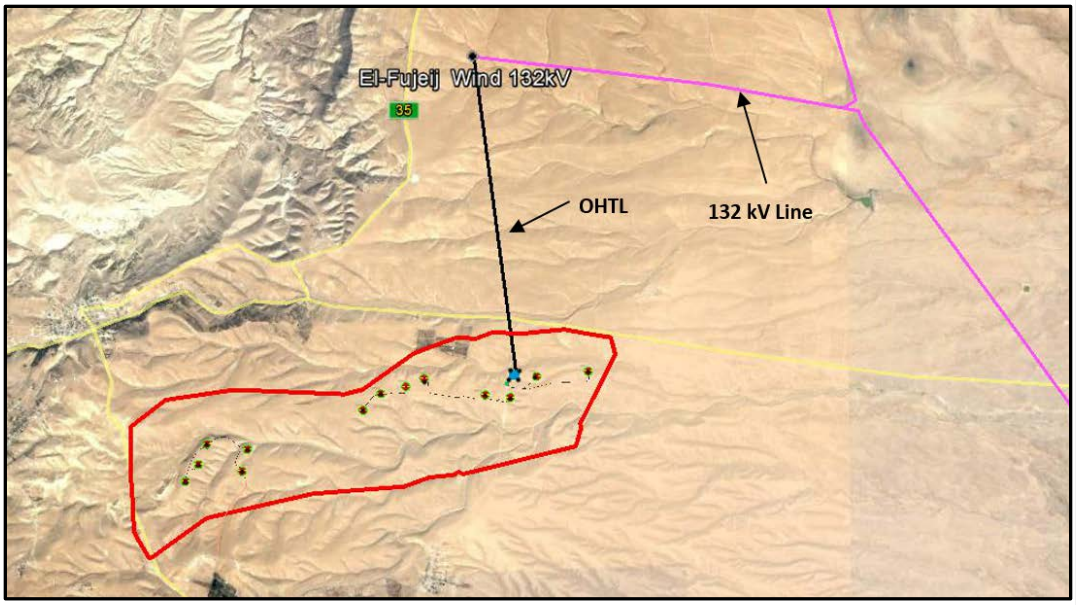

Figure 105: Route for the Overhead Transmission Line

Table 86 below provides a rapid assessment of the anticipated impacts from the associated facilities to the Project and which mainly include the OHTL. It is important to note that the table below will only provide a rapid assessment based on secondary data and desk studies, a detailed assessment of potential impacts and respective mitigation measures and monitoring requirements will be provided in a Preliminary Enviornmental Assessment (PEA) currently being undertaken by ECO Consult for the OHTL.

Table 99: Summary of Anticipated Impacts from Associated Facilities

Attribute	Baseline Information	Potential Impact	Discussion	Further studies in the detailed PEA
Landscape and Visual		Issues related to visibility in relation to nearby sensitive receptors.	Given that the Project site itself is considered an area with no particular structures of interest or any key visual receptors – such as recreational activities, environmental reserves, remarkable/unique historical or cultural sites, or other natural structures normally seen as valuable by the human perception. Hence, there are no potential impacts on the visibility from developing the OHTL	Site visits will be undertaken before assessing the impacts of visibility of the OHTL on the neighbouring area.
Land Use	The OHTL passes through lands that are mainly governmental and only a small portion of the Project site passes through private land parcels.	OHTL could conflict with formal land use planning set for the area	1. The formal land use planning is summarized below to include: 2. Land Use Planning by MoMA: according to the National Land Use Master Plan, the OHTL runs within an area designated as "Agricultural Area of the Third Degree (A3)" and only a small parcel passes through an area designated as "Desert of the Second Degree (D2)" in which electric power generation facilities, transmission, and distribution networks are allowed, see Figure 105. 3. Areas of Critical Environmental Concern planning by MoEnv: the OHTL does not run within or near areas of critical environmental concern. 4. Grazing Reserve planning by MoA: the OHTL does not run within any established or planned grazing reserve. However, The OHTL is approximately 1 km east of Al Fujeij grazing reserve, see Figure 103.	Include detailed description of the formal land use set by different governmental entities. In addition to assessing potential impacts.
		Issues related to informal use of the site.	NEPCO has a compensation process for landowners that is set within the "Electricity Law No. 64 for the year 2002" and "Instructions for Electrical Safe Distances No.1 of 2003". However, the cable runs within the KHBTDA area over lands that are owned by the MDC. Therefore, in this case this issue is considered not applicable, see Figure 101.	Further studies on the actual land use of the OHTL route will be investigated to indicate whether the lands are of any specific value or utilized for any specific purpose by the local community (to include agricultural activities, grazing activities) or by nomadic populations. In addition, the PEA will assess the potential impacts and suggest the mitigation measures and monitoring actions accordingly.

Geology, Hydrology and Hydrogeology		Issue related to improper housekeeping activities for management of waste streams onsite during construction.	The nature of construction activities is considered minimal and small scale and thus unlikely to raise any issues of concern. In addition, for construction works NEPCO and/or the OHTL EPC Contractor is expected to implement best management practices for management of solid waste, wastewater, solid waste and hazardous waste where applicable.	The PEA must identify proper and adequate management practices (to include mitigation and monitoring requirements) that would ensure management measures expected to be implemented.
Biodiversity		Construction activities could disturb existing habitats.	The OHTL (similar to the Project site) is located within an area that is barren and of ecological significance with no sensitive habitats. Human land alterations have impacted most of the area thus greatly affecting the biodiversity and natural habitat of the site. To the extent, there are no issues of concern related to biodiversity, see Figure 104.	Flora, fauna and avifauna field assessments in order to assess the value of the habitats along the line especially in regard to breeding birds. Survey would be recommended to be carried out in spring season
Archaeology and Cultural Heritage	Construction activities could damage or disturb potential archaeological remains which might be present on the surface along the OHTL Project site and which could potentially be of archaeological importance.	Construction activities could disturb any archaeological remains within the Project site.	Desk review of available secondary data included the search of the official register and database of all archaeological/cultural sites of Jordan known as the Middle Eastern Geodatabase for Antiquities – Jordan (MEGA Jordan). Search of MEGA Jordan database returned 8 archaeological sites within the Project area and its surroundings as presented in Figure 102 below.	Coordinate with DoA to determine the importance of the preliminary sites found on MEGA Jordan and undertake an extensive archaeological survey for the route of the OHTL. The ESIA will assess potential impacts and suggest the appropriate mitigation measures accordingly.
Air Quality and Noise	Considering the extent of construction activities, associated magnitude of excavations, and the best practice mitigation measures, an air quality assessment is deemed unnecessary. A noise assessment will mainly be based on secondary data collected as part of the Shobak Windfarm ESIA. However, if it is seen that one or more source emissions/activities were identified in parallel to the establishment of the Shobak OHL, such as construction activities of the neighbouring windfarm project (Fujeij), then there is a potential need for an exclusive Air Quality and Noise Baseline Assessment.	Construction activities could result in increased level of dust and noise levels.	The nature of construction activities is considered minimal and small scale; thus, is unlikely to raise any issues of concern. In addition, the trench has already been excavated. However, for remaining works NEPCO and/or the cable EPC Contractor is expected to implement best practices for dust and noise control.	The PEA must identify proper and adequate management practices (to include mitigation and monitoring requirements) that would ensure dust and noise suppression during the construction activities adhere to the maximum allowable limits of ambient air pollutants stipulated within the Jordanian Standards 1140/2006 – Ambient Air Quality and the Instruction for Reduction and Prevention of Noise for 2003
Infrastructure and Utilities	A desk study shows that within the OHTL vicinity, several Infrastructure and Utility	Ensure existing utilities would be able	As discussed throughout the ESIA, utilities related to water, wastewater, solid waste and hazardous waste	Identify the entities to be coordinated with in relation to the respective

	features exist; including water, wastewater, solid waste and hazardous waste facilities. Figure, Figure 5-8, Figure 5-9 illustrate the exact locations of said facilities in relation to the OHTL. An existing water network will intersect with the OHTL where it extends from the Project site.	to support the OHL Project in terms of water supply, wastewater, solid waste and hazardous waste during the construction phase.	facilities are expected to easily provide such service related to the Project. In addition, the nature of construction activities is considered minimal and small scale and thus unlikely to raise any issues of concern and the trench has already been excavated. Finally, for remaining works NEPCO and/or the cable EPC Contractor is expected to coordinate with the relevant utilities for such services, see Figures 106, 107 and 108.	infrastructure and utilities; and in accordance, the PEA will highlight the legal compliances to be considered in relation to each identified infrastructure and utility.
Health and Safety	Assessment of baseline conditions related to Community Health, Safety and Security is considered irrelevant.	Trespassing of unauthorized personnel into the OHTL site which could result in potential risks from several hazards of various project components.	Standard practice undertaken by NEPCO is to install warning tapes about public safety hazards along the route of the trench and emergency contact information.	It is expected that as part of the detail design, security measures to prevent unauthorized access to the Project site will be identified which in turn will control any such impacts.
	The Occupational health and safety baseline will be based on anticipated impacts during the construction and operation phases of the OHTL. During construction, the risks are generally associated with construction sites which include: Slips and falls, working at heights, struck-by objects, moving machineries; working in confined spaces and excavations, exposure to chemicals or hazardous material, and exposure to electric shocks or burns. During operation, these risks are mainly associated with working at heights throughout maintenance activities, and exposure to a variety of hazards such as electric shock and thermal burns.	Generic risks to workers' health and safety from working on construction sites and from maintenance activities.	Normal practice undertaken by NEPCO is to require as part of the selection process for the EPC Contractor to provide an Occupational Health and Safety Plan (OHSP) regarding the Project's construction activities and NEPCO has its own OHSP which is implemented for all their maintenance activities during the operation phase.	An Occupational Health and Safety Plan must be developed for the construction and operation phase in accordance with the provisions of the "Labor Law No. 8 for the Year 1996 and its amendments", including Chapter IX, Occupational Safety & Health. The Plan must address the likely hazards and identify adequate prevention and control measures to reduce occupational health and safety risks to the greatest extent possible.

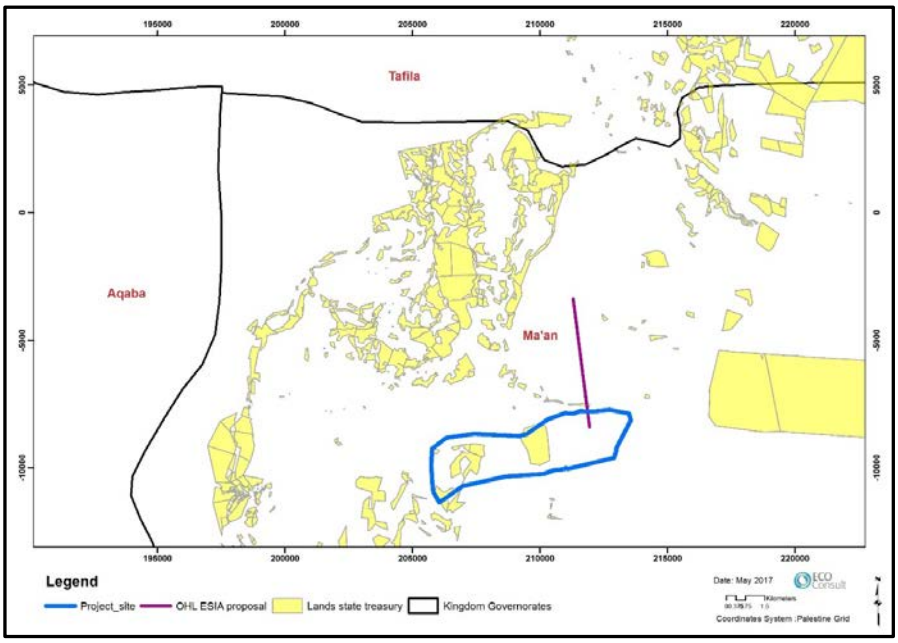

Figure 106: Land Ownership in relation to the OHTL

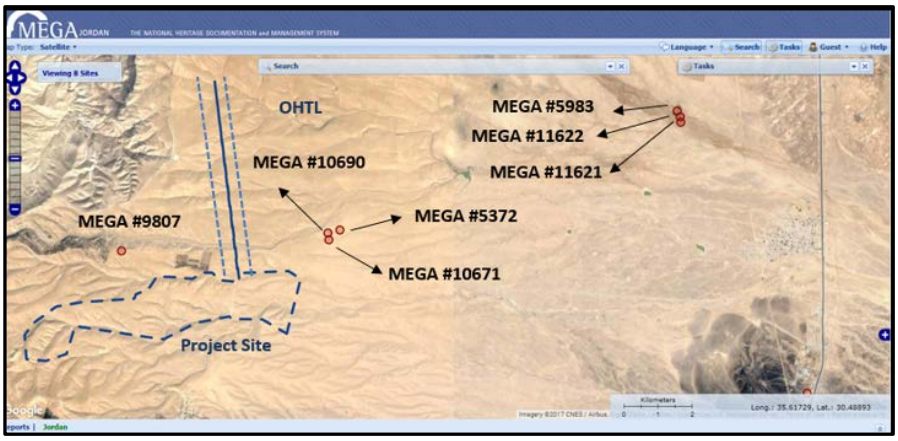

Figure 107: MEGA Jordan Search Results

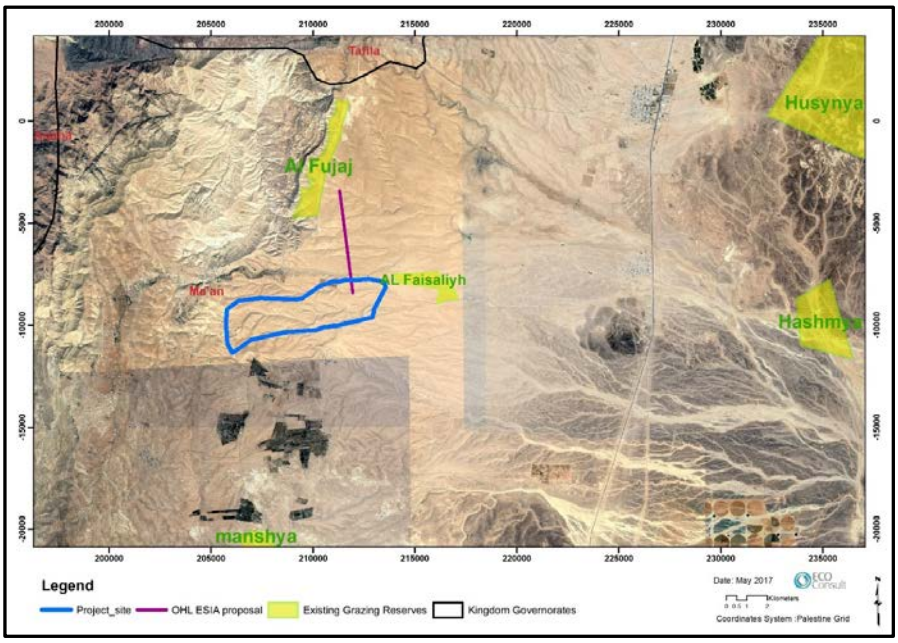

Figure 108: Project Site in Relation to Grazing Reserves

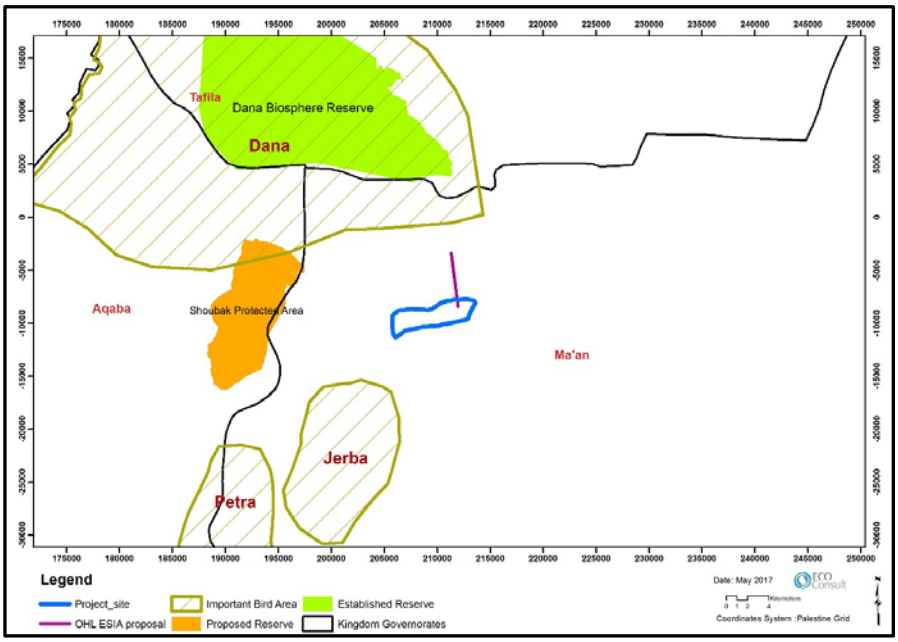

Figure 109: Project Site in Relation to Areas of Critical Environmental Concern

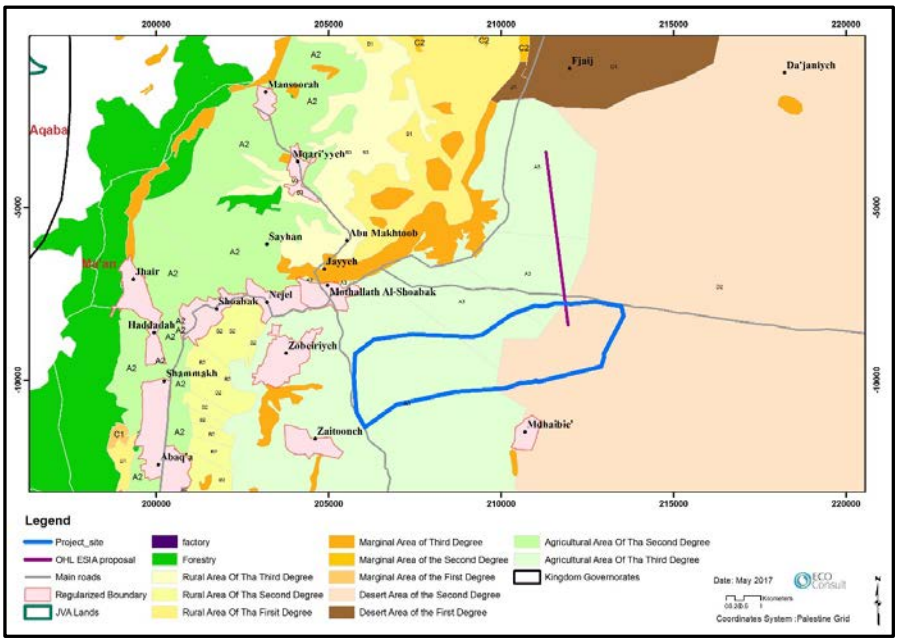

Figure 110: MoMA National Land Use Master Plan for the Project Site and its Surroundings

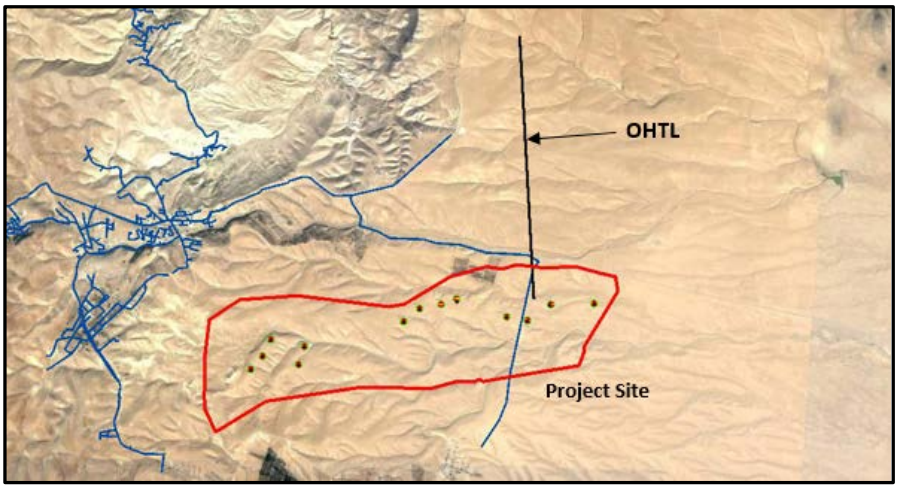

Figure 111: Shobak Water Supply Systems in Relation to the Project Site

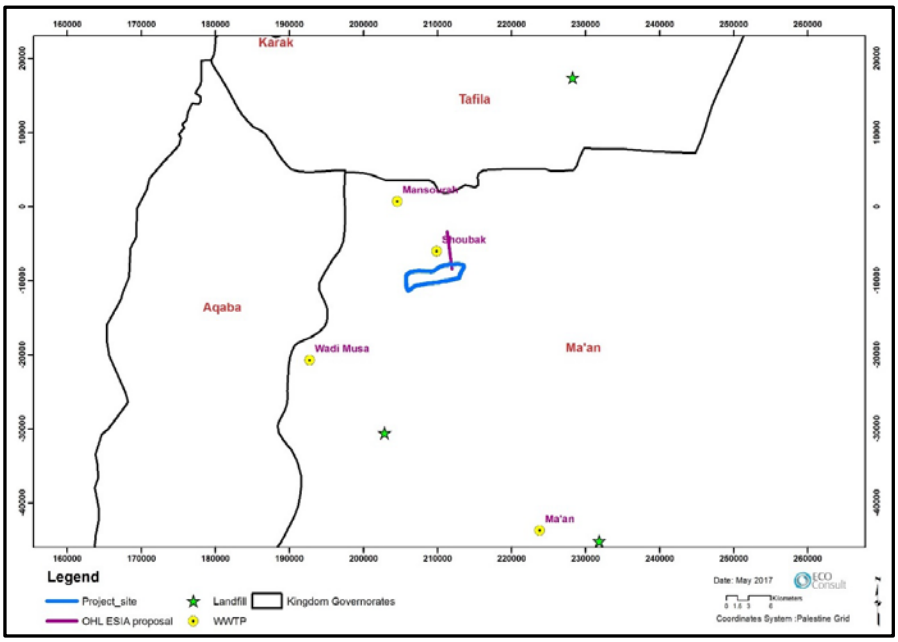

Figure 112: Location of WWTP in relation to Project Site

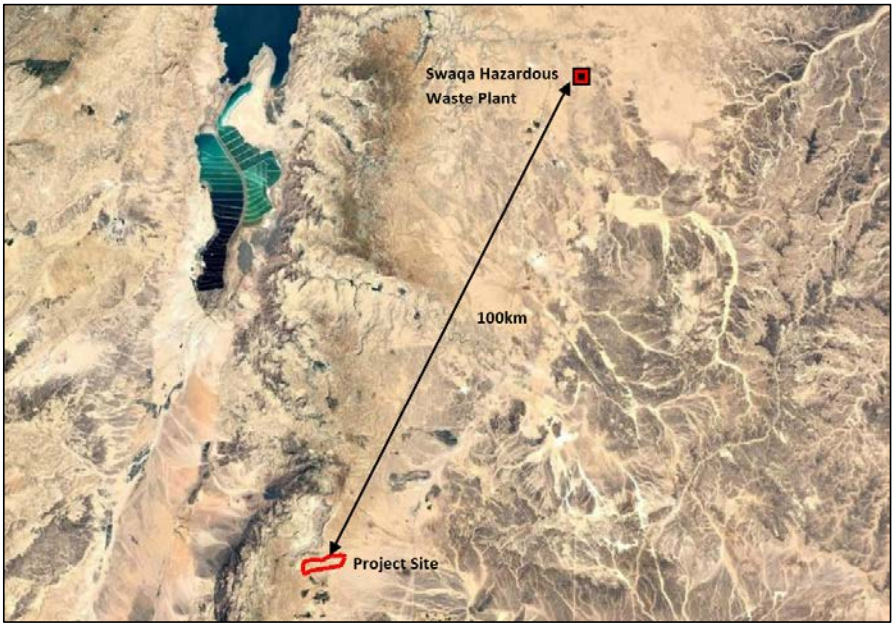

Figure 113: Location of Swaqa Hazardous Dumpsite in relation to the Project Site

24. REFERENCES

- Al-Eisawi, D. 1996. Vegetation of Jordan. UNESCO-Cairo Office, Regional Office for Science and Technology for Arab States, Cairo.
- Anderson, R. Morrison, M., Sinclair, K. & Trickland, D. 1999. Studying wind energy/birds interactions: A guidance document. National Wind Coordinating committee/Resolve, Washington DC.
- Andrews, I.J. 1995. The Birds of the Hashemite Kingdom of Jordan. Burns and Harris Limited, Dundee.
- Bibby, C.J. & Burgess, N.D. 1992. Bird Census Techniques. Academic Press Limited, London.
- BirdLife International. 1995. Important Bird Areas In The Middle East. Page Bros. Norwich, UK.
- BirdLife International and RSCN. 2000. Important Bird Areas of the Hashemite Kingdom of Jordan. Dar Amman Publishing Ltd. Amman.
- Country Report on the Solid Waste Management in Jordan, SWEEPNET, 2010
- del Hoyo, J. & Collar, N.J. 2014. HBW and BirdLife International Illustrated Checklist of the Birds of the World. Volume I: Non-passerines. Lynx Edicions, Barcelona.
- De Lucas, M. Janss, G. & Ferrer, M. 2007. Wind Farm Effects on Birds in the Strait of Gibraltar. In: de Lucas, M., Janss, G.F.E. & Ferrer,M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation, pp. 259-275.Quercus, Madrid.
- Forsman, D. 2012. The Raptors Of Europe And The Middle East. Bloomsbury Publishing PLC. London, UK.
- International Finance Corporation – IFC. Tafila Region Wind Power Projects Cumulative Effects Assessment. 2017. Washington DC, USA.
- Johnson, G.D., Strickland, M.D., Erickson, W.P. &Young Jr., D.P. 2007. Use Of Data To Develop Mitigation Measures for Wind Power Development Impacts to Birds. In: de Lucas, M., Janss, G.F.E. & Ferrer,M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation, pp. 259-275.Quercus, Madrid.
- Lekuona, J.M. & Ursua, C. 2007. Avian Mortality in Wind Power Plants of Navarra (Northern Spain). In: de Lucas, M., Janss, G.F.E. & Ferrer,M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation, pp. 259-275.Quercus, Madrid.
- Madders, M. & Whitfield, D.P. 2006. Upland raptors and the assessment of wind farm effects. Ibis (2006), 148, 43–56
- Morrison, M.L., Sinclair, K.C. & Thelander, C.G. 2007. A sampling framework for conducting studies of the influence of wind energy developments on birds and other animals. In: de Lucas, M., Janss, G.F.E. & Ferrer, M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation, pp. 259-275.Quercus, Madrid.
- Porter, R. Aspinall, S. 2010. Birds of the Middle East. Second Edition. Christopher Helm, London.
- Poverty Situation in Jordan, Department of Statistics, 2010
- Poverty Situation in Jordan, Department of Statistics, 2012
- Royal Society for the Conservation of Nature. 2000. Important Bird Areas in the Hashemite Kingdom of Jordan. Dar Amman Publishing, Amman.
- Scottish Natural Heritage. 2010. Survey Methods For Use In Assessing The Impacts Of Onshore Wind farms On Bird Communities - SNH Avoidance Rate Information & Guidance Note. September 2010
- Strategic Master Plan for Municipal Water Infrastructure, USAID ISSP, 2015
- Svensson, L. 2009. Collins Bird Guide. The Most Complete Guide to the Birds of Britain and Europe. Second Edition. HarperCollins Publishers, London.
- Symes, A., Taylor, J., Mallon, D., Porter, R., Simms, C. & Budd. K. 2015. The Conservation Status and Distribution of the Breeding Birds of the Arabian Peninsula. Cambridge, UK and Gland, Switzerland: IUCN, and Sharjah, UAE: Environment and Protected Areas Authority.

- Taifour, H. & El-Oqlah A. 2014. Jordan Plant Red List Vol. I. Royal Botanic Garden, Amman, Jordan.
- Thelander, C.G. & Smallwood, K.S. 2007. The Altamont Pass Wind Resource Area's Effects on Birds: A Case Study. In de Lucas, M., Janss, G.F.E, and Ferrer, M. (eds). Birds & Wind Farms. Quercus
- Thiollay, J.M. 1994. Family Accipitridae (Hawks and Eagles). Pp 52-205 in: del Hoyo, J. Elliott, A. & Sargatal, J. eds. 1994. Handbook of the Birds of the World. Vol. 2. New World Vultures to Guineafowl. Lynx Edicions, Barcelona.
- van Duivendeijk, Nils. 2011. Advanced Bird ID Handbook The Western Palearctic. NewHolland Publishing. London. UK.

25. ANNEXES

Annex I – Regulatory Approvals

Telecommunication Regulatory Commission

Jordan Radio and Television Corporation

المملكة الأردنية الهاشمية
مؤسسة الاذاعة والتلفزيون

الرقم ت ه/٢٧٥٩/٢/
التاريخ .....
الموافق ٢٠١٧/٦/٢٦

السيد مدير مشروع الشوبك لتوليد الكهرباء من طاقة الرياح

تحية طيبة وبعد ،،،

الموضوع : مشروع الشوبك لتوليد الكهرباء من طاقة الرياح في محافظة معان

اشارة الى كتابكم رقم ECS-14-16 /5/352 تاريخ 2017/6/13 ، نعلمكم بان مؤسسة الاذاعة والتلفزيون لديها محطة ارسال اذاعي في مدينة الشوبك ، وهذه المحطة مخصصة للبث الاذاعي على الموجة المتوسطة (612 كيلو هيرتز) ، وتستخدم برج ارسال بارتفاع 245 متر واحداثياته هي (N30° 31' 55.13'', E35° 36' 54.09'') ، وحتى تسير الموجة بشكل صحيح ودون ان تؤثر / او تتأثر يجب أن تكون هناك مسافة فارغة من السكان والبنايات والحواجز لمسافة حول الموجة المستخدمة البالغ 490 مترعن مركز احداثيات برج الارسال

وبناءً على الاحداثيات المرفقة في كتابكم ، نعلمكم بانه لا مانع لدينا من انشاء مشروع توليد الطاقة المذكور

واقبلوا فائق الاحترام

المدير العام

فراس نديم

Department of Antiquities

وزارة السياحة والآثار
دائرة الآثار العامة

نهضة

الرقم ٣٥١٩/٢/٩/٥
التاريخ ٢٠١٦/١٠/٠٦
الموافق

السادة شركة ECO CONSULT

اشاره لكتابكم رقم ECS -14-16 /دائرة الاثار العامة/1/269 تاريخ 2016/8/17 والمتعلق بطلب تشكيل فريق فني من دائرة الاثار العامة لاجراء مسح اثري في منطقة الشوبك/محافظة معان الخاص بدراسة تقييم الأثر البيئي والاجتماعي لمشروع ميكانتي لتوليد الكهرباء من طاقة الرياح.

أرجو أن اعلمكم بان دائرة الاثار العامة قامت بعمل المسوحات اللازمة من خلال كوادرها المتخصصة في هذا المجال ، وبناءاً عليه لا مانع لدينا من بدء العمل في المشروع اعلاه شريطة التقيد بمايلي:

1- ترك مسافة لاتقل عن (100) م كحرم للمواقع الاثرية المبينة بالتقرير التي تم تسجيلها في موقع المشروع ومحيطه عند تنفيذ اعمال البنية التحتية في الموقع والمحافظة عليها.

2- ترك مسافة لا تقل عن (400) م كحرم للمواقع الاثرية المبينة احداثياتها بالتقرير عند تركيب المراوح الهوائية في الموقع.

3- التوقف عن العمل في حال العثور على اية معالم او لقى اثرية اثناء تنفيذ المشروع وابلاغ دائرة الاثار العامة بذلك.

و اقبلوا الاحترام

د. منذر جمحاوي
مدير عام دائرة الآثار العامة

وزارة السياحة والآثار
دائرة الآثار العامة

الرقم ٢٩٦٤/٢/٩/٥
التاريخ ٢٠١٧/٠٨/١٤
الموافق

السادة شركة ECO CONSULT

اشاره لكتابكم رقم ECS – 12 – 16 / دائرة الاثار العامة/6/364 تاريخ 7201/1/16 و الخاص بالاجراءات الاحترازية لحماية المواقع الاثرية الواقعة ضمن مشروع الشوبك لطاقة الرياح/محافظة معان.

أرجو أن اعلمكم بان دائرة الاثار العامة قامت العام الماضي بعمل المسوحات اللازمة من خلال كوادرها الفنية المتخصصة في هذا المجال وتبين وجود عدد من المواقع الاثرية على السطح ، وبناءاً عليه لا مانع لدينا من تنفيذ المشروع حسب ما تم الاتفاق علية بخصوص حماية المواقع من خلال احاطة المواقع المذكورة في كتابكم اعلاة بسياج معدني حسب المواصفات المتبعة لديكم والتنسيق مع مدير مديرية آثار محافظة معان بهذا الخصوص.

و اقبلوا الاحترام

د. منذر جسحاوي
مدير عام دائرة الآثار العامة

Annex II – Detailed Noise Baseline Results

Noise Measurement Site 1 Results: Al-Shobak

20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)
11:15 am	40.0	17:30 pm	42.2	23:45 pm	40.2	06:00 am	39.6
11:30 am	40.0	17:45 pm	41.3	24:00 pm	41.7	06:15 am	37.8
11:45 am	40.0	18:00 pm	40	00:15 am	43.6	06:30 am	49.2
12:00 am	47.3	18:15 pm	39.2	00:30 am	43.2	06:45 am	39.2
12:15 pm	45.2	18:30 pm	42.3	00:45: am	41.7	07:00 am	40.1
12:30 pm	43.6	18:45 pm	46.6	01:00 am	42	07:15 am	40.7
12:45pm	44.2	19:00 pm	42.3	01:15 am	42.6	07:30 am	41.6
13:00pm	43.5	19:15 pm	43.2	01:30 am	42.3	07:45 am	43.6
13:15 pm	48.3	19:30 pm	43.1	01:45 am	45.2	08:00 am	41.2
13:30 pm	49.6	19:45 pm	44.3	02:00 am	40.6	08:15 am	43.2
13:45 pm	46.4	20:00 pm	42.2	02:15 am	41.2	08:30 am	40.5
14:00 pm	44.3	20:15 pm	41.3	02:30 am	43.2	08:45 am	41.2
14:15 pm	41.2	20:30 pm	42.3	02:45 am	44.3	09:00 am	38.3
14:30 pm	40.5	20:45 pm	38.6	03:00 am	46.6	09:15 am	39.9
14:45pm	41.3	21:00 pm	40.6	03:15 am	47.8	09:30 am	42.3
15:00 pm	42.6	21:15 pm	41.4	03:30 am	44.8	09:45 am	41.2
15:15 pm	44.6	21:30 pm	42.3	03:45 am	43.6	10:00 am	40.3
15:30 pm	46.9	21:45 pm	43.9	04:00 am	42.3	10:15 am	42.2
15:45 pm	47.4	22:00 pm	42.3	04:15 am	38.3	10:30 am	44.5
16:00pm	53.5	22:15 pm	41.3	04:30 am	39.5	10:45 am	42.9
16:15 pm	48.6	22:30 pm	40.5	04:45 am	40.3	11:00 am	44.6
16:30 pm	49.2	22:45 pm	41.2	05:00 am	42.5		
16:45 pm	48.2	23:00 pm	39.6	05:15 am	41.6		
17:00pm	48.6	23:15 pm	38.5	05:30 am	40.7		
17:15 pm	46.5	23:30 pm	39.3	05:45 am	40.8		

Noise Measurement Site 2 Results: Al-Zaitouna

20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)
11:15 am	40.0	17:30 pm	41.7	23:45 pm	43.2	06:00 am	47.6
11:30 am	40.0	17:45 pm	42.3	24:00 pm	44.6	06:15 am	45.6
11:45 am	48.6	18:00 pm	40.3	00:15 am	42.3	06:30 am	44.6
12:00 am	44.5	18:15 pm	42.3	00:30 am	41.3	06:45 am	43.6
12:15 pm	43.3	18:30 pm	41.3	00:45: am	42.5	07:00 am	44.6
12:30 pm	55.2	18:45 pm	40.3	01:00 am	41.3	07:15 am	42.5
12:45pm	44.6	19:00 pm	44.6	01:15 am	40.6	07:30 am	47.8
13:00pm	47.6	19:15 pm	48.9	01:30 am	39	07:45 am	48.6
13:15 pm	48.5	19:30 pm	51.2	01:45 am	40.5	08:00 am	47.4
13:30 pm	49.3	19:45 pm	55.3	02:00 am	38	08:15 am	46.8
13:45 pm	50.2	20:00 pm	52.3	02:15 am	39.8	08:30 am	48.6
14:00 pm	47.2	20:15 pm	48.3	02:30 am	42.1	08:45 am	46.5
14:15 pm	48.3	20:30 pm	46.3	02:45 am	41.6	09:00 am	44.8
14:30 pm	48.6	20:45 pm	45.8	03:00 am	41.8	09:15 am	51.5
14:45pm	47.4	21:00 pm	52.3	03:15 am	44.6	09:30 am	50.1
15:00 pm	48.3	21:15 pm	49.2	03:30 am	54.3	09:45 am	49
15:15 pm	49.6	21:30 pm	48.8	03:45 am	51.9	10:00 am	48.5
15:30 pm	46.6	21:45 pm	44.5	04:00 am	50.2	10:15 am	49.8
15:45 pm	45.6	22:00 pm	43.5	04:15 am	49.6	10:30 am	48.7
16:00pm	44.7	22:15 pm	42.3	04:30 am	48.6	10:45 am	49.2
16:15 pm	46.2	22:30 pm	42.5	04:45 am	48	11:00 am	47.5
16:30 pm	45.7	22:45 pm	41.7	05:00 am	49.9		
16:45 pm	44.2	23:00 pm	40	05:15 am	51.2		
17:00pm	43.3	23:15 pm	42.2	05:30 am	52.6		
17:15 pm	42.1	23:30 pm	41.6	05:45 am	48.8		

Noise Measurement Site 3 Results: Al-Faisaliah

20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)	20/06/17 to 21/06/17	SLP (Av+) (dBA)
11:15 am	40.0	17:30 pm	42.2	23:45 pm	40.2	06:00 am	39.6
11:30 am	40.0	17:45 pm	41.3	24:00 pm	41.7	06:15 am	37.8
11:45 am	40.0	18:00 pm	40	00:15 am	43.6	06:30 am	49.2
12:00 am	47.3	18:15 pm	39.2	00:30 am	43.2	06:45 am	39.2
12:15 pm	45.2	18:30 pm	42.3	00:45: am	41.7	07:00 am	40.1
12:30 pm	43.6	18:45 pm	46.6	01:00 am	42	07:15 am	40.7
12:45pm	44.2	19:00 pm	42.3	01:15 am	42.6	07:30 am	41.6
13:00pm	43.5	19:15 pm	43.2	01:30 am	42.3	07:45 am	43.6
13:15 pm	48.3	19:30 pm	43.1	01:45 am	45.2	08:00 am	41.2
13:30 pm	49.6	19:45 pm	44.3	02:00 am	40.6	08:15 am	43.2
13:45 pm	46.4	20:00 pm	42.2	02:15 am	41.2	08:30 am	40.5
14:00 pm	44.3	20:15 pm	41.3	02:30 am	43.2	08:45 am	41.2
14:15 pm	41.2	20:30 pm	42.3	02:45 am	44.3	09:00 am	38.3
14:30 pm	40.5	20:45 pm	38.6	03:00 am	46.6	09:15 am	39.9
14:45pm	41.3	21:00 pm	40.6	03:15 am	47.8	09:30 am	42.3
15:00 pm	42.6	21:15 pm	41.4	03:30 am	44.8	09:45 am	41.2
15:15 pm	44.6	21:30 pm	42.3	03:45 am	43.6	10:00 am	40.3
15:30 pm	46.9	21:45 pm	43.9	04:00 am	42.3	10:15 am	42.2
15:45 pm	47.4	22:00 pm	42.3	04:15 am	38.3	10:30 am	44.5
16:00pm	53.5	22:15 pm	41.3	04:30 am	39.5	10:45 am	42.9
16:15 pm	48.6	22:30 pm	40.5	04:45 am	40.3	11:00 am	44.6
16:30 pm	49.2	22:45 pm	41.2	05:00 am	42.5		
16:45 pm	48.2	23:00 pm	39.6	05:15 am	41.6		
17:00pm	48.6	23:15 pm	38.5	05:30 am	40.7		
17:15 pm	46.5	23:30 pm	39.3	05:45 am	40.8		