ARABIA ONE SOLAR PV POWER PLANT PROJECT

(10MW)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

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ABBREVIATIONS & ACRONYMS

AC	Alternating Current
ARC	Aqaba Railway Corporation
CARC	Civil Aviation Regulatory Commission
CHSS	Community Health, Safety and Security
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSP	Concentrated Solar Power
DC	Direct Current
DFZC	Development and Free Zones Commission
DoA	Department of Antiquities
DoS	Department of Statistics
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment
EOI	Expression of Interest
EPC	Engineering, Procurement, and Construction
E&S	Environmental & Social
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GWh	GigaWatt Hour
HSE	Health, Safety, and Environment
IBA	Important Bird Area
IEA	International Energy Agency
IFC	International Finance Corporation
IFI	International Financing Institutions
ILO	International Labour Organization
IUCN	International Union for Conservation of Nature
JS	Jordanian Standard
kWh	KiloWatt Hour
MCM	Million Cubic Meter
MDA	Ma'an Development Area
MDC	Ma'an Development Company
MEMR	Ministry of Energy and Mineral Resources
MoA	Ministry of Agriculture
MoEnv	Ministry of Environment
MoH	Ministry of Health
MoL	Ministry of Labour
MoMA	Ministry of Municipal Affairs

MoU	Memorandum of Understanding
MPWH	Ministry of Public Works and Housing
MW	Megawatt
MWI	Ministry of Water and Irrigation
NEPCO	National Electricity Power Company
NERC	National Energy Research Center
NGO	Non-Governmental Organization
NO_2	Nitrogen Dioxide
NRA	Natural Resources Authority
NTS	Non-Technical Summary
OHS	Occupational Health and Safety
O&M	Operation and Maintenance
PM_{10}	Particulate Matter smaller than 10.0 microns in diameter
$PM_{2.5}$	Particulate Matter smaller than 2.5 microns in diameter
PPA	Power Purchase Agreement
PS	Performance Standard
PV	Photovoltaic
REA	Rapid Environmental Assessment
REOI	Request for Expressions of Interest
RJAF	Royal Jordanian Air Force
RSCN	The Royal Society for the Conservation of Nature
ToR	Terms of Reference
TSP	Total Suspended Particulates
SDU	Social Development Unit
SEP	Stakeholder Engagement Plan
SO_2	Sulphur Dioxide
VTC	Vocational Training Center
WAJ	Water Authority of Jordan
WWTP	Wastewater Treatment Plant

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". The Ministry of Energy and Mineral Resources (MEMR) is fully committed to substantially progress the development of renewable energy in order to make energy from the sun, wind and other renewable resources an important contribution to the energy supply system of the Kingdom.

This law established the basis in Jordan for the submission of renewable energy project proposals to MEMR by the private sector. In May 2011, MEMR issued a Request for Expressions of Interest (REOI) in order to promote the investment opportunities in renewable energy projects and to select the possible projects under the "Proposal Submission Procedure" set out in the Law.

Developers have 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 projects.

Only those solar power projects will be selected for further development which offer the greatest benefits to the country. The selection of the solar power projects will be in accordance with the criteria and procedures developed by MEMR and set out in the "Instruction and Requirements for Proposal Preparation and Submission for Solar Power Projects". Recently, and based on the "Proposal Submission Procedure", twelve (12) solar photovoltaic (PV) development projects were selected by MEMR for a total capacity of 200 Mega Watt (MW).

Within this context, Arabia One for Clean Energy Investments PSC has participated in submitting an EOI to MEMR as part of the "Proposal Submission Procedure" for the development of a Solar PV Project in Ma'an Governorate. Arabia One for Clean Energy Investments PSC was selected by MEMR, as part of the twelve (12) solar PV development projects, for the development of a 10MW PV project, and signed a Power Purchase Agreement (PPA) in March 2014.

Arabia One for Clean Energy Investments PSC (hereafter referred to as 'the Developer') propose to develop a solar PV project of 10MW capacity (hereafter referred to as 'the Project'). This document forms the Environmental and Social Impact Assessment (ESIA) (or termed as Environmental Impact Assessment (EIA) in some cases) of the Project in order to obtain the environmental permit from the Ministry of Environment (MoEnv). The ESIA has been prepared in accordance with the Jordanian "Environmental Impact Assessment Regulation No. (37) of 2005" and the "International Finance Corporation (IFC) Performance Standards in Environmental & Social Sustainability" (IFC, 2012) and Environment, Health, and Safety (EHS) Guidelines.

1.2 Project Location & Setting

The Project is located within Ma'an Governorate in the South of Jordan, approximately 200km south of the capital city of Amman. The Project site is 9km southeast of Ma'an city, while the closest village (Al-Mahata Village) is located approximately 6km to the northwest. The site is near a major highway (Highway #5) which runs from Ma'an city to the Saudi Arabian Border in the South (known as the Mudawwara Borders) and is located approximately 100km from the Jordanian-Saudi border. The Figure below presents the location of the Project site.

The Project area in general can be characterized as being dominantly of fairly flat surfaces. A wadi system intersects within the Project site and which runs from the western part of the site to the eastern part.

The site can be classified as a desert-like habitat that is barren and arid (with rainfall rates less than 60mm per year) and mostly covered with Chert Pebbles, while few vegetation strips can be found scattered mainly within the wadi system.

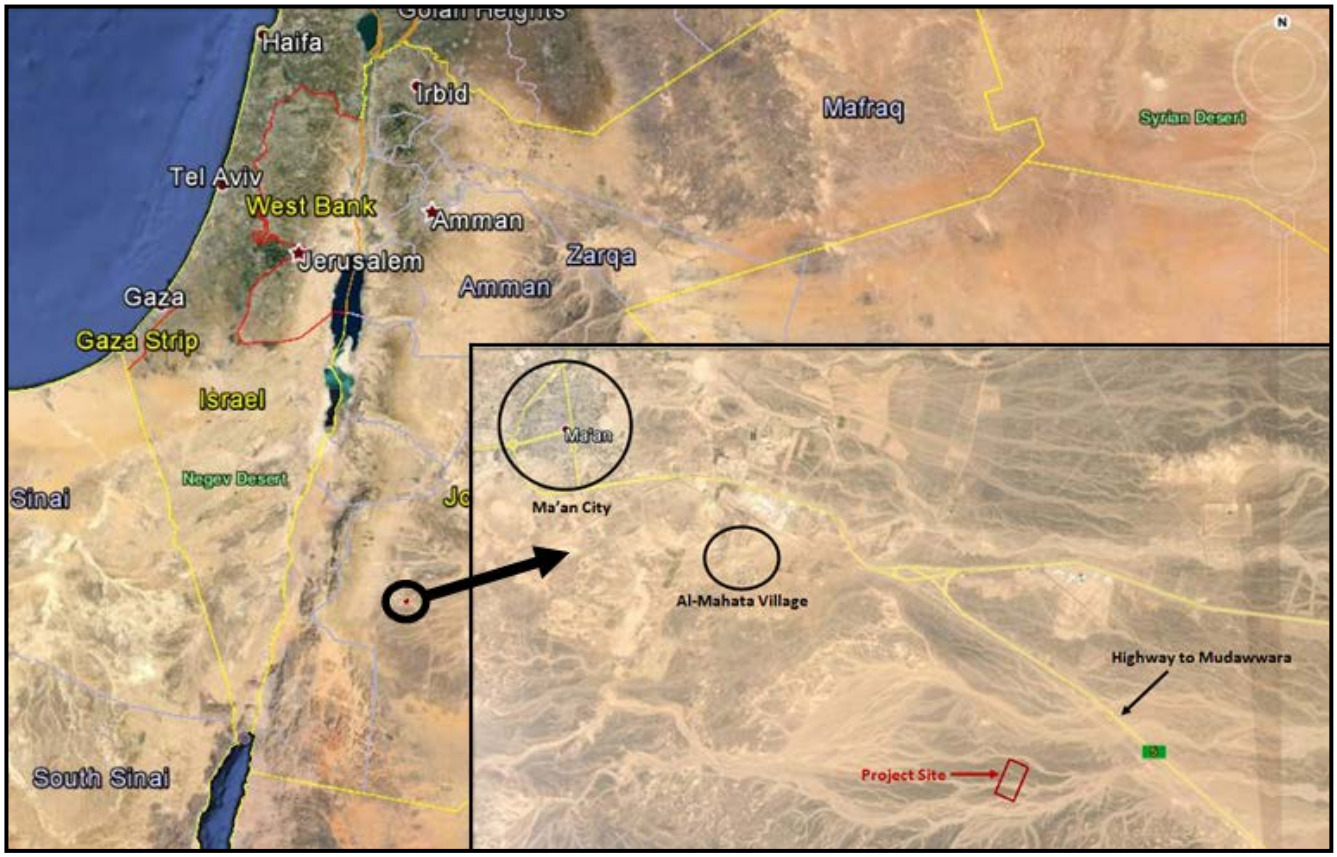

Figure 1: Overview of Project Location

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) – mainly the International Finance Corporation (IFC). 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:

- IFC Environmental & Social Sustainability Performance Standards (2012);

- IFC General Environment, Health, and Safety (EHS) Guidelines; and
- Applicable IFC Industry Sector EHS Guidelines.

ECO Consult was commissioned by the Developer 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 with the MoEnv's "Environmental Impact Assessment Regulation No. (37) of 2005" and the IFC Performance Standards and EHS Guidelines.

1.4 Document Structure

The following table provides an overview of the Chapters within this ESIA document. The ESIA includes a standalone Non-Technical Summary (NTS) and supporting Annexes.

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 – Regulatory & Policy Framework	Provides an overview of the environmental and social regulatory and policy framework applicable to the Project.
Chapter 4 – ESIA Approach & Methodology	Presents the assessment methodology and approach.
Chapter 5 – Project Justification and Analysis of Alternatives	Investigates several alternatives to the Project development in relation to the Project site, chosen technology, Project design, and finally investigates the 'no action alternative' – which assumes that the Project development does not take place.
Chapter 6 – Stakeholder Consultation and Engagement	Discusses 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.
Chapter 7 – Environmental and Social Baseline Conditions	Presents the environmental and social baseline conditions within the Project site and its surroundings in relation to: landscape and visual; land use; geology, hydrogeology and hydrology; biodiversity; archeology; air quality and noise; infrastructure and utilities; and socio-economic conditions.
Chapter 8 – Assessment of Environmental and Social Impacts and Identification of Mitigation Measures	Identifies and assesses the potential impacts from the Project on the various environmental and social receptors. In addition, for each impact a set of mitigation measures have been identified to eliminate or reduce the impacts to acceptable levels.
Chapter 9 – Environmental and Social Management Plan (ESMP) and Compliance Program	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 10 – Environmental & Social Performance Requirements for NEPCO	The National Electric Power Company (NEPCO), which is the national electricity company of Jordan will be responsible for designing and building the substation, together with high voltage overhead lines and the connection to the existing grid for the Project. As details and information are not available or finalized at this stage by NEPCO, these offsite construction activities related to the Project have not been assessed within the ESIA. This Chapter presents therefore the Environmental & Social Performance Requirements which must be implemented by NEPCO, and which aim to ensure that environmental and social issues are taken into account and adequately considered during the development of these facilities connected to the Project's development.

1.5 Project Proponent & Key Contributors

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

- *Arabia One for Clean Energy Investments PSC:* are the Project Proponent and will be the owner and developer of the Project;
- *Engineering, Procurement, and Construction (EPC) Contractor:* Arabia One has appointed Hanwha as the Project's EPC Contractor, whom will be responsible for preparing the detailed design and layout of the Project; supply of the material and equipment (panels, inverters, etc.); construction of the Project and its various components (PV arrays, internal roads, building infrastructure, connections, etc);
- *Project Operator:* an operation and management (O&M) contract for the Project has been signed between Arabia One and MASE. In addition, MASE has a technical support agreement with Hanwha for a duration of two (2) years;
- *International Finance Corporation (IFC):* lead lenders;
- *National Electric Power Company (NEPCO):* is the national electricity company of Jordan responsible for the high voltage electric grid in the country and, for this Project, will be responsible for designing and building the substation, together with high voltage overhead lines and the connection to the existing grid.
- *ECO Consult:* hereafter referred to as the 'ESIA Team' who is the ESIA Practitioner and the consultant commissioned by the Developer to prepare the ESIA for the Project in accordance with the requirements of the MoEnv and its "EIA Regulation No. (37) of the year 2005".
- *The Development and Free Zones Commission (DFZC):* the Project site is located in Ma'an Governorate and specifically within the Ma'an Development Area (MDA). Development and Free Zones in Jordan (such as the MDA) are administratively under the responsibility of the Development and Free Zones Commission (DFZC); including issuing environmental permits and granting environmental clearances for projects. However, it is important to note that all environmental matters (including environmental permitting) in Free Zones (including MDA) were delegated by the DFZC to the MoEnv.
- *The Ministry of Environment (MoEnv):* the official governmental entity responsible for the protection of the environment in Jordan. The MoEnv is responsible for the approval of the ESIA Study and making sure it complies with the "EIA Regulation No. (37) of the year 2005" and also responsible for granting the environmental clearance for the Project.

2. PROJECT DESCRIPTION

This section 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 of the Project area, as those will be referred to many times throughout the ESIA document.

The Project site is located within Ma'an Governorate which consists of 4 main Districts (Table 2) and 4 main Sub-districts that belong to the District of Qasabit Ma'an. Of those, the Project is located within the District of Qasabit Ma'an which hosts Ma'an City (the capital of the Governorate) and which is located 9km to the northwest from the Project site, and Al-Mahata village (the closest village to the Project site) which is located approximately 6km from the Project site.

From a municipality perspective, the Project site is located within Greater Ma'an Municipality but outside 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 Al-Shobak District of Al-Husseiniyeh	Greater 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)

The Project site is located within a Development Area, known as the Ma'an Development Area (MDA). In 2008, Development Areas were established to enhance the economic capacity in Jordan through attracting investments and creating a proper investment climate for economic activities aiming to bring social and economic prosperity to Jordanian citizens.

Among the regions chosen to host a Development Area is Ma'an Governorate – and thus the MDA was established. The MDA is an area of approximately 9km² consisting of complementary components to be utilized mainly for industrial activity and vocational training centers. Development Areas (such as MDA) are assigned a Master Developer whom is responsible for managing, planning, and developing the area. The Master Developer for the MDA is Ma'an Development Company (MDC).

Within Development Areas in Jordan (including MDA) the regulatory authority in charge is the Development and Free Zones Commission (DFZC); an independent administrative and financial authority connected directly to the Prime Minister. The MDA is administratively under the responsibility of the DFZC, including issuing environmental permits and granting environmental clearances for projects. However, as stated earlier, all environmental matters (including environmental permitting) in Development Areas (including MDA) were delegated by the DFZC to the MoEnv.

Environmental & Social Documentation for the Ma'an Development Area

As stated earlier, the Project site is located within the MDA, an area of approximately 9km² consisting of complementary components to be utilized mainly for industrial activity and vocational training centers. A Master Plan has been prepared for the MDA which specifies five (5) different yet complementary clusters spread around Ma'an city. Those clusters are summarized in the table below.

Table 3: Clusters of the MDA

Cluster	Description
Solar Park	The Master Plan of MDA envisions renewable energy investments and in particular solar PV energy projects. Therefore, an area of approximately 5km^2 has been allocated for Solar PV developments (known as the Solar Park) and which is located around 8km to the southeast of Ma'an city. The Project site is located within the Solar Park and the Developer has been allocated an area of 0.2km^2 for their 10MW Project, while the remaining 4.8m^2 will be developed by eight (8) other companies.
Industrial Park	The Industrial Park spreads across 2.5 km², including an area of 750,000 m² that is already fully functional and equipped with a complete infrastructure. Located around 8km to east of Ma'an city, the Industrial Park will cater to a wide variety of industries (light, medium, and heavy) and be home to an important number of manufacturing and production plants.
Residential Community	A real estate and infrastructure cluster that will include employees housing, residential areas, community services (parks and open landscape), and local commercial facilities. The Residential Community is located around 7km to the northwest of Ma'an city.
Skill Development Center	Education and training cluster that will include skill development center as well as residential areas, community services (parks and open landscape), and local commercial facilities. The Development Center is located within Ma'an city.
Hajj Oasis	A hospitality and accommodation cluster that will includes facilities for religious tourism as well as residential areas, community services (parks and open landscape), and local commercial facilities. The Hajj Oasis is located around 10km to the north of Ma'an city.

As discussed earlier, within Development Areas in Jordan the regulatory authority in charge is the DFZC which was also responsible for issuing environmental permits and granting environmental clearances for projects.

In accordance with the "Development and Free Zones Law No. (2) of the year 2008", the DFZC has the overall authority and responsibility for protection of the environment within the development zones. However, at the time the Master Plan for the MDA was developed, the environmental regulatory framework for the DFZC was not yet finalized and was still unclear.

Nevertheless, at that time, the DFZC commissioned the undertaking of a Rapid Environmental Assessment (REA) for the Master Plan of the MDA. The objective of the REA was to provide high level baseline information, impact/risk analysis, and recommendations to promote effective environmental management of the Development Area.

Nevertheless, it is important to note that in 2013 all environmental matters (including environmental permitting) in Free Zones (including MDA) were delegated by the DFZC to the MoEnv.

2.2 Project Location

The Project is located within Ma'an Governorate in the South of Jordan, approximately 200km south of the capital city of Amman. More specifically, the Project site is 9km southeast of Ma'an city, while the closest village to the Project site (Al-Mahata Village) is located approximately 6km to the northwest. In addition, the Project site is near a major highway (Highway #5) which runs from Ma'an city to the Saudi Arabian Border in the South (known as the Mudawwara Borders); the Project is located approximately 100km from the Jordanian-Saudi border.

In addition, the Project site is near an existing operating railway that runs 1.4km north of the Project site. The railway is operated and managed by the Aqaba Railway Corporation (ARC) and is dedicated for transporting Phosphate from the mines in Ma'an Governorate to Aqaba Governorate.

Also, located 3km to the North of the Project site is the MDA Industrial Park. The Industrial Park houses several industrial facilities, to include mixed concrete and construction supplies facilities, a leather tannery, and glass factory, and other planned facilities for production of water and juice, cigarettes, ceramics, plastics, marble, granite, electrical appliances, and others.

As part of the MDA, the MDC has allocated an area of 5km^2 for the development of solar PV power generation projects – known as the Solar Park (highlighted in black in the figure below). The Developer has been allocated an area of 0.2km^2 within the Solar Park (highlighted in red in the figure below) for the development of their 10MW Project. The remaining 4.8km^2 of the Solar Park will be developed by eight (8) other companies.

The coordinates of the Project site are presented in UTM in Table 4 below.

Table 4: Project Site Coordinates in UTM

Point Number	North	East
1	3337652.64	770695.26
2	3338080.73	771232.86
3	3338207.77	770924.49
4	3337525.67	771004.19

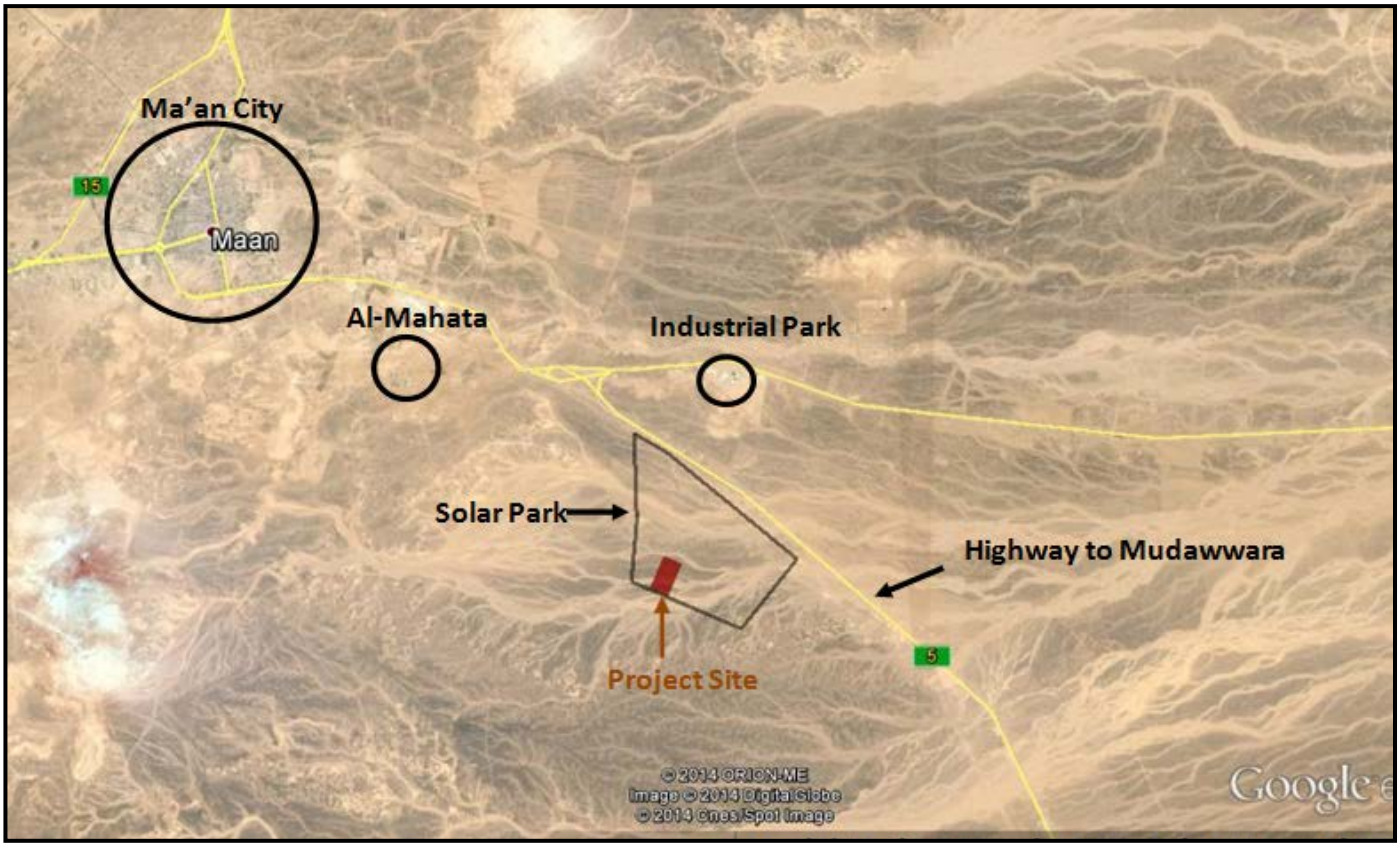

Figure 2: Project Site Location

2.3 Outline of Photovoltaic (PV) Technology

PV is a method of generating electricity through solar panels which are composed of a number of solar cells. Such cells convert solar energy (radiation from the sun) into electricity using semiconductors (photovoltaic material that exhibit the photovoltaic effect); following the exposure of the PV panel to light, voltage is created in the material as photons from sunlight excite electrons in those materials into a higher state of energy, allowing them to act as charge carriers for an electric current.

Solar cells produce Direct Current (DC) electricity from sun light, 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 the DC current to AC current. In addition, cells produce electricity at a certain voltage which must be matched to the grid it connects to. Therefore, transformers are used to convert the output from the panels to a higher voltage that matches the grid.

2.4 Project Components

Table 5 below provides a summary of the key project components for the 10MW Project, along with a detailed description of each of those components to follow. In addition, Figure 4 presents the preliminary layout of each of those components within the Project site.

Table 5: Summary of Key Project Components

Component	Description
Project Generation Capacity	10 MW
Project Area	0.2km^2 (0.6 km x 0.34Km)
Technology Type	PV (photovoltaic)
Number of Zones	8 (each zone consists of a number of PV Power arrays)
PV Panel Type	Polycrystalline technology
Infrastructure and Utilities	This includes: (i) internal road network (ii) underground cables, (iii) warehouse and offices (iii) central inverter stations (iv) power conversion station (v) substation.

2.4.1 PV Power Arrays

One of the major components of such a Project is the PV Power arrays which are distributed throughout the Project site. The PV power arrays are composed of the PV panels which generate the electricity from sun as discussed earlier. Figure 3 below presents typical PV power arrays composed of PV panels.

For this Project, the PV Power arrays are divided into 8 zones within the Project site. Each zone has a total capacity of around 1.4MWp. Each zone is composed of the following:

a) **5,625 PV Panels disturbed over PV Power Arrays:** each panel has a capacity of 255Wp for a total capacity per zone of 1.4MWp. Each panel is of 1,652mm length, 1000mm width, 45mm thickness, and weights around 21kg. The panel requires protection from the environment and is usually packaged tightly behind a tempered glass sheet which has an anti reflective coating layer to capture maximum sunlight and to minimize reflections. The panel is a polycrystalline solar module technology which utilizes silicon as a semiconductor material for generation of electricity. Silicon is considered a non-hazardous materialIn addition, each array is fixed onto a galvanized steel fixed mounting structure; and

- **One Central Inverter Station** which consists of an inverter which converts electricity generated from the array from DC current to AC current.

Figure 3: Typical PV Power Arrays Composed of PV Panels

2.4.2 Infrastructure and Utilities

The Project will require the following infrastructure and utilities related components:

- **Underground Cables:** All the power arrays are connected through underground cables to the Inverter Station located within each zone. Each Inverter Cabin then connects through underground cables with a power conversion station (discussed below);
- **Power Conversion Station** all electricity generated from the Inverter Cabins will be collected through underground cables with a Power Conversion Station located in the eastern part of the Project site. The Power Conversion Station includes a transformer which converts the output to a higher voltage (from 360 V to 35kV) that is appropriate for connection with the substation. The power conversion station will then connect with NEPCO's substation as discussed below;
- **Substation:** The NEPCO substation is a high voltage transformer substation that converts the output from the Delivery Station to a higher voltage (from 33 kV to 132 kV) that is appropriate for connection with the High Voltage National Grid (132 kV) (which is located 500m to the north of the substation area). The substation will connect to the National Grid through High Voltage power lines. The substation will be constructed and operated by NEPCO and is located 1km north of the Project site. It is important to note that details and information are not available or finalized at this stage by NEPCO with regards to the layout of substation, grid connections plans and route for the overhead lines, etc. Therefore, the ESIA has not considered within its study boundary the NEPCO substation and related works;
- Other infrastructure and utilities in the Project site include the following:
  - **Building Infrastructure:** onsite building infrastructure is required for the daily operation of the Project. This will include offices used for normal daily operational related work and a warehouse for storage of equipment and machinery;
  - **Fencing:** around the entire facility and security will be required to ensure safety from criminal activity and trespassing of unauthorized personnel. Fencing will not be electric;
  - **Internal road network:** an internal road network will be established for ease of access to the arrays for operation and maintenance purposes; and
  - **On-site water reservoirs:** are most likely to be utilized for the water requirements of the Project. Water will be used mainly for potable purposes as well as for the regular cleaning of the panels to prevent dust build-up as this would affect their performance

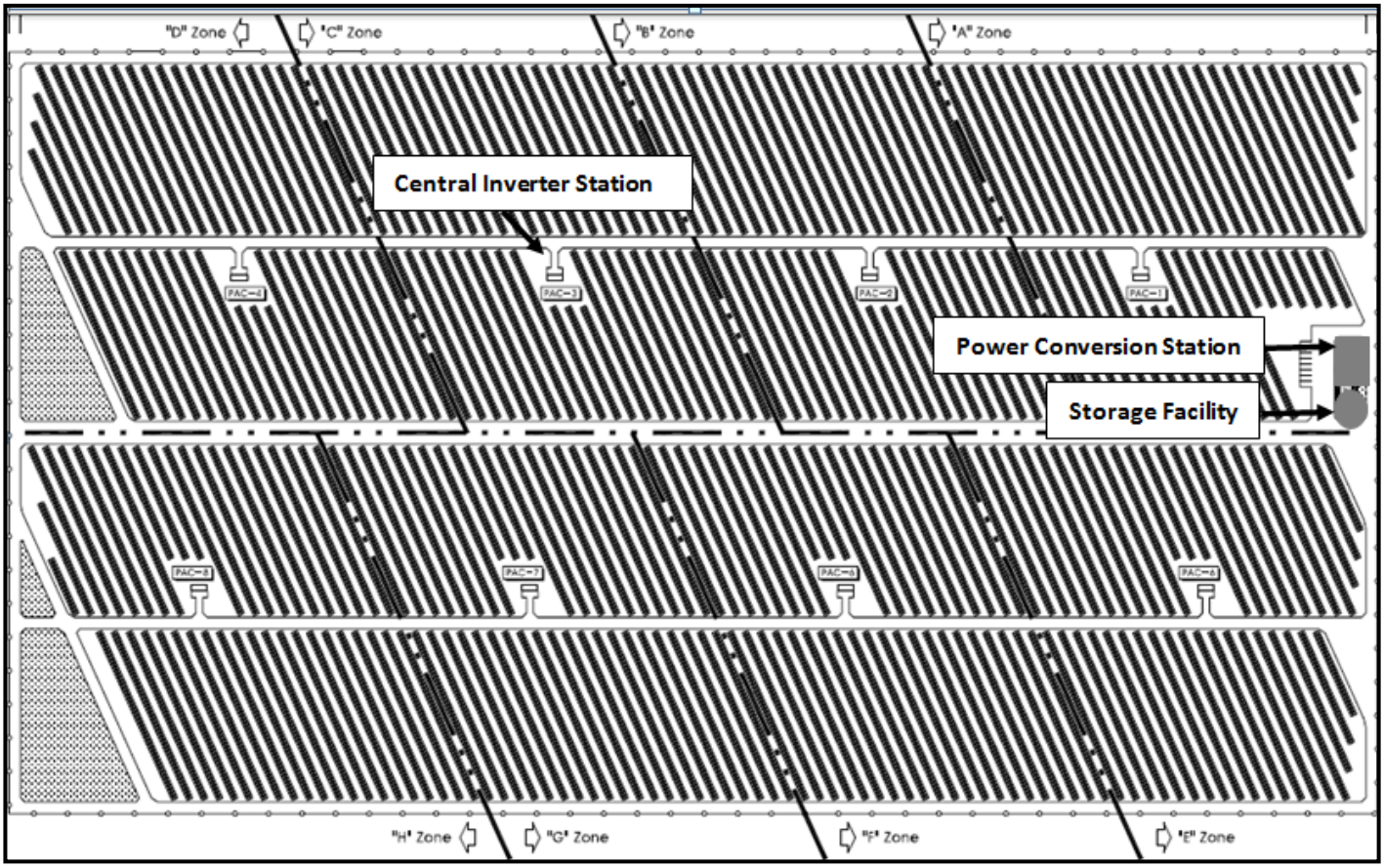

Figure 4: Layout of Project Components

2.5 Land Take Requirements & Land Use Context

The Project site is located within the MDA and specifically within the Solar Park. In accordance with the "Development and Free Zones Law No. (2) of the year 2008", Development Areas and Free zones and their boundaries are established based on a decision by the Council of Ministers. Once Development Areas and Free Zones boundaries are defined, the land parcels owned by the Public Treasury are transferred to the ownership of the DFZC.

According to the MDA Master Plan, the Solar Park was initially located at an area adjacent to the Industrial Park. However, according to discussions with the MDC, this site was disregarded so that the activity of the local community in the area is not affected or disrupted.

Based on investigations by the MDC, the disregarded site has been in use by local cooperative associations for olive tree plantation throughout the past ten (10) years. Approximately 200-300 Dunums have been planted with olive trees by those associations, although the land belongs to the Public Treasury. Nevertheless, to avoid any issues with the local community, the Solar Park area has been relocated to its current location.

According to MDC, the current Solar Park area has been allocated after ensuring that those lands provide no specific use value to the locals. Those lands belong to the Public Treasury and have been transferred to the MDC under the approval of the Council of Ministers. This was done in coordination with the Department of Lands and Survey and the Treasury Lands Directorate as well as a "State Property Committee" which includes representatives of the local governmental institutions which are aware of local settings and local community activities in the area – this includes the Governor of Ma'an, Director of Ma'an Lands Directorate, Director of Ma'an Agriculture Directorate, Director of Ma'an Health Directorate, etc.

Figure 5 below presents the location of the Industrial Park, previously identified Solar Park area (which has been disregarded) and the new location of the Solar Park.

As detailed within Section 7.2 the 'ESIA Team' also investigated the formal and informal land use of the current Project site. It was concluded that there is no conflict of the Project site in relation to the formal land use planning as set by the various governmental institutions (e.g. Ministry of Municipal Affairs, Ministry of Environment, Ministry of Agriculture, etc.). In addition, the 'ESIA Team' also investigated the informal land use and whether the proposed Solar Park site is of any specific value to the local community – through discussions with the relevant local governmental entity (mainly the Social Development Unit of Ma'an Governorate) and consultations with the local community.

The outcomes of such consultations reconfirm that the current Solar Park area has no specific value or use by the local community (refer to Section 6.4.2 for additional details). In addition, the issue of nomadic and semi-nomadic settlements in the area was investigated as well. Generally, the Project area in general is not known for nomadic/semi-nomadic settlements given the natural characteristics of the site (being desert area that is arid and barren with no water resources). In general, in Ma'an Governorate, nomads tend to move during the winter season to warmer areas such as Wadi Araba (located around 40km west of Ma'an city) or Al-Jafr (located around 30km to the east of Ma'an city). During spring and summer season, nomads tend to move to cooler areas with proper range lands to feed their livestock and to undertake agricultural and harvesting activities – which mainly include areas west of Ma'an city such as Al-Shobak and Al-Sherah (around 30km from Ma'an city).

To this extent, the Developer has signed a Land Lease Agreement with the MDC for leasing of the Project site for the required development over the Project duration.

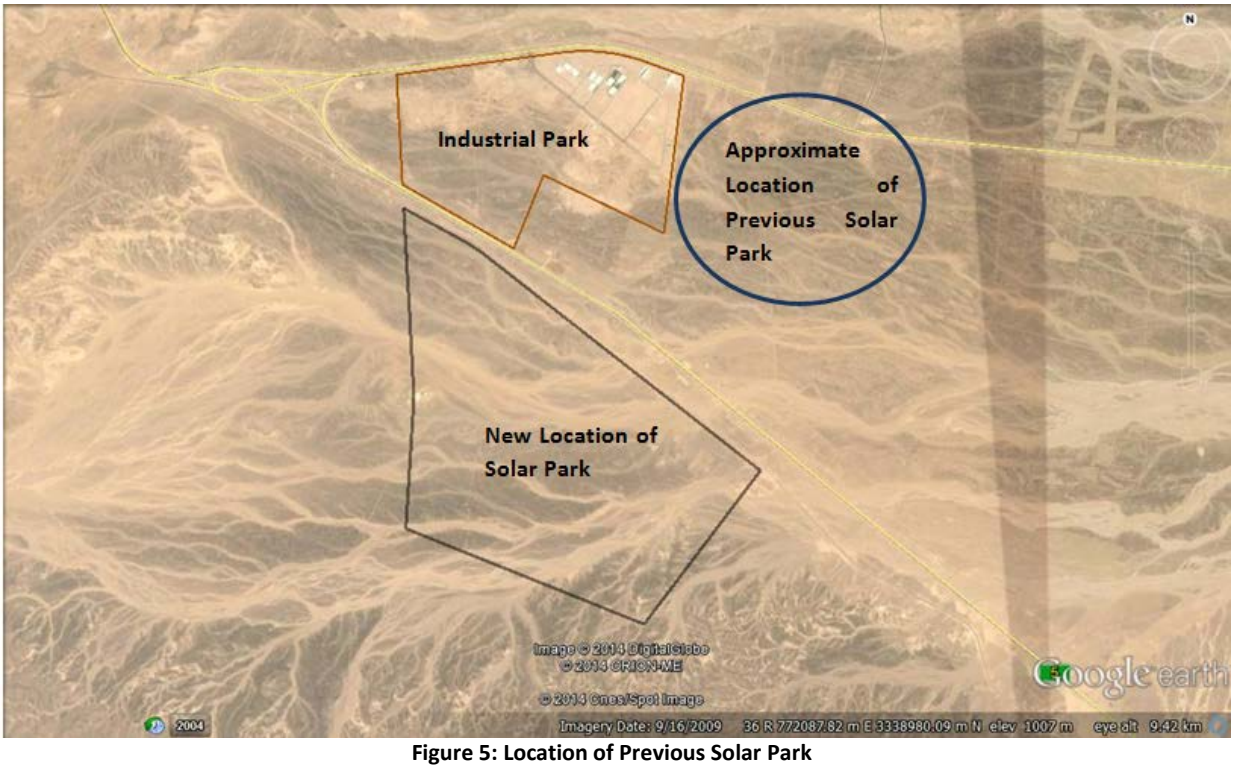

Figure 5: Location of Previous Solar Park

2.6 Workforce & Training

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

- Around 40-60 job opportunities during the regular construction period for a duration of approximately 9 months. This number could reach around 100 towards the peak period of the construction phase. This will mainly include engineers, electrical and mechanical technicians, as well as unskilled workers.

  During construction, workers whom do not live in the area will most likely be accommodated in the nearest accommodation facilities to the site (most likely at Ma'an city 9km from the site) and will be provided with means for transportation to the site. There will be no onsite construction camps for workers.

- Around 5 job opportunities during the operation phase to include skilled labour (such as electrical and mechanical technicians) and unskilled labour (such as module cleaners and security personnel) for a duration of 20 years. Similarly, during operation, workers whom do not live in the area will most likely be accommodated in the nearest accommodation facilities to the site (most likely at Ma'an city 9km from the site).

2.7 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.

2.7.1 Planning and Construction Phase

Typical activities during the planning and construction phase for PV farms include the following:

- Detailed and final planning and design for the project;
- Transportation of Project components to the Project site which mainly includes the PV panels. The components are expected to be transported to the Port of Aqaba and then transported by road to the Project site;
- Site preparation activities as the Project requires a flat physical land area for installation of the PV arrays and the various Project components. Such activities are expected to be limited and could include levelling, land clearing activities, grading, excavations;
- In addition to the installation of the panels, there is additional construction work (which could include land clearing activities, levelling, excavations, etc.) that must be conducted to connect each array to the power grid. This could include the installation and laying of underground cables, central inverter stations, power conversion station, etc; and
- Additional construction works (which could include land clearing activities, levelling, excavations, etc.) for the internal access road and the building infrastructure such as administrative buildings and warehouses.

2.7.2 Operation Phase

PV plants generally require limited operational activities which mainly includes the following:

- Commissioning tests which usually involve standard electrical tests for the electrical infrastructure as well as the panels, and inspection of routine civil engineering quality records. Careful testing at this stage is vital if a good quality PV farm is to be delivered and maintained.

- Operation and Maintenance (O&M) of the PV farm. This includes the normal daily operation of the PV farm including its maintenance to optimise the energy yield and the life of the system. Maintenance can be divided into the preventive and corrective maintenance. The preventive maintenance follows a routine service schedule aimed at preventing faults from occurring and keeping the plant operating at its optimum level. The frequency of the preventive maintenance depends on a number of factors such as the technology selected, environmental conditions of the site, warranty terms and seasonal variances. It contains for example activities like PV module cleaning, inverter servicing or checks on structural integrity of the mounting structure. The corrective maintenance is carried out in response to failures for example the repair/ exchange of damaged equipment or inverter faults.
- It is important to note that the PV modules will be cleaned on a regular basis to prevent dust build-up which could affect their performance. Cleaning will be undertaken through the use of water trucks equipped with sprayers.

2.7.3 Decommissioning Phase

It unclear at this point whether at the end of the lifetime of the Project (where according to the PPA and agreement between the Developer and MEMR is set for 20 years) MEMR would take ownership of the Project and continue operating it or whether the Project will be completely decommissioned. Should MEMR decide to continue to operate the Project, then in this case, the Project is expected to operate for an additional five years (given that the PV modules lifetime is 25 years).

Nevertheless, in the case of the complete decommissioning of the PV farm, decommissioning activities could include the disconnection of the various Project components (PV arrays, underground cables, central inverter stations, power conversion station, etc) for final disposal. In addition, internal road network will be restored and gates and fences will be removed.

It is important to note that the Developer is part of PV CYCLE – an association organizing the take-back and recycling of PV modules at end-of-life. The recycling program of PV CYCLE is a comprehensive recycling process which recovers most of the materials within the PV panel (including glass, semiconductor material, ferrous and non-ferrous metals, etc.) for reuse in new products. Such an option could be used for the PV panels at the end-of-life, but if such an option is not possible, then the panels will most likely be disposed at a landfill site as a worst case scenario.

2.7.4 Project Schedule

According to the existing timelines of the Developer, the construction of the PV Project is anticipated to commence in January 2015 and will require approximately 9 months. Thus, operation of the Project is therefore anticipated to commence in October 2015 for a period of 20 years as agreed with MEMR and based on the PPA signed.

2.8 Resource Use Efficiency

The objective of this section is to demonstrate how the Project design has endeavored to optimize the use of all natural resources involved in the Project processes to the greatest extent possible.

1) One of the key positive impacts of the Project, as far as resource efficiency, is that it will be utilizing solar energy to produce electricity. The Project is expected to be of an installed capacity of 10 MW and will contribute to supplying electricity to the National Grid for end users and help meet the increasing electricity demands throughout the Kingdom – as opposed to meeting such increasing demands through conventional electricity production from thermal power plants.

   The Project will provide around 20 Gigawatt Hour (GWh) of electricity per year which is enough to cover the average annual electricity consumption of around 4,000 households in Jordan. This has been based on taking into account that in 2012 the annual electricity consumption of households in Jordan was 6,126 GWh (MEMR, 2012) while the number of households in 2012 in Jordan was 1,173,200 (DoS, 2012) and thus the average annual electricity consumption of households in Jordan can be assumed to be around 5,200 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) "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. The Project is expected to provide around 20 GWh of electricity per year; this will offset around 13,000 ton of CO_2 per year, apart from the reduction of air pollutants emitted from conventional thermal power plants – such as ozone, sulfur 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.

2) In addition, the resource use efficiency of the proposed technology has been considered within the recycling plan for the PV modules. The Developer is part of PV CYCLE – an association organizing the take-back and recycling of PV modules at end-of-life. The recycling program of PV CYCLE is a comprehensive recycling process which recovers most of the materials within the PV panel (including glass, semiconductor material, ferrous and non-ferrous metals, etc.) for reuse in new products. Such an option could be used for the PV panels at the end-of-life.

3. REGULATORY & 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 IFC which must be adhered to by the Developer.

3.1 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. (52) of 2006", "Environmental Impact Assessment Regulation No. (37) of 2005", and the "Instructions for Site Selection of Development Projects for the year 2012".

Generally, the environmental clearance process, as governed by the MoEnv, is a two (2) step process. First, the developers of the Projects, and prior to commencement of the EIA study, must apply for a site approval permit in accordance with the "Instructions for Site Selection of Development Projects of 2012". The second step involves undertaking the EIA study for the Project in accordance with the "Environmental Impact Assessment Regulation No. (37) of 2005".

Both steps are discussed in additional details below.

3.1.1 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 such as the Ministry of Agriculture, Ministry of Municipal Affairs, Ministry of Health, etc. 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 2012" stipulated in accordance to Article No. 4 of the "Environmental Protection Law No. 52 for the Year 2006". The 2012 instructions identify requirements on the setting of development projects and minimum distances that must be respected in relation to nearby sensitive receptors. On broad terms, Article (34) of the Instruction requires that renewable energy projects be located a distance of at least 1km from organized boundaries (urban areas) and/or populated areas; where in the case of this Project the closest is around 6km from the Project site. Based on the findings of the site visit, the Committee either approves the site for the development of the project or rejects the site.
- ***Screening Decision/EIA 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.

3.1.2 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 EIA Study procedures are officially started. The 'EIA Technical Committee' also includes representatives from the MoEnv as well as other governmental authorities such as the Ministry of Agriculture, Ministry of Municipal Affairs, Ministry of Tourism and Antiquities, etc.

- ***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 EIA study. This report must be approved by MoEnv, prior to undertaking the EIA study.

- ***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 EIA document is the output of the assessment, prepared in accordance with the ToR.

- ***Approval of EIA:*** Upon submission of the EIA 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 EIA fails to identify plans for reducing adverse impacts. In order to issue the environmental permit for the Project environmental clearance is required.

3.2 Summary of Jordanian Environmental & 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 6 below lists the key legislation and regulator/entity relevant to each of the E&S 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 6: 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: - Environmental Protection Law No. 52 of 2006 - Instruction for site selection of development projects for the year 2012
ESIA and Post ESIA Requirements	
Visual and Landscape	▪ Ministry of Environment: - Environmental Protection Law No. 52 of 2006 ▪ Civil Aviation Regulatory Commission - Civil Aviation Law No. 41 of the year 2007
Land Use Planning	▪ Ministry of Municipal Affairs (MOMA) - Municipalities Law No. Law No. 13 of year 2011 - Land Use Planning Regulation no. (6) For the Year 2007 ▪ Ministry of Environment: - Environmental Protection Law No. 52 of 2006 ▪ Ministry of Agriculture - Agriculture Law No. 44 of 2002 ▪ Development and Free Zones Commission - Development and Free Zones Law No. 2 of year 2008
Geology and Hydrology (soil and groundwater)	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 - 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 - 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 - 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: - Environmental Protection Law No. 52 of 2006 ▪ Ministry of Agriculture - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008
Archeology	▪ Department of Antiquities - Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
Air Quality and Noise	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 - Air Protection Regulation No. 28 for 2005\ - Instruction for Reduction and Prevention of Noise for 2003 ▪ Jordan Institution for Standards and Metrology (JISM) - JS 1140-2006 Ambient Air Quality
Infrastructure and Utilities	▪ Ministry of Interior - Traffic Law No. 49 for 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 ▪ Ministry of Water and Irrigation - Water Authority Law No. 18 for 1988 and it's amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof ▪ Ministry of Municipal Affairs (MOMA) - Municipalities Law No. Law No. 13 of year 2011 ▪ Ministry of Environment: - Environmental Protection Law No. 52 of 2006 - Instruction for Hazardous Waste Management for the year 2003
Occupational Health and Safety	▪ Ministry of Labour - Labour 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. 36 for 1997 and its amendments thereof
Community Health, Safety, and Security	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 ▪ Ministry of Health - Public Health Law No. 47 for 2008

3.3 Jordanian Institutional Set-up

This section identifies the institutional and administrative framework of entities involved in environmental management in Jordan. Environmental management is mainly the responsibility of the Regulator, MoEnv, in accordance with the "Environment Protection Law No. (52) of 2006". However, other regional and national entities are involved through providing a supporting role to the MoEnv such as the Ministry of Agriculture, Ministry of Water and Irrigation, Ministry of Health, etc. The role of each of those entities is summarized in Table 7 below.

Table 7: Institutional and Administrative Framework

Entity	Mandate
Ministry of Environment (MoEnv)	Responsible for protecting the environment through setting policies and legislation as well as ensuring enforcement, through licensing, monitoring and inspection processes. It is responsible for designating and supervising the management of national parks, reserves and other protected areas although it may delegate these tasks to other bodies. The Ministry is also responsible for developing relevant information management programs, raising public awareness, and promoting co-operation with relevant national, regional and international parties. The MoEnv chairs two national committees that relate to project planning and approval decisions, namely: the 'Central Licensing Committee' and the 'EIA Committee'. In 2006, MoEnv established the Environmental Rangers (Police) department to spearhead enforcement of environmental regulation.
Ministry of Agriculture (MoA)	Responsible for managing public rangelands and forests, protecting soil resources, pastureland and flora, permitting pesticides, protecting and managing wildlife, issuing fishing and hunting licenses, determining capacity and setting 'take' limits.
Ministry of Municipal Affairs (MoMA)	Responsible for monitoring the financial, administrative and organizational performance of Jordan's municipalities (city, town and village local authorities), and supports them in planning and infrastructure development within their boundaries.
Ministry of Health (MoH)	Responsible for the health sector in Jordan, and for community health and safety. It operates most hospitals and clinics and collects data on health indicators.
Ministry of Labour	Responsible for the protection of workers' health and safety and has requirements on health

(MoL)	checks, provision and use of protective equipment and operational procedures for employees in different types of industry.
Water Authority of Jordan (WAJ)	Responsible for the regulation and protection of Jordan's surface and groundwater resources, including monitoring and protecting water against pollution, in addition to water supplies, irrigation and sewerage. Groundwater, aquifer management and abstraction monitoring and licensing are the responsibility of WAJ.
Governorate of Ma'an	The country is divided into a series of 12 administrative Governorates each headed by an appointed Governor. Governorates are further divided into districts and sub districts. Key government services (health, education, security, etc.) are organized within Governorate divisions. Governors are also responsible for maintaining law and order, but since 2001, have a new mandate to include coordination of economic development in their regions. The Governors now chair two governorate-level bodies. An Executive Council (comprising the Governor, representatives of line Ministries in the Governorate and local mayors) is tasked with the general coordination of socio-economic planning in the Governorate, and a Consultative Council (comprising local notables, private sector representatives, NGOs and community leaders) acts as a link with the local community. Governorates report to the central Ministry of the Interior. The Project is located within Ma'an Governorate.
Local Municipalities	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 located within the Greater Ma'an Municipality.
Royal Society for the Conservation of Nature (RSCN)	The RSCN is an environmental NGO. It is empowered to establish and manage protected environmental reserves as well as Important Bird areas under the supervision of the MoEnv.

3.4 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.

3.4.1 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.

3.4.2 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.

3.4.3 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.

3.4.4 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.

3.4.5 Obligations Relating to Membership of the International Labour Organization (ILO)

The International Labour 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 Labour Convention, 1930 (No.29) ratified 06:06:1966
- C 81 Labour 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 Labour 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 Labour 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 Labour 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 Labour Convention, 1999 (No.182) ratified 20:04:2000

3.5 Requirements for Project Financing

The Developer will be seeking financing for the Project from prospective lenders, including international Financial Institutions (IFIs) – mainly the International Finance Corporation (IFC). Therefore, 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.

In addition to the Performance Standards, the IFC has the EHS Guidelines, which contain technical performance levels and measures related to environmental, health, and safety that are normally acceptable to IFC. There are general EHS guidelines which are applicable to all projects and sector specific guidelines.

However, there is no sector specific Guidelines for Solar Projects as opposed to other renewable energy such as Wind Farm Guidelines.

Table 8: Overview of IFC Performance Standards of Social and Environmental Sustainability

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: Labour 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 Labour 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.
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.

Where the IFC are investors in a Project, as part of their review of environmental and social risks and impacts of a proposed investment, they use a process of environmental and social categorization. The same categorization is also applied under Equator Principles (EP) III (June 2013) by Equator Principle Financial Institutions (EPFIs). The category also specifies IFC's institutional requirements for disclosure in accordance with IFC's Access to Information Policy. The main applicable categories are:

- Category A: Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented;
- Category B: Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures; and
- Category C: Business activities with minimal or no adverse environmental or social risks and/or impacts.

It is considered that the Arabia One Solar PV Power Plant Project is likely to be categorized as a Category B project.

4. ESIA APPROACH & METHODOLOGY

This chapter of the Environmental and Social Impact Assessment (ESIA) describes the approach and methodology used to assess the environmental and social impacts of the Project. The chapter describes the ESIA assessment methodology, including:

- 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).

4.1 Screening, Scoping & Assessment

The ESIA process for the Project has followed the environmental clearance process outlined in Chapter 3, as summarized below:

- ***Location/Site Approval Permit & Screening Decision:*** the Central Licensing Committee has approved the site for the development of the Project conditional that a comprehensive EIA study is undertaken before commencement of any construction or operational activities;
- ***Scoping Phase:*** the scoping session for the Project was held on 16 June 2014. In addition, the Scoping Report/ToR was submitted to the MoEnv on 3 July 2014 and was approved on 17 July 2014.
- ***Assessment Phase:*** The assessment phase has been carried out in accordance with the ToR submitted to the MoEnv. This ESIA report is the output of this assessment for submission to the MoEnv for approval.

4.2 Analysis of Alternatives

The "Environmental Impact Assessment Regulation No. (37) of 2005" requires that the ESIA shall identify and analyze alternatives, including project site, process and technological alternatives, the no project alternatives etc., and present the main reason for the preferred choice. The examination of alternatives is 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 application of the environmental and social mitigation hierarchy (avoid; reduce; mitigate and manage; and compensate and offset) was considered throughout the Project development process and as part of the consideration of alternatives.

The analysis of alternatives is presented in Chapter 5. This Chapter investigates and compares several alternatives to the Project development in relation to: i) the Project site, ii) the chosen technology, iii) the Project design, and finally investigates the 'no action alternative' – which assumes that the Project development does not take place.

4.3 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. The previous and planned future stakeholder consultation and engagement for the Project is presented and discussed in detail in Chapter 6.

The "EIA Regulation No. (37) of 2005" requires that for those projects which the MoEnv requires a comprehensive EIA study, a scoping session must be held from the onset of the EIA for all stakeholders whom may be potentially affected by the Project. In addition, the "IFC Performance Standard 1" (IFC, 2012) sets out certain recommendations for stakeholder engagement.

The stakeholder consultation and engagement for the Project to date has included both: (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 was held on 16 June 2014 and included stakeholder groups such as national governmental entities, local governmental entities, non-governmental organizations, academic and research institutions, and local community representatives.

The detailed engagement and consultation has focused on a single entity within a stakeholder group at a given time. The detailed engagement includes specific consultations with certain key stakeholder entities whose concerns need to be taken into account throughout the ESIA study. Such detailed engagement and consultation included:

- **Local community consultation**. This includes the closest community settlement to the Project site whom are likely to be affected by the Project development, and which include Ma'an City (the capital of the Governorate) and which is located 9km to the northwest from the Project site and Al-Mahata Village located approximately 6 km from the Project site.

  The consultation session was held on 28 May 2014 and included representatives of local community members, Community Based Organizations (CBO), local academic institutions, local enterprises and businesses, women groups, youth and the unemployed, and elder representatives of tribal groups.

- **Other stakeholder engagements**. This mainly includes consultations with certain groups (governmental organizations, NGO's, etc) whose specific concerns needed to be taken into account throughout the ESIA. Such engagement plans included communication protocols such as bi-lateral meetings, e-mail communication, phone communication, formal letters and other. Such engagements have taken place all throughout the ESIA study.

The Chapter also discusses future stakeholder engagement and consultations which are to take place and which mainly include the following:

- The disclosure of the ESIA to stakeholders with regards to the findings and recommendations proposed within the ESIA study. This mainly includes the following: the disclosure of the ESIA, Non-Technical Summary (NTS), and Stakeholder Engagement Plan (SEP) on the Developer's website, and the distribution of the NTS and SEP to key local community members and key stakeholders for review; and
- The implementation of the Stakeholder Engagement Plan (SEP) by the Developer. The SEP is presented in Annex I. The SEP for the Project describes the planned stakeholder consultation activities and engagement process.

The ESIA, Non-Technical Summary, and SEP will be disclosed on the Developer's website and as it is considered that the Project is likely to be categorized as a Category B project it will be disclosed for a minimum of 30 day disclosure period.

4.4 Delineation of Study Boundaries and Scope of Assessment

4.4.1 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 red in Figure 6 below.

However, for the assessment of the individual environmental and social parameters (infrastructure and utilities, air and noise, 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. 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. For the purpose of the social assessments, the Study Area was determined by consideration of the potential effects on the nearby local communities which mainly includes Ma'an City and Al-Mahata Village.

It is important to note that the Study Area does not cover the off-site associated works to be undertaken by NEPCO, and which are mainly related to the construction of the substation and connection to the national grid through the High Voltage overhead line – which is expected to be minimal given the proximity of the substation to the National Grid (around 500m north of the substation area). Details and information are not available or finalized at this stage by NEPCO – which include methods of construction, layout of substation, finalized and detailed grid connections plans and route for the overhead lines, etc.

Such offsite activities are not considered due to the fact that details and information are not available (e.g. grid connection plans, route for overhead lines, etc). Nevertheless, within Chapter 10, a set of Environmental Performance Requirements have been identified which must be considered by NEPCO. Such performance requirements aim to ensure that environmental issues are taken into account and adequately considered.

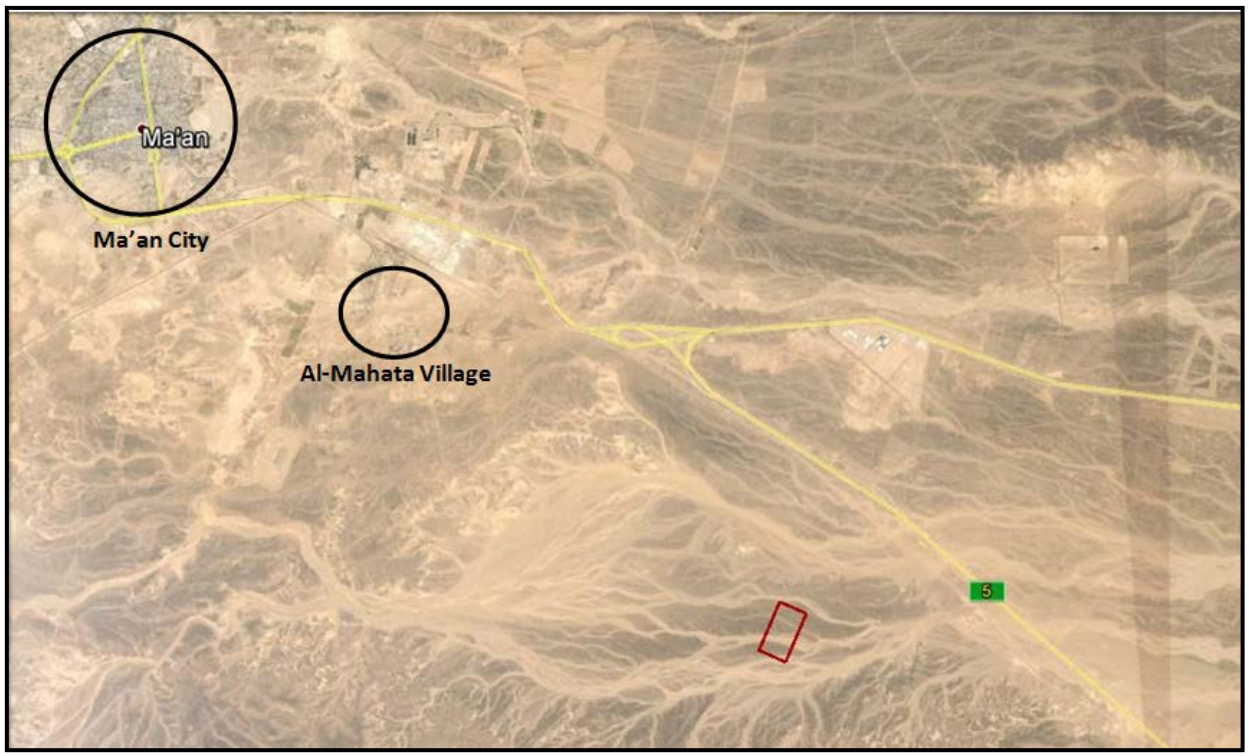

Figure 6: Study Area

4.4.2 Temporal Scope of the Assessment

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

- Planning & Construction Phase;
- Operation Phase; and
- Decommissioning Phase.

Potential impacts are assessed throughout the various Project phases as defined below. As noted earlier, the scope for assessment of impacts is mainly for those onsite activities which will be undertaken within the Project site throughout the various phases. However, there are additional anticipated offsite impacts which are mainly related to the construction of the substation and connection to the national grid through the High Voltage overhead line which are not taken into account due to lack of information at this stage. Nevertheless, within Chapter 10, a set of Environmental Performance Requirements have been identified which must be considered by NEPCO.

(i) Planning and Construction Phase

This includes onsite 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 *onsite site preparation and construction activities* for installation of PV arrays, internal access roads, buildings, switchgear.

(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 PV Plant and the routine maintenance activities (e.g. PV module cleaning, inverter servicing, checks on structural integrity, etc.).

(iii) Decommissioning Phase

It is not clear at this point whether at the end of the lifetime of the Project (where according to the agreement between the Developer and MEMR is set for 20 years) MEMR would take ownership of the Project and continue operating it or whether the Project will be completely decommissioned. Should MEMR decide to continue to operate the Project, then in this case, the Project is expected to operate for an additional five years (given that the PV modules lifetime is 25 years) or could decide to completely decommission the Project. Nevertheless, in the case of the complete decommissioning of the PV farm, decommissioning activities could include the disconnection of the various Project components (PV arrays, inverter cabins, etc) for final disposal. In addition, tracks used for maintenance vehicles will be restored and gates and fences will be removed.

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 noise, 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 the relevant section. However, impacts which are clearly specific to the decommissioning phase only (e.g. disposal of panels at end of life) have been clearly identified and assessed throughout this chapter.

4.5 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 as defined within the Terms of Reference Report. 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 in the Chapter 7 and include the following: Landscape & Visual; Land Use; Geology & Hydrology; Biodiversity; Archaeology; Air Quality & Noise; Infrastructure & Utilities; Socio-economic. Within the Chapter, the methodology which was undertaken for assessment of the each of those baseline conditions is described in detail.

4.6 Impact Assessment Methodology

The impact assessment is presented in Chapter 8. Given the scale and type of the Project, the Chapter 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.

It then moves forward into the main body of the ESIA undertaking the assessment of impacts on environmental and social parameters 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.

4.6.1 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 environmental 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.

4.6.2 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.

4.6.3 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 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.

4.6.4 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'.

4.6.5 Mitigation

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 minimise 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. However, as noted throughout this ESIA there are no significant residual effects which require compensation or offsetting.

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. Moreover, for positive impacts it is not possible to identify mitigation measures, but rather recommendations have been identified which aim to enhance the positive impact.

4.6.6 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*.

As noted throughout this ESIA, the effect of all impacts assessed will be reduced to insignificant levels. Residual effects are discussed for each environmental and social theme in the ESIA chapters, and their significance determined and summarized in an Impact Assessment Table.

4.7 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.

Taking the above into account, the assessment of cumulative impacts will mainly include those anticipated impacts from the various PV development projects which will take place within the Solar Park, over an area of 5,000 Dunums. The Solar Park Area will be developed by a total of 9 developers (including this Project) for a total generation capacity of 160 MW.

4.8 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, MoEnv, and other responsible parties.

5. PROJECT JUSTIFICATION AND ALTERNATIVES

The "Environmental Impact Assessment Regulation No. (37) of 2005" requires that the ESIA shall identify and analyze alternatives, including project site, process and technological alternatives, the no project alternatives etc., and present the main reason for the preferred choice. The examination of alternatives is 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 the decision-making process.

This chapter summarizes the Project's approach to the application of the mitigation hierarchy during the development of the Project. Furthermore it presents the analysis of certain alternatives to the Project development in relation to: (i) the Project site, (ii) the chosen technology, (iii) the Project design, and finally investigates (iv) the 'no action alternative' – which assumes that the Project development does not take place.

5.1 Application of Mitigation Hierarchy

The application of the environmental and social mitigation hierarchy (avoid; reduce; mitigate and manage; and compensate and offset) was considered throughout the Project development process. A summary of such mitigation hierarchy for certain key environmental and social issues is summarized below and discussed throughout this Chapter.

1) Land Use Issues. The original location identified for the Solar Park area in a land area used by local cooperative associations for olive tree plantation throughout the past ten (10) years. Approximately 200-300 Dunums have been planted with olive trees by those associations, although the land belongs to the Public Treasury. However, in order *to avoid* any potential issues with the local community and/or disrupt or affect their activities in the area, the proposed new Project site location was selected for the Solar Park.

According to MDC, the current Solar Park area has been allocated after ensuring that those lands provide no use value to the locals. Those lands belong to the Public Treasury and have been transferred to the MDC under the approval of the Council of Ministers. This was done in coordination with the Department of Lands and Survey and the Treasury Lands Directorate as well as a "State Property Committee" which includes representatives of the local governmental institutions which are aware of local settings and local community activities in the area – this includes the Governor of Ma'an, Director of Ma'an Lands Directorate, Director of Ma'an Agriculture Directorate, Director of Ma'an Health Directorate, etc.

In addition, as detailed later within Section 0, the 'ESIA Team' investigated the formal and informal land use of the current Project site. It was concluded that there is no conflict of the Project site in relation to the formal land use planning as set by the various governmental institutions (e.g. Ministry of Municipal Affairs, Ministry of Environment, Ministry of Agriculture, etc.). In addition, the 'ESIA Team' also investigated the informal land use and whether the current Solar Park area is of any specific value to the local community (e.g. agricultural activities, nomadic/semi-nomadic settlements, etc). Based on the above, it was also concluded that the Project site is considered of no specific value to local communities.

2) Water Requirements. PV modules require regular cleaning in order to prevent dust build up which in turn could affect their output capacity. Generally, panels are cleaned through the use of water resources. The Project has considered as an alternative the cleaning of the panels through a 'dry' brush cleaning mechanism which does not entail the use of water to *reduce water consumption* levels of the Project during the operation phase and maximizes water efficiency measures.

However, such an option was not possible to utilize. The panels that will be utilized for the Project have an anti reflective coating layer to capture maximum sunlight and to minimize reflections. Dry brushing the panel with anti reflective coating will cause scratches over the surface of the modules which will subsequently affect the generation output negatively especially considering the long-term plant operation.

3) ***Flood Risks*.** A wadi system runs within the Project area known as Wadi Aqeeqa. Thus, the Project site is subject to potential risk of local flood hazards during the rainy season and especially during flash flood events which in turn could inflict damage to the Project and its various components.

   Taking the above into account, another location could be selected outside of wadi systems to eliminate such risks. However, as discussed earlier, the Solar Park area is part of the MDA and was established based on a decision by the Council of Ministers, in which the Project area has been specifically zoned for the development of such PV Projects – in accordance with the Master Plan of the MDA. Thus, such an impact cannot be avoided.

   Nevertheless, as discussed in further details later in Section 8.4.1, in order to reduce such an impact a Flood Risk Study needs to be undertaken in which the general objective is to determine flood quantities within the Project site and peak flood estimates. Based on that, the Study must aim to provide recommendations to minimize the impact and mitigate flood risks, and which also aim to maintain the natural drainage patterns of the area. Such recommendations will be taken into account by the Developer throughout the detailed design of the Project.

4) ***Other Issues*.** One of the objectives of this ESIA is the identification of any environmental and social constraints on the site specific level which must be taken into account by the Project developer throughout the planning and design phase of the Project. Such constraints could include amongst others: possible onsite archeological resources of significant value, critical habitats which must be protected, infrastructure and utilities restrictions, etc. However, as presented throughout the ESIA, no site specific constraints have been identified in relation to the Project site which needs to be taken into account throughout planning and design phase of the Project.

   In addition, as noted throughout this ESIA study, the significance of the anticipated impacts from the Project are generally minor. Furthermore, appropriate mitigation and management measures have been identified for such impacts, and there are no significant residual effects predicted which would require compensation or offsetting.

5.2 Site Selection Alternatives

As discussed earlier, the Solar Park area is part of the MDA, which was established based on a decision by the Council of Ministers, and in which the Project area has been specifically zoned for the development of such PV Project – in accordance with the Master Plan of the MDA.

There are several factors which ensure that an optimal location has been chosen with regards to a solar PV Project development, and those include the following:

1) ***Ideal Solar Resources:*** according to the National Energy Research Center (NERC), the southern region represented by Ma'an and Aqaba have the highest solar isolation in Jordan and the lowest values of diffuse irradiance. Such areas have an annual average daily global irradiance between 6-4 kWh/m^2. In addition, the average sunshine duration is more than 300 days per year. Such characteristics make the Project site an ideal location for solar PV Project.
2) ***Proximity to Grid***: the Project site is around 1.8km from the existing 132kV transmission line, with which it will connect through a substation (located around 500m from the existing 132kV transmission line) with overhead lines. This substantially decreases the distance required for transmission line connections, which in this case is kept to a minimum. Besides reduced costs, this would avoid environmental impacts associated with the construction of new transmission lines.
3) ***Proximity to Road Network:*** the project site is around 1.5km from a major Highway (Highway #5). This substantially reduces the need for access roads to the Project site which in this case is kept to a minimum. Besides reduced costs, this would avoid environmental impacts associated with the construction of roads.

4) ***Natural Landscape of the Site:*** PV solar developments generally require flat surface for the installation of the various Project components to include the PV arrays. The Project area in general can be characterized as being dominantly of fairly flat surfaces and therefore site preparation and earthwork activities are not expected to be substantial.

5) ***Distance to Key Sensitive Receptors***: the Project site in general is located at a reasonable distance from any key potential sensitive receptors which includes community settlements, environmental sensitive areas, grazing reserves, airports, etc.

From the factors mentioned above, it can be concluded that the Project site, to some extent, offers the ideal factors for the development of a solar PV Project.

Nevertheless, another location was considered for the Solar Park area by the MDC (part of which is this Project). The alternative site was located around 1.5km to the north of the current site as presented in the figure below. This site was initially next to the MDC Industrial Park.

However, this site was disregarded so that the activity of the local community in the area is not affected or disrupted. Based on investigations by the MDC, the disregarded site has been in use by local cooperative associations of Ma'an city for olive tree plantation throughout the past ten (10) years. Approximately 200-300 Dunums have been planted with olive trees by those associations, although the land belongs to the Public Treasury. Nevertheless, to avoid any issues with the local community, the Solar Park area has been relocated to its current location.

In addition, as detailed within Section 7.2 the 'ESIA Team' investigated the formal and informal land use of the current Project site. It was concluded that there is no conflict of the Project site in relation to the formal land use planning as set by the various governmental institutions (e.g. Ministry of Municipal Affairs, Ministry of Environment, Ministry of Agriculture, etc.). In addition, the 'ESIA Team' also investigated the informal land use and whether the current Solar Park area is of any specific value to the local community (e.g. agricultural activities, nomadic/semi-nomadic settlements, etc). Based on the above, it was also concluded that the Project site is not considered of any specific value to local communities.

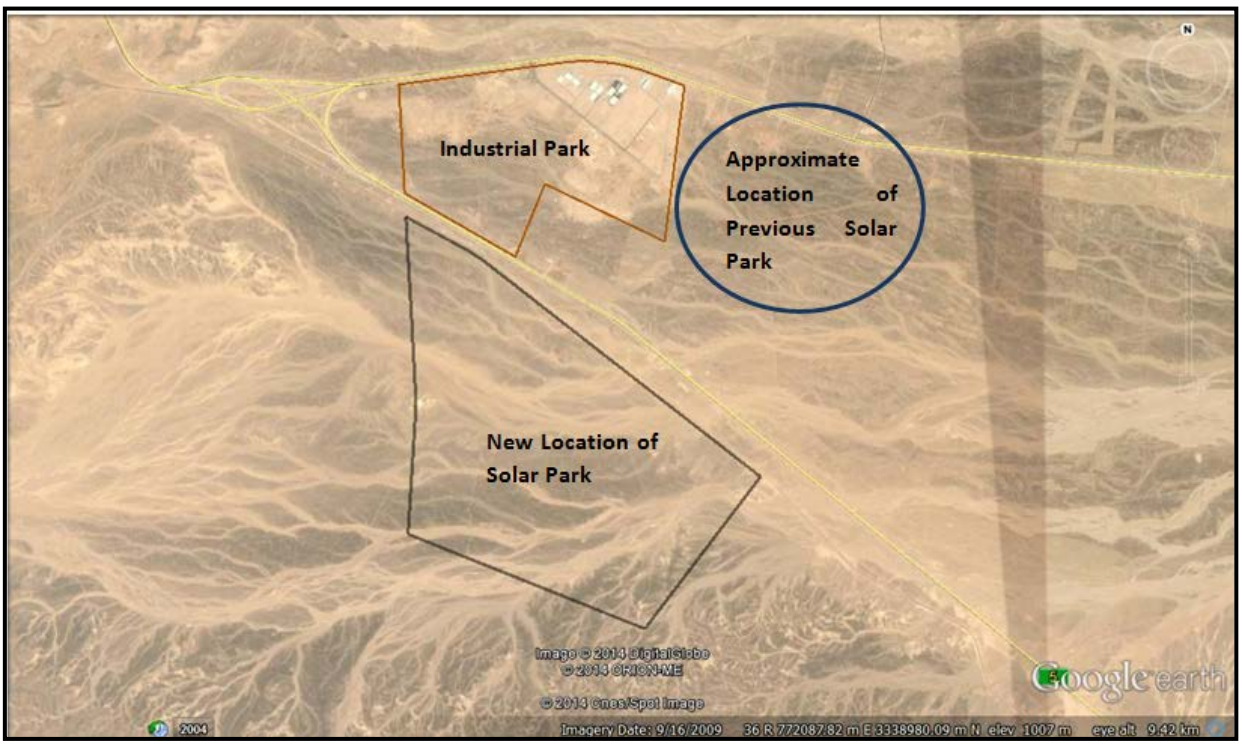

Figure 7: Previous Solar Park Location

5.3 Technological Alternatives

This section discusses several alternatives besides the development of a solar PV project. This mainly includes other renewable energy alternatives (mainly wind power) and thermal power plants.

(i) Wind Technology Alternative

MEMR have installed wind measurement systems throughout the Kingdom to undertake wind measurement campaigns. The objective is to assign promising locations for wind farm developments throughout the Kingdom, and the outcome was a comprehensive map which denotes such areas. As noted in Figure 8 below, such areas are mainly limited to the Northern and Southern parts of Jordan.

In addition, Figure 8 presents the Solar Park area location relevant to those promising locations for wind farm developments. As noted in the figure, the Solar Park area is located outside those areas. Therefore, the natural characteristics of the Project site are likely to be considered unsuitable for the development of a feasible wind farm at a commercial scale.

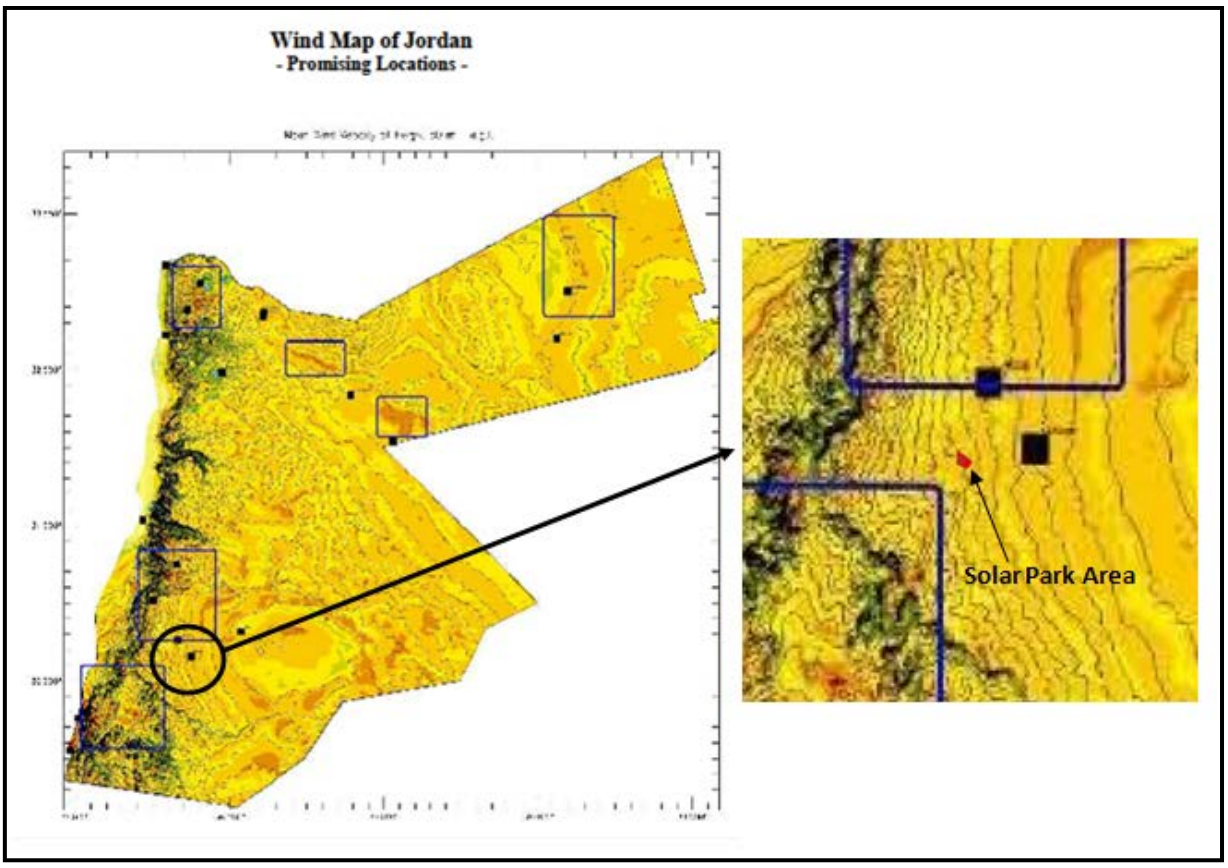

Figure 8: Wind Map of Jordan with Promising Locations

In addition, from an environmental stand point of view, wind farms are associated with other environmental impacts when compared to PV development projects. Apart from general impacts similar to those associated with PV development projects as discussed throughout this ESIA (biodiversity, archeology, air quality and noise, occupational health and safety, etc), wind farm developments are associated with other more important impacts. This includes the following: (i) impacts on birds from risks of strikes and collision on both migratory and resident soaring birds, (ii) community health and safety impacts related to noise and shadow flicker caused by operating turbines, and (iii) visual impacts as turbines are tall structures that can be seen from several kilometers away and impose a change on the landscape of the area where they are installed.

(ii) Thermal Power Plant Alternative

Other energy generation alternatives suitable to be built in Jordan include thermal power plants which are fuelled with natural gas or 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. Thermal power plants are well known for their environmental impacts when compared to this Project and could include significantly higher water consumption, generation of air pollutants and green house gas emissions, noise generation, etc. More importantly, such developments would not be in line with the Government of Jordan's "Master Strategy of Energy Sector in Jordan" 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.

5.4 Project Design Alternatives

One of the objectives of this ESIA is the identification of any environmental and social constraints on the site specific level which must be taken into account by the Project developer throughout the planning and design phase of the Project. Such constraints could include possible onsite archeological resources of significant value, critical habitats which must be protected, infrastructure and utilities constraints restrictions amongst others.

However, as presented throughout the ESIA, no site specific constraints have been identified in relation to the Project site, which need to be taken into account throughout planning and design phase of the Project. Therefore, there are no design alternatives to be considered in relation to environmental issues.

In addition, as noted throughout this ESIA study, the significance of the anticipated impacts from the Project are generally minor. In addition, as presented throughout this ESIA, appropriate mitigation and management measures have been identified for such impacts, and there are no significant residual effects which would require compensation or offsetting.

Nevertheless, several other project component alternatives were investigated with the Developer which is mainly related to the PV modules cleaning process. PV modules require regular cleaning in order to prevent dust build up which in turn could affect their output capacity. Generally, panels are cleaned through the use of water resources. The Project has considered as an alternative the cleaning of the panels through a 'dry' brush cleaning mechanism which does not entail the use of water to *reduce water consumption* levels of the Project during the operation phase and maximizes water efficiency measures.

However, such an option was not possible to utilize. The panels that will be utilized for the Project have an anti reflective coating layer to capture maximum sunlight and to minimize reflections. Dry brushing the panel with anti reflective coating will cause scratches over the surface of the modules which will subsequently affect the generation output negatively especially considering the long-term plant operation.

5.5 The 'No Project' Alternative

The 'no project' alternative assumes that the 10MW 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 –a desert-like habitat that is barren and mostly covered with Chert Pebbles, with few vegetation strips scattered mainly within the wadi system. In addition, the land use of the area would most likely remain as is; unused and uninhabited.

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 issues of concern and can be adequately controlled and mitigated through the implementation of general best practice management measures. Nevertheless, should the Project not move forward, then the significant and crucial positive economic and environmental benefits would not be realized. Such benefits have been previously discussed and 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 realising 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 this ESIA concludes to be minor in nature and can be adequately mitigated. The comparison in this chapter clearly concludes that the 'no project' alternative is not a preferable option.

6. STAKEHOLDER CONSULTATION AND ENGAGEMENT

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 International Finance Corporation's (IFC's) Policy on Environmental and Social Sustainability and Performance Standards. 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 requirements with affected people, and is designed to be both fair and inclusive. Consultation activities have been underway since the commencement of the ESIA in April 2014.

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.

6.1 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:

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

6.2 Requirements & Policy Requirements for Stakeholder Engagement

6.2.1 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, 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 (NGOs), (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 – taking into account the type and nature of the project development.

6.2.2 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) will 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 Project is likely to be categorized as a Category B project under the IFC requirements, it will be disclosed for a minimum of 30 days.

6.3 Stakeholder Identification & Analysis

The Project has been identifying potential stakeholders since it began the development of the ESIA program in April 2014. 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 people and organisations 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 (see below).

- Other Interested Parties, defined as people and organisations that are interested in the Project and/or could affect the Project in some way.

6.3.1 Affected Communities

The affected communities have been identified based on a detailed understanding of the Project site location and its administrative setup in addition to discussions with the concerned local authorities (i.e. the Social Development Unit of Ma'an Governorate).

The Project site is located within Ma'an Governorate and specifically within the District of Qasabit Ma'an and within the Greater Ma'an Municipality. The closest community settlement to the Project site, and those whom are likely to be affected by the Project development include Ma'an City (the capital of the Governorate) and which is located 9km to the northwest from the Project site and Al-Mahata Village located approximately 6km from the Project site as presented in Figure 9 below.

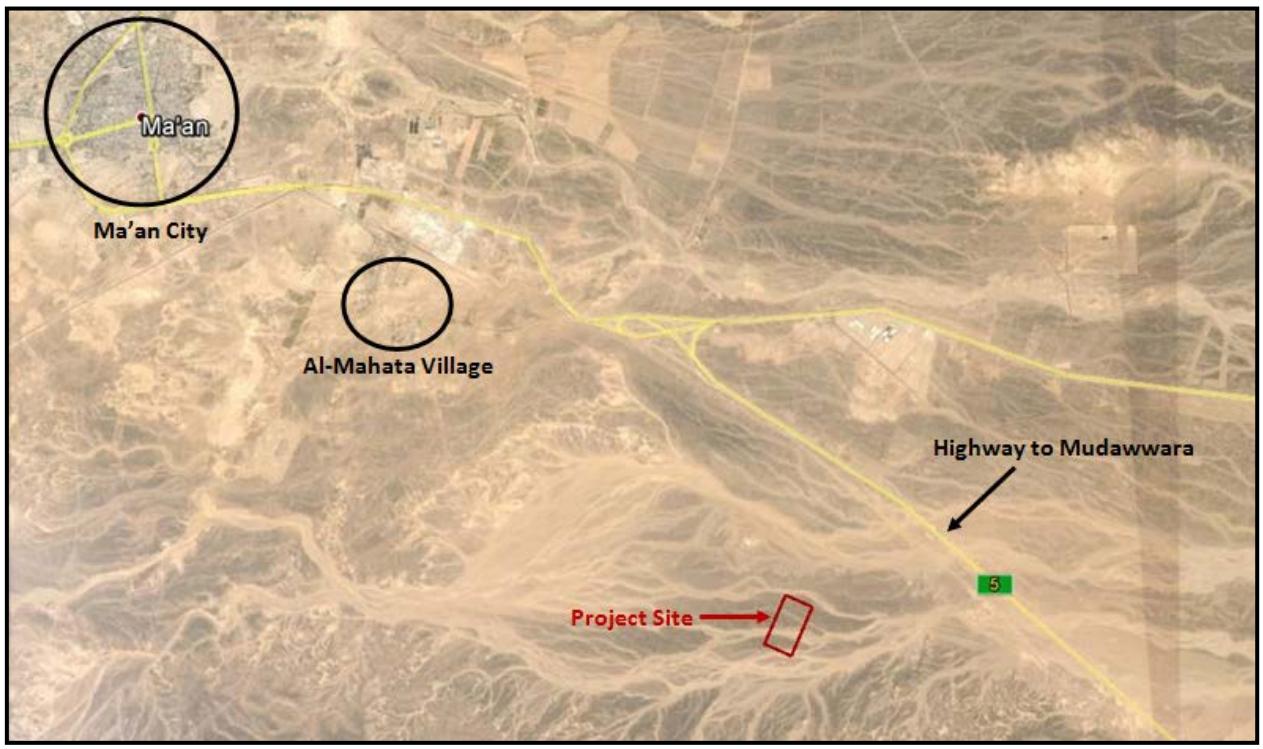

Figure 9: Nearby Local Communities

Representatives from the local communities were engaged and consulted throughout the ESIA study through a targeted consultation session which was held on 28 May 2014, headed by the Mayor of Ma'an Municipality.

The representatives were selected by the ESIA Team, SDU of Ma'an Governorate, and MDC to include the following groups:

- Representatives of local community members;
- Community Based Organizations (CBO);
- Local academic institutions;
- Local enterprises and businesses;
- Women groups;
- Youth and the unemployed; and

- Elder representatives of tribal groups.

Refer to Section 6.4.2 for additional details on the objective and outcome of this consultation session.

6.3.2 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.

Such stakeholder groups were mainly identified by the 'ESIA Team' and the MoEnv and were mainly consulted through the scoping session which was held for the Project on 16 June 2014 (refer to Section 6.4.1 below for additional details). In addition, some of those stakeholder groups were engaged in more details through specific engagement plans as those had specific concerns which needed to be taken into account throughout the ESIA (refer to Section 6.4.3 for additional details on those stakeholder groups and the objective for additional engagements).

(i) Jordanian Governmental Stakeholders (National and Local)

National and local government stakeholders include Ministries, Directorates, and other agencies whom 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 authorisation of the Project and assist in its delivery.

More specifically, it is important to note that the majority 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.

Generally, the objective of consultations with such entities was to introduce the project and its various components, and allow them to participate in the process of scoping of environmental impacts from the Project and address any concerns and fears they might have regarding the Project development.

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. Other governmental stakeholders which were consulted throughout the ESIA are presented in Annex II.

Table 10: List of Key Governmental Stakeholders

Governmental Entity	Interest in/influence on the Project
National Governmental Entities	
Ministry of Environment	The official governmental entity 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.
Development and Free Zones Commission (DFZC)	The Project is located in a Development Area which is administratively under the responsibility of the DFZC. In specific to this Project is issues related to land use as Development zones are established based on a decision by the Council of Ministers, and once defined, the land parcels owned by the Public Treasury are transferred to the ownership of the DFZC.
Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ)	The official 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 Agriculture (MoA)	The official 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 official 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 Energy and Mineral Resources (MEMR)	The overall regulator for the development of the private sector renewable energy projects in Jordan to include this Project in specific.
Ministry of Health (MoH)	The official 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 to include waste management, wastewater management, etc.
Ministry of Tourism and Antiquities (MoTA)	The official body responsible for tourism development and protection of antiquities in Jordan. For this project, this mainly includes potential impacts relate to archeology and cultural heritage related to the Project.
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 the potential of glare from the PV modules.
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 the potential of glare from the PV modules.
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 of 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.
Greater Ma'an Municipality	The official governmental body responsible for providing infrastructure and utility services to Ma'an such as waste collection, street and road maintenance, public lighting, etc. For this Project this mainly includes issues related to nuisance prevention from the Project to include waste management, wastewater management, traffic, etc.
Ma'an Development Company (MDC)	Master Developer of the MDA whom is responsible for managing, planning, and developing the area. For this Project, the MDA is responsible for providing a land area as well as the development and supply of the necessary infrastructure and utility elements. A key issue in relation to this Project is land use issues and understanding how Solar Park area was allocated for PV developments.
Aqaba Railway Corporation	The official governmental body responsibilities for operation, management, and maintenance of the Aqaba railway which runs close to the project site. For this project this could include issues related to damage/disturbances to the railway from the project activities.

(ii) Non-Governmental Organizations and Academic Institutions

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

Similarly, the objective of consultations with such entities was to introduce the project and its various components, and allow them to participate in the process of scoping of environmental impacts from the Project and address any concerns and fears they might have regarding the Project development. The key organizations and institutions which were consulted are summarized in the table below. Other organizations and institutions which were consulted throughout the ESIA are presented in Annex II.

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	The RSCN is an environmental NGO responsible 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.
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.
Jordanian Hashemite Fund for Human Development	The NGO is dedicated to promoting rights-based sustainable human development in Jordan. For this project this mainly includes issues related to socio-economic development of the local communities from the Project.
Al-Hussein Bin Talal University	An academic institution located within the Project area (specifically around 18km from the Project site). For this project this mainly includes issues related to socio-economic development of the area in general.

6.4 Stakeholder Consultation & Engagement To-date

The stakeholder consultation and engagement for the Project to date has included both:

- High level consultations; and
- Detailed engagement and consultations.

The high level consultation mainly includes the scoping session, and which is considered high level as various stakeholder groups representing various entities 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. The detailed engagement includes specific consultations with certain key stakeholder entities whose concerns need to be taken into account throughout the ESIA study. Such detailed engagement and consultation included:

- Local community consultation; and
- Other stakeholder engagement both of which are discussed in details below.

6.4.1 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 MoEnv, the Scoping Session for the Project was held on 16 June 2014 at the Holiday Inn Hotel in Amman. The list of invitees was identified jointly by the MoEnv and the 'ESIA Team'.

The list of invites mainly included the following stakeholders: (i) national governmental entities (e.g. various Ministries, Civil Aviation Regulatory Commission, etc), (ii) Local Governmental Agencies (e.g. Ma'an Municipality, Ma'an Governorate, Aqaba Railway Corporation, local government institution such as Ma'an Water Directorate, etc), (iii) Non-Governmental Organizations (environmental and social development), (iv)

Academic and Research Institutions (e.g. Al-Hussein Bin Talal University), and (v) local community representatives which were identified in collaboration with the Social Development Unit of Ma'an Governorate.

Annex II presents the full list of invitees, list of attendees, and the agenda for the scoping session. Selected photos from the session are shown in Figure 10 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:

- A welcome speech by **Mr. Izzat Abu Hamra, Director of Licensing Directorate at the MoEnv.** Mr. Abu Hamra started by welcoming the attendees to the scoping session, after which he briefly explained the purpose of the session and stressed on its importance as it aims to take into account the concerns and comments of stakeholders throughout the ESIA study. In addition, Mr. Abu Hamra discussed and emphasized the importance of renewable energy projects to Jordan given the current challenges it faces in meeting its energy demands.
- A presentation on the Project by **Mr. Tareq Khalifeh, Project Coordinator at Arabia One for Clean Energy Investments PSC and Mr. Jafar Azim Project Coordinator at MASE**. Mr. Khalifeh started by briefly discussing the profile of the Developer and then discussed representative projects undertaken throughout the world which are similar to this Project in specific.

  Mr. Azim then thoroughly discussed the Project details to include the following: (i) Project location, (ii) Project technology, (iii) main Project components, (iii) Project schedule and duration, and (iv) anticipated activities expected to take place during the Project's various phases.
- A presentation by **Mr. Ibrahim Masri, Consultant from ECO Consult.** Mr. Masri reiterated the objectives of the scoping session and then briefly discussed the environmental clearance process for the Project and explained the importance of this ESIA process in identifying the benefits of this Project to the country and weighing them against the implications on the environment and in designing mitigations for the impacts, which must be considered in the design and implementation of the Project. Mr. Masri discussed in details the anticipated negative and positive environmental and social impacts during the various Project phases and the methodology that will be adopted throughout the ESIA study for assessing those impacts.

  There was time for questions and answers following this presentation as well as a facilitated discussion, moderated by **Mr. Ra'ed Daoud, Managing Director of ECO Consult**.

It is important to note that the scoping session that was undertaken for this Project also included the developers of three (3) other PV development projects within the Ma'an Governorate area - which ECO Consult is also undertaking the ESIA study for. These Projects are listed below:

1. Projects located within the MDA:
   - Anwar Al-Ardh PV Power Plant Project – 20MW
   - Ard Al-Amal PV Power Plant Project – 10MW
2. A Project located west of Ma'an City:

- Scatec PV Power Plant Project – 10 MW

Such an approach was favored by the 'ESIA Team' and the MoEnv given that such projects are located within the same area and given that in general (at least from an environmental perspective) such projects are very similar in nature. Therefore, in order to avoid repetitiveness of such sessions with stakeholders (by taking a separate scoping session for each project), the 'ESIA Team' and the MoEnv agreed that the most suitable approach would be to undertake one scoping session for all those projects collectively. Additionally, this would give the chance for the ESIA Team and stakeholders to discuss the PV Projects at a macro-level taking the cumulative impacts into account. Differences do exist between each project in terms of modules, designs, management plans, etc. A sufficient time was given to each developer to present the projects and to answer questions from stakeholders on the project-specific technicalities.

Figure 10: Selected Photos from the Scoping Session

The following table presents the main issues raised by the stakeholders throughout the scoping session and also highlights how those comments were taken into account and incorporated throughout the ESIA study.

Table 12: Summary of Comments Raised during Scoping Session and Response

No.	Attribute	Comment	Response with ESIA
1	Landscape and Visual	A suggestion was raised regarding improving the area visually by plantation of trees within the Project site.	Such suggestions were discussed with the Developer. Generally, such suggestions would result in increasing the water consumption of the Project, but more importantly there could be technical limitations to such suggestions as trees could cast shadows on the area which in turn would affect the PV panel performance and electricity output, specially that the Developer is bound by a specific land lot area for their development. In addition, refer to Section 8.2.2 which asses the visual characteristics of the site and the potential impacts from the project on those visual receptors.
2	Land Use	A stakeholder stated that the ESIA must document the informal land uses of the area to include any activities of the local community such as grazing activities.	As detailed in Section 7.2.3 informal land uses of the area was investigated and documented to include the use of the land by local community members for agriculture, grazing, nomadic settlement, etc.
3	Geology and Hydrology	A question was raised regarding the potential for flood risks within the Project site, which could entail damage to the Project and its various components. In addition, questions were raised regarding what measures will be undertaken to mitigate such risks.	As detailed in Section 8.4.1, flood risks in the Project site are discussed and assessed and appropriate recommendations to manage such risks have been identified.
4	Biodiversity	A stakeholder inquired whether the ESIA will discuss potential impacts from the panels during operation on birds; mainly risks of collisions and strikes with the panels.	Section 7.4 provides a detailed baseline assessment of avi-fauna within the site. In addition, Section 8.5 investigates and assesses all potential impacts on avi-fauna throughout the various project phases and discusses proper mitigation measures to reduce such impacts to acceptable levels.
5	Infrastructure and Utilities	Some stakeholders inquired about the water requirements of the Project and how will they be supplied and managed	Section 7.7.2 characterizes in details the current water resources supplying the area and the water supply option to the project. In addition, Section 8.8.1 discusses the water requirements of the project and the water efficiency measures considered by the Developer and finally assess the impacts from project's water requirements on the local water resources in the area. In addition, the cumulative impacts from the water requirements of the other PV projects within the Solar Park was investigated and assessed in and is presented in Section 8.13.
6	Socio-economic development	A detailed discussion was undertaken by stakeholders regarding the socio-economic development expected from those projects for the area in terms of job opportunities, capacity building, as well as other social and economic benefits. In addition, several stakeholders stressed on the importance of the developer's involvement in capacity building and training of the local community for them to be involved in job opportunities during the construction and operation phase. Stakeholders also stressed on the lack of qualified	Section 7.8 investigates and characterizes in details the current socio-economic conditions of the area. In addition, Section 8.9 assess the anticipated positive impacts from the Project and discusses the current plans of the developer for contribution to local community and employment opportunities as well as other engagement plans (e.g. capacity building programs) and provides recommendations for enhancing such positive impacts. Finally, the ESIA also includes a Stakeholder Engagement Plan which is to be implemented by the developer during the various Project phases.

		training and capacity building programs in the Ma'an area.	

After the scoping session, a Scoping Report & Terms of Reference (ToR) was submitted to the MoEnv and which included the following components highlighted below.

- A brief description of the Project, the overall concept and components;
- The accrued environmental, economic, and social benefits of the project;
- The anticipated impacts which may arise during the various projects phases (planning, construction, operation, and decommissioning);
- Main outcomes of the scoping session and deliberations that took place to include a table that summarizes the raised concerns/comments/questions, and their response. In addition, details on invitees, attendees, and minutes of meetings are also presented; and
- The detailed methodology that will be adopted for the ESIA study.

The Scoping Report & ToR was approved by the MoEnv on 17 June 2014.

6.4.2 Local Community Consultation

The 'ESIA Team' has undertaken additional consultations with the local community of Ma'an through a consultation session which was held on 28 May 2014 at the Greater Ma'an Municipality Hall, headed by the Mayor of Ma'an Municipality.

It is important to note that the local community consultation that was undertaken for this Project also included the developers of five (5) other PV development projects within the Ma'an Governorate area - which ECO Consult is also undertaking the ESIA study for. These Projects are listed below:

3. Projects located within the Solar Park:
    - Shams Ma'an PV Power Plant Project – 50 MW
    - SunEdison Ma'an PV Power Plant Project – 20 MW
    - Anwar Al-Ardh PV Power Plant Project – 20MW
    - Ard Al-Amal PV Power Plant Project – 10MW
4. A Project located west of Ma'an City:
    - Scatec PV Power Plant Project – 10 MW

Such an approach was favored by the 'ESIA Team', SDU of Ma'an Governorate and the MDC given that such projects are located within the same area and given that in general such projects are very similar in nature. Therefore, in order to avoid repetitiveness of such sessions with the local community (by taking a separate consultation session for each project), it was agreed that the most suitable approach would be to undertake collaborative consultation for all six (6) developers which would avoid repetitiveness of engagement actions and plans with stakeholders and provide a more systematic and structured approach for local community engagement in a way that would also trigger macro-level discussions.

Such a consultation session focused on the local community which includes the closest community settlement to the Project site, and those whom are likely to be affected by the Project development, to include Ma'an City (the capital of the Governorate) and which is located 9km to the northwest from the Project site and Al-Mahata Village located approximately 6km from the Project site.

Generally, such a consultation aimed to take into account their thoughts and concerns on the Project development, while allowing the discussion to focus on slightly different angles (when compared to the scoping session) from more of a first-hand experience/practical, less-technical perspective.

The representatives were identified jointly by the 'ESIA Team', SDU of Ma'an Governorate, and MDC to include the following groups:

- Representatives of local community members;
- Community Based Organizations (CBO);
- Local academic institutions;
- Local enterprises and businesses;
- Women groups;
- Youth and the unemployed; and
- Elder representatives of tribal groups.

Annex II presents the full list of invitees and list of attendees. Selected photos from the session are shown in Figure 11 below.

In accordance with the above, the consultation session focused on four (4) main themes, each of which is discussed throughout this section.

Vulnerable Groups

The consultation session also targeted vulnerable groups of the local community. 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' along with SDU of Ma'an Governorate and the MDC. Such vulnerable groups include the following:

- Women groups - because of cultural norms in Jordan which could limit their participation in decision-making; and
- Youth and unemployed – given that one of the key socio-economic challenges facing the area is unemployment, the consultation aimed to take into account specifically the concerns of those groups into account.

Given the nature and location of the Project there are considered to be no additional vulnerable groups which would require special consideration throughout the consultation process and which could include groups which are expected to be disproportionally affected by the project impacts.

Figure 11: Selected Photos from the Local Community Consultation Session

(i) 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) structure of the Project, (ii) investment required to develop such a Project, (iii) amount of electricity produced from the Project, and (iv) utility requirements of the Project (mainly water requirements and how wastewater will be handled).

(ii) 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.

(iii) Discussion on Socio-economic Baseline Conditions

Within the ESIA, the socio-economic conditions of Ma'an were established based on review of secondary data available mainly from the Department of Statistics (DoS) and the Social Development Unit (SDU) of Ma'an Governorate. However, statistical data often does not fully represent the situation in reality and in some instances is not specific to those local communities identified.

Therefore, one of the objectives of the local community consultation session was to understand the main socio-economic challenges facing those communities which would allow a better understanding and characterization of the current socio-economic conditions. In addition, the consultation session also aimed to understand whether the Project area in general was considered of any value to the local community. The main outcomes the session includes the following:

- In general, one of the main socio-economic challenges facing Ma'an is unemployment. This is mainly attributed to the lack of governmental and private sector investment projects that can employ labour and thus positively impact unemployment levels in the area. In addition, the investment and development projects/programs that were targeted for Ma'an and which are supposed to improve the socio-economic conditions are generally weak and till today their benefits have not been realized by the local community. Several of those investment and development projects/programs failed to employ local community members (specifically in skilled labour) as such employment opportunities were generally targeted for people outside of Ma'an Governorate;
- The Lack of qualified training and capacity building programs in the area. Based on several past experiences by the local community, several Vocational Training Center's (VTC) were established with the objective of providing adequate training and capacity building for the local community in the hope of providing employment opportunities in such development projects. Such VTC's failed to deliver the required set of skills and qualifications to local community, and thus they were not employed within such development projects as they were considered incompetent. Similar expectations were held by the local community with regards to the renewable energy VTC which was recently established by the MDC ; and
- The Project area in general is not considered of any specific value to the local community as it is not utilized for certain activities such as agriculture. In addition, the Project area is not known for nomadic/semi-nomadic settlements – in general, in Ma'an Governorate, nomadic settlement is in Wadi Araba (located around 40km west of Ma'an city) and Al-Jafr (located around 30km to the east of Ma'an city).

(iv) 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.

In general, the local communities were supportive of such a Project and understood its importance to Jordan. Nevertheless, they also emphasized on the important role of the Developer in engaging and building trust with the local community members to the greatest extent possible.

To this extent, summarized below are the main points raised by the local community in relation to their expectations in terms of socio-economic development.

- From the onset of the Project, the developer is expected to identify the number of job opportunities targeted to the local community throughout the construction and operation phase (to include skilled and unskilled job opportunities). The developer is expected to provide in details the qualifications required for each job opportunity;

- There must be a transparent recruitment procedure for the local community members which provides an equal opportunity for all, including females;
- Given the local community past experiences in VTC's (as discussed earlier), they required that the Developer be directly involved and contribute to the VTC's training and capacity building program to ensure that local community are equipped with the required skills and qualifications to be involved in job opportunities throughout the Project;
- Commit to hiring labour from the VTC throughout the construction and operation phase; and
- The local community has several expectations from the Developer in implementing additional social responsibility actions. Several suggestions were raised such as: (i) installation of residential PV systems for local community facilities (such as governmental buildings, mosques, schools, hospitals, etc) (ii) provide scholarship programs for students, (iii) support academic institutions (such as Al-Hussein Bin Talal University) in developing academic programs and degrees in PV and renewable energy.

6.4.3 Summary of 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 13 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. Annex II presents in details the contact details of the person from the various entities discussed below.

Table 13: List of Other Consultations during the ESIA

Entity	Attribute	Objective of Consultation
Ministry of Environment (MoEnv)	General	Discussion on general concerns and impacts from Project development.
	Infrastructure and Utilities	Collection of information on hazardous waste landfills and discussion on disposal plans for the Project at decommissioning phase.
Ministry of Agriculture (MoA)	Land Use	Current and future land use planning in relation to agriculture.
Ministry of Municipal Affairs (MoMA)	Land Use	Current and future land use planning in Project area as set by MoMA.
Ministry of Water and Irrigation (MWI)	Geology and Hydrology	Collection of secondary data on site geology and hydrology.
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.
	Biodiversity	Discussion on biodiversity issues related to the Project to include methodology for baseline assessment, anticipated impacts, any concerns over the project site and development, etc.
BirdLife International – Middle East Regional Office, Jordan	Biodiversity	Discussion on biodiversity issues related to the Project in particular related to avi-fauna (methodology for baseline assessment, anticipated impacts, any concerns over the project site and development, etc).
Civil Aviation Regulatory Commission (CARC)	Landscape and Visual	Collection of data on nearby airports and discussion on potential impacts from the Project.

Royal Jordanian Air Force (RJAF)	Landscape and Visual	Collection of data on nearby airports and discussion on potential impacts from the Project.
Ma'an Governorate	Socio-economic	Understand thoughts, views, and concerns from the Project development.
		Collection of secondary data on socio-economic indicators for Ma'an Governorate in general and nearby communities. In addition, detailed meetings were undertaken to characterize and understand the socio-economic conditions in reality.
	Land Use	Discuss and document the actual land use of the Project site and its nearby areas to determine whether it was considered of any value or utilized for any purpose by local community members.
Ma'an Municipality	Infrastructure and Utilities	Collection on information on existing municipal approved landfills.
Aqaba Railway Corporation (ARC)	Infrastructure and Utilities	Collection of data on existing railway, discussion on potential impacts from the Project, and discussion on proposed mitigation measures.
Ma'an Development Company (MDC)	Infrastructure and Utilities	Collection of secondary data on infrastructure and utilities (water, wastewater, road networks, etc),
	Archeology	Collection of secondary data available on archeology (Department of Antiquities Survey Report on Solar Park Area)
	Land Use	Collection of secondary data available on land use planning for the Ma'an Development Area
	Socio-economic	Socio-economic development and plans for local community engagement.
Ma'an Chamber of Commerce	Socio-economic	Understand thoughts, views, and concerns from the Project development and collection of secondary data on socio-economic indicators for Ma'an Governorate.
Dr. Fares Khoury - Faculty Member and Chair of Biology and Biotechnology Department at the American University of Madaba (AUM)	Biodiversity	Discussions on the ecological significance of the Project site and significance of anticipated impacts from the Project.
Dr. Zuhair Amr - Faculty Member and Head of the Department of Applied Biological Science at the Jordan University of Science and Technology (JUST)	Biodiversity	Discussions on the ecological significance of the Project site and significance of anticipated impacts from the Project.

6.5 Future Stakeholder Engagement & Consultation

Future stakeholder engagement and consultations mainly include the disclosure of the ESIA and the implementation of the Stakeholder Engagement Plan (SEP) by the Developer. Both are discussed in additional details below.

6.5.1 Disclosure of Documentation

The ESIA, Non-Technical Summary (NTS) and 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;
- Social Development Unit of Ma'an Governorate;
- Greater Ma'an Municipality; and
- Ma'an Development Company (Amman and Ma'an office).

The ESIA, NTS and SEP will be disclosed for a minimum 30 day disclosure period. Finally, the' ESIA Team' in coordination with the MoEnv will send the NTS and SEP to all key stakeholders. The list of stakeholders will be identified jointly by the MoEnv and the 'ESIA Team'. This will include all the stakeholders invited to the scoping session as well as other stakeholders consulted during the making of this ESIA. In addition, the 'ESIA Team' will specifically coordinate with the Social Development Unit of Ma'an Governorate to send the NTS and SEP to key local community representatives as well as inform the local community that the documents are available at the locations mentioned above.

6.5.2 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 is presented in Annex I.

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. ENVRIONMENTAL AND SOCIAL BASELINE CONDITIONS

This Chapter investigates the environmental and social baseline conditions within the Project site for the parameters/receptors identified below. For each receptor, the parameter specific methodology adopted for the assessment has been identified, followed by a detailed description of the outcomes and results. This has followed the generic approach and Study Area, where applicable, outlined in Chapter 4.

- Landscape and Visual;
- Land Use;
- Geology, hydrogeology, and Hydrology;
- Biodiversity;
- Archeology;
- Air Quality and Noise;
- Infrastructure and Utilities; and
- Socio-economic conditions.

Impacts on the above parameters are considered within Chapter 8 along with impacts related to Occupational Health and Safety (OHS) and Community Health, Safety, and Security (CHSS).

7.1 Landscape and Visual Characteristics

This section presents the landscape and visual characteristics of the Project site and surrounds.

7.1.1 Baseline Data Collection Methodology

The baseline data collection assessment of the Project site was based on a site visit by the 'ESIA Team' which aimed to characterize the landscape, topography, and visual character of the Project site. In addition, based on understanding of the potential impacts from the Project (as discussed in further details in Section 8.2.2), the most important critical visual receptors which could be affected within the area have been identified (which includes civil/military airports, environmental reserves, recreational activities, etc.). This involved communications with the relevant authorities, which mainly include the Civil Aviation Regulatory Commission (CARC), Royal Jordanian Air Force (RJAF), MoEnv, and the Royal Society for Conservation of Nature (RSCN).

7.1.2 Landscape and Topography

The Project area in general can be characterized as being dominantly of fairly flat surfaces, with an elevation generally between 1,015 m – 1,020 m above sea level.

A wadi system intersects within the Project site and which runs from the western part of the site to the eastern parts. In addition, the site can be classified as a desert-like habitat that is barren and mostly covered with Chert Pebbles, while few vegetation strips can be found scattered mainly within the wadi system. Figure 12 below presents the general topography and landscape of the Project site along with the limited vegetation coverage within the wadi system.

Figure 12: General Topography and Landscape of the Project Site

7.1.3 Visual

Views from the Project site towards the north are limited to the following:

- Highway #5 which runs from Ma'an city towards the Saudi Arabian Border (Mudawwara Border) and which is located around 1.5km from the site;
- High Voltage National Grid Network (132kV Transmission Line) which runs around 1.8km from the site;
- Railway which runs around 1.4km from the site; and

- Industrial Park in which several industrial establishments are operating and which is located around 3km to the northwest.

Figure 13 below presents the view from the Project site towards the north with all 4 receptors discussed earlier being visible and in particular the Grid Network and the Industrial Park.

Figure 13: Views to the North from the most Northern Part of the Project Site on Highway, Grid, Railway, and Industrial Park

View from the site towards the south, east, and west are limited to the desert stretch as noted in Figure 14 below.

Figure 14: Typical Views towards the South, East, and West

The classification of the value of the visual character of a site is highly subjective and depends on the viewer and on the usages that the area is subject to. However, the Project area in general is not known for any key sensitive visual receptors within the surrounding vicinity, and in fact is considered close to an Industrial Park in which several industrial establishments are operating; for what its aesthetical value loses some importance.

Within the Project area in general and its surroundings there are no recreational activities, environmental reserves, remarkable historical or cultural sites, water courses or other natural structures normally seen as valuable by the human perception. In addition, as part of the visual character, important receptors which would be impacted by the Project have been investigated (as discussed in details in Section 8.2.2). This most importantly includes any civil or military airports and/or landing strips. Based on communication with CARC and the JRAF, it is concluded that there are no airports/landing strips within the area or its vicinity; the closest civil airport is the King Hussein International Airport located around 100km to the southwest, while the closest military airport is in Al-Jafr located around 40km to the northeast.

7.2 Land Use

This section presents the land use, including both formal and actual, of the Project site and surrounds.

7.2.1 Baseline Data Collection Methodology

The baseline assessment of the 'formal' land use was based on collection of secondary data and plans available from the relevant governmental entities - to include Ministry of Municipal Affairs (MoMA), MoEnv, Ministry of Agriculture (MoA), DFZC and MDC, and others.

Understanding and characterizing the informal or 'actual' land use of the Project site was mainly based on discussions with the relevant local authorities (mainly the Social Development Unit (SDU) of Ma'an Governorate), consultations with the local community (refer to Section 6.4.2), and many site visits undertaken by the 'ESIA Team to the Project area in general.

7.2.2 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, (iii) forest lands and grazing reserves planning by MoA, (iv) Development Area planning by the DFZC and MDC.

(i) Land Use Planning by MoMA

The Project might conflict with the allowed land use set for the area by the 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 designates 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. Therefore, in 2006 a project to prepare a land-use map for such areas (which lie outside the organized boundaries) 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.

The Project site is located within Ma'an Governorate but outside the organized boundaries of Ma'an City. Figure 15 below presents the location of the Project site and the land use plan set within the National Land Use Master Plan of 2007.

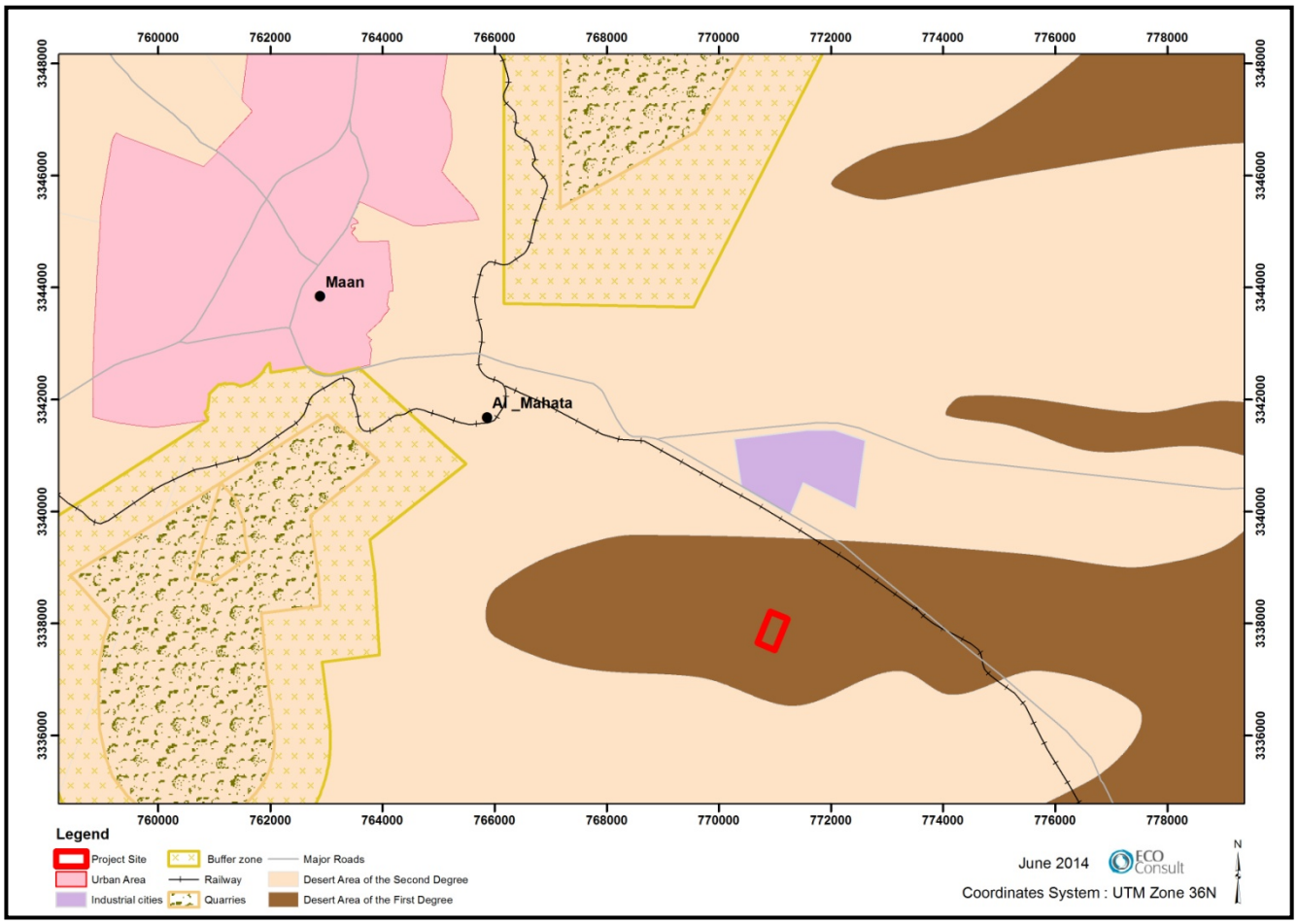

Figure 15: MoMA National Land Use Master Plan for the Project Site

The pink area includes urban areas within organized boundaries of Ma'an city with assigned land use categories in the "Law for the Organization of Cities, Villages and Buildings No. 79 for 1966". The rest are areas outside land use planning boundaries and are considered as areas outside planning zones with assigned land use categories set in accordance with the Regulation No. 6 of 2007.

According to Figure 15 above and the Regulation No. 6 of 2007, the Project site is classified as a Desert Area of the 1st Degree (D1) which, is described in Article [9(a)–1] of the Regulation as "areas that can be exploited during the rainy season and are suitable for grazing, especially in the those areas located in Wadis, and it is not allowed to set up any permanent or temporary installations to ensure the protection of public safety". However, the Article [9(b)–7] of the Regulation specifically says "In those areas (referring to areas classified as Desert areas (D including D1)) the following land use are allowed: wire and wireless telecommunication stations and electric power generation facilities with associated transmission and distribution networks".

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 the development of such a Project.

In addition, within the surrounding area of the Project site the National Land Use Master Plan also identifies the following:

- An Industrial area just north of the Project Site (known as the Industrial Park) and which is discussed in further details under land use planning by the DFZC and MDC; and
- Existing operating quarries licensed a long time ago by the Natural Resources Authority (NRA). As presented within Figure 15 there are two (2) main quarries; the first lies approximately 7km west of the Project site with an area of approximately 20km^2 and a buffer zone of 25km^2 where no activities or settlements are allowed to ensure public safety, while the second lies approximately 5km to the north of the Project site with an area of approximately 53km^2 with a buffer zone of 51 km^2. Those quarries are

mainly involved in the quarrying of sand, gravel, and crushed stone (aggregates) used for building construction purposes.

(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 natural 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 a number of 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 (IBA's): areas proposed within "Important Bird Areas of the Hashemite Kingdom of Jordan".

Taking the above into account, the RSCN has prepared a comprehensive plan that identifies the location of the reserves and IBA's discussed above. Figure 16 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 Project area or its immediate surroundings; there are no established, under establishment, proposed reserves or IBA's. A number of preservation areas exist further away from the Project site with the closest delineation being around 15km away; those include three (3) IBA's – Jerba (34km northwest), Petra (38 km northwest), and Wadi Abu Tarfa (15km south) and one (1) proposed reserve – Al-Shobak (49 km northwest).

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

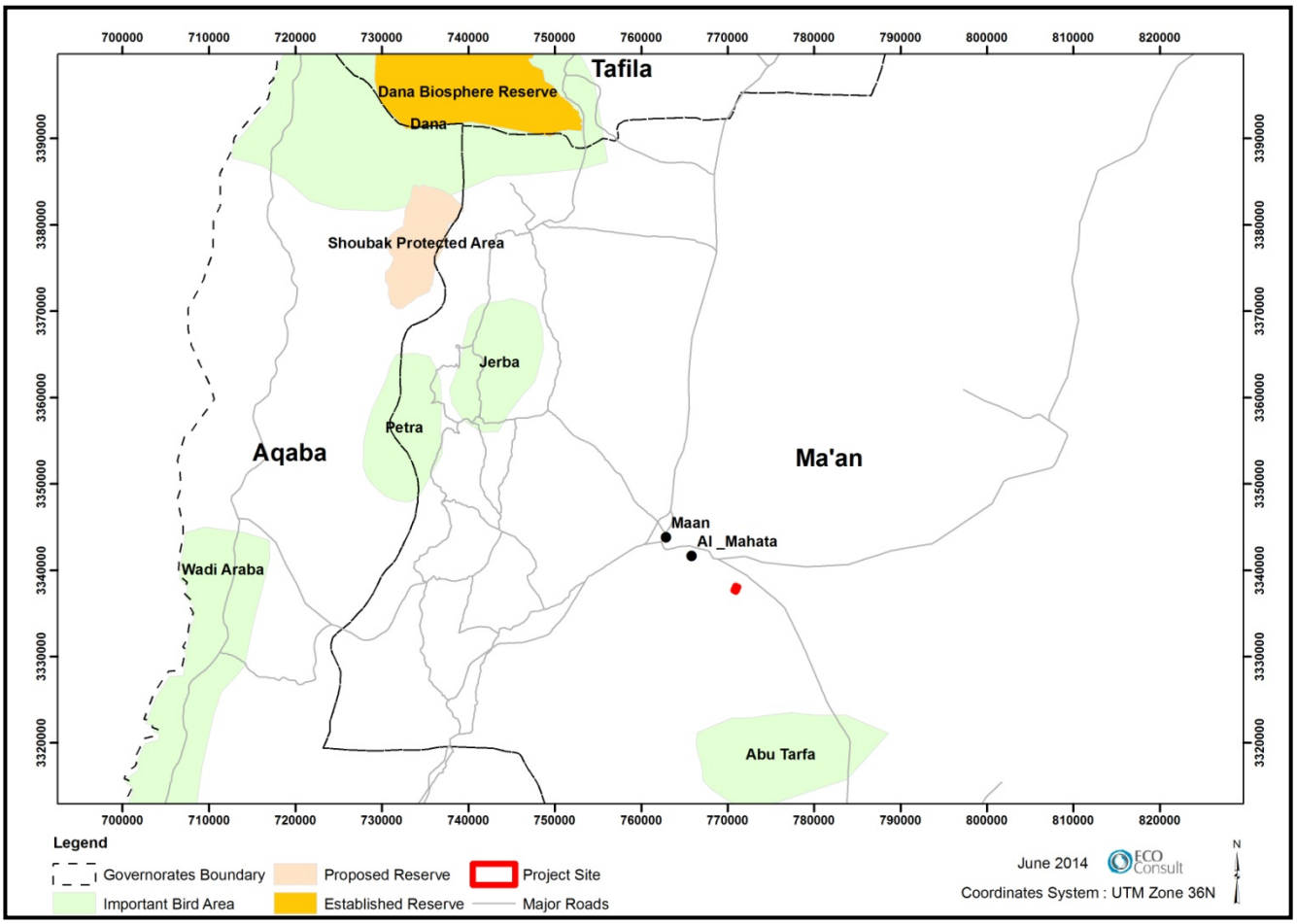

Figure 16: Areas of Critical Environmental Concern in Relation to Project Site

(iii) Forest Lands and Grazing Reserves 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 forest lands and/or grazing reserves of the MoA.

The MoA has been consulted on the above. According to discussions with the Rangeland Directorate, there are no forest lands within or in the surrounding area of the Project site. However, grazing reserves exist and this was investigated further as detailed below.

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. In addition, through establishing grazing reserves, the Ministry also aims to improve and develop the socio-economic conditions of local communities within the area through the creation of immediate job opportunities and collaboration with communities in terms of management and operation of the reserve.

Within the area, only one grazing reserve exists; known as 'Al-Mdawara Grazing Reserve' located approximately 5km southeast of the Project site. This reserve was established in 1992 and is around 20,000 Dunums of which only 1,000 is currently developed for grazing. The reserve is cultivated with pasture vegetation for the local livestock raisers in the area to use as grazing lands. Figure 17 below presents the location of 'Al-Mdawara Grazing Reserve' in relation to the Project site.

In addition, there are four (4) planned areas to be established as grazing reserves in the Kingdom for an additional area of 60,000 Dunums. From those, only one is located in Ma'an Governorate and specifically in Al-Jafr Sub-district located approximately 50km northeast of 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 forest lands and grazing reserves. The Project Site is not located within currently established or planned forest lands or grazing reserves.

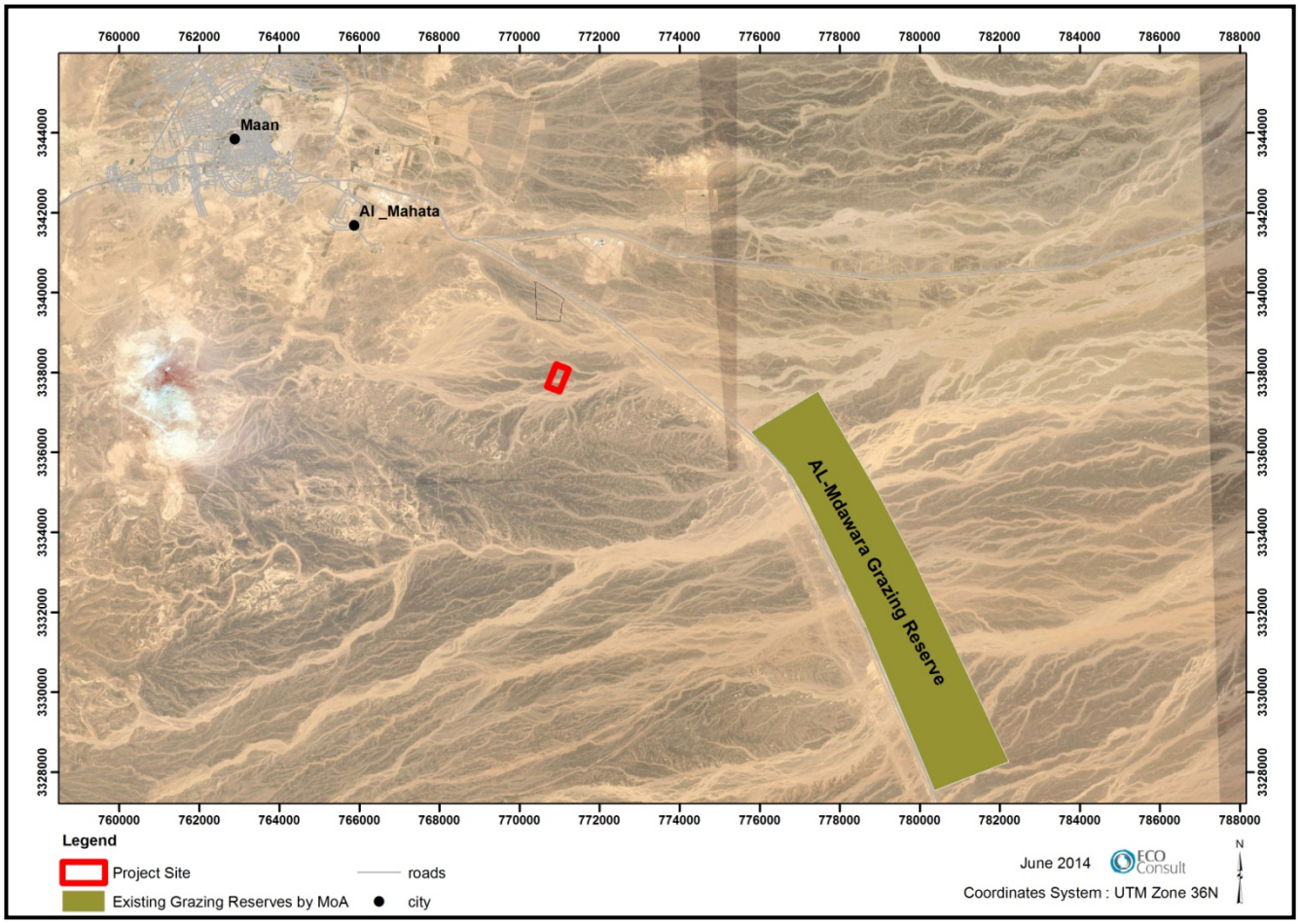

Figure 17: Location of MoA Grazing Reserve in Relation to Project Site

(iv) Development Areas Planning by the DFZC and MDC

In his quest to further improve social and economic conditions in Jordan, reduce regional disparities, provide jobs, and establish the Kingdom as a regional business hub, his Majesty King Abdullah II set in place an ambitious vision for the future of his country that seeks to leverage Jordan's major assets in attracting investors and tourists, and instituting an investment climate conducive to business and entrepreneurship.

To help fulfill His Majesty's vision, in 2008, Development Zones were established to enhance the economic capacity in Jordan through attracting investments and creating a proper investment climate for economic activities aiming to bring social and economic prosperity to all Jordanian citizens.

Within Development Zones in Jordan the regulatory authority in charge is the Development and Free Zones Commission (DFZC); an independent administrative and financial authority connected directly to the Prime Minister. In accordance with the "Development and Free Zones Law No. (2) of the year 2008", Development and Free zones are established based on a decision by the Council of Ministers, and once Development and Free Zones boundaries are defined, the land parcels owned by the Public Treasury are transferred to the ownership of the DFZC.

Among the regions chosen to host a Development Area is the city of Ma'an, in the South of Jordan; known as the Ma'an Development Area (MDA).To this extend, Ma'an Development Company (MDC) was established with the vision of developing MDA into an engine of economic growth for the South of Jordan, while preserving its cultural and religious heritage and enhancing the living environment for its inhabitants and elevating the standards of living in Ma'an.

To this extent, a Master Plan has been prepared for the MDA which specifies five (5) different yet complementary clusters that cover approximately 9 km^2 of surface area. The clusters have been conceived in a way to create synergy between them and leverage the unique attributes of each, while being tailored to the needs of local and regional markets, rendering MDA an all-inclusive and unique area offering some of the region's most advantageous incentives to investors. Those clusters are summarized in Table 14 below. Of those clusters, the most important would be the Industrial Park and the Solar Park which are further discussed below.

Table 14: Ma'an Development Area Clusters

Cluster	Description
Solar Park	Discussed in details below
Industrial Park	Discussed in details below
Residential Community	A real estate and infrastructure cluster that will include employees housing, residential areas, community services (parks and open landscape), and local commercial facilities. The Residential Community is located around 7km to the northwest of Ma'an city.
Skill Development Center	Education and training cluster that will include skill development center as well as residential areas, community services (parks and open landscape), and local commercial facilities. The Development Center is located within Ma'an city.
Hajj Oasis	A hospitality and accommodation cluster that will includes facilities for religious tourism as well as residential areas, community services (parks and open landscape), and local commercial facilities. The Hajj Oasis is located around 10km to the north of Ma'an city.

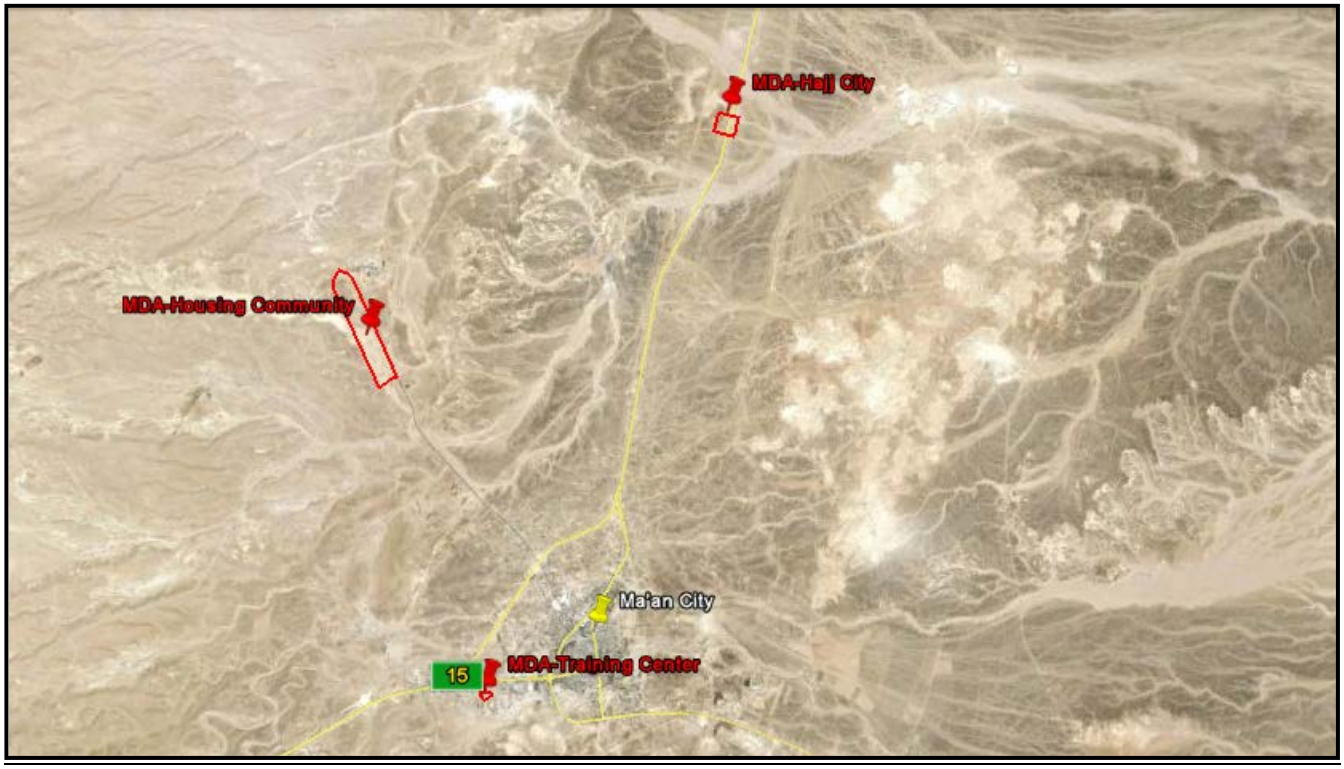

Figure 18: Location of the Clusters of the MDA

The Industrial Park

The Industrial Park spreads across 2.5 km², including an area of 750,000 m² that is already fully functional and equipped with a complete infrastructure. Located to the east of City of Ma'an, the Industrial Park will cater to a wide variety of industries (light, medium, and heavy) and be home to an important number of manufacturing and production plants. It will also offer housing and recreational facilities to low income workers, reducing the cost for investors and the burden on workers from having to commute to work.

The Industrial Park will house several industrial facilities to include mixed concrete and construction supplies facilities, a leather tannery, and glass factory (already operating within the Park), and other planned facilities for production of water and juice, cigarettes, ceramics, plastics, marble, granite, and electrical appliances and others. The Park is currently served with the following infrastructure and utilities:

- Existing road network that will be upgraded to serve the future planned industries in the Park;
- Existing wastewater treatment plant for sewerage as well as industrial wastewaters provided they are pre-treated on-site at the respective factories for the removal of toxic and hazardous pollutants. It involves settling, conventional biological treatment, sludge handling and disinfection to produce irrigation water; The current capacity of this facility is 700 m^3/d with a possible expansion to 2,100 m^3/d, and currently receives between 150 – 200 m^3/d; and
- A water storage tank of 1,500 m^3 capacity with another elevated storage tanks of 450 m^3 for distribution.

The Solar Park

The Master Plan of MDA envisions renewable energy investments and in particular solar energy projects. Therefore, an area of approximately 5km^2 has been allocated for Solar PV developments and which is located around 1.5km to the south of the Industrial Park. The Developer has been allocated an area of 0.2km^2 for their 10MW Project, while the remaining 4.8km^2 will be developed by eight (8) other companies.

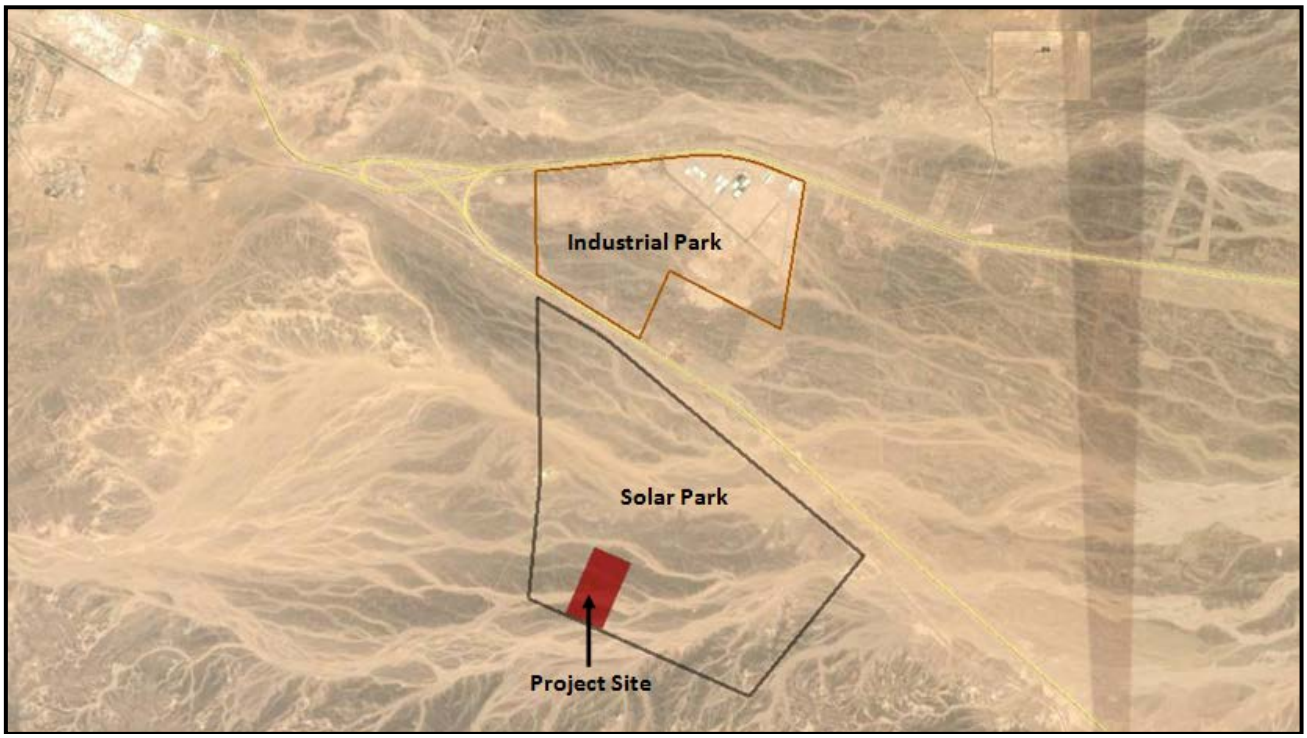

Figure 19: The Solar and Industrial Park in MDA

7.2.3 Actual Land Use

The actual land use of the Project site was investigated by the 'ESIA Team'. This has been based on discussions with MDC, detailed discussions with the relevant local governmental entity (mainly the Social Development Unit of Ma'an Governorate), consultations with the local community (refer to Section 6.4.2), and many site visits undertaken to the Project area.

The actual land use of the site was investigated to indicate whether it was considered of any specific value or utilized for any specific purpose by the local community, to include agricultural activities, grazing activities, nomadic or semi-nomadic settlement, etc.

Based on the above, it has been concluded that the Project site is not considered of any specific value to local communities as detailed below.

1) As discussed earlier, according to the MDA Master Plan, the Solar Park was initially located at an area adjacent to the Industrial Park. However, according to discussions with the MDC, this site was disregarded so that the activity of the local community in the area is not affected or disrupted.

   Based on investigations by the MDC, the disregarded site has been in use by local cooperative associations for olive tree plantation throughout the past ten (10) years. Approximately 200-300 Dunums have been planted with olive trees by those associations, although the land belongs to the Public Treasury. Nevertheless, to avoid any issues with the local community, the Solar Park area has been relocated to its current location.

   According to MDC, the current Solar Park area has been allocated after ensuring that those lands provide no use value to the locals. Those lands belong to the Public Treasury and have been transferred to the MDC under the approval of the Council of Ministers. This was done in coordination and consultation with the Department of Lands and Survey, the Treasury Lands Directorate, as well as a "State Property Committee" which includes representatives of the local governmental institutions which are aware of local community activities in the area – this includes the Governor of Ma'an, Director of Ma'an Lands Directorate, Director of Ma'an Agriculture Directorate, Director of Ma'an Health Directorate, and others.

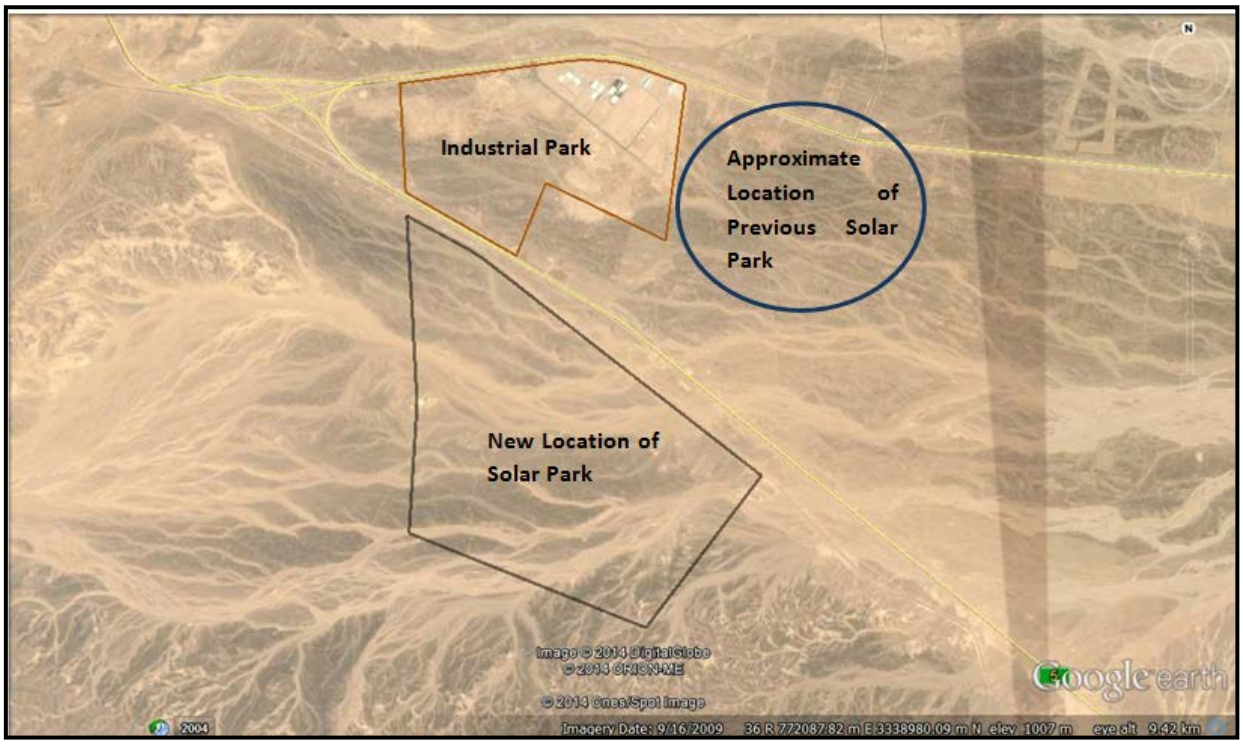

Figure 20: Previous Location of Solar Park where Local Community Activity Exists

2) Based on consultations with the SDU of Ma'an Governorate as well as consultations with the local community representatives (refer to Section 6.4.2) the Project area in general has no specific value to the local community. It was reconfirmed that are certain lands which are utilized by local communities for agricultural activities; the closest of which is located around 3km to the north of the Project site (where the Solar Park was previously located (Figure 20 above). As discussed earlier, that area has been used by local cooperative associations for olive tree plantation throughout the past 10 years, where approximately 200-300 Dunums are planted with olive trees by those associations.

3) Based on consultations with the SDU of Ma'an Governorate as well as consultations with the local community representatives (refer to Section 6.4.2) the issue of nomadic and semi-nomadic settlements in the area was investigated. Generally, the Project area is not known for nomadic/semi-nomadic settlements given the natural characteristics of the site (being desert area that is arid and barren with no water resources). In general, in Ma'an Governorate, nomads tend to move during the winter season to warmer areas such as Wadi Araba (located around 40km west of Ma'an city) or Al-Jafr (located around 30km to the east of Ma'an city). During spring and summer season, nomads tend to move to cooler areas with proper range lands to feed their livestock and to undertake agricultural and harvesting activities– which mainly include areas west of Ma'an city such as Al-Shobak and Al-Sherah (around 30km from Ma'an city).

4) Several site visits were undertaken by the 'ESIA team' for the Project site throughout study period in addition to many site visits to the Solar Park area for other ESIA studies which ECO Consult is undertaking for other PV Projects within the Solar Park. Throughout such site visits, no grazing activities or any other human activity was noticed nor was any evidence recorded, except once where camels were noticed to roam within the area in general.

   Based on investigations it was revealed that the camels belong to a local of Ma'an city whom has a small scale camel farm (around 20 camels) located around 5km from the Project site (Figure 21 and Figure 22 below). Discussions were undertaken with the shepherd at the farm and it was understood that the camels generally roam and graze within the area which could up to a distance of 30km. In some instances the shepherd tends to these camels but in other instances they are left to roam on their own. In addition, it was noted that grazing is not limited to the Project area per say as there is no specific value to the Project site; there are widespread alternative lands of similar habitat within the area which camels roam and graze in.

   Nevertheless, taking the above into account, it is highly unlikely that the Project site in specific is considered of any specific value in terms of grazing due to the following:

   a. The Ministry of Agriculture is responsible for establishing grazing reserves for sustainable grazing. As discussed earlier a grazing reserve exists approximately 5km southeast of the Project site which is cultivated with pasture vegetation for the livestock raisers to use as grazing lands;
   b. The natural characteristic of the Project site - being barren and mostly covered with Chert Pebbles with scattered vegetation strips within the wadi system only, limit its ability to be used as grazing grounds;
   c. Based on consultations with the SDU of Ma'an Governorate, the local community in general is not known for high activity of livestock raising. Such activities are more concentrated in other sub-districts of Ma'an Governorate such as Al-Jafr, Eel, and Al-Husseiniyeh;
   d. No indication of any grazing activities was noted within the Project site. Throughout the several site visits undertaken no fecal remains of livestock were noted. More importantly, along the wadis within the area in general there was relatively high coverage of Trefoil; a species widely known for being a highly palatable species that is heavily grazed by livestock when available. The Trefoil plants that were observed were completely dry and in seed-setting state, an indication that grazing has not taken place;

e. Even if grazing activities are to take place (which are likely to be very limited) there are widespread alternative lands of similar habitat extending within the area which can be used for grazing activities in addition to a grazing reserve; thus the development of the Project area per se is highly unlikely to affect grazing activities in the area.

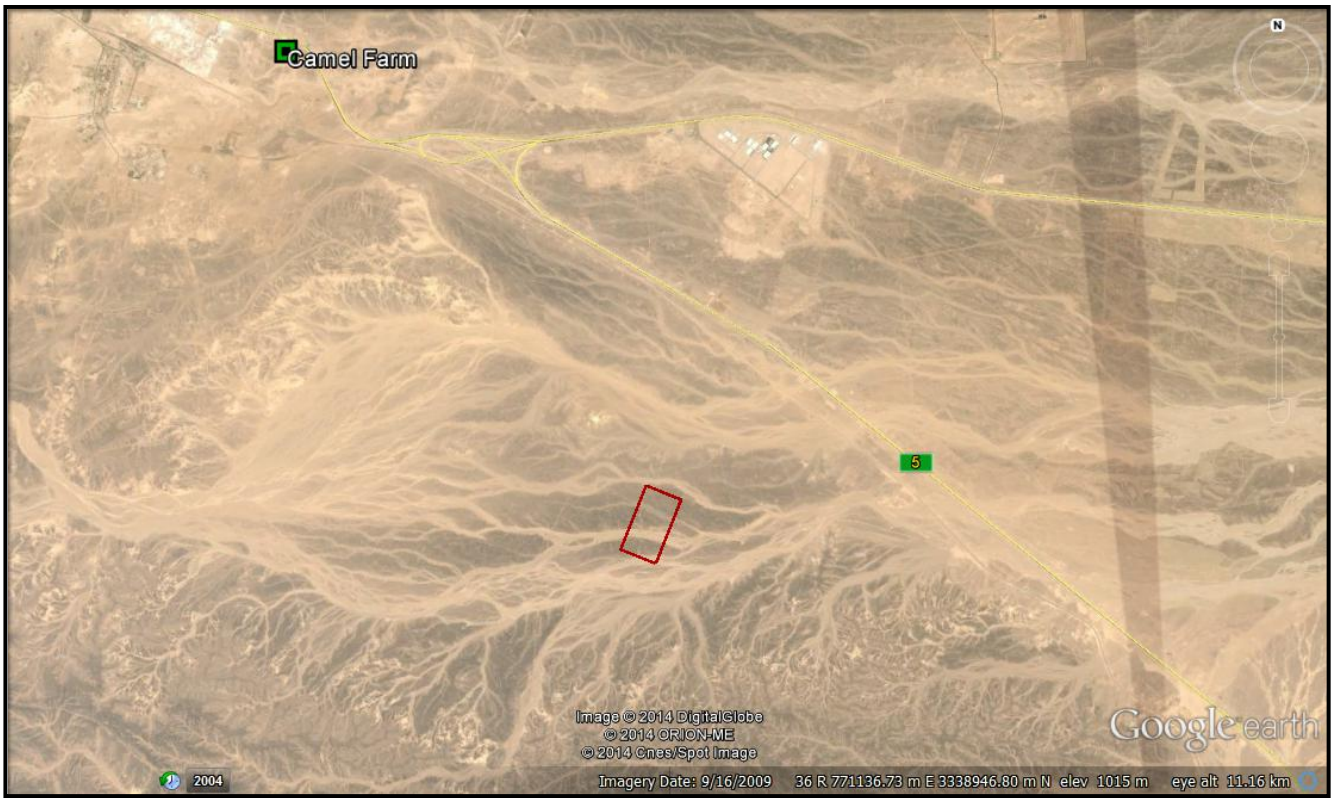

Figure 21: Location of Camel Farm in Relation to the Project Site

Figure 22: Camel Farm

7.3 Geology, Hydrogeology, and Hydrology

This section presents the geological and hydrological characteristics of the Project site and surrounds.

7.3.1 Baseline Data Collection Methodology

The assessment was based on review of secondary data available from the Ministry of Water and Irrigation (MWI). This mainly includes collections of records and data as well as review of studies from MWI – mainly the "Ma'an Water and Wastewater Master Plan" (CDM International, 2013) which investigates geological and hydro-geological conditions within Ma'an Governorate.

In addition, the assessment was also based on studies provided by the MDC and the Developer and which mainly includes the "Hydraulic and Hydrological Analysis Report for Ma'an Solar Panels"(Amman Consulting, 2013) which investigate the hydrological conditions within the Project area in general.

7.3.2 Geology

The bed rock outcropping in the investigated area is of sedimentary origin of Upper Cretaceous (Campanian to early Tertiary) as shown in Figure 23 below. In some places, the bed rock is covered by superficial deposits of Pleistocene to Recent age.

The lithological formations exposed on the geological map for the area location are as follows (from oldest formations to earliest):

- Muwaqqar Chalk-Marl Formation (MCM)

The outcrops of this formation are distributed in most parts of the area. The formation is distinguished by soft lithology with light tone and dendritic drainage pattern. Most exposures are obscured by talus or Pleistocene gravel, which give rise to absence of stratification.

- Fluviatile Deposits of Pleistocene Age (Pl)

The outcrops of these deposits occur predominantly in the central parts of the area. These poorly consolidated sediments consist mainly of 2-3 m thick level strewn plain occur as lateral terraces to present day drainage. It comprises angular, poorly sorted pebbles and gravels, mostly of black chert lithology, in a light brown silty to sandy matrix, sometime cemented by calcite or gypsum.

- Holocene to Recent Sediments (Al)

The sediments include alluvial and wadi sediments, which comprise angular to sub-rounded gravels ranging in size from pebbles to cobbles, and mostly with coarse-to fine-grained sand. Clasts are poorly sorted and ill-graded. The clasts comprise chert and limestone. These sediments fill the wadis and incised terraces comprising gravel and boulders at the base, and fine-to coarse-grained sand, at the top. Alluvial terraces are still preserved above incised wadis particularly.

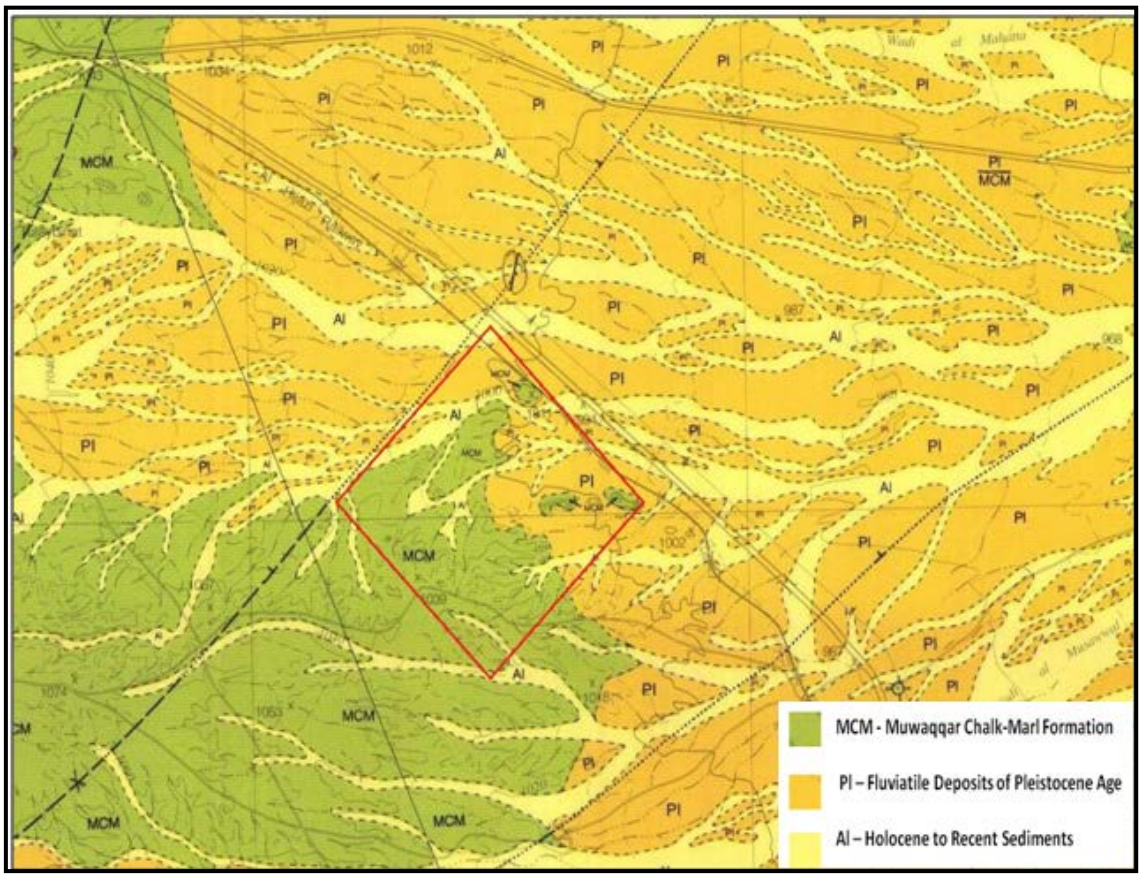

Figure 23: Geological Map of the Project Area

7.3.3 Hydrogeology

The Hydrogeology of the study area is controlled by the geological set-up, which also controls the piezometry, occurrence and movement of the ground water and the distribution of productive areas in the aquifers.

According to Ma'an Water and Wastewater Master Plan (CDM International, 2013), the Project area itself falls within Al-Jafer Groundwater Basin, which has a sustainable yield reported between about 500 and 1000 m^3/km^2/year. Based on reported 2009 data, abstractions totaled 30.6 MCM, well in excess of the sustainable yield. The renewable water component of this was estimated in the amount of 9 MCM/y in the upper portion which has surface communication that allows recharge. The balance of 21 MCM/y abstracted is considered non-renewable water resulting in aquifer depletion. Estimates are reported to suggest that the Al-Jafer basin could continue to supply 18 MCM/yr of non renewable water for a period of 50 years. Comparison of the 2009 total abstractions of 30.6 MCM in the basin with the total supply well abstractions of 9.2 MCM suggests 30 percent of the water abstracted is for potable water, the remaining is likely used for agriculture.

The main aquifer in the Project area is the Amman Wadi Es Aquifer system (the B2/A7 aquifer system). The Aquifer system has regional and economic importance for groundwater development as the majority of the wells in the Ma'an area are located within this aquifer. This aquifer is the most important in Jordan from a water supply perspective; it extends over most of the country, has high permeability and storativity, and receives significant recharge from precipitation. This formation consists of limestone, dolomite limestone, marl and chert. The B2/A7 aquifer system has been considered to be a semi-uniform aquifer unit with hydraulic connections, which are widespread in the entire Project area with thickness of 100 to 300m. The groundwater quality of the A7/B2 aquifer is good. The report notes an increasing trend in nitrate concentrations in the aquifer due to surface infiltration of agricultural fertilizers and wastewater.

7.3.4 Hydrology

The Project site is located within Al-Jafer surface water basin, which has an annual discharge of 13 MCM respectively. The sub-catchment area of the Project site (Figure 24 Below) extends more than 13 km to the west, where rainfall is around 80 mm per year. With the presence of relatively steep slopes, runoff will be triggered and generated along the main wadi heading from West to Northeast towards the Project site.

Figure 24 below presents the sub-catchment area in relation to the Solar Park from the "Hydraulic and Hydrological Analysis Report for Ma'an Solar Panels"(Amman Consulting, 2013).

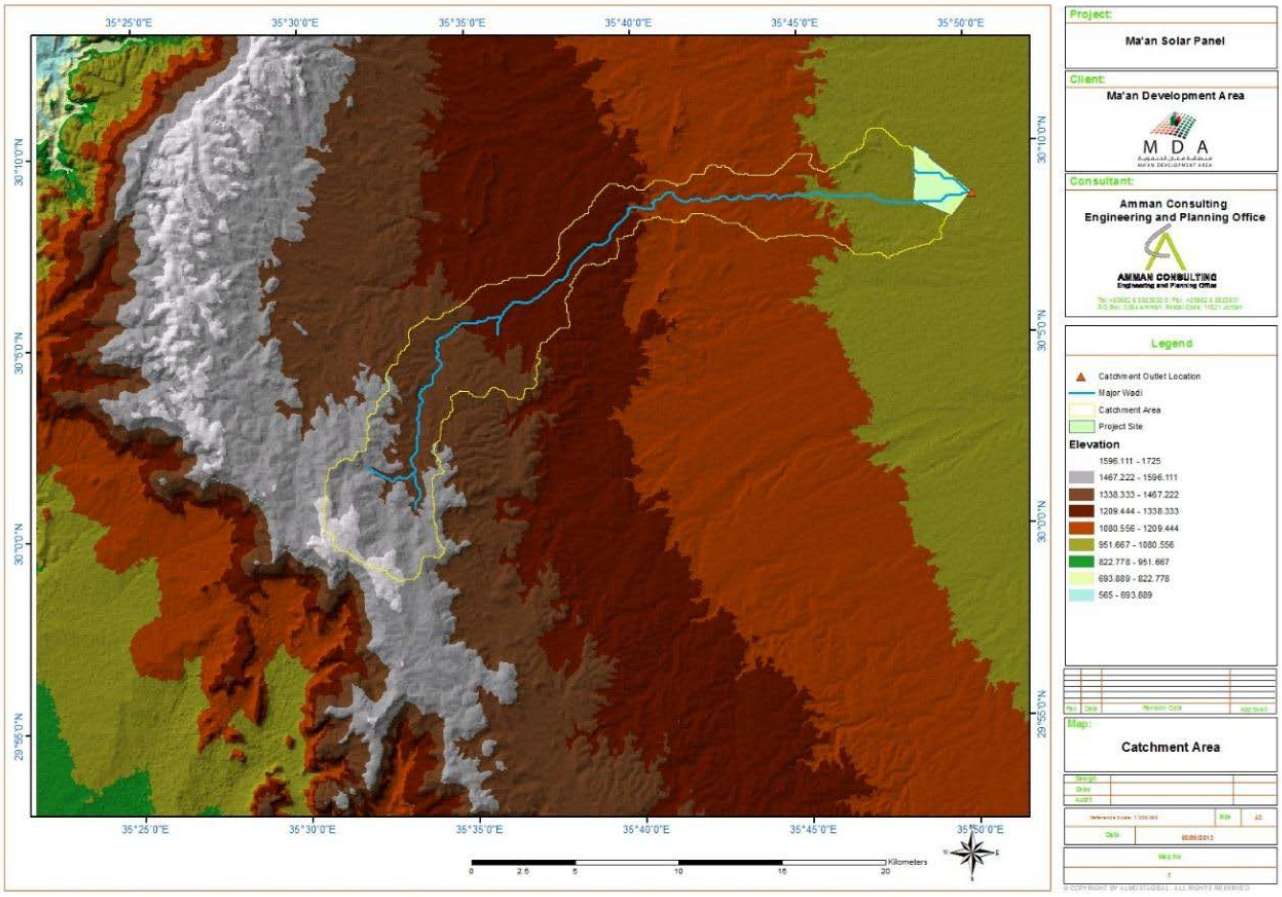

Figure 24: Sub-catchment Area of the Project Site

Within the Project area, the wadi system is known as Wadi Aqeeqa (Figure 25 below). This wadi is generated from high land of the sub-catchment area and reaches a narrower place located at 3 km to the west of the Project area and then spreads to several branches which merges and diverges in and near the Project area location. This wadi has only seasonal floods to short duration – mainly during flashflood events during the winter season. Some of the water in this wadi seeps into the underlying sediments, and sometimes they flow to the Project area. The wadis drain mostly eastward towards the railway and the Highway (Highway#5) located in the east of the Project site.

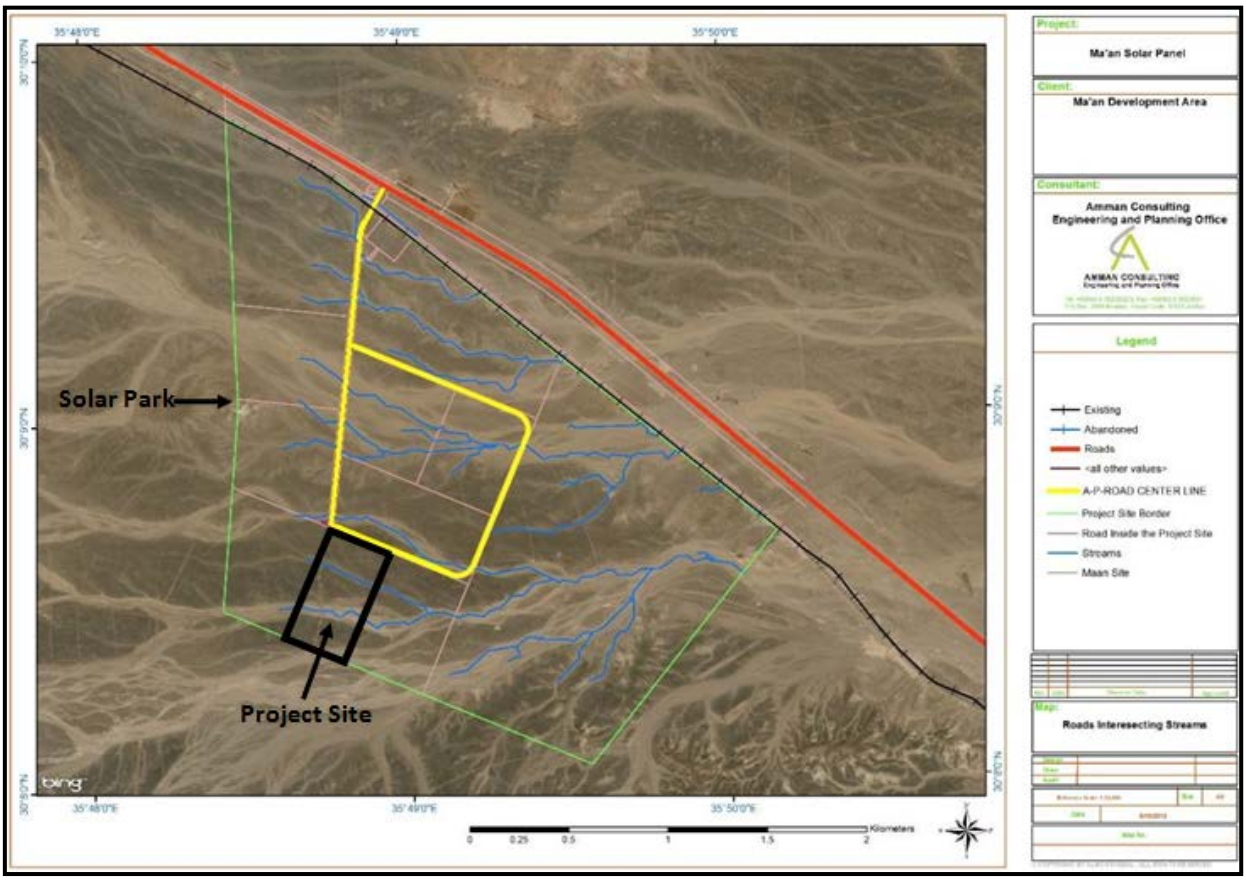

Figure 25: Wadi System within the Solar Park

Taking the above into account, it is evident that the area in general could be subject to potential risk of local flood hazard during the rainy season and especially during flash flood events. Therefore, within the railway which runs to the north of the Project site are seven (7) culverts. These culverts were constructed by the Ottoman Empire in the 1900s. The general condition of the existing culverts is good. In addition, on the Highway (Highway #5) a culvert has been constructed draining storm water to the other side of the road.

7.4 Biodiversity

This section presents the biodiversity of the Project site and surrounds.

7.4.1 Baseline Data Collection Methodology

The baseline assessment of the Project site was based on a literature review, field survey, and consultations with experts, each of which is discussed in details 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.

For avi-fauna assessment specifically, the literature review was based on BirdLife International's Migratory Soaring Bird Sensitivity Map Tool which was used to provide preliminary site-scale information. In addition, literature review also included the review of previous bird surveys and assessment undertaken by ECO Consult for avi-fauna in the area and near the Project site which exhibits similar habitats (to include migratory, resident, and breeding birds).

(ii) Field Survey

A one day field survey was undertaken at the Project site during spring/early summer time for flora, fauna, and avi-fauna. The survey was undertaken onsite throughout this period as generally the biodiversity of the site is considered to be the highest and thus most representative of the site.

The field survey mainly included the Project site through the following methods:

- Field observations: the site was examined carefully for the presence of breeding and resident birds, nests, active animals, animal signs and tracts, active burrows, remains or any other vital signs that indicate the activity of animals or avi-fauna species. 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.
- Line transects: transects in many areas of the project site of over 100 m long were undertaken for the detailed assessment of flora, fauna, and avi-fauna species. Observed species were recorded and photographed as possible.

(iii) Consultations with Experts

As part of assessing the biodiversity of the Project site, consultations were undertaken with Environmental NGO's and academic experts from various Jordanian Universities, both of which are considered specialists in relation to the subject matter. Such consultations mainly involved the following:

- BirdLife International – Middle East Regional Office, Jordan. BirdLife International is an international NGO widely recognized as the world leader in bird conservation;
- The Royal Society or the Conservations of Nature (RSCN). The RSCN is an environmental NGO responsible 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;
- Dr. Zuhair Amr – Faculty Member and Head of the Department of Applied Biological Science at the Jordan University of Science and Technology. Dr. Amr has over 22 years of experience in biology, ecology and

biodiversity with many publications related to ecology such as the Database of Animal Biodiversity in Jordan. In addition, he was awarded the "JUST Award for Research Excellence" as well as the "Distinguished Researcher Award" by the Ministry of Higher Education and Scientific Research in Jordan. He was a member of many scientific Journals advisory boards such as, Zoology in the Middle East, ZooKeys and Fauna of Arabia. Dr. Amr has also undertaken extensive faunal surveys in the Ma'an area in general. Dr. Amr is considered a prominent academic and point of reference in Jordan and when it comes to fauna assessments;

- Dr. Fares Khoury – Faculty Member and Chair of the Biology and Biotechnology Department at the American University of Madaba (AUM). Dr. Fares Khoury has more than 20 years of experience in ecological and ornithology field research in addition to ecological impacts and wildlife hazard assessments. Most of his research includes the study of vertebrate ecology in arid and semi-arid regions, particularly how environmental factors determine community structure and distribution of birds. Focal themes of research also include the study of adaptive responses of birds to desert conditions in combination with predation and competition and the stopover ecology of migratory birds in Jordan. Dr. Fares Khoury is considered a prominent academic and point of reference in Jordan and when it comes to avi-fauna assessments.

(iv) Fauna & Flora Species' status

Floral species recorded onsite had no international conservation status as they were not assessed by the International Union for the Conservation of Nature (IUCN). Therefore, their status classification was based on an extensive national level study named "Jordan Country Study on Biological Diversity: Plant Biodiversity and Taxonomy" (Dawud Al Eisawi, 2000). This is the only study conducted to date that assessed the conservation status of flora species.

The fauna 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) and "The Status and Distribution of Reptiles and Amphibians for the Mediterranean Basin" (Cox *et al*., 2006). In addition, the conservation status of avi-fauna species was based on their global status according to the IUCN Red List of Threatened Species.

The outcomes of the above, in addition to an expert opinion, were utilized to identify the status and importance of the biodiversity of the Project site.

7.4.2 Results

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

(i) Flora

Jordan is divided into four bio-geographical regions; Mediterranean, Irano-Turanian, Saharo-Arbian and Sudanian-Penetration each representing different elements of flora. The Project site is located within the Saharo-Arbian bio-geographical region which is generally characterized with its poor vegetation, which sometimes is non-existent. Within such area, most (if not all) vegetation is restricted to watersheds in wadis where enough moisture is available to support some vegetation.

The area is composed of two vegetation sub-types and which include the Gravel Hamada (found throughout most of the Project site) and the Runoff Hamada (confined in the wadi parts of the site) – refer to Figure 26 below. The Hamada habitat is the most common habitat in eastern deserts of Jordan.

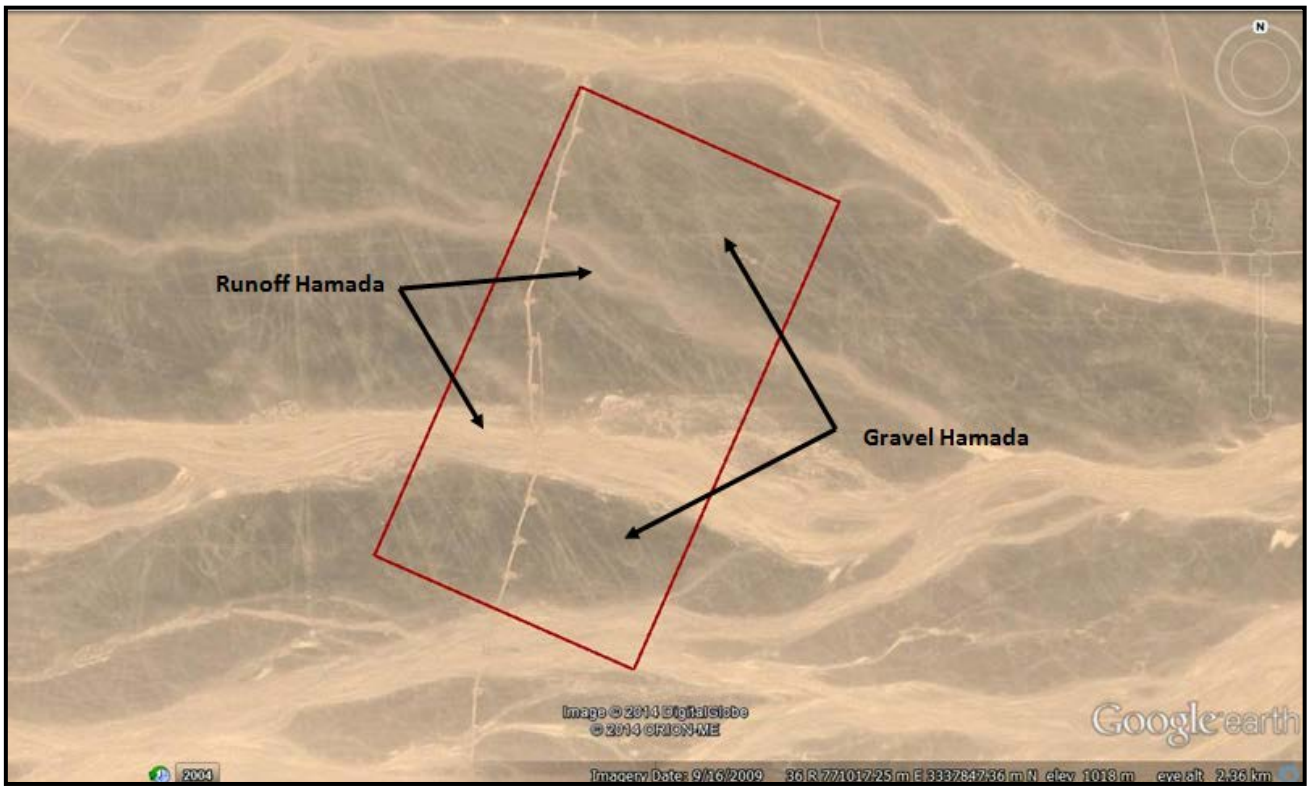

Figure 26: Vegetation Sub-Types within the Project Site

Generally, the Gravel Hamada habitats are barren and vegetation is scarce if not absent due to natural reasons. The soil composition in such habitats is covered with Chert Pebbles which generally inhibit the growth of vegetation. This type of habitat was found predominantly within the Project site as illustrated in the figure below.

Figure 27: Gravel Hamada Habitat in the Project Site

On the other hand, the Runoff Hamada habitat type was confined within the wadi parts of the site. Generally, those areas offer suitable habitats for a variety of plant species as occasional runoff water creates moisture which is able to support vegetation.

In accordance with the above, the survey identified a total of six (6) plant species scattered within the wadi system within the Project site (Runoff Hamada habitat – refer to Figure 28 below). No species were recorded within other parts of the site (Gravel Hamada habitat). A complete list of those recorded species is presented

in Annex III. All recorded species are considered common to such area habitats and none are considered rare or endangered species.

Figure 28: Limited Scattered Vegetation within the Wadi System in the Project Site

Within such habitats (Hamada habitat), a key flora species is the Acacia tree - which is considered of national importance due to continuous threats from locals from logging and use as a source of fire wood. However, this species in particular is known to occur further south of the Project site (distribution begins at around 40km to the south). In accordance with the above, the field survey has not recorded any Acacia trees.

Discussions were also undertaken with the RSCN regarding the importance of the Project site from a biodiversity perspective. Generally, the RSCN has no issues of concern in relation to the Project development given that it is not within areas of critical environment concern assigned by the RSCN (such as established, under establishment, proposed reserves or IBA's – refer to Section 7.2.2). In addition, based on such discussions it was reiterated that the Project site lies within the (Hamada habitat) which is considered the most common habitat in Jordan and is not considered a sensitive, critical, or limited habitat. In addition, discussions also stressed on the fact that the area (from a biodiversity perspective) in general is considered disturbed by human activities to some extent, by the highway and railway which runs close to the Project site. In addition, within the wider area there are several factors which could contribute to such disturbances such as mining areas (which are around 6km from the Project site) and proximity to urban areas (Ma'an city) and industrial areas (MDA Industrial Park).

(ii) Fauna

Generally, the site area is considered barren and of low ecological significance due to its natural characteristics. Nevertheless, the Runoff Hamada habitats (restricted to the wadi systems within the site) could provide selective habitats and feeding ranges for certain faunal species to include mammals and reptiles that differ in niches.

Throughout the assessment, the Project 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. No faunal species or any indications for faunal species were noticed or recorded within the Project site. However, within nearby area of the Project site several burrows and holes were noticed as presented in the figure below. Such burrows are most likely for rodents which are common in such area habitats.

Figure 29: Burrows Observed near the Project Site

As discussed earlier, from a biodiversity perspective, the site is considered disturbed by human activities. Such disturbances could affect, to some extent, the presence of faunal species within the site (especially large animals).

However, based on a literature review there are several faunal species which are known to typically inhabit such areas of similar habitat, and which could be present within the Project site. This includes various species of mammals (rodents, hedgehogs, and carnivores) as well as reptiles and amphibians (geckos, agamids, lacretids, snakes, etc). Generally, most of the species recorded throughout the literature review are considered of Least Concern according to the IUCN Red List of Threatened Species (refer to Annex III).

Based on the literature review, two key species are considered important and have a conservation status at the national level. This includes the Arabian Hare *(Lepus capensis)* – which is considered important at the national level due to hunting activities by locals, in addition to the Spiny Tailed Lizard (*Uromastyx aegyptius)* – which is also considered important at the national level due to hunting activities and extensive harvesting for collection and selling purposes. However, those species in particular have not been recorded throughout the field survey.

Discussions were undertaken with Dr. Zuhair Amr (Faculty Member and Chair of the Department of Applied Biological Science at the Jordan University of Science and Technology). Dr. Amr reconfirmed that the site habitat (Hamada habitat) is considered the most common habitat in Jordan and is not considered a sensitive, critical, or limited habitat. The Project site is considered of low ecological significance, and most faunal species known to occur within such habitats are considered of least concern and common to such area habitats; thus, with regards to the Project development there are no issues of concern. However, attention must be given to two main species which are known to inhabit such habitats and which have a conservation status on the national level (as discussed earlier) and which include the Arabian Hare and Spiny Tailed Lizard.

(iii) Avi-Fauna

The avi-fauna assessment discussed below includes assessment on soaring birds (migratory and resident) as well as non-soaring and breeding resident birds.

Soaring birds assessment was first based on BirdLife International's Migratory Soaring Bird Sensitivity Map Tool. This Tool was recently launched to provide preliminary site-scale information to be reviewed at the earliest stages of development planning process. The tool is designed to inform and complement the assessments undertaken as part of an ESIA study.

It is important to note that this Tool is primarily designed to guide wind energy projects (given the important anticipated impacts from turbines on soaring birds), but nevertheless it can be used for a wide range of other development sectors.

The analysis with the Tool was undertaken by inputting a polygon which represents the study area location in order to assess the site's significance and sensitivity for soaring birds (migratory and resident). As noted in the figure below, the analysis reported that the area has an 'unknown status' in regard to sensitivity of soaring birds, as there are no soaring bird species recorded within the study area. However, the assessment identified 25 soaring bird species which are thought to occur in the area. Most of those species are considered of Least Concern; however some of those species which are thought to occur in the area have a conservation status. The complete list is presented in Annex III.

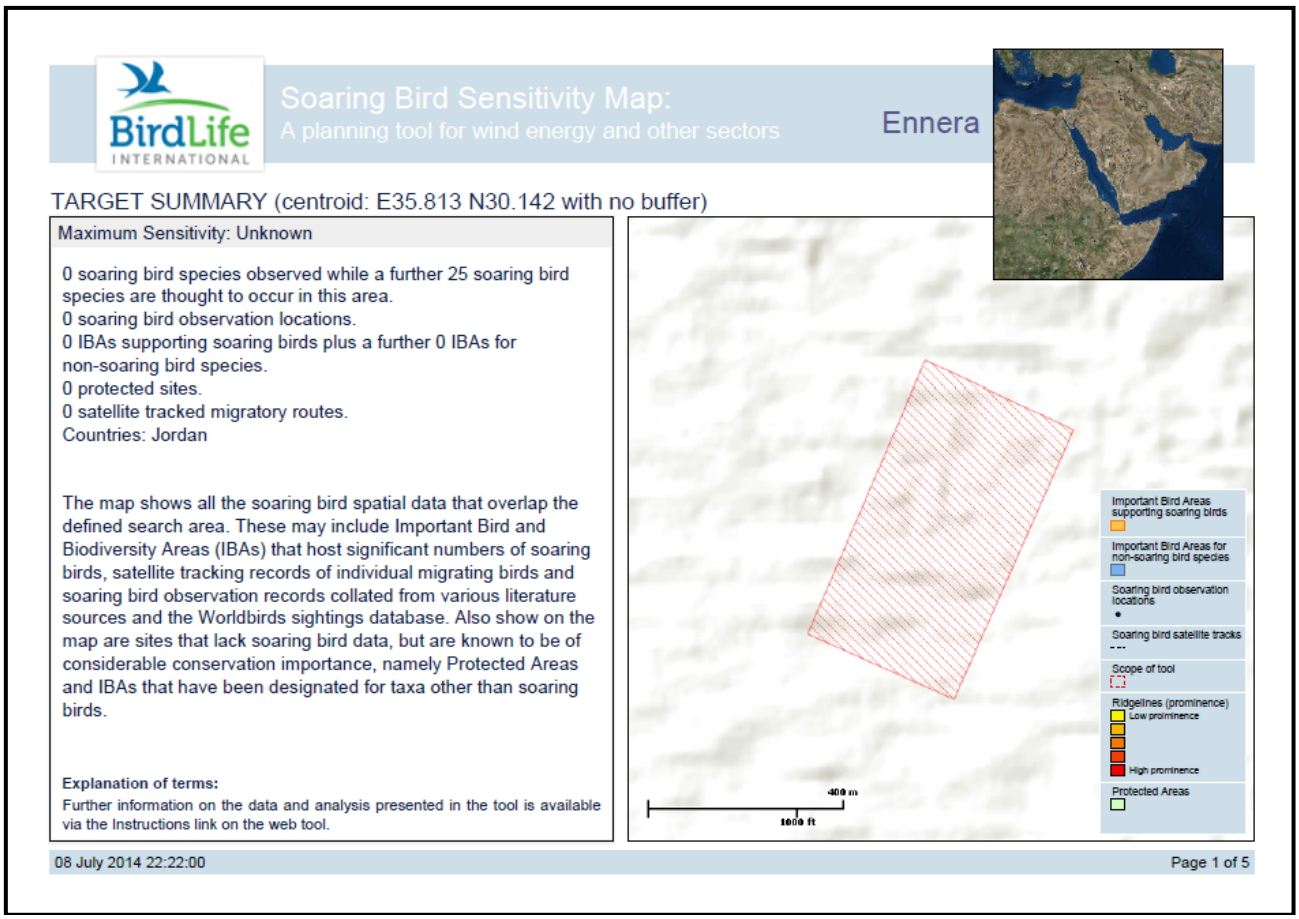

Figure 30: Outcome of BirdLife International's Migratory Soaring Bird Sensitivity Map Tool

Taking the above into account, it is important to note that ECO Consult has undertaken several bird assessments in the South of Jordan (e.g. Al-Fujeij, Al-Rajif, Al-Shobak, and Ma'an) during spring and autumn to observe the numbers and behavior of migratory birds.

Generally, such assessments have concluded that with regards to migratory birds, site sensitivity tends to decrease at areas located at a distance from the Jordan Rift Valley and its margin – where large numbers of migratory raptors pass are known to pass during the spring and autumn migration periods.

In accordance with the above, the Project site is located outside of the migratory flyway path of the rift valley as it is at a distance from the rift valley and its margins (around 40km). Thus, the Project site is not considered to be within an area of intensive passage or traffic of migratory soaring birds.

The above conclusion is in fact confirmed by an assessment undertaken in the Ma'an area (around 18km to the northwest of the Project site) as part of an the "Environmental and Social Impact Assessment for the Ma'an 65-75MW Wind Farm" (ECO Consult, 2013). The assessment concluded that the number of migratory soaring birds was negligible – especially when compared to other areas which are close to the escarpment.

The assessment indicates that the area in general is not within an area of intensive passage or traffic of migratory soaring birds during migration seasons.

In addition, based on the site survey undertaken for the Project site, a single species was recorded during the field visit and that was Temminck's Lark (*Eremophila bilopha)*. In addition, no nests or breeding activities were recorded within the Project site although the survey was undertaken generally during the breeding season (which lasts from March till mid May).

The recorded species is considered of Least Concern according to the IUCN Red List of Threatened Species, and is considered common to such area habitats.

The limited bird activity in the site can be attributed to the fact that the site is, to some extent, disturbed by human activity as discussed earlier.

Discussions were undertaken with Dr. Fares Khoury (Faculty Member and Chair of the Biology and Biotechnology Department at the American University of Madaba) with regards to the avi-fauna assessment of the Project site.

Dr. Khoury stressed that such a habitat type (Hamada habitat – within which the Project is located) covers vast and wide areas (roughly around 50% of Jordan) and is not considered a sensitive, critical, or limited habitat.

With regards to Project development, Dr. Fares Khoury stated that there are no issues of concern. With regards to resident avi-fauna, several species of Larks, Wheaters, and Doves are expected within the Project area in general, which are generally common to such habitats. Such species are likely to nest and breed within the Wadi systems which supports limited vegetation. In addition, such an area is considered, to some extent, disturbed by human activity and which could affect resident bird activity in the area. With regards to migratory birds, the site sensitivity is considered low as it is located at a distance from the rift valley and its margins and is not considered to be located within an area of intensive passage or traffic of migratory soaring birds during migration seasons.

Finally, discussions were also undertaken with BirdLife International – Middle East Regional Office, Jordan regarding the importance of the Project site in terms of avi-fauna (migratory and resident). The outcomes of such discussions are in line with the above. BirdLife International – Middle East Regional Office, Jordan have stated that there are no issues of concern in relation to avi-fauna from the Project site due to the following:

- The Project site is located outside of the Rift valley/Red Sea flyway;
- The Project site is not located within or near IBA's within Jordan;
- Several species of birds are expected within the area such as Larks, Wheaters, and Doves which are generally common to such habitats;
- The Project site, to some extent, is disturbed due to several factors as discussed earlier (highway, railway, nearby industrial activities and mining areas, proximity to urban areas, etc); and
- The methodology undertaken for assessment of baseline conditions with regards to avi-fauna by the 'ESIA Team' within the Project site is considered sufficient, given the low sensitivity of the site.

7.5 Archeology & Cultural Heritage

This section presents the baseline conditions within the Project site in relation to archeology and cultural heritage.

7.5.1 Baseline Data Collection 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

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. The DoA is the official governmental entity in Jordan responsible for the protection, conservation, and preservation of antiquities in accordance with the "Antiquities Law No. 21 for the year 1988".

In addition, it is important to note that the literature review included the review of the "Archeological Survey of the Solar Park Area" Report which was undertaken by the DoA in December 2013. The DoA has undertaken a full scale archeological survey of the Solar Park Area. The report was obtained from MDC.

The objective of the literature review includes the following:

- Provide background information on the archeological history of the Ma'an area in general – which mainly includes Ma'an city and the desert areas to the east and southeast; and
- Discuss outcomes of the archeological survey undertaken for the Solar Park Area based on the DoA Assessment.

(ii) Field Survey

A site specific field survey was undertaken for the exact Project site, where the aim of the survey was to confirm the results of the survey undertaken by the DoA as discussed earlier.

Throughout the field survey, the Project site was divided into a number of transects running in a north-south direction and separated by approximately 10 m. The transects aimed to cover the entire Project site. Each transect was walked by an archeological expert and a detailed inspection of any potential archeological remains present on the surface was undertaken. This includes inspections for presence of potential remains such as flint tools, pottery shards or other archeological features such architectural remains, graves and burial cairns, cisterns, ancient roads, etc; all of which are indicators of ancient/old human activities which might have occurred in the site and which could potentially be of archeological importance.

7.5.2 Results

In accordance with the methodology discussed above, the results first provide an overview of the archeological history of the Ma'an area in general. The results then presents the outcomes of the archeological importance of the Project site in specific based on the review of the DoA survey of the Solar Park as well as the survey undertaken by the 'ESIA Team' for the exact Project site.

(i) Overview of the Archeological History of the Ma'an Area

Based on the literature review, in summary the archeological history of the Ma'an area in general can be summarized to three (3) main chronological periods each of which is discussed in further details below.

- *Prehistoric period*– which represents the span of time before recorded history and which includes the Stone Age, Bronze Age, Chalcolithic Age, etc. Within this period, several sites have been recorded in the Ma'an area, and mainly in Al-Jafr around 50km east of the Project site.
- *Byzantine/Early Islamic Period* (roughly between 300 AD – 1500 AD): sites have been recorded near Ma'an city located around 8km from the Project site.
- *Ottoman Period* (1516 AD – 1918 AD): sites have been recorded near Ma'an city located around 8km from the Project site.

a) Prehistoric Period

The evidence of human settlements during prehistoric periods in the Ma'an area was recorded in Al-Jafr – around 50km from the Project site; where in the past such semi-deserts of the eastern badia have had periods of greater rainfall and therefore could have sustained human populations. In the Al-Jafr area there are many enigmatic traces of the nomadic pastoralists who lived there. The most visible of these in the landscape are burial cairns often located on prominent hilltops, which no doubt helped to demarcate their territories, in addition to many stone enclosures, often containing a scatter of stone tools – notably the typical tabular scarpers of the Chalcolithic and Early Bronze Ages. The source of many of these ancient stone tools were found in strings of late prehistoric flint mines located on the northern fringes of the Al-Jafr basin.

b) Byzantine/Early Islamic Period

Evidence of human use of the eastern deserts becomes very limited after the Bronze Age until the Byzantine/Early Islamic period. Throughout this period, evidence of human settlement has been recorded around the springs in Ma'an, just on the eastern edge of the modern city – which is located around 9km to the northwest of the Project site.

A major establishment was recorded (known today as Hammam) which entailed a large reservoir and large buildings nearby, in addition to an aqueduct which led to the reservoir from the springs. However, such remains have been destroyed. In addition, to the east of this settlement, are the remains of an ancient irrigated field system with at least two caravanserais associated with it.

c) Ottoman Period

The Ma'an area (and specifically Ma'an city located around 9km from the Project site) really began developing during the Ottoman period. In the early 16th century the Ottoman sultan decided, for safety reasons, to move the Hajj route (Islamic pilgrimage to Mecca in Saudi Arabia) away from its traditional itinerary in the well-watered hills along the Kings Highway, out to the east, into the fringes of the desert.

To make this route viable, they built a string of fortresses (five of which are in modern Jordan) that could provide water and security to the Hajj caravans. In the 18th century, a further four forts were added. The main hub in the south, before entering Arabia, was Ma'an. The fort in Ma'an, built in 1531 AD, dates to this period, and Ma'an's economy has revolved around the pilgrims ever since. The remains of the fort are located in Ma'an city around 9km from the Project site.

Undoubtedly, the main feature of the Ottoman landscape in Jordan is the Hejaz Railway, built between 1900 and 1908, connecting Damascus (in Syria) to Saudi Arabia. The idea behind it was, in part, to facilitate the journey for the pilgrims on the annual Hajj to Mecca, which before that had been done on foot. But it also had a military dimension, whereby the Ottomans could deploy troops rapidly into the heart of Arabia where, by the late 19th century, there was growing unrest amongst the Arab tribes.

With the coming of the Hejaz Railway, which reached Ma'an in 1904, the town was finally connected with the larger settled communities to the north and south. As well as being the seat of a provincial district governor, Ma'an was now a significant communication hub, and quarantine station for pilgrims.

Throughout the Ottoman Period, and specifically in 1845 there were around 220 families in Ma'an city what was then a town divided into two parts, each around a spring, which provided them with their water requirements. By 1912, there were around 3,000 people, growing to 4,500 in 1956, 9,500 in 1973 and 23,000 in 1994. With such rapid recent growth, the mud-brick tower houses and the walled gardens of old town are fast disappearing.

(ii) Archeological Assessment of the Project Site

The "Archeological Survey of the Solar Park Area" report prepared by the DoA concludes that the Solar Park area in general is devoid of any archeological or cultural remains which are considered of significant value, and this is likely attributed to the natural characteristics of the site, being dry and barren and lacking any permanent water resources (such as springs). Thus, such natural characteristics are unlikely to support any historical human settlements.

However, the report shows 3 locations of findings from the archeology survey and discusses the importance of these locations. Those 3 sites are summarized below and presented in Figure 31 below.

- *Location 1 – Ottoman Military Camp:* An Ottoman military camp site was recorded within the Solar Park Area (approximately 1.5km outside of the Project site to the north) and which consists primarily of two rows of circular Ottoman military tents each with a diameter of approximately 4m.The camp site was most likely used temporarily by a garrison with a limited military mission, probably for protection during the construction of the Hejaz Railway. The DoA report recommends that this location be fenced to prevent potential damage by developers of the Solar Park as it represents findings related to the construction of the Hejaz Railway.
- *Location 2 – The Watch Tower:* This site is located outside of the Solar Park area and around 2km outside of the Project site to the east. According to the DoA report, this site includes remnants of a military watchtower which dates back to the Ottoman period. The tower is located on the top of a hill which is elevated from the surrounding area by around 25m. The DoA report recommends that this location be fenced to prevent potential damage by developers as it represents findings related to the defense system of the Hejaz Railway.
- *Location 3 – The Single Tent:* A Bedouin tent was recorded within the Solar Park area (approximately 1.3km outside of the Project site to the east). This mainly includes a single small stone enclosure which was most likely used as a Bedouin tent by the locals, and which could have worked in servicing the Ottoman army – nevertheless the report suggests that this site has no archeological or cultural value or significance.

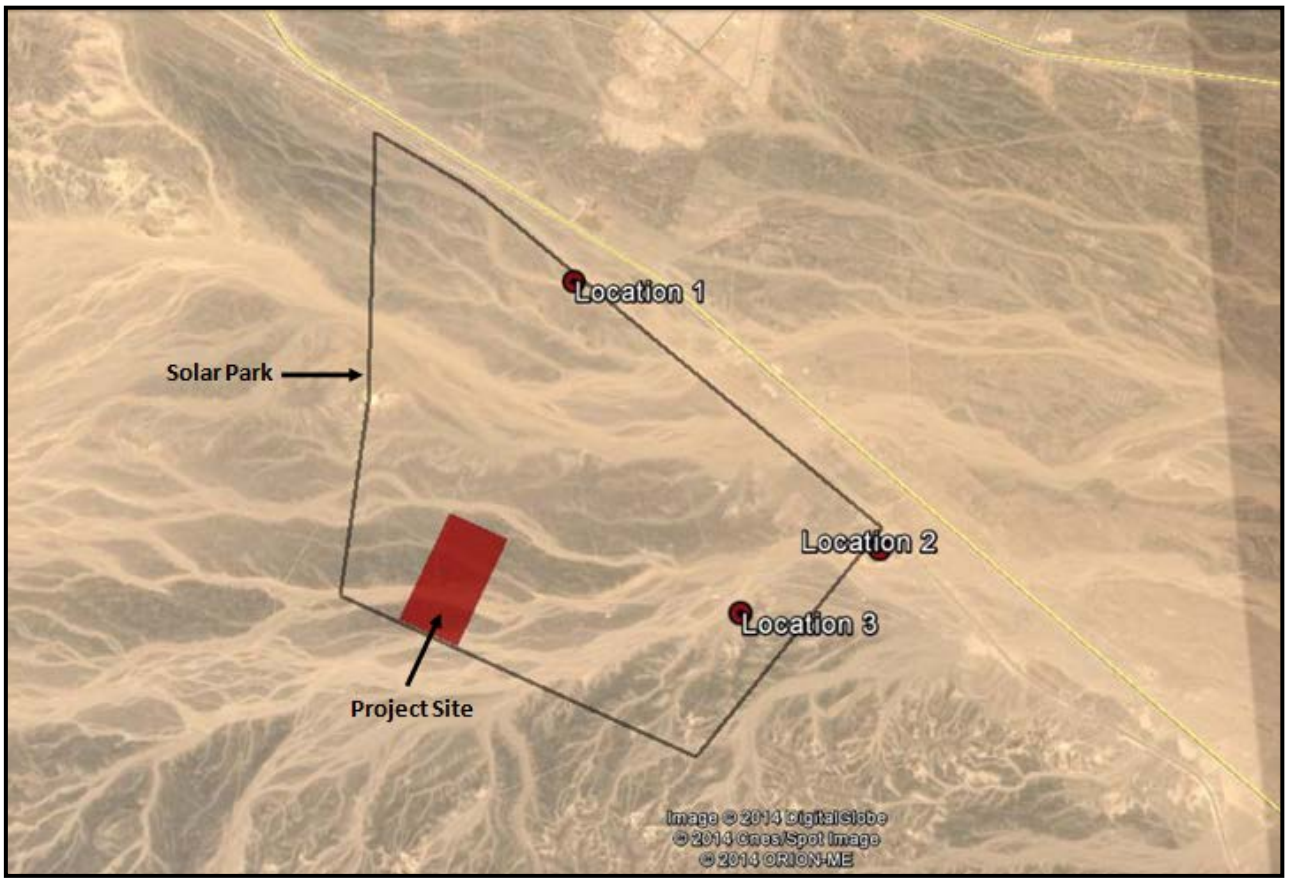

Figure 31: Location of Findings from DoA Report

The detailed survey undertaken by the 'ESIA Team' for the exact Project site, confirms the results of the DoA assessment. The Project site is devoid of any important or significant archeological or cultural remains. Throughout the survey not a single artifact was recorded within the Project site nor any archeological features such as cisterns, isolated buildings, terraces, old roads, burial cairns, stone heaps, etc.

7.6 Air Quality and Noise

This section presents the ambient air quality and noise conditions of the Project site and surrounds.

7.6.1 Baseline Data Collection Methodology

Baseline assessment for air quality and noise was undertaken through onsite monitoring which was conducted continuously for 24 hours at 2 different monitoring sites that represent the Project location. Monitoring was conducted on the 6th of June and the 7th of June 2014 for the following parameters:

- Gases to include Carbon Monoxide (CO),Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2);
- Suspended Particulate Matter to include Total Suspended Particulate (TSP), Particulate Matter smaller than 10.0 microns in diameter (PM_{10}) and Particulate Matter smaller than 2.5 microns in diameter ($PM_{2.5}$); and
- Noise Pressure Levels.

The main objectives of the monitoring conducted included the following:

- Establish ambient air quality baseline conditions and background data to assess the existing level of pollution within the Project site;
- Establish noise level conditions and background data to assess the existing noise levels within the Project site;
- Identify the main sources of air pollutants as well as noise sources within the Project site or from surrounding areas which might affect air quality and noise, thus avoiding potential liability to the Project from any existing level of pollution;
- Define inter-relationship of source of pollution, atmospheric parameter and measurable manifestations in order to evaluate the character and magnitude of existing problems (if any); and
- Establishing baseline conditions in terms of both ambient air quality and noise ensures thorough identification and logical assessment of anticipated impacts on air quality and noise from the Project's construction and operational activities as detailed later.

Results of the monitoring conducted were compared against the relevant legislations in Jordan that govern the subject matter to include the following:

- Air quality results were compared against the Ambient Air Quality Jordanian Standard 1140/2006. This standard specifies the maximum allowable limits of pollutant concentration in ambient air. The standard also presents guidelines and methods that have to be followed when conducting monitoring for ambient air quality; and
- Instruction for Reduction and Prevention of Noise for 2003. This instruction is issued by the Ministry of Environment and specifies the maximum allowable limits of noise levels within various areas to include cities, suburbs, villages, industrial areas and other.

Table 15 below summarizes the location of each monitoring point and other logistical information, whereas Figure 32 presents the location of the monitoring points within the Project area.

Table 15: Air Quality and Noise Monitoring Points

Parameters	Point 1	Point 2
Coordinates (UTM Zone 36)	36 R 0770957 3337899	36 R 0768608 3339873
Duration of Monitoring	Continuously for 24 hours	Continuously for 24 hours
Gases Monitored	CO, SO_2, NO_2	CO, SO_2, NO_2
Suspended Particulate Matter Monitored	TSP, PM10, PM2.5	TSP, PM10, PM2.5
Noise	Noise Level Equivalent (Leq)	Noise Level Equivalent (Leq)

Wind Speed (m/s)	0.5 – 2.5	0.5 – 2.6
Prevaialing Wind Direction	West / Northwest	West / Northwest
Temperature (^{o}C)	18 – 32	18 – 32
Humidity (%)	15 – 22	16 - 24

Figure 32: Location of Monitoring Points

(i) Selection of Parameters

As stated earlier, monitoring was conducted for the following parameters: (i) gases to include CO, SO_2, NO_2, (ii) suspended particulate matter (TSP, PM10, and PM2.5) and (iii) Noise Pressure Level. The characteristics of each of the parameters are discussed in further details in Annex IV. These parameters were selected based on the following rationale:

- Such parameters are likely to be present within the Project site given its characteristic and attributes. Suspended particulate matter is expected given the desert nature of the site. On the other hand, pollutants (such CO, SO_2, and NO_2) are expected onsite from motor emissions particularly from vehicles from the nearby highway (but most likely at minimal concentrations given the prevailing wind direction in the area being west and west-northwest). Finally noise levels are expected from vehicular movement as well as train movement on the nearby railway. Any source of emission from the nearby Industrial Park are highly unlikely to affect the Project site given the prevailing wind direction in the area being west and west-northwest;
- Such parameters are likely to be affected mainly during the Project's construction activities. Emission from vehicles and machinery used onsite will increases gaseous emissions as well as suspended particulate matter, and are expected to be a source of noise generation within the Project site and its surrounding areas.

(ii) Selection of Locations

Proper selection of monitoring sites is crucial as an inappropriate location may result in data that may not meet the objectives of monitoring and could be of limited value. Several factors need to be taken into account when selecting the sites to include the objectives of monitoring, size of the area to be covered, variability of pollutant concentration over the area to be covered, pollutants to be monitored and possible sources of pollutants. The following was considered for site selection:

- One site was located within the Project area to represent conditions within the Project site, while another was located upwind as a reference point taking into account the prevailing wind direction in the area being west and west-northwest;
- Those 2 points were considered representative areas where concentrations of selected air quality parameters and noises are expected to reflect the real concentrations of various pollutants;
- Logistical issues such as the particular method of instrument used for sampling, resources available, physical access and security against loss and tampering were also taken into account;
- Monitoring instruments were located in such a place where free flow of air is available and taking into account the direction of prevalent wind and topography of the site; and
- Air sampling points of intake were located at a height of 1.2 meter above ground level, whereas noise measurements were performed at about 1.5 meter above ground level.

(iii) Methods of Air Sampling and Analysis

JS 1140/2006 includes clear guidelines and methods that have to be followed when monitoring for air quality criteria pollutants, all of which were followed for the monitoring conducted. The guidelines include specifications for siting monitors, use of equipment that has demonstrated capability, repeatability, and reliability needed to collect accurate data, and operation of the equipment within established methods. All monitoring, sampling and analytical procedures used conform to JS 1140/2006. Table 16 below presents a summary of monitoring equipment used.

Table 16: Summary of Monitoring Equipment Used for Air Quality and Noise

Parameter	Name of Instrument	Minimum detection limit (MDL)	Principle of Measurement
CO	CO Analyzer Model 2000	0.1ppm	Infra red photometry
SO_2	Serinus 50 Sulfur Dioxide (SO_2) analyzer	0.3 parts per billion (PPB)	UV-Fluorescence
NO_2	Serinus 40 Oxides of Nitrogen (NOX) analyzer	0.4 parts per billion (ppb)	Chemiluminescence technology
TSP	SKC Gast Rotary Vane Pump Model1532, Flow rate of 22l/min.	1.0 µg/m^3	Gravimetric Method
PM10	The Thermo Scientific Model ADR-1500	1.0 µg/m^3	Light scattering photometry
PM2.5	The Thermo Scientific Model ADR-1500	1.0 µg/m^3	Light scattering photometry
Noise Monitoring	Octave band analyzer and noise level meter Model 407790 type 2	Accuracy = ±1.5 dB	Measures Noise Pressure levels. 30 to 130 dB(A) with Auto Ranging

7.6.2 Results

This section presents the results of the monitoring conducted at each monitoring site. The detailed results for each site are presented in Annex IV. All parameters have been recorded on an hourly basis continuously for 24 hours at each monitoring site.

Table 17 below presents a summary of the results for the monitoring conducted at each of the monitoring sites. The table presents the average, maximum, and minimum values recorded, and the maximum allowable limits for air pollutants as stipulated within the Jordanian Standard 1140/2006 and the maximum allowable limits for noise levels as stipulated within the Jordanian Instruction for Reduction and Prevention of Noise of 2003.

To avoid confusion in reading the air quality results in the table below, it must be noted that the average daily concentration (summation of all concentrations at each hour divided by 24) for a pollutant is equivalent to the 24-hour concentration. When comparing results with the Jordanian Standard, the hourly concentration must be compared (that is the results at every hour) with the maximum allowable hourly limits, and the 24-hourconcentration (or average daily concentration) with the 24-hour maximum allowable limits.

With regards to noise levels, the Instruction specifies a maximum allowable limit for the day average (7:00 am till 6:00 pm) and night average (from 7:00 pm till 6:00 am), and this is calculated by summing all recorded levels at each hour for the day and night respectively and dividing it by 12 hours. Results are then compared with the maximum allowable limits for industrial areas which require a level of 75dBA during day and 65dBA during night. Comparison with maximum allowable limits for industrial areas has been adopted given that the Project site is to some extent located within an industrial area (as the industrial Park is located around 3km to the north) and is located at a distance from the closest inhabited area (around 6km and thus is not classified as a city, village, or rural area per say).

Overall, the results for air quality monitoring are all well within the limits specified within the JS 1140/2006, where none of the monitored parameters exceeded any of the maximum allowable limits. With regards to the gases, recorded concentrations at both sites of CO, SO_2 and NO_2 were within, and even significantly lower, than the maximum allowable hourly and 24-hour limits specified within the JS 1140/2006. With regards to the suspended particulate matter which includes TSP, PM10 and PM 2.5, there are no hourly concentrations specified within the Jordanian Standard but only 24-hour maximum allowable concentrations. Recorded 24-hour concentrations at both sites where within, and even significantly lower, than the 24-hour limit specified within the JS 1140/2006.

Finally, with regards to noise, recorded concentrations at both sites were within the levels specified within the Instruction for day and night.

Table 17: Summary of Monitoring Results

Location	Parameters Measured							
	Gases (ppm)			Dust (µg/m^3)			Noise (dBA)	
	CO	SO_2	NO_2	TSP	PM10	PM2.5	Day	Night
First Monitoring Point								
Average (24h)	0.4,0.4,0.4*	3.6×10^{-3}	4.9×10^{-3}	25.6	12.5	2.8	39.3**	37.0**
Max (hourly)	0.5	4.9×10^{-3}	6.8×10^{-3}	36.3	17.9	4.9	41.5	37.9
Min (hourly)	0.4	2.6×10^{-3}	3.6×10^{-3}	14.6	5.0	1.0	36.9	36.1
Second Monitoring Point								
Average (24h)	0.5, 0.5, 0.3*	2.9×10^{-3}	6.8×10^{-3}	53.6	26.7	10.4	39.2**	37.1**
Max(hourly)	0.5	4.2×10^{-3}	9.4×10^{-3}	66.6	44.2	18.5	41.4	40.3
Min(hourly)	0.3	1.9×10^{-3}	4.6×10^{-3}	32.1	17.1	5.0	36.4	34.4
JS 1140/2006 Limits								
Hourly	**26ppm**	**0.3ppm**	**0.21ppm**	**No value**	**No value**	**No value**	**N/A**	
24-hour	**9 ppm***	**0.14 ppm**	**0.08 ppm**	**260 µg/m^3**	**120 µg/m^3**	**65 µg/m^3**		
Instruction on Reduction and Prevention of Noise for 2003								
Rural (dBA)	**N/A**						**75**	**65**

*Based on 8-hours as required by JS 1140/2006

**Daytime is from 7:00 am till 6:00 pm and nighttime is from 7:00 pm till 6:00 am

(i) Gases - Carbon Monoxide (CO), Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2)

The results for each of the gaseous pollutants are summarized below. The detailed results for the monitoring are presented in Annex IV along with the graphical representations.

Generally, results were consistent with no significant variations recorded at both monitoring sites. Results are significantly lower than the maximum allowable limits stipulated within JS 1140/2006.

Throughout the monitoring period (at both monitoring sites) no point sources of emissions were noted and no off-road vehicular movement was recorded, which could especially affect results at monitoring sites. In addition, traffic volume on the nearby Highway (Highway #5) was very limited and the train did not pass at anytime during monitoring hours at both monitoring sites.

To this extent, the main source of all of the above gaseous pollutant emissions can be rather attributed to their natural formation and/or represent their trace values in the atmosphere. The results indicate rather very low concentrations especially when compared to the maximum allowable hourly and 24-hour concentrations within JS 1140/2006.

(ii) Suspended Particulate Matter - TSP, PM10, and PM 2.5

The detailed results for the monitoring are presented in Annex IV along with the graphical representations. As presented in Table 17, slightly higher values were recorded at monitoring point 2 when compared to monitoring point 1, but nevertheless at both sites the average daily concentrations of all three parameters were rather low and well within the maximum allowable limits stipulated within the JS 1140/2006. It must be noted that the JS 1140/2006 has no limits for maximum allowable hourly concentrations.

Throughout the monitoring period (at both monitoring sites) no point sources of emissions were noted and no off-road vehicular movement was recorded, which can be an important contributor to suspended particulates. In addition, traffic volume on the nearby Highway (Highway #5) was very limited and the train did not pass at anytime during monitoring hours at both monitoring sites.

Thus, the main source of suspended particulates (to include TSP, PM10 and PM2.5) can be attributed to the natural characteristics of the site (being a desert area) and related to dust blown by wind. However, it is important to note that low concentrations were recorded most likely due to the following: (i) the generally stable and calm wind speeds recorded at both sites throughout the monitoring period (0.5 -2.6 m/s); higher wind speeds (exceeding 5m/s) can considerably disturb the soil and dust and thus tend to significantly affect recorded values especially when compared to instances with stable or clam wind, and (ii) the Project site is mainly covered with Chert Pebbles which would limit disturbance of soil and dust.

(iii) Noise Pressure Level

The detailed results for the monitoring are presented in Annex IV along with the graphical representations. As presented in Table 17 above the average noise levels during the day is 39.3dBA and 39.2dBA at the first and second site respectively. The hourly average noise levels during night are 37.0dBA and 37.1dBA at the first and second site respectively.

The results of the monitoring were compared to the maximum allowable limits stipulated within the Instruction for Reduction and Prevention of Noise for 2003 which specifies a maximum allowable limit in industrial areas of 75dBA during daytime and 65dBA during nighttime. Generally, the average noise levels during daytime and nighttime are all within the maximum allowable limits specified within the Instruction.

During the monitoring conducted no major source of noise generation was noticed or recorded at both monitoring sites and no off-road passing vehicles or activities were recorded or heard. In addition, traffic volume on the nearby Highway (Highway #5) was very limited and the train did not pass at anytime during monitoring hours at both monitoring sites.

7.7 Infrastructure and Utilities

This section discusses the methodology adopted for the assessment of baseline conditions within the Project area in relation to utility and service supply infrastructure, to include: (i) water resources and utilities, (ii) wastewater, solid waste, and hazardous waste utilities, (iii) road networks, (iv) railway, and (v) electricity network, each of which is discussed separately below.

7.7.1 Baseline Data Collection 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 details throughout this section.

7.7.2 Water Resources and Utilities

The water sector in Jordan is governed by the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ), and the Jordan Valley Authority (JVA). 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. Whereas JVA is responsible for the socio-economic development of the Jordan Rift Valley, including water development and distribution for irrigation.

WAJ assumes all responsibilities related to water and wastewater structures including design, construction, operation, maintenance and administration. Within the Ma'an Governorate, the Ma'an Water Administration is the responsible entity representing WAJ.

According to the "Ma'an Water and Wastewater Master Plan" (CDM International, 2013), ten (10) water systems supply water to the various localities within Ma'an Governorate, which are summarized in Table 18 below. The systems vary significantly in size, with the population served ranging from 300 people to 38,000 people.

Table 18: Water Supply Systems in Ma'an Governorate

Water Supply System	Water Sources			Water Tanks		Pump Stations			Pipe Length km	Per Capita Supply lpcd
	Wells No.	Capacity m^3/hr	Pumpage MCM/yr	No.	Capacity m^3	Stations No.	Pumps No.	Capacity m^3/hr		
Ma'an City	***14***	***690***	***3.421***	***4***	***7,250***	***2***	***5***	***1,000***	***142***	***283***
Wadi Mousa	13	590	2.513	6	15,300	4	12	2,804	199	181
Shobak	7	380	0.789	4	1,120	3	10	925	79	157
Al-Manshiyya	2	90	0.242	1	100	1	2	80	20	155
Wahida	2	75	0.488	1	50	0	0	0	1.4	2,160
Al-Muraygha	2	50	0.362	2	520	1	3	400	38	121
Al -Muhamadiyya	2	50	0.037	1	300	1	2	430	8	335
Al -Husayniyya	3	190	0.680	3	220	1	1	50	26	180
Al –Jafr	2	130	0.584	1	500	1	3	172	5	237
Al -Mudawwara	1	50	0.123	1	200	0	0	0	21	202
Total	**48**	**2,295**	**9.239**	**24**	**25,560**	**14**	**38**	**5,861**	**540**	**216**

All the water supply comes from wells, which typically pump into water tanks, from which water is pumped to other water tanks or directly to customers. Some customers receive water by gravity flow from water tanks, while others receive water directly from pump stations. Ma'an Governorate has the highest level of Non-Revenue Water (NRW) in Jordan, amounting to 55% of the water pumped from wells in 2009. Within the Governorate, the average per capita supply is 216 lpcd (liters/capita/day), far in excess of the MWI consumption allowance of 100 lpcd for urban areas.

Water is rationed to customers in accordance with a weekly schedule. Some customers receive water continuously, while others receive water two or three days each week. The pumpage from wells varies significantly by season, at half the annual rate in winter and 50% higher than the annual rate in summer.

The closest water supply system to the Project area of the ten discussed above is the Ma'an City Water Supply System. This system supplies Ma'an city in addition to Al-Mahata village. In addition, a pipeline also runs to the Industrial Park which lies approximately 3km to the North of the Project site.

The Ma'an City Water Supply System consists of 14 wells located within 2 well fields (Al-Tahooneh and Samneh). The wells collectively have a capacity of 690m^3/hr with an annual pumpage of 3.4 MCM/yr. Table 19 below summarizes the characteristics of the water supply wells of the Ma'an City Water Supply System. The system is supplemented by 4 water tanks with a total capacity of 7,250m^3 (capacity ranges between 250m^3 and 4,500m^3) and 2 pump stations collectively consisting of 5 pumps with a capacity of 1,000m^3/hr. The total pipe length is 142km and the per capital supply 283 liter per capita per day, slightly higher than the Governorate average.

Most of the Al-Tahooneh wells pump to small tanks (Al-Tahooneh Old and Al-Tahooneh 1A) from which the water flows by gravity to a larger tank (Al-Tahooneh New), while three of the Al-Tahooneh wells pump directly to the Al-Tahooneh New tank. The Al-Tahooneh New tank serves some customers by gravity, and other customers through a pump station. Four wells in the Samneh well field pump to the Samneh water tank, from which water is pumped directly to a portion of the service area.

Figure 33 below presents a schematic of the Ma'an water supply system in relation to the Project site.

Table 19: Characteristics of Water Supply Wells of Ma'an Water Supply System

Groundwater Well	Pumpage Annual (MCM/yr)	Monthly Variation (m^3/d)			Pump Capacity (m^3/hr)	Well Depth (m)
		Avg	Max	Min		
Al-Tahooneh Field						
Al-Tahooneh Well 2	0.417	1,141	1,681	462	50	104
Al-Tahooneh Well 3	0.412	1,128	2,296	475	150	130
Al-Tahooneh Well 4	0.392	1,074	2,063	610	35-50	172
Al-Tahooneh Well 5	0.127	348	963	2	50	132
Al-Tahooneh Well 6	0.089	245	305	198	25-30	121
Al-Tahooneh Well 7	0.021	59	274	0	35-50	190
Al-Tahooneh Well 8	0.464	1,270	2,217	465	50	151
Al-Tahooneh Well 9	0.172	472	586	284	50	162
Al-Tahooneh Well 10	0.321	881	1,934	4	50-100	130
Al-Tahooneh Well 11	0.000	0	0	0	70	250
Subtotal	*2.415*	*6,617*	*9,119*	*4,500*	*600*	
Samneh Field						
Samneh Well 1	0.308	843	1,342	92	35-50	90
Samneh Well 2	0.522	1,431	1,962	1,093	50	118
Samneh Well 4	0.176	481	1,581	0	-	112
Samneh Well 5	0.000	0	0	0	-	106
Subtotal	*1.006*	*2,755*	*4,085*	*1,641*	*90*	
Total	***3.421***	***9,372***	***13,130***	***6,281***	***690***	

Table 20: Characteristics of the Tanks and Pumps of Ma'an Water Supply System

Tank	Capacity (m^3)	Pump Characteristics	
		No. of Pumps	Flow (m^3/hr)
Al-Tahooneh New Tank	4,500	3	150;150;200
Al-Tahooneh Old Tank	500	0	
Al-Tahooneh 1A Tank	250	0	
Samneh Tank	2,000	2	250;250
Total	***7,250***	***5***	***1,000***

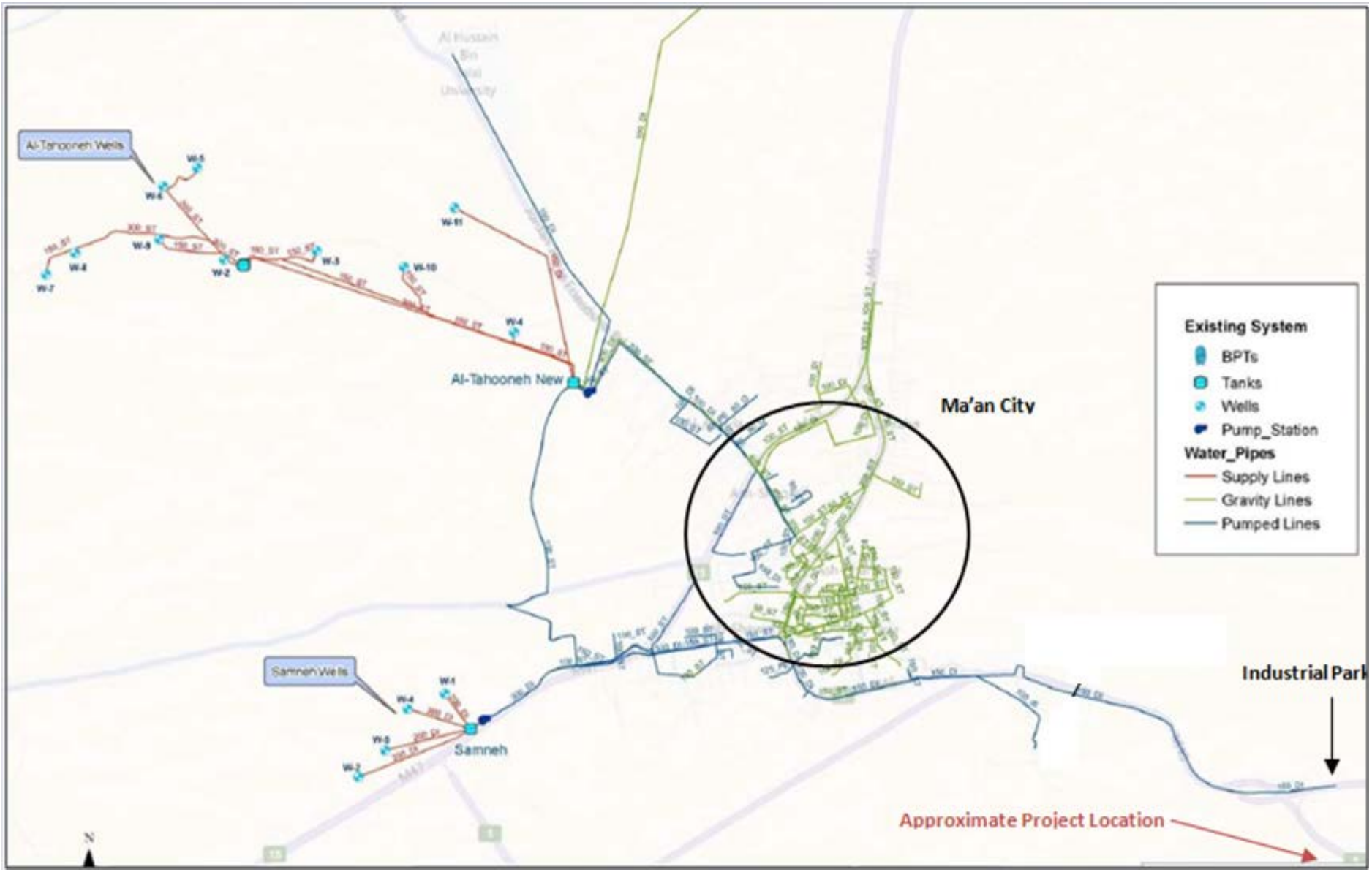

Figure 33: Ma'an Water Supply System

The MDC have also established a separate water supply system for the Industrial Park to cater for the water requirements of the various industries which are to be established (based on a Master Plan Study undertaken for the Industrial Park), as well as the water requirements of the Solar Park area.

A separate study has been undertaken by the MDC to estimate the water requirements of the Solar Park area – "Master Plan for the Solar Park Area" (Amman Consulting, 2013). The Master Plan takes into account the water demand from the entire PV developments during operation which are to take place within the Solar Park area based on consultations with the various developers. The total daily consumption was estimated at around 85m^3/day and the annual consumption of around 31,000 m^3.

The MDC have coordinated with the Ministry of Water and Irrigation and Ma'an Water Directorate for supply of their water requirements taking into account the developments within the Industrial Park and Solar Park. It has been decided that the water requirements will be supplied through the local water network in addition to water wells. As discussed earlier, a pipeline from the local water network (Ma'an Water Supply System) runs to the Industrial Park and will likely provide around 3,600m^3/day. The remaining water demand will be met through two (2) wells located within the Industrial Park, each with a capacity of around 25m^3/hour. Only one of the wells is currently in operation, as current demand within the Industrial Park does not require the operation of the second well. A license has been granted from the Ministry of Water and Irrigation for drilling and operation of the wells. In addition, two storage tanks have been established – the first being an underground tank with a capacity of 1,500m^3 and another elevated tank with a capacity of 450m^3.

7.7.3 Wastewater, Solid Waste, and Hazardous Waste

(i) Wastewater Utilities

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 Ma'an Governorate, the Ma'an Water Administration is the responsible entity representing WAJ.

Ma'an City and Wadi Mousa have the only wastewater collection and treatment systems within Ma'an Governorate. The Wadi Mousa wastewater network serves the Petra hotel industry and several surrounding communities which include At-Taybeh, Al-Baida and Bdoul. The system also includes a Wastewater Treatment Plant (WWTP) which serves those communities - Wadi Mousa WWTP. The WWTP was constructed in 2003 with a design capacity of 3,400 m^3/day. The major process units include oxidation ditch reactors, final clarifiers, polishing ponds and sludge drying beds. The WWTP currently receives around 2,640 m^3/day and serves around 85% of the population as well as the Petra tourism trade. The WWTP is relatively new and in good conditions.

The Ma'an wastewater network serves around 75% of the population of Ma'an city and also includes a WWTP – Ma'an WWTP. Waste stabilization ponds were constructed to provide wastewater treatment in 1988, and in 2008 the ponds were replaced by an extended aeration activated sludge plant. The major process units include an equalization tank, aeration tanks, settling tanks, polishing lagoons, and sludge drying beds. The WWTP has a design capacity of 5,772m^3/day and currently receives around 2,260 m^3/day. The WWTP is relatively new and in good conditions.

In addition, within the Industrial Park a WWTP has been established by MDC, located at the east end of the Industrial Park. The WWTP is a mechanical – biological system for sewerage as well as industrial wastewater– provided they are pre-treated on-site at the respective factories for the removal of toxic and hazardous pollutants. It involves settling, conventional biological treatment, sludge handling and disinfection. The current capacity of this facility is 700 m^3/d, with a possible increase to 2,100 m^3/d. the WWTP currently receives around 150 – 200 m^3/d.

In addition to the WWTP, the system includes a main grey water reservoir, a 200mm distribution network and a pumping station. The treated effluent can be used either for some industrial processes or for restricted irrigation on-site and in nearby areas (such as roadside planting and other landscaped buffers).

Figure 34 below presents the location of the WWTPs in relation to the Project site. The Wadi Moussa WWTP is located 45km to the northwest of the Project site while Ma'an WWTP is also located 7km to the northwest of the Project site. The Industrial Park WWTP is located around 3km to the north of the Project site.

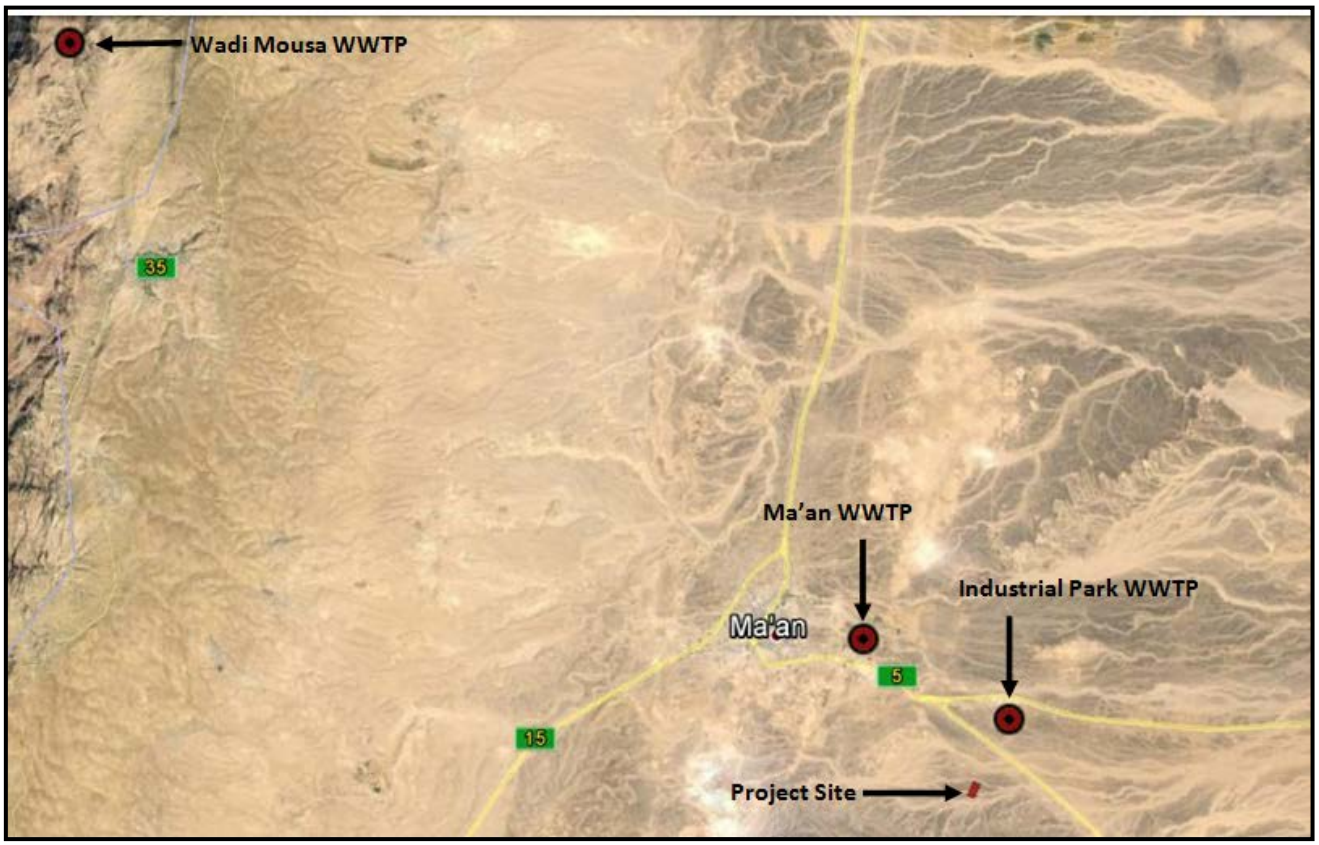

Figure 34: Location of WWTP in Ma'an Governorate

(ii) Solid Waste Management Utilities

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 the Project area, the Greater Ma'an Municipality is the responsible entity for collection and transportation of solid waste within Ma'an municipality for final disposal. Within Ma'an municipality there is only one authorized landfill which can be utilized for disposal of solid waste – known as Ma'an Central Landfill Site.

This landfill is located around 10km to the east of Ma'an city, and around 5km to the northeast of the Project site. According to discussions with Greater Ma'an Municipality, the landfill has an area of approximately 500 Dunums and receives around 80 tons of solid waste per day. Solid waste is disposed in trenches (each trench is approximately 600m in length, 10m width, and depth of 8m) after which the trench is covered with soil. 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. In addition, according to discussions with Greater Ma'an Municipality the landfill can also accept

construction waste and debris, whereas current practice within Ma'an is disposal through illegal dumping in wadis.

Figure 35: Location of Ma'an Central Landfill in relation to the Project Site

(iii) Hazardous Waste Management Utilities

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 located in Al-Karak Governorate, around 70km south of the capital city of Amman and 130km to the north of the Project site. The facility is operated and managed by the MoEnv.

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. Tenders for the second phase are expected to be released by the end of 2014, while construction to be completed by 2016.

In addition, there is currently a pilot project for disposal and management of electronic waste at Swaqa. Electronic waste is currently collected and stored at the landfill, and there are plans for collaborating with private entities for implementing recycling programs for such electronic waste streams.

Currently, there are no additional plans by the MoEnv for hazardous waste management facilities in Jordan.

7.7.4 Road Network

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 the Ma'an Governorate, the Ma'an Public Works Directorate assumes the responsibilities of the MPWH.

The Project site is accessed through the major 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 (Ma'an, Aqaba, Karak, and Al-Tafileh). This highway is heavily travelled on a daily basis 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 at about 100km road distance from the Port of Aqaba and about 200 km from Amman.

Once Highway #15 reaches the Ma'an area, an exit leads to Highway #5 (which runs to the north of the Project site by around 1.5km). Highway #5 is a major highway which connects Ma'an city with the Saudi Arabian Border (Mudawwara borders).

From Highway #5 currently there is no road network which leads to the Project site. However, the MDC will be establishing an access road network from Highway #5 which leads directly to the Solar Park area, and which will be utilized by the various developers. In addition, the Project Developer will be establishing an internal road network within the Project site for ease of access to the modules for operation and maintenance purposes.

Figure 36 below presents the Project site in relation to Highway #15 and Highway #5 which lead to the Project site, while Figure 37 below presents the access road which will be constructed by the MDC from Highway #5 to the Solar Park area.

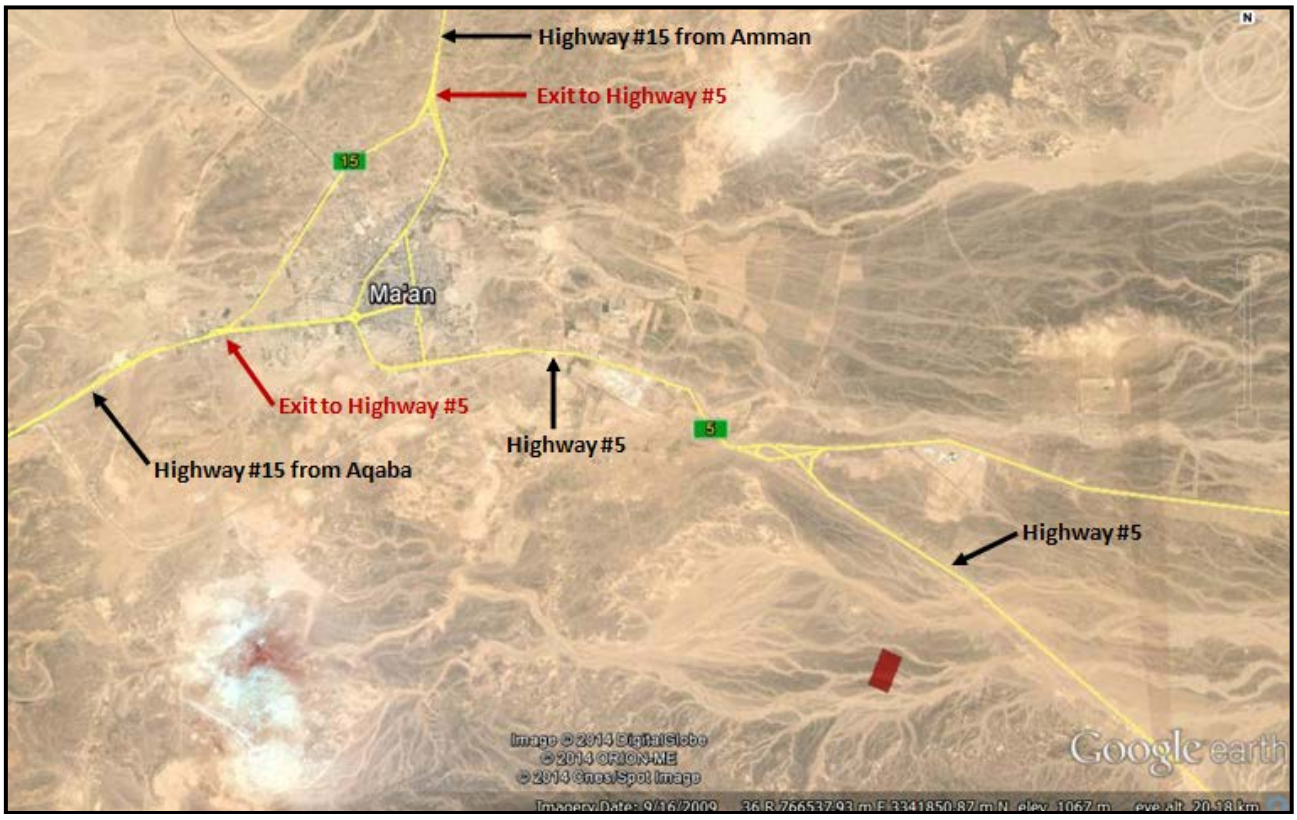

Figure 36: Road Network in the Project Area

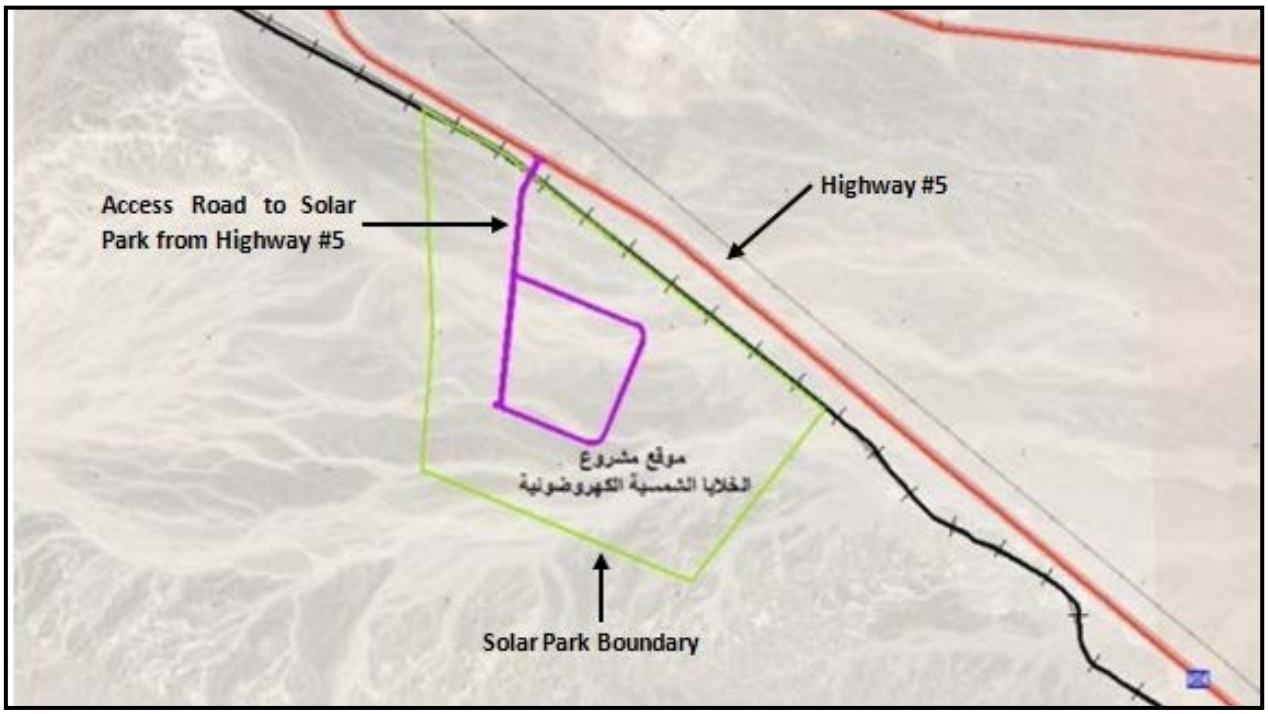

Figure 37: Access Road within the Solar Park Area

7.7.5 The Aqaba Railway

The railway which runs near the Project site is known as the Aqaba Railway and which is owned by the Hejaz Railway Corporation. However, the Hejaz Railway Corporation delegates responsibilities for operation, management, and maintenance of the Aqaba railway to the Aqaba Railway Corporation (ARC) in accordance with the "Aqaba Railway Corporation Law No. (22) of the year 1972".

The Aqaba Railway runs from the phosphate mines in Ma'an Governorate (in an area known as 'Batin Al Ghoul') till the Port of Aqaba in the south of Jordan. The railway was constructed and started operation in 1975 with a total length of around 290km.

The ARC was contacted in order to obtain the exact route of the railway in the area in addition to details regarding the nature of activities and schedule of the train passing within the Project site. The following provides a summary of the train and the railway:

- The railway runs around 1.4km to the north of the Project site;
- The railway near the Project site is utilized mainly for the daily transportation of phosphate from the mines in Ma'an Governorate to Aqaba in the south of Jordan. The wagons transporting phosphate are covered. In addition, the railway is also utilized for the following purposes:
  - Transportation of freight wagons from Aqaba to the workshops in Ma'an Governorate for maintenance activities;
  - Transportation of storage wagons incase transportation on the railway is closed and for refueling purposes;
  - Transportation of other various materials from Ma'an Governorate to various industries in Aqaba;
  - Transportation of maintenance material and equipment for the railway from Ma'an Governorate to the various industries in Aqaba
- The train passes in Project site area at a speed of 30km/h;
- There is no fixed time schedule for the train in the Project site as it operates according to the demands of the Jordan Phosphate Mines Company (JPMC) and the need for the various maintenance activities

discussed earlier. However, generally within the Project area transportation does not exceed three (3) trains per day with a frequency of six (6) times per day.

- The train is operated by two (2) operators which runs the train along the railway for its destination.

With regards to access to the Solar Park area through the railway, the MDC has undertaken meetings with the ARC and Hejaz Railway Corporation to discuss possible solutions to cross the railway into the Solar Park area. Based on such meetings it was agreed with the ARC and the Hejaz Railway Corporation that the optimal solution would be the establishment of a road (with a width of 6-7m) to cross the railway and which will run on the same level. No overpass or underpass is required. On the junctions between the road and railway the necessary safety measures will be implemented, and which will include a railway signal which would instruct the user of the road not to pass when the train is near. The MDC has signed a 'Right of Passage' with ARC and Hejaz Railway Corporation

Figure 38 below presents the location of the Aqaba Railway and the point of access to the Solar Park area. Figure 39 presents a view of the railway in the area.

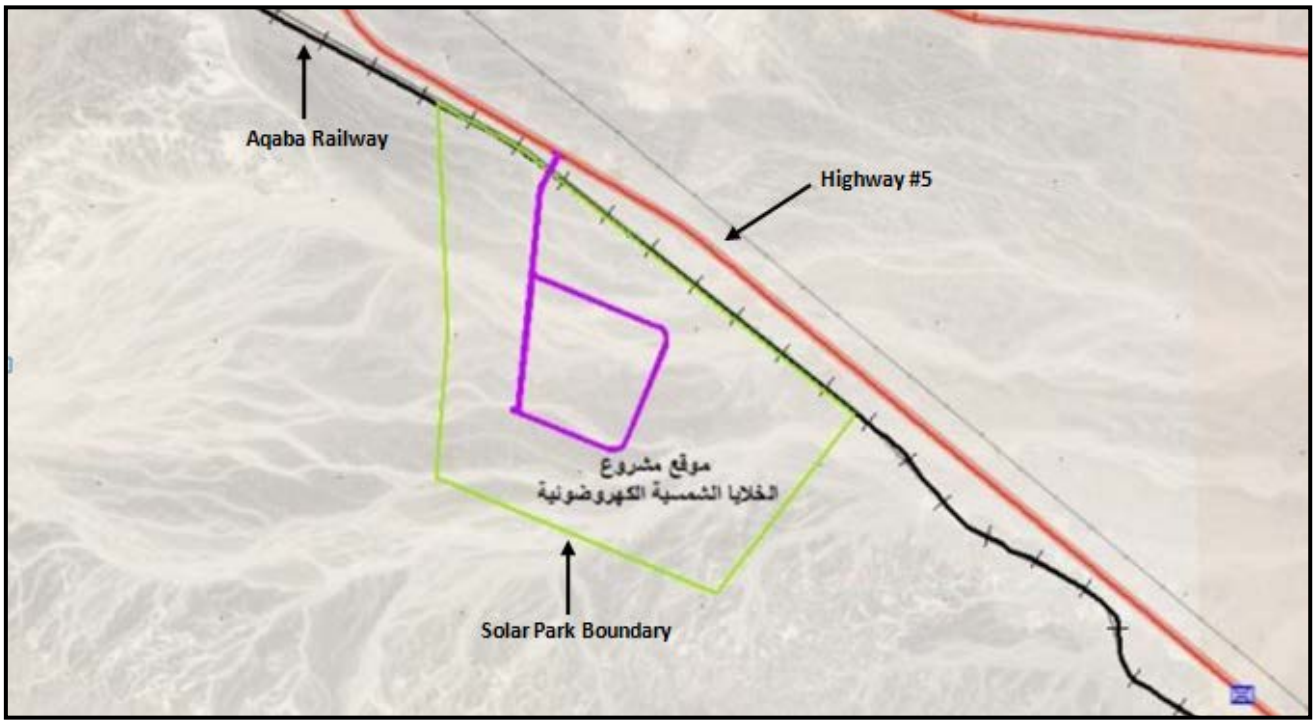

Figure 38: Location of the Aqaba Railway within the Area

Figure 39: View of the Aqaba Railway within the Area

7.7.6 Electricity Network

The electricity structure in Jordan is compromised of the following entities:

- Three generation companies, namely: the Central Electricity Generating Company (CEGCO), the Samra Electricity Power Generation Company (SEPGCO), and the Amman East Power Company (AES Jordan PSC);
- The National Electric Power Company (NEPCO) responsible for transmission of electricity through high voltage lines; and
- Three distribution companies responsible for distribution of electricity through medium and low voltage lines: the Jordanian Electric Power Company (JEPCO), the Irbid District Electricity Company (IDECO) and the Electricity Distribution Company (EDCO).

The electricity system is regulated by the Electricity Regulatory Commission (ERC), while the Ministry of Energy and Mineral Resources (MEMR) is responsible for political decisions.

Jordan transmits electricity through high voltage lines (400 and 132 kV) under the responsibility of NEPCO and distributes electricity through medium and low voltage lines (33/11/4 kV) under the responsibility of the respective distribution companies mentioned above. There are about 2,200 circuit-km of transmission lines currently operated at 132 kV, and 809 circuit-km of transmission lines operated at 400 kV.

The two overhead high voltage line corridors run from north to south in Jordan. The 132kV transmission line is located about 1.8km to the north of the Project site, and the Project will be connecting with this line through the substation that will be built by NEPCO near the Project site. The 400kV transmission line is located around 8km to the northwest of the Project site.

In addition, a 132/33 kV substation is located in Ma'an city at about 10km from the Project site. The substation is managed by NEPCO as it is a high voltage substation. This substation supplies Ma'an city with its electricity requirements through distribution lines which are within the jurisdiction of the Electricity Distribution Company (EDCO). EDCO is responsible for all electricity distribution in the southern governorates (Ma'an, Aqaba, Al-Tafileh, and Karak).

Figure 40 below presents the Project site in relation to the high voltage lines (400 and 132 kV) as well as the Ma'an 132/33 kV substation.

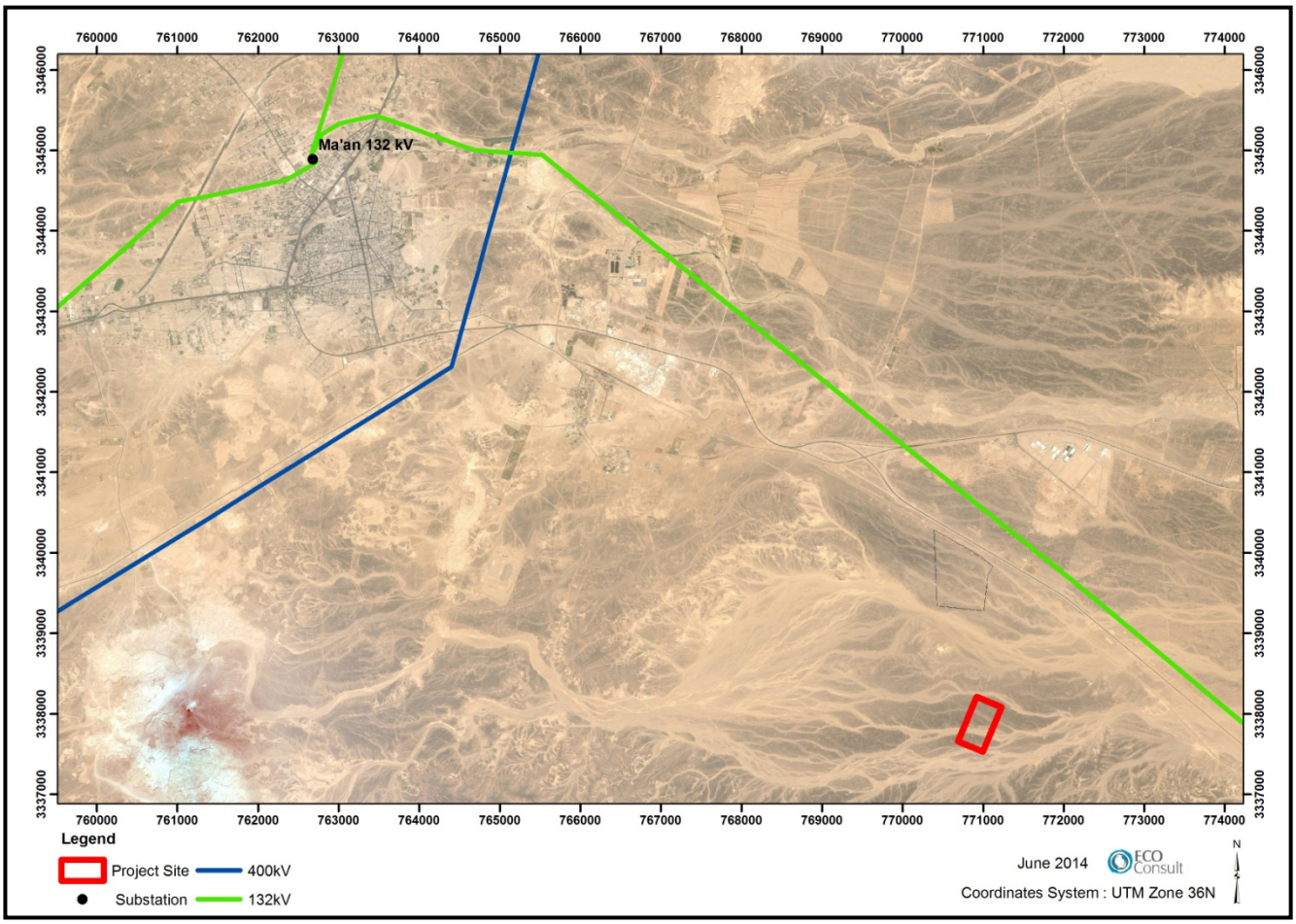

Figure 40: High Voltage Electricity Network in the Project Area

7.8 Socio-Economic Conditions

This section describes the current socio-economic conditions in the Governorate as a whole and within those local communities near the Project area to the greatest extent possible.

7.8.1 Baseline Data Collection 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 Social Development Unit (SDU) of the Ma'an Governorate (mainly the "Economic and Social Situation of Ma'an Governorate Report of 2013"). Available data from DoS and SDU was collected and reviewed for certain indicators in order to characterize and describe the socio-economic situation.

However, it is important to note that the majority of the socio-economic data is mainly available at the Governorate or sub-district level; little or no data is available specifically for the local communities near the Project area. Therefore, the 'ESIA Team' undertook discussions with the SDU of Ma'an Governorate as well as consultations with the local community (refer to Section 6.4.2) to better understand and characterize the socio-economic conditions of the nearby Project area to the greatest extent possible.

In addition, it is important to note that statistical data does not fully represent the current socio-economic conditions within Ma'an Governorate or the local communities. Therefore, the aim of the discussions with the SDU and consultations with the local community was also to better understand and characterize the socio-economic conditions and the main challenges they face to the greatest extent possible.

7.8.2 Results

This section presents the results of the socio-economic conditions in relation to (i) population and demographics, (ii) livelihood and employment, (iii) income, unemployment, and poverty, (iv) education services, and (v) health services.

As discussed earlier, the Project site is located within the District of Qasabit Ma'an. The closest settlements to the Project site, within the District of Qasabit Ma'an, include Ma'an City (which is the capital city of the Governorate and which is located around 9km to the northwest of the Project site) and Al-Mahata Village (located approximately 6km to the northwest of the Project site). Taking the above into account, those are referred to the 'local community' throughout this Section.

In addition, as discussed earlier, the Project area in general is not known for any nomadic/semi-nomadic settlements given its natural characteristics (being desert area that is arid and barren with no water resources).

(i) Population and Demographics

According to DoS, the population of Ma'an Governorate in 2012 was estimated at 121,400 with an annual average population increase of 2.3% over the last decade. The population of the Governorate represents 2% of the total population of the Kingdom.

The Governorate has a similar gender distribution ratio of approximately 1:1, and an average household size of around 6 members. As expected, the majority of the population lives in the major district (around 55%) of the Governorate where the capital city is located; Ma'an City (representing around 30% of the total population of the Governorate). The Governorate has a population density less than 4 people/km^2, which is significantly lower than the national average of 72 people/km^2 given that the majority of the Governorate is unpopulated desert land.

A summary of the Governorate's profile is presented in Table 21 below; in addition Table 22 provides a breakdown of population by administrative setup including the population of the local communities near the Project area; mainly Ma'an City and Al-Mahata Village.

Table 21: Summary of Ma'an Governorates Profile

Statistic	Ma'an Governorate	National Average
Population	121,400	6,249,000
Average Household Size	6	5.3
Number of households	20,101	1,134,177
Population Density (people/km^2)	3.7	71.9
% Living in Major District	55%	N/A
% of Male /Female	52/48	52 / 48

Table 22: Breakdown of Population by Administrative Setup

Governorate	District	Population
Ma'an	***Qasabit Ma'an District***	***65,710***
	Ma'an City	*33,349*
	Al-Mahata Village	*300*
	Eel Sub-district	*9,410*
	Al-Jafr Sub-district	*8,730*
	Mregha Sub-district	*8,480*
	Athroh Sub-district	*4,750*
	Petra District	***30,710***
	Al-Shobak District	***14,280***
	Husseiniyeh District	***10,700***
Total		**121,400**

Ma'an governorate is characterized by three major social environments; these are the city style, the village style, and nomadic. The city style is represented mainly by Ma'an city. In spite of that, the simple village life style is dominant in the villages and small settlements scattered along the Governorate, and are still the base that governs all social relations in Ma'an.

Nomadic population is decreasing due to several factors, however nomads move on seasonal basis in search of proper range land to feed their livestock; however, the Project area in general is not known for any nomadic/semi-nomadic settlements.

(ii) Livelihood and Employment

The section below discusses the main employment sectors in the Ma'an Governorate and nearby communities based on statistics from DoS and SDU of the economically active population, as well as discussions with representatives from the SDU and consultations with the local community.

According to DoS, in 2012, the main employment sectors in Ma'an Governorate were public services, education, and industry and trade. These statistics are based on the economically active population of age 15 and above. A description of each is given below in addition to an important sector which does not employ high percentages of the population; agriculture and livestock.

Public Services and Education

The public service constitutes the highest percentage of the working population, accounting for 43% of the population in Ma'an. This sector mainly entails working for armed forces, police, and public administration offices and civilian central government. On the other hand, the education sector accounts for 19% of the working force mainly in public schools. The staff mainly includes teachers and administrative personnel, whom

are mostly females. Together; these two sectors constitute around two thirds of the working population in Ma'an Governorate, indicating that the majority of the workforce work for the government and in the public sector.

Industry and Commerce

Industry and commerce forms an important part of the employment sector in Ma'an that accounts for 20% of the workforce respectively. According to DoS, in 2006 (latest statistic) there were approximately 2,260 active economic establishments in Ma'an. The breakdown for the active economic establishments that represent 90% of the total active establishments is presented in Table 23 below.

Table 23: Major Economic Establishments in Ma'an

Economic Establishment	Number of Establishments	Comment
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods.	1,274	Represents 60% of the total active establishments. Mainly includes retail in food and beverages , and some in clothing and household appliances
Sale, maintenance and repair of motor vehicles	199	Mainly includes maintenance and repair of motor vehicles and sales of parts
Hotels and restaurants	149	Mainly restaurants
Other service activities	127	Mainly includes hairdressing and other beauty treatment
Other business activities	73	Mainly includes legal activities
Manufacture of fabricated metal products	60	Mainly manufacture of structural metal products and treated and coating of metals
Manufacture of fabricated metal products, except machinery and equipment.	57	Mainly includes manufacture of structural metal products
Manufacture of other non-metallic mineral products	47	Engaged in manufacture of articles of concrete, cement and plaster as well as cutting, shaping and finishing of stone
Manufacture of food products and beverages	34	Mainly includes bakery products and grain mill products
Mining and quarrying	22	Quarrying of stone, sand, and clay
Construction	8	Engaged in civil engineering and building construction
Total	**2,050**	**Represent 90% of the total active economic establishments**

It can be concluded that the majority of economic establishments in the Governorate are those that engage in retail trade of commodities (food, beverage, clothing, and household appliances) all of which are considered to be small establishments. In fact, according to discussions with Ma'an Chamber of Commerce it was confirmed that the majority of economic establishments engage in retail trade, and most economic establishments are of small size. There are a limited number of economic establishments which have a registered capital greater than 1 million JD which are mainly chains of national banks and telecommunication companies in addition to three important economic establishments which include: (i) Jordan Phosphate Mining Company – engaged in mining of phosphate, (ii) Indo-Jordan Chemicals Company – engaged in production of Phosphoric Acid and Sulfuric Acid , and (iii) a newly established plant - Al Awsat for chemical production.

Discussions with the Chamber of Commerce also highlighted the lack of private sector investment projects in the Governorate which must focus on the unique characteristics of Ma'an. However, according to discussions it is believed that with the vision of MDC for MDA they hope for a higher level of private sector investments which should focus on investments in production and manufacturing as well as renewable energy projects such as solar which should exploit the abundance of sunlight in Ma'an throughout the year.

Agriculture and Livestock

Agriculture and livestock are also considered important economic activities within the Ma'an Governorate, both of which emphasize the cultural and traditional practices in Ma'an. However, statistics indicate a very low percentage of the working population in those two sectors given that it is generally undertaken for self-sufficiency purposes rather than being a main source of income, especially in the villages within the Governorate.

The Nearby Communities

According to discussions with the SDU and consultations with the local community, the following summarized the livelihood and employment patterns of the local community:

- Employment opportunities are similar to the statistics presented at the Governorate level. Employment opportunities are mainly limited to public services (to include public administration offices and civilian central government) in addition to industry and commerce which is mainly limited to small economic establishments that engage in retail trade of commodities (food, beverage, clothing, household appliances, etc);
- There are limited agricultural and livestock raising activities undertaken by those communities and mainly for self sufficiency purposes. In particular, the area in general is not known for high activity of livestock raising – where such activities are more concentrated in other sub-districts of Ma'an Governorate such as Al-Jafr, Eel, and Al-Husseiniyeh.

(iii) Income, Unemployment, and Poverty

The section below discusses the income, unemployment, and poverty in Ma'an Governorate and nearby communities.

According to DoS, the average annual income per household in 2010 (latest statistic) in Ma'an was around 7,500 JD , lower than the national average of 8,800 JD. This translates into 625 JD per month for the entire household (which averages around 6 members). In addition, around 60% of the income is generated from employment, 20% from transfers (which in general are in the form of pensions, subsidy transfers from the Government and transfers from expatriates), 5% from own business, and 13% from rent. Similarly, the average annual income per household member in Ma'an is 1,300 JD which is lower than the national average of 1,660, which translates into less than 110 JD per month.

Comparing those figures to the national averages clearly reveals that households in Ma'an Governorate are poorer and are at a lower standard of living when compared to the average Jordanian household.

In regards to employment, in both Governorates, in 2012 (latest statistic) 40% of the population of age 15 and above are economically active, of which 32% are working and 8% are seeking a job, whereas 60% are economically inactive. The high rate for the inactive population is due to the fact that they are mostly students (30% of the inactive) and housekeepers (50% of the inactive). It is worth mentioning that the majority of the economically inactive that can work but do not, believe that there are no job opportunities in the market for them and/or are tired of searching for a job.

Taking into account 2012 statistics for population, labour, and age breakdown gives insights about the human resources that are capable of being producers, of age 15 – 60+, in the community (economically active but cannot find a job); estimated at 6,000. The majority of the workforce, more than 50%, is between the age of 25 years old and 39, and around 19% are between 20-24 and 40-49. A very low percentage of the workforce is between the age of 15 -19 and 60+ (around 1%). Assuming a similar distribution among the unemployed, then projects targeting men and women in their twenties and thirties would have the highest impact on employment.

Figure 41 below presents the unemployment rate of Ma'an Governorate during the last 10 years compared to the national average. All statistics were based on DoS figures. The trend indicates a decreasing unemployment rate from around 24% to around 19% during the last 10 years; although from year to year it varies and most notable it increases from 2011 till 2012 from 15% to 19%. Nevertheless, the gap between the national figure and that of Ma'an Governorate clearly decreases throughout the last decade as presented in the figure below. However, although unemployment rate has improved throughout the last 10 years, it still remains higher than the national average, estimated at 12% in 2012, compared to 19% in Ma'an.

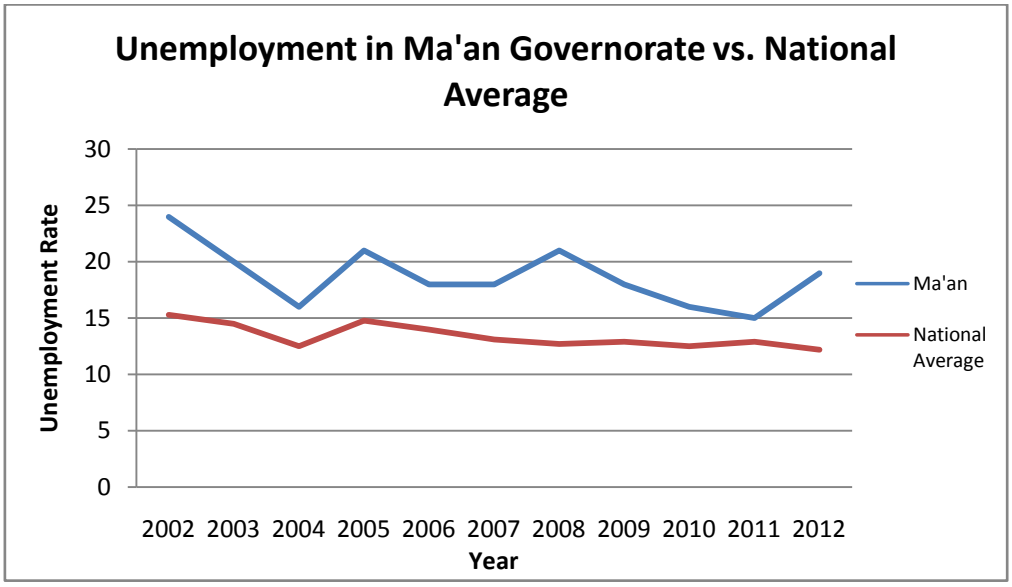

Figure 41: Unemplyoment in Ma'an vs. National Average from 2002-2012

Figure 42 below presents the poverty rates for the Governorate for 2008 and 2010 compared to the national average. Similarly, all statistics were based on DoS figures. Poverty rate accounts for the percentage of residents who spend less than the national absolute poverty line. The absolute poverty line, also known as the general poverty line, is the required level of income or expenditure for an individual to secure the basic nutritional needs along with other basic non-nutritional needs related to housing, clothing, education, health, and transportation. In 2008, the absolute national average poverty line for the Kingdom was estimated at 680 JD and increased to 814JD in 2010.

The numbers in the figure below indicate that poverty rates in Ma'an are significantly higher than that of the national average in 2008 and 2010; around 24% compared to 13% and around 27% compared to 14% respectively. Ma'an ranked second (after Mafraq) in 2008 and was ranked first in 2010 for the Governorates with the highest poverty rates in the Kingdom.

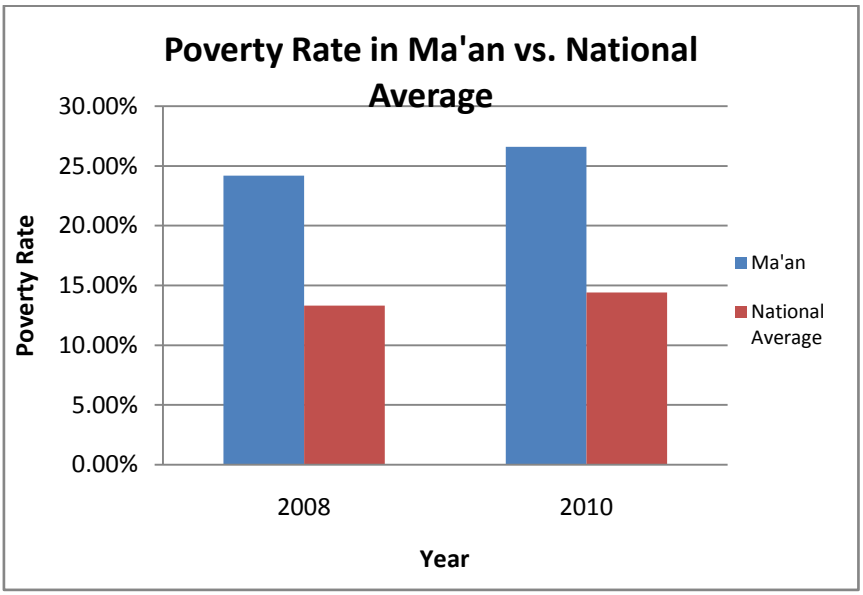

Figure 42: Poverty Rate in Ma'an vs. National Average for 2008 and 2010

According to the report "Poverty Situation in Jordan" (DoS, 2010 and 2012) (which was based on 2008 and 2010 data respectively), the increase in poverty is likely attributed to the reduction in the purchasing power due to inflation throughout the years which has reflected on the actual expenditure of individuals in those areas. However, generally poverty rates can be considered rather constant in Jordan as it is constant in those Governorates with the highest population numbers where more than two-thirds of the population of the Kingdom are concentrated.

The poverty statistics above are consistent with the listings of poverty pockets within Ma'an Governorate. Poverty pockets are the sub-districts in Jordan where poverty rate equals or exceeds 25%. According to DoS, in 2008 Ma'an Governorate had 4 poverty pockets (Mregha, Al-Jafr, Husseiniyeh, and Athroh) in all of which poverty increased in 2010 along with the introduction of a new sub-district (Eel Sub-district). Table 24 below identifies the poverty pockets in Ma'an in 2008 and 2010. As noted in the table below, the District of Qasabit Ma'an (where the Project site is located and which hosts Ma'an city and Al-Mahata village) has not been listed as a poverty pocket in 2008 or 2010.

Table 24: Poverty Pockets in Ma'an in 2008 and 2010

District/Sub-District	Poverty Rate in 2008	Poverty Rate in 2010
Mregha	48.4%	50.5%
Al-Jafr	25.7%	33.8%
Husseiniyeh	37%	52.5%
Athroh	27.7%	26.5%
Eel	Not listed as poverty pocket	48.3%

Statistically speaking, it is evident that the situation in Ma'an Governorate is rather unclear as unemployment has generally been decreasing while poverty has been increasing. However, in order to understand and characterize the situation in reality and better understand the situation for those local communities, the 'ESIA Team' undertook discussions with the SDU of Ma'an Governorate as well as consultations with the local community.

Based on the above, it has been concluded that generally unemployment and poverty rates have not been improving and both rates are still considered high. This is attributed to the following:

- General difficult economic conditions in the Kingdom as a whole along with a reduction in the purchasing power due to inflation throughout the years which has been reflected on the actual expenditure;
- Local communities mainly work in the public services which are considered low income professions;

- The lack of governmental and private sector investment projects that can employ labour and thus positively impact slevel tnemyolpmenu. The area requires more private sector investment which can capitalize on its unique characteristics such as: (i) abundance of natural resources such as phosphate, phosphoric acid, silica sand, kaolin and building stone, (ii) abundance of sunlight throughout the year, (iii) its strategic geographical location in Jordan being close to the Port of Aqaba and on the Iraqi-Saudi land route;
- The investment and development projects/programs that were targeted for the Ma'an area and which are supposed to improve the socio-economic conditions are generally weak and till today their benefits have not been realized by the local community. Several of those investment and development projects/programs failed to employ local community members (specifically in skilled labour) as such employment opportunities were generally targeted for people outside of Ma'an Governorate; and
- The increase in graduate numbers against the backdrop of employment opportunities in the area.

(iv) Education Services

According to the SDU, Ma'an has 201 schools (59 secondary schools, 135 primary schools, and 7 military education schools) with a total of 3,000 teachers whom educate a total of 29,000 students. The schools are distributed within most of the communities' in Ma'an Governorate. Specifically within the District of Qasabit Ma'an, there are 40 schools (7 secondary schools and 33 primary schools) with a total of 960 teachers whom educate a total of 9,200 students. No data was available on students that continue to higher education.

With regards to higher education, two main universities/colleges exist which the local community attends for higher education (both of which are located around 10km from Ma'an city). Those include Al-Hussein Bin Talal University and the Ma'an College both of which are discussed in further details below.

- Al-Hussein Bin Talal University: the University is a public coeducational university founded in 1999. The University is located on the western and south-western borders of the Project site with an approximate area of 171,000 m^2. The University has around 1,110 staff members to include around 280 faculty members and around 830 administrative staff. The University hosts around 8,700 students. The University offers bachelor degree programs through eight (8) colleges to include arts, science, engineering, education, information technology, tourism and archaeology, economic and business administration, and nursing.

  In addition, the University has seven (7) scientific centers engaging in research and development projects to serve local and national communities and improve students' life quality and delivery of study programs. Of particular importance is the Renewable Energy Research and Development Centre. The Centre aims to promote renewable energy and energy efficiency by developing training activities, educational programs, scientific research, development projects and industrial partnership.
- Ma'an College: the Ma'an College was established in 1989 and is under the umbrella of the Al-Balqa Applied University on an academic, administrative and financial level. The College is located on the south-western borders of the Project site. The University has around 140 staff members: around 32 faculty members and around 60 administrative staff. The University hosts around 450 students.

  The College offers intermediate diploma degrees in various programs to include child education, nursing, management information systems, accounting, finance, business administration, special education, and railway engineering.

It is important to note that based on consultations with the local community (refer to Section 6.4.2), they have expressed that within the Ma'an area there is a lack of qualified training and capacity building programs. Based on several past experiences by the local community, several Vocational Training Center's (VTC) were established with the objective of providing adequate training and capacity building for the local community in the hope of providing employment opportunities in such development projects. Such VTC's failed to deliver the required set of skills and qualifications to local community, and thus they were not employed within such

development projects as they were considered incompetent. Similar expectations were held by the local community with regards to the renewable energy VTC which was recently established by the MDC as discussed below.

The MDC has recently established a renewable energy Vocational Training Center (VTC) within Ma'an city. The VTC will offer a one year training and capacity building program in solar PV projects in specific (programs for other renewable energy, such as wind power, will commence at a later stage). According to discussions with the MDC, the program includes two phases, each consisting of a 6 month period; the first period involves education and soft skill building in the basics of PV, while the second period involves training in PV developments. Upon completion of the program, graduates will develop the necessary skills and requirements to be involved in skilled job opportunities throughout the construction and operation phases of the various PV development Projects within the Solar Park area.

The first program will commence in June 2014. The program has a capacity of 20-25 students and is targeted for students within colleges and universities as well as interested local community members.

(v) Health Services

Within Ma'an Governorate there are two (2) public hospitals, the Ma'an Public Hospital located within Ma'an city and the Queen Rania Hospital located within Petra District. The following table summarizes the profile of each hospital.

Table 25: Summary of the Hospitals within Ma'an Governorate

Name	Bed Capacity	Number of Staff	Services Provided (Medical Specialties)
Ma'an Public Hospital	132	45 doctors, 35 administrative staff, 132 nurses, and 40 technicians	Surgery, internal medicine, orthopaedics, urology, gynaecology, paediatrics, ophthalmology, dermatology, physiotherapy, and otolaryngology.
Queen Rania Hospital	75	37 doctors, 99 nurses, and 28 technicians	Surgery, internal medicine, orthopaedics, urology, gynaecology, paediatrics, ophthalmology, dermatology, and otolaryngology.

The Governorate is also served with five (5) comprehensive health centers of which one is located within Ma'an city and which serves the local communities, while the others are located in Al-Shobak, Wadi Mousa, Al-Husseiniyeh, and Al-Jafr. In addition, spread throughout the Governorate are 38 primary health centers , 22 dentistry centers, 22 maternity and child care centers, 30 pharmacies, 16 laboratories, and 5 radiology laboratories.

8. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

8.1 Overview of the Strategic Environmental and Economical Impacts

The Project will results 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.

8.1.1 Master Strategy of Energy Sector in Jordan

The energy demand in Jordan is characterized with a rapid increase. 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 demands in 2020 is 5,770 MW compared to 2,100 MW in 2007; and average increase of 300MW per year.

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 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 Section 1.2.

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.

8.1.2 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 in specific will contribute to increasing energy security through reliance on an indigenous, inexhaustible and mostly import-independent energy resource. The expected electricity generation from the Project is around 20 GWh per year; which will serve the average annual electricity needs of around 4,000 local households.

8.1.3 Economic Benefits

The reliance on imported energy as discussed earlier above has led to major economic burdens to the Jordanian economy. Over the past year, 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 decrease in the Government of Jordan's fiscal deficit.

8.1.4 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, sulfur 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 PV power is rather pollution-free during operation and compared with the current conventional way of producing electricity, 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. The Project will on average displace around 14,000 ton of CO_2 annually.

8.2 Landscape and Visual

This section identifies the anticipated impacts on the landscape and visual characteristics of the site from the Project activities during the construction and operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements have been identified.

8.2.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for the installation of PV arrays and the various Project components to include transmission cables, inverter stations, internal roads, buildings, etc are expected to include land clearing activities, leveling, 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 excavators, trucks, front end loaders, compactors and other.

However, as discussed in Section 7.1.3, there are no key sensitive visual receptors within the surrounding vicinity – such as recreational activities, environmental reserves, remarkable historical or cultural sites, water courses or other natural structures normally seen as valuable by the human perception. In fact, the Project site is close to an Industrial park to which the aesthetical value of the area loses some importance.

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 be noticeable, 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 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 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 8.4.2.

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 during the construction phase and which include:

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

8.2.2 Potential Impacts during the Operation Phase

(i) Potential Impacts from Project Visibility

The Project is expected to be visible within the immediate vicinity and up to some kilometers around the Project site only and thus is likely to create visual impacts. The maximum height of the PV mounting structures is expected to be in the range of 2-3.5 m. Only the PV substation of NEPCO, which will be located to the north of the Project site, will comprise higher installations being typical for HV substations and 132 kV transmission lines - including towers of the transmission line, which will be in line with the already existing towers of the 132 kV line near the Highway. The most important receptor to which this Project would be visible would be commuters on the road on Highway #5 – where such views would be temporary and limited to the time of passage within the area.

However, being visible is not necessarily the same as being intrusive. Aesthetic issues are by their nature highly subjective. For some viewers, a PV Plant 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.

More importantly, as discussed earlier, there are no key sensitive visual receptors within the surrounding vicinity of the Project site – such as recreational activities, environmental reserves, remarkable historical or cultural sites, water courses or other natural structures normally seen as valuable by the human perception. In fact, the Project site is close to an Industrial park to which the aesthetical value of the area loses some importance.

The visual environment created will be of a long-term duration throughout the operation phase of the Project. For the duration of operation, the visual impacts will be of a negative nature and be noticeable, 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 of the above, such an impact is considered to be of minor significance.

(ii) Potential Impacts from Glare

Another issue associated with the Project is the potential for glare caused by sunlight reflected off the PV panel modules. It is important to note that PV Panels work on the concept of absorbing sunlight rather than reflecting it as in the case of other technologies (e.g. Concentrated Solar Panels CSP).

Nevertheless, not all of the incoming sunlight is absorbed and thus a minimal amount of incoming sunlight is reflected. Therefore, PV panels could be associated with potential for glare caused by sunlight reflected off the modules. This depends on several factors such as the amount of sunlight hitting the surface, surface reflectivity, geographic location, time of year, cloud cover, and solar panel orientation. However generally, glare is likely to occur when the sun moves away from perpendicular to the panel and when the sun is low on the horizon (toward sunrise and sunset), because the solar panel is absorbing much less of the incoming light.

In addition, it is important to put things into perspective. According to the "Glint and Glare Study for Panoche Valley Farm" (Jack Pfaff, 2011), standard solar glass reflects much less light and has lower potential for glare when compared to other materials widely used in other developments such as steel, standard glass, plastic and even when compared to snow and smooth water. Figure 43 below provides a comparison of sunlight reflection from various incidents angles of solar glass in comparison to such materials.

In addition, throughout the world there are several PV development projects operating close to sensitive areas which could be potentially impacted by glare – such as airports; and thus indicating that the potential for glare is rather not considered an issue of concern. This include PV Project development near Thunder Bay Airport in Canada, Nellis Air Force Base in USA (Figure 44 below), Dusseldorf International Airport in Germany, Denver Airport in USA, and many others.

Common Reflective Surfaces (in surrounding environments for PV systems)		Incident angle in degrees						
		0	15	30	45	60	75	90
Material Reflectivity (percent of incident light reflected)	Steel	36.73%	39.22%	46.34%	57.11%	70.02%	83.15%	94.40%
	Snow (fresh, flakey)	21.63%	23.09%	27.29%	33.63%	41.23%	48.96%	55.59%
	Standard Glass	8.44%	9.01%	10.65%	13.12%	16.09%	19.10%	21.69%
	Plexiglass	8.00%	8.54%	10.09%	12.44%	15.25%	18.11%	20.56%
	Plastic	6.99%	7.46%	8.82%	10.87%	13.33%	15.83%	17.97%
	Smooth Water	4.07%	4.35%	5.14%	6.33%	7.76%	9.22%	10.47%
	Solar Glass (high light transmission, low iron)	3.99%	4.26%	5.03%	6.20%	7.61%	9.03%	10.26%
	Solar Glass w/AR coating	2.47%	2.64%	3.12%	3.84%	4.71%	5.59%	6.35%

(Note: Index of refraction values may vary slightly depending on suppliers and reference documentation. The values for the above calculations are averages or single values obtained from the list of references for this document).

Figure 43: Reflectivity of Various Materials based on Incident Angles

Figure 44: PV Modules Installed near the Nellis Air Force Base in Nevada – USA

In addition, the PV modules for the Project are designed with anti-reflective coatings to capture maximum sunlight and to minimize reflections and thus reduce the potential for glare. Moreover, an even more relevant effect of minimizing glare is soiling, though not regarded as desirable. With soiling, the deposition of dust and small particles on the module surface is inevitable, which often starts accumulating some hours after cleaning. The higher the degree of soiling, the lower the potential for glare. Therefore the highest possibility of glare exists only directly after cleaning.

Nevertheless, taking all of the above into account, the sensitive receptors which could be affected by glare would include the following:

- Civil and military aviation. There are no airports or landing strips within the area – as the closest civil airport is the King Hussein International Airport located around 100km to the southwest, while the closest military airport is in Al-Jafr located around 40km to the northeast. Nevertheless, the 'ESIA Team' has previously consulted with CARC and JRAF to investigate whether they have any specific requirements or issues of concerns regarding PV development Projects within the Solar Park (as part of the ESIA studies undertaken for other Solar PV Development Projects within the Solar Park), and were provided with the required details and information. Accordingly, CARC officially stated that is has no objection on the Project development based on assuring that the panels are state of the art and won't result in reflections greater than natural surfaces such as water bodies or other common materials.
- The railway runs close to the Project site. However, this train is not for passenger transport but rather dedicated to transportation of phosphate from the phosphate mines in Ma'an Governorate to Aqaba Governorate. Thus, the only receptor which could be affected by glare (in certain conditions as discussed earlier) would be the operator of the train as it passes within the Project area. However, such impacts are minimal and temporary as it is limited to when the trains pass near the Project area; and
- The Highway which runs close to the Project site. In certain conditions, commuters along this Highway could be temporarily affected by glare as they pass through the area. However, such impacts are minimal and temporary.

The potential impacts from glare will be of a long-term duration throughout the operation phase of the Project. For the duration of operation, the potential for glare will be of a negative nature and be noticeable, and therefore of medium magnitude. The only key sensitive visual receptors which would be affected are the operator of the train and commuters along the highway, and thus the receiving environment is determined to be of a medium 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 Developer and/or EPC Contractor during the operation phase and which include:

- Submit an application for a permit from CARC and JRAF along with the required details and information. It is highly likely that CARC and JRAF will respond officially with no objection on the Project development (given that such official responses have been obtained for other PV developments within the Solar Park as discussed earlier) but will require a guarantee from the Developer/EPC Contractor that the panels are state of the art and won't result in reflections greater than natural surfaces such as water bodies or other common materials (where such issues has been discussed earlier);
- Upon completion of construction activities, coordinate with various PV developers within the Solar Park and MDC to notify the Aqaba Railway Corporation (ARC) that there could be potential for glare within the area;
- Upon completion of construction activities, coordinate with various PV developers within the Solar Park, MDC, and the Ma'an Public Works Directorate to install informative signs on the Highway for commuters regarding potential for glare within the area.

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 operation phase and which include:

- Submission of proof of coordination with authorities discussed above.

8.3 Land Use

This section identifies the anticipated impacts on land use from the Project activities during the planning and construction and operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements have been identified.

8.3.1 Potential Impacts during the Planning and Construction Phase

The Project site location does not conflict with any of the relevant governmental entities formal planning context. In addition, the Project site does not provide any specific value or specific use to local communities. Therefore, there are no anticipated impacts during the planning and construction phase of the Project.

8.4 Geology, Hydrogeology, and Hydrology

This section identifies the anticipated impacts on geology, hydrology, and hydrogeology from the Project activities during the planning and construction and operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements has been identified.

8.4.1 Potential Impacts from Local Flood Hazards during Planning and Construction Phase

As discussed in Section 7.3, a wadi system runs within the Project area known as Wadi Aqeeqa (Figure 45 below). This wadi is generated from high land of the sub-catchment area and reaches a narrower place located at 3 km to the west of the Project area and then spreads to several branches which merges and diverges in and near the Project site location. This wadi has only seasonal floods to short duration – mainly during flashflood events during the winter season. The wadis drain mostly eastwards towards the railway and the Highway (Highway#5) located in the east of the Project site.

To this extent, the MDC has undertaken a flood risk study which generally aimed to determine flood quantities within the Solar Park area and peak flood estimates to determine the peak flow for the return period of 50 years – "Hydraulic and Hydrological Analysis Report for Ma'an Solar Panels" (Amman Consulting, 2013). The Study states that there is a flooding risk within the Solar Park due to its topography, rainfall storm pattern, soil type, etc and the area needs to be protected from potential floods.

Taking the above into account, it is evident that the Project site is subject to potential risk of local flood hazards during the 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.

Should such risks not be taken into account by the Developer, 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 given that they are limited to seasonal floods of short durations. However, this is considered of high sensitivity given that it could entail serious damage to the Project. Given all of the above, such an impact is considered to be of moderate-major significance.

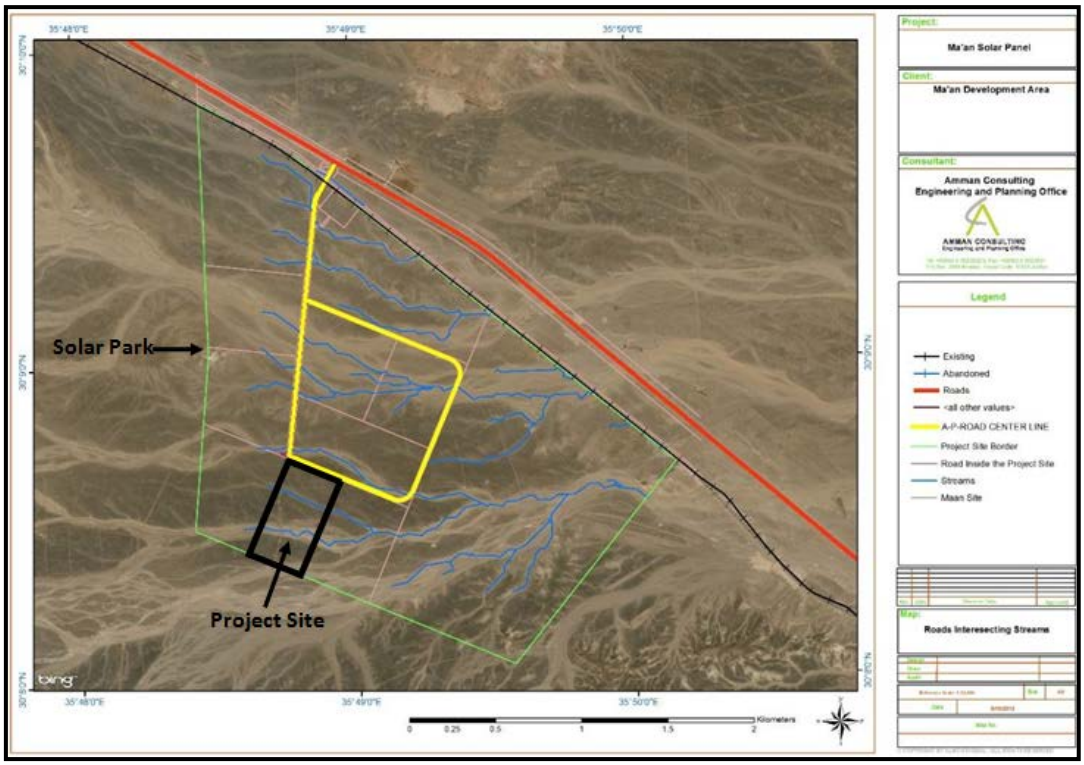

Figure 45: Wadi Systems within the Project Site

Mitigation Measures

As discussed earlier, the MDC has undertaken a flood risk study which generally aimed to determine flood quantities within the Solar Park area and peak flood estimates to determine the peak flow for the return period of 50 years. Based on that, the study identified the required hydraulic design structure which would be able to convey these flows safely and prevent flood risks for the infrastructure elements within the Solar Park under the responsibility of MDC; which mainly includes the access road to the Solar Park area only.

The Study states that there is a flooding risk within the Solar Park due to its topography, rainfall storm pattern, soil type, etc and based on the Unit Hydrograph Approach the peak flow was determined to be 22m^3/s; thus the Study recommends that the access road should be protected from potential floods through 10 culverts to be constructed at the wadi and road intersections.

However, it is important to note that the Study does not specify the required hydraulic design structures to be implemented by the developers in the Solar Park area within their project sites. To this extent, the MDC has requested that each developer undertake a flood risk study for the specific project site.

To this extent, the Developer is required to undertake a flood risk study for the Project site in order to determine the required hydraulic design structure to be taken into account throughout the design of the Project to mitigate flood risks.

However, such an approach (where each developer undertakes a separate study for their own Project site) is not favored given the generic nature of such risks on all developments. The wadi system which runs through the Solar Park passes through tall the land plots of all developers, and thus is highly likely to affect all developments within the Solar Park (refer to Figure 45 above). Through adopting such an approach, mitigation measures implemented by one developer could affect other developments within the Solar Park area (e.g. diversion of wadi from one development to another) and/or could result in implementation or duplication of unnecessary flood risk mitigations which are already being undertaken by another developer.

Thus, it is highly recommended that a holistic approach is adopted by the MDC in coordination with the various developers within the Solar Park area for managing and mitigating flood risks, given the generic nature of such risks on all developments. Such an issue is discussed further in Section 8.13 related to the cumulative impacts from the various PV development projects within the Solar Park area.

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

Given the generic nature of the impacts on soil and groundwater 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 and Project Operator throughout construction and operation phase.

The potential impacts from improper management of waste steams could be of a long-term duration throughout the construction and operation phase. Such impacts are negative in nature, and could be noticeable and are therefore of medium magnitude. However, they are considered of low sensitivity as they are generally controlled through the implementation of general best practice housekeeping measures. 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 solid waste generated will likely be collected and stored onsite and then disposed to the closest municipal approved landfill (Ma'an Central Landfill); whereas the construction waste will be stored onsite and then disposed at the Ma'an Central Landfill (which accepts construction waste) or, if possible, reused in the construction activities.

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively:

- Coordinate with Ma'an Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill (the closest landfill being the Ma'an Central Landfill);
- 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 Developer must seek ways to reduce construction waste by reusing materials;
- 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 the EPC Contractor and Project Operator during the construction and operational phase respectively:

- 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 (e.g. from sinks) 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 the Industrial Park Wastewater Treatment Plant (WWTP).

Mitigation Measures

The following identifies the mitigation measures to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively:

- Coordinate with Ma'an Water Directorate to hire a private contractor for the collection of wastewater from the site to the Industrial Park 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 Industrial Park WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas;
- EPC Contractor only – during construction 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 the EPC Contractor and Project Operator during the construction and operation phase respectively:

- 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 consumed oil, chemicals, paint cans, etc. 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 the EPC Contractor and Project Operator during the construction and operation phase respectively:

- 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;
- Possibly contaminated water (e.g. runoff from paved areas) must be drained into appropriate facilities (such as sumps and pits) and contaminated drainage must be orderly disposed of as hazardous waste;
- 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 the EPC Contractor and Project Operator during the construction and operation phase respectively:

- 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 the EPC Contractor and Project Operator during the construction and operation phase:

- 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 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 refueling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material;
- Ensure that a minimum of 1,000 liters of general purpose spill absorbent is available at hazardous material storage facility. Appropriate absorbents include zeolite, clay, peat and other products manufactured for this purpose;
- 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 the EPC Contractor and Project Operator during the construction and operation phase respectively.

- 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.

8.5 Biodiversity

This section identifies the anticipated impacts on biodiversity from the Project activities during the construction and operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements have been identified.

8.5.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of PV arrays and the various Project components to include transmission cables, inverter stations, internal road network, buildings, etc. are expected to include land clearing activities, leveling, excavation, grading, etc.

Such construction activities could result in the alteration of the site's habitat and thus potentially disturb existing habitats (flora, fauna, and avi-fauna) and result in the displacement of exclusion of species particularly threatened, endemic, or endangered species which might be present within the Project site and surrounding areas.

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).

However, based on the biodiversity baseline assessment conducted (which included review of secondary data, a site survey, and consultations with academic experts), it was concluded that the site's habitat in general is considered barren and of low ecological significance due to its natural setting. In addition, the site is considered, to some extent, disturbed by human activities by the highway and railway which runs close to the Project site. In addition, within the wider area there are several factors which could contribute to such disturbances such as mining areas (which are around 6km from the Project site) and proximity to urban areas (Ma'an city) and industrial areas (MDA Industrial Park). Such disturbances could affect, to some extent, the presence of fauna (especially large animals) and avi-fauna within the Project site.

In addition, as discussed in Section 7.2.2, the Project site is not located within or near areas of critical environment concern (to include environmental reserves of important bird areas), where the closest is around 15km away from the site.

Generally, all recorded flora/fauna/avi-fauna species within the Project site are considered of least concern and common to such habitat areas. However, based on the literature review, two key species are considered important at the national level. This includes the Arabian Hare (due to hunting activities) and the Spiny Tailed Lizard (due to hunting activities and extensive harvesting for collection and selling purposes). However, those species in particular have not been recorded throughout the field survey.

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. 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 minor significance.

Mitigation Measures

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

- Before construction commences, undertake a fauna survey (through an ecological expert) to identify the presence of any key faunal species of importance (reptiles and mammals). Should viable populations of such key species exist within the Project site (e.g. Spiny Tailed Lizard) then it should be relocated outside of construction active areas;

- Ensure that the fencing constructed for the Project site 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 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 Section 8.4.2
  - 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

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:

- Reporting on outcomes of fauna survey and actions undertaken if applicable (e.g. relocation of certain key species to areas outside of construction activities); and
- Inspection of the works should be carried out at all times.

8.5.2 Potential Impacts during the Operation Phase

Potential impacts during the operation phase are mainly limited to avi-fauna. According to the "Guidelines to Minimize the Impact of Solar Facilities and Associated Infrastructure in South Africa" (BirdLife International), the most important impact of solar facilities on avi-fauna is the displacement of critical species and loss of habitat from construction activities – which were discussed earlier.

In addition, according to the Guidelines, other impacts discussed also include the electrocution and collision caused when perching on, or flying into, the power line infrastructure. During operation there is a particular risk to birds mainly from operation of the high voltage overhead lines from the substation onsite to the High Voltage National Grid. Risks for avifauna are electrocution and collision, both leading to serious injuries and, in most cases, death. Big and heavy birds are in special risk, because of their reduced ability to avoid suddenly appearing power lines, especially in times of reduced sight distances (sandstorms, fog, rain, etc) or strong winds. However, as discussed earlier, impacts from substation construction and overhead lines have not been taken into account (given that details are not available at this stage) but are rather addressed through the identification of Environmental Performance Requirements (refer to Chapter 10) to be considered by NEPCO. Such Performance Requirements include measures to reduce collision risk of birds with overhead lines.

Other potential impacts on avi-fauna from the Project could be from the PV panels being reflective surfaces which could act as attractants for birds (as discussed later in Section 8.5.3). These surfaces may be confused for large water bodies, and can cause disorientation of flying birds, resulting in injury and/or death. However, according to the BirdLife Guidelines discussed above, such impacts from PV projects are considered not applicable as PV panels are considered less reflective, especially when compared to other technologies such as Concentrated Solar Power (CSP).

Nevertheless, putting things into perspective there is some risk of avi-fauna mortality and which could occur with most human development (ranging from buildings to large scale industrial projects). However, with regards to the Project in specific it is highly unlikely that avian mortality levels would be of any concern due to the following:

- Proximity of the Project site to the existing grid with which it will connect (located around 500m from the substation) and thus overhead lines will be minimal, thus reducing any risks of electrocution and collision of birds;
- The Project site in general is considered barren and of low ecological significance due to its natural setting and does not support endangered or rare species or sensitive avi-fauna habitats, while all recorded avi-fauna species are generally common to such habitats. In addition, such an area is considered, to some extent, disturbed by human activity and which would affect bird activity in the area. With regards to migratory birds, the site sensitivity is considered low as it is located at a distance from the rift valley and its margins and is not considered to be located within an area of intensive passage or traffic of migratory soaring birds during migration seasons. In addition, the Project is located at a distance from the Important Bird Areas of Jordan (where the closest is around 15km away – refer to Figure 16);
- As stated earlier, the PV panels work on the concept of absorbing sunlight rather than reflecting it and thus reflections and potential for glare are not considered issues of concern as in the case of other technologies (e.g. Concentrated Solar Panels CSP); and
- To date, there is no empirical evidence that PV facilities lead to significant avian mortality or large-scale collision impacts resulting from contact or collision with PV panels or from reflective surfaces.

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).

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 as they are likely to be minimal. 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 minor significance.

Mitigation Measures

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

- Undertake short term avi-fauna monitoring through an ornithologist during the first year of operation of the Project. The objective of the monitoring is intended to confirm and validate the outcomes of this ESIA assessment in relation to impacts on avi-fauna from the Project. Given the low sensitivity of the site, short-term monitoring is required for 8 days distributed throughout the spring, summer, autumn, and winter season – as this would ultimately cover migration seasons, breeding seasons, and wintering seasons of resident and migratory birds.

  The monitoring must be undertaken through observational visits which aim to investigate any potential impacts from the Project's operation on avi-fauna (through for example undertaking mortality and carcass search) and also document behaviors.

- 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 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 Section 8.4.2
  - 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:

- Report the outcomes of the avi-fauna monitoring which summarizes the results and observations; and
- Inspection of the works should be carried out at all times.

8.5.3 The BirdLife Solar Energy Guidance

The "Solar Energy Guidance V.1 – Birds and Solar Energy within the Rift Valley/Red Sea Flyway" (BirdLife International) is a guidance document designed to inform solar farm developers of potential impacts of developments upon birds within the Rift Valley/Red Sea region and recommends specific practices that can reduce these impacts.

The document identifies potential impacts from industrial-scale solar technologies. Those relevant to PV projects are summarized below.

- Habitat loss/fragmentation: this is considered the most important impact as generally the construction of such facilities involves large areas of habitats to be removed, replaced, or degraded. The actual ecological significance of the impact will be site and scale-specific; and many developments are likely to have limited impacts. An assessment of the ecological value will show the significance of the impact;
- Risk of collision: with associated infrastructure particularly with associated power lines. In addition, some species of birds may collide with panels because they are attracted to shaded areas, particularly if panels are located in previously undisturbed areas; and
- Pollution: activities during construction and maintenance activities could lead to the release of pollutants to the environment.

In addition, the Document refers to a number of other impacts but which have limited data and require further study such as disorientation of birds from panels which may resemble water bodies.

According to discussions with BidLife International – Middle East Regional Office, Jordan the above guidelines are not applicable for the Project site given that it is located outside of the Rift valley/Red Sea flyway. Nevertheless, BidLife International – Middle East Regional Office, Jordan suggested that the recommendations provided within the Guidelines be considered, to the greatest extent possible, throughout the Project Development.

Summarized below are the main recommendations discussed within the Guidelines and how they were taken into account throughout this ESIA:

- ***Strategic planning and assessment***: Strategic Environmental Assessment (SEA) should be consulted to inform the choice of sites which are appropriate for development. Where no SEA exists, developers should look to governments, designated national authorities and conservation organizations and experts for guidance on appropriate areas for development. As discussed in Section 7.2.2, the Project site is not located within or near areas of critical environmental concern (to include environmental reserves of important bird areas) assigned by the MoEnv and RSCN; where the closest is around 15km away from the site. In addition, as discussed in Section 7.4.2, based on consultations with experts there are no issues of concern within the Project site in relation to avi-fauna – a conclusion which was also agreed with BirdLife International – Middle East Regional Office, Jordan.
- ***Appropriate site selection*** can also be informed by the use of sensitivity mapping such as the mapping tool for the Rift Valley/Red Sea Area. As discussed in Section 7.4, this mapping tool has been used and analysis reported that the area has an 'unknown status' in regard to sensitivity of soaring birds, as there are no soaring bird species recorded within the study area.

- ***Undertake an EIA for the site specific development***. The EIA must include a baseline survey which appropriately assesses the ornithological value and the biodiversity of the site. The Document recommends that the baseline survey take place for a minimum of one year for breeding birds, vulnerable and protected species, and migratory birds as well as one year post-construction monitoring.

  A baseline survey has been undertaken (as presented in Section 7.4) which appropriately assess the biodiversity of the site based on literature review, field survey, and consultations with experts. Based on the outcome of the biodiversity assessment, the Project site is considered to be of low ecological significance. Refer to Section 7.4 for additional details on the biodiversity baseline assessment of the Project site.

  The extent of the survey recommended in the Document (minimum of one year) is unwarranted when taking into account the Project site area (mainly being of low ecological significance and located outside of the Rift/Valley Red Sea flyway). This has been agreed with BirdLife International – Middle East Regional Office, Jordan whom was in accord that the methodology adopted for baseline assessment for avi-fauna for the Project was sufficient, given the low sensitivity of the site.

  A similar rationale is adopted with regards to the post-construction monitoring and was agreed with BirdLife International – Middle East Regional Office, Jordan. Given the low sensitivity of the area a one year post-construction monitoring is unwarranted, and short-term monitoring throughout the spring, summer, autumn, and winter season is sufficient. Post-construction short-term monitoring has been taken into account and was highlighted earlier throughout this section.

- ***Consider recommendations to reduce impacts from power lines and associated infrastructure*** - which mainly includes appropriate routing of lines, use of bird deflectors, and pole design which minimizes electrocution risks. Those have been taken into account and are highlighted in Chapter 10.

- ***Consider recommendations to reduce impacts from construction activities*** and which include measures such as minimizing any clearing of natural vegetation, ensuring propel disposal of waste streams, etc. Those have been taken into account to the greatest extent possible and were highlighted earlier throughout this section.

8.6 Archeology and Cultural Heritage

This section identifies the anticipated impacts on archeology from the Project activities during the construction and operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements have been identified.

8.6.1 Potential Impacts during the Construction Phase

Site preparation activities which are to take place onsite by the EPC Contractor for installation of PV arrays and the various Project components to include transmission cables, inverter stations, internal road network, buildings, etc are expected to include land clearing activities, leveling, excavation, grading, etc.

Such activities could damage or disturb potential archaeological remains which might be present on the surface of the Project site and which could potentially be of archeological importance. However, based on the baseline archeological assessment conducted, it was concluded that the Project site is devoid of any important or significant archeological or cultural remains. Therefore, there are no anticipated impacts on surface archeological remains within the site.

However, as discussed in the baseline section, the "Archeological Survey of the Solar Park Area" report prepared by the DoA, identified two locations which must be fenced and protected (Location 2 and Location 3 – refer to Figure 31) from the various construction and operation activities of the PV Projects in the Solar Park Area. Those locations are outside of the Project site. Nevertheless, improper management of construction activities of the Project could potentially disturb or damage those sites – this could include for example improper movement of vehicles and machinery into/out of the site, improper conduct by construction workers, etc.

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 archeological 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 as it is possible that once a site is damaged or disturbed it cannot be restored. In addition, given that two locations have been recorded (although outside of the Project site) the receiving environment is considered of medium 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 EPC Contractor during the construction phase and which include:

- Properly plan construction activities to take into account the identified archeological 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, 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 archeological locations in the area - this could 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 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.

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:

- 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.
- Inspections of construction activities to ensure that archeological locations are avoided throughout the construction activities and proper code of conduct is enforced.

8.6.2 Potential Impacts during the Operation Phase

Potential impacts during the operation phase are limited to improper management of operation activities of the Project could potentially disturb or damage the archeological locations identified by the "Archeological Survey of the Solar Park Area" report prepared by the DoA Location 2 and Location 3 (refer to Figure 31). 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 as it is possible that once a site is damaged or disturbed it cannot be restored. In addition, given that two locations have been recorded (although outside of the Project site) the receiving environment is considered of medium 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 activities to take into account the identified archeological 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, prohibit movement of vehicles near those areas during the various operational activities, etc.
- Ensure that the Code of Conduct, awareness raising, and training developed for construction workers and personnel involved in the operation phase of the Project to emphasizes the presence of archeological 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 archeological locations are avoided throughout the operation activities and proper code of conduct is enforced.

8.7 Air Quality and Noise

This section identifies the anticipated impacts on air quality and noise from the Project activities during the construction and operation phase. In addition, for each impact a set of mitigation measures and monitoring requirements have been identified.

8.7.1 Potential Impacts during the Construction Phase on Air Quality

Site preparation activities which are to take place onsite by the EPC Contractor for installation of the PV arrays and the various Project components to include transmission cables, inverter stations, internal road network, buildings, etc are expected to include land clearing activities, leveling, excavation, grading, etc.

The above 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 the Highway). However, it is highlight unlikely that other nearby surrounding receptors (such as Al-Mahata Village or the Industrial Park) will be affected from windblown dust, given the distance and the fact that the prevailing wind direction in the area is West and West-Northwest, and thus such receptors are located upwind from the Project site.

It is important to note that the generation and dispersion of dust depends on weather conditions; dry conditions with high wind speeds would cause excessive dust generation, while wet conditions and low wind speeds wouldn't. Given the characteristics of the site (its arid desert nature with frequent dry/windy conditions) sandstorms are probable. However, this is not within the control of the Project Developer and hence impacts from such events are not within their responsibility.

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 SO_2, NO_2, 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 (to prevent impacts caused by their construction activities and which are within their control) and which include:

- If dust or pollutant emissions were found to be excessive, construction activities should be stopped until the source of such emissions have been identified and adequate control measures are implemented;
- Comply with the Occupational Safety and Health Administration (OSHA) requirements and the Jordanian Codes to ensure that for activities associated with high dust levels, workers are equipped with proper Personal Protective Equipment (e.g. masks, eye goggles, breathing equipment, etc);
- Apply basic dust control and suppression measures which could include:
  - Regular watering of all active construction areas.
  - Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period.
  - Proper management of stockpiles and excavated material (e.g. watering, containment, covering, bunding).

- Proper covering of trucks transporting aggregates and fine materials (e.g. through the use of 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. nearby Highway) to determine whether high levels of dust from construction activities exist; and
- Reporting of any excessive levels of pollutants/dust and the measures taken to minimize the impact and prevent it from occurring again.

8.7.2 Potential Impacts during the Construction Phase on Noise

Site preparation activities which are to take place onsite by the EPC Contractor for installation of PV arrays and the various Project components to include transmission cables, inverter stations, internal road network, buildings, etc are expected to include land clearing activities, leveling, excavation, grading, etc.

All the above activities will likely include the use of machinery and equipment such as generators, hammers, compressors, etc and which 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 construction workers onsite. It is highlight unlikely that other nearby surrounding receptors (such as Al-Mahata Village or the Industrial Park) will be affected from noise generating activities given their distance from the Project site.

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 given that the baseline conditions will be restored after construction works is completed, 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 and which include:

- If noise levels were found to be excessive, construction activities should be stopped until adequate control measures are implemented;
- 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; and
- Comply with the Occupational Safety and Health Administration (OSHA) requirements and the Jordanian Codes to ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment (e.g. Earmuffs)

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:

- Inspection of the works should be carried out at all times; and
- Reporting of any excessive levels of noise and the measures taken to minimize the impact and prevent from occurring again.

8.8 Infrastructure and Utilities

This section identifies the anticipated impacts on infrastructure and utilities from the Project activities during the construction, operation, and decommissioning phase. In addition, for each impact a set of mitigation and monitoring requirements have been identified.

8.8.1 Potential Impacts on Water Resources during the Construction and Operation Phase

It is expected that the Project throughout the construction phase will require water for potable usage (drinking, showering, etc) and non-potable usage (mainly used for minimizing fugitive dust emissions, and to some extent for cleaning of machinery and vehicles).

The potable water requirements for a maximum of 100 workers onsite is not expected to exceed 50 liters per capita per day for a duration of 9 months. Thus the daily water consumption is likely to be around 5,000 liters per day – or $5m^3$ per day. In addition, water for non-potable usage will be mainly used for minimizing fugitive dust emissions and this will greatly depend on weather conditions throughout the construction period (as well as other factors), but has been estimated to be around $5m^3$/ day. Thus, total water requirements during the construction phase are likely to be around $10m^3$/ 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 5 personnel) and for the cleaning of the panels. Similarly, potable water requirements for the onsite workers is not expected to exceed 50 liters per capita per day – thus a daily water consumption is likely to be around 250 liters per day – or $0.25m^3$ per day.

On the other hand, the PV modules will be cleaned on a regular basis to prevent dust build-up which could affect their performance. Cleaning will be undertaken through the use of water trucks equipped with sprayers. According to information from the Developer, it is expected that around $37m^3$ of water is required per cleaning cycle of the panels, where it is expected that one cleaning cycle will take place per month (12 times per year). Thus, the daily water requirement for cleaning of the panels is estimated around $1.2m^3$/day.

It is important to note, that there isn't any utility scale solar PV project operating within the Ma'an area, and thus the assumption on water requirements for cleaning of the panels as discussed above is rather a conservative assumption. As the operation goes on, The Project Operator will have more realistic knowledge on the amount of cleaning water, the frequency of cleaning the module, etc.

Nevertheless, the total water consumption during operation is likely to be around $1.5m^3$/day for a duration of 20 years. Putting things into perspective, as discussed in Section 7.7.2 , the total annual water supplied within Ma'an city from the wells is around 3.42 MCM. The annual water requirements of the Project during the operation phase is anticipated to be around $550m^3$ ($1.5m^3$/day) – representing less than 0.02% of the total water supplied to Ma'an city.

Nevertheless, it is important to ensure that adequate water resources are available which would be able to meet the Project requirements without entailing any constraint on the existing users – such as the Industrial Park or the local community. However, based on the above it is clear that the water requirements for the Project during construction and operation are rather minimal and would not entail any constraints on the existing users.

As discussed in Section 7.7.2, the MDC have coordinated with Ministry of Water and Irrigation and Ma'an Water Directorate for supply of water requirements of the Industrial Park as well as the various developments within the Solar Park. The Ma'an Water Directorate has decided that the water requirements will be supplied through the local water network in addition to water wells. As discussed earlier, a pipeline from the local water network (Ma'an Water Supply System) runs to the Industrial Park and will likely provide around $3,600m^3$/day. The remaining water demand will be met through two (2) onsite wells, each with a capacity of

around 25m^3/hour – a license was granted by the Ministry of Water and Irrigation for drilling and operation of the wells.

Based on discussion with the MDC, a water network which extends from the Industrial Park to the Solar Park was first proposed to be established in order to supply the various developments with their water requirements. However, the developers have decided that a network is not necessary as their water requirements can be supplied through tankers and then stored onsite through reservoirs.

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.

Mitigation Measures

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 MDC for securing water requirements of the Project, whom has sufficient capacity to cover the rather minimal water requirements of the Project.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above

8.8.2 Potential Impacts on Wastewater 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 (e.g. sinks). 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 the Industrial Park WWTP.

Generally, the approximate estimated wastewater to be generated from the Project can accounted as follows. Throughout the construction phase, a maximum of 100 construction workers are expected, whereas during the operation phase around 5 workers are expected. The water requirements of workers on a per capita basis during the construction and operation is not expected to exceed 50 liters per day; and taking into account an 80% wastewater generation factor per capita – then the anticipated wastewater to be generated during construction is 4,000 l/d (4m^3/d) for a duration of 9 months, and 200 l/d (0.2m^3/d) during operation for a duration of 20 years.

The wastewater generated will most likely be collected by tankers from the Project and disposed at the Industrial Park WWTP. Such quantities are expected to be easily handled by the WWTP which has a current design capacity of 700 m^3/day with a possible increase to 2,100 m^3/day and currently receives around 150 – 200m^3/ day (around 30% of its design capacity only).

Taking all of the above into account, the anticipated impacts on wastewater utilities are considered of short-term duration during the 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 by the WWTP. Given the above impact is considered not significant.

Mitigation Measures

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 MDC for disposal of wastewater at the Industrial Park Wastewater Treatment Plant.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above.

8.8.3 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 (mainly during construction to include cables, metal, wood, 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 the Ma'an Central Landfill Site.

The approximate estimated municipal solid waste to be generated from the Project during the construction phase can accounted as follows. Throughout the construction phase, a maximum of 100 construction workers are expected. 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 can be estimated to be around 85kg/day for a duration of 9 months. In addition, construction waste is likely to be around 20kg/day to include waste such as cables, metal, wood, etc. Therefore, the total estimated solid waste to be generated during the construction phase is around 100kg/day.

Similarly, during operation solid waste will mainly include municipal waste. Around 5 workers are expected and based on the average theoretical municipal solid waste generation in Jordan (0.85kg/capita/day) (SWEEPNET, 2010) the estimated municipal solid waste is 4kg/day for a duration of 20 years.

Comparing those numbers to the daily amount of solid waste currently handled by the Ma'an Central Landfill Site reveals that such quantities are negligible and are expected to be easily handled by the Landfill; the landfill receives around 80 tons of solid waste per day. Thus the project during the construction and operation phase is expected to contribute to an increase of around 0.2% of the total daily waste currently handled by the Landfill. In addition, according to discussions with the representatives from the Greater Ma'an Municipality have stated that such quantities are negligible and can be easily handled by the landfill site.

Taking all of the above into account, the anticipated impacts on solid waste utilities are considered of short-term duration during the 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.

Mitigation Measures

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 Greater Ma'an Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved landfill (Ma'an Central Landfill).

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Submit report with proof of coordination with authorities discussed above

8.8.4 Potential impacts on Hazardous Waste Disposal Utilities during Decommissioning Phase

Of particular importance is the disposal of the panels at the end of their lifetime. Based on discussions with the "Hazardous Substances and Waste Management Directorate" of the MoEnv, the panels are classified as electronic waste and must be disposed at the Swaqa Hazardous Waste Treatment Facility.

Therefore, during the decommissioning phase of the Project –and assuming as a worst case scenario that the panels will be disposed at a landfill and no recycling will take place as part of the PV CYCLE recycling program – it is important to ensure that the Swaqa Hazardous Waste Treatment Facility would be able to accept and handle the panels and the quantities to be disposed.

However, this issue in itself is unclear at this stage given the following:

- The responsible entity for undertaking such disposal is unclear as to whether it could be the Developer or MEMR. It is not clear at this point whether at the end of the lifetime of the Project MEMR would take ownership of the Project and operate it for an additional five (5) years or whether the Project will be completely decommissioned; and
- The prospects of hazardous waste management are not clear, taking into account the Project timeline of 20 years. Based on discussions with the "Hazardous Substances and Waste Management Directorate" of the MoEnv, the only hazardous landfill in Jordan is the Swaqa Hazardous Waste Treatment Facility and there are no plans to establish or construct new hazardous waste disposal facilities. At Swaqa, currently, stabilized and inert hazardous waste is land-filled, while other types of hazardous waste which require physical-chemical treatment or incineration are stored in safe storage spaces. However, there is a second phase development plan for Swaqa which involves physical-chemical treatment and incineration facilities to improve handling and management of hazardous waste and which is expected to significantly improve the capacity of the landfill. The second phase is expected to be completed by 2016. More importantly there is currently a pilot project for disposal and management of electronic waste at Swaqa. Electronic waste is currently collected and stored at the landfill, and there are plans for collaborating with private entities for implementing recycling programs for such electronic waste streams.

Nevertheless, based on discussions with the "Hazardous Substances and Waste Management Directorate" of the MoEnv, and *based on current conditions*, the landfill would be able to accept and store the solar modules. Based on preliminary calculations and taking into account the number of panels expected to be generated at the end of life (around 45,000 panel each with a dimension of 1,652mm× 1,000mm × 45mm) and taking into account the maximum height of the storage space allowed in the Swaqa Facility of 6m – then the area required for the storage space is estimated at around 500m^{2}assuming vertical stacking of the panels.

Based on current conditions, the "Hazardous Substances and Waste Management Directorate" of the MoEnv stated that it would be able to accept and store the modules. In addition, at the time disposal would take place (after 20 years) the prospects of the electronic waste recycling program undertaken at Swaqa would be more clear and those modules could be recycled as part of this program.

It is also important to note that the previous discussion assumes a worst case scenario with regards to the final disposal of panels at a landfill with no recycling. However, the Developer is part of PV CYCLE – an association organizing the take-back and recycling of PV modules at end-of-life. The recycling program of PV CYCLE is a comprehensive recycling process which recovers most of the materials within the PV panel

(including glass, semiconductor material, ferrous and non-ferrous metals, etc.) for reuse in new products. Such an option is available and could be used for the PV panels at the end-of-life

Taking all of the above into account, the anticipated impacts on hazardous waste disposal facilities are considered of long-term duration, of a negative nature, and are expected to be of medium magnitude and of low sensitivity. Given the above such an impact is considered of minor significance.

Mitigation Measures

Given that at this stage there are is a great deal of uncertainty at the decommissioning phase of the Project (with regards as to whom is the responsible party, prospects on hazardous waste disposal facilities in Jordan, etc), it is recommended that before any decommissioning activities take place a Disposal Plan for the PV Panels is prepared by the responsible entity undertaking decommissioning activities. The plan should consider the following options and compare the costs/benefits of each:

- It is recommended that the Plan first opt for disposing the panels at the end of their lifetime as part of PV CYCLE's recycling program; and
- If the above could not be achieved, as a last option the plan must investigate the disposal of the Panels at existing hazardous waste facilities in Jordan through coordination with the MoEnv.

Monitoring Measures

- Submission of Disposal Plan to the MoEnv along with proof of coordination with the authorities discussed above for works required as part of the Study.

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

8.8.5 Potential Impacts on Road Networks during the Construction Phase

Components for PV plant 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 maneuver their way through existing roads to the installation site.

With regards to the Project, the various Project components and equipment are expected to be transported to the port of Aqaba and then transported by road to the Project site. The Port of Aqaba is suitable for transport of bulky components and is connected by a sufficiently large road to the main highway (Highway #15).

As discussed in Section 7.7.4, Highway #15 runs all the way to the Ma'an area after which an exit is taken to Highway #5 which leads to the Project site. From that point access to the site will be through a road network established within the Solar Park area.

It is evident that all transportation requirements discussed above will rely on Highway#15. Transportation activities will likely involve a significant number of trucks to transport the various Project components - and mainly the PV panels which are around 45,000. Such transportation requirements of the Project would temporary and intermittently increase traffic volume and movement on the highways and to some extent a reduction of roadway capacities due to their slower movements compared to passenger vehicles.

This highway is the major route in Jordan that connects the capital city with the southern Governorates of Jordan. This highway is heavily travelled on a daily basis 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). This short-term increase in vehicle trips is not expected to substantially affect level of service and traffic flow on this highway. The estimated increase in traffic volumes caused by truck traffic is not expected to be substantial relative to background traffic conditions and is expected to fall well within the capacity of the road network.

In addition, if transportation activities are not properly managed beforehand, they could entail risk of damage to the existing roads, highways, overpasses and could be of public safety concerns to other users on the road.

Taking all of the above into account, the anticipated impacts on road networks are considered of short-duration as they are limited to the transportation phase of the Project components, of a negative nature, and are expected to be of medium magnitude and of low sensitivity. Given the above such an impact is considered of minor significance.

Mitigation Measures

It is recommended that EPC Contractor conduct a Transport Study 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 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 identify in details the bridges and points which need to by bypassed (if any) and other works which could be required along the transportation route (e.g. traffic diversion);
- 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, Ministry of Public Works and Housing (Ma'an Public Works Directorate), and Ma'an Municipality 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 Transport Study which could include bypasses required (if any), traffic diversion, 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 EPC Contractor during the construction phase and which include:

- Submission of Transport Study to MoEnv along with proof of coordination with the authorities discussed above for works required as part of the Study.

8.8.6 Potential Impacts on the Aqaba Railway during the Construction and Operation Phase

As noted in Section 7.7.5, a railway runs around 1.4km to the north of the Project site. During the construction and operation phase movement of vehicles, equipment and machinery is expected and in order to access the Project site movement on the railway is required, as there is no other alternative.

Improper management of movement of vehicles and machinery into/out of the site could damage the railway which runs close to the northern parts of the project site, and could affect the movement of the train.

However, the MDC is aware that such an issues needs to be taken into account in order to provide access to the Solar Park area for the various PV developments which are to take place. Therefore, the MDC has

undertaken meetings with the ARC and Hejaz Railway Corporation to discuss possible solutions to cross the railway into the Solar Park area.

Based on such meetings it was agreed with the ARC and the Hejaz Railway Corporation that the optimal solution would be the establishment of a road (with a width of 6-7m) to cross the railway and which will run on the same level. No overpass or underpass is required. On the junctions between the road and railway the necessary safety measures will be implemented, and which will include a railway signal which would instruct the user of the road not to pass when the train is near. The location of the street on the railway is presented in Figure 46. The MDC has signed a 'Right of Passage' with ARC and Hejaz Railway Corporation.

Taking all of the above into account, the anticipated impacts on the railway is considered of long-term duration, of a negative nature, and is expected to be of low magnitude and of low sensitivity. Given the above impact is considered not significant.

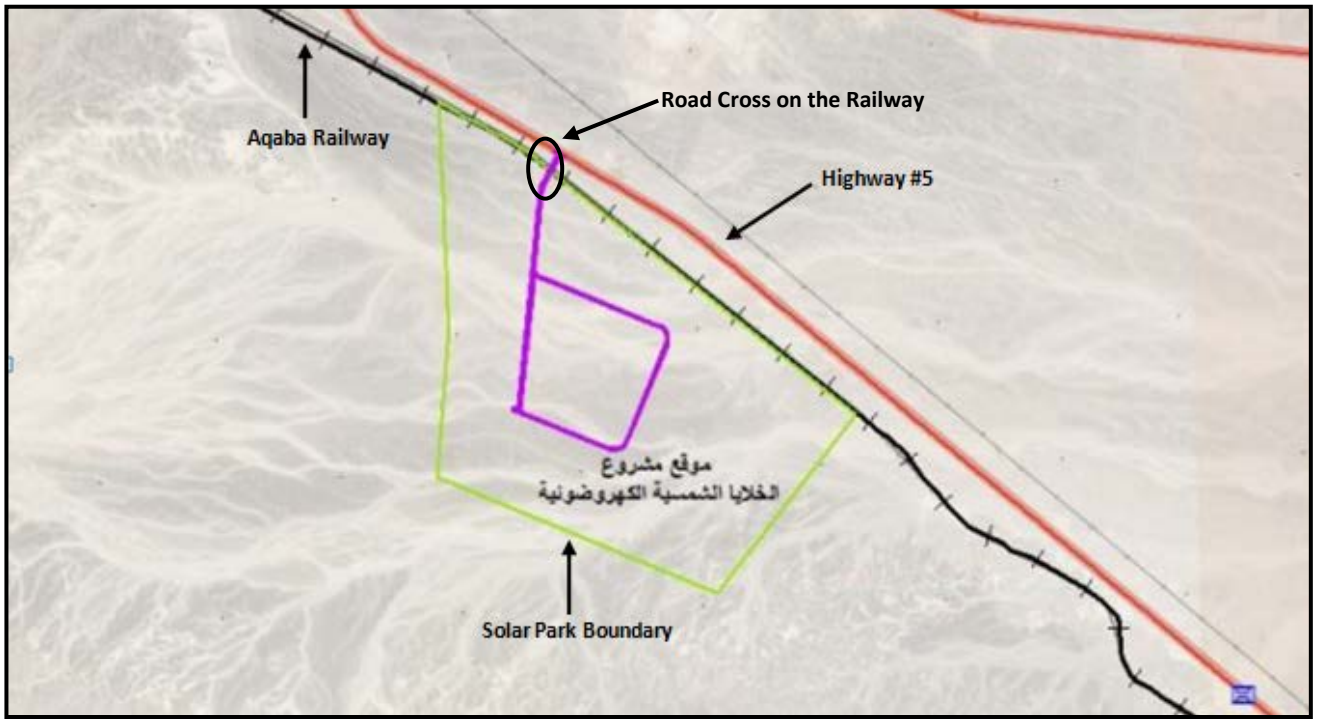

Figure 46: Location of Road Cross on the Aqaba Railway

Mitigation Measures

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:

- Ensure that movement of vehicles, machinery, and equipment into the Project site takes places through the designated road which passes the railway only. Passage to the Project site through other means should be prohibited. In addition, all working personnel involved throughout the construction and operation phase should be notified beforehand on the designated access road and the safety measures in relation to the railway signal.

Monitoring and Reporting Requirements

The following identifies the monitoring and reporting requirements to be applied by the EPC Contractor and Project Operator during the construction and operation phase respectively and which include:

- Inspection of transportation activities must take place at all times.

8.8.7 Potential Impacts on Electricity Network during Operation Phase

The Project is expected to an installed capacity of 10 MW and will connect with the National Grid 132kV line through High Voltage overhead lines. The substation, high voltage overhead lines and the connection to the existing grid will be designed and built by NEPCO.

To this extent, the Project is expected to entail positive impacts on the electricity network as it will contribute to supplying electricity to the National Grid for end users and help meet the increasing electricity demands throughout the Kingdom. The Project is expected to provide around 20 GWh of electricity per year, which is enough to power around 4,000 local households in Jordan.

Additional positive impacts include amongst others: (i) contributing to increasing energy security through development of local energy resources and reducing dependency on external energy sources, (ii) producing electricity which contributes 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 (iii) the Project will produce 'clean' energy which will help Jordan reduce its carbon footprint by displacing around 14,000 ton of carbon dioxide per year.

8.9 Socio-economic

This section identifies the anticipated impacts on the socio-economic development from the Project activities during the construction and operation phase. Those mainly include positive impacts as discussed below.

8.9.1 Potential Impacts during the Construction and Operation Phase

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 of Ma'an. The Project will create the following job opportunities:

- Around 40-60 job opportunities during the regular construction period for a duration of approximately 9 months. This number could reach around 100 towards the peak period of the construction phase. This will mainly include engineers, electrical and mechanical technicians, as well as unskilled workers.
- Around 5 job opportunities during the operation phase to include skilled labour (such as electrical and mechanical technicians) and unskilled labour (such as module cleaners and security personnel) for a duration of 20 years.

The Developer is committed to social responsibly as well as working closely with the local community members. The Developer is aiming to hire to the greatest extent possible local community members throughout the construction and operation phase, and is also considering other social responsibility aspects to the local community. This could include committing to hiring labor from the MDC VTC, renewable energy and solar energy education and awareness sessions and make the plant available for site visit purposes for local community, schools, universities and others.

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 from local contractors, as well as other supplies and services (accommodation services, food, household products, etc). Such demands could improve the existing local economic activities and impact certain sectors, such as construction, wholesale/retail trade, hotels and accommodations, etc.

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 stated in Section 7.8, 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. The area requires investment projects which can capitalize on the unique characteristics of Ma'an to include abundance of solar resources throughout the year; and this Project is in line with the above.

In addition, the Project being part of the MDA, is expected to be in line with MDC's vision of developing Ma'an into an engine of economic growth while enhancing the living environment for its inhabitants, elevating the standards of living in Ma'an, and bring social and economic prosperity to local communities.

Discussions with the Social Development Unit as well as consultations with the local community focused on the importance of the Project to Jordan. However, they also emphasized the important role of the developer in engaging and building trust with the local community members in the Project to the greatest extent possible through providing job opportunities and social development.

To this extend, similar expectations are set for MDA and the development and investment projects that are part of it. However, it is understood that the socio-economic development of the area is not hinged on a single project but rather on implementing collective and coordinated actions, including other development projects and investment within the MDA.

Nevertheless, 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 an Action Plan for working with the local community members, and this may be built into the actions within the SEP (presented in Annex I). The Plan must aim to support the local economy 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. The Action Plan must also aim to manage expectations so that local communities are realistic about opportunities from the Project.

However, given that the Project is part of the Solar Park where other PV developers will be operating it is highly recommended that the various PV developers, along with MDC, collaborate and collectively develop and adopt a holistic social Action Plan for the area. Such collaboration is favored over individual planning and implementation by each developer because it is more likely to bring a greater and more sustainable benefit to the local community.

Such recommendations are further discussed in the cumulative impacts under Section 8.13.

8.10 Occupational Health and Safety

This section identifies the anticipated impacts on the occupational Health and Safety from the Project activities during the construction and operation phases. In addition, for each impact a set of mitigation and monitoring requirements have been identified.

8.10.1 Potential Impacts during the Construction and Operation Phase

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;
- Particularly for the PV plant, 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 in very hot weather conditions, and thus are exposed to dehydration, heat exhaustion, and heat stroke.

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:

- Exposure to a variety of hazards such as electric shock, and thermal burn hazards;
- Exposure to chemicals, hazardous or flammable materials;
- Taking into account the Project site, maintenance activities are expected to work in very hot weather conditions, and thus workers are exposed to dehydration, heat exhaustion, and heat stroke; and

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, and are expected to be of medium magnitude and medium sensitivity as in extreme cases they could entail permanent impacts (e.g. permanent disability). Nevertheless such impacts are generally controlled through the implementation of general best practice. Given the above such an impact is considered of minor significance.

Mitigation Measures

The EPC Contractor and Project Operator (Hanwha) prepared a Health, Safety, and Environment (HSE) Plan to be implemented throughout the construction and operation phase respectively. The objective of the Plan includes amongst others providing a program of safety consistent with international best practice and standards and minimizing accidents through the preplanning of safety into the work to be performed.

The HSE Plan covers the outlines of the Safety, Health, Environment and Security management system and HSE programs to be applied to project execution. This plan is intended to outline the systems that will be implemented and maintained throughout the life of the project in order to achieve HSE targets, meet Employer/Legislative Requirements and to effectively manage risks to the prevention of Health, Safety & Environment harm. The Plan defines the following:

- Health, Safety, and Environment Policies and Objectives;
- Strategy to be employed to achieve stated objectives ;
- Accountabilities and responsibilities for the Project Management Team (PMT) Management, Supervisors and employees, Sub-Contractor and their employees ;
- The framework for the administration of the HSE Management system;
- Planning, inspection and review protocols for the identification, elimination and/or control of potential project and workplace risks; and
- Process for the recording & reporting of HSE Performance.

With regards to occupational health and safety, the Plan also discusses in details the following plans and procedures:

- Risk assessment and work execution procedures;
- Practical safety procedures;
- Emergency response preparedness, and evacuation plan;
- Personal protective equipment;
- Fire prevention and protection;
- Health management plan;
- Accident/incident investigation and reporting;
- Medical services plan; and
- Security control plan.

The EPC Contractor and Project Operator are expected to adopt and implement the provisions of the HSE Plan throughout the Project construction and operation phase.

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 HSE Plan and assess compliance with its requirements; 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.

8.11 Community Health, Safety, and Security

This section identifies the anticipated impacts on the community health, safety, during the operation phase. In addition, for each impact a set of mitigation and monitoring requirements have been identified.

8.11.1 Potential Impacts during the Operation Phase

The only foreseen impacts in relation to community health, safety, and security is related to the Project operation phase. Such impacts are mainly limited to trespassing of unauthorized personnel into the Project site and which could result in potential risks from several hazards of the various Project components (e.g. electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc).

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 medium sensitivity as in extreme cases they could entail permanent impacts (e.g. permanent disability). Given the above such an impact is considered of minor significance.

Mitigation Measures

The Developer will be installing a non-electric fence around the entire facility to control trespassing of unauthorized personnel. The fence will functions with an alarm to a control room when there is any movement detected on the touch basis of the fence. Furthermore, two (2) security cameras will be installed to support site security.

In addition, security arrangements will be subcontracted to a certified and authorized local security company operating in compliance with local and international standards such as the World Bank's Voluntary Principles on Security and Human Rights and other applicable measures. It is expected that maintaining the security of the Project will require two armed private guards available onsite a 24hour/7day basis.

The Project Operator is expected to undertake the following measures throughout the operation phase:

- Ensure fence around the facility is well maintained at all times and in good conditions; and
- Ensure onsite guards are adequately trained to deal with trespassing incidents. In addition, guards must be adequately trained in the use of force (and where applicable, firearms) and appropriate conduct toward workers and Affected Communities. Guards must refrain from using excessive force, unless situation extremely requires so. In addition, all firearms and ammunition issued should be licensed, recorded, stored securely, and marked appropriately.

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:

- Regular inspections on fence around the facility; and
- Reporting of any trespassing incidents and the measures undertaken in such cases to control the situation and prevent it from occurring again.

8.12 Summary of Anticipated Impacts

Table 26, Table 27, and Table 28 below present a summary of the anticipated impacts during the planning and construction, operation, and decommissioning phase of the Project. 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 – this describes whether impact can be mitigated or not. In addition, for positive impacts recommendations have been provided which aim to enhance the impact. Hence, those collectively have been referred to as management measures (mitigation and recommendations); and
- Residual significance after management actions are implemented (major, moderate, minor, or not significant).

Table 26: 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	Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Negative	Short term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
Land use	Project could conflict with formal land use set at the planning level for the area. In addition, project could conflict with actual land use as it could provide value to locals.	No anticipated impact.							
Geology and Hydrology	A wadi system runs within the Project site and thus there is a potential risk of local flood hazard within the site during the rainy season and especially during flash flood events	Negative	Long term	Irreversible	Medium	High	Moderate – minor	Mitigation available	Minor
	Risk of soil and groundwater contamination during the various construction activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater.	Negative	Could be long term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not significant
Biodiversity	Construction activities could disturb existing habitats (flora, fauna, avi-fauna) and any threatened or endangered species which might be present within the Project site. In addition, other impacts could be from improper management of the site (e.g. improper conduct and housekeeping practices).	Negative	Long Term	Irreversible	Medium	Low	Minor	Mitigation available	Not Significant
Archeology	Improper management of construction activities could disturb/damage the archaeological locations in the nearby area as well as potential archaeological remains which could be buried in the ground (if any).	Negative	Short-term	Could be irreversible	Medium	Medium	Minor	Mitigation available	Not Significant
Air Quality and Noise	Construction 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
	Possible noise emissions to the environment from the construction 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
Infrastructure and utilities	Water Requirements – water requirements of the Project could entailing constraint on the existing users such as the Industrial Park or local communities.	Negative	Short term	Reversible	Low	Low	Not significant	Mitigation Available	Not Significant
	Wastewater Utilities – it is improtant to ensure that existing utilitis would be able to handle the amount of wastewate gneerated from the Project during the construction phase.	Negative	Short term	Reversible	Low	Low	Not significant	Mitigation Available	Not significant
	Solid Waste Utilities – it is improtant 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	Mitigation Available	Not significant
	Road Netowrks – if transportation activities of the various project components to the site are not properly managed beforehand, they could entail reduction of roadway capacities and risk of damage to the existing roads and could be of public safety concerns to other users on the road.	Negative	Short term	Reversible	Medium	Low	Minor	Mitigation available	Not significant
	Railway – improper movement of vehicles and machinery into/out of the site could damage the railway and could affect the movement of the train.	Negative	Short term	Could be irreversible	Low	Low	Not significant	Mitigation available	Not significant
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 to local communities.	Positive	Not applicable.						
Occupational Health and Safety	There will be some generic risks to workers health and safety from working on construction sites, as it increases the risk of injury or death due to accidents.	Negative	Short Term	Could be irreversible	Medium	Medium	Minor	Mitigation Available	Not significant

Table 27: 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	The Project is expected to be visible within the immediate vicinity and up to some kilometers around the Project site only and thus is likely to create visual impacts related to interaction with surrounding landscape.	Negative	Long term	Reversible	Medium	Low	Minor	Not applicable	Minor
	Potential for glare caused by minimal sunlight reflected off the PV panel modules which in turn could affect nearby receptors.	Negative	Long term	Reversible	Medium	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	Medium	Low	Minor	Mitigation available	Not significant
Biodiversity	Impacts limited to improper management of the site (e.g. improper conduct and housekeeping practices).	Negative	Long term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not significant
Archeology	Improper management of operational activities could disturb/damage the archaeological locations in the nearby area.	Negative	Could be long term	Could be irreversible	Medium	Medium	Minor	Mitigation available	Not significant
Infrastructure and utilities	Water Requirements – water requirements of the Project could entailing constraint on the existing users such as the Industrial Park or local communities.	Negative	Long term	Reversible	Low	Low	Not significant	Mitigation Available	Not significant
	Wastewater Utilities – it is improtant to ensure that existing utilitis would be able to handle the amount of wastewate gneerated from the Project during the construction phase.	Negative	Long term	Reversible	Low	Low	Not significant	Mitigation Available	Not significant
	Solid Waste Utilities – it is improtant to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project during the construction phase	Negative	Long term	Reversible	Low	Low	Not significant	Mitigation Available	Not significant
	Railway – improper movement of vehicles and machinery into/out of the site could damage the railway and could affect the movement of the train.	Negative	Long term	Could be irreversible	Low	Low	Not significant	Mitigation available	Not significant
	Electricity network - Project is expected to contribute to supplying electricity to the National Grid for end users and help meet the increasing electricity demands throughout the Kingdom	Positive	Not applicable.						
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 to local communities.	Positive	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	Medium	Minor	Mitigation available	Not significant
Community Health, Safety, and Security	Trespassing of unauthorized personnel into the Project site could result in potential risks from several hazards of the various Project components (e.g. electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc).	Negative	Long term	Could be irreversible	Medium	Medium	Minor	Mitigation available	Not significant

Table 28: 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	Short term	Could be irreversible	Medium	Low	Minor	Mitigation available	Not significant
Air Quality and Noise	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
	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
Infrastructure and utilities	Of particular importance related to infrastructure and utilities is the final disposal of the panels at the end of their lifetime. Final disposal of panels, which may contain hazardous material, needs to ensure that existing waste facilities would be able accept such solar modules. In addition, it is also important to investigate other disposal options such as buyback and recycling programs.	Negative	Long 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	Medium	Minor	Mitigation Available	Not significant

8.13 Assessment of Cumulative Impacts

This section first includes general information about the planned developments which are to take place within the Project area and then discusses the cumulative impacts which could result from incremental impacts of those planned developments.

8.13.1 General Information on Planned Developments

This mainly includes the following, each of which is discussed in details below and presented in Figure 47: (i) other PV development projects within the Solar Park, and (ii) the Industrial Park.

(i) Solar Park

The Project is located within the Solar Park – an area of 5km^2 allocated by the MDC for solar PV development projects for a total generation capacity of 160MW. The Project has been allocated an area of around 0.2km^2, while the remaining 4.8km^2 will be developed by eight (8) other companies.

The Solar Park is located within the MDA, an area of approximately 9km² consisting of complementary components to be utilized mainly for industrial activity and vocational training centers. A Master Plan has been prepared for the MDA which specifies five (5) different yet complementary clusters spread around Ma'an city. Those clusters include the Solar Park, Industrial Park, a Residential Community, Skill Development Center, and the Hajj Oasis.

As discussed earlier in Section 2.1, the DFZC commissioned the undertaking of a Rapid Environmental Assessment (REA) for the Master Plan of the MDA (to include the Solar Park). The REA provided high level recommendations aimed to promote effective environmental management of the MDA, and included conditions such as the undertaking of flood risk studies for the Solar Park area.

(ii) Industrial Park

Located 3km to the North of the Project site is the MDA Industrial Park. The Industrial Park spreads across 2.5 km², including an area of 750,000 m² that is already fully functional and equipped with a complete infrastructure. The Industrial Park will cater to a wide variety of industries (light, medium, and heavy) and be home to an important number of manufacturing and production plants. It will also offer housing and recreational facilities to low income workers, reducing the cost for investors and the burden on workers from having to commute to work.

The Industrial Park will house several industrial facilities to include mixed concrete and construction supplies facilities, a leather tannery, and glass factory (already operating within the Park). In addition, there are other planned facilities for production of water and juice, cigarettes, ceramics, plastics, marble, granite, and electrical appliances and others. The Park is currently served with the following infrastructure and utilities:

- Existing road network that will be upgraded to serve the future planned industries in the Park;
- Existing wastewater treatment plant for sewerage as well as industrial wastewaters provided they are pre-treated on-site at the respective factories for the removal of toxic and hazardous pollutants. It involves settling, conventional biological treatment, sludge handling and disinfection to produce irrigation water; The current capacity of this facility is 700 m^3/d with a possible expansion to 2,100 m^3/d, and currently received around 150 – 200m^3/d; and
- A water storage tank of 1,500 m^3 capacity with another elevated storage tanks of 450 m³ for distribution.

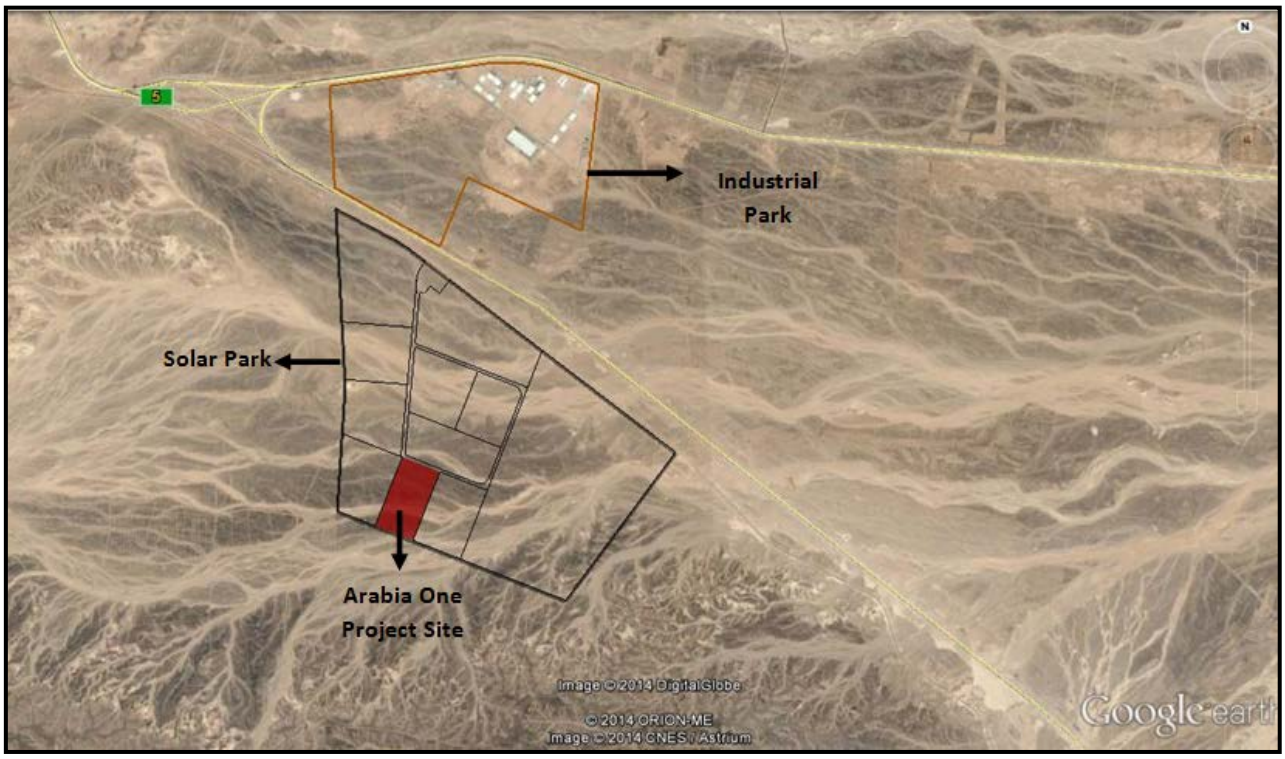

Figure 47: Planned Developments in the Area

8.13.2 Assessment of Cumulative Impacts

This Section investigates the cumulative impacts which could result from incremental impacts from the other known existing and/or planned developments in the area, and based on currently available information on such existing/planned developments.

Taking the above into account, the assessment of cumulative impacts will mainly include those anticipated impacts from the various PV development Projects which will take place within the Solar Park, over an area of 5,000 Dunums. The Solar Park Area will be developed by a total of 9 developers (including this Project) for a total generation capacity of 160 MW as summarized in the table below and presented in Figure 48 below.

Table 29: List of PV Developers within the Solar Park

Developer	Capacity (MW)
Arabia One (or Ennera)	10
Shams Ma'an	50
Anwar Al-Ardh (EJRE)	20
SunEdison	20
Ardh Al-Amal (GLAE)	10
Catalyst	20
Martifer	10
Bright Group Investments	10
CEC	10
Total	**160**

Figure 48: Solar PV Developers in the Solar Park

However, it is important to note that the assessment of cumulative impacts throughout this section is rather a high level assessment – this is due to the fact that limited information is available at this stage to the 'ESIA Team' on other PV developers within the Solar Park.

This mainly includes limited information available to ECO Consult from the other PV developers in the Solar Park which ECO Consult is also undertaking the ESIA study for (to include Anwar Al-Ardh (EJRE), Ardh Al-Amal (GLAE), Shams Ma'an, and SunEdison), as well as broad assumptions which were made regarding the other developers; where those have been clearly stated throughout this section.

The main cumulative impacts investigated include the following, each of which is discussed in details below.

- Landscape and visual;
- Land use;
- Geology, hydrogeology, and hydrology;
- Biodiversity;
- Archeology;
- Air Quality and noise;
- Infrastructure and utilities; and
- Socio-economic development.

The current and planned activities which will take place within the Industrial Park are not considered to be of a nature or type which would result in combination effects with this Project of a significant nature. This is due to the fact that generally, the nature of the operating activities (current and planned) within the Industrial Park and the nature of interaction of those activities with the surrounding environment differ significantly when compared to those from the Project as well as the various PV developments within the Solar Park.

(i) Landscape and Visual

The most important cumulative impacts to be investigated are those anticipated impacts during the operation phase in relation to visual interaction with the surrounding landscapes and potential for glare, both of which are discussed below.

The Projects within the Solar Park collectively are expected to be visible within the immediate vicinity and up to some kilometers. The maximum height of the PV mounting structures are generally expected to be in the range of 2-3.5 m, whereas only the NEPCO substation will comprise higher installations being typical for HV substations and 132 kV transmission lines - including towers of the transmission line, which will be in line with the already existing towers of the 132 kV line near the Highway.

However, it is important to note that within the surrounding areas of the Solar Park there are no key sensitive visual receptors. There are no unique landforms, sites of particular importance, visual or scenic features, environmental reserves or parks, or nearby sensitive receptors which would interfere with the proposed development. In fact, the closes receptor is an industrial area (the MDA Industrial Park). Thus, the receiving area can be classified as having a low sensitivity. To this extent, such cumulative impacts are likely to be considered not significant.

Another issue associated with such projects collectively is the potential for glare caused by sunlight reflected off the PV panels from the various developments over an area of 5,000 Dunums. However, it is important reiterate that PV Panels work on the concept of absorbing sunlight rather than reflecting it – however some minimal reflections for the panels are inevitable and could be associated with potential for glare in certain circumstances. Nevertheless, putting things into perspective standard solar glass reflects much less light and has lower potential for glare when compared to other materials widely used in other developments (such as steel, standard glass, plastic, etc).

Therefore, such an issue is highly unlikely to be of concern and specially that there are no key sensitive receptors which could be affected from such glare. Such minimal impacts are mainly limited to temporarily impacts on the operator of the train and commuters on the Highway as they pass through the Solar Park area.

However, as recommended throughout this ESIA the various PV project developers are encouraged to coordinate with each other and the MDC to notify the Aqaba Railway Corporation of potential for glare in the area as well as the Ma'an Public Works Directorate to install informative signs on the Highway for commuters.

Following the implementation of such mitigation measures, the significance of the cumulative residual impacts is likely to be not significant.

(ii) Land Use

Improper selection and planning for the Solar Park site could entail conflicts with assigned formal land uses set by various governmental agencies and/or land areas which are of value to the local communities. However, the Solar Park area in general is characterized with the following land uses:

- **MoMA Land Use Planning**: the Solar Park area in general lies within areas classified as a Desert Area of the 1st Degree (D1) and Desert Areas of the Second Degree (D2). According to Article [9(b)–7] of the "Land Use Planning Regulation No. 6 of 2007" states that "In those areas the following land use are allowed: wire and wireless telecommunications stations and electric power generation facilities, transmission, and distribution networks";
- **MoEnv/RSCN Areas of Critical Environmental Concern Planning**: the Solar Park area does not lie within areas of critical environment concern; there are no established, under establishment, proposed reserves or IBA's. A number of preservation areas exist further away with the closest delineation being around 15km away;

- **MoA's Forest Lands and Grazing Reserves Planning**: there are no forest lands within or in the surrounding area of the Solar Park and the closest grazing reserve lies around 4km to the southeast;
- **Actual Land Use**: Based on discussions with the SDU of Ma'an Governorate, local community consultations, and many site visits undertaken to the area, it was concluded that the Solar Park area is not considered of any specific value to local communities and is not utilized for any specific purpose. Please refer to Section 7.2.3 for additional details on the actual land use of the site.

Taking all of the above into account, there is no cumulative impact associated with the land use of the area.

(iii) Geology, Hydrogeology, and Hydrology

The most important cumulative impact in relation to geology, hydrogeology, and hydrology would be that related to flood risks within the Solar Park area.

As discussed earlier, the MDC has undertaken a flood risk study which generally aimed to determine flood quantities within the Solar Park area and peak flood estimates to determine the peak flow for the return period of 50 years. Based on that, the study identified the required hydraulic design structure which would be able to convey these flows safely and prevent flood risks for the infrastructure elements within the Solar Park under the responsibility of MDC; which mainly includes the access road to the Solar Park area only.

However, it is important to note that the Study does not specify the required hydraulic design structures to be implemented by the developers in the Solar Park area within their project sites. To this extent, the MDC has requested that each developer undertake a flood risk study for the specific project site.

However, such an approach (where each developer undertakes a separate study for their own Project site) is not favored given the generic nature of such risks on all developments. The wadi system which runs through the Solar Park passes through the land plots of all developers, and thus is highly likely to affect all developments within the Solar Park (refer to Figure 49 below). Through adopting such an approach, mitigation measures implemented by one developer could affect other developments within the Solar Park area (e.g. diversion of wadi from one development to another) and/or could result in implementation or duplication of unnecessary flood risk mitigations which are already being undertaken by another developer.

Thus, it is highly recommended that a holistic approach is adopted by the MDC in coordination with the various developers within the Solar Park area for managing and mitigating flood risks, given the generic nature of such risks on all developments.

To this extent, it is recommended that one flood risk study is undertaken for the entire Solar Park, which must determine and/or build on the study undertaken by MDC to determine flood quantities within the Solar Park area and peak flood estimates to determine the peak flows. Based on the outcomes, and based on understanding the specifics of each PV developer (such as their detailed design) the study must identify the appropriate required hydraulic design structure which would be able to convey these flows safely and prevent flood risks within the entire Solar Park area in a unified and coordinated approach. In addition, the study must emphasize on the importance of maintaining the natural drainage patterns of the area and ensure downstream receptors are not impact or affected.

Following the implementation of such a recommendation, the significance of the cumulative residual impacts is likely to be not significant.

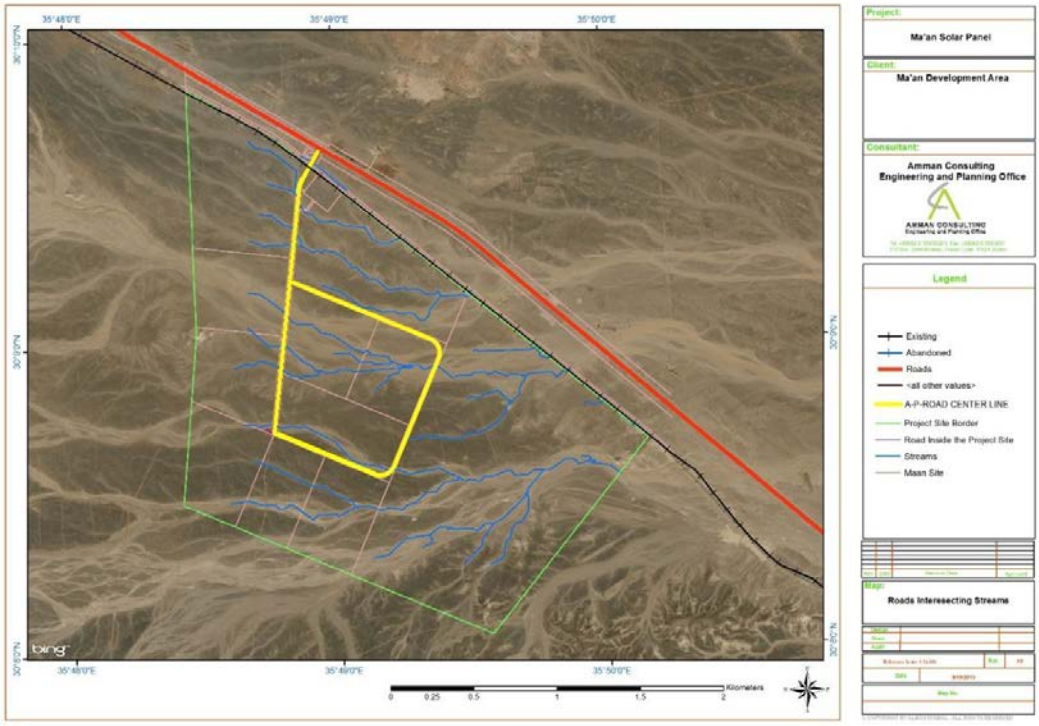

Figure 49: Wadi Systems within the Solar Park

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(iv) Biodiversity

It is expected that the various PV developments which are to take place within the Solar Park area will entail similar construction activities as that of this Project in specific. This would mainly include site preparation activities such as land clearing activities, leveling, excavation, grading, etc.

Such construction activities collectively will result in the alteration of the area's habitat and disturb existing habitats (flora, fauna, and avi-fauna), which could result in the displacement or exclusion of species particularly threatened, endemic, or endangered species which might be present in such habitats.

From a biodiversity perspective, the Solar Park area is similar to that of Arabia One Project Site. As concluded throughout this ESIA, the site's habitat in general is considered barren and of low ecological significance due to its natural setting. Most of the recorded flora/fauna/avi-fauna species within the Project site are considered of least concern and common to such habitat areas. In addition, the site is considered, to some extent, disturbed by human activities by the highway and railway which runs close to the Project site. Moreover, within the wider area there are several factors which could contribute to such disturbances such as mining areas (which are around 6km from the Project site) and proximity to urban areas (Ma'an city) and industrial areas (MDA Industrial Park). Such disturbances could affect, to some extent, the presence of fauna (especially large animals) and avi-fauna within the Project site.

Also, the Solar Park area is not located within or near areas of critical environment concern (to include environmental reserves of important bird areas), where the closest is around 15km away from the site.

In addition, similar to the rationale discussed in Section 8.5.2, potential impacts during the operation phase from the PV Panels and in particular to avi-fauna are highly unlikely to be of any concern.

Finally, it is assumed that the ESIA's conducted for those various project developments would emphasize on the importance of implementing similar mitigation measures highlighted within this ESIA in relation to prevent any damage to the biodiversity of the site. Those mainly include proper management measures such as establishing a proper code of conduct and awareness raising with respect to prohibiting hunting, good housekeeping practices, etc.

Following the implementation of such mitigation measures, the significance of the cumulative residual impacts is likely to be not significant.

(v) Archeology and Cultural Heritage

It is expected that the various PV developments which are to take place within the Solar Park area will entail similar construction activities as that of this Project in specific. This would mainly include site preparation activities such as land clearing activities, leveling, excavation, grading, etc.

Such activities could damage or disturb the archaeological location within the Solar Park area. The "Archeological Survey of the Solar Park Area" report prepared by the DoA recommends that the two (2) location of findings (the Ottoman Military Camp and the Watch Tower – refer to Figure 31) be fenced by the respective PV Developer to prevent potential damage during the construction and operation phase. Improper management of construction activities by the various developers could potentially disturb or damage those sites – this could include for example improper movement of vehicles and machinery into/out of the site, improper conduct by construction workers, etc.

It is assumed that the ESIA's conducted for those project developments will emphasize the protection measures as required within this ESIA – in addition to fencing of those sites by the respective developer within which the sites above are located. In addition, is it assumed that similar mitigation measures will be implemented by each developer with regards to chance find procedures.

Following the implementation of such mitigation measures, the significance of the cumulative residual impacts is likely to be not significant.

(vi) Air Quality and Noise

It is expected that the various PV developments which are to take place within the Solar Park area will entail similar construction activities as that of this Project in specific. This would mainly include site preparation activities such as land clearing activities, leveling, excavation, grading, etc.

However, it is unlikely that the various developments within the Solar Park will commence construction activities simultaneously; however construction activities could overlap given the construction duration of each Project.

Nevertheless, such construction activities will likely results in an increased level of dust and particulate matter emissions, which in turn will directly and temporarily impact ambient air quality. In addition, the use of machinery and equipment are expected to be a source of noise and vibration within the Project site and its surrounding. Such impacts could occur collectively, should there be an overlap between construction activities of one or more developer in the Solar Park area.

However, taking all of the above into account, such impacts are temporary and of short-term nature as they are limited to the construction period only and are reversible as baseline conditions will be restored upon completion of construction works. More importantly, it is highlight unlikely that other nearby surrounding receptors (such as Al-Mahata Village or the Industrial Park) will be affected given the distance and the fact that such receptors are located upwind from the Solar Park area.

Finally, it is assumed that the ESIA's conducted for those various project developments would emphasize on the implementation of the general dust control/suppression measures and noise suppression measures to control such impacts.

Following the implementation of such mitigation measures, the significance of the cumulative residual impacts is likely to be not significant.

(vii) Infrastructure and Utilities

The various PV Project developments within the Solar Park area are expected to affect the infrastructure and utilities within the Ma'an area in general throughout the construction and operation phase as highlighted below.

a) Water Requirements

The water requirements of the various PV development Projects within the Solar Park has have been estimated and are presented in the table below for the construction and operation phase. Several assumptions have been made and which are clearly stated in the table below.

Table 30: Estimated Water Consumption of the Solar Park during Construction and Operation

Developer	Capacity (MW)	Estimated Water Consumption during Construction	Estimated Waste Consumption during Operation
Arabia One	10	There will a maximum of 100 workers where the water requirements of workers on a per capita basis is not expected to exceed 50 liters per day; thus total water requirements anticipated to be around 5,000 l/d (5m^3/d). In addition, it assumed that around 5m^3/day is required mainly for fugitive dust emissions control given the nature of the site (although this greatly depends on weather conditions and other factors). Total requirements are around 10m^3/day for a duration of 9 months.	With regards to water requirements during operation, as discussed earlier the MDC undertook a study to estimate the water requirements of the Solar Park Area – "Master Plan for the Solar Park Area" (Amman Consulting, 2013). The Master Plan takes into account the water demand from the entire PV developments during operation which are to take place within the Solar Park area based on consultations with the various developers. The total daily consumption was estimated at around 85m^3/day and the annual consumption of around 31,000 m^3.
Shams Ma'an	50	Based on information from Shams Ma'an, 500 workers are expected and similar to rationale above (assuming 50 liters per capita per day) total water requirements anticipated to be 25,000 l/d (25m^3/d). In addition, it assumed that around 40m^3/day is required mainly for fugitive dust emissions control given the nature of the site (although this greatly depends on weather conditions and other factors). Total requirements are around 65m^3/day for a duration of approximately 15 months.	
Anwar Al-Ardh (EJRE)	20	Based on information from EJRE, a maximum of be 155 workers are expected and similar to rationale above (assuming 50 liters per capita per day) total water requirements anticipated to be 8,000 l/d (8m^3/d). In addition, it assumed that around 10m^3/day is required mainly for fugitive dust emissions control given the nature of the site (although this greatly depends on weather conditions and other factors). Total requirements are around 20m^3/day for a duration of 6 months.	
SunEdison	20	Based on information from SunEdison, a maximum of 200 workers and similar to rationale above (assuming 50 liters per capita per day) total water requirements anticipated to be around 10,000 l/d (10m^3/d). In addition, it assumed that around 10m^3/day is required mainly for fugitive dust emissions control given the nature of the site (although this greatly depends on weather conditions and other factors). Total requirements are around 20m^3/day for a duration of 5-6 months.	

Ardh Al-Amal (GLAE)	10	Based on information from Ardh Al-Amal, around 80 workers are expected and similar to rationale above (assuming 50 liters per capita per day) total water requirements anticipated to be 4,000 l/d (4m^3/d). In addition, it assumed that around 5m^3/day is required mainly for fugitive dust emissions control given the nature of the site (although this greatly depends on weather conditions and other factors). Total requirements are around 10m^3/day for a duration of approximately 6 months.	
Catalyst	20	No information is available. Assumed similar to SunEdison given it is of similar capacity and land size. Total requirements are around 20m^3/day for a duration of 6 months.	
Martifer	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. Total requirements are around 10m^3/day for a duration of 5-6 months.	
Bright Group Investments	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. Total requirements are around 10m^3/day for a duration of 5-6 months.	
CEC	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. Total requirements are around 10m^3/day for a duration of 5-6 months.	
Total Estimation	**160**	**Around 200m^3/day if we assume all construction activities at some point take place simultaneously.**	**Around 85m^3/day (31,000m^3 per year)**

In accordance with the table above, the water consumption during construction was estimated to be around 200m^3/day if we assume construction activities of all PV developers at some point take place simultaneously; nevertheless, the water requirements during the construction phase are temporary and of short term duration as they are limited to the construction phase only.

During the operation phase a separate study has been undertaken by the MDC to estimate the water requirements of the Solar Park area – "Master Plan for the Solar Park Area" (Amman Consulting, 2013). The Master Plan takes into account the water demand from the entire PV developments during operation which are to take place within the Solar Park area based on consultations with the various developers. The total daily consumption was estimated at around 85m^3/day and the annual consumption of around 31,000 m^3 for a duration of 20 years. Putting things into perspective, as discussed in Section 7.7.2, the total annual water supplied to Ma'an city is around 3.42 MCM. The water requirements of the Solar Park during the operation phase is anticipated to be around 31,000 m^3 per year – representing less than 1% of the total water supplied to Ma'an city.

The MDC have established a separate water supply system for the Industrial Park to cater for the water requirements of the various industries which are to be established (based on a Master Plan Study undertaken for the Industrial Park), as well as the water requirements of the Solar Park area.

To supply the various developers with their water requirements (in addition to supplying the water requirements of the Industrial Park), the MDC have coordinated with Ministry of Water and Irrigation and Ma'an Water Directorate. It has been decided that the water requirements will be supplied through the local water network in addition to water wells. A pipeline from the local water network (Ma'an Water Supply System) runs to the Industrial Park and will likely provide around 3,600m^3/day, while the remaining water demand will be met through two (2) onsite wells at the Industrial Park each with a capacity of around

25m^3/hour. A license has been granted from the Ministry of Water and Irrigation for drilling and operation of the wells and supply of water from the local network.

Nevertheless, it is important to ensure that the water requirements of the Project would not affect the water resources and water supply of the area. However, it is important to note that the Ministry of Water and irrigation would not grant a license for the operation of the wells and supply of the water from the local network without ensuring that it would not affect the local water resources.

Nevertheless, the 'ESIA Team' has also undertaken a regional assessment of the water resources in the area which covers a distance of around 15km surrounding the Solar Park area. Records of the water wells from the Ministry of Water and Irrigation in that area were collected for a total of 33 wells (this includes the public wells which supply the local water network as well as the private wells in the study area).

The assessment takes into account the productivity rate of each well (which is highly variable and depends on the well site, finishing, depth and other geologic factors) as well as the drawdown rate. Based on that the sustainable well yield was calculated – which is the yield which would not affect the local water resources of the study area. Based on this assessment, the sustainable well yield is expected to range between 20 – 30 m^3/hr based on the hydrogeological settings and the available data on wells from the Ministry of Water and Irrigation. To this extent, the water wells of the Industrial Park are within the sustainable yield for the area.

Given the above, the significance of the cumulative impacts is likely to be not significant.

b) Wastewater Utilities

Table 31 below summarized the amounts of wastewater expected to be generated by the various PV project developments in the Solar Park. Several assumptions have been made and which are clearly stated in the table below.

Table 31: Estimated Wastewater from Solar Park during Construction and Operation

Developer	Capacity (MW)	Estimated Wastewater during Construction	Estimated Wastewater during Operation
Arabia One	10	There will be a maximum of 100 workers where the water requirements of workers on a per capita basis is not expected to exceed 50 liters per day; and taking into account an 80% wastewater generation factor per capita – anticipated wastewater to be generated is 4,000 l/d (4m^3/d) for a duration of 9 months.	There will be 5 workers where the water requirements of workers on a per capita basis is not expected to exceed 50 liters per day; and taking into account an 80% wastewater generation factor per capita – anticipated wastewater to be generated is around 200 l/d (0.2m^3/d) for a duration of 20 years.
Shams Ma'an	50	Based on information from Shams Ma'an, 500 workers are expected and similar to rationale above (assuming 50 liters per capita per day and 80% wastewater generation factor) anticipated wastewater to be generated is 20,000 l/d (20m^3/d) for a duration of approximately 15 months.	Based on information from Shams Ma'an, 25 workers are expected and similar to rationale above (assuming 50 liters per day and 80% wastewater generation factor) anticipated wastewater to be generated is 1,000 l/d (1m^3/d) for a duration of 20 years.
Anwar Al-Ardh (EJRE)	20	Based on information from EJRE, 155 workers are expected and similar to rationale above (assuming 50 liters per capita per day and 80% wastewater generation factor) anticipated wastewater to be generated is 6,000 l/d (6m^3/d) for a duration of 6 months.	Based on information from EJRE, 7 workers are expected and similar to rationale above (assuming 50 liters per day and 80% wastewater generation factor) anticipated wastewater to be generated is 300 l/d (0.3m^3/d) for a duration of 20 years.

SunEdison	20	Based on information from SunEdison, a maximum of 200 workers and similar to rationale above (assuming 50 liters per capita per day and 80% wastewater generation factor) anticipated wastewater to be generated is around 8,000 l/d (8m^3/d) for a duration of 5-6 months.	Based on information from SunEdison, a maximum of 30 workers and similar to rationale above (assuming 50 liters per capita per day and 80% wastewater generation factor) anticipated wastewater to be generated is around 1,200 l/d (1.2m^3/d) for a duration of 20 years.
Ardh Al-Amal (GLAE)	10	Based on information from Ardh Al-Amal, around 80 workers are expected and similar to rationale above (assuming 50 liters per capita per day and 80% wastewater generation factor) anticipated wastewater to be generated is around 3,000 l/d (3m^3/d) for a duration of approximately 6 months.	Based on information from Ardh Al-Amal, around 5 workers are expected and similar to rationale above (assuming 50 liters per capita per day and 80% wastewater generation factor) anticipated wastewater to be generated is around 200 l/d (0.2m^3/d) for a duration of 20 years.
Catalyst	20	No information is available. Assumed similar to SunEdison given it is of similar capacity and land size. 8,000 l/d (8m^3/d) for a duration of 5-6 months.	No information is available. Assumed similar to SunEdison given it is of similar capacity and land size. 1,200l/d (1.2m^3/d) for a duration of 20 years.
Martifer	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 3,000 l/d (3m^3/d) for a duration of 5-6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 200 l/d (0.2m^3/d) for a duration of 20 years.
Bright Group Investments	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 3,000 l/d (3m^3/d) for a duration of 5-6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 200 l/d (0.2m^3/d) for a duration of 20 years.
CEC	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 3,000 l/d (3m^3/d) for a duration of 5-6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 200 l/d (0.2m^3/d) for a duration of 20 years.
Total Estimation	**160**	**Around 60,000 l/d (60m^3/d) if we assume construction activities at some point take place simultaneously.**	**Around 5,000 l/d (5 m^3/d)**

In accordance with the table above, the total estimated amount of wastewater expected to be generated during construction is 60m^3/d if we assume construction activities of all PV developers at some point take place simultaneously; nevertheless, such impacts are temporary and of short term duration as they are limited to the construction phase only.

In addition, during the operation phase the total amount of wastewater expected to be generated is around 5m^3/day for a duration of 20 years.

Nevertheless, such wastewater quantities will most likely be collected by tankers and disposed at the Industrial Park WWTP which has a current capacity of 700 m^3/d, with a possible increase to 2,100 m^3/d. The WWTP currently receives around 150 – 200 m^3/d of wastewater. Taking of all the above into account, the WWTP is expected to easily handle such generated amounts of wastewater. Given the above, the significance of the cumulative impacts is likely to be not significant.

c) Solid Waste Utilities

Table 32 below summarizes the amounts of solid waste expected to be generated by the various PV project developments in the Solar Park; this includes municipal solid waste and construction waste. Several assumptions have been made and which are clearly stated in the table below.

Table 32: Estimated Solid Waste from Solar Park during Construction and Operation

Developer	Capacity (MW)	Estimated Solid Waste during Construction	Estimated Solid Waste during Operation
Arabia One	10	There will be a maximum of 100 workers and taking into account the average theoretical municipal solid waste generation in Jordan of 0.85kg/capita/day (SWEEPNET, 2010) (as a worst case scenario) total municipal solid waste generated is estimated at 85kg/day for a duration of duration of 9 months. In addition, construction waste is estimated to be around 20kg/day. Total solid waste is estimated at around 100kg/day.	There will be 5 workers and taking into account the average theoretical municipal solid waste generation in Jordan of 0.85kg/capita/day (SWEEPNET, 2010) total solid waste generated is estimated at 4kg/day for a duration of duration of 20 years.
Shams Ma'an	50	Based on information from Shams Ma'an, 500 workers are expected and similar to rationale above (0.85kg/capita/day) anticipated solid waste to be generated is estimated at 425kg/day for a duration of approximately 15 months. Construction waste is estimated at around 130kg/day. Total solid waste is estimated at around 550kg/day.	Based on information from Shams Ma'an, 25 workers are expected and similar to rationale above (0.85kg/capita/day) anticipated solid waste to be generated is estimated at 21kg/day for a duration of 20 years.
Anwar Al-Ardh (EJRE)	20	Based on information from EJRE, 155 workers are expected and similar to rationale above (0.85kg/capita/day) anticipated solid waste to be generated is estimated at 130kg/day for a duration of duration of 6 months. In addition, construction waste is estimated to be around 50kg/day. Total solid waste is estimated at around 180kg/day.	Based on information from EJRE, 7 workers are expected and similar to rationale above (0.85kg/capita/day) anticipated solid waste to be generated is estimated at 6kg/day for a duration of duration of 20 years.
SunEdison	20	Based on information from SunEdison, a maximum of 200 workers and similar to rationale above (0.85kg/capita/day) anticipated solid waste to be generated is estimated at 170kg/day for a duration of duration of 5-6 months. In addition, construction waste is estimated to be around 50kg/day. Total solid waste is estimated at around 220kg/day.	Based on information from SunEdison, a maximum of 30 workers are expected and similar to rationale above (0.85kg/capita/day) anticipated solid waste to be generated is estimated at 26kg/day for a duration of duration of 20 years.
Ardh Al-Amal (GLAE)	10	Based on information from Ardh Al-Amal, around 80 workers are expected and similar to rationale above (0.85kg/capita/day) solid waste to be generated is estimated at around 70 kg/day for a duration of approximately 6 months. Construction waste is estimated at around 25kg/day. Total solid waste is estimated at around 100kg/day.	Based on information from Ardh Al-Amal, 5 workers are expected and similar to rationale above (0.85kg/capita/day) solid waste to be generated estimated at around 5kg/day for a duration of 20 years.
Catalyst	20	No information is available. Assumed similar to SunEdison given it is of similar capacity and land size. Total solid waste is estimated at around 220kg/day for a duration of	No information is available. Assumed similar to SunEdison given it is of similar capacity and land size. Total solid waste generated is estimated at 26kg/day for a

		duration of 5-6 months.	duration of duration of 20 years.
Martifer	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. Total solid waste is estimated at around 100kg/day for a duration of approximately 5-6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity. Estimated at around 5kg/day for a duration of 20 years.
Bright Group Investments	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. Total solid waste is estimated at around 100kg/day for a duration of approximately 5-6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity. Estimated at around 5kg/day for a duration of 20 years.
CEC	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. Total solid waste is estimated at around 100kg/day for a duration of approximately 5-6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity. Estimated at around 5kg/day for a duration of 20 years.
Total Estimation	**160**	**Around 1,700 kg/day if we assume all construction activities at some point take place simultaneously.**	**Around 100 kg/day**

In accordance with the table above, the total amount of solid waste expected to be generated is around 1,700 kg/day if we assume construction activities of all PV developers at some point take place simultaneously; nevertheless, such impacts are temporary and of short term duration as they are limited to the construction phase only.

In addition, during the operation phase the total amount of solid waste expected to be generated is around 100 kg/day for a duration of 20 years.

Such solid waste quantities will most likely be disposed at the Ma'an Central Landfill located around 5km to the north of the Project site. According to discussions with Greater Ma'an Municipality, 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.

Based on discussions with the representatives from Greater Ma'an Municipality, the landfill will be able to handle such amounts Given the above, the significance of the cumulative impacts is likely to be not significant

d) Hazardous Waste Utilities

Of particular importance is the disposal of the panels from all of those PV development Projects at the end of their lifetime. Based on discussions with the "Hazardous Substances and Waste Management Directorate" of the MoEnv, the panels are classified as electronic waste and must be disposed at the Swaqa Hazardous Waste Treatment Facility.

Therefore, during the decommissioning phase of the Project –and assuming as a worst case scenario that all these panels will be disposed at a landfill and no recycling will take place as part of global recycling programs of these developers – it is important to ensure that the Swaqa Hazardous Waste Treatment Facility would be able to accept and handle the panels and the quantities to be disposed.

However, this issue in itself is unclear at this stage given the following:

- The responsible entity for undertaking such disposal is unclear as to whether it could be the developers or MEMR. It is not clear at this point whether at the end of the lifetime of the Project MEMR would take ownership of those Projects and operate them for an additional five (5) years or whether these projects will be completely decommissioned; and

- The prospects of hazardous waste management are not clear, taking into account the Project timeline of 20 years. Based on discussions with the "Hazardous Substances and Waste Management Directorate" of the MoEnv, the only hazardous landfill in Jordan is the Swaqa Hazardous Waste Treatment Facility and there are no plans to establish or construct new hazardous waste disposal facilities. At Swaqa, currently, stabilized and inert hazardous waste is land-filled, while other types of hazardous waste which require physical-chemical treatment or incineration are stored in safe storage spaces. However, there is a second phase development plan for Swaqa which involves physical-chemical treatment and incineration facilities to improve handling and management of hazardous waste and which is expected to significantly improve the capacity of the landfill. The second phase is expected to be completed by 2016. More importantly there is currently a pilot project for disposal and management of electronic waste at Swaqa. Electronic waste is currently collected and stored at the landfill, and there are plans for collaborating with private entities for implementing recycling programs for such electronic waste streams.

Nevertheless, based on discussions with the "Hazardous Substances and Waste Management Directorate" of the MoEnv, and *based on current conditions*, the landfill would be able to accept and store the solar modules; which were estimated to require an area of around 5,000 m^2.

Based on preliminary calculations and assumptions for each developer (which are clearly stated in the table below) and taking into account the maximum height of the storage space allowed in the Swaqa Facility of 6m – then the total area required for the storage space for all those panels is estimated at 5,000m^2 assuming vertical stacking of the panels.

Table 33: Estimated Area of Storage Required for Panels at Swaqa as a Worst Case Scenario Disposal Option

Developer	Capacity (MW)	Estimated Area of Storage Required (m^2)
Arabia One	10	Based on information from Arabia One around 45,000 panel each with a dimension of 1,652mm×1000mm× 45mm thickness –area required for storage space is estimated at 500m^2.
Shams Ma'an	50	Based on information from Shams Ma'an around 680,000 panels each with a dimension of 1,200mm× 600mm× 6.8mm - area required for the storage space is estimated at 500m^2assuming vertical stacking of the panels.
Anwar Al-Ardh (EJRE)	20	Around 88,000 panels each with a dimension of 1,650mm× 992mm × 35mm - area required for the storage space is estimated at 800m^2 assuming vertical stacking of the panels.
SunEdison	20	Based on information from SunEdison, around 82,000 panels each with a dimension of 1,976mm× 990mm× 50mm –area required for the storage space is estimated at 1,300m^2assuming vertical stacking of the panels.
Ardh Al-Amal (GLAE)	10	Based on information from Ardh Al-Amal around 44,000 panels each with a dimension of 1,650mm× 992mm × 35mm – area required for the storage space is estimated at 400m^2.
Catalyst	20	No information is available. Assumed to be similar to SunEdison as it is of similar capacity. Storage space required estimated at 1,300m^2
Martifer	10	No information is available at this stage. Assumed to be similar to GLAE as it is of similar capacity and land size. Storage space required estimated at 400m^2.
Bright Group Investments	10	No information is available at this stage. Assumed to be similar to GLAE as it is of similar capacity and land size. Storage space required estimated at 400m^2.
CEC	10	No information is available at this stage. Assumed to be similar to GLAE as it is of similar capacity and land size. Storage space required estimated at 400m^2.
Total Estimation	**160**	**Around 5,000 m^2 if we assume as a worst case scenario all panels will be disposed at the Swaqa Facility.**

Based on current conditions, the "Hazardous Substances and Waste Management Directorate" of the MoEnv confirmed that it would be able to accept and store the modules. In addition, at the time disposal would take place (after 20 years) the prospects of the electronic waste recycling program undertaken at Swaqa would be more clear and those modules could be recycled as part of this program.

It is also important to note that the previous discussion assumes a worst case scenario with regards to the final disposal of panels at a landfill with no recycling. However, many of the developers have their own global

recycling programs for their PV panels at the end of life time or are part of PV CYCLE – an association organizing the take-back and recycling of PV modules at end-of-life. The recycling program of PV CYCLE is a comprehensive recycling process which recovers most of the materials within the PV panel (including glass, semiconductor material, ferrous and non-ferrous metals, etc.) for reuse in new products. Such an option is available and could be used for the PV panels at the end-of-life

However, it is assumed that the ESIA's conducted for those various project developments would emphasize on the importance of developing a Disposal Plan for the PV Panels by the responsible entity undertaking decommissioning activities. The plan should first consider recycling programs for the panels through the suppliers of the modules. Should this not be achieved, as a last option, the responsible entity must investigate the disposal of the panels at existing hazardous waste facilities in Jordan through coordination with the MoEnv. Following the implementation of such mitigation measures, the significance of the cumulative residual impacts is likely to be not significant.

e) Road Networks

Transportation activities will likely involve a significant number of trucks to transport the various Project components of the various developers within the Solar Park - and mainly the PV panels. However, as stated earlier, it is unlikely that the various developments within the Solar Park will commence construction and transportation activities simultaneously; however there could be an overlap between some developers. Should this be the case, simultaneous transportation activities for one or more developers within the Industrial Park could temporary and intermittently increase traffic volume and movement on the highways and to some extent a reduction of roadway capacities.

However, it is assumed that the ESIA's conducted for those various project developments would emphasize on the importance of developing a Transport Study which would also require coordination with the Traffic Department, Ministry of Public Works and Housing (Ma'an Public Works Directorate), and Ma'an Municipality. Through coordination with the entities above, it is likely that should simultaneous transportation activities take place, then those would be adequately managed and coordinated. Following the implementation of such mitigation measures, the significance of the cumulative residual impacts is likely to be not significant.

f) Aqaba Railway

During the construction and operation phase movement of vehicles, equipment and machinery is expected and in order to access the Solar Park through movement on the railway is required as there is no other alternative. Improper management of movement of vehicles and machinery into/out of the site could damage the railway which runs close to the project site, and could affect the movement of the train.

However, the MDC is aware that such an issues needs to be taken into account in order to provide access to the Solar Park area for the various PV developments which are to take place. However, it was agreed with the ARC and the Hejaz Railway Corporation that the optimal solution would be the establishment of a road (with a width of 6-7m) to cross the railway and which will run on the same level as that of the railway. On the junctions between the road and railway the necessary safety measures will be implemented, and which will include a railway signal which would instruct the user of the road not to pass when the train is near.

However, it is assumed that the ESIA's conducted for those various project developments are expected to emphasize on ensuring movement of vehicles, machinery, and equipment into the Solar Park Area takes place through the designated road and prohibit passage through other means.

Following the implementation of such mitigation measures, the significance of the cumulative residual impacts are likely to be not significant.

(viii) Socio-economic

Looking at the socio-economic aspect of the projects, the most straight forward benefit that the various projects will bring to the local communities of Ma'an is job creation. The various projects within the Solar Park are expected, at a minimum, to provide job opportunities during the construction and operations phases as follows:

Table 34: Estimated Job Opportunities from the Various PV Developers within the Solar Park

Developer	Capacity (MW)	Estimated Job Opportunities during Construction	Estimated Job Opportunities during Operation
Arabia One	10	There will be a maximum of 100 workers for a duration of 9 months.	There will be 5 workers for a duration of 20 years.
Shams Ma'an	50	Based on information from Shams Ma'an, 500 workers are expected for duration of approximately 15 months.	Based on information from Shams Ma'an, 25 workers are expected for duration of 20 years.
Anwar Al-Ardh (EJRE)	20	Based on information from EJRE, there will be 155 workers for a duration of duration of 6 months.	Based on information from EJRE, there will be 7 workers for a duration of duration of 20 years.
SunEdison	20	Based on information from SunEdison, a maximum of 200 workers for duration of 5-6 months.	Based on information from SunEdison, a maximum of 30 workers for duration of 20 years.
Ardh Al-Amal (GLAE)	10	Based on information from Ardh Al-Amal, 80 workers for a duration of 6 months.	Based on information from Ardh Al-Amal, 5 workers for a duration of 20 years.
Catalyst	20	No information is available. Assumed similar to SunEdison given it is of similar capacity. 200 workers for duration of 5-6 months.	No information is available. Assumed similar to SunEdison given it is of similar capacity. 30 workers for duration of 20 years.
Martifer	10	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 80 workers for a duration of 6 months.	No information is available. Assumed similar to GLAE given it is of similar capacity and land size. 5 workers for a duration of 20 years.
Bright Group Investments	10	Same as above. 80 workers for a duration of 6 months.	Same as above. 5 workers for duration of 20 years.
CEC	10	Same as above. 80 workers for a duration of 6 months.	Same as above. 5 workers for duration of 20 years.
Total Estimation	**160**	**Around 1,500 – but differ in their duration**	**Around 120**

The developers are expected to commit to their social responsibility by aiming to hire the largest possible number of local community members throughout the construction and operation phases. In addition, they are expected to consider other aspects of their social responsibility toward the local community

Therefore it is vitally recommended that the various PV developers, along with MDC, collaborate and collectively develop and adopt a holistic Action Plan for the social development of the area. Such collaboration is favored over individual planning and implementation by each developer because it is more likely to bring a greater and more sustainable benefit to the local community

Thereby the Action Plan must firstly, acknowledge the importance of building a strong relationship with the local community; secondly clearly state its commitment to its social responsibility towards this community; thirdly adopt a participatory approach whereby the local community is given voice to express its needs, preferences, fears and concerns.

It is recommended that the Plan, at a minimum, consider the following:

- Manage expectations so that local communities are realistic about opportunities from the Project and clearly identify commitments by developers related to social development;

- Identify the number of skilled and unskilled job opportunities targeted to the local community throughout the construction and operation phases. The developers are expected to provide in details 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;
- Given the local community past experiences in VTC's as discussed earlier(refer to Section 4.2), it is highly recommended that the developers be directly involved and contribute to the VTC's training and capacity building program to ensure that local community that is to be recruited are equipped with the required skills and qualifications. In addition, it is recommended that the developers commit to hiring labour from the VTC throughout the construction and operation phase;
- 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 the appointment of local contractors, local sourcing of materials and supplies, etc; and
- Ensure timely and continuous communication and dissemination of information between the developers 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.

In addition to the above, it is recommended that as part of the Action Plan, each developer allocate funds for social responsibility programs to be implemented for the local communities. Such funds could be used for the following amongst other options:

- Installation of residential PV systems for local community facilities such as governmental buildings, mosques, schools, hospitals and health centers, etc;
- Provide scholarship programs for students;
- Support local academic institutions (such as Al-Hussein Bin Talal University) in developing academic programs and degrees in PV and renewable energy; a
- Provide educational benefits and attracting visits by local schools, universities and colleges, etc.

However, it is highly recommended that such funds be managed in coordination with other entities (such as the MDC) whom have the expertise in working with the local community and have an understanding and awareness on their needs and the socio-economic challenges that they face. Such collaboration would allow for a transparent and systematic method for allocating funds which in turn would ensure maximum benefit to those local communities.

To this extent, the MDC in collaboration with the King Abdullah II Fund for Development are currently developing the "Ma'an Development Fund". The overall vision for this Fund his to achieve overall economic development by working with the local community to improve their quality of life throughout the concept of social responsibility. The objective of this Fund includes the following:

- Support local community activities and institutions;
- Support cultural and educational initiatives;
- Support small and medium enterprises;
- Support the use of renewable energy;
- Support training and skills development programs; and
- Support initiatives aimed to provide job opportunities.

A "Concept Note for the Ma'an Development Fund" (MDC, 2014) has been prepared for the Fund in relation to the mechanism in which it will be executed, operated and managed. The Concept Note states the following:

- Announce the establishment of the Fund and invite all companies and development projects operating within Ma'an Governorate (such as the developers of the Solar Park area) to contribute to supporting the fund and participate in its work;
- Establish an Advisory Board for the Fund which includes representatives from the Executive Board of Ma'an Governorate, Greater Ma'an Municipality, King Abdullah II Fund for Development, Ma'an Chamber of Industry and Commerce, Al-Hussein Bin Talal University, local community representatives, and others.
- Form an Executive Committee from the Advisory Board of the Fund to develop the program and methodology for the proposed work, implementation instructions, the basis and foundations for accepting grants and donations, and the entities, organizations, and projects whom are eligible for these funds;
- Undertake consultations with representatives of social development organizations within Ma'an Governorate to discuss the overall adopted methodology and mechanism for managing the Fund; and
- Assign a date for the launch of the Fund and assign appropriate disclosure means.

Finally, the Concept Note also discusses the proposed areas where such funds could be allocated and those include but not limited to the following:

- University scholarships in accordance with the needs of the labor market in Ma'an Governorate;
- Capacity building and training programs for university students and young workers in accordance with the needs of the labor market in Ma'an Governorate;
- Develop financing schemes for small scale development and productive projects which serve Ma'an Governorate and bring benefits to all segments of the society;
- Support youth clubs and associations through funding their projects and programs.

Thereby, it is recommended that the developers consider allocating their funds as part of the "Ma'an Development Fund", as well as support and participate in the fund's activities, by for example providing support to the allocation schemes of the fund in relevance to their projects and which could include the installation of residential PV systems for local community facilities (e.g. mosques, schools, hospitals and health centers, etc.). In addition, it is important that the developers, as part of the Action Plan discussed earlier, ensure continuous communication and dissemination of information to the local communities regarding the Fund and encourage the local community to apply to this fund.

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 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 35 below summarizes the overall proposed institutional and procedural arrangement for the implementation of the ESMP, while Table 36 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.

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 bi-annual 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 35: 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 Requirements	Project Operator – Project Staff Member	Project Developer – HSE Officer or third party Employer Representative (on a bi-annual basis)	MoEnv
Compliance with environmental legislations	Project Operator – Project Staff Member	Project Developer – HSE Officer or third party Employer Representative (on a bi-annual basis)	MoEnv

Table 36: Roles and Responsibilities of Entities Involved in ESMP

Designation	Entity	Project Role	Environmental and Social Responsibilities
Project Developer	Arabia One for Clean Energy Investments PSC	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 bi-annual basis during the operation phase.
Engineering, Procurement, and Construction (EPC) Contractor	Hanwha	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.
National Electric Power Company (NEPCO)	National Electric Power Company (NEPCO)	Build substation with overhead lines to the existing grid	▪ Refer to Chapter 10.
Project Operator	MASE, which has a technical support agreement with Hanwha for a duration of 2 years	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; ▪ 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.
Environmental Regulator	Ministry of Environment	Granting environmental clearance to the Project	▪ Undertake compliance monitoring

9.2 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.

9.3 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 responsible entity of the non-compliance. Responsible entity should then take all necessary measures to address the non-compliance.

9.4 Compilation of Environmental and Social Management Plan

Table 37, Table 38 , and Table 39 below present the ESMP for the planning and construction, operation, and decommissioning phase respectively and which include the following:

- The environmental attribute (e.g. air quality) that is likely to be impacted;
- A summary of the potential impact and/or likely issue;
- The identified mitigation actions that aim to eliminate and/or reduce the potential impact to acceptable levels;
- 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 37: ESMP for the Planning and Construction Phase

Environmental Attribute	Potential Impact	Mitigation Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Landscape and Visual	Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Submit an application for a permit from CARC and JRAF along with the required details and information. It is highly likely that CARC and JRAF will respond officially with no objection on the Project development but will require a guarantee that the panels are state of the art and won't result in reflection greater than natural surfaces such as water bodies or other common materials/	Submission of permit from CARC and JRAF	Once; before operation commences	Developer or EPC Contractor	- Civil Aviation Law No. 41 of the year 2007
		Ensure proper general housekeeping and personnel management measures are implemented which could include: (i) ensure the construction site is left in an orderly state at the end of each work day, (ii) to the greatest extent possible construction machinery, equipment, and vehicles not in use should be removed in a timely manner, (iii) proper handling of waste streams, etc.	Inspection	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006
Geology and Hydrology	A wadi system runs within the Project site and thus there is a potential risk of local flood hazard within the site during the rainy season and especially during flash flood events	The MDC has requested that each Developer undertake a flood risk study for their project site which must aim to determine flood quantities within the Project site and peak flood estimates. Based on that, the study must provide recommendations for the development of hydraulic structures to minimize the impact and mitigate flood risks within the Project site. However, such an approach is not favored given the generic nature of such risks on all developments. **Thus, it is highly recommended that a holistic approach is adopted by the MDC in coordination with the various developers within the Solar Park area for managing and mitigating flood risk.** It is recommended that one flood risk study is undertaken for the entire Solar Park, which must determine flood quantities within the Solar Park area and peak flood estimates to determine the peak flows. Based on the outcomes, and based on understanding the specifics of each PV developer (such as their detailed design) the study must identify the appropriate required hydraulic design structure which would be able to convey these flows safely and prevent flood risks within the entire Solar Park area in a unified and coordinated approach. In addition, the study must emphasize on the importance of maintaining the natural drainage patterns of the area and ensure downstream receptors are not impacted or affected.	Not applicable	Once; before construction commences	MDC in collaboration with the Project Developer and the other PV developers within the Solar Park	- Environmental Protection Law No. 52 of 2006
	Improper management of solid waste	Coordinate with Ma'an Municipality or hire a competent private contractor for the collection of solid waste from the site to the Ma'an Central Landfill.	Review contract with contractor	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Solid Waste Management Regulation No. (27) of 2005
		Prohibit fly-dumping of any solid waste to the land.	Inspection	Continuous	EPC Contractor	
		Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".	Inspection	Continuous	EPC Contractor	
		Distribute a sufficient number of properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. Where possible, seek ways to reduce construction waste by reusing materials.	Inspection	Continuous	EPC Contractor	
		Implement proper housekeeping practices on the construction site at all times.	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.	Review manifests to ensure consistency	Continuous	EPC Contractor	
	Improper management of wastewater	Coordinate with Ma'an Water Directorate to hire a private contractor for the collection of wastewater from the site to the Industrial Park WWTP.	Review contract with contractor	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
		Prohibit illegal disposal of wastewater to the land.	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.	Inspection	Once	EPC Contractor	
		Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing.	Inspection	Continuous	EPC Contractor	
		Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the Industrial Park WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.	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.	Review contract with contractor	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Management, Transportation, & Handling of Harmful
		Follow the requirements for management and storage as per the 'Instructions for Hazardous Waste Management and Handling of the Year 2003' of the MoEnv.	Inspection	Continuous	EPC Contractor	
		Prohibit illegal disposal of hazardous waste to the land.	Inspection	Continuous	EPC Contractor	

		Possibly contaminated water (e.g. runoff from paved areas) must be drained into appropriate facilities (such as sumps and pits) and must be orderly disposed of as hazardous waste.	Inspection	Continuous	EPC Contractor	& 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
		Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing.	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.	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.	Inspection	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - 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.	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).	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.	Inspection	Continuous	EPC Contractor	
		Ensure that a minimum of 1,000 liters of general purpose spill absorbent is available at hazardous material storage facility.	Inspection	Continuous	EPC Contractor	
		If spillage occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.	Inspection Reporting of incident and measures taken to minimize impact	Upon Occurrence	EPC Contractor	
Biodiversity	Impacts are mainly limited to improper management of the site (e.g. improper conduct and housekeeping practices).	Before construction commences, undertake a fauna survey (through an ecological expert) to identify the presence of any key faunal species of importance (reptiles and mammals). Should such key species exist within the Project site (e.g. Spiny Tailed Lizard) then it should be relocated to areas outside of construction activities.	Reporting on outcomes of survey	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
		Ensure that the fencing constructed for the Project site 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).	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).	Inspection	Continuous	EPC Contractor	
Archeology	Improper management of construction activities could disturb/damage the archaeological locations in the nearby area as well as potential archaeological remains which could be buried in the ground (if any).	Properly plan construction activities to take into account the identified archeological 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, prohibit movement of vehicles near those areas, etc.	Inspection	Continuous	EPC Contractor	- 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 construction workers and personnel to emphasizes the presence of archeological locations in the area.	Inspection	Once; before construction commences	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.	Inspection	Upon Occurrence	EPC Contractor	
			Report prepared and submitted to the DoA	Upon occurrence		
Air Quality and Noise	Construction activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality	If dust or pollutant emissions are found to be excessive, construction activities should be stopped until adequate control measures are implemented.	Inspection and visual monitoring to include periodic inspections at nearby sites (e.g. nearby Highway) to determine whether high levels of dust from construction activities exist.	Continuous	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - Air Protection Regulation No. 28

			Reporting of any excessive levels of pollutants and measures taken to minimize impact	Upon occurrence	EPC Contractor	for 2005 - Instruction for Reduction and Prevention of Noise for 2003 - JS 1140-2006 Ambient Air Quality
		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).	Inspection	Continuous	EPC Contractor	
		Apply basic dust control and suppression measures which could include: regular watering of all active construction surfaces, 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.	Inspection	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.	Inspection	Continuous	EPC Contractor	
	Possible noise emissions to the environment from the construction activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities	If noise levels were found to be excessive, construction activities should be stopped until adequate control measures are implemented.	Inspection	Continuous	EPC Contractor	
			Reporting of any excessive levels of noise and measures taken to minimize impact.	Upon occurrence	EPC Contractor	
		Comply with OSHA requirements and the Jordanian Codes to ensure that for activities associated with high noise levels, workers are equipped with proper protective equipment (e.g. earmuffs).	Inspection	Continuous	EPC Contractor	
Infrastructure and Utilities	Water Requirements – water requirements of the Project could entailing constraint on the existing users such as the Industrial Park or local communities.	Coordinate with the MDC for securing water requirements of the Project, whom has sufficient capacity to cover the rather minimal water requirements of the Project	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	- Environmental Protection Law No. 52 of 2006 - 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
	Wastewater Utilities – it is improtant to ensure that existing utilitis would be able to handle the amount of wastewate gneerated from the Project.	Coordinate with the MDC for disposal of wastewater at the Industrial Park Wastewater Treatment Plant	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
	Solid Waste Utilities – it is improtant to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project	Coordinate with Greater Ma'an Municipality or hire a competent private contractor for the collection of solid waste from the site to Ma'an Central Landfill.	Submit report with proof of coordination	Once; before construction commences	EPC Contractor	
	Road Netowrks – if transportation activities are not properly managed, they could entail reduction of roadway capacities and risk of damage to the existing roads and could be of public safety concerns to other users on road.	Conduct a Transport Study 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.	Submit Transport Plan to MoEnv	Once; before construction commences	EPC Contractor	
	Railway – improper movement of vehicles and machinery into/out of the site could damage the railway and affect the movement of the train.	Ensure movement of vehicles, machinery, and equipment takes places through the designated road which passes the railway only. Passage to the Project site through other means should be prohibited.	Inspection	Continuous	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 a holistic approach is adopted for socio-economic development in the area through coordination and collaboration with the PV developers within the Solar Park through adopting and implementing an Action 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.	Regular reporting on outcomes of Action Plan implementation	Continuous	MDC in collaboration with the Project Developer and the other PV developers within the Solar Park	N/A
Occupational Health and Safety	There will be some generic risks to workers health and safety from working on construction sites, as it increases the risk of injury or death due to accidents	Adopt and implement the provisions of the HSE Plan throughout the Project construction phase	Inspections to ensure the implementation of provisions of Plan	Continuous	EPC Contractor	- Labour Law No. 8 for the Year 1996 and its amendments
			Regular reporting 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.	Upon occurrence		

Table 38: ESMP for the Operation Phase

Environmental Attribute	Potential Impact	Mitigation Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
Landscape and Visual	Potential for glare caused by minimal sunlight reflected off the PV panel modules which in turn could affect nearby receptors.	Coordinate with various PV developers within the Solar Park and MDC to notify the Aqaba Railway Corporation (ARC) that there could be potential for glare within the area	Submission of report with proof of coordination.	Once; before operation commences	MDC in collaboration with the Project Developer and the other PV developers within the Solar Park	- Environmental Protection Law No. 52 of 2006
		Upon completion of construction activities, coordinate with various PV developers within the Solar Park and the Ma'an Public Works Directorate to install informative signs on the Highway for commuters regarding potential for glare within the area	Submission of report with proof of coordination	Once; before operation commences		
Geology and Hydrology	Improper management of solid waste	Coordinate with Ma'an Municipality or hire a competent private contractor for the collection of solid waste from the site to the Ma'an Central Landfill.	Review contract with contractor	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Solid Waste Management Regulation No. (27) of 2005
		Prohibit fly-dumping of any solid waste to the land.	Inspection	Continuous	Project Operator	
		Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".	Inspection	Continuous	Project Operator	
		Implement proper housekeeping practices on site at all times.	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	Review manifests to ensure consistency	Continuous	Project Operator	
	Improper management of wastewater	Coordinate with Ma'an Water Directorate to hire a private contractor for the collection of wastewater from the site to the Industrial Park WWTP	Review contract with contractor	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - Public Health Law No. 47 for 2008
		Prohibit illegal disposal of wastewater to the land	Inspection	Continuous	Project Operator	
		Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing	Inspection	Continuous	Project Operator	
		Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the Industrial Park WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas	Review manifests to ensure consistency	Continuous	Project Operator	
	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	Review contract with contractor	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - 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	Inspection	Continuous	Project Operator	
		Prohibit illegal disposal of hazardous waste to the land	Inspection	Continuous	Project Operator	
		Possibly contaminated water (e.g. runoff from paved areas) must be drained into appropriate facilities (such as sumps and pits) and must be orderly disposed of as hazardous waste	Inspection	Continuous	Project Operator	
		Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing	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	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.	Inspection	Continuous	Project Operator	- Environmental Protection Law No. 52 of 2006 - JS 431/1985 –

		Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. Spilled material should be tracked and accounted for.	Inspection	Continuous	Project Operator	General Precautionary Requirements for Storage of Hazardous Materials
		Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc).	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.	Inspection	Continuous	Project Operator	
		Ensure that a minimum of 1,000 liters of general purpose spill absorbent is available at hazardous material storage facility.	Inspection	Continuous	Project Operator	
		If spillage occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.	Inspection Reporting of incident and measures taken to minimize impact	Upon occurrence	Project Operator	
Biodiversity	There could be potential impacts on avi-fauna during the project operation phase such as collision risks with PV panels, overhead lines, etc.	Undertake short term avi-fauna monitoring through an ornithologist during the first year of operation of the Project. The objective of the monitoring is intended to confirm and validate the outcomes of this ESIA assessment in relation to impacts on avi-fauna from the Project. Monitoring is required for 8 days distributed throughout the spring, summer, autumn, and winter season. The monitoring must be undertaken through observational visits which aim to investigate any potential impacts from the Project's operation on avi-fauna (through for example undertaking mortality and carcass search) and also document behaviors.	Reporting on outcomes of monitoring	Once	Project Operator	- Environmental Protection Law No. 52 of 2006 - Agriculture Law No. 44 of 2002 - Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008.
	Other impacts limited to improper management of the site (e.g. improper conduct and housekeeping practices).	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).	Inspection	Continuous	Project Operator	
Archeology	Improper management of operational activities could disturb/damage surface archaeological remains in the area	Properly plan operational activities to take into account the identified archeological 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, prohibit movement of vehicles near those areas, etc.	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 emphasizes the presence of archeological locations in the area.	Inspection	Once; before operation commences	Project Operator	
Infrastructure and Utilities	Water Requirements – water requirements of the Project could entailing constraint on the existing users such as the Industrial Park or local communities.	Coordinate with the MDC for securing water requirements of the Project, whom has sufficient capacity to cover the rather minimal water requirements of the Project	Submit report with proof of coordination	Once; before operation commences	Project Operator	- Environmental Protection Law No. 52 of 2006 - 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
	Wastewater Utilities – it is improtant to ensure that existing utilitis would be able to handle the amount of wastewate gneerated from the Project.	Coordinate with the MDC for disposal of wastewater at the Industrial Park Wastewater Treatment Plant	Submit report with proof of coordination	Once; before operation commences	Project Operator	
	Solid Waste Utilities – it is improtant to ensure that existing utilities would be able to handle the amount of solid waste generated from the Project	Coordinate with Greater Ma'an Municipality or hire a competent private contractor for the collection of solid waste from the site to Ma'an Central Landfill.	Submit report with proof of coordination	Once; before operation commences	Project Operator	
	Railway – improper movement of vehicles and machinery into/out of the site could damage the railway and affect the movement of the train.	Ensure movement of vehicles, machinery, and equipment takes places through the designated road which passes the railway only. Passage to the Project site through other means should be prohibited.	Inspection	Continuous	Project Operator	
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 a holistic approach is adopted for socio-economic development in the area through coordination and collaboration with the PV developers within the Solar Park through adopting and implementing an Action 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.	Regular reporting on outcomes of Action Plan implementation	Continuous	MDC in collaboration with the Project Developer and the other PV developers within the Solar Park	N/A
Occupational Health and Safety	There will be some generic risks to workers health and safety from operational and maintenance	Adopt and implement the provisions of the HSE Plan throughout the Project operation phase.	Inspections to ensure the implementation of provisions of the Plan	Continuous	Project Operator	- Labour Law No. 8 for the Year 1996 and its amendments

	activities.		Regular reporting in addition to reporting of accidents, incidents and/or emergencies and measures undertaken in such cases to control the situation and prevent reoccurrence.	Upon occurrence		
Community Health, Safety, and Security	Trespassing of unauthorized personnel into the Project site could result in potential risks from several hazards of the various Project components	Ensure fence around the facility is well maintained at all times and in good conditions	Inspections	Continuous	Project Operator	- Public Health Law No. 47 for 2008
		Ensure onsite guards are adequately trained to deal with trespassing incidents. In addition, guards must be adequately trained in the use of force (and where applicable, firearms) and appropriate conduct toward workers and Affected Communities. Guards must refrain from using excessive force, unless situation extremely requires so. In addition, all firearms and ammunition issued should be licensed, recorded, stored securely, and marked appropriately.	Reporting of trespassing incidents and measures to control situation.	Upon occurrence	Project Operator	

Table 39: ESMP for the Decommissioning Phase

Environmental Attribute	Potential Impact	Mitigation Action	Monitoring Action	Frequency	Responsible Entity	Legal Requirements
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	Refer to mitigation and monitoring actions for improper management of waste streams within Table 37.			Project Developer or MEMR	Refer to legal requirements within Table 37.
Air quality and noise	Decommissioning activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Refer to mitigation and monitoring actions for air quality within Table 37.			Project Developer or MEMR	Refer to legal requirements within Table 37.
	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	Refer to mitigation and monitoring actions for noise within Table 37.			Project Developer or MEMR	
Infrastructure and utilities	Of particular importance related to infrastructure and utilities is the final disposal of the panels at the end of their lifetime. Final disposal of panels, which may contain hazardous material, needs to ensure that existing waste facilities would be able accept such solar modules. In addition, it is also important to investigate other disposal options such as buyback and recycling programs.	It is recommended that before any decommissioning activities take place a Disposal Plan for the PV Panels is prepared by the responsible entity undertaking decommissioning activities. The plan should consider the following options and compare the costs/benefits of each: (i) It is recommended that the Plan first opt for disposing the panels at the end of their lifetime as part of PV CYCLE's global recycling program; and (ii) If the above could not be achieved, as a last option the plan must investigate the disposal of the Panels at existing hazardous waste facilities in Jordan through coordination with the MoEnv.	Submit disposal plan to MoEnv	Once; before decommissioning activities commence	Project Developer or MEMR	- Environmental Protection Law No. 52 of 2006 - Instruction for Hazardous Waste Management for the year 2003
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.	Refer to mitigation and monitoring actions for occupational health and safety within Table 37.			Project Developer or MEMR	Refer to legal requirements within Table 37.

10. ENVIRONMENTAL PERFORMANCE REQUIREMENTS FOR NEPCO

As discussed earlier, there are offsite construction activities to be undertaken by NEPCO for building of substation and connection to the national grid through the High Voltage overhead line – which is expected to be minimal given the proximity of the substation to the National Grid (around 500m north of the substation area) Details and information are not available or finalized at this stage by NEPCO - which include layout of substation, finalized and detailed grid connections plans and route for the overhead lines, etc.

Therefore, throughout the ESIA such offsite construction activities were not taken into account, due to the fact that details and information are not available. Nevertheless, detailed below are a set of Environmental Performance Requirements which must be implemented by NEPCO, and which aim to ensure that environmental issues are taken into account and adequately considered.

Table 40: Performance Requirements for NEPCO

Component	Performance Requirement
Biodiversity	Once a final detailed design is available for the substation and the grid connections plans and route for the overhead lines, NEPCO must undertake a biodiversity survey. The survey must cover the substation area as well as the individual areas where the poles are to be erected for installation of the high voltage overhead lines. The survey must aim to determine whether any sensitive or endangered or rare flora/fauna/avi-fauna species exist – although this is unlikely given the low ecological significance of the area due to its natural setting. Nevertheless, should this be the case, then appropriate mitigation measures must be identified and which could include the relocation of species outside of construction active areas.
	During the construction phase NEPCO is expected to implement general 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).
	With regards to the high voltage overhead lines, NEPCO must consider measures which reduce collision risk of birds with the overhead lines. This could include the following: (i) the installation of bird diverters which increase the visibility of the power lines. The installation of dynamic bird diverters in a distance of 15 to 25 m between each other is recommended, and (ii) horizontal arrangement of the phases, reducing the height of the conductors, and, as therefore, minimizing the risks of collision and electrocution of birds
Archeology	The final and detailed design for the substation must take into account the archeological locations noted by the DoA within the Solar Park area – refer to Figure 31.
	Once the final design for grid connections plans and route for the overhead line is available, NEPCO is responsible for undertaking an archeological survey for the individual areas where the poles are to be erected for installation of the high voltage overhead lines. The survey must aim to assess whether any surface archeological remains of significance exist. Should this be the case, appropriate mitigation measures must be identified such as the protection and fencing of the site in coordination with the DoA.
	Implement appropriate chance find procedures. Throughout the construction phase 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. Those 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 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.
Air Quality and Noise	During the construction phase, NEPCO is expected to apply adequate dust suppression measures for dust generating activities and avoid unnecessary pollutant emissions from vehicles, machinery, and equipment to be used.
	During the construction phase NEPCO is expected to apply adequate general noise suppressing measures.
Geology and Hydrology	During the construction phase, NEPCO is expected to implement proper waste management practices onsite to include solid waste, wastewater, hazardous waste, and hazardous materials. Refer to section 8.4.2 which identifies in detail the mitigation actions required for proper management of waste streams.
Occupational Health and Safety	NEPCO is expected to develop an Occupational Health and Safety Plan in accordance with the provisions of the Labour Law No. 8 for the Year 1996 and its amendments, including Chapter IX, Occupational Safety & Health before construction activities commence. The Plan must address the likely hazards, emergency response procedures, and provision of protective clothing, adequate safety management.

11. REFERENCES

- Archaeological Survey of the Solar Park Area Report, Department of Antiquities, 2013
- Carbon Dioxide Emissions from Fuel Combustion, International Energy Association, 2013
- Concept Note for the Ma'an Development Fund, Ma'an Development Company, 2014
- Country Report on the Solid Waste Management in Jordan, SWEEPNET, 2010
- Environmental Impact Assessment for the 65-75 MW Ma'an Wind Farm Project, ECO Consult, 2013.
- Glint and Glare Study for Panoche Valley Farm, Jack Pfaff, 2011
- Guidelines to Minimize the Impact of Solar Facilities and Associated Infrastructure in South Africa, BirdLife International
- Hydraulic and Hydrological Analysis Report for Ma'an Solar Panels, Amman Consulting, 2013
- International Finance Corporation (IFC) Performance Standards in Environmental & Social Sustainability (January 1, 2012)
- IFC Performance Standard One: Assessment and Management of Environmental and Social Risks and Impacts; January 2012.
- IFC Guidance Note 1: Assessment and Management of Environmental and Social Risks and Impacts; January 2012.
- Jordan Country Study on Biological Diversity: Plant Biodiversity and Taxonomy, Dawud Al Eisawi, 2000
- Jordan in Figures: Statistical Year Book for the year 2012, Department of Statistics, 2012
- Ma'an Water and Wastewater Master Plan, CDM International, 2013
- Master Plan for the Solar Park Area, Amman Consulting, 2013
- Ministry of Energy and Mineral Resources Annual Report, 2012
- Poverty Situation in Jordan, Department of Statistics, 2010
- Poverty Situation in Jordan, Department of Statistics, 2012
- Social and Economic Situation in Ma'an Governorate Report, Social Development Unit of Ma'an Governorate, 2012
- The Status and Distribution of Mediterranean Mammals, Temple & Cuttelod, 2009
- The Status and Distribution of Reptiles and Amphibians for the Mediterranean Basin, Cox *et al*., 2006

12. ANNEXES

Annex I – Stakeholder Engagement Plan

Annex II – Stakeholder Consultation Details

Annex III – Detailed Biodiversity Results

Annex IV – Detailed Air Quality Results