NOOR Boujdour 20 MW Photovoltaic Power Project

Boujdour Province

Specific Environmental and Social Impact Assessment Vol2:

Main Text

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
As	Arsenic
AC	Alternate Current
ACWA	ACWA Power
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CBD	Convention on Biological Diversity
CCR	Central Control Room
CCTV	Closed-Circuit Television
Cd	Cadmium
CESMP	Construction Environmental Social Management Plan
CN	Cyanide
CNEIE	Comite National des Etudes d'Impact sur L'Environnement
CO	Carbon Monoxide
CO2	Carbon Dioxide
Cr	Chromium
Cu	Copper
DDS	Dust Detection System
DC	Direct Current
DESMP	Decommissioning Environmental and Social Management Plan
D&D	Deactivation and Decommissioning
dB(A)	A-weighted decibels
dB(C)	C-weighted decibels
EHS	Environmental, Health and Safety
EPC	Engineering Procurement and Construction
ESMP	Environmental and Social Management Plan
EPs	Equator Principles
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
E&S	Environmental and Social
FESIA	Framework Environmental Impact Assessment

Abbreviation	Meaning
GHG	Green House Gas Emissions
GHI	Global Horizontal Irradiance
GIIP	Good International Industry Practice
HCPV	High Concentration Photovoltaics
Hg	Mercury
H_2SO_4	Sulfuric Acid
IBA	Important Bird Location
IFC	International Finance Corporation
ILO	International Labour Organization
INSAP	Institut National des Sciences de L'Archéologie et du Patrimoine
Laeq	A-weighted Equivalent Continuous Sound Level
Lamax	A-weighted Maximum Sound Level
MASEN	Moroccan Government through the Moroccan Agency for Solar Energy
MASL	Meters Above See Level
MFS	Minimum Functional Specifications
MSDS	Material Safety Data Sheet
MW	Megawatt
MWac	Mega Watt (alternating current)
MWp	Mega Watt (peak)
Ni	Nickel
NOx	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NTP	Notice to Proceed
NTS	Non-Technical Summary
O_2	Oxygen
O&M	Operation and Management
OESMP	Operational Environmental and Social Management Plan
ONEE	Office National d'Electricité et de d'Eau Potable
O&M	Operation and Maintenance
PAH	Polycyclic Aromatic Hydrocarbons

Abbreviation	Meaning
Pb	Lead
PDT	Plan D'Acquisition de Terrain
PL	Power Line
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometers.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 micrometers.
PPA	Power Purchase Agreement
PS	Performance Standards on Environmental and Social Sustainability
PV	Photovoltaic
RO	Reverse Osmosis
Se	Selenium
SEP	Stakeholder Engagement Plan
SESIA	Specific Environmental and Social Impact Assessment
SF^6	Sulfur Hexafluoride
SO_2	Sulphur Dioxide
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compounds
WHO	World Health Organisation
Zn	Zinc
5 Capitals	5 Capitals Environmental and Management Consulting

NON-TECHNICAL SUMMARY

The Non-Technical Summary for the Boujdour PV is provided in a separate document; SESIA Vol.1 Non-technical Summary.

CONTENTS

1 INTRODUCTION 1

1.1 Assessment Objectives 1

1.2 Report Structure 2

2 LEGAL AND ADMINISTRATIVE FRAMEWORK 4

2.1 National Framework 4

2.2 International and Regional Conventions 10

2.3 International Requirements 13

2.4 Standards and Guidelines 21

3 PROJECT OBJECTIVES, LOCATION AND ALTERNATIVES 34

3.1 Key Project Objectives 34

3.2 Project Location 34

3.3 Site Conditions and Land Use 36

3.4 Potential Sensitive Receptors 37

3.5 Project Alternatives 39

4 PROJECT DESIGN 42

4.1 PV Station 42

4.2 Construction Equipment/Facilities 44

4.3 Operational Equipment/Facilities 44

4.4 Access road 45

4.5 Internal road 45

4.6 Earthworks and site levelling 46

4.7 Run-off Drainage System 46

4.8 Power Line 47

4.9 Resource use and waste streams 47
4.10 Security Provisions 52
5 CONSTRUCTION SCHEDULE AND WORKFORCE 53
6 LAND ACQUISITION 54
7 SESIA METHODOLOGY 55
7.1 Introduction 55
7.2 Baseline Conditions 55
7.3 Impact Assessment Significance Criteria 56
8 CONSULTATION PROCESS 61
8.1 Public Consultation Meeting 61
8.2 Stakeholder Engagement Plan 63
9 AIR QUALITY 64
9.1 Introduction 64
9.2 Methodology 64
9.3 Baseline 65
9.4 Sensitive Receptors 67
9.5 Construction Assessment 68
9.6 Operational Assessment 75
9.7 Decommissioning Assessment 78
10 NOISE AND VIBRATION 79
10.1 Introduction 79
10.2 Methodology 79
10.3 Baseline 81
10.4 Sensitive Receptors 82
10.5 Construction Assessment 83

10.6 Operational Assessment 90
10.7 Decommissioning Assessment 98
11 SOIL AND GROUNDWATER 99
11.1 Introduction 99
11.2 Methodology 99
11.3 Baseline 100
11.4 Sensitive Receptors 101
11.5 Construction Assessment 102
11.6 Operational Assessment 109
11.7 Decommissioning Phase 112
12 BIODIVERSITY 113
12.1 Introduction 113
12.2 Methodology 113
12.3 Baseline 114
12.4 Sensitive Receptors 121
12.5 Construction Assessment 122
12.6 Operation Assessment 127
12.7 Decommissioning Assessment 133
13 HAZARDOUS AND NON-HAZARDOUS WASTE AND WASTE MANAGEMENT 134
13.1 Introduction 134
13.2 Methodology 134
13.3 Baseline 135
13.4 Sensitive Receptors 137
13.5 Construction Assessment 137

13.6 Operational Assessment 145
13.7 Decommissioning Assessment 152
14 WASTEWATER MANAGEMENT 153
14.1 Introduction 153
14.2 Methodology 153
14.3 Baseline 153
14.4 Sensitive Receptors 154
14.5 Construction Assessment 154
14.6 Operational Assessment 159
14.7 Decommissioning Phase 164
15 TRAFFIC AND TRANSPORT 165
15.1 Introduction 165
15.2 Methodology 165
15.3 Baseline 165
15.4 Sensitive Receptors 166
15.5 Construction Assessment 167
15.6 Operational Assessment 173
15.7 Decommissioning Phase 175
16 ARCHAEOLOGY AND HERITAGE 176
16.1 Introduction 176
16.2 Methodology 176
16.3 Baseline 177
16.4 Sensitive Receptors 177
16.5 Construction Assessment 177

16.6 Operational Assessment 179
16.7 Decommissioning Assessment 179
17 LANDSCAPE AND VISUAL IMPACT 180
17.1 Introduction 180
17.2 Methodology 180
17.3 Baseline 181
17.4 Sensitive Receptors 183
17.5 Construction Assessment 183
17.6 Operational Assessment 185
17.7 Decommissioning Assessment 189
18 SOCIOECONOMIC 190
18.1 Introduction 190
18.2 Methodology 190
18.3 Baseline 190
18.4 Sensitive Receptors 194
18.5 Construction Assessment 194
18.6 Operational Assessment 201
18.7 Decommissioning Assessment 207
19 MONITORING PLAN 208
20 REFERENCES 221
APPENDIX 1 – CONSTRUCTION SCHEDULE A
APPENDIX 2 – SPECIES LIST B

1 INTRODUCTION

The Moroccan Government plans to develop a 20 MW photovoltaic (PV) power plant in Boujdour, south Morocco. The Moroccan Agency for Solar Energy (MASEN), the public company that sponsors solar energy in the Kingdom of Morocco, has declared ACWA Power as the preferred bidder for the 20 MW Boujdour PV Project (henceforth the Project). ACWA Power will be responsible for the design, engineering, procurement, financing, construction, permitting, completion, start-up, testing, commissioning, operation and maintenance of the Project for a 25-year period.

The proposed site for the Project is a greenfield desert area located 13 km northeast from Boujdour City and 3 km from the N1 road. The specific plot for the project has a total area of 58 ha and will be connected to the N1 road by a ~2.8 Km road. The Project includes the construction of a 22 kV power line (PL) to connect the PV to an existing substation located in Boujdour.

As required by MASEN, the environmental and social impact assessment for the PL has been undertaken in a dedicated Specific Environmental and Social Impact Assessment (SESIA) and therefore, this document only addresses the 20 MW PV power plant and the access road, as no other secondary facilities are included in the scope of this assessment. The construction of the access road to connect the 20 MW PV site with the N1 road will be the responsibility of MASEN.

5 Capitals Environmental and Management Consulting (5 Capitals), an independent environmental and social consultancy, has been commissioned by ACWA Power to undertake the Specific Environmental and Social Impact Assessment (SESIA) for the proposed Project. ACWA Power aims to manage the Environmental and Social (E&S) aspects of the Project in accordance with international best practice. 5 Capitals has undertaken this SESIA in line with the World Bank/International Finance Corporation (IFC) Performance Standards (PS) on Environmental and Social Sustainability (2012) and the IFC Environmental, Health and Safety Guidelines (2007). This SESIA has also adopted the requirements established by the Moroccan regulations and in the project-specific Framework Environmental Impact Assessment (FESIA) of the Boujdour PV, prepared by NOVEC for MASEN, May 2016.

1.1 Assessment Objectives

The following SESIA document has several objectives in relation to its preparation, use and application for the 20MW Boujdour PV Project. Such objectives include and are not limited to the following:

- The assessment of baseline conditions prior to development;

- The identification and implementation of national and international regulations applicable to the project;
- The assessment of potential impacts of the project during construction, operation and decommissioning;
- Ensuring that potential impacts are avoided or minimised through the recommendation of mitigation measures;
- Inclusion, information and consultation with affected stakeholders (e.g. public, public bodies and local populations) regarding the project, and
- Exploration of alternatives that can be used for the Project leading to greater social and environmental gains.

1.2 Report Structure

To comply with the requirements for environmental assessment and international best practice, this report is presented in the following format:

Volume 1: Non-Technical Summary

Volume 2: Main Text

Volume 3: Environmental and Social Management Plan (ESMP)

Volume 4: Technical Appendices

Volume 1 contains the Non-Technical Summary, which provides an overview of the main elements of the PV and including the proposed PL and summarises the main E&S impacts and recommended mitigation measures.

Volume 2 comprises the Main Text of the report with the issues identified that the project may impact upon each following a similar general structure:

- Introduction and Project Background;
- Legal Framework, Standards and Guidelines;
- SESIA Assessment Method;
- Baseline Information;
- Methodology
- Assessment of Effects/Impacts, Mitigation Measures, and Residual Effects During Construction Phase;
- Assessment of Effects/Impacts, Mitigation Measures, and Residual Effects During Operational Phase; and
- Assessment of Effects/Impacts, Mitigation Measures, and Residual Effects During Decommissioning Phase, where relevant.

Volume 3: provides the framework for the development of the Construction Environmental Social Management Plan (CESMP) by the main contractor (the EPC) and all sub-contractors; and the Operational Environmental and Social Management Plan (OESMP) to be developed and implemented by the Operation and Management (O&M) team. The CESMP and the OESMP include an Environmental and Social Monitoring Program (ESMP). The ESMP will provide procedures to ensure the implementation and monitor the performance of the mitigation measures and other elements.

Volume 4 comprises all Technical Appendices (consultation meeting, baseline survey reports and other technical studies).

2 LEGAL AND ADMINISTRATIVE FRAMEWORK

The proposed Project will adopt and comply with the following regulations and standards:

- National regulations and standards;
- International and Regional Treaties ratified by Morocco, and
- International requirements applicable to the project (Equator Principles. IFC Environmental and Social Performance Standards and IFC Environmental, Health and Safety Guidelines).

2.1 National Framework

2.1.1 Environmental protection

Law No 11-03 concerning Protection and improvement of the Environment

This law sets the general framework for the protection of the environment in Morocco, by identifying:

- Principles of environmental protection related to human settlements and the protection of nature and natural resources;
- Principle for establishing discharge standards and the definition of nuisances;
- Management tools and protection of the environment that are described within the impact studies, plans and standards;
- Standards of environmental quality and financial and tax incentives. The law also establishes a national fund for the protection and enhancement of the environment; and
- Procedural rules defining the responsibilities and obligations in the event of damage.

Law No. 99-12 on the National Charter of Environmental and Sustainable Development.

This law sets the basic objectives of state action in the field of environmental protection and sustainable development. It aims to: improve the protection and conservation of resources and the natural environment, biodiversity and cultural heritage, to prevent and fight against the pollution, integrate sustainable development in sectoral public policies and adopt a national development strategy, harmonize the national legal framework with international conventions and standards relating to environmental protection and sustainable development, improve measures for climate change adaptation and measures against desertification, and lead institutional, economic, financial and cultural reforms on environmental governance defining State commitments, among others.

2.1.2 Environmental Impact Assessment

Law No 12-03 concerning Environmental Impact Study Process and implementing decrees.

Promulgated by Dahir No. 1-03-06 of 10 Rabii I 1424 (12 May 2003) lists the projects subject, the procedure of implementation and methodology of impact studies.

This Act establishes the creation of a national committee and regional committees entrusted with the review of the environmental impact studies.

The "Décret n° 2-04-563 du 5 kaada 1429 relatif aux attributions et au fonctionnement du comité national et des comités régionaux des études d'impact sur l'environnement" outlines the responsibilities of the National Committee on the review and approval processes of the environmental impact assessments.

2.1.3 Public Consultation

The "Décret n° 2-04-564 du 5 kaada 1429 (4 novembre 2008) fixant les modalités d'organisation et de déroulement de l'enquête publique relative aux projets soumis aux études d'impact sur l'environnement".

This Decree establishes the considerations to follow when undertaken public consultation procedures. Public consultation will include, as minimum, the following:

- Fact sheet outlining the main technical characteristics;
- Nontechnical Summary, and
- Site plan clearly showing the project boundaries.

Permission will be addressed to (and granted by) the regional committee of environmental impact studies (secrétariat permanent du comité régional des études d'impact sur l'environnement). The committee is required to designate a commission for the public consultation process.

This Decree also establishes the minimum information and timelines that need to be considered during the consultation process.

2.1.4 Ecology and Biodiversity

Law No 11-03 concerning the protection and improvement of the environment provides a framework of legislation under which the Kingdom can meet its obligations as a signatory to the Convention on Biological Diversity (CBD).

Law No 1-11-84 du 29, 1432 (2 July 2011) promulgating the Law no 29-05 with regards to protection of wildlife and trade control.

2.1.5 Air Quality

Law No 13-03 on the Prevention of Air Pollution

Chapter II of the Act, Article 2 states that the Act applies to any person or entity, public or private, who owns or possesses or uses or operates buildings or mining, industrial, commercial, agricultural or crafts. It also applies to motor vehicles, equipment, combustion, waste incineration, heating or cooling.

Chapter III of the Act, Article 4 states that "it is forbidden to release, issue or refuse to allow the release, emission or discharge of pollutants in the air such as toxic gas or corrosive fumes, vapours, heat, dust, odours beyond the quality or concentration allowed by the standards laid down by regulation"

This article states the following "in the absence of standards laid down by regulation, operators of installations referred to in Article II are required to apply the most advanced technologies available to prevent or reduce emissions."

Through Decree No. 2-09-286 of 20 Di Hijja 1430 (8 December 2009), this law sets standards for air quality and air monitoring.

2.1.6 Water Quality

Law 10-95 concerning Water Management. Moroccan Law 10-95 on water and its implementing regulations establish the measures to protect artificial water bodies, the water quality, use of these water systems and protection of the watercourses. This Law the legal basis for the country´s water policy and sets the following objectives:

- Establish a Management Plan on water resource use at a National Level;
- Protect the qualitative and quantitative characteristics of the hydrological resources in Morocco while investing on water project development taking into consideration the economic and social interests of the local population.

Decree No. 2-04-553 concerning Wastewater Management

The Decree 553 paves the way for the effective implementation of reporting procedures for existing discharges and subsequent payment of fees. The implementation of the Decree induces the need to:

- Request authorization to discharge from the concerned water authority;
- Meet the discharge limits set by domestic Order No. 1607-06 (25 July 2006).

Decree 2-97-787 regarding Water Quality Standards defines quality classes to normalize and standardize the assessment of water quality. It also defines orders via quality standards which water must meet depending on the treated water use, including: potable water, irrigation and wastewater for irrigation and aquaculture.

Decree N° 1276-01 concerning Water Quality standards for irrigation

This Decree establishes the standards for water irrigation that will need to be followed for treated sanitary wastewater reuse.

Decree No. 2-97-224: Setting the Conditions Governing the Artificial Accumulation of Water (1997)

Decree No. 2-97-489, February 4 1998. Identifies publicly accessible water bodies, the procedures to manage these waterways, and their safe extraction.

Decree No. 2-04-553. January 24 2005. Identifies measure to prevent spills, leaks, and discharges and protect surface and ground waters from direct or indirect contamination events.

2.1.7 Soil Quality

The "Dahir n° 1-69-170 du 10 joumada I 1389 (25 juillet 1969) sur la défense et la restauration des sols" determines requirements for soil restoration on high erosion risk areas and the creation of creation of buffer areas where appropriate.

2.1.8 Seismicity

Decree No 2-02-177 of February 2002 (RPS 2000) concerning seismicity areas

This regulation was issued by the National Committee of Seismic Engineering (NCSE). The objectives of this Decree are:

- Establishing a seismic zonation within Morocco;
- Improving urban and development planning through seismic micro-zonation.

The RPS 2000 is applicable for new constructions exceeding 50m2 and existing buildings. It covers structures in reinforced and steel concrete.

2.1.9 Protected Areas

Law n° 22-07 concerning Protected Areas

Promulgated by Decree n° 1-10- 123 (16 July 2010), this Law, encourages the environmental protection by the establishment of national protected areas.

2.1.10 Waste Management

Law No 28-00 concerning Waste Disposal and Management

This Law adopted in 2006 aims to prevent and protect human health, fauna, flora, water, air, soil, ecosystems, sites and landscapes and the environment in general against the effects of harmful waste, by ensuring the reduction of harmful waste production; the organization of

the collection, transport, storage, waste treatment and disposal in an environmentally sound manner; the recovery of waste by waste hierarchy, planning national, regional and local management and disposal waste; informing the public about the harmful effects of waste on public health and environment as well as measures to prevent or compensate for their adverse effects; and the establishment of a system of control and punishment for offenses.

Consequently, several decrees have been promulgated, which outline the procedures and standards that will be implemented to ensure compliant transport and disposal of wastes based on their classification. With respect to this project the following Decrees have been applied:

- Decree No. 2-07-253 Identifies and lists hazardous wastes by Industrial process.
- Decree No 2-09-538 Identifies hazardous wastes management procedures.
- Decree No. 2-09-683 Identifies non-hazardous wastes management procedures.

2.1.11 Labour

Law n° 65-99 promulgated by Decree 1-03-194 of 11 September 2003

Article 9 of the Moroccan Labour Code prohibits discrimination based on race, colour, gender, handicap, marital situation, religion, political opinion, union participation, national origin, social origin for any employment matters notably hiring, distribution of work, training, salary, promotion, granting of benefits, disciplinary measures and termination.

2.1.12 Socio-Economic

Moroccan Labour Law no 65-99 concerning the Labour Code, is applicable to this project. Other legislation relating to the social and health sector includes:

- 17-08 (dahir 1-08-153 du 18 février 2009) regarding the Communal Charter
- Dahir 1-60-063 (25 June 1960) for the development of rural communities Order 23 November 1950. Ensures that medicinal products and medical equipment should be provided on-site, where 100 workers are permanently stationed or where projects are located more than 10 km from a supply centre.
- Decree 2-70-510 (8 October 1970) identifies preventive measures that should be implemented on construction sites.

2.1.13 Cultural Heritage

Law 22-80 (1981) regarding the conservation of Cultural Heritage

This Law establishes measures for the protection of Historic Monuments and sites.

2.1.14 Traffic and Road Safety

The following national laws have been considered:

- Decree No. 2-03-169 of 22 Muharram 1424 (26 March 2003) on the transport of goods by road;
- Law 52-05 relating to traffic.

Dangerous goods must be transported by vehicles or trailers appropriately equipped. The characteristics of these vehicles must be established by a statutory instrument, which will in turn respect those outlined in the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

2.1.15 Landscape and Visual

No standards exist with regard to landscape or visual impact in the guidance. In the absence of specific standards with regards to landscape or visual impact, the existing visual characteristics of the Project site have been assessed using professional judgment and experience.

2.1.16 Urban Planning

- Loi 12-90 relative à l'urbanisme (dahir 1-92-31 du 17 juin 1992) ;

Dahir n° 1-92-31 du 15 hija 1412 (17 juin 1992) portant promulgation de la loi n° 12-90 "relative à l'urbanisme".

2.1.17 Project Development

Law No. 13-09 regarding Renewable Energy

The key objectives of this law are to:

- Reduce the oil-dependency of the Kingdom of Morocco;
- Diversify the sources and resources of energy production;
- Use an indigenous natural resource; and
- Reduce CO2 emissions to the atmosphere.

Law no. 37-16 for the creation of the Moroccan Agency for Sustainable Energy.

Provides the legal framework for the NOOR Boujdour Project and outlines how it aligns with the national economic and social development strategy.

Law no. 16-09 for the creation of the "l'Agence nationale pour le développement des énergies renouvelables et de l'efficacité énergétique".

2.2 International and Regional Conventions

The international and regional conventions and protocols ratified by the Kingdom of Morocco that are relevant to protection of the environment will be acknowledged in relation to the environmental impact assessment of the proposed NOOR Boujdour project are provided below:

The international and regional conventions and protocols that are relevant to protection of the environment are summarised below:

Berne Convention (1979):

The Bern Convention on the Conservation of European Wildlife and Natural Habitats, also known as the Bern Convention, is a bindings international legal instrument on the filed of Nature Conservation. It covers the natural heritage in Europe, as well as in some African countries. The Convention was open for signature on 19 September 1979 and came into force on 1 June 1982. It is particularly concerned about protecting natural habitats and endangered species, including migratory species.

Bonn Convention on Migratory Species of Wild Animals (1983).

This global convention created in 1979 by the United Nations Environment Program (UNEP) is an agreement for the conservation of migratory species of wild animals. Two appendices list migratory species that require conservation measures.

Under the Bonn Convention Morocco has signed several agreements including the Agreement on the Conservation of Migratory Waterbirds in Africa - (AEWA). To this end the Contracting Parties "... investigate problems that arise due to human activities and endeavor to implement remedial measures including restoration and habitat rehabilitation and compensatory measures for loss of habitat. "

Washington Convention on International Trade in Endangered Flora and Wildlife (CITES 1975).

Morocco has signed the Convention in 1975 and entered into force in 1976. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to more than 34,000 species of animals and plants. This convention is regularly cited as a reference to the threat level of the species.

Protecting the ozone layer: the Montreal Protocol (1992);

As a party to the Montreal Protocol, has the obligation to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in

scientific knowledge, taking into account technical and economic considerations and bearing in mind the developmental needs of developing countries.

RAMSAR convention on the protection of Wetlands of International Importance (1971, updated 1980).

Morocco has committed to maintain the ecological character of its Wetlands of International Importance and to plan for the sustainable use, of all of the wetlands in its territories.

The Convention uses a broad definition of the types of wetlands covered in its mission, including lakes and rivers, oases, estuaries, and human-made sites such as fish ponds, and reservoirs, to name a few.

Climate Change Framework: United Nations Convention on Climate Change (1995) and protocol of Kyoto (2002)

Morocco has committed to develop national inventories of anthropogenic emissions and removals of greenhouse gases, consider climate change in policies and actions and adopt methods such as impact assessments, and formulate mitigation measures.

Biodiversity Convention of Rio Janeiro on Biological Diversity (1995)

Morocco has committed to the conservation and maintenance of biological diversity alongside economic development.

Vienna Convention and the London amendment (1995)

Morocco was committed to adopt appropriate legislative or administrative measures and co-operate in harmonizing appropriate policies to control, limit, reduce or prevent human activities under their jurisdiction or control should it be found that these activities have or are likely to have adverse effects resulting to the depletion of the ozone layer.

African Convention on the Conservation of Nature and Natural Resources whose acts were reaffirmed at Earth Summit in Johannesburg in South Africa in 2002

This agreement was signed in Algiers on 15 September 1968, replacing the London Convention 1933. Its objectives include the conservation of species, the creation of protected areas and conservation, utilization and development of soil, water, flora and fauna. The Convention establishes three categories of protected areas in parks, reserves and special reserves and introduces the concept of optimal handling for sustainable wildlife resources.

The International Convention for the Protection of Birds

Replaces and enhances the Convention for the Protection of Birds Useful to Agriculture, held in Paris in 1902. The updated convention is essentially based on ecological considerations, even if Article 5 introduces an ethical argument and it prohibits the infliction of unnecessary suffering to birds. This Convention shall be applied without exception to all wild birds and designed specifically to protection of all species during their breeding and migration.

The World Heritage Convention

The World Heritage Convention was adopted by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) General Conference, in Paris 1972. It aims to promote cooperation among nations to protect heritage around the world that is of such outstanding universal value that its conservation is important for current and future generations. It is intended that, unlike the seven wonders of the ancient world, properties on the World Heritage List will be conserved for all time.

The Kingdom of Morocco has also signed 54 International Labour Organisation (ILO) conventions, including the following:

- Unemployment Convention, 1919 (No. 2)
- Night Work (Women) Convention, 1919 (No. 4)
- Workmen's Compensation (Agriculture) Convention, 1921 (No. 12)
- Holidays with Pay Convention, 1936 (No. 52)
- Labour Inspection Convention, 1947 (No. 81)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Equal Remuneration Convention, 1951 (No. 100)
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Employment Policy Convention, 1964 (No. 122)
- Workers' Representatives Convention, 1971 (No. 135)
- Minimum Age Convention, 1973 (No. 138)
- Minimum age specified: 15 years
- Termination of Employment Convention, 1982 (No. 158)
- Asbestos Convention, 1986 (No. 162)
- Maternity Protection Convention, 2000 (No. 183)

2.3 International Requirements

2.3.1 IFC Requirements

ACWA Power's Policy ascertains that all power assets will be designed, constructed, operated and decommissioned in accordance with the E&S requirements stabilised by the Word Bank Group - International Finance Corporation.

This SESIA has been prepared in accordance with the Performance Standards on Environmental and Social Sustainability (2012) and the General Environmental, Health and Safety Guidelines (2007).

Performance Standards on Environmental & Social Sustainability

The IFC Environmental and Social Sustainability Framework defines the IFC approach towards sustainability and the environment, and the IFC describes the best practices for managing the environmental and social risks associated to asset development. The Performance Standards and how they apply to the proposed Project are outlined below.

Performance Standard 1: covers several types of environmental and social management instruments. These standards require that the environmental and social assessment (SESIA) is undertaken to a high standard and compliant with International Best Practice, and that an Environmental and Social Management System (ESMS) is implemented. Specifically, the objectives required by the PS1 are:

- Establish an overarching environmental and social policy;
- To identify and evaluate environmental and social risks and impacts of the project;
- To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment;
- To promote improved environmental and social performance of clients through the effective implementation of a management program.
- To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately; and
- To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.

The PS1 also requires the assessment of cumulative impacts that result from incremental impacts on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

Performance Standard 2: Labour and Working Conditions aims to promote the fair treatment, non-discrimination, and equal opportunity of workers; to establish, maintain, and improve the worker-management relationship; to promote compliance with national employment and labour laws; to protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain; to promote safe and healthy working conditions, and the health of workers and to avoid the use of forced labour. This Performance Standard requires overall alignment to the following conventions:

- ILO Convention 87 on Freedom of Association and Protection of the Right to Organize;
- ILO Convention 98 on the Right to Organize and Collective Bargaining;
- ILO Convention 29 on Forced Labour;
- ILO Convention 105 on the Abolition of Forced Labour;
- ILO Convention 138 on Minimum Age (of Employment);
- ILO Convention 182 on the Worst Forms of Child Labour;
- ILO Convention 100 on Equal Remuneration;
- ILO Convention 111 on Discrimination (Employment and Occupation);
- UN Convention on the Rights of the Child, Article 32.1; and
- UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families.

Performance Standard 3: Resource Efficiency and Pollution Prevention, aims to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, to promote more sustainable use of resources, including energy and water and to reduce project-related GHG emissions.

Performance Standard 4: Community Health, Safety, and Security aims to anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances and to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

The IFC's Guidance Note 4 requires that the exacerbation of impacts caused by natural hazards, such as landslides or floods that could arise from land use changes should be avoided or minimized.

Performance Standard 5: Land Acquisition and Involuntary Resettlement. This PS focuses on project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. A Land Acquisition Review / Plan and a

Livelihood Restoration Plan will be prepared to assess, or anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected; and to ensure that there is a restoration and improvement of the livelihoods and standards of living of the economically displaced persons.

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. This IFC performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard are guided by the Convention on Biological Diversity.

This standard aims to:

- Protect and conserve biodiversity;
- Maintain the benefits from ecosystem services; and
- Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

The SESIA will follow the requirements of this standard for the assessment of the project impact on the ecosystem.

Performance Standard 7: Indigenous Peoples. This PS focuses on the protection of indigenous communities. None of the communities around the project site can be classified as indigenous, so this standard is not applicable.

Performance Standard 8: Cultural Heritage. The PS aims to protect cultural heritage from the adverse impacts of project activities and support its preservation and to promote the equitable sharing of benefits from the use of cultural heritage. This standard will be taken into consideration to determine whether the project affects any cultural heritage.

General EHS Guidelines

The IFC EHS Guidelines 'are technical reference documents with general and industry specific examples of good international industry practice'. In addition to this the EHS Guidelines specify limit values for environmental aspects and pollution sources, upon which quantitative project impacts can be assessed.

The updated EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to

Performance Standard 3: Pollution Prevention & Abatement, as well as certain aspects of occupational and community health and safety.

When Moroccan regulations differ from the levels and measures presented in the EHS Guidelines, the Project will be expected to achieve whichever is the more stringent.

2.3.2 Equator Principles

Equator Principle	Details
Principle 1	Review and Categorisation of a project proposed for financing based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC). These categories are: *Category A*- Projects with potential significant adverse social or environmental risks and/or impacts that are diverse, irreversible or unprecedented; *Category B* – Projects with potential limited adverse social or environmental risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and *Category C* – Projects with minimal or no social or environmental risks and/or impacts.
Principle 2	Environmental and Social Assessment For all Category A and Category B Projects, the EPFI (Equator Principle Financial Institution) will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project. The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment ESIA (SESIA). One or more specialised studies may also need to be undertaken. Furthermore, in limited high risk circumstances, it may be appropriate for the client to complement its Assessment Documentation with specific human rights due diligence. For other Projects, a limited or focused environmental or social assessment (e.g. audit), or straight-forward application of environmental siting, pollution standards, design criteria, or construction standards may be carried out
Principle 3	Applicable Environmental and Social Standards The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.

Equator Principle	Details
	EPFIs operate in diverse markets: some with robust environmental and social governance, legislation systems and institutional capacity designed to protect their people and the natural environment; and some with evolving technical and institutional capacity to manage environmental and social issues. The EPFI will require that the Assessment process evaluates compliance with the applicable standards as follows: 1. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines). 2. For Projects located in Designated Countries, the Assessment process evaluates compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Host country laws meet the requirements of environmental and/or social assessments (Principle 2), management systems and plans (Principle 4), Stakeholder Engagement (Principle 5) and, grievance mechanisms (Principle 6). The Assessment process will establish to the EPFI's satisfaction the Project's overall compliance with, or justified deviation from, the applicable standards. The applicable standards (as described above) represent the minimum standards adopted by the EPFI. The EPFI may, at their sole discretion, apply additional requirements.
Principle 4	Environmental and Social Management System and Equator Principles Action Plan For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.
Principle 5	Stakeholder Engagement For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an on-going process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable

Equator Principle	Details
	groups. This process should be free from external manipulation, interference, coercion and intimidation. To facilitate Stakeholder Engagement, the client will, commensurate to the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner. The client will take account of, and document, the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts, disclosure should occur early in the Assessment process, in any event before the Project construction commences, and on an on-going basis. EPFIs recognise that indigenous peoples may represent vulnerable segments of project-affected communities. Projects affecting indigenous peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for indigenous peoples contained in relevant national law, including those laws implementing host country obligations under international law. Consistent with the special circumstances described in IFC Performance Standard 7 (when relevant as defined in Principle 3), Projects with adverse impacts on indigenous people will require their Free, Prior and Informed Consent (FPIC).
Principle 6	Grievance Mechanism For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process.
Principle 7	Independent Review Project Finance For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.

Equator Principle	Details
	The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible. Project-Related Corporate Loans An Independent Review by an Independent Environmental and Social Consultant is required for Projects with potential high risk impacts including, but not limited to, any of the following: • adverse impacts on indigenous peoples • Critical Habitat impacts • significant cultural heritage impacts • large-scale resettlement In other Category A, and as appropriate Category B, Project-Related Corporate Loans, the EPFI may determine whether an Independent Review is appropriate or if internal review by the EPFI is sufficient. This may take into account the due diligence performed by a multilateral or bilateral financial institution or an OECD Export Credit Agency, if relevant.
Principle 8	Covenants An important strength of the Equator Principles is the incorporation of covenants linked to compliance. For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. Furthermore, for all Category A and Category B Projects, the client will covenant the financial documentation: a) to comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and b) to provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and c) to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan. Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the Project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.

Equator Principle	Details
Principle 9	Independent Monitoring and Reporting Project Finance To assess Project compliance with the Equator Principles and ensure on-going monitoring and reporting after Financial Close and over the life of the loan, the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI. Project-Related Corporate Loans For Projects where an Independent Review is required under Principle 7, the EPFI will require the appointment of an Independent Environmental and Social Consultant after Financial Close, or require that the client retain qualified and experienced external experts to verify its monitoring information, which would be shared with the EPFI.
Principle 10	EPFIs Reporting Client Reporting Requirements The following client reporting requirements are in addition to the disclosure requirements in Principle 5. For all Category A and, as appropriate, Category B Projects: • The client will ensure that, at a minimum, a summary of the SESIA is accessible and available online. • The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually. Refer to Annex A for detailed requirements on GHG emissions reporting. EPFI Reporting Requirements The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations. The EPFI will report according to the minimum reporting requirements detailed in Annex B.

2.4 Standards and Guidelines

2.4.1 Soil Quality

National Requirements

There are no specific Moroccan standards and guidelines for soil protection.

International Requirements

The IFC EHS regulations do not specify pollutant standards for soils. In light of this, sector-specific guidance documents on pollution prevention and good practices produced by the IFC (e.g. IFC 'Environmental Health and Safety Guidelines (EHS) Guidelines: Contaminated Land' (2007)) will be referred to in the assessment. Such guidance includes the following:

The General EHS guidelines detail that the '…Transfer of pollutants to another phase, such as air, soil, or the sub-surface, will be minimized through process and engineering controls.'

Section 1.8 of the IFC's General Guidelines details the specific requirements with regards to contaminated land. It notes that: "*Contamination of land will be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release will be identified and corrected to avoid further releases and associated adverse impacts*."

Internationally recognized assessment values for soil contamination set by the Dutch Ministry of Housing, Spatial Planning and Environment have been applied. The baseline results have been compared against standard values and guidelines.

In the Netherlands, environmental quality values have been established based on the philosophy of protecting ecosystems, environmental functions and ensuring the multi-functionality of soil and groundwater quality. These are discussed below:

- Target Value: average background concentration or detection limit; exceeding this value indicates a possible diminishing of the functional abilities of the soil for humans, plants or animals.
- Intervention Value: concentration level above, which there is a serious or threatening diminishing of the functional abilities of the soil for humans, plants or animals.

The following Table provides a list of the Dutch Soil and Groundwater standards that the proposed project will be required to comply with.

Table 2-1 Dutch Soil Standards

Contaminant	Dutch Soil mg/Kg dry weight	
	Target	Intervention
Beryllium	1.1	30
Cadmium	0.8	12
Chromium (total)	100	220
Cobalt	20	180
Copper	36	96
Lead	85	530
Nickel	35	100
Mercury	0.3	10
Molybdenum	3	190
Selenium	0.7	100
Thallium	1	15
Vanadium	42	250
Zinc	140	350
Benzene	0.05	2
Total PAH	1	40
The values listed above will be adapted to the soil type at the site. Constituent levels greater than the target value indicate that the soil has lost some of its multi-functional properties and can be considered as contaminated soil. If the contamination level is exceeding the intervention value, further investigation will be carried out. The soil intervention values indicate when the functional properties of the soil are seriously impaired or threatened.		

It will be noted that the target values are not specific clean up criteria. They represent targeted objectives. Also, in the latest (2009) version of the Dutch Standard, Target values for soils have been removed for all compounds except Metals.

2.4.2 Water and Wastewater

National Requirements

Loi 42-09 complétant la loi 10-95 sur l'eau (dahir 1-10-104 du 16 juillet 2010)

The Water Act, Law 10-95 on water and its implementing regulations, was promulgated on 16 August 1995. It aims to ensure the rational use of water and access to this resource throughout the Kingdom. The main decrees implementing this law published to date are:

- Decree No. 2-04-553 of 13 Hijja 1425 (24 January 2005) relating to spills and direct and indirect discharges into surface or groundwater (O.B. No. 5292 of 17 February 2005)
- Dahir 2-97-787 on the establishment of water quality standards

This decree regulates water discharges, including runoff and direct or indirect discharges to surface water or groundwater.

As a result of the implementation of this decree an authorization has to be requested for water discharges from the relevant authorities.

In addition, domestic discharge standards set by Order No. 1607-06 (July 25, 2006), are shown in table 2-5.

- Decree No. 2-05-1533 covers wastewater discharges from rural settlements.
- Decree No. 2-97-875 of 6 Shawwal 1418 (4 February 1998) on the use of wastewater (O.B. 5 February 1998). This Decree regulates the reutilization of wastewater. An authorization is required for wastewater reuse except for onsite reutilization.
- Decree No. 2-97-657 of 6 Shawwal 1418 (4 February 1998) on the delimitation of protected areas (B.O. February 5, 1998), which regulates zoning around public waters.
- Decree No. 2-97-787 of 6 Shawwal (4 February 1998) on water quality standards and water pollution inventories (O.B. No. 4558 of 5 February 1998). This Decree defines, inter alia, the necessary parameters for the assessment of water quality and the quality standards that water must meet depending on its use.

To date, the legislations enacted based on this decree are:

- Decree n ° 1277-1201 enacted on the 17th of October 2002 on quality standards for water used for the production of drinking water. These standards are specified below, in table 2-3.
- Order 1276-01 enacted on the 17th of October 2002 on quality standards for irrigation water. These standards are specified below in table 2-2;
- Decree n ° 1275-1201 enacted on the 17th of October 2002 on quality of surface waters;

- Decree No. 2028-03 enacted on the 10th of November 2003 on quality standards for fishing waters.

Table 2-2 Water Standards for irrigation

Parameters	Units	Value	Specifications
Biological Parameter			
Faecal Coliform	ml	1000/100	100ml for agricultural products eaten raw
Salmonella		Absence	in 5 litres
Vibrio cholera		Absence	in 450ml
Parasitological Parameter			
Pathogenic parasites		Absence	
Parasite cysts		Absence	
Larvae of Ankylostomides		Absence	
Fluococercaires of Schistosoma haemotobium		Absence	
Toxic Parameters			
Mercury	mg/l	0.001	
Cadmium	mg/l	0.01	
Arsenic	mg/l	0.1	
Total Chromium	mg/l	1	
Lead	mg/l	5	
Copper	mg/l	2	
Zinc	mg/l	2	
Selenium	mg/l	0.02	
Fluorine	mg/l	1	
Cyanides	mg/l	1	
Phenols	mg/l	3	
Aluminium	mg/l	5	
Beryllium	mg/l	0.1	
Cobalt	mg/l	0.5	
Iron	mg/l	5	
Lithium	mg/l	2.5	
Manganese	mg/l	0.2	

Parameters	Units	Value	Specifications
Molybdenum	mg/l	0.01	
Nickel	mg/l	2	
Vanadium	mg/l	0.1	
Physical and Chemical properties			
Salinity			
Total salinity	mg/l	7680	
Electrical conductivity	mS/cm	12	at 25°C
Infiltration			
- Sodium Absorption Ratio 0-3	EC	< 0.2	
- Sodium Absorption Ratio 3-6		< 0.3	
- Sodium Absorption Ratio 6-12		< 0.5	
- Sodium Absorption Ratio 12-20		< 1.3	
- Sodium Absorption Ratio 20-40		< 3	
Toxic Ions (affecting sensitive agricultural product receptors)			
Sodium			
- Surface Irrigation	mg/l	69	
- Overhead irrigation	mg/l	9	
Chloride			
- Surface Irrigation	mg/l	350	
- Overhead irrigation	mg/l	15	
Boron	mg/l	3	
Effect drivers (affecting sensitive agricultural product receptors)			
Temperature	°C	35	Temperature
pH		6.5 to 8.4	pH
Suspended solids			Suspended solids
- Gravitational Irrigation	mg/l	200	- Gravitational Irrigation
- Localised overhead irrigation	mg/l	100	- Localised overhead irrigation
Nitrate (N-NO3-)	mg/l	30	Nitrate (N-NO3-)
Bicarbonate (HCO3) [overhead irrigation]	mg/l	518	Bicarbonate (HCO3) [overhead irrigation]
Sulphates (SO42-)	mg/l	250	Sulphates (SO42-)

Table 2-3 Drinking Water Standards

Parameter	Units	A1-G	A1-I	A2-G	A2-I	A3-G	A3-I
Toxic Substances							
Arsenic	µ g/l	-	50	-	50	-	100
Cadmium	µ g/l	1	5	1	5	-	5
Chromium (total)	µ g/l	-	50	-	50	-	50
Cyanides	µ g/l	-	50	-	50	-	50
Lead	µ g/l	-	50	-	50	-	50
Mercury	µ g/l	-	1	-	1	-	1
Nickel	µ g/l	-	50	-	50	-	50
Selenium	µ g/l	-	10	-	10	-	10
Pesticides, per substance	µ g/l	-	0.1	-	0.1	-	0.1
Pesticides, total	µ g/l	-	0.5	-	0.5	-	0.5
HPA	µ g/l	-	0.2	-	0.2	-	0.2
Undesirable Substances							
Boron	mg/l	-	1	-	1	-	1
Ammonia	mg/l	0.05	0.5	1	1.5	2	4
TKN	mg/l	1	-	2	-	3	-
Nitrates	mg/l	-	5	-	50	-	50
Phosphorous	mg/l	0.4	-	0.7	-	0.7	-
Barium	mg/l	-	1	-	1	-	1
Copper	mg/l	-	1	-	2	-	2
Zinc	mg/l	-	50	-	5	-	5
Manganese	mg/l	-	0.1	0.1	0.1	1	-
Dissolved iron	mg/l	-	0.3	1	2	1	3
Fluorides	mg/l	0.7	1.5	0.7	1.5	0.7	1.5
Dissolved hydrocarbons	mg/l	-	0.05	-	0.2	0.5	1
Phenols	mg/l	-	0.01	-	0.05	-	0.1

Parameter	Units	A1-G	A1-I	A2-G	A2-I	A3-G	A3-I
Anionic detergents	mg/l	-	0.5	-	0.5	-	0.5
Physical-chemical Parameters							
Temperature	°C	20	30	20	30	20	30
pH		6.5-8.5	-	6.5-9.2	-	6.5-9.2	-
Conductivity at 20° C	μ S/cm	1300	2700	1300	2700	1300	2700
Chlorides	mg/l	300	750	300	750	300	750
Sulfates	mg/l	200	-	200	-	200	-
Suspended materials	mg/l	50	-	1000	-	2000	-
Dissolved Oxygen	mg/l	7 (90%)	-	5 (70%)	-	3 (50%)	-
BOD5	mg/l	3	-	7	-	10	-
COD	mg/l	-	-	25	-	40	-
Oxydability	mg/l	2	-	5	-	10	-

Category A1: Water requiring a simple physical treatment and disinfection, including filtration, to be drunk.

Category A2: Water requiring normal physical and chemical processing and disinfection, including pre-chlorination, coagulation, flocculation, sedimentation, filtration and disinfection (final chlorination), to be drunk.

Category A3: Waters requiring physical treatment, chemical pushed refining and including disinfection by chlorination, coagulation, flocculation, sedimentation, filtration, adsorption and disinfection (ozone, final chlorination), to be drunk.

Within each category, there are two columns:

Column G (guideline values): correspond to the recommended values that surface water to be used for the production of drinking water.

Column I (mandatory values): values that are shown are the requirements that any surface water used for the production drinking water must meet.

Table 2-4 Domestic Discharge Standards

Parameters	Units	Value
BOD5	O2/l	120
COD	O2/l	250
Suspended Materials	mg/l	150

Table 2-5 Sanitary wastewater treatment plan discharge limits (as per the Minimum Functional Specifications, MASEN, 23-Feb-2016)

Parameter	Recommended Limits
BOD5	25 mg/l
COD	125 mg/l
TSS	35 mg/l
Total Nitrogen Compounds (as N)	15 mg/l

International Requirements

Two sections of the IFC general HSE guidelines, namely section 1.3 'Wastewater and Ambient Water Quality' and section 1.4 'Water Conservation' have been considered for this project.

Table 2-6 Indicative Values for treated Sanitary Sewage Discharge

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPNb / 100 ml	400a
Notes: a Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation. b MPN = Most Probable Number		

2.4.3 Air Quality

National Requirements

Moroccan Law No. 13-03 establishes the regulations for prevention of air pollution. The law identifies and addresses the sources and types of air pollution, and stipulates that in the absence of any defined national regulations, the polluter is required to integrate and implement the latest technology available to reduce or prevent pollution to the air.

- Decrees No. 2-09-286 establishes the national ambient air quality standards and monitoring mechanisms. These are presented in Table 2-7.
- Decree No. 2-09-631 establishes point source and non-point source emission levels, and the mechanism to control these emissions. These are presented in Table 2-8.

International Requirements

The following IFC EHS guidelines have been considered for the air quality assessment:

- IFC Environmental, Health and Safety General Guidelines (2007) and specifically sections relating to Ambient Air quality.

The assessment of air quality primarily ensures compliance with Moroccan regulations and standards. Where national regulations differ from the guidelines and standards presented in the IFC/WB guidelines, the project will be required to achieve whichever is the more stringent. As per the IFC/WB EHS Guidelines, the WHO ambient air quality standards are applicable in the absence of any national ambient air quality standards.

The following tables present the air emission standards that must be achieved, including those described above, extracted from: Decree 286 and 631 and World Bank/IFC EHS Guidelines.

Table 2-7 Ambient Air Quality Standards (µg/m³ unless otherwise specified)

Parameter	IFC EHS General GLs/WHO GLs		Moroccan		
	24 hour	Annual	1 hour	24 hour	Annual
PM10	150 (Interim target 1)	70 (Interim target 1)	-	90.4 50%centile	-
	100 (Interim target 2)	50 (Interim target 2)			
	75 (Interim target 3)	30 (Interim target 3)			
	50 (guideline)	20 (guideline)			
PM2.5	75 (Interim target 1)	35 (Interim target 1)	-	-	-
	50 (Interim target 2)	25 (Interim target 2)			
	37.5 (Interim target 3)	15 (Interim target 3)			
	25 (guideline)	10 (guideline)			
Nitrogen Dioxide	200 (1 hour)	40	98 200%centile	-	50 health 30

Parameter	IFC EHS General GLs/WHO GLs		Moroccan		
	24 hour	Annual	1 hour	24 hour	Annual
					vegetation
Sulphur Dioxide	125 (Interim target 1)	500 (10 minute guideline)	-	99.2 125%centile	20 (ecosystem)
	50 (Interim target 2)				
	20 (guideline)				
	150 (Interim target 1)				
Ozone	100 (8 hour daily maximum guideline)	-	110 for 8hr	65 vegetation	-
Carbon Monoxide	-	-	10mg/m^3 for 8hr	-	-
Cadmium	-	-	-	-	5ng/m^3 Health
Benzene (C6H6)	-	-	-	-	10 Health
Pb	-	-	-	-	1 Health

2.4.4 Noise and Vibration

National requirements

Currently no noise regulations or standards have been enacted within the Moroccan environmental regulatory system.

MFS Requirements

The MFS dated on the 23rd of February 2016 included the maximum noise levels applicable to the site boundary during the construction and operational phases of the project.

Table 2-8 Permissible Noise Levels as per the MFS

Location	Maximum Noise Level dB(A) – 1 hour
At one (1) meter outside the Plant fence/boundary during night time (22:00 – 7:00)	45
At one (1) meter outside the Plant fence/boundary when all equipment is running (7:00 – 22:00)	50
Within the central control room	45

The MFS also requires compliance with the guidelines values established by the World Health Organization (WHO) in 1999. However, there are no specific limits for the setting that represents the project area. Nonetheless, the noise levels established above and below are more stringent than those established by the WHO and therefore, will be used as the permissible noise limit.

International Requirements

Noise

The proposed plant will be required to comply with the noise limits as specified by the IFC EHS General Guidelines (2007).

These guidelines represent maximum noise values that must be achieved at surrounding/nearby receptors. It is stated within the IFC EHS Noise Level Guidelines that noise impacts will not exceed the levels which are presented in Table 2-9, or result in a maximum increase in background levels of 3dB at the nearest off-site point of reception.

Table 2-9 IFC EHS General Noise Guidelines at off-site receptor

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 – 22:00	Night time 22:00 – 07:00
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

Furthermore, the following requirements have also been specified in the IFC EHS Occupational Health and Safety Guidelines (April 2007) regarding noise exposure limits:

- No employee will be exposed to a noise level greater than 85 dB (A) for duration of more than 8 hours per day without hearing protection. In addition, no unprotected

ear will be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C);

- The use of hearing protection will be enforced actively when the equivalent sound level over 8 hours reaches 85 dB (A), the peak sound level reaches 140 dB(C), or the average maximum sound level reaches 110 dB (A). Hearing protective devices provided will be capable of reducing sound level at the ear to at least 85 dB (A);
- For every 3 dB (A) increase in sound levels, the allowed exposure period or duration will be reduced by 50%;
- Where feasible, use of acoustic insulating materials isolations of the noise source and other engineering controls will be investigated and implemented prior to the issuance of hearing protection devices as the final control mechanism; and
- Medical hearing checks on workers exposed to high noise levels will be performed periodically.

To help provide an understanding to the magnitude of noise, the following table describes noise levels subjectively in comparison to example sources/situations.

Table 2-10 Relative Assessment of Noise

Noise Level (dbA)	Examples	Subjective Evaluation
150	Jet take-off (at 25 metres)	Ear drum rupture
140	Near Jet Engine	Deafening
130	Threshold of pain	
120	Threshold of feeling - loud rock band, jet aircraft overhead. 32 times as loud as 70dB.	
110	Accelerating motor cycle nearby	
100	Loud vehicle horn	
90	Noisy urban street, motor mower nearby, noisy factory	Very Loud
80	Telephone ringing in same room, diesel truck at 65Km/h at 15m	Twice as loud as 70db
70	Baby crying in same room, vacuum cleaner being used, passenger car at 105Km/h at 7m	Loud. Upper 70 becomes annoying to some people
60	Freeway vehicle traffic nearby	
50	Average office, washing machine, large electrical transformers at 30m	Moderate
40	Soft radio music indoors, wind in trees	Low
30	Average residence	Faint

Noise Level (dbA)	Examples	Subjective Evaluation
20	Close to average whisper	
10	Rustle of leaves in wind, human breathing	Very Faint
0	Threshold of audibility	

Source: U.S Department of Transportation. Federal Highway Administration, and Outdoor Noise and the Metropolitan Environment, M.C Branch et al., Department of City Planning, City of Los Angeles, 1970

Vibration

None of the above standards set out specific standards in relation to vibration impacts at either the construction or operation phase. The IFC's General EHS Guidelines (2007) do however reference potential impacts from vibrations due to the use of hand held power tools and other equipment, as below:

"Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, will be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values, (i.e. the level of exposure at which remediation will be initiated) are provided by the ACGIH66. Exposure levels will be checked on the basis of daily exposure time and data provided by equipment manufacturers."

3 PROJECT OBJECTIVES, LOCATION AND ALTERNATIVES

3.1 Key Project Objectives

The proposed 20 MW Boujdour PV Project is aligned with the national energy policy objectives outlined in law No. 13-09 regarding renewable energy. This renewable energy project is aligned with the following key objectives of this law:

- Reducing oil-dependency and energy imports of the Kingdom of Morocco;
- Diversifying the sources of energy production while meeting increasing demand;
- Promoting a competitive energy market;
- Avoiding CO_2 emissions to the atmosphere. Specifically, the Boujdour PV Project will prevent the generation of 28,678.86 tonnes of CO_2 greenhouse gases, helping to offset the effects of Global Warming;
- Creating a sustainable local industry, and
- Generating local employment opportunities.

3.2 Project Location

The proposed project will occupy a 58 ha plot that is located in the commune rurale of Lamsid, in the province of Boujdour, approximately 13 km northeast from the city of Boujdour and 4 km southeast of the N1 road. Although the project is located in Lamsid, the closest residential community within this commune rurale is over 35 km northeast from the Boujdour PV project site.

Figure 3-1 Location of 20 MW Boujdour PV

The project centre coordinates are 565854.64 m E and 2892584.96 m N (28R).

The table below contains the coordinates of the proposed 20MW Boujdour PV project site.

Table 3-1 Proposed Project Site Coordinates

Boujdour PV	Easting	Northing
	UTM R28	
1	563604.45 m	2894102.11 m
2	564668.16 m	2894039.81 m
3	563559.22 m	2893540.65 m
4	564622.88 m	2893478.29

The Project will be located strictly within the boundaries established in MASEN's Minimum Functional Specifications (MFS). All temporary equipment, vehicles and materials required during the construction phase of the project will be deployed within the Project boundary.

3.3 Site Conditions and Land Use

The proposed PV site and the access road to the N1 are located in a greenfield. There are no residential, agricultural or industrial establishments, or archaeological or biological sites of special interest in or near the proposed footprint. There are no isolated dwellings on the site and its immediate vicinity or the access road either.

The proposed project site is located within a large pasture area used/wandered by pastoralists in a temporary basis each year. The ecosystem has a low productivity and carrying capacity, so extensive pastoralism is practiced over large areas on a seasonal basis. The project is located in a historical itinerary for passing herds (pastoralists) between two water points. According to the Provincial Director of Agriculture, the available area for grazing is 3 million ha and therefore the size of the project site (58 ha) is negligible and will not result in a disruption of pastoral activities. Similarly, due to the amount of land available and the relative small size of the project site, it will not constitute a barrier for passage.

There is no surface water or shallow aquifers in the proposed area and the distance from the site to the Atlantic Ocean is approximately 10.2 Km.

The plate below depicts the current site conditions (February 2016).

Plate 3-1 Proposed Project Site

3.4 Potential Sensitive Receptors

Socio-economic sensitive receptors could include the nearest city, residential communities, villages, arable lands and other privately or communal land uses that may be positively or negatively affected by the project development. As stated earlier, there are no cities or residential/commercial communities within a 10 km buffer of the site, the only identified potential sensitive receptors are the users of the N1 highway which is located approximately 3 km of the project boundary and pastoralists that use the area seasonally for extensive pastoralism and passage.

Ecological sensitivities could include the physical, biological and ecological aspects of the site and surroundings that may be positively or negatively affected by the development of the project. These sensitivities will be identified and discussed in detail within the specific sub chapters of this SESIA.

The figure below shows an aerial image of the project site with 5 and 10 km buffer areas from its centre point.

Figure 3-2. 10 Project location and adjacent area

3.5 Project Alternatives

Under Moroccan and international guidelines for environmental impact assessments, the evaluation of various project design and activity alternatives were considered, in order to ensure that the objectives of the proposed project have accounted for social, ecological, economic and technological options.

3.5.1 No Project Scenario

The "No Project" option is not considered to be a sustainable alternative, as the objective of the renewable energy law is to diversify the sources and production measures of power for the Kingdom of Morocco. Therefore, the development of the PV Project will contribute to the target of providing 25% of 2,000 MW national production by 2020. The project will prevent the generation of up to 28,678.86 tonnes of CO_2 greenhouse gases. The "No Project" alternative would have a higher contribution to Global Warming, as other polluting sources of electricity would need to be used to generate the 20 MW that the Project will generate.

Furthermore, the "No Project" option would not promote a competitive energy market that diversifies the sources of energy production while meeting increasing power demand or prevent national oil-dependency rates and energy imports from improving.

Finally, from a local perspective, the "No Project" option would not contribute to creating a locally sustainable industry nor generate local employment opportunities in the field of solar production or contribute to establishing a more attractive and sustainable economy in the region.

3.5.2 Alternative Solar Power Technology

The FESIA identified and assessed four technologies for solar power production in relation to ecological and social settings of the proposed site. The alternative photovoltaic technologies considered and the main findings of the comparative assessment are outlined in the table below:

Technology		Efficiency	Area (m^2) needed per kW	State of Commercialisation	Other Remarks
Crystalline Silicon	Monocrystalline Modules	22 to 25 %	7	Mature with large scale production	The most efficient yet most expensive on the market. They require the highest purity silicon and have the most involved manufacturing process
	Polycrystalline Modules	17 to 21 %	8	Mature with large scale production	Most common solar panels on the market, being less expensive than

Technology		Efficiency	Area (m^2) needed per kW	State of Commercialisation	Other Remarks
					monocrystalline silicon. They are also less efficient, though the performance gap has begun to close in recent years
Thin-Film Solar Cell	Amorphous Silicon Modules	10 to 13%	15	Early deployment phase, medium scale production	It can be deposited in thin layers onto a variety of surfaces and offers lower costs than traditional crystalline silicon, though it is less efficient at converting sunlight into electricity
	Copper, Indium, Gallium, Selenide (CIGS) Solar Cell	12 to 19%	10	Early deployment phase, medium scale production	It has only recently become available for small commercial applications, and is considered a developing PV technology
	Cadmium Telluride (CdTe) Solar Cell	18 to 21%	11	Early deployment phase, small-scale production	They are the most common type of thin film solar panel on the market and the most cost-effective to manufacture. CdTe panels perform significantly better in high temperatures and in low-light conditions
High Concentration Photovoltaics (HCPV) modules		36 to 41%	N/A	It has only recently become available for commercial applications	
Dye-sensitized modules	1-5%	N/A	R&D Phase		
Organic or Polymermodules	1%	N/A	R&D Phase		

Source: International Renewable Energy Agency

The result of the assessment was that the proposed PV technology (Crystalline Silicon with Polycrystalline Modules) was suitable for the site and environmental conditions of the area.

3.5.3 Alternative Project Location and Layout

The proposed site has been selected for the following reasons:

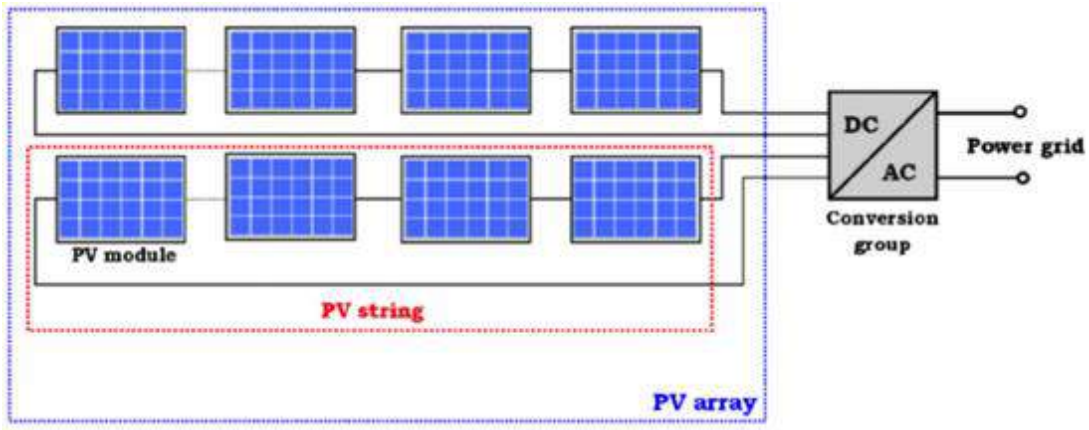
- Abundant unoccupied land;
- 3 million ha of grazing land available in the area;
- No nearby sensitive receptors (communities, industries, agricultural land, etc.)
- Lack of biological features of significant concern;
- No significant cumulative impacts foreseen resulting from the operation of the PV,
- No economic or physical displacement required;
- Convenient topographic conditions;
- No surface water bodies in the project site or nearby;
- No areas or archaeological sensitivity;
- Availability of fresh water from the local desalination facility, and
- Significant solar radiation (2,100 to 2,250 kWh/m GHI).

4 PROJECT DESIGN

4.1 PV Station

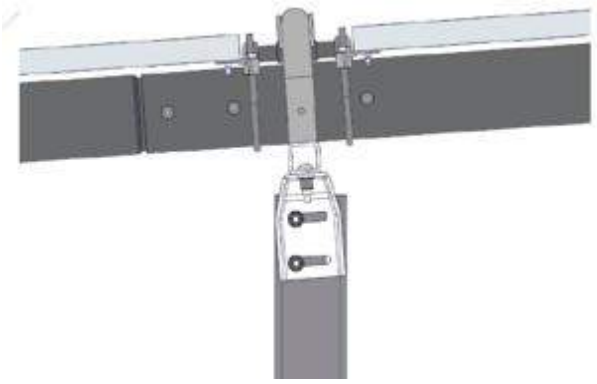
The PV Station has the capacity to generate 19.5 MW_p (15 MW_{ac}). The PV array will occupy a total of 117,886 m^2 and consist of 60,940 modules distributed in 3,047 strings (see figure below). The PV Station will also include 5 (five) inverters to change direct current (DC) to alternating current (AC). DC is the electricity produced by PV cells while AC is suitable to be transported through the power lines

Figure 4-1 General PV Assembly



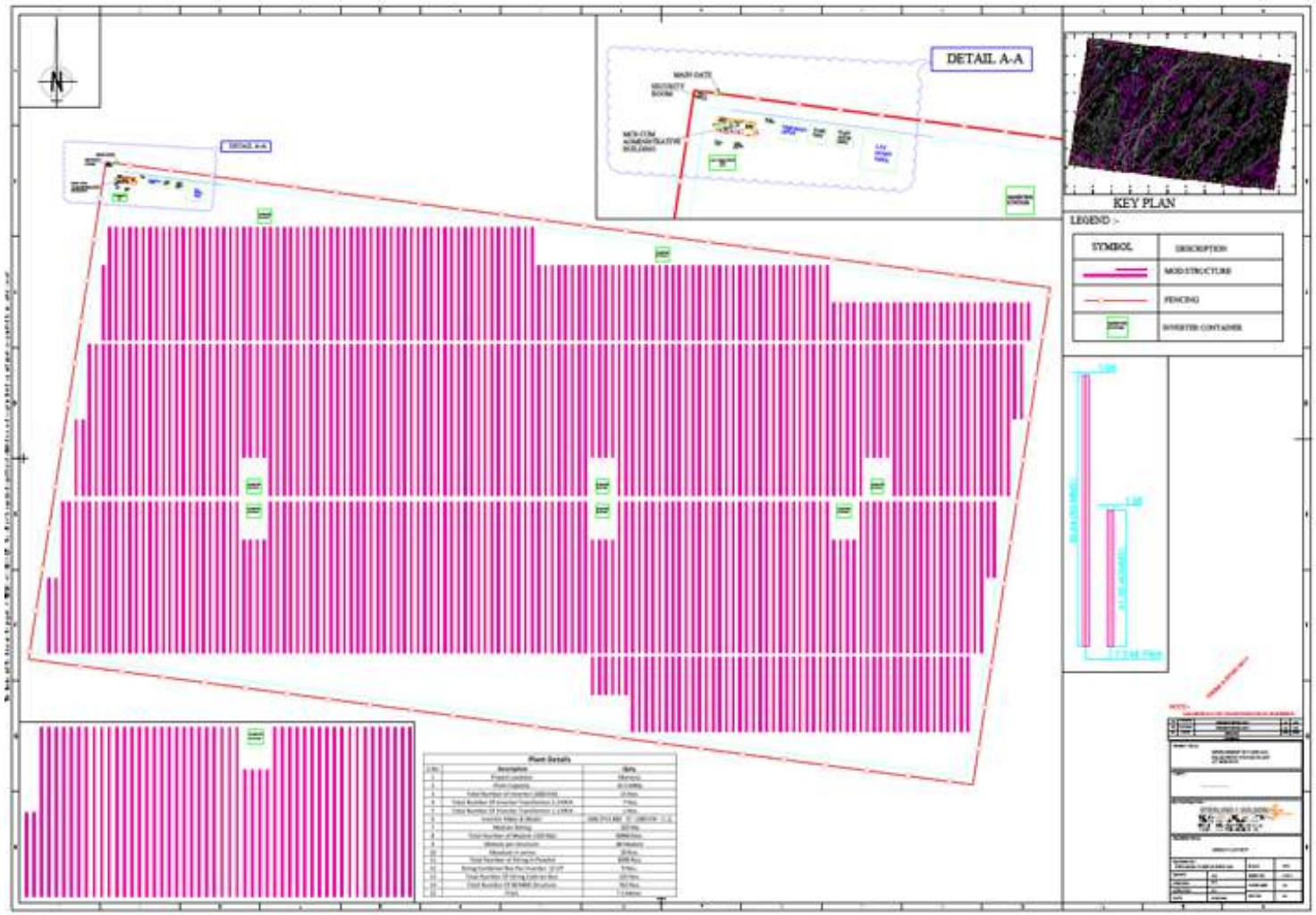
The modules will be mounted on a single axis tracker system with a bearing housing assembly attached to the piers that provides and adjustment range up to ±5˚ (8.7% grade).

Figure 4-2 Bearing Housing Assembly at 3.5 ˚ (6.1% grade)



A detailed layout is provided below.

Figure 4-3 Project Layout



4.2 Construction Equipment/Facilities

During construction, temporary facilities and equipment will be installed within the proposed PV site boundary and will be removed once the construction is complete. These facilities and equipment will include:

- Laydown area;
- Hazardous materials storage area;
- Hazardous waste storage area;
- Non-hazardous solid and liquid waste (septic tank and chemical toilets) area;
- Workshop/warehouse;
- Site offices;
- Canteen;
- Potable water storage;
- Security office;
- Diesel generators.

The above list covers key temporary facilities, but is not exhaustive.

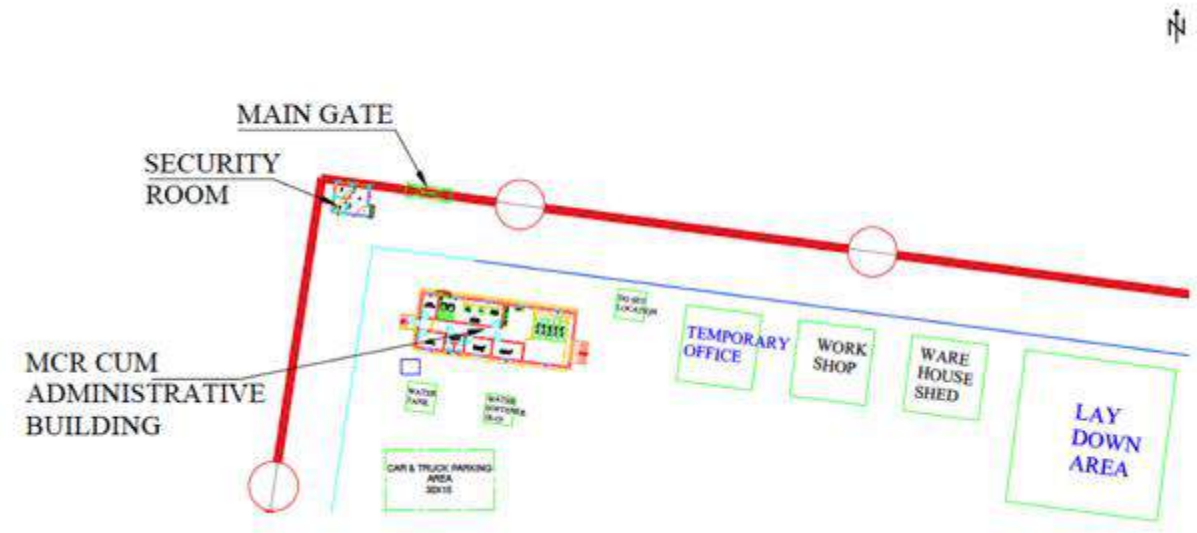
4.3 Operational Equipment/Facilities

The following permanent facilities will be built within the site boundary:

- Security building at the main gate;
- Administrative building;
- Wash Room and septic tank;
- Raw water tank;
- Reverse Osmosis polishing plant;
- Workshop/warehouse; and
- Parking area.

It is anticipated that at least one maintenance vehicle and one cleaning truck will be required during the operational phase.

Figure 4-4 Detailed administrative/workshop area (northwest corner)



4.4 Access road

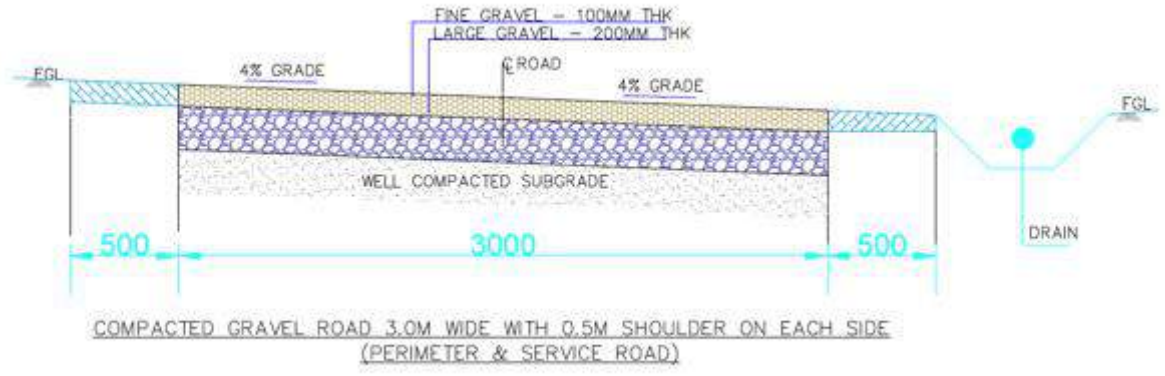
MASEN will build the access road to connect the PV site with the N1. The tentative design of the access road includes a two-lane 8 m wide (1|3-3|1) asphalt-paved road and compacted aggregate unpaved shoulders.

4.5 Internal road

An internal road will be built to allow access to the site during normal and emergency operating conditions.

The internal road will comprise a one-lane 3 m wide (0.5|3|0.5) gravel road and compacted aggregate unpaved 0.5 m shoulders. Design details and alignment are provided in the figure below.

Figure 4-5 Internal Access Road

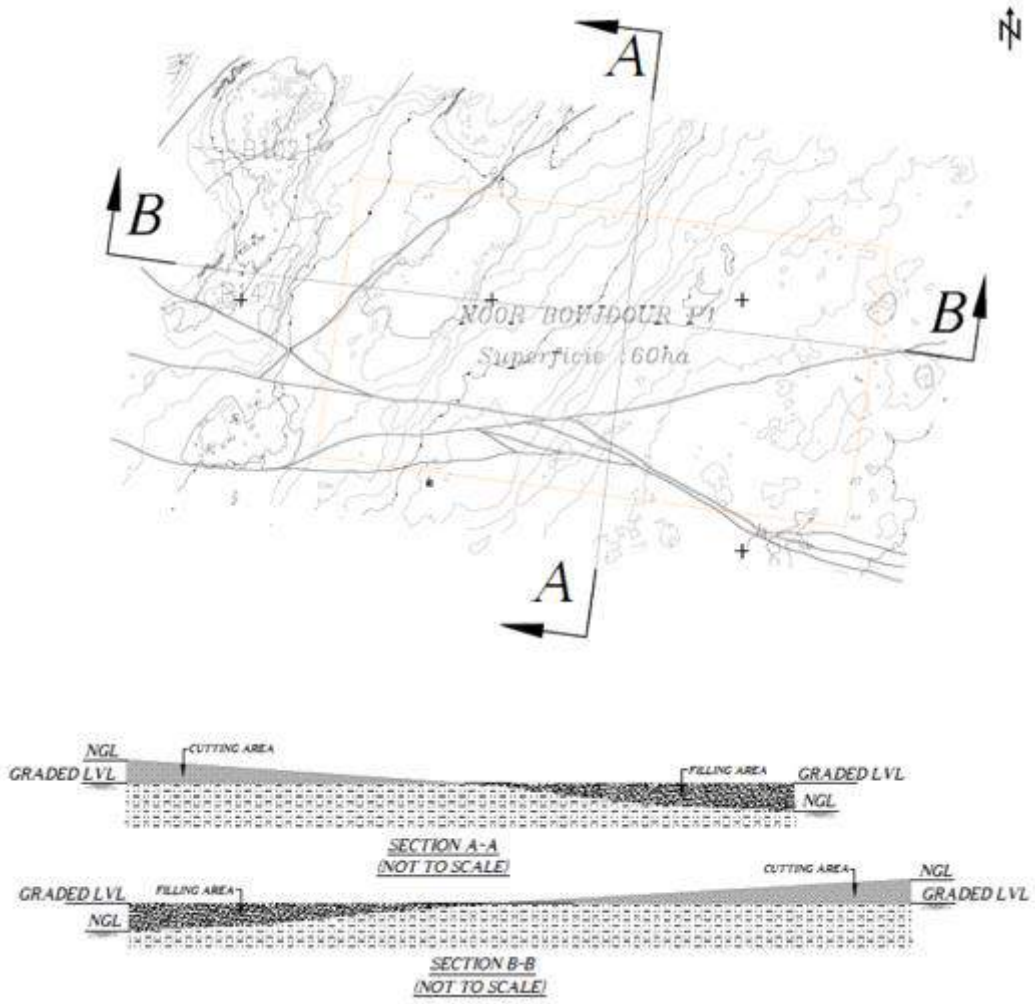


4.6 Earthworks and site levelling

The site is relatively flat and has a minor slope, as show in the figure below. Minor earthworks (levelling -cutting and filling- and compacting) will be required at the initial stage of the construction phase. Soil removal from the site is not anticipated.

The figure below shows the tentative cutting and filling requirements to adjust the topography of the site to the required level.

Figure 4-6 Planned Site Levelling

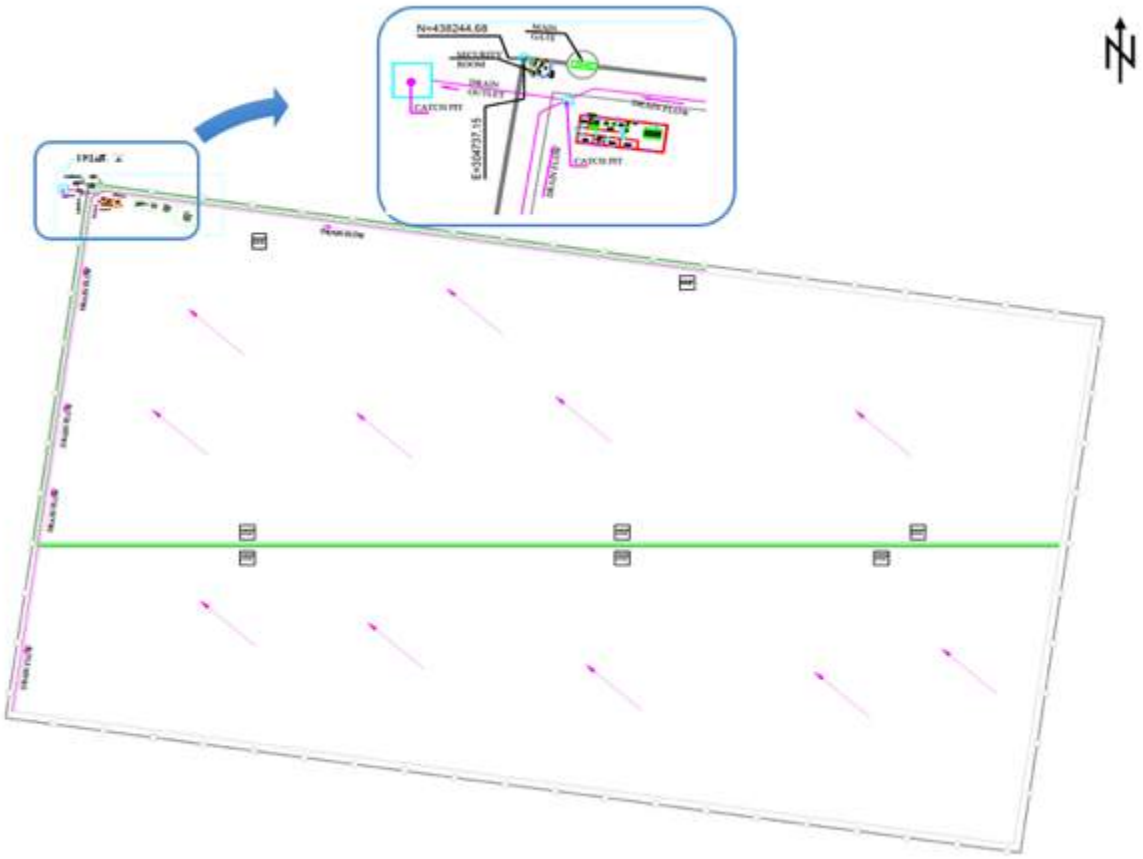


4.7 Run-off Drainage System

As a result of site levelling, the existing stormwater runoff within the site will be altered. The project design includes a site drainage system to minimise erosion and avoid flash floods. The design of the storm water drainage system has considered the geotechnical and hydrological (i.e. natural drainage system) characteristics of the proposed site and surroundings.

The drainage system will collect and direct rain water to an interface point at the northwest of the site, as requested in the MFS.

Figure 4-7 Stormwater Drainage System



4.8 Power Line

The PV facility will be connected to an existing 60/22 kV substation owned by l'Office National de L'electricite et L'Eau (ONEE), located in the northeast boundary of the city of Boujdour, through a double circuit overhead 22 kV power line. The E&S impacts associated with this secondary facility are covered in a dedicated SESIA report.

4.9 Resource use and waste streams

4.9.1 Power Demand

Power for temporary facilities, lighting and electric equipment/machinery will be provided by diesel generators during the construction phase. A diesel tank with adequate capacity to supply at least a 100 KVA demand for 10 days will be deployed at the construction site.

The table below includes estimates on power demand throughout the construction phase.

Table 4-1- Boujdour PV - Estimated Power Demand (Construction)

Activities	Month					
	1	2	3	4	5	6
Site Establishment	25 kVA					
Site Preparation		25 kVA				
Lighting & Security			25 kVA	2*25 kVA	25 kVA	25 kVA
Civil Construction		25 kVA	25 kVA			
Internal roads & Buildings	25 kVA	25 kVA	25 kVA	25 kVA	25 kVA	
Installation			25 kVA	25 kVA	25 kVA	
Testing & Commissioning					25 kVA	
Total	50 kVA	75 kVA	100 kVA	100 kVA	100 kVA	25 kVA

During the operational phase, the PV plant will be equipped with an emergency generator.

4.9.2 Water Demand

Water will be tankered to the site from the ONEE local desalination plant in Boujdour and stored in an onsite water tank with a minimum capacity of 50 m^3.

The following table provides the water requirements expected for each project phase:

Figure 4-8 Phase-specific Water Requirements

Phase	Approximate Quantity	Comments
Construction	720 m^3/month (average) (~3,200 m^3/phase). Approximately 8 m^3/day for dust suppression*, and 4 m^3/day for domestic uses.	Main activities include soil conditioning and curing activities. The quality of water used for construction activities (e.g. preparation of concrete) will be monitored to ensure compliance with the parameters required in the MFS.
Commissioning	800 m^3/phase (1 month)	Testing (firefighting system, spray system and containers) and equipment cleaning
Operation	The water consumption for modules cleaning is expected to be no more than 2,800 m^3/year, significantly lower than the	Panel cleaning (one cycle every ~10 days**) and domestic needs

	maximum quantity (4,000 m^3/year) allowed for in the MFS. Water for panel cleaning will not include chemicals others than the ones listed in the MFS. 100 m^3/year are estimated for domestic needs.	
Decommissioning	Quantity will be determined by the entity responsible for decommissioning, which is not expected to occur until at least 25years from the start of operations.	
*This amount might vary as a result of local soil conditions, climate variables and weather conditions. Manual dry cleaning might be considered after sand storms. Clean storm water or treated sewage water could be used for dust suppression if national standards for irrigation are met. **Manual dry cleaning might be considered after sand storms.		

The plant has been designed to minimise water consumption during all project phases. The maximum annual quantity of water estimated during the operation stage for all needs is significantly lower than the quantities specified in the MFS.

At a later stage, the O&M Contractor might consider manual cleaning with soft sponges and squeegees as an option to reduce the water consumption over the operational phase. The O&M Contractor estimates that this alternative may reduce the water consumption by over 40 to 50%. The O&M will focus on implementing the most environmentally and cost effective cleaning solution in line with the requirements recommended by the manufacturer of the PV panels and the MFS.

Construction water quality will be monitored on a regular basis to ensure that the following values are met, as suggested in the MFS:

Table 4-2 Permissible limits applicable for construction water

Organic content	200 mg/l
Inorganic content	3000 mg/l
Sulphates (SO4)	500 mg/l
Chlorides (Cl)	a) 1000 mg/l for RCC work b) 2000 mg/l for PCC work
Suspended solids	2000 mg/l
Alkalinity	Neutralize 200 ml of sample should not require more than 10 ml of 0.1 normal HCl using methyl orange as an indicator
pH	Neutralize 200 ml sample of water should not require more than 2 m of 0.1 normal NaOH (Caustic soda). The pH value

	of water shall generally be not less than 6

PV Panel Cleaning

Automated wet cleaning technology is envisaged to be used to remove dust and other particles accumulated on the panels. Automated cleaning is a high quality cleaning solution that provides cost optimization and lower occupational health and safety risks while requiring less quantity of water than other technologies available in the market.

The following solution for wet cleaning has been approved by the PV panels supplier:

- Cleaning truck/tractor with water temperature, flow and pressure regulation system and water trailer with a minimum capacity of 5,000 l, and
- Mobile cleaning arm attached to the tractor.

This system will be operated by one employee. It is estimated that one automated cleaning cycle (for all cells) will require 10 days and the tractor will consume ~216 l of fuel.

Cleaning procedures will be initiated when the energy generation efficiency is low. Cleaning frequency will attempt to keep loses resulting from soiling below 2%, using a specific tool to measure soiling losses -similar to a Dust Detection System (DDS). Weather conditions and forecast will be considered before initiating cleaning. The cleaning will be done at night to avoid thermal shock and potential cell failures.

Allocation of additional workers for manual dry cleaning might be considered under specific conditions that result in 10% loses from soiling accumulation (e.g. after dust storm events or other conditions).

The PV plant will include a Reverse Osmosis (RO) Water Treatment Plant to ensure that water for panel cleaning contains no deposits that might remain on the PV cells once dried. The RO plant will have a capacity to produce 1,000 LPH (l per hour.)

Water used for module cleaning will need to be tested regularly to ensure that parameters are kept within the following ranges, as suggested in the MFS:

Table 4-3 Permissible limits applicable to water for panel cleaning

Parameter	Value
P.H	6,5- 8.5
Conductivity	<250 us/cm
TDS	25-150 mg/l
Total Alkalinity	25-65mg/l as $CaCo_3$
Total Hardness	25-70 mg/l as $CaCo_3$

Parameter	Value
Calcium Hardness	25-65 mg/l as $CaCo_3$
Magnesium Hardness	‹15 mg/l as $CaCo_3$
Chloride	‹50 mg/l as Cl
Sulphate	‹3 mg/l as So_4

4.9.3 Wastewater

During construction and operation, all wastewater generated (mostly domestic) will be stored in appropriate septic tanks and collected by licensed operators. The expected amount of domestic wastewater generated is 15 l per worker per day.

Vehicle washing will not be allowed within the project site and will only be undertaken in suitable offsite premises.

Contamination of storm water will be avoided by preventing rain from entering material storage rooms, maintenance sheds, and other areas that could potentially contain hazardous materials.

During operation, the RO Plant will be polishing previously treated water from the Boujdour desalination plant, in order to meet the water quality limits listed in table 4-3 for PV panel cleaning. Since the water from the desalination plant will be of potable grade water, and the requirements for the PV cleaning water, only require a minor further reduction in the concentration of dissolved minerals and solids, the proportion of reject water resulting from the polishing process will be negligible. This reject water will be stored in appropriate impermeable tanks and collected by licensed operators.

4.9.4 Non-hazardous Solid Waste

The main types of waste generated during the construction phase will be inert (sand, gravel, glass, plastic, cables, metals, packaging materials, etc.) and domestic waste from workers.

During operation, the main types of expected waste are: domestic waste, plastic, paper, and cardboard. Waste handling during construction and operation phases will include storage in separate containers in a dedicated area within the site and regularly collected by licensed operators.

4.9.5 Hazardous Materials and Wastes

Materials

The construction and operation of a PV power plant does not require the storage of significant amounts of hazardous materials.

Fuel for vehicles and equipment will be stored onsite during construction, and small amounts of fuel for the emergency generator during the operational phase.

During operations, hazardous fluids will be integrated in the equipment (oil in the transformers or H_2SO_4 in batteries).

Waste

Other than sanitary wastewater, small amounts of hazardous waste (e.g. empty fuel drums or damaged PV panels) will be generated by the construction and operational maintenance activities.

Hazardous waste will be stored in adequate containers/facilities and collected by an authorized hazardous waste management company.

4.10 Security Provisions

The project site will be fenced and will include a closed-circuit television (CCTV) surveillance system operated from the main control room. The construction of the fence shall start as soon as the construction works start. An Access Control System will also be installed at the Security Gate to ensure registered and authorized entry only.

A security provider will be employed and trained security personnel will be onsite site 24/7 to protect access and the workforce. The number of security guards required and the equipment needed is based on existing regional security/safety conditions, previous experiences from the EPC/O&M contractors in similar projects and previous experiences of the security provider. It is expected that no more than 6 guards working in pairs on a shift rotation will be required.

5 CONSTRUCTION SCHEDULE AND WORKFORCE

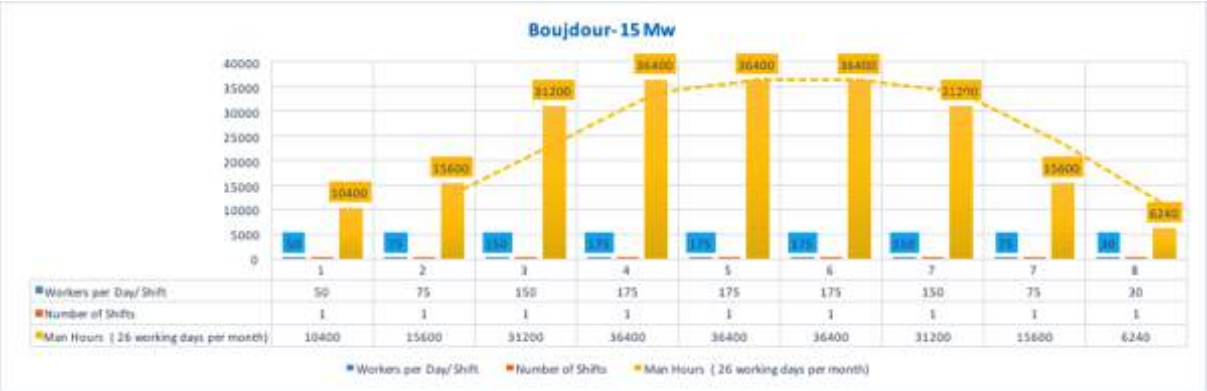
The construction phase of the PV facility is expected to last approximately nine months from the Notice to Proceed (NTP), which is planned for the second quarter of 2017. A detailed schedule for the construction phase is included in the Appendix 1. No night time works are anticipated during construction.

The following main works will be undertaken during the construction of the Project:

- Civil works ("cut and fill") at the site.
- Infrastructure works (PV site): construction of the fence, internal road, drainage system, etc.
- Infrastructure works (power line): foundations, erection of poles and installation of wire conductors (i.e. stringing, tensioning, clipping, etc.), connection to interconnection point.
- Infrastructure works (water pipe): excavation of trenches, pipe positioning and assembly, installation of valves and metering equipment, covering of trenches, etc.
- Construction of PV site facilities, pipework, etc.
- Installation of PV panels, mounted on a single axis tracker system foundation, and other equipment (e.g. Reverse Osmosis Plant).
- PV connection to power line.

The figure below shows the estimated total workforce and man-hours per month during the construction phase of the photovoltaic power facility.

Figure 5-1 Expected Construction Workforce



The project will result in the creation of employment locally during both construction and operations and, subsequently, the dissemination of best practice construction skills into the local labour force. The local economy is likely to benefit from the use of local businesses and services. Workers from onsite the region will likely be accommodated in the city of Boujdour or other nearby villages.

6 LAND ACQUISITION

MASEN is the current owner of the land allocated for the proposed project. The land acquisition procedures were documented in the *Plan D'Acquisition de Terrain* (PDT) for Boujdour prepared by MASEN in June 2016.

MASEN procured 1,735 ha of land procured through a voluntary buyer-seller agreement between the Moroccan State and MASEN in April 2016. The cost of the transaction was agreed on 10,000 Moroccan Dirhams per ha.

The site is not subject to any scheme documented in existing land use plans and no economic or physical displacement was required, other than the economic displacement for pastoralists that use the area for passage and extensive pastoralism, but this impact was assessed as negligible. MASEN has allocated 58 ha of land that will be leased by ACWA Power for the 20 MW Boujdour PV Project.

It is stated in the *Plan D'Acquisition de Terrain* for Boujdour that the land acquisition procedures conducted by MASEN considered both national and international requirements, namely IFC and KfW.

7 SESIA METHODOLOGY

7.1 Introduction

The SESIA methodology is specific to each of the technical subjects but includes, as a minimum, a desk study review of available information and standards, on-line information sources and existing site data and laboratory analyses where available. Detailed site surveys, monitoring and predictive modelling have been undertaken to determine the baseline situation and to predict impacts that are likely to occur during the construction, operational and decommissioning phases of the proposed project.

7.2 Baseline Conditions

Document Review

The following documents have been reviewed and provided key information for the SESIA:

- Framework Environmental Impact Assessment (FESIA) of the Boujdour PV, May 2016, prepared by NOVEC for MASEN. Original document in French.
- Revised (3rd amendment) Request for Proposals. April 2016, prepared by MASEN. The request for proposals includes the Minimum Functional Specifications (MFS) referred to throughout this document.

Baseline Surveys

Forming an integral part of the SESIA, the baseline surveys provide a benchmark of the existing conditions by which the potential impacts of the proposed Boujdour PV project can be assessed for construction and operational phases.

The environmental baseline surveys carried out as part of the SESIA have consisted of the following:

- Site walkover survey – February 2016;
- Biodiversity baseline survey – November 2016;
- Air quality baseline survey – November 2016;
- Background noise monitoring – November 2016;
- Soil sampling survey – November 2016, and
- Social survey – November 2016.

These surveys are described further within the relevant chapters.

The analysis of the physical, natural and social environment has considered the immediate site as well as an appropriate buffer surrounding the project site. The buffer width will vary in accordance with the environmental and social issues).

The identification of the buffer area of the Project follows international best practice procedures (Institute of Ecology and Environmental Management IEEM 2006) and has taken into consideration the type of project, the construction methods, the operation activities, and the environmental and social setting of the project site. Therefore, for each environmental and social issue the buffer width is based on the extent to which impacts from the construction and operation of the proposed Project would extend if no mitigation measures were implemented.

7.3 Impact Assessment Significance Criteria

In order to obtain a credible assessment of environmental impacts, the assignment of 'impact significance' for each identified impact needs to be a robust, consistent and transparent process. The methodology to assess 'impact significance' is outlined below and follows International Best Practice based on the assumption that the significance of an impact on resources or receptors is considered to result from an interaction between three factors:

- The nature and magnitude of the impact or change;
- The number of resources or receptors affected; and
- The environmental value (sensitivity) of those resources or receptors to the change.

A three-step approach has been used to determine the significance of environmental effects, as follows:

- Step 1 – evaluation of value / sensitivity of resource;
- Step 2 – assessing the magnitude of the impact on the resource; and
- Step 3 – determining the significance of effects.

The environmental value (or sensitivity) of the resource or receptor has been defined by using the criteria below in the table below.

Table 7-1 Environmental Value of Receptor or Resource

Value (sensitivity)	Description of Value
Very High	High importance and rarity on an international scale and limited or no potential for substitution. The receptor has already reached its carrying capacity, so any further impact is likely to lead to an excessive damage to the system that it supports. Locations or communities that are highly vulnerable to the environmental impact under consideration or critical for society (e.g. indigenous peoples, hospitals, schools).

Value (sensitivity)	Description of Value
High	High importance and rarity on an national scale, and limited potential for substitution. The receptor is closed to reaching its carrying capacity, so a further impact may lead to a significant damage to the system that it supports. Locations or communities that are particularly vulnerable to the environmental impact under consideration (e.g. residential areas, vulnerable/marginalized groups).
Medium	High or medium importance and rarity on a regional scale, limited potential for substitution. The receptor is already significantly impacted, but it is not close to reaching its carrying capacity. Further impacts will get increase the stress of the underlying system, but evidence does not suggest that it is about to reach a critical point. Locations or groups that are relatively vulnerable to the environmental impact under consideration (e.g. commercial areas).
Low (or Lower)	Low or medium importance and rarity on a local scale. The receptor is not significantly impacted and shows a large spare carrying capacity. Impacts are not likely to generate any noticeable stress in the underlying system. Locations or groups that show a low vulnerability to the environmental impact under consideration (e.g. industrial areas).
Very Low	Very low importance and rarity on a local scale. The receptor is not impacted and shows a very large spare carrying capacity. Impacts are very unlikely to generate any noticeable stress in the underlying system. Locations or groups that show a very low vulnerability to the environmental impact under consideration (e.g. industrial areas).

The existence of receptors that are legally protected (e.g. designated areas, protected habitats or species) will be taken into consideration for the assessment of the sensitivity of the receptors.

The magnitude of the impact is defined where possible in quantitative terms. The magnitude of an impact has a number of different components, for example: the extent of physical change, the level of change in an environmental condition, its spatial footprint, its duration, its frequency and its likelihood of occurrence where the impact is not certain to occur.

The criterion that has been used for assessing the magnitude of impacts includes the geographical scale of the impact, the permanence of the impact and the reversibility of the impacted condition. A brief description of the magnitude of the impacts is provided in the table below.

Table 7-2 Criteria for Magnitude of Impact

Magnitude of Impact	Description of Magnitude
Major	Adverse: Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements. A major impact is usually large scale, permanent and irreversible. Beneficial: Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	Adverse: Significant impact on the resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. Moderate impacts usually extend above the site boundary, and are usually permanent, irreversible or cumulative. Beneficial: Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse: Some measurable change in attributes quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Minor impacts usually are only noticeable within the site and are temporary and reversible. Beneficial: Minor benefit to, or addition of, one (maybe more) key characteristic(s), features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse: Very minor loss or detrimental alteration to one or more characteristics, features or elements. Beneficial: Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

In addition to the factors outlined in the table above, the possibility of any standards being breached will be taken into consideration in the determination of the magnitude of the impact.

The significance of effects is a combination of the environmental value (or sensitivity) of a receptor or resource and the magnitude of the project impact value (change). The table below shows the criterion used for determining the significance of effects. Definitions of each significance category are provided for in the table further below.

Table 7-3 Criteria for Determining Significance of Effects

		Magnitude of impact (degree of change)				
		No Change	**Negligible**	**Minor**	**Moderate**	**Major**
Environmental value (sensitivity)	**Very High**	Neutral	Minor	Moderate to Major	Major	Major
	High	Neutral	Minor	Minor to Moderate	Moderate to Major	Major
	Medium	Neutral	Negligible to Minor	Minor	Moderate	Moderate to Major
	Low	Neutral	Negligible to Minor	Negligible to Minor	Minor	Minor to Moderate
	Very Low	Neutral	Negligible	Negligible to Minor	Minor	Minor

Table 7-4 Definition of Significance of Effects

Significance Category	Criteria
Very Large	Only adverse effects are assigned this level of importance as they represents key factors in the decision-making process. Effects are associated with sites and features of national or regional importance. Effects exceed statutory limits. Mitigation measures are unlikely to remove such effects.
Large	Important considerations at a local scale but, if adverse, are potential concerns to the project and may become key factors in the decision making process. Mitigation measures and detailed design work are unlikely to remove all of the effects upon the affected communities or interests.
Moderate	These effects, if adverse, while important at a local scale, are not likely to be key decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource. They represent issues where effects will be experienced but mitigation measures and detailed design work may ameliorate or enhance some of the consequences upon affected communities or interests. Some residual effects will still arise.

Significance Category	Criteria
Minor	Local issue unlikely to be of importance in the decision-making process. Effects do not exceed statutory limits. Nevertheless, they are of relevance in enhancing the subsequent design of the project and consideration of mitigation or compensation measures.
Neutral or Negligible	No effect or effect, which is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error. No mitigation is required.

It should be noted that the decommissioning phase of the project has only been discussed in general terms since the proprietorship will change once the 25-year Power Purchase Agreement (PPA) ends. The Project will be handed over to MASEN at the end of the 25-year period and consequently the responsibilities for the decommissioning of the plant will fall under the responsibility of the future owner.

8 CONSULTATION PROCESS

The scale and nature of the proposed project and the emphasis that the IFC Performance Standards place upon community involvement or affected parties emphasise this important aspect of the environmental and social impact assessment process.

The SESIA has included a process by which the project stakeholders' input on matters affecting them is sought. The main goals of this procedure have been improving the efficiency, transparency and public involvement in the projects.

The project may have an impact on communities and consultation is key to understanding the existing social constraints, identifying any community grievances and identifying mitigation measures. Mitigation for the social or environmental concerns of these stakeholders has been considered at the early stage of the project development.

In Morocco, the public consultation process (enquête publique) is well defined under decree no. 2-04-564 and is a pre-requisite to carrying out the SESIA. The procedures and objectives are similar to those defined under the IFC Performance Standards 1, 4, 5, 7 and 8, which ensure that the development of the Project considers any impacts or practices which may affect local communities or other stakeholders.

8.1 Public Consultation Meeting

In addition to the national public enquiry, a public consultation was carried out on December 1st 2016. The detailed report of the community consultation meeting is provided in SESIA Vol. 4.

The public consultation meeting was advertised through the publication of an advert in French and Arabic national newspapers and by coordination with the Governor of Boujdour Province to send official invitations to provincial technical departments. The meeting was led by representatives Phenixa, ACWA Power and MASEN. Local Arabic was spoken during the meeting and 53 people attended.

A copy of the non-technical summary in French and Arabic was provided to all attendees and an initial presentation was undertaken to outline the main elements of the Boujdour PV project, to summarise the baseline conditions in the study area (physical, biological and socioeconomic), to outline the positive and negative impacts identified, explain the preliminary assessment undertaken and specify the mitigation measures that were being considered.

The stakeholders present at the meeting consisted of the following:

- Population;

- Provincial technical departments
- Elected Communal councillors
- Non- Governmental Organisations

The meeting was considered to fulfill its aims, for the following reasons:

- It allowed for precise information to be provided about the main issues raised by the local population;
- It confirmed that the concerns raised by the population were in line with the mitigation measures being proposed.

The following is a summary of the perspectives and concerns of the stakeholders:

- Impacts on the livelihood of the herders
- Assuring that the livelihood of the herders is not impacted
- Developing social programs to help sustain the herders
- Employment and training opportunities for the local population
- Environmental impacts in relation to source of water, soil quality, ecology, livestock, and health/security impacts; and
- Communications and grievance mechanisms

The following table summarises the most commonly raised questions and concerns raised, and the mechanism proposed/addressed in the design of the project:

Table 8-1 Summary of comments and questions

Questions/Comments	Clarifications and Answers
The site is regularly used by herders for grazing and looking for water wells. It is requested that notice boards are placed to inform the herders of the sites boundaries and to guarantee their security.	It should be noted that there is no water wells within the project site, and that a fence will be constructed, avoiding any risks for the herds.
The residents of Lamsid commune are looking forward to the positive impacts from the implementation of the project, such as job creation and skills development.	Employment applications will be conducted through the ANAPEC, and the employment priority will be given to the local residents of the commune and province, according to available qualifications.
Which source of water will be used for the construction and operation of the project?	The supply of water for the need of the plant will be from the desalination plant at Boujdour in coordination with ONEE while obtaining necessary approvals.

Questions/Comments	Clarifications and Answers
The site has a couple of environmental considerations: The UAE has been introducing Houbara Bustards in the province (from historical data), and the IBA *Oufist* is located 55 km south of Boujdour, which is an important resting area for migratory birds. Therefore the mitigation measures should considered the potential impacts to these organisms.	Ecological mitigation measures during construction and operation have considered the impacts to migratory birds and monitoring will be conducted to ensure that these measures are effective at preventing any losses. Specialist ornithological surveys have confirmed the absence of any Houbara Bustard in the project area.

8.2 Stakeholder Engagement Plan

A Stakeholder Engagement Plan was prepared in order to guide the stakeholder identification, assessment, and plan the stakeholder engagement actions including the implementation of a grievance mechanism by which stakeholders and/or interested parties can raise their concerns during the construction and operational phases. The SEP is provided through the Volume 4 of the SESIA.

A Grievance Mechanism has also been included within the SEP.

9 AIR QUALITY

9.1 Introduction

This chapter describes the existing air quality conditions in the project site and the potential impacts that may occur as a result of the construction and operation of the proposed Boujdour PV Project. This chapter also identifies the measures that will be implemented in order to mitigate these impacts. The assessment of impacts has been measured against national Moroccan standards and applicable IFC standards and guidelines.

Impacts of poor air quality can be profound and can adversely affect human health, ecosystems and vegetation. Such impacts can include long-term health impacts and premature mortality related to heart and lung problems, as well as discomfort to humans and other health effects (e.g. asthma). Short-term exposures can also be dangerous and can lead to increases in hospital admissions. The air quality impacts on the environment can have direct effects on vegetation, as well as indirect effects to the acid and nutrient characteristics of soils and waters, which in turn impact upon species and habitats.

Air quality impacts will arise mainly during the construction and decommissioning phases of the proposed project. During operation, the impacts to air quality will be significantly reduced and will consist mainly of particulates arising from dust. Such emissions are indirect and naturally occurring, as the nature of operation of a PV plant does not rely on the combustion of any fossil fuels.

9.2 Methodology

In order to adequately evaluate and develop suitable mitigation and management measures for implementation in the various phases of the project throughout its lifecycle, an assessment of the current ambient air quality condition of the project area surrounding the proposed projects was carried out.

The construction of a photovoltaic power plant typically result in increased dust levels, mainly resulting from site preparation activities and, at a lower level from vehicle movements. During operation, activities that are likely to generate dust are minimal, since the PV panels have to be kept dust free in order to maximise power generation. As such, and considering the existing impacts to ambient air quality, the project's impacts are considered negligible, and only particulate matter has been considered for the air quality survey.

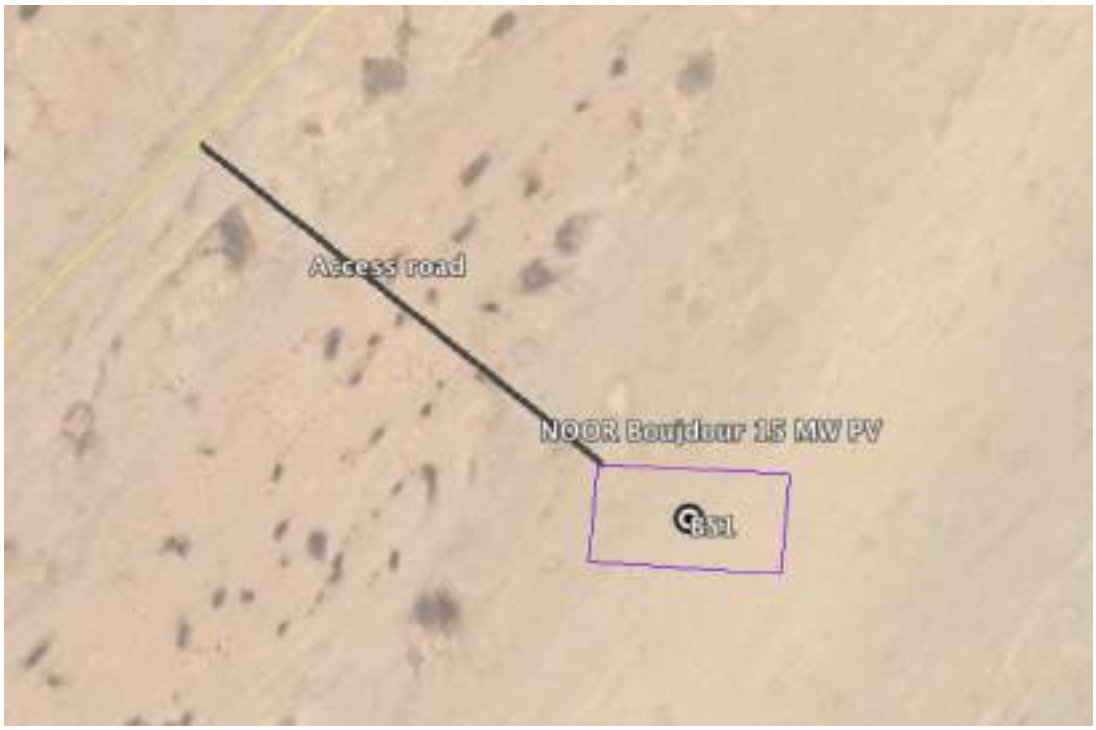
Ambient Air Quality Monitoring of PM_{10} and $PM_{2.5}$ was undertaken on November 13th for 24 hours at two (2) locations using a continuous high volume mass sampler. Equipment to continuously monitor wind speed, wind direction, humidity, and temperature was also installed for the monitoring period.

Monitoring of these parameters was conducted at the project site to provide representative air quality characteristics of the un-influenced free-field site.

Table 9-1 Air Sampling Coordinates

Monitoring Station	Lambert Coordinates		Description
	X	Y	
BS1	305 347.656	437 671.756	Centre coordinate of PV project site

Figure 9-1: Air Survey Locations



9.3 Baseline

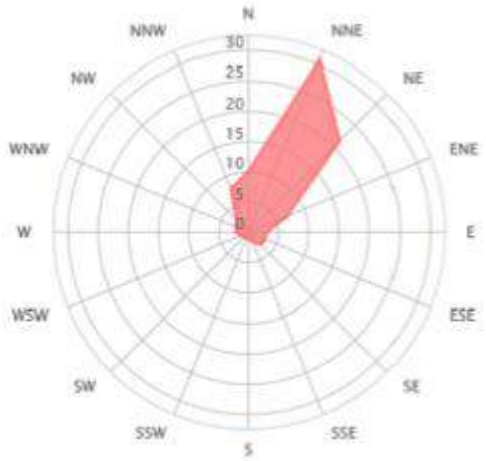
9.3.1 Meteorology

The mean monthly air temperature was 17.3°C for the coldest month (January) and 24.8°C for the warmest (August) during the 2001-2014 period. During these years, the minimum and maximum average temperatures were, respectively, 12.5 °C (February) and 31.2°C (August)- data obtained from the Laayoune weather station.

The average annual precipitation in the project area is 40 mm, and rainfall occurs in short and intense events. The high relative humidity (inter-annual variation of 60 – 72%) reflects the proximity of the ocean.

The Saharan coastal region is exposed to high winds and the project area is exposed to aeolian transport, involving the movement and weathering of sand particles. Sand enters and leaves the project site in a SW direction (wind rose in the figure below).

Figure 9-2 Prevailing Wind Pattern at the Project Site



9.3.2 Existing Air Quality Conditions

The proposed Project is situated in a greenfield, with no commercial or industrial facilities within the buffer area of the PV site. As such, no point sources of emissions from industries are located within the project's air shed. The closest non-point sources are the vehicles travelling on the N1, located 4 km northwest from the proposed Project site.

Analytical Results

Table 9-2 Air Monitoring Results, µg/m³

Parameter	IFC EHS General GLs/WHO GLs	Moroccan	Results (BS1)
PM_{10}	150 (Interim target 1)	90.4 (50%centile)	31.6
	100 (Interim target 2)		
	75 (Interim target 3)		
	50 (guideline)		
$PM_{2.5}$	75 (Interim target 1)	-	15.3
	50 (Interim target 2)		
	37.5 (Interim target 3)		
	25 (guideline)		

The monitoring values observed for coarse dust particles PM10 (2.5 to 10 micrometres ⌀) and fine dust particles PM2.5 (<2.5 micrometres ⌀) show that the ambient air quality conditions within and adjacent to the Boujdour PV project site are well within the national and international ambient air quality guidelines, and considered good.

9.4 Sensitive Receptors

In accordance with good international practice, the assessment of sensitive receptors should consider up to 500 m from the site boundary for both human and ecological receptors (Holman et al, 2014), due to the typical distance of dust dispersion. The assessment of other pollutants (e.g. gaseous exhaust fumes) will require a smaller area of assessment (~ 200 m) as suggested by Bignal, K. et al, 2004, before emissions are indistinguishable from background concentrations.

There is no existing residential receptor within close proximity to the proposed project site as the town of Boujdour is 10 Km southwest of the site and due to their location and distance from the project site there is little potential to be impacted by the emissions sources anticipated during the construction and operational phase. N1 users are unlikely to be exposed to increased dust levels from the construction of the PV site.

Table 9-3 Air Quality Sensitive Receptors

Receptor	Sensitivity	Justification
Air Quality (Gaseous and Particulate)	Low	The proposed location is within a non-degraded air shed as no significant polluting sources are found in the neighbouring area.
N1 users	Very Low	Road users have a low sensitivity to impacts since they are in vehicles and their residence time in the area is low.
Residents – Transport Route	Medium	Construction and operational vehicles will use the available route from the Casablanca/Agadir Port, which goes through several residential areas where there is no bypass road, so all traffic bringing equipment from the ports is likely to cross such residential area leading to increased air pollution. Human exposure to air pollutants can lead to health effects, principally in the respiratory system.
Site employees	High	Workers will experience emissions from heavy machinery and generators, and increased dust conditions. Human exposure to air pollutants can lead to health effects, principally in the respiratory system. Site employees are considered medium sensitivity as they will work on a shift basis and exposure will be on a temporal basis.

Receptor	Sensitivity	Justification
Moroccan GHG emissions	Moderate	The average contribution of the Moroccan energy sector to the to the total GHG emissions of the country is ~55% of, which currently highly relies on non-renewable sources of energy. Even though the country is making a noticeable effort to build new renewable energy plant, the GHG emission of the energy sector remains high.

9.5 Construction Assessment

9.5.1 Potential Impacts

During construction, the ambient air quality at the project site may potentially be affected by increased dust, particularly during the earthworks phase and by gaseous exhaust fumes from construction activities, equipment and additional vehicle movements to and from the site.

The principle anthropogenic sources of dust and emissions at the project site during construction will be:

- Excavation and earthwork, such as ground breaking, levelling (cutting and filling);
- Vehicle movement over unpaved surfaces;
- Movement of vehicles to and from the site (e.g. for deliveries);
- Dust from uncovered stockpiled powdery materials or truckloads;
- Emissions (e.g. NOx, SOx and CO) and particulates from vehicles, diesel generators, heavy plant and other mechanical equipment; and
- Stored VOCs and other volatile hazardous materials.

Dust due to site preparation

Dust resulting from construction activities typically comprises large diameter particles, which settle rapidly and close to the generation source, e.g. within 500m under low/calm conditions. Far field dust impacts from construction works are therefore not considered significant. Studies by the US EPA (1995) show that particles larger than 100 μm will likely settle out within 6 to 9 m from the point of emission at wind speeds of 16km/h. Factors such as the meteorology and particle mass will influence the dispersion of dust.

Additional impacts relate to the movement of soil where trucks are not effectively covered, or where vehicles are moving on unpaved surfaces.

The significance of dust impacts from construction works is largely based on the direction of the wind and the proximity of sensitive receptors. The prevailing wind direction the project area may vary between seasons and could therefore disperse dust in almost any direction.

Dust due to movement of trucks and material transportation

Except for vehicle movements on unpaved surfaces, dust due to the movement of trucks and material transportation should only occur where mitigation measures are not effectively implemented at the site or in the access road being used by the construction vehicles.

Uncontained and/or un-sheeted trucks may be subject to losses of material where the containment is not effective (i.e. spills), or where wind or other air turbulence may disturb the contents and result in dispersion of material. Such impacts have the potential to degrade local air quality in the immediate area of such movements, if particles become suspended.

Vehicular and Equipment Gaseous and Particulate Emissions

Vehicles and equipment that operate on liquid fuel (i.e. oil) will result in the emission of gases and particulates to air due to the combustion of fossil fuels. Such vehicle and equipment include, but are not be limited to the following:

- Excavators;
- Graders;
- Trucks;
- Generators, and
- Hand held equipment operating on liquid fuel.

Air quality impacts relating to the use of the above are generally small. Equally, the equipment used on site is relatively new and well maintained, as such these impacts are unlikely to occur.

Where there are multiple vehicles or equipment in operation, the potential for cumulative impacts from the combination of these emissions increases.

Volatile Organic Compound (VOC) emissions

A small volume of fuels, paints, solvents and other volatile substances are required during the construction phase. If not properly contained, such substances have the potential to result in the dispersion of volatile emissions to the local air shed. However, only small volumes of these substances will be needed, and these will be stored at the laydown area. As such, the potential impacts are limited to the immediate area.

The following table summarises the predicted impact levels from the various sources on the nearest sensitive receptors.

Table 9-4 Air Quality – Magnitude of construction impacts

Impact	Magnitude	Justification
Dust from Earthworks and site activities	Minor	Temporary but reversible effects and cumulative loss of air quality in the site and immediate surroundings due to dust dispersion outside project boundary. All dust impacts will be generated outdoors, reducing the impact magnitude due to dust dispersal in addition to dust settling.
Dust from Vehicles	Minor	Temporary and reversible impacts are anticipated and the number of vehicles is expected to be low. Dust suppression will be employed when and where necessary. All dust impacts will be generated outdoors, reducing the impact magnitude due to dust dispersal in addition to dust settling.
Gaseous and Particulate emissions from Vehicles	Minor	Minor temporary impacts are likely to occur at the project site throughout the construction phase.
VOCs and other hazardous volatiles	Minor	Noticeable temporary impacts are anticipated, but these will be limited to the site.

Table 9-5 Air Quality - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Dust from Earthworks and site activities	Minor	Air Quality (Gaseous and Particulate)	Low	Negligible to Minor
		N1 users	Very Low	Minor
		Construction employees	High	Minor to Moderate
Dust from Vehicles	Minor	Air Quality (Gaseous and Particulate)	Low	Negligible to Minor
		N1 users	Very Low	Negligible to Minor
		Construction employees	High	Minor to Moderate
Air Emissions from	Minor	Air Quality (Gaseous and	Low	Negligible to

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Vehicles		Particulate)		Minor
		N1 users	Very Low	Negligible to Minor
		Residents – Transport Route	Medium	Minor
		Construction employees	High	Minor to Moderate
VOCs and other hazardous volatiles	Minor	Construction employees	High	Minor to Moderate

9.5.2 Mitigation Measures

Table 9-6 Air Quality – Mitigation Measures - Construction Phase

Impact / Source	Mitigation Measure	Responsibility	Schedule
Dust Generation due to site preparation and site activities	Site preparation and levelling will be undertaken during periods of low winds (<15 km/h).	EPC and Subcontractors	CESMP –Site preparation
	Material stockpiles of dusty materials higher than 5 metres will be avoided where possible, with dust suppression sprays being utilised on any piles during periods where the wind speed exceeds 15km/h. Alternatively, stockpiles of dusty materials can be covered.	EPC and Subcontractors	CESMP – Construction Management and Monitoring
	Adding to stockpiles of dusty materials will be stopped when high winds are present (15 km/h).	EPC and Subcontractors	CESMP – Construction Management and Monitoring
	Dusty material stockpiles will be located only onsite and away from the site boundaries and be effectively contained	EPC and Subcontractors	CESMP – Construction Management and Monitoring
	Where sand and other dusty materials are transported to site, trucks will not be overloaded and will be appropriately covered / sheeted to avoid loses en-route.	EPC and Subcontractors	CESMP – Management and Monitoring
	Powdery materials (e.g. cements) will be stored and transported in sealed containers	EPC and	CESMP – Management and

Impact / Source	Mitigation Measure	Responsibility	Schedule
		Subcontractors	Monitoring
	No burning of wastes or other materials will be allowed on site through the construction phase	EPC and Subcontractors	CESMP – Management and Monitoring
	Undertake daily visual assessment of dust levels and take actions (dust suppression) to reduce emissions, when these are identified as excessive.	EPC and Subcontractors	CESMP – Monitoring
	Transport of uncovered dusty loads (materials and waste) is strictly forbidden.	EPC and Subcontractors	CESMP – Management and Monitoring
Gaseous and Particulate Emissions from Vehicles	Onsite/offsite speed limits are included in the Traffic and Road Safety Section of this SESIA. Besides road safety, these limits will contribute to reduce exhaust gases resulting from traffic movements.	EPC and Subcontractors	CESMP – Management
	Efficiently manage deliveries of equipment/plant to the site, to reduce the number of trips.	EPC and Subcontractors	CESMP – Management
	Minimise exhaust fumes and particulates emitted from trucks and vehicles by ensuring the use of vehicles in good condition. Vehicles entering the site for the first time will be inspected for their worthiness and when deemed inadequate will not be permitted to enter the site.	EPC and Subcontractors	CESMP – Management & Monitoring
VOCs and other Fugitive Emissions	Hazardous materials stored and used on site with potential gas emissions (e.g. Volatile Organic Compounds) will be located in well-ventilated, secure low-risk areas.	EPC and Subcontractors	CESMP – Training and Monitoring
	Fires and material burning is prohibited on the Project site.	EPC and Subcontractors	CESMP – Management and

Impact / Source	Mitigation Measure	Responsibility	Schedule
			Monitoring
General	Personal Protection Equipment will be provided to all employees when necessary. Special attention will be given during site preparation and other activities likely to cause significant levels of dust.	EPC and Subcontractors	CESMP – Management & Monitoring

9.5.3 Residual Impacts

Following the implementation of an appropriate CESMP (which will at least include the mitigation measures outlined above, and others as noted within the Environmental and Social Management and Monitoring section) the overall residual effects are expected to be of a temporary / short-term duration and of minor to negligible negative significance.

Table 9-7 Air Quality – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Dust from Earthworks and site activities	Air Quality (Gaseous and Particulate)	Negligible to Minor	Yes	Negligible
	N1 users	Minor	Yes	Negligible
	Construction employees	Minor to Moderate	Yes	Minor
Dust from Vehicles	Air Quality (Gaseous and Particulate)	Negligible to Minor	Yes	Negligible
	N1 users	Negligible to Minor	Yes	Negligible
	Construction employees	Minor to Moderate	Yes	Minor
Air Emissions from Vehicles	Air Quality (Gaseous and Particulate)	Negligible to Minor	Yes	Negligible
	N1 users	Negligible to Minor	Yes	Negligible
	Residents – Transport Route	Minor	Yes	Negligible
	Construction employees	Minor to Moderate	Yes	Negligible
VOCs and other hazardous volatiles	Construction employees	Minor to Moderate	Yes	Negligible

9.6 Operational Assessment

9.6.1 Potential Impacts

Generally, photovoltaic power plants by their very nature are zero emission facilities since it uses renewable and clean sources to generate power. The power plant will have a positive

impact on the regional air quality, as it will prevent CO_2 from being emitted if a conventional fossil fuel power plant had been used.

Vehicle emissions due to movements to/from and around the site will result in limited pollutants. The typical air emissions resulting from these activities include: Particulate Matter (PM10 & PM2.5), Nitrogen Oxides, Sulphur Dioxide and BTEX. Adequate protection measures must be outlined in the O&M's OESMP prior to the start of construction activity.

The onsite generator is not considered a potential source of exhaust gases as it will only be used during emergency situations (less than 500 hours per year).

Greenhouse Gas Assessment

This GHG assessment has been prepared to estimate the greenhouse emissions displacement associated with the generation of electricity from the 20 MW Boujdour photovoltaic power plant.

The project emissions are calculated based on the following equation:

Project Emissions = Upstream Emissions + Operational Emissions + Downstream Emissions + Leakage

Based on the IFC Greenhouse Gas Reduction Accounting Guidance for Climate-Related Projects (2013), upstream, downstream and leakage emissions are considered negligible for renewable projects since total contribution is not significant once annualized over the project life.

Electricity generated by photovoltaic power projects does not result in GHG emission and are assumed to reduce generation from more GHG-emission intense sources – i.e. displace grid generation. The following calculation has been applied:

According to the information obtained from the EPC, the expected annual energy production will be at least 45,522 MWh per year. Therefore, the environmental benefit of the project will be to reduce greenhouse gases emission in a volume of approximately 28,678.86 tonnes of CO_2 tons per year - calculated based on the emission factor representative for projects supplying additional electricity to the grid in Morocco, as of 0.630 tCO2/MWh.

Annual production(MWh)*EFgrid,reduced (tCO2/MWh)=Emission Savings (t CO2-e/yr.)
45,522 MWh*0.63 tCO2/MWh=28,678.86 t CO2

Table 9-8 Air Quality – Magnitude of Operation impacts

Impact	Magnitude	Justification
Vehicle Emissions	Negligible	Maintenance or workers/visitors' vehicles will result in minimal traffic movements that are unlikely to result in identifiable impacts to local air quality.
Avoided GHG emissions	Minor Positive	The avoided GHG emissions will have a positive impact on achieving Moroccan GHG emission reduction targets.

Table 9-9 Air Quality - Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Air Emissions from Vehicles	Negligible	Air Quality (Gaseous and Particulate)	Low	Negligible to Minor
		O&M plant employees	Medium	Negligible or Minor
Avoided GHG emissions	Minor Positive	Moroccan GHG emissions	Moderate	Minor Positive

9.6.2 Mitigation Measures

Table 9-10 Air Quality – Mitigation Measures – Operational phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Air emission from vehicles	Regular vehicle maintenance in dedicated maintenance areas.	O&M	OESMP – operation
	Third parties employed to provide services during the operation of the project which involves regular transport to site (e.g. waste or septic tanks collectors) will be required to use vehicles regularly maintained and in good condition and will be inspected before entering the site.	O&M	OESMP – operation

9.6.3 Residual Impacts

Table 9-11 Air Quality – Residual Impacts – Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Air Emissions from Vehicles	Air Quality (Gaseous and Particulate)	Negligible	Yes	Negligible
	O&M plant employees	Negligible	Yes	Negligible
Avoided GHG Emissions	Moroccan GHG Emissions	Minor Positive	No	Minor Positive

9.7 Decommissioning Assessment

A detailed Decommissioning Environmental and Social Management Plan (DESMP) will be prepared to ensure that all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not realistic to outline mitigation measures for the decommissioning phase at this stage, since decommissioning techniques are likely to be updated. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

10 NOISE AND VIBRATION

10.1 Introduction

Noise and vibration are environmental impacts that will be generated, mainly through the construction phase of the proposed Boujdour PV Project. Noise and vibration may also be generated during the operational period but this is unlikely to be noticeable.

This section considers the potential effects associated with the generation of noise and vibration during the construction and operational phases of the proposed project. It includes the results of a noise modelling for the operational phase, which was undertaken to determine operational noise emissions from the plant.

The potential impacts are assessed, mitigation measures considered and the residual impacts reported.

10.2 Methodology

10.2.1 Noise

This study has been undertaken based on the following:

- Initial identification of the relevant standards and requirements relating to noise during the construction and operational phases (included in the Legal and Administrative section of this SESIA);
- An assessment of the likely construction activities and basic modelling of the potential operation phase noise generation. The assessment has been made against the permitted national and IFC standards;
- Determination of required mitigation measures, including noise abatement technologies that might be needed to comply with national and international noise limits. Mitigation measures have been recommended in light of the results of the assessment and the residual impacts on receptors outside the site and workers at the site predicted, and
- Noise modelling to assess the expected noise levels during the operational phase.

In order to establish a benchmark of the noise conditions at the site, an environmental noise survey was undertaken in the day and night time in November 2016.

During this survey, noise monitoring measurements were conducted at two (2) locations to consider the ambient noise levels within the site and the influence of existing and surrounding noise sources. The table and figure below provide the location details.

The monitoring was undertaken using a pre-calibrated sound level meter, which was connected to a laptop for direct download of the data. A computer software specifically developed for the instrument, then interpolated the data and provided tables and graphs of the noise levels. Measurements were taken for a 15-minute period, in the day time and night

time, at each of the two locations using a broadband noise setting, within a measurement range of 20-100 dB.

The results of the noise monitoring survey will be used as a benchmark for the programmed noise monitoring activities, which will be implemented for the construction and operation phase within the ESMP.

Table 10-1 Noise Sampling Coordinates

Monitoring Station	Lambert Coordinates		Description	Sampling time
	X	Y		
BS1	305 344.349	437 656.690	Centre coordinate of PV project site	15 minutes day and night time
BS2	304 845.134	437 845.895	Along the Northwest boundary of the PV project site, bordering the northwest corner of the proposed project site	

Figure 10-1 Noise Survey Locations

10.2.2 Vibration

The impacts due to vibration have been determined by considering the likely construction and operational processes involved at the proposed PV project. As such, a discussion of the impacts and any necessary mitigations measures has been provided in the following sections.

10.3 Baseline

The proposed site is located in an isolated area, with no significant developments or commercial activities located within a 13 Km radius. The closest identified source of noise is the highway N1, located 4km northwest of the site. The only other source of noise observed is the wind.

Noise Survey Analytical Results

The following tables provide the noise levels measures within the proposed project site.

Table 10-2 Noise Monitoring Results, Day Time

Monitoring Station	Measured Noise Levels Day Time			IFC EHS Noise Limits (Daytime 07:00 – 22:00)	Description
	Leq, dB (A)	Lmax dB (A)	Lmin, dB (A)		
BS1	43.0	74.5	33.2	Well within the guidelines for industrial/commercial (70 dB) and residential (55 dB) areas.	Average noise levels reflect a quiet environment, and are within the standards.
BS2	45.9	74.0	33.1		

Table 10-3 Noise Monitoring Results, Night Time

Monitoring Station	Measured Noise Levels Day Time			IFC EHS Noise Limits (Night-time 22:00 - 07:00)	Description
	Leq, dB (A)	Lmax dB (A)	Lmin, dB (A)		
BS1	40.8	71.6	34.5	Within the guidelines for industrial/commercial (70 dB) and residential (45 dB night time).	Average noise levels reflect a quiet environment, and well within the standards.
BS2	40.5	78.1	35.2		

The wind speed, during the monitoring period, was weak with a minimum of 2.8 m/s and a maximum of 11.2 m/s. The predominant direction was NNE-SSW.

Generally, both the day time and night time noise levels at the proposed project site reflect a quiet, undeveloped area. The levels do not change significantly between night and day and they are below the maximum allowable noise limits for residential areas. The noise levels at BP1 do change between night and day, and this is reflection of the impact from road noise between day time traffic activity and night time activity. The levels are still within the standards.

10.4 Sensitive Receptors

The table below outlines the identified receptors in relation to noise and vibration as well as the determined sensitivity of those receptors.

In accordance with Good International Industry Practice (GIIP), the identification of sensitive noise receptors has considered a 1km buffer from the PV plant, which ensures that all sensitive receptors are identified considering the standard noise attenuation factors due to geometric divergence (i.e. 20 dB reduction for each tenfold increase of distance according to Murphy, E. et all, 2014). Therefore, the N1 road users and the closest residential area, 3 and 11 km from the site respectively, are not considered sensitive receptors to noise or vibration generated as a result of the construction and operation of the power plant.

Giving that the anticipated construction activities will not generate significant levels of vibration, only those sensitive receptors in close proximity to the source are considered.

Table 10-4 Noise/Vibration - Receptors sensitivity

Receptor	Sensitivity	Justification
Workers	High	Constructions workers are sensitive receptors for noise/vibration. The sensitivity is considered high as:

Receptor	Sensitivity	Justification
		-Human exposure to consistent elevated sound levels could cause hearing impairment, stress, hypertension, etc. -Repeated exposure to high levels of vibration is known to cause direct injury to the fingers and hand, affecting feeling, dexterity, and grip, besides being a known contributing factor to carpal tunnel syndrome and other ergonomic-related injuries.

10.5 Construction Assessment

Construction activities normally result in temporary and short duration increases in the noise and vibration levels of a site.

10.5.1 Noise

Noise will be created and emitted to the surrounding environment via a range of processes. Pertinent construction activities in relation to noise and vibration are likely to include earthworks, piling, site levelling, installation of structures and services, use of diesel generators, etc.

Increases in traffic during construction may also lead to increases in the noise level particularly given the very low existing flows of vehicles in the area.

During construction it is envisaged that the work activities, are likely to include the following:

- Site preparation - back-filling, levelling and grading and the removal of made ground in areas where foundations are to be installed. The initial clearing and grading of the area will require use of a common excavator. Noise from dumper trucks, compressors, excavators and generators, and well as occasional dump rumblings;
- Installation of structures, panels and other services;
- Drainage and road paving - This stage of the works will comprise of several operations that will likely include excavation for and laying of drainage pipes and road surfacing.

With regard to the impacts upon ambient noise levels, a basic assessment of the likely construction noise levels to be experienced at the site boundary has been undertaken in regard to the expected construction plant/machinery to be used at the site. This basic assessment is provided below, but it will be noted that the predicted noise levels are indicative and are subject to variables including location, topography, weather conditions, specifications of construction plant, and works phasing.

Noise data for the likely plant/equipment to be used at the site has been obtained from 'BS:5228, British Standards: Code of practice for noise and vibration on construction and

open sites'. Noise values for likely site plant/equipment have been set out in the following table. These noise levels represent the typical magnitudes observed at 10m from the construction activities.

Table 10-5 Noise Level of Anticipated site Plant/Equipment

Construction Plant	BS:5228 Noise level at 10m (db(A))	BS:5228 Reference
Excavator	79	C.2, 14
Loader	82	C.6, 33
Motor lorry	80	C.2, 34
Scraper/leveller	82	C.5, 8
Roller	80	C.5, 19
Truck mixer	80	C.4, 18
Truck crane	77	C.4, 53
Generator	84	C.4, 84
Motor-driven compressor	75	C.3, 19
Fork Lift	67	C.4, 57
Cumulative noise at 10m assuming 50% of the time	89	

For the assessment it is assumed that each item of plant/equipment is utilised at approximately half its operational capacity over a given period of time, rather than continuously at full power; as is typical with any construction process. A 50% on time factor has therefore been applied in the calculation.

As such, the accumulation of the noise levels from all the above equipment at a reception point 10m away will be approximately 89 dB(A). It will be noted that this basic assessment assumes that the noise is being received at a distance of 10m from the source and does not account for any other background noises.

It is known that noise levels dissipate with distance propagation and the following table sets out the anticipated noise levels at distances from the construction sources. The propagation due to distance has been calculated from the appropriate attenuation formula for distance, as set out in the BS:5228 British Standard.

Table 10-6 Construction noise levels in terms of distance from the source

Distance from Construction Works (m)	Noise Level dB (A)
10	89
20	83
50	73
100	66
200	58
300	53.6
500	48.1
1000	40.6

The above table demonstrates that the attenuating effects of distance on a noise source is profound; reducing noise levels when at greater distances from the source. Given the seclusion of the site, the construction activities are unlikely to affect ambient noise levels beyond the neighbouring area.

Prior to the implementation of mitigation measures, this impact can be assessed as being of minor negative significance. However, measures will be introduced to reduce noise levels when working in close proximity to the site boundary, as they could exceed the required standards without mitigation. It is likely that at certain locations of the site, noise levels will be in excess of 85 dB(A), for which ear protection would be required for the personnel on site. Such areas will include those immediately next to plant or machinery. Prior to the mitigation measures, the impact to workers can be deemed to be of a minor to moderate negative impact.

10.5.2 Vibration

Certain construction processes, particularly those involved with site preparation and civil works, e.g. breaking, piling and planning, have the potential to create vibration within the vicinity of the works. Vibration will also occur sporadically around the construction site due to the movement of materials and equipment. However, it should be noted that vibrations dissipate rapidly as they spread due to losses of energy radiating 360 degrees from the source.

Within the project footprint, only the small size temporary structures, offices, canteens, and storage, are likely to be sensitive to vibration from the construction activities.

The response of an edifice or other erections to ground borne vibration is dependent on various features, such as foundation construct, underlying ground conditions, state of repair, etc. Response can also depend on whether vibration is continuous or constant/intermittent.

BS5228-2 recommends that a conservative threshold for minor or cosmetic damage should be taken as a peak particle velocities (ppv) of 10mms-1 for intermittent vibration and 5mms-1 for continuous vibration to determine whether there is any risk of building damage, particularly from construction works involving piling.

Surface plant such as transformers or inverters are not recognised as sources of high levels of environmental vibration and reference to 'Control of Vibration and Noise during Piling' (British Steel. 1998) confirms that even at a closest distance of 10m, ppv significantly less than 5mms-1 are generated by such plant. For example, the indication is that a bulldozer would generate a ppv of approximately 0.6mms-1 and a heavy lorry on poor road surface a ppv of less than 0.1mms-1 at 10m.

Table 10-7 Noise and Vibration - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Construction Noise	Moderate	Moderate increases in noise levels from the existing background, with possible temporary exceedances of noise standards for receptors in the construction site.
Vehicle Noise	Moderate	Required traffic levels associated with the construction phase are likely to result in discernible noise impact. Increased noise levels from frequent deliveries (goods and workers) or visitor traffic are anticipated.
Construction Vibration (including vehicle vibration)	Minor	Very minor vibration impacts may occur during construction activities, which will be limited to the site, or to immediately adjacent areas from vehicle routes.

Table 10-8 Noise and Vibration - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Construction Noise	Moderate	Construction Workers / Operators	High	Moderate to Major
Vehicle Noise	Moderate	Construction Workers / Operators	High	Moderate to Major
Construction Vibration (including	Minor	Construction Workers / Operators	High	Minor or moderate

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
vehicle vibration)				

10.5.3 Mitigation measures

The following mitigation measures will be implemented:

Table 10-9 Noise –Mitigation Measures for Construction

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Construction Noise and vibration	Diesel compression equipment or generators will be equipped with effective silencers when necessary	EPC	CEMP – monitoring
	Electrically powered equipment will be preferred, where practical, to mechanically powered alternatives. All mechanically powered equipment will also be fitted with suitable silencers when necessary.	EPC	CEMP – planning
	Items of plant on site operating intermittently will be shut down in the intervening periods between uses.	EPC	CEMP – monitoring
	Construction employees will, at all times, carry out all work in such a manner as to keep any disturbance from noise and vibration to a minimum.	EPC	CEMP – start of monitoring
	Where appropriate, noise barriers /attenuation to be employed (e.g. for generators) to ensure that the maximum noise level at 1 m distance from a single source will not exceed 85 dB(A).	EPC	CEMP – planning
	Where noise levels exceed 85dB(A) for an 8-hour time-weighted average, hearing protection devices shall be provided to personnel on-site. No unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C)	EPC	CEMP – monitoring
Vehicle Noise	Vehicles will be equipped with effective silencers when necessary and switched off when are not in motion for more than 2 minutes	EPC	CEMP – planning
	Deliveries of fuel and materials and removals of waste are to be undertaken	EPC	CEMP – planning

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	during day hours, when possible.		
	All vehicles will be adequately maintained in order to minimise sound emissions.	EPC	CEMP – planning
	Onsite/offsite speed limits are included in the Traffic and Road Safety Section of this SESIA. Besides road safety, these limits will contribute to reduce noise levels resulting from traffic movements particularly in residential areas without bypass road. These limits will be included in the Traffic Management Plan that will be prepared by the EPC prior to the construction works.	-	-

10.5.4 Residual Impacts

Table 10-10 Noise and Vibration – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Construction Noise	Construction Workers / Operators	Moderate to Major	Yes	Minor to Moderate
Vehicle Noise	Construction Workers / Operators	Moderate to Major	Yes	Minor
Construction Vibration (including vehicle vibration)	Construction Workers / Operators	Minor or moderate	No	Minor

10.6 Operational Assessment

10.6.1 Noise

The operation of the PV will not include the use of heavy machinery and equipment. The main plant which are likely to emit noise levels are transformers and inverters. Adequate protection measures must be outlined in the O&M's OESMP as part of the design determination.

Operational Noise Modelling

A noise modelling study was undertaken to determine the extent of noise propagation at the proposed project, emanating from variables that may have a significant effect on the site's noise levels. Variables that are unpredictable or one-off events were not included because they are impossible to quantify.

Following International Best Practice, the acoustic modelling took into consideration sound emission parameters from sound sources and environmental characteristics:

- Average temperature and humidity;
- Topography;
- Vegetation (simplifying it as a uniform distribution);
- Elements which can interfere with acoustic propagation (buildings, walls, slopes, roads, etc.);
- Roads with a high traffic or railways. Both may interfere in a significant way with local noise levels; and

- Industry or others activities with high acoustic emissions.

The result of the modelling is a mesh created over a Digital Elevation Model (DEM) with noise values for the area surrounding the project classified by noise-areas.

The software used to obtain these values was Cadna-A®-v4.0 (Computer Aided Design Noise Abatement), an acoustic prediction software. Cadna-A® takes into consideration and complies with a large number of international standards that are detailed in the SESIA Vol3 – Technical Appendices.

Using CADNA each sound source is positioned in a three-dimensional system with X, Y and Z axis and can be referred to topography by inputting a relative height over the ground. The software also considers every parameter which interferes with sound propagation: noise shielding, acoustic reflection, ground acoustic attenuation, meteorology, wind direction, wind speed, acoustic diffraction and others.

Model Assumptions

The following assumptions were made for the acoustic simulation:

- Sound Pressure emitted by electric transformers. Transformers are considered as operating at maximum rate of acoustic emission considered as most adverse scenario, for all of the cases considered in the modelling.
- Sound sources with a low level of acoustic emission were not considered during the acoustic simulation. Acoustic emissions from these sources are unpredictable and intermittent. Examples of this sound sources are single-family buildings, farms, traffic on paths and tracks, domestic animals (dogs, donkeys, cows, etc.).
- Meteorological parameters don't include events such as thermal inversion or others which can affect the acoustic propagation, increasing or decreasing it.
- As for reflection and attenuation from terrain and vegetation, the acoustic modelling considered the terrain and vegetation an absorbent area and with a maximum of one degree of reflection.

Model Parameters

- Solar Plant Characteristics

The sound sources are a main step-up transformer located in the substation and the group of 9 inverter transformers associated with the solar panels. The main transformer has an assumed acoustic emission of 83 dB(A) in the worst case scenario. Inverter transformers were assumed at 55 dB(A) acoustic emission. Wind conditions were not considered because the height of these sources did not exceed 4 m height, which is the threshold of wind influence on noise propagation at the site.

The proposed location of the transformer and the inverters is shown on the maps below.

- Topography and Land Use

Topography of study area was was obtained from OpenStreetMap which is a free cartography world service.

The ground acoustic attenuation was assigned a value of G=0,5. This value is determined by the characteristics of the area, which has an uninhabited environment and medium absorbing elements (sand) as per ISO 6913.

Also the industrial areas are considered as a ground acoustic attenuation G=0 (roads, solar panels...).

- Sensitive Receptors

All buildings and structures in a 1,000 m buffer around the project were identified using satellite imagery and considered potentially sensitive receptors. However, no buildings or structures were identified within this buffer, as such 10 sensitive receptor points were positioned at the boundary of the solar plant and within the 1km buffer, and listed in the following table, and shown in Figure 9-1

The impact on every sensitive receptor was modelled at a height of 1.5 m.

Table 10-11 Coordinates of Sensitive Receptors

Noise Receptor	UTM Coordinates [WGS84 - 29]			Height (m)
	X	Y	Z	
RC01	563589,74	2894114,43	1,5	1,5
RC02	564675,18	2894039,47	1,5	1,5
RC03	564625,21	2893473,16	1,5	1,5
RC04	563550,88	2893534,23	1,5	1,5
RC05	564022,80	2893503,69	1,5	1,5
RC06	564072,77	2894100,54	1,5	1,5
RC07	565091,59	2894611,34	1,5	1,5
RC08	563020,65	2894733,49	1,5	1,5
RC09	563173,33	2893040,09	1,5	1,5
RC10	565160,99	2892851,32	1,5	1,5

Other Noise Sources

The site investigation revealed that no railways or industries were identified in the study area, as such the only other noise source, which was used in the model was from the road.

The following table summarizes the data collected in relation to traffic noise.

Table 10-12 Traffic characteristics in the project area

Road	Average Daily Traffic	Average Speed km/h)
Service roads of solar plants	25	70

These daily traffic ratios were included in the model set up and converted to sound emissions by taking into consideration the period of day, type of road and the different vehicles classes which are using the road (based on transformations established by the NMPB-Routes'96 standard).

Model Scenarios

The acoustic model included 2 possible scenarios, defined in relation the time of the day:

Scenario	Wind Conditions	Time of the Day
1	Windless	Daytime
2	Windless	Night time

Considering the World Bank/IFC's Guidelines about noise limits and time of the day, two periods were defined:

- Daytime period: from 07.00 to 22.00.
- Night-time period: from 22.00 to 7.00.

Taking account of this, two indices have been considered during the acoustic modelling:

- Ld – Daytime noise index
- Ln – Night-time noise index

The noise levels at each of the identified sensitive receptors was defined for these scenarios based on the noise modelling.

➢ Project Stage

Depending on the stage of the project two conditions can be defined:

- No project Stage: Preliminary simulation considering local noise sources constructed at the area (roads)

- Project Stage: Acoustic modelling for the project, considering local sound sources (roads) and project sound sources (transformer and inverters).

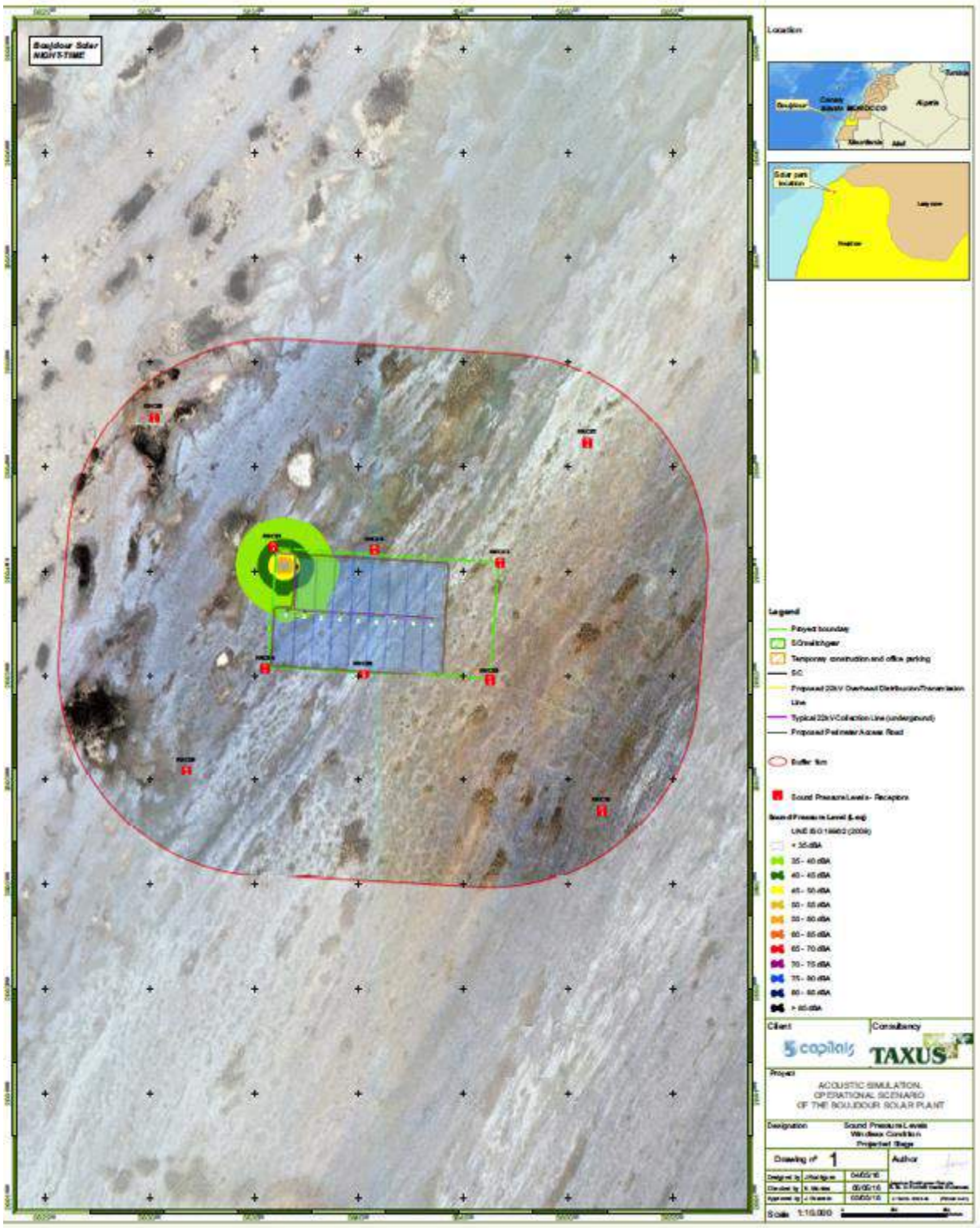
Noise Model Results

The acoustic emission that will be generated by the proposed sound sources has been considered at maximum acoustic emission. The results for project stage (values obtained by acoustic modelling of sound sources) are shown in the following table and illustrated in the map.

Table 10-13 Project Stage Comparison with maximum acoustic emission

Receptor	L_{de} Daytime (dBA)	L_n Night-time (dBA)
RC01	29,0	29,0
RC02	7,5	7,5
RC03	6,9	6,9
RC04	14,9	14,9
RC05	13,2	13,2
RC06	16,1	16,1
RC07	1,8	1,8
RC08	7,8	7,8
RC09	6,2	6,2
RC10	0	0

Figure 10-2 Noise Modelling Results



The results show that none of the receptors selected will exceed the limits established during daytime or night-time (50/45 dB(A) limits). The largest increase obtained during simulations is detected at RC1, which is located near the transformer, which is the main sound source from the project.

Table 10-14 Noise Partial Contribution during Daytime period (Ld). Windless Projected Stage

SOUND SOURCES		RC01	RC02	RC03	RC04	RC05	RC06	RC07	RC08	RC09	RC10
BOUJDOUR SOLAR PLANT	SET1	29	7,4	6,7	14,8	12,9	16	1,8	7,8	6,2	0
	Inv01				0						
	Inv02				0						
	Inv03					0					
	Inv04					0					
	Inv05					0	0				
	Inv06					0	0				
	Inv07		0	0		0	0				
	Inv08										
	Inv09		0	0							

In the table above, the sound sources with the highest contribution are shown for each receptor. None of the receptors exceeds the limits established and, as it has been expected, the main sound source is the transformer located in the substation, which emits 83 dB(A).during the worst assumptions.

Conclusions

This study shows that the noise emitted by the proposed Boujdour solar plant and its elements, will not have a significant impact on sensitive receptors.

The proposed Boujdour solar plant will not cause exceedances of noise standards at the sensitive receptors in any scenario considered.

10.6.2 Vibration

Operational vibration is not anticipated to be significant as a result of the plant activities. The majority of the equipment is static and does not involve interaction with the ground or other surfaces that could result in significant vibration.

Table 10-15 Noise and Vibration - Magnitude of Operation Impacts

Impact	Magnitude	Justification
Vehicle noise	Minor	Traffic requirements to and from the site are likely to be associated with maintenance and inspection requirements. No frequent deliveries or visitor traffic is anticipated. These minimal traffic movements are unlikely to result in any discernible noise impact.
Operational noise	Negligible	Noise generated from site electrical and other equipment is within established guidelines. Operational noise modelling results showed that the noise emitted by the proposed Boujdour solar plant and its elements, will not have a significant impact.

Table 10-16 Noise and Vibration - Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Vehicle Noise	Minor	Workers / Operators	High	Minor to moderate
Operational Noise	Negligible	Workers / Operators	High	Minor

10.6.3 Mitigation measures

Table 10-17 Noise –Mitigation Measures for Operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Vehicle Noise	Deliveries of fuel and materials and removals of waste are to be undertaken during daylight hours.	O&M	OESMP – Management
	All vehicles will be adequately maintained in order to minimise sound emissions	O&M	OESMP – Management
Operational Noise	All machinery will be adequately maintained in order to minimise sound emissions	O&M	OEMP – planning
	All equipment specifications, will limit near field noise to 85 dB(A) at 1m. Where equipment and plant exceed 85 dB(A) at 1m under typical operating conditions, noise suppression techniques will be developed, these may include: silencers, noise insulation, noise attenuation barriers and	O&M	OESMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	housing for equipment. This will be determined and validated during performance testing		
	Onsite/offsite speed limits are included in the Traffic and Road Safety Section of this SESIA. Besides road safety, these limits will contribute to reduce noise levels resulting from traffic movements.	O&M	OESMP – Management

10.6.4 Residual Impacts

Table 10-18 Noise and Vibration – Residual Impacts - Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Vehicle	Workers / Operators	Minor to Negative	Yes	Negligible
Operational Noise	Workers / Operators	Negligible	Yes	Negligible

10.7 Decommissioning Assessment

A detailed DESMP will be prepared to ensure that all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

11 SOIL AND GROUNDWATER

11.1 Introduction

This chapter assesses the potential impacts to soil and groundwater resulting from the construction and operation activities of the proposed Boujdour PV Project.

The relatively undisturbed and undeveloped nature of the site signifies that the potential for existing contamination is unlikely. However, the construction phase may potentially increase the risk of contamination through poor site management practices and inadequate waste disposal management. At the operational stage of the proposed project, the risk of contamination is minor.

General contamination risks are associated with the handling and processing of products. Liquid hazardous materials can escape into the soil, these are associated with the transport, handling and storage of such materials and the potential threat of releases and spills onto the ground. The only hazardous materials onsite will be diesel and oil/lubricants and specific measures are provided in the mitigation section. Other risk to soil quality are associated to soil compaction due to heavy vehicles.

11.2 Methodology

The assessment of the potential impact of the project is based on desktop research as well as soil information observed during the site visit, gathered from the baseline survey, sampling, testing and investigations undertaken for the project area.

5 Capitals has reviewed the following studies:

- Review of relevant guidelines identified within the IFC Performance Standards;
- Review of Dutch guidelines for assessing soil, and
- Consultant's research and desktop review.

The desk study includes the assessment of the proposed design, and procedures for construction and operational issues that may impact on both the society and environment. Based on the findings of the assessment, measures have been identified to mitigate any negative effects and promote the positive effects associated with both construction and operational phases (including commissioning of the plant).

As part of the establishment of the baseline soil conditions at the proposed site, 5 Capitals undertook a limited soil sampling and analysis campaign. The sampling comprised of the collection of the top soil layer (at 0.1-0.2m depth) collected from the centre of the proposed project site, which was then analysed for heavy metals, in accordance with Dutch standards.

The purpose of the soil sampling activity was to establish a benchmark of the soil conditions at the site, which will be used for the long-term monitoring and environmental management of the site. Particularly if a spill or leak were to occur, the successful clean up procedure would include soil testing for any residual contaminants and the benchmark would be used in the assessment.

11.3 Baseline

11.3.1 Geology and topography

The area is located on a coastal plain and is characterised by plateaus with minor undulations and gentle slopes. The geological formations are of tertiary and quaternary deposits.

11.3.2 Hydrology

The proposed project is located in the Sahara basin, where surface flows are limited and deep groundwater is the only water source. The overland flow at the project site has a northwest direction, characterised by a near-zero slope. There is no permanent surface water reservoirs/flows in or near the project site.

Groundwater is the only reservoir of freshwater in the Sahara basin, which has low recharge rates as a result of the scarce precipitation. These deep reservoirs have been present for more than 5,000 years and are considered fossil water.

According to the FESIA, the groundwater table at the project site area is at least 90m deep and water salinity is approximately 9,000 mg/l.

11.3.3 Seismicity

According to the FESIA and available information on the region, the seismic activity is not significant in the project area.

11.3.4 Soil contamination

The relatively undisturbed and undeveloped nature of the site signifies that the potential for existing contamination to the soil is unlikely. No visual indications of soil contamination were identified at the project site during the site visit.

Analytical results

The following table provides the results for the soil sample collected within the PV site boundaries.

Table 11-1 Soil Quality Results and Applicable Standards

Parameter	Results (mg/kg MS)	Dutch Target	Dutch Action
As	7.92	29	55
Cd	<0.40	0.8	12
Cr	28.4	100	380
Co	17.5	20	240
Cu	8.13	36	190
Pb	<5	85	530
Mo	<1.00	3	10
Hg	<0.1	0.3	200
Ni	7.78	35	210
Zn	15.8	140	720

The results reveal that heavy metal concentrations at the sample locations are within the Dutch Target values. Therefore, based on the analytical information, historical land use and site observations, it can be concluded that the soils on site are not contaminated by heavy metals. No evidence of other type of contamination were identified during the site studies.

11.4 Sensitive Receptors

The table below outlines the identified receptors in relation to soil and groundwater as well as the determined sensitivity of those receptors.

Table 11-2 Soil and Groundwater - Receptor Sensitivity

Receptor	Sensitivity	Justification
Soil	Medium	The site is a greenfield, and no contamination was observed. The site is not used for farming and only extensive pastoralism has taken place in the area.
Groundwater	Low	Groundwater in the site is saline (9,000 mg/l) and the groundwater table is located at 90 m deep. Recharge rates are small due to low rainfall and absence of surface water.

11.5 Construction Assessment

11.5.1 Potential Impacts

There is a range of construction related activities that could pose a threat and lead to changes in the chemical properties of the soil, resulting in potential contamination. Impacts can occur from the spillage of liquid materials used during construction, improper management of generated construction waste, and cross contamination of soil at the site. Adequate waste management and soil and groundwater protection measures must be outlined in the EPC's CESMP prior to the start of construction activity. These control measures are required in order to prevent the risk of soil and groundwater contamination at the proposed development site.

Spillage: During the construction phase, the risk of accidental spillage and leakage of chemical products (e.g. fuels), sanitary wastewater and cleaning agents is present. Impacts of this can take place at the storage areas of the construction site as well as during the transportation of such materials on site. Improper methods of storing, transferring, and handling of these products can result in spillage to the ground and result in soil contamination. Depending on the volume of the spill and the characteristics of the pollutants, the contamination may reach the groundwater. Once contamination has reached the groundwater, the volume of contaminated soil and groundwater can increase quite rapidly. This is a function of the physical and chemical properties of the contaminants and the velocity of the groundwater.

Waste Management: Construction activities typically generate solid and hazardous waste on-site, which are a threat to the soil and groundwater. Of special concern is the management of hazardous waste generated during the construction phase. Although the hazardous fraction of construction waste such as used oil, machinery lubricants, paints and sludge, represents a relatively small proportion of the total amount of construction waste, it requires special attention. If the temporary storage and handling of such waste on the construction site is inadequate prior to being removed for disposal, the risk of soil and groundwater contamination increases.

Cross Contamination of Soil: During construction work, cross contamination is the transfer of contaminated earth from one location to another, thereby exacerbating any existing environmental problem through poor management. Currently the general soil conditions on site are good. Isolated points of contamination, perhaps through localised spills during construction activities may occur on site. If this contaminated soil was relocated during levelling activities, a chance of spreading the contaminants can occur, which could lead to a negative environmental impact. In addition, if contaminated soil is dispersed through dust

generation as a result of construction activities like earthworks, then further spreading of contaminants will also occur.

Change of Drainage Regime: The proposed design of the PV plant will require levelling and grading of the site, as described in the Project Design section of this SESIA. The changes will result with impacts to the drainage patterns of the site, and prior to the implementation of adequate drainage measures, the intermittent and infrequent rains are likely to result with moderate temporary impacts for erosion.

Table 11-3 Soil, and Groundwater – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Spillage	Moderate (Soil) Minor (groundwater)	The volumes and quantities of hazardous materials being transported and handled during the construction phase are low, however poor handling practices will increase the likelihood of spills. Impacts could be temporary to permanent.
Inadequate waste management	Moderate (Soil) Minor (groundwater)	Minor volumes of hazardous wastes will be generated during the construction phase. If these wastes are not properly handled, separated, stored and then disposed, contamination is very likely to occur.
Cross contamination of soils	Minor (Soil)	During ground preparation works or levelling of the site there is a minor risk of cross contamination if management and monitoring mechanisms are not implemented.
Removal of natural site drainage / Soil erosion / Compaction	Moderate	Site levelling will result in the redirection of storm runoff water to other areas and hence change the attributes of the natural land drainage. Soil erosion risk (aeolian and rain) will potentially be higher due to earthworks and loosened soil particles. Soil will be compacted as a result of vehicles and heavy machinery, stockpiled supplies and equipment, and even pedestrians.

Table 11-4 Soil, and Groundwater – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Spillage	Moderate	Soil	Medium	Moderate
	Minor	Groundwater	Low	Minor
Inadequate waste management	Moderate	Soil	Medium	Moderate
	Minor	Groundwater	Low	Minor
Cross contamination of soils	Minor	Soil	Medium	Minor
Removal of natural site drainage/Soil erosion / Compaction	Moderate	Soil	Medium	Moderate

11.5.2 Mitigation Measures

The CESMP that will be prepared by the EPC will include at least the following measures:

Table 11-5 Soil and Groundwater– Mitigation measures - Construction Phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Spillage and leakage	Chemicals, fuels, lubricants and paints will be stored in dedicated locations on impermeable surfaces to prevent leakage into the ground and contained inside a secondary bund (110% of largest container). Additional mitigation measures are included in the Non-hazardous Waste and Hazardous Materials section.	EPC	CEMP – Management
	Permanent/temporary storage areas will be designed and located considering potential ground contamination risks. Runoff will be prevented from entering areas where hazardous materials are stored, handled or transferred. If runoff can enter potentially contaminated areas, a dedicated drainage system will direct the run off to dedicated tanks to avoid impacts to soils and groundwater. The fluids in these tanks will be collected by licensed operators and managed as Hazardous wastewater.	EPC	CEMP – Management
	Hazardous materials storage areas will be positioned away from major transport corridors and construction activities, in order to avoid potential collisions from vehicles or other machinery.	EPC	CEMP – Management
	All chemicals will be handled in accordance with relevant instructions (MSDS).	EPC	CEMP – Management
	Reduce quantity of chemicals and fuels on site to minimum practicable levels.	EPC	CEMP – Management
	Regularly inspect drip collectors and containers for spills and leaks.	EPC	CEMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
			and Monitoring
	Provide spill kits at all areas where hazardous liquids are stored.	EPC	CEMP – Training and Monitoring
	Develop and implement an Emergency preparedness and Response Plan, to immediately remediate the affected area in the event of a spill or leakage of chemicals, fuels, paints, and any hazardous material.	EPC	CEMP – Training and Monitoring
	Develop a Vehicle Maintenance Plan.	EPC	CESMP- Management
	Washing of equipment, machinery, and vehicles will not permitted on site and will only be carried out in adequate premises.	EPC	CEMP – Management
	Vehicle maintenance will not be undertaken in the project site and will be carried out only in offsite permitted premises	EPC	CEMP – Management
	If vehicles and machinery are too large to be moved off site, or if it is not practicable to move the machinery for regular maintenance during the construction phase, then measures to protect the soils from spills and leaks during the cleaning/maintenance activity must be implemented (impermeable hard standing area with dedicated drainage system).	EPC	CEMP – Management
Cross contamination of soils	Implement good housekeeping practices during construction activities including procedure and requirements for proper handling, storage, and transport of hazardous chemicals and waste	EPC	CEMP – Management and Training
	If contaminated soil is observed during construction activity, the identified contaminated soil will be excavated separately, and stored onsite in accordance with environmentally adequate measures for waste management, to avoid cross-contamination. A licensed operator will collect the contaminated soil for disposal.	EPC	CEMP – Training and Monitoring

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	Construction Workers will attend training programmes, and safety induction sessions with regards to the transportation and handling of hazardous materials. Toolbox talks will also be held.	EPC	CEMP – Management and Training
Storage and waste management	All hazardous construction waste and chemicals, such as fuel, will be stored in well-equipped, leak-tight enclosures where drums have drip trays to avoid spillage to the ground. The storage tanks of fuels or chemicals and septic tanks will be properly maintained and stored in bunded areas equivalent to 110% of the storage capacity.	EPC	CEMP – Management and Monitoring
	Wherever possible, reduce the quantity of chemicals and fuel stored on site to minimum practical level. Infrequently used chemicals will be ordered just before they are needed.	EPC	CEMP – Planning
	All servicing, refuelling, stockpiles, waste disposal and storage areas will be located as far as possible from the run-off drainage system to reduce potential of pollution via spillage or windblown debris.	EPC	CEMP – Planning
	No hazardous material will be stockpiled.	EPC	CEMP – start of Planning
	Minimise the size and height of the stockpile as far as possible.	EPC	CEMP – start of Monitoring
Removal of natural site drainage / Soil erosion	The storm water and drainage system will minimize and control surface run off and erosion. This will include the necessary sediment retaining systems.	EPC	Design
	Minimise disturbed areas	EPC	CEMP – Management
	Road gradient will be avoided or minimized (contour and slopes) in order reduce run-off induced erosion.	EPC	Design
	Excavated materials will be kept in the stockpile for as short a time as	EPC	CEMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	possible and, once an area is back-filled with soil material, compacted in a short time		
	Disturbed areas will be stabilized to minimise further erosion.	EPC	CEMP – Management
	Runoff from the PV site will be free of excessive sediment and other constituents.	EPC	CEMP – Management
Soil Compaction	Areas where visiting vehicles are allowed to circulate or park will be minimized and located only inside the project boundaries or access road.	EPC	CEMP – Management

11.5.3 Residual Impacts

Table 11-6 Soil and Groundwater – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Spillage	Soil	Moderate	Yes	Minor
	Groundwater	Minor	Yes	Negligible
Inadequate waste management	Soil	Moderate	Yes	Minor
	Groundwater	Minor	Yes	Negligible
Cross contamination of soils	Soil	Minor	Yes	Negligible
Removal of natural site drainage / Soil erosion/Compaction	Soil	Moderate	Yes	Minor

11.6 Operational Assessment

11.6.1 Potential Impacts

Although there will be little or no interaction with hazardous materials or chemicals, the potential for uncontrolled releases to soils during the operational phase is still possible. Such releases have the potential to occur during material transportation, handling and storage as well as during cleaning activities and accidental spillages to the ground. The potential sources for these contaminants are the following:

- The use of solvents/cleaning fluids, lubricants and oils is likely to be limited. Although these materials may be used in small quantities, attention must be paid to proper storage, handling and transportation;
- The transformers on site will contain oils. These units are generally very well self-contained, but precaution should be given to ensure adequate spill prevention measures are in place;
- Sanitary wastewater/waste on site has potential to contaminate soils and groundwater, and
- Only small quantities of fuels might be stored for site vehicles and emergency generators.

Table 11-7 Soils and Groundwater– Magnitude of Operational Impacts

Impact	Magnitude	Justification
Spills and Accidental Releases	Moderate	Inappropriate storage and handling of materials may result in uncontrolled contamination of soils and groundwater.
Inadequate solid/liquid waste management	Moderate	Small amounts of domestic liquid and solid wastes will be generated during the operation of the plant, and if waste facilities are not provided nor waste management procedures implemented, then contamination could occur.

Table 11-8 Soil and Groundwater– Significance of Operational Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Spills and Accidental Releases	Moderate	Soil quality	Medium	Moderate
		Groundwater	Low	Minor to Moderate
Inadequate waste management	Moderate	Soil quality	Medium	Moderate
		Groundwater	Low	Minor to Moderate

11.6.2 Mitigation measures

The pathways for soil and groundwater contamination during the operational phase are similar to the construction phase. Therefore, similar control techniques and mitigation measures will be in place to tackle such risks. Best housekeeping practices will be adopted to ensure proper measures are in place.

The O&M will implement the mitigation measures listed below. Day to day measures included in the OESMP will determine the storage of hazardous chemicals as key concerns with maintenance, storage requirements, refuelling procedures and spill clean-up procedures being particular issues which will be adequately covered in the OESMP.

Table 11-9 Soil and Groundwater– Mitigation measures - Operation Phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Spillage	Develop and implement a spill emergency and contingency plan	O&M	OEMP – Management and Training
	Develop and implement training program for employees to increase their awareness of chemical management protocols including proper handling and storage of chemicals, emergency response, contingency plans and appropriate PPE, if needed.	O&M	OEMP – Management and Training
Storage and waste management	Storage areas for domestic waste will be sealed, covered, leak tight flooring, and correct shelving / cabinets in order to prevent spillage and leakage into the ground.	O&M	OEMP – Planning and Management
	The storage tanks of fuels/chemicals/sewage will be properly maintained and stored within a bunded area of 110% of their storage capacity.	O&M	OEMP – Planning and Management

11.6.3 Residual Impacts

Table 11-10 Soil and Groundwater– Residual Impacts - Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impacts
Spills and Accidental Releases	Soil quality	Moderate	Yes	Negligible
	Groundwater	Minor to Moderate	Yes	Negligible
Inadequate waste management	Soil quality	Moderate	Yes	Negligible
	Groundwater	Minor to Moderate	Yes	Negligible

11.7 Decommissioning Phase

A detailed DESMP will be prepared to ensure that all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

12 BIODIVERSITY

12.1 Introduction

Protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. Impacts on biodiversity can often adversely affect the delivery of ecosystem services, impacting over human beings and biodiversity. The lifecycle of the Project could potentially result in direct and indirect ecological impacts of either a temporary or long-term nature if appropriate measures are not implemented.

This Chapter includes the Ecological Impact Assessment process of identifying, quantifying and evaluating potential effects of the Project-related actions on habitats, species and ecosystems. The assessment has considered the direct and indirect, temporary and permanent changes to the ecological environment.

12.2 Methodology

The preparation of this assessment has followed international best practice guidelines (CIEEM 2016). In order to gain an understanding of the terrestrial ecology of the Project Site and the biodiversity sensitive areas in the region, a combination of desk studies and field survey was undertaken.

The ecological section of the FESIA report, which was carried out in 2016 by NOVEC, provided the results of a detailed survey.

5 Capitals / Phenixa undertook additional ecological surveys in November 2016 to gather additional and updated information on the Proposed PV site. The biodiversity baseline study was undertaken by an experienced ecologist over a 2 days survey (including nocturnal surveys) and covered the proposed footprint and a1000m buffer.

The following table summarises the surveys that have been conducted for the proposed project.

Table 12-1 Summary of Baseline Ecological Surveys

Report Name	Date	Survey Activities	Purpose
Projet de la réalisation d'une centrale solaire à Boujdour; FESIA by NOVEC	May 2016	Terrestrial flora and fauna in the project area	Gather information of the habitats, fauna and flora species
EIE Centrale Solaire de Boujdour et ligne électrique de raccordement - Biodiversité	November, 2016	Terrestrial flora and fauna in the project area and 1000m buffer	Gather updated information of the habitats, fauna and flora species

12.2.1 Desk Studies – Information Sources

Desk studies for the area included reviewing ecological survey data from the FESIA, literature review of habitats and fauna of the South Atlas Region, existing data for the Mammals of Morocco (Aulagnier C. *et al* 2016), and verification on the IUCN Red list of threatened species that may have been recorded in the region.

12.2.2 Habitats and Flora Survey Methods

During the habitat assessment undertaken in November 2016, habitats and flora species along the study area were assessed using an adaptation of the standardized Joint Nature Conservation Committee (JNCC) Phase 1 classification and mapping methodology (JNCC, 2010). The habitats at the site were surveyed using DAFOR scale and % of coverage.

12.2.3 Fauna Survey Methods

Transects were undertaken in the buffer area in November 2016 and this included the direct observation of avifauna in the field, with the use of binoculars in order to identify species.

Bat surveys were undertaken for one night using a bat detector and recorder (BatloggerM).

Camera trapping systems (Reconix system) were used for 24 consecutive hours in order to detect and identify mammal species.

12.3 Baseline

12.3.1 Designated Areas

The proposed PV site is not located within any national or international protected area.

No national or international Designated Areas were identified within 5km of the proposed project site.

The nearest International Designated Area, Pointe d'Awfist Important Bird Area (IBA) is located approximately 75km to the south of the proposed PV. This designated area is an important wintering roost for the Audouin's Gull *Larus audouinii*. This species is listed as Least Concern (LC) according to the IUCN Red list of threatened species. This area is also listed as a national site of Biological and Ecological interest (SIBE).

More than 5000 individuals of Gulls and Waders were counted in January 1993, including 1679 Audouin Gulls (which exceeds 1% of the worlds population), 15 individuals of Yellow-legged Gull *Larus michaelis*, 2763 individuals of Black-backed Gull *Larus marinus, approximately 500 Northern Gannet Morus bassanus individuals, minor numbers of Great Cormorant Phalacrocorax carbo and Sandwich Tern Thalasseus sandvicensis* and other 724 undetermined gull species.

Figure 12-1 Designated Areas

12.3.2 Study Area

Habitats

A total of four habitats were identified within the study area (project site and 1000m buffer) and these included:

- Rocky/Steppe Plateau: also designated as desert pavement, is a desert surface covered by closely packed interlocking angular or rounded rock fragments. This habitat also included sandy soils and a low vegetation cover.
- Depressions: This habitat included small sand dunes. Vegetation coverage was the highest in the study area.
- Graras are depressions located over silt substrate, which collect rainwater using an endorrhoeic hydrographic network. Graras comprise a medium vegetation cover and highest biodiversity within the study area.
- Pre-littoral steppe: degraded habitats found to the north, south and west of the proposed footprint. This habitat had the lowest vegetation cover in the study area.

As illustrated in the figure below, the proposed footprint is situated over Rocky/Steppe Plateau habitat only.

Figure 12-2 Habitats within the Study Area

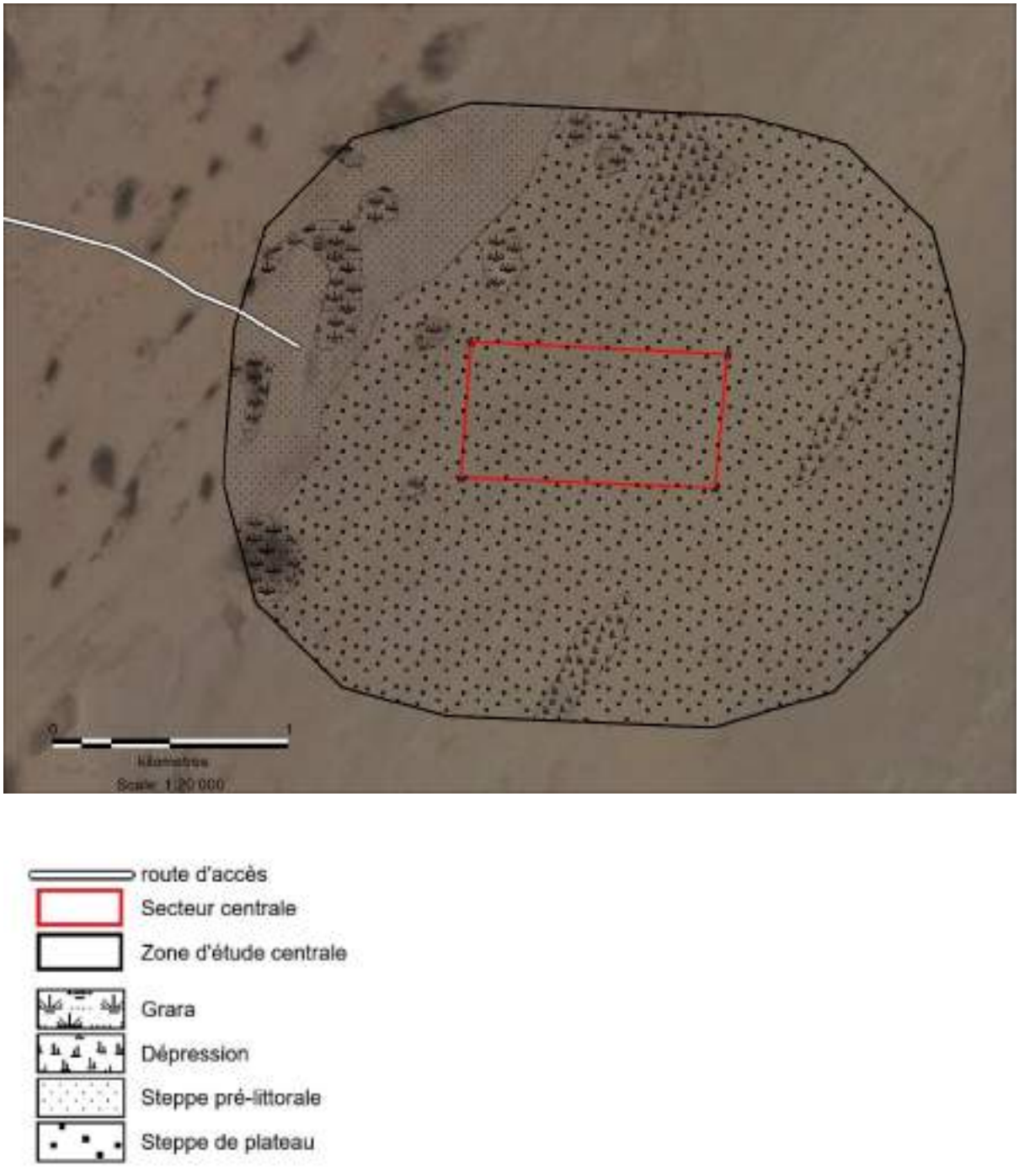
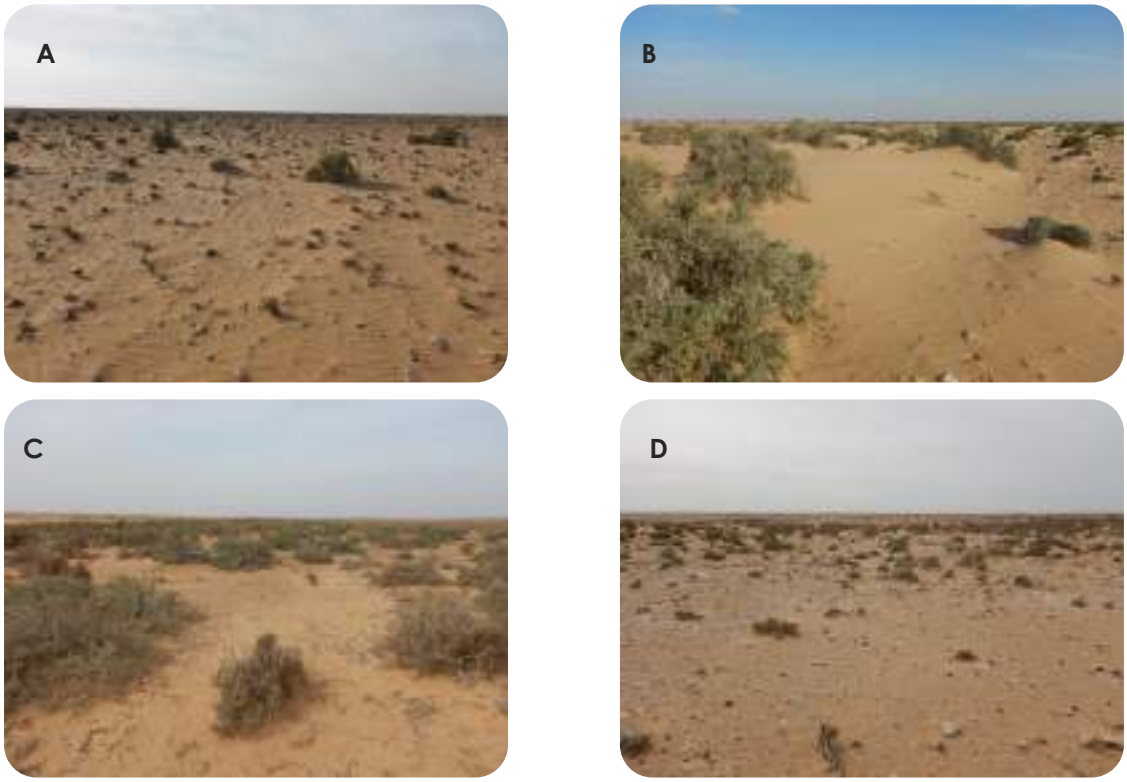


Plate 12-1 Habitats within the proposed PV



Above: (A) Rocky Plateau (Project footprint), (B) Depression (buffer area), (C) Grara (buffer area) and (D) Pre-littoral Steppe (buffer area).

Flora

A total of twenty-seven species of flora were identified within the study area. From these nine endemic species were identified within the study area. A table listing the flora species is provided in Appendix 2.

None of the observed species are listed of international conservation concern (IUCN Red list of threatened species, 2016).

A total of eleven flora species were identified within the Rocky Plateau habitat, which will be directly impacted by the project footprint. From these, five are endemic species in Morocco: *Ononis hesperia, Teucrium chardonianum*, *Helianthemum canariense, Pentzia hesperdium and* Zygophyllum waterlottii. None of these are flora species of international concern and no major threats are known for any of these species.

Fauna

Herpetofauna

The desk study identified a total of fourteen reptile species that could potentially be present in the habitats identified within the study area. A complete list of the species identified during the desk study is presented in Appendix 2.

Only two reptile species were identified during the site visit within the study area: *Acanthodactylus aureus* and Wedge-snouted Skink *Chalcides sphenopsiformis.* None of the species identified during the surveys is listed as nationally or internationally threatened.

Further details of the reptile species that could potentially be present in the habitats identified within the study area but were not identified during the site surveys are provided below:

- Helmethead Gecko *Tarentola chazaliae* is internationally listed as Vulnerable according to the IUCN Red List of Threatened Species.
- Two (2) are Moroccan endemic species: *Saurodactylus brosseti* and Helmethead Gecko.
- A single (1) species is endemic of Maghreb: *Tropiocolotes algericus.*
- A single (1) endemic species from North Africa: Algerian Whip Snake *Hemorrhois algirus.*
- Three (3) endemic species from Western Sahara: Duméril's Wedge-snouted Skink *Chalcides sphenopsiformis, Trapelus boehmei* and *Acanthodactylus aureus.*

Helmethead Guecko is found in succulent vegetation on sandy and stony soil in coastal areas, dunes where shelters are available, and rocky plateaus with refuges. Helmethead Gecko is threatened in Morocco by urbanization and fragmentation of its coastal habitats. The species is also hit by vehicles along the roads and is commonly traded in relatively large numbers (IUCN, 2016).

Saurodactylus brosseti is found in various stony or rocky areas, including degraded agricultural lands. Threats include habitat loss resulting from agricultural intensification and developments.

Duméril's Wedge-snouted Skink is generally restricted to coastal dunes and sand banks. The species is not thought to be facing any major threats, but people often persecute it.

Tropiocolotes algericus, Algerian Whip Snake, *Trapelus boehmei Trapelus boehmei,* and *Acanthodactylus aureus* occurs in Rocky plateau habitats. No threats are known for any of these species.

No amphibian species were identified and presence onsite is unlikely due to the lack of any wetlands in the nearby areas.

Birds

A total of nineteen bird species may potentially be present in the habitats identified in the study area, as per the desk studies undertaken for the FESIA and the SESIA.

A total of nine bird species were identified within the study area during the site visit: Cream-coloured Courser *Cursorius cursor,* Crested Lark *Galerida cristata,* Greater Hoopoe-lark *Alaemon alaudipes,* Great Grey Shrike *Lanius excubitor,* Sardinian Warbler *Sylvia melanocephala,* Spectacled Warbler *Sylvia conspicillata,* Streaked Scrub-warbler *Scotocerca inquieta,* Red-rumped Wheatear *Oenanthe moesta*, and Desert Wheatear *Oenanthe deserti.* All the species identified onsite are widespread and none of these species is listed as a national or international species of conservation concern.

Ten bird species not identified within the study area during the site visit are described in other studies as being present in the wider region. All these species are also widespread and none are listed as national or international species of conservation concern.

The African Houbara *Chlamydotis undulata* is an extinct species in Boujdour since the end of the 20th Century. A release of this species was made in 2013 under the initiative of Middle East for hunting proposes. The release was undertaken at the northern limit between the Provinces of Boujdour and Laayoune (Lemsid sector), about 70 km to the northeast of the Project. Since the release of individuals in 2013 was undertaken just for hunting purposes, and at a considerable distance from the project area, the species is currently considered extinct in the area.

Avifauna typically nest in favourable environments and, as such, the species identified in the area will likely nest within areas with vegetation coverage (e.g. graras and depressions) located in the study area but outside the site, rather than in areas with low vegetation cover (such as rocky plateau of the project site).

No migratory species passing through the area were observed as surveys were undertaken out of the migratory periods. The proposed site is not located on a main flyway path; however, some migratory species such as Scopolis Shearwater *Calonectris diomedea*, Lesser Kestrel *Falco naumanni* and Bulwer's Petrel *Bulweria bulwerii* could occasionally use this area for migration (migration maps provided on the operational assessment below). None of these species is listed as a national or international species of conservation concern.

Mammals

A total of twenty (20) mammal species may potentially be present in the habitats identified on the study area, as per the desk-based reviews undertaken for the FESIA and the SESIA. The list of species is included in the annexes.

A single (1) species of mammal was identified within the study area during the field survey undertaken in November 2016. The Fat Sand Rat *Psammomys obesus* is widely distributed within its range and the species is listed as an internationally "Least Concern" species (IUCN, 2016).

No bat species were detected during the bat surveys undertaken onsite.

From the desk study species list:

- A single (1) species is endemic of Maghreb: Asian Garden Dormouse *Eliomys melanurus*
- A single (1) species is endemic from North Africa: *Canis anthus*
- Three (3) species is endemic from the Sahara: Saharan Shrew *Crocidura tarfayaensis,* Fat-tailed Gerbil *Pachyuromys duprasi* and the Libyan Striped Weasel *Ictonyx libyca.*

The Asian Garden Dormouse exists in a wide variety of habitats from steppes and semi-desert to high mountains in rocky areas, which are devoid of trees and bushes. Overgrazing is a minor threat for the species in some areas.

Canis anthus occur within rocky plateaus and steppe habitats. No major threats are known globally for this species.

The Saharan Shrew occurs within sand dune habitats along with dense shrubs and its therefore unlikely to occur within the proposed footprint. No major threats are known worldwide for the species.

The Fat-tailed Gerbil is found in deserts and semi-deserts with a solid, non-sandy substrate. No major threat is known globally for this species.

The Libyan Striped Weasel is only found on desert fringes with sparse vegetation. This species is protected in Morocco (K. de Smet pers. comm. 2007).

No species of international conservation concern were identified onsite or in the study area.

A number of mammal species including Dorcas Gazelle and Striped Hyena are extinct species within the region due to direct persecution, poaching, and trade activities..

12.3.3 Ecosystem Services

Ecosystem services onsite are limited due to the extreme environmental conditions, including lack of rain, salinity and extreme temperatures. The site is used as a grazing area; however, its productivity is very limed due to the arid conditions and low vegetation cover described above. Graras and depressions are the most productive areas within the region.

12.4 Sensitive Receptors

For the PV, the surrounding land use is generally homogenous and the topography is relatively flat. This buffer is deemed a sufficient distance for the extent to which impacts from the lifecycle of the PV would extend if no mitigation measures were implemented.

The figure below identifies sensitive receptors likely to be present within the 1000km buffer. Migratory species wintering within the IBA and passing over the PV are also considered sensitive receptors even though this Designated Area is located more that 1000m away.

The table below outlines the identified receptors in relation to biodiversity as well as the determined sensitivity of those receptors.

Table 12-2 Ecology – Receptor Sensitivity

Receptor	Sensitivity	Justification
Rocky Plateau habitat / Fauna and flora in the Rocky Plateau	**Medium**	The vegetation cover of the rocky plateau is relatively low. No species of conservation concern have been identified in the project area or in the rocky plateau habitat in the study area, and the relatively low vegetation cover makes the area less suitable for nesting than other nearby habitats. However, a number of endemic flora and reptile species were identified in the habitat, in the study area and onsite.
Species of Conservation Concern	**High**	Some species of international conservation concern such as the Helmethead Gecko are vulnerable are described in the literature as potentially present in the area, even though they were not identified onsite. These species can be impacted by direct mortality by vehicles and hunting for trade.
Migratory Birds	**Medium**	Migratory birds, including Gulls and Wader migrating to/from the IBA can potentially fly over the area, might be vulnerable to collision with the PV panels. While these species are not protected, they are subject to different risks due to the pressure on breeding areas and developments along migratory routes that can cause bird mortality.

12.5 Construction Assessment

12.5.1 Initial Impacts

During the construction of the proposed PV Project, the vegetation cover will be removed, during earthworks and the establishment of laydown areas. .

Furthermore, during the excavation works, direct mortality of small fauna could occur onsite, as some species such as reptiles or small mammals could fall into open trenches. The movement of vehicles and machinery could also pose a risk of direct mortality on small fauna.

Bird nests, if present on site, may be destroyed if construction starts during the breeding period. Nesting is most likely in habitats with higher vegetation cover than the site, but could potentially occur onsite if the vegetation has not been cleared beforehand (as birds nest in shaded areas).

Illegal hunting/trade by the workers could pose an ecological risk for some species of conservation concern which may potentially occur in the area.

The displacement of fauna due to disturbance from noise, vibration and lighting could potentially occur.

Table 12-3 Ecology – Magnitude of Construction impacts

Impact	Magnitude	Justification
Direct habitat loss	**Minor Negative (on the rocky Plateau)** **Moderate Negative (on Endemic species)**	The habitat onsite will be cleared for the project. The project footprint will only directly affect a small area of rocky plateau habitat, which is a very common habitat in the region. Therefore, the small geographic extent of the impact compared to the size of the receptor makes the impact minor, even though the project site will be cleared. Considering that the actual distribution and density of the endemic species identified onsite on the entire habitat area is not known, the impact of habitat loss and vegetation clearance on the endemic species identified in the project site and study area is considered to be moderate.
Poaching/Hunting/Trade	**Minor Negative**	The nature and type of project activities makes hunting or poaching by project employees unlikely, since these activities are usually carried out by local inhabitants for food or trade as a livelihood strategy.
Direct mortality of fauna	**Minor Negative**	The increase of traffic levels and heavy machinery as well as the site works and excavation could potentially cause a direct mortality of fauna species such as invertebrates, reptiles, birds or small mammals. The low density of

Impact	Magnitude	Justification
		populations in the rocky plateau habitat makes encounters unlikely. Nests could be destroyed during site clearance.
Displacement due to Human disturbance	**Minor Negative**	Displacement of fauna due to human disturbance could arise from increased noise, vibration and lighting..

Table 12-4 Ecology - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Direct Habitat loss	**Minor Negative**	Rocky Plateau habitat	Medium	Minor
	Moderate Negative	Endemic Flora	Medium	Minor
Poaching/Hunting/Trade	**Minor Negative**	Species of Conservation Concern potentially present in the area (Helmethead Gecko and *Duméril's Wedge-snouted Skink)*	High	Moderate
Direct mortality of fauna	**Minor Negative**	Species of Conservation Concern (Helmethead Gecko)	High	Minor to Moderate
		Fauna in the habitat	Medium	Minor
Displacement due to Human disturbance	**Minor Negative**	Local fauna	Medium	Minor

12.5.2 Mitigation Measures

Table 12-5 Ecology – Mitigation Measures - Construction

Impact/Source	Mitigation Measures	Responsibility	Schedule
Habitat Loss	The following Moroccan endemic *species* were identified within the project footprint: *Ononis hesperia, Teucrium chardonianum, Helianthemum canariense, Pentzia hesperdium and* Zygophyllum waterlottii. These endemic species will be selected for landscaping, where practical, at the end of construction phase, to mitigate site clearance. This can be undertaken by collection of seed within the Region for sowing on site If agreed by the relevant stakeholders, the project company will support efforts for habitat restoration in the region (project area or nearby protected areas.	EPC	CEMP – Design, Management
	The laydown areas of the site will be minimised in size wherever possible, and preferably located in areas with little or no vegetation, wherever possible. Post construction restoration may include sowing seed from local endemic species.	EPC	CESMP –Management and monitoring
	The contractor will ensure that no encroachment to the nearby, adjacent land will occur.	EPC	CESMP –Management and monitoring
	All construction vehicles adhere to clearly defined transportation routes. Transport routes will be identified and training provided to emphasise the need to adhere to the designated routes in order to protect the existing vegetation and reduce encroachment on adjacent land, and reduce dust fall across the site.	EPC	CESMP –Management and monitoring
	Restoration will take place where colonization is difficult or in the interest of accelerating the process will be carried out in areas were vegetation will not be a safety concern during the operational phase. Particular effort will be placed in selection of endemic species and location of planting in order to	EPC	CESMP –Management and monitoring

Impact/Source	Mitigation Measures	Responsibility	Schedule
	successfully achieve 'in-kind' ecological restoration. Restoration will only be conducted in sites away from electrical equipment to avoid future fire hazards. Therefore planting will be limited to the herbaceous species that currently inhabit the site.		
Poaching/Hunting/Trade	Hunting, falconry and fauna/flora trade will be strictly forbidden on site. Warning signs will be placed around the site.	EPC	CESMP –Management and monitoring
Direct mortality of fauna	Prior to vegetation clearance, the EPC will engage an ecologist to advise on the removal of reptiles that may be found on the site. A procedure will be prepared including photographs of any species found on site during previous surveys and potentially present onsite, and a procedure to safely remove them from the site. The HSE team will ensure that all workers are trained on the procedure. Alternatively, an ecologist can be deployed onsite to implement a translocation programme. All removals of reptiles from the site will be documented with photographs.	EPC	CEMP – Design, Management
	Speed limit will be imposed across the construction site in order to avoid direct mortality of fauna. Speed limits onsite are specified on the Traffic chapter.	EPC	CESMP –Management and monitoring
	Workers will be trained to report trapped herpetofauna or small mammals encountered inside any trenches. Trapped wildlife will be released on the natural areas outside the construction area. Photographs of captured / released fauna to be retained by HSE Manager for inspection during external audits.	EPC	CESMP –Management and monitoring
	Establish procedures for the occasion any species are found on the construction site including procedures for reporting, identification and	EPC	CESMP –Management and monitoring

Impact/Source	Mitigation Measures	Responsibility	Schedule
	potential relocation.		
	Fires will be forbidden onsite	EPC	CESMP –Management and monitoring
	Induction training will include content to raise awareness of fauna that may be encountered, including reptiles and insects and protocols for alerting HSE Manager and avoiding harm to the fauna.	EPC	CESMP –Management and monitoring
	In order to avoid the destruction of active nests/burrows, vegetation clearance works will be scheduled before the commencement of the breeding period (end-February 2017)	EPC	CESMP –Management and monitoring
	Training on conservation awareness on bird nests and burrows will be undertaken onsite.	EPC	CESMP –Management and monitoring
	Fencing design will minimise the permeability for fauna, where practical, as there is a direct mortality risk due to the operation of vehicles onsite during both construction and operations.	EPC	CEMP – Design
Human disturbance	No floodlights will be directed to the natural environment around the project site by controlling light spill.	EPC	CESMP –Management and monitoring
	No noisy activities will be undertaken outside the project site.		

12.5.3 Residual Impacts

Table 12-6 Ecology - Significance of Residual Impacts

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Direct Habitat loss	Rocky Plateau habitat	Minor	Yes	Minor
	Endemic Flora	Minor	Yes	Negligible to Minor
Poaching/Hunting/Trade	Species of Conservation Concern potentially present in the area	Moderate	Yes	Negligible to Minor
Direct mortality of fauna	Species of Conservation Concern (Helmethead Gecko)	Minor to Moderate	Yes	Negligible to Minor
	Fauna in the habitat	Minor	Yes	Negligible to Minor
Displacement due to Human disturbance	Local fauna	Minor	Yes	Negligible to Minor

12.6 Operation Assessment

12.6.1 Potential Impacts

Potential impacts on biodiversity during the operational phase include direct mortality of terrestrial fauna, poaching/hunting/trade and direct mortality of avifauna due to collision.

Direct mortality of terrestrial fauna and poaching/hunting/trade have been described in the previous section. The likelihood of this impacts is lower due to the smaller number of staff onsite and the lower number of vehicles movements. Direct mortality of avifauna due to collision with PV panels is discussed below.

According to BirdLife International (http://migratorysoaringbirds.undp.birdlife.org) 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/or within migratory paths.

The proposed site is in the general area of the Mediterranean flyway (BirdLife,. The Mediterranean Flyway is one of three Palearctic-African flyways connecting Europe with Africa. The proposed site is not located on the main flyway path; however, some migratory species potentially use this area for migration. The following Figures from BirdLife International

Mediterranean flyway database (http://www.migraciondeaves.org) present some examples of the species identified using the proposed site or the nearby areas during migration.

Some migratory species such as Scopolis Shearwater *Calonectris diomedea*, Lesser Kestrel *Falco naumanni* and Bulwer's Petrel Bulweria bulwerii have been identified using the proposed area for the PV as an flyway (see Figures 11-3 to 11-5 below), eventhough it is not the more common migration route. None of these species are of international conservation concern (IUCN, 2016).

Figure 12-3 Shearwater Bulwer's Petrel individual migratory path (2010-2011)

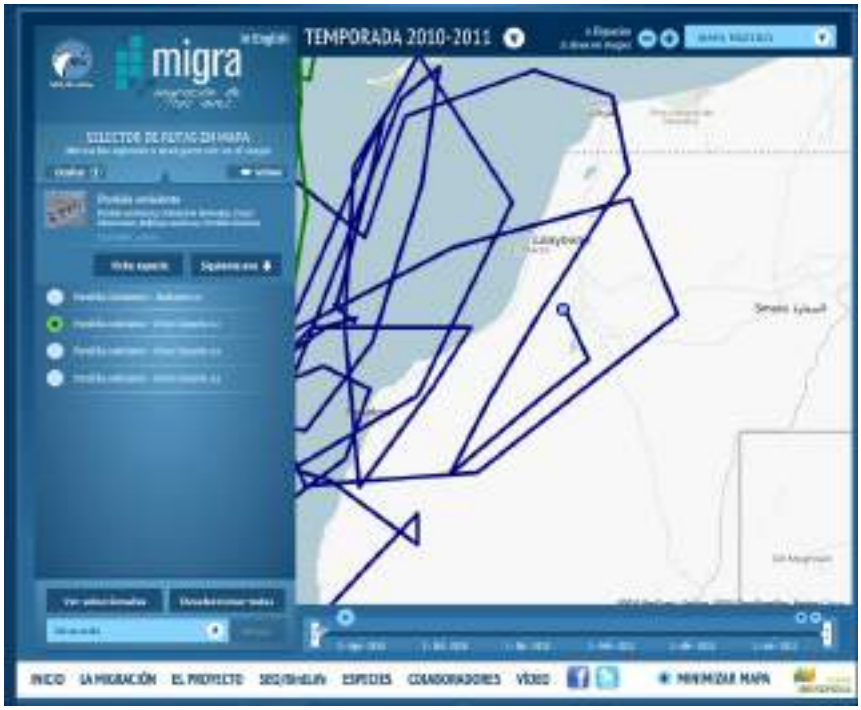


Figure 12-4 Lesser Kestrel´s individual migratory path (2010-2011)

Figure 12-5 Scopolis Shearwater´s individual migratory path (2011-2012)

Some migratory bird species, which use Pointe d'Awfist IBA as a stopover area, and might fly over the site, even though it is not a main migratory route, could confuse the panels as a freshwater reservoir.

However, most of the migratory bird species within the region use the Canary Islands as a frequent migratory stopover and main path; therefore it is considered that the proposed PV is outside the main Mediterranean/black sea flyway.

Natural vegetation will be allowed to regrow onsite during operation phase. Only vegetation that grows to a point to be a safety risk or impact production will be removed. Vegetation onsite will not be subject to grazing and will benefit from panels' shade, so it will likely be more densely vegetated than the pre-construction habitat.

Regrowth of natural vegetation onsite will favour nesting of local birds. Fencing will likely reduce predatory pressure, hence making the area more attractive for birds than the pre-construction habitat.

Table 12-7 Ecology and Biodiversity – Magnitude of Operational Impacts

Impact	Magnitude	Justification
Direct mortality of avifauna due to collision	**Minor Negative**	Migratory birds might mistake the PV panels with surface freshwater and collide with panels. No long-term scientific data has showed direct mortality from collision. The likelihood of the impact is low because the plant is not on the main migratory path.
Direct mortality of terrestrial fauna	**Negligible Negative**	Minor increment of traffic levels might cause a direct mortality of reptiles and other terrestrial fauna in the project site and in the access route.
Poaching/Hunting/Trade	**Minor Negative**	The nature and type of project activities makes hunting or poaching by project employees unlikely, since these activities are usually carried out by local inhabitants for food or trade as a livelihood strategy.

Table 12-8 Ecology - Significance of Operational Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Direct mortality of avifauna due to collision	Minor Negative	Migratory Birds	High	**Minor to Moderate**
Direct mortality of terrestrial fauna	Negligible Negative	Local Fauna	Medium	**Minor**
Poaching/Hunting/Trade	Negligible Negative	Species of Conservation Concern	High	**Minor**

12.6.2 Mitigation Measures

Impact	Mitigation	Responsibility	Schedule
Direct mortality of avifauna due to collision	If significant direct mortality is identified through the monitoring programme, bird deterrence measures will be implemented to avoid migratory birds from attempting to "land" on the plant. Since there are no comprehensive international studies for bird collision with PV panels, it is not possible to recommend a single technique to avoid collisions. The mitigation will follow the following two principles: 1) The objective will be to avoid bird collisions, as this is the preferred approach in the mitigation hierarchy; 2) The latest methods that are used internationally will be applied onsite. If specific guidance for PV plants is issued addressing this risk before the operational phase commences, it will be followed. Alternatively, the methods outlined in the guidelines to deter large flocks of birds from approaching airports (such as the UK Civil Aviation Authority 2014 Wildlife Hazard Management at Aerodromes CAP 772) will be applied.	O&M	OEMP – Monitoring
Direct Mortality of Fauna	Speed limit will be imposed across the construction site in order to avoid direct mortality of fauna. Speed limits onsite are specified on the traffic chapter.	O&M	OEMP – Management
	Vehicles will keep to the designated routes during transportation of goods in order to prevent unnecessary land encroachment, thus protecting the natural resources and reducing dust emissions	O&M	OEMP – Management and Training
Poaching/Hunting/Trade	Hunting, falconry and fauna/flora trade will be strictly forbidden on site. Warning signs will be placed around the site.	O&M	OESMP – Management and monitoring

Following the mitigation and management techniques outlined above, which will be further developed within the OESMP, the residual impacts are generally expected to be as follows:

Table 12-9 Ecology – Residual Impacts – Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Direct mortality of avifauna due to collision	Migratory Birds	Minor to Moderate	Yes	Minor
Direct mortality of terrestrial fauna	Local Fauna	Minor	Yes	Negligible
Poaching/Hunting/Trade	Species of Conservation Concern	Minor	Yes	Negligible

12.7 Decommissioning Assessment

The decommissioning impacts are likely to be similar to those of the construction phase but of a lower magnitude. A detailed Decommissioning E&S Management Plan will be prepared to ensure that all impacts are identified, assessed and mitigated. The DESMP will use the construction impacts of this SESIA as a basis to develop the MP. It is expected that the National and IFC standards will be updated at the time of decommissioning, and the DESMP will be compliant with the applicable requirements at the time of preparation. Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation and monitoring measures at this stage.

13 HAZARDOUS AND NON-HAZARDOUS WASTE AND WASTE MANAGEMENT

13.1 Introduction

This chapter provides an assessment of the environmental impacts that may occur as a result of non-hazardous waste generation and inadequate handling of hazardous materials (including waste) during both the construction and operational phases of the Boujdour PV Project.

Non-hazardous waste and hazardous materials have the potential to contribute to a number of environmental problems if not properly stored and/or managed, such us direct contamination to ground and indirect contamination to sensitive receptors, leading to severe environmental and public health issues.

With proper management, a large amount of discarded materials can be reduced, reused, or recycled; and hazardous materials can be adequately contained and managed reducing the risk of environmental and public health impacts.

The construction and operational phases of the proposed project will necessitate the proper management of non-hazardous waste and hazardous materials on site. Specific mitigation measures are recommended to address the identified potential impacts.

13.2 Methodology

The main objective of this chapter is to assess the impacts associated with the generation, handling, storage and transportation of non-hazardous waste and hazardous waste and hazardous materials during both construction and operational phases of the project. This assessment has been informed through a desktop study, site visit, and an overall understanding of associated issues gained from assessing the environmental impacts of other PV facilities. The following specific information has been reviewed as part of the desk study:

- Assessment of applicable national and international standards and guidelines identified within the IFC Performance Standards;
- Assessment of available site specific information relating to waste generation;
- Assessment of the proposed design, construction procedures and project features that may impact on both the society and environment in terms of waste generation and hazardous materials, and
- Walkover survey to identify sensitive receptors and determine the existing baseline conditions.

Based on the findings of the assessment, measures have been identified in order to mitigate any negative effects and promote positive effects associated with both the construction

and operational phases. General waste management and hazardous materials practices are evaluated with respect to legal requirements and where applicable, mitigation measures resulting in the improvement of waste management and minimisation, and storage, transport and handling of hazardous materials are recommended.

The main aims of the chapter are to identify the following:

- Materials required or generated onsite with the potential to pose substantial or potential threats to public health or the environment;
- Options for the reduction, re-use, recycling and recovery of all waste streams;
- Opportunities to minimise waste streams from project inception, thereby minimizing the amount of waste sent to landfill;
- Specify methods for the segregation of waste streams within the facility, and
- Detail methods for safe storage, transfer and handling of hazardous materials.

13.3 Baseline

13.3.1 Non-hazardous and Hazardous Waste

Solid waste generation is generally growing rapidly due to industrial and economic growth. Consequently, responsible waste management is essential to minimise direct and indirect impacts upon the environment as a result of waste generation and resource consumption. In order to promote sustainable economic development in Morocco, it is vital to consider the methods for handling, storing and managing the waste generated.

Waste management sites and facilities in Morocco are operated and managed either by private companies or local municipalities. When new sites are proposed and constructed, the regulator plays an important role in advising the operators on the environmental protection requirements for each facility. The required authorizations and contracts for the collection, transport and disposal of waste shall be obtained by the EPC and the O&M before the start of the construction and operation phases.

Waste Characterisation

Waste can exhibit certain characteristics according to the process stream from which it is generated and any pre-treatment processes that are undertaken. Different types of waste require different management and disposal techniques according to the potential risk that the material poses to human health or the environment. In order to categorise the different risks to these receptors, it is often useful to demarcate the streams into 3 main categories that effectively equate to the level of the management and disposal which are required for each:

- Hazardous waste which pose a potential hazard to the environment or health of employees or the general public;
- Non-hazardous wastes - solid materials which are not hazardous and degrade, chemically or biologically in the environment; and
- Non-water soluble wastes - materials that do not breakdown in the environment, and are otherwise inert.

It is considered likely that the proposed project will potentially generate waste in all of the categories listed above.

Waste Management Hierarchy

The waste management hierarchy is a key element of waste management. Minimising the amount of waste to be stored and disposed of not only protects the environment but also has the potential to reduce costs that may be incurred by the main contractor or the proponent for handling and disposing of the waste.

In general, waste generation is evaluated according to the waste minimisation approach. This approach is common to various national and internal guidelines and principles and involves the following steps in decreasing order of importance. The waste hierarchy is illustrated in the following figure.

Figure 13-1 Waste Management Hierarchy

Initially, options to prevent or reduce the amount of waste generated should be considered. Where waste generation cannot be avoided or further reduced at source, opportunities for reuse of materials should be explored, either for use for the same or a different purpose.

Disposal to landfill is the least favoured option in the waste hierarchy and is the last resort after all other options have been considered.

13.3.2 Hazardous materials

A hazardous material is any substance or agent (biological, chemical, radiological, and/or physical) which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Hazardous materials include chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents which act on the hematopoietic system; agents which damage the lungs, skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapours, mists or smoke which may have any of the previously mentioned characteristics.

Mitigation measures to ensure safe transport, transfer, storage and handling of hazardous materials are provided below.

13.4 Sensitive Receptors

Table 13-1 Solid and Hazardous Waste - Receptors sensitivity

Receptor	Sensitivity	Justification
Soil & Groundwater	Medium	The site is a greenfield and no contamination was observed or identified through soil contamination analysis. The soil has low organic matter and productivity. There is no surface water or superficial groundwater tables onsite.
Local Waste Infrastructure	Medium	Construction and operational/maintenance activities will result in an additional input of waste materials into the regional waste management service/infrastructures. There is no infrastructure for the handling of hazardous waste in the province, and the only authorised companies are in the Casablanca region.

13.5 Construction Assessment

13.5.1 Potential Impacts

During construction, waste will be generated during earthworks, construction of the fence, paths, buildings, etc. The main types of waste generated are outlined below. Given the size of the facility, the amount of waste generated will not be significant but if not properly managed will look unsightly, and may lead to contamination of the soils and groundwater.

Non-Hazardous Waste

During the construction phase, a number of activities will result in waste generation. These activities include but are not limited to the following Site clearance and levelling;

- Backfilling and excavation;
- Constructing a boundary wall and site offices, and
- Temporary wastewater storage and drainage network construction.

The types of waste generated by these activities include:

- Sand;
- Gravel;
- Asphalt paving;
- Scrap steel;
- Plastics;
- Packaging materials;
- Wood; and
- Domestic waste from construction workers.

Most construction waste is often bulky and heavy and mostly unsuitable for disposal by incineration or composting. The expected construction waste is inert and does not pose a threat to human health or the environment. However, proper management is required in order to reduce associated secondary impacts such as resource use, dust emissions, landscape disturbance or habitat destruction. Increased pressure may be placed upon local facilities/services and result in a reduced capacity for handling waste from municipal sources.

Hazardous Materials

Even though no significant amounts of hazardous materials (either waste generated or supplies) are likely to be stored in the proposed project site during the construction phase, a small amount of hazardous material requires careful consideration. Typical hazardous materials stored onsite and waste streams that may arise during construction include:

- Diesel;
- Solvents;
- Lubricants;
- Resins and paints;
- Batteries;
- Waterproofing compounds;

- Adhesives;
- Clean-up materials (such as rags) contaminated with the items listed above;
- Drums, containers and tins with remains of hazardous substances, or
- Broken PV panels or other components (e.g. inverter).

The hazardous materials can potentially cause significant adverse impacts on human health and the environment if managed improperly. Inappropriate handling as a result of deficient training may lead to accidental spills and inadequate infrastructure or equipment may lead to leaks to the ground that will result in soil and groundwater contamination events. Contamination may also arise as a result of transportation by diesel suppliers or waste contractors who have not been approved by the authorities.

Other environmental and social impacts that might arise from the construction activities are waste disposal to unlicensed landfills or increased pressure upon local licensed landfills that result in a reduced capacity for handling waste from municipal sources.

Therefore, prior to the implementation of mitigation measures, it is expected that the hazardous waste generated during the construction phase of the Project will result in a temporary impact of moderate negative significance.

Table 13-2 Solid Wastes - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Non Hazardous wastes	Minor	Given the size of the project and the technology to be implemented, moderate amounts of waste are expected to be generated. However, the risk of non hazardous wastes to the environment is low.
Hazardous Materials	Moderate	Small volumes of hazardous materials will be generated and/or kept onsite. However, the uncontrolled release of small amounts of hazardous materials poses a moderate risk to the environment.

Table 13-3 Solid Wastes - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Non Hazardous wastes	Minor	Local Waste Infrastructure	Medium	Minor
		Soil and Groundwater	Medium	Minor
Hazardous Materials	Moderate	Local Waste Infrastructure	Medium	Moderate

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
		Soil and Groundwater	Medium	Moderate

13.5.2 Mitigation Measures

The mitigation measures provided refer to both hazardous and non-hazardous materials. Whilst some mitigation measures are specific, many measures are applicable to both and therefore this section does not consider these measures separately, unless specified.

In addition to the CESMP, the EPC will be required to prepare the following documents:

- Hazardous Materials Management Plan (this will contain procedures, rules and training for hazardous waste handling and storage, spill response protocols, contingency plans to detail the clean-up of any spillages, etc.);
- Waste Management Plan (this will comprise the necessary measures to fully apply the Waste Hierarchy described in the baseline section);
- Emergency Preparedness and Response Plan.

These documents will incorporate, as a minimum, the mitigation measures included in the table below. These plans can be standalone documents or can be incorporated into the CESMP.

Table 13-4 Waste Management –Mitigation Measures for Construction

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Solid waste volumes/quantities	Prepare a site-specific Waste Management Plan (WMP) including hazardous and non-hazardous waste. The plan will include training of staff.	EPC	CESMP – Management
	Waste masonry should be re-used in the internal road construction and base fillings, when possible. Reasonable levels of utilization would be 60 to 80%	EPC	CEMP – Management
	100% waste metal will be recycled	EPC	CEMP – Management
	Ordering materials that have reusable packaging and/or in bulk can significantly reduce waste generated	EPC	CEMP – Management
	Request suppliers to use minimal packaging.	EPC	CEMP – Management
	Chemicals should be ordered in returnable drums.	EPC	CEMP – Management
	"Buy-back" arrangements should be made with key suppliers so that any surplus chemicals or materials can be returned	EPC	CEMP – Management
	Refillable containers will be used, where possible, for collection of solid and liquid wastes	EPC	CEMP – Management
Housekeeping	Separate waste streams to facilitate recycling. All storage areas must be well organised and waste appropriately managed through segregation of hazardous and non-hazardous waste. Waste within each category will be further segregated by type (paper, plastic, metal, masonry) and whether the material is recyclable or non-recyclable.	EPC	CEMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	A waste log will be kept onsite and will contain, at least, information about quantities, management solution (according to the waste management hierarchy described in the baseline section) types, operator, final disposal/destination, etc.)	EPC	CEMP – Monitoring Monitoign
	Install adequate storage facilities for non-hazardous waste in designated areas to prevent waste from dispersing throughout the site	EPC	CEMP – Management
	Include in the employees' inception training sections to increase their awareness of waste management protocols including proper handling and storage of waste, and emergency response and contingency plans.	EPC	CEMP –- Training
Waste Storage	Food waste must be stored within a sealed metal or plastic skip or bin with self-closing lid, in order to prevent birds/vermin/pests gaining access	EPC	CEMP – Management
	Lightweight waste e.g. paper, cardboard, plastics: Must be stored within a skip sealed with a secured tarpaulin/netting sufficient to prevent any material being dispersed.	EPC	CEMP – Management
	Heavy waste can be contained within an open skip, providing that segregation occurs effectively enough to remove all lightweight material that could be blown away.	EPC	CEMP – Management
	Litter, bins for different types of waste (food waste, domestic waste) categories will be placed throughout the site at locations where construction workers and staff consume food. These will be regularly collected and taken to the main waste storage area. Portable separate bins will also be placed at areas where works will be undertaken (interconnection point, power line, access road, etc.)	EPC	CEMP – Management
	No underground waste containers will be deployed.		Design and

Impact/ Source	Mitigation Measure	Responsibility	Schedule
			CEMP – Management
	Waste containers will be clearly marked with appropriate labels to accurately describe their contents and detailed safety precautions. Labels will be waterproof, and securely attached. Wherever possible, chemicals will be kept in their original container	EPC	CEMP – Management
	Waste generated during construction will only be transported off-site for disposal by an appropriately licensed vendor. This service provider will follow the proper protocols to ensure that all waste handling and disposal from the site is carried out according to the environmental regulations. A record for all waste streams will be kept onsite.	EPC	CEMP – Management - Monitoring
	Regular training of site personnel in proper waste management and chemical handling procedures will be conducted at regular intervals.	EPC	CEMP – Training
	Incineration/burning of wastes will not be allowed onsite	EPC	CEMP – Management
Hazardous Materials	Implement best practice and regulations procedures for adequate handling, establishment of secure temporary storage areas, and disposal of waste by approved contractors.	EPC	CEMP – Management
	Hazardous wastes will be disposed in an environmentally safe manner and by licensed hazardous waste operators	EPC	CEMP – Management
	Materials will be separated into combustible and non-combustible, and all flammable substances must be kept away from sources of ignition.	EPC	CEMP – Management
	No underground hazardous materials storage containers will be deployed. Storage of hazardous materials will be undertaken in a fenced dedicated	EPC	Design and CEMP –

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	area with a dedicated drainage system and roofed to prevent rainwater from entering the area. This hazardous materials storage area will be located considering potential risks (e.g. traffic accidents/collisions, fall of items, drainage system, etc.).		Management
	Provide bunds for storing hazardous materials containers. The bunds will have the capacity to contain 110% of the total volume of stored materials and will be protected from vehicles or other risks. This area must be placed away from any sources of ignition. Storage areas will have impermeable bases (this need to cover a wider area if needed to avoid soil contamination, e.g. refuelling areas will include an impermeable base that protects the ground where the vehicles will be parked), will be roofed and be equipped with spill kits.	EPC	CEMP – Management
	Hazardous Materials containers will be clearly marked with appropriate warning labels to accurately describe their contents and detailed technical specifications and safety precautions. Labels will be waterproof, and securely attached. Wherever possible, hazardous materials will be kept in their original container	EPC	CEMP – Management
	Hazardous materials will only be transported to/from the site by a licensed operator. This service provider will follow the proper protocols to ensure that all hazardous materials are transported and transferred according to the environmental regulations. A record for all hazardous materials will be kept onsite.	EPC	CEMP – Management - Monitoring
	Only trained personnel will be permitted to handle hazardous materials.	EPC	OESMP –Training
Waste Facilities	Only licensed waste management facilities shall be used for the disposal of non-hazardous and hazardous wastes, respectively.	EPC	CEMP – Management

13.5.3 Residual Impacts

Following the implementation of the mitigation measures detailed above and through effective implementation of the measures and protocols set out within the Waste Management Plan, the potential residual impacts of waste generated during the construction phase are likely to be negligible to minor in significance.

Table 13-5 Solid Waste– Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Non Hazardous wastes	Soil and Groundwater	Minor	Yes	Negligible
	Local Waste Infrastructure	Minor	Yes	Minor
Hazardous Wastes	Soil and Groundwater	Moderate	Yes	Negligible
	Local Waste Infrastructure	Moderate	Yes	Minor

13.6 Operational Assessment

13.6.1 Potential Impacts

Domestic waste

The operation of the proposed project will generate domestic waste from administration and workers. This waste can be classified as both recyclable and non-recyclable. Recyclable waste includes paper, tin cans, plastics, cartons, rubber, and glass, while non-recyclables will consist mainly of food residues and other organic waste.

Industrial Non-Hazardous Waste

Industrial non-hazardous waste refers to waste generated by operation activities that do not exhibit any characteristics that can potentially harm human health or the environment. This type of waste can be classified further as recyclable and non-recyclable.

Small amounts of industrial non-hazardous waste generated during the operation of the proposed Boujdour PV. These may include empty containers, general clean-up materials, packaging materials resulting from general and inert insoluble solid materials such as glass, rubber, and plastics.

Hazardous Materials

Hazardous Materials can potentially cause significant adverse impacts on human health and the environment if managed improperly. However, the amount of hazardous materials required and the hazardous waste generated from the operation of a PV is undeniably minor.

Examples of likely hazardous materials/waste streams that may arise during the operation of the Project include the following:

- Used chemicals;
- Soil contaminated by potential spills and leaks;
- Miscellaneous wastes such as batteries, wire cables, and
- General clean-up materials, oils and other chemicals.

Hazardous materials could potentially be released into the environment. This subsequently represents a potential impact upon soil and groundwater, in terms of contamination events. Potential sources, contamination pathways and appropriate mitigation measures are addressed in the Soil and Groundwater chapter.

Inappropriate handling through lack of personnel training on site may lead to accidental spills or leaks to the soil which leads to a contamination event, resulting in a potential health risk to workers and environmental impacts. Contamination may also arise as a result of transportation by waste contractors who have not been approved by the regulator or disposal to unlicensed landfills. Increased pressure may be placed upon local hazardous waste landfills and result in a reduced capacity for handling waste from municipal sources.

Table 13-6 Solid Wastes - Magnitude of Operational Impacts

Impact	Magnitude	Justification
Non Hazardous wastes	Minor	The low number of staff employed at the site and type of daily activities will only generate small volumes of waste which represent a low risk to the environment.
Hazardous Materials	Minor	The amount of hazardous materials stored/generated during the operation of a PV plant is very small, but could cause localised contamination if released to the environment.

Table 13-7 Solid Wastes - Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Non Hazardous wastes	Minor	Land fill	Medium	Minor
		Soil and Groundwater	Medium	Minor

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Hazardous Wastes	Minor	Land fill	Medium	Minor
		Soil and Groundwater	Medium	Minor

13.6.2 Mitigation Measures

The mitigation measures provided refer to both hazardous and non-hazardous materials. Whilst some mitigation measures are specific, many measures are applicable to both and therefore this section does not consider these measures separately, unless specified.

The O&M will be required to prepare the following documents in addition to the OESMP:

- Hazardous Materials Management Plan (this will contain procedures, rules and training for hazardous waste handling and storage, spill response protocols, contingency plans to detail the clean-up of any spillages, etc.);
- Waste Management Plan (this will comprise the necessary measures to fully apply the Waste Hierarchy described in the baseline section);
- Emergency Preparedness and Response Plan.

These documents will incorporate, as a minimum, the mitigation measures included in the table below. The plans, procedures and measures can be presented as standalone documents or included in a comprehensive OESMP.

Table 13-8 Solid Wastes–Mitigation Measures for Operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Solid waste volumes/quantities	Prepare a site-specific Waste Management Plan (WMP) including hazardous and non-hazardous waste. The plan will include training of staff.	O&M	OESMP – Management
	100% waste metal will be recycled	O&M	OESMP – Management
	Ordering materials that have reusable packaging and/or in bulk can to reduce waste generated	O&M	OESMP – Management
	Request that suppliers use minimal packaging.	O&M	OESMP – Management
	Chemicals should be ordered in returnable drums.	O&M	OESMP – Management
	"Buy-back" arrangements should be made with key suppliers so that any surplus chemicals or materials can be returned	O&M	OESMP – Management
	Refillable containers will be used, where possible, for collection of solid and liquid wastes	O&M	OESMP – Management
Housekeeping	Separate waste streams to facilitate recycling. All storage areas must be well organised and waste appropriately managed through segregation of hazardous and non-hazardous waste. Waste within each category will be further segregated by type (paper, plastic, metal) and whether the material is recyclable or non-recyclable. A waste log will be kept onsite and will contain, at least, information about quantities, management solution (according to the waste management	O&M	OESMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	hierarchy described in the baseline section) types, operator, final disposal/destination, etc.)		
	Install adequate storage facilities for non-hazardous waste in designated areas to prevent waste from dispersing throughout the site.	O&M	OESMP – Management
	Include in the inception training for employees sections to increase their awareness of waste management protocols including proper handling and storage of waste, and emergency response and contingency plans.	EPC	CEMP –- Training
Waste Storage	Food waste must be stored within a lidded metal or plastic skip or bin, in order to prevent vermin/pests gaining access.	O&M	OESMP – Management
	Lightweight waste e.g. paper, cardboard, plastics must be stored within a skip lidded with a secured tarpaulin/netting sufficient to prevent any material being dispersed.	O&M	OESMP – Management
	For litter (food waste, domestic waste), bins for separate categories will be placed throughout the site at locations where construction workers and staff consume food. These will be regularly collected and taken to the main waste storage area.	O&M	OESMP – Management
	Waste containers will be clearly marked with appropriate warning labels to accurately describe their contents and detailed safety precautions. Labels will be waterproof, and securely attached. Wherever possible, chemicals will be kept in their original container	O&M	OESMP – Management
	Waste generated during operation will only be transported off-site for disposal by an appropriately licensed vendor. This service provider will follow the proper protocols to ensure that all waste handling and disposal from the site is carried out according to the environmental regulations. A record for all	O&M	OESMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	streams of generated and collected waste will be kept onsite.		
	Regular training of site personnel in proper waste management and chemical handling procedures will be conducted at regular intervals.	O&M	OESMP – Management
	Incineration/burning of wastes will not be allowed	O&M	OESMP – Management
	Food waste must be stored within a lidded metal or plastic skip or bin, in order to prevent vermin/pests gaining access.	O&M	OESMP – Management
Hazardous Materials	Implement best practice and regulations procedures for adequate handling, establishment of secure temporary storage areas, and disposal of waste by approved contractors.	O&M	OESMP – Management
	Hazardous wastes be disposed in an environmentally safe manner and by licensed hazardous waste operator	O&M	OESMP – Management
	Materials will be separated into combustible and non-combustible, and all flammable substances must be kept away from sources of ignition.	O&M	OESMP – Management
	No underground hazardous materials storage containers will be deployed. Storage of hazardous materials will be undertaken in a fenced dedicated area with a dedicated drainage system and roofed to prevent rainwater from entering the area. This hazardous materials storage area will be located considering potential risks (e.g. traffic accidents/collisions, fall of items, drainage system, etc.).	O&M	OESMP – Management
	Provide bunds for storing hazardous materials containers. The bunds will have the capacity to contain 110% of the total volume of stored materials and will be protected from vehicles or other risks. This area must be placed away from any sources of ignition.	O&M	OESMP – Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	Storage areas will have impermeable bases (this need to cover a wider area if needed to avoid soil contamination, e.g. refuelling areas will include an impermeable base that protects the ground where the vehicles will be parked), will be roofed and be equipped with spill kits.		
	Hazardous Materials containers will be clearly marked with appropriate warning labels to accurately describe their contents and detailed technical specifications and safety precautions. Labels will be waterproof, and securely attached. Wherever possible, hazardous materials will be kept in their original container	O&M	OESMP – Management
	Hazardous materials will only be transported to/from the site by an appropriately licensed operator. This service provider will follow the proper protocols to ensure that all hazardous materials are transported and transferred according to the environmental regulations. A record for all hazardous materials will be kept onsite.	O&M	OESMP – Management
	Only trained personnel will be permitted to handle hazardous materials.	O&M	OEMP –Training
Waste Facilities	Only licensed waste management facilities approved by national/regional authorities shall be used for the disposal of non-hazardous and hazardous wastes, respectively.	O&M	OESMP – Management

13.6.3 Residual Impacts

Following the implementation of the mitigation measures detailed above, it is predicted that the residual impacts of the Project upon the local waste infrastructure, landfill capacities and human health and the environment are likely to be of minor to negligible negative significance.

Table 13-9 Solid Waste– Residual Impacts – Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Non Hazardous wastes	Land fill	Minor to Moderate	Yes	Minor
	Soil and Groundwater	Minor	Yes	Negligible
Hazardous Wastes	Soil and Groundwater	Minor	Yes	Negligible

13.7 Decommissioning Assessment

High amounts of waste as a result of panels/structures dismantling and site restoration activities is expected during the decommissioning phase of NOOR Boujdour. A detailed DESMP will be prepared to ensure that all impacts are identified, assessed and addressed.

It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

14 WASTEWATER MANAGEMENT

14.1 Introduction

This chapter identifies the main issues associated with wastewater production and management. Wastewater refers to any contaminated water resulting from any project activities. Wastewater can result from many processes, both man-made (i.e. sewage, oily wastewater) and naturally (i.e. contaminated storm water runoff). This chapter also discusses the potentials risks for soil erosion and flooding from resulting from storm water runoff.

Environmental impacts from poor wastewater management can be significant and can impact various environmental components including the degradation or contamination of surface waters, soils and groundwater, with secondary impacts upon ecology, living natural resources and communities (in terms of health and economics).

Both the construction and operational phases of the proposed Boujdour project will generate domestic wastewater and will have a relative potential to detrimentally impact upon the surrounding environment and society.

Additionally, the development of the project will change the topography and soil characteristics of the site and infrequent heavy rain events will result with increased erosion and the sediment laden run-off discharges.

This section provides a number of measures to ensure that appropriate management is achieved during construction and operation.

14.2 Methodology

The assessment has been conducted by identifying the relevant local and international standards and best practice relating to wastewater and storm water runoff and erosion management during the construction and operational phases of the proposed facility. Estimates and figures relating to wastewater volumes and proposed treatment processes have been based on the data available from the bid proposal.

14.3 Baseline

The site is currently a greenfield there is no engineered storm water system and excess overland flow crosses the proposed site SE to NW. There is no wastewater collection system in the project site or in close proximity.

The design of the Boujdour PV has included a site drainage system to protect equipment against erosion and flash floods and has considered the geotechnical and hydrological (i.e. natural drainage system) characteristics of the site and surroundings. The drainage system

will collect and direct rain water to an interface point at the northwest of the site as requested in the MFS and showed in the Project Design section of this SESIA.

14.4 Sensitive Receptors

The table below outlines the identified receptors in relation to wastewater as well as the determined sensitivity of those receptors.

Table 14-1 Sensitive Receptors

Receptor	Sensitivity	Justification
Soil and Groundwater	Medium	In the event of any spills or leaks of non-treated or poorly treated wastewater, ground contamination may occur.
Site Topography	Low	The project will modify the current topography and soil characteristics of the site

14.5 Construction Assessment

14.5.1 Potential Impacts

Wastewater

The main wastewater contamination risks arising during construction relate to sanitary waste from canteens and lavatories, and contaminated wastewater generated by storm water events washing hazardous spills/leaks.

Although construction activities are limited to a 9-month period, the impacts from poor wastewater storage could lead to significant impacts to the soil and groundwater. This could be particularly pertinent if the contaminants include high concentrations of bacteria, nutrients or oil from domestic activities.

The quantities of sanitary wastewater that will be produced is estimated on an average of 14 litres/worker/day and the total predicted volume of sanitary wastewater produced would equate to 2,450 litres of wastewater per day at peak construction periods. This wastewater will be stored on-site prior to removal by a licensed contractor. If the storage tanks and removal process are not properly managed and handled, contamination to soils or surface waters can take place.

Storm Water

The earthworks on site will disturb natural drainage patterns, potentially increasing erosion on site. The changes in the soil characteristics and increased earthworks activity, may result with increased siltation in the storm water, however, given the construction activities will be temporary and most soils will be compacted, the risk for increased silt will be temporary and infrequent.

Flooding risk at the site is not an issue, and is unlikely to change as a result of construction activities.

The storm water runoff can wash areas containing hazardous materials and either infiltrate into the soil or carry them off site, potentially contaminating watercourses or groundwater.

Table 14-2 Wastewater and Storm Water– Magnitude of Construction Impacts

Impact	Magnitude	Justification
Domestic Wastewater	Moderate	Domestic wastewater will contain bacteria, parasites, and nutrients.
Flooding	Minor	Infrequent and short duration rain events may result in minor flooding events in localised areas.
Erosion	Minor	Construction is temporary. The site already experiences natural erosion from precipitation.
Polluted Runoff	Moderate	Rainfall or runoff storm water entering areas where hazardous materials are stored could lead to distribute pollutants onsite/offsite the proposed site

Table 14-3 Wastewater and Storm Water - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Domestic Wastewater	Moderate	Soil and Groundwater	Medium	Moderate
Flooding	Minor	Site Topography	Low	Negligible or Minor
Erosion	Minor	Soil and Groundwater	Medium	Minor
Polluted Runoff	Moderate	Soil and Groundwater	Medium	Moderate

14.5.2 Mitigation measures

The mitigation measures provided refer to wastewater management.

The EPC will be required to prepare the following documents:

- Wastewater Management Plan (this will comprise the necessary measures to fully apply the Waste Hierarchy described in the baseline section), and
- Emergency Preparedness and Response Plan.

These documents will incorporate, as a minimum, the mitigation measures included in the table below.

Table 14-4 Wastewater – Mitigation Measures for Construction

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Sanitary wastewater	Develop a Wastewater Management Plan	EPC	CESMP – Management and Monitoring
	The reuse of wastewater on site is allowed if the following conditions are met : - Wastewater is treated in the ONEE STEP; - Analysis are provided to Masen showing that national and international water quality standards are met before its discharge into the environment; - Authorizations are obtained from local authorities allowing the reuse of the water.	EPC	CESMP – Management and Monitoring
	Chemical toilets/ septic tanks will be available at the construction site in sufficient number to attend the number of employees expected	EPC	CESMP – Planning
	No domestic wastewater will be discharged outside the chemical toilets / septic tanks	EPC	CESMP – Monitoring
	Wastewater from chemical toilets/ septic tanks will be collected by licensed operators. Each chemical toilets/ septic tank will generally be collected and emptied before its contents reach 80% of its capacity. The required authorizations and contracts shall be obtained by the EPC before the construction works start.	EPC	CESMP – Management
	Septic tanks must be completely emptied before demobilisation to avoid contamination to the site area. The demobilisation procedure will ensure that tanks are not destroyed or damaged during the removal process.	EPC	CESMP – Management
Storm Water	Construct a specific area for site equipment maintenance (lubrication, oil and filter		

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Drainage	changes, repair work, etc.). A waterproof concrete area or impermeable geo-textile liner shall be provided with a tank or perimeter ditch to collect any liquid waste that will be stored in a dedicated septic tank and collected by a licensed operator. Maintenance of vehicles will only be undertaken offsite in appropriate premises.		
	Hazardous materials storage areas will be roofed to prevent rainfall entering such areas and avoid polluted runoff	EPC	CESMP – Management, Planning
	Permanent/temporary storage areas will be designed and located considering potential ground contamination risks. Runoff will be prevented from entering areas where hazardous materials are stored, handled or transferred. If runoff can enter potentially contaminated areas, a dedicated drainage system will direct the run off to dedicated tanks to avoid impacts to soils and groundwater. The fluids in these tanks will be collected by licensed operators and managed as Hazardous wastewater.	EPC	CESMP – Management, Planning
	The stormwater drainage system will be able to accommodate and evacuate runoff so that it protects equipment during the worst case scenario as per local rain conditions and site area (funnelled to the channel) and soil and vegetation coverage conditions.	EPC	Design
	The stormwater drainage system will need to consider the increase on speed of the water flow with a concrete channel and consider the flood conditions that can potentially be caused downstream (particularly at the discharge point) to avoid erosion.	EPC	Design
	Adequate drainage systems will be provided to minimize and control infiltration. Sediment traps (i.e. filter fabric) will also be installed.	EPC	CESMP – Planning

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	The stormwater drainage system will include a system to retain garbage carried by the runoff water. The system will be at the project boundary and allow easy access to collect retained materials.	EPC	Design / CESMP – Management, Planning
	The site will be fenced to ensure that no soil disturbance occurs outside of the site area. The areas requiring excavation/filling shall be clearly demarcated to ensure that the soil is no disturbed outside that area	EPC	CESMP – Planning
	Internal roads/routes gradients should not exceed 15%	EPC	CESMP – Planning
	The longitudinal slope of the road must be at least 3% in order to facilitate surface run-off of water and to avoid the build-up of sediment in gutters	EPC	CESMP – Planning
	Reduce height of any built up embankments and slopes, if possible.	EPC	CESMP – Planning
	Recover vegetation on slopes and embankments where possible and in areas away from electrical equipment to avoid fires	EPC	CESMP – Planning
	Construct gabions and concrete barriers for containment, use metal mesh and nets, drains and gutters in slopes for terrain stability	EPC	CESMP – Planning
	From the outset of work, plan, select and define areas for clearing, stripping and access routes in order to minimise unnecessary stripping of vegetation	EPC	CESMP – Planning
	Reduce cut-offs and embankments, if possible.	EPC	CESMP – Planning

14.5.3 Residual Impacts

Table 14-5 Wastewater – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Domestic Wastewater	Soil and Groundwater	Moderate	Yes	Negligible
Flooding	Site Topography	Negligible to Minor	Yes	Negligible
Erosion	Site Topography	Negligible to Minor	Yes	Minor
Polluted Runoff	Soil and Groundwater	Moderate	Yes	Negligible

14.6 Operational Assessment

14.6.1 Potential Impacts

Water use during operation is only likely to be for sanitary/domestic purposes and general panel washing activities.

Sanitary Wastewater

The facility will include washroom facilities for maintenance and administration workers. Sanitary/domestic wastewater requirements for the facility are anticipated to be no more than 14 litres/worker/day. Inappropriate containment and disposal could result in uncontrolled discharge to ground, resulting in contamination of soils and waterbodies throughout the operation of the facility. This wastewater will be stored on-site prior to removal by a licensed contractor. If the storage tanks and removal process are not properly managed and handled, contamination to soils or surface waters can take place.

Panel Washing

Treated water from the Reverse Osmosis (RO) plant will be used for cleaning the PV panels. The amount of water required for panel washing is expected to be 2,800 m^3/year. No chemicals will be used for panel washing. Therefore, run off water from the panels will only contain dust and this wastewater will be left to naturally evaporate.

The O&M will focus on implementing the most environmentally and cost effective cleaning solution in line with the requirements recommended by the manufacturer of the PV panels and the MFS. The O&M Contractor will consider manual cleaning with soft sponges and squeegees as an option to reduce the water consumption over the operational phase. The

O&M Contractor estimates that this alternative may reduce the water consumption by approximately 40 to 50%.

RO Plant

The RO Plant will only be used to polish treated water received from the desalination plant and will only contain few trace minerals and suspended solids, resulting from the polishing of potable water. Typically, the wastewater generated by a polishing plant is 1/4 of the raw water treatment volume, per treatment cycle. This wastewater comprises of the backwash following the cleaning of the filter cartridges and the high concentrate water resulting from the polishing process. Since these wastewaters emanate from a potable water source and no hazardous chemicals are used in the polishing process, the wastewater is inert and is temporarily stored on site, in dedicated above ground storage tank that will be collected by licensed operator for disposal according to national legislation.

Independent treatment of the wastewater is not required, and it can/will be combined with the domestic wastewater during collection and treatment at a licensed off site facility.

Storm Water

The water flowing from the SE to the NW of the site will be collected by a concrete channel at the north and west boundaries of the site, and discharged to the Northwest. The origin of these waters would be from the southeast landscape strip (see figure in the Runoff Drainage section).

The drainage system on site has been designed to divert any rainfall away from any hazardous materials storage areas or waste storage areas. The storm water will be collected in a dedicated drainage system and stored in a septic tank.

The discharge points of the drainage system will be protected against erosion.

Table 14-6 Wastewater and Storm Water - Magnitude Impacts

Impact	Magnitude	Justification
Sanitary Wastewater Generation	Minor	Given the small work force, potential impacts associated with Sanitary and Domestic Wastewater Generation are considered Minor.
Storm water Contamination	Minor	Any storm water that comes into contact with contaminated soils or flows into some areas may result with contamination of the storm water.
Erosion	Minor	On site soils will be compacted. Off site, erosion will occur where run-off is directed to unpaved, bare or unprotected areas.

Table 14-7 Wastewater and Storm Water – Significance of Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Sanitary Wastewater Generation	Minor	Soil and Groundwater	Medium	Minor
Storm water Contamination	Minor	Soil and Groundwater	Medium	Minor
Erosion	Minor	Site Topography	Low	Negligible to Minor

14.6.2 Mitigation measures

Table 14-8 Wastewater and Storm Water – Mitigation Measures for Operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Sanitary Wastewater Generation	Develop a Wastewater Management Plan.	O&M	OESMP – Management and Planning
	The reuse of wastewater on site is allowed if the following conditions are met : - Wastewater is treated in the ONEE STEP; - Analysis are provided to Masen showing that national and international water quality standards are met before its discharge into the environment; - Authorizations are obtained from local authorities allowing the reuse of the water.	O&M	OESMP – Management and Planning
	Sanitary and domestic wastewater will only be discharged to chemical toilets/ septic tanks that will be available on the project site.	O&M	OESMP – Design and Management
	The septic tanks will be sited away from vehicle traffic, in order to prevent any damage to the tanks.	O&M	OESMP – Monitoring
	Aboveground septic tanks will be bunded. The bund will be able to accommodate 110% of the capacity of the tank.	O&M	OESMP – Design and Management
	Underground septic tanks will be equipped with flow metres (to identify leaks) and overflow alarms.	O&M	OESMP – Design and Management
	Wastewater from the chemical toilets/ septic tanks will be collected by a licensed operator.	O&M	OESMP – Management and Planning

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Storm Water Drainage	The site will be inspected regularly to ensure that no spills have occurred in areas that may be susceptible to storm water run off. Any and all spills must be immediately contained and cleaned, in order to prevent direct and indirect contamination to soils and water sources.	O&M	OEMP – Monitoring
	The stormwater drainage system will include a system to retain garbage carried by the runoff. The system will be located before the project boundary and allow easy access to collect retained materials.	O&M	OESMP – Planning and Management
	Runoff collection system will be inspected monthly and at the start of a rain event to ensure that no blockages could result with overflowing.	O&M	OEMP – Monitoring
	Waste storage areas have to be designed in such a way that rainwater is not in contact at any point with the waste.	O&M	OEMP – Design and Management
	The effectiveness of erosion prevention mitigation measures at rainwater discharge points will be verified after storm events to ensure that the adequacy of the design measures. Otherwise, these should be upgraded to meet storm water flows.	O&M	OEMP – Monitoring
	A re-vegetation programme on the slopes and embankments where storm water will be discharged shall be considered to reduce soil erosion. Only native species of shrubs native to the area shall be used in areas where dry vegetation do not pose a fire risk.	O&M	OEMP – Design and Management

14.6.3 Residual Impacts

Table 14-9 Water and Wastewater – Residual impacts - Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Sanitary Wastewater Generation	Soil and Groundwater	Minor	Yes	Negligible
Storm water Contamination	Soil and Groundwater	Minor	Yes	Negligible
Erosion	Site Topography	Negligible to Minor	Yes	Negligible

14.7 Decommissioning Phase

A detailed DESMP will be prepared to ensure that all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

15 TRAFFIC AND TRANSPORT

15.1 Introduction

This chapter focuses on the transportation related impacts associated with the construction and operation of the Boujdour PV project. The baseline transportation infrastructure within the region and particularly within the immediate vicinity of the project is described. Consequently, the impacts from the increased traffic generated by the construction and operation phases of the project have been considered. Where necessary and possible, opportunities to pursue measures to minimise and / or mitigate any impacts have been developed and put forward.

15.2 Methodology

The baseline analysis of this chapter is principally desk based, drawing from the technical proposal for the project, secondary sources (transportation and local authorities) and the site visit. Once the baseline conditions are established, the impact of the development on the surrounding transport infrastructure is evaluated.

As the development will have differing impacts throughout the lifecycle of the project, we have structured our analysis to reflect the key development stages of construction and operation. The analysis in this chapter deals solely with primary transport impacts, namely demands placed on transportation infrastructure by the development. Issues relating to secondary impacts arising from the transportation needs of the development, such as noise, are dealt with separately in the relevant chapters of this report.

15.3 Baseline

The site will be accessed by road for transport of materials, equipment and machinery and by workers. Ports will be used to bring equipment into the Kingdom of Morocco. Migrant workers may use the airport of Laayoune to access the region.

Main Port Facilities

The Casablanca (1,275 km to site) and Agadir (828 km to site) ports are the two options to be utilised to transfer cargo.

Given the size of the components required to operate a PV plant, no special transportation is expected to be required.

Road Network

The closest main road to the project site is the National Route 1 (N1). The N1 is a national highway that connects the south (Dakhlan) with the northwest (Tanger) of the Kingdom along the Atlantic coast.

Access Road

MASEN will build a 2.8 km road to connect the PV site with the N1. The access road will comprise a two-lane 8 m wide (1|3-3|1) wide asphalt-paved road and compacted aggregate unpaved shoulders.

Figure 15-1 Project site, access road and N1 National road

15.4 Sensitive Receptors

Table 15-1 Traffic and Transport – Receptor Sensitivity

Receptor	Sensitivity	Justification
N1 (Casablanca - Agadir – Boujdour Route)	Very Low	The N1 is the only road connecting the various cities in south morocco. Currently, population density is low and congestion on the N1 road is low.
Site access	Low	Dedicated road, built specifically for the site.
Residents	High	Residents are particularly vulnerable to increased traffic and number of heavy vehicles as these might lead to accidents, particularly those in areas with no bypass road.
Drivers	Low	Drivers will experience increased traffic levels. Sensitivity is considered low as the project site is connected to the transfers ports by the N1 road, which capacity can absorb the increased traffic levels with no significant disturbance to regular users.
Workers	High	Workers are particularly vulnerable to traffic and movements of heavy vehicles and machinery in the project site.

15.5 Construction Assessment

15.5.1 Potential Impacts

Two aspects of transport during construction can potentially generate impacts: The transport of the workforce and the transport of equipment to the site.

The major components for the construction of the plant are equipment that will be assembled in-situ and no special platforms will be required.

The Casablanca (1,275 km to site) and Agadir (828 km to site) ports are the two options to be utilised to transfer cargo since they are well connected to the proposed site. The vast majority of the plant's equipment and supplies will go via the N1 route that connects the region north to south. Vehicles using the N1 road will need to go through several municipalities with no bypass road available.

Figure 15-2 Main Connection Route from Boujdour to Transfer Ports

Workers are likely to be accommodated in Boujdour. Transport services will therefore need to be included as part of the daily construction activities.

In summary, there will be a noticeable increase in Heavy Goods Vehicles (HGV) and vehicle movements for the transport of workers during construction activities. The severity of the impact will vary significantly depending on the stage of construction (frequency of deliveries and volumes of workers required).

Table 15-2 Traffic and Transport – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Increased congestion on N1 road	Minor	Temporary impact on local roads generating direct impacts (e.g. congestion). The magnitude is considered minor as the N1 road has the capacity to absorb the increased traffic expected for the construction of a PV of the proposed size
Movement of vehicles on residential areas	Moderate	Noticeable temporary impacts (e.g. noise, air quality, etc.) caused by the movement of vehicles in residential areas and other impacts.
Movement of vehicles on the site	Moderate	Noticeable temporary impacts (e.g. noise, air quality, etc.) caused by the movement of vehicles and machinery in the project site (or other areas where works will be done) and other impacts.

Table 15-3 Traffic and Transport – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Increased congestion on N1 roads	Minor	N1 (Casablanca -Agadir – Boujdour Route)	Very Low	Negligible to Minor
Movement of vehicles on residential areas	Moderate	Residents	High	Moderate or Major
Movement of vehicles on the site	Moderate	Site access	Low	Minor
Movement of vehicles on the site	Moderate	Workers	High	Moderate or Major

15.5.2 Mitigation Measures

The mitigation measures provided refer to traffic and transportation. The EPC will be required to prepare a Traffic and Road Safety Management Plan in accordance with national and IFC requirements and aligned with GIIP.

These documents will incorporate, as a minimum, the mitigation measures included in the table below.

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Increased traffic load along National Highway and other on Residential Areas	Develop a Traffic Management Plan	EPC	CESMP – Planning and Management
	Determine the designated access routes for delivery of equipment, road capacity, site entrance/exit points, etc.	EPC	CESMP – Planning and Management
	Determine requirements for regular maintenance of vehicles (currently implemented) and use of manufacturer approved parts	EPC	CESMP – Planning and Management
	Identify areas/spots sensitive to road safety issues and implement the necessary road safety measures, including residential areas where construction-related vehicles will pass through and at the interconnection point of the access road with the N1 road. Sensitive area will be communicated in advance to all drivers who will be provided with maps to ensure awareness. Special measures will need to be implemented if deemed necessary and appropriately communicated to drivers (e.g. lowers speed at a specific vulnerable spot in the route).	EPC	CESMP – Planning and Management
	Manage delivery times of construction materials and equipment outside of peak hours.	EPC	CESMP – Planning and Management
	Stagger key deliveries or periods of high vehicle movements to the site and reduce waiting times for drivers and over demand on receiving staff at the site.	EPC	CESMP – Planning and Management
	Engines will be turned off while waiting in or outside the project site.	EPC	CESMP – Planning and Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	Staff will not be allowed to rest in vehicles to prevent excessive fuel wastage through the need to use air conditioning. Appropriate resting facilities will be provided at the landing for the drivers.	EPC	CESMP – Planning and Management
	Drivers should be fully competent and authorised to drive HGVs and should receive specific road safety training	EPC	CESMP – Planning and Management
	All vehicles dedicated full time for the project and circulating on roads outside the project site (owned or used by the Project Company, EPC or subcontractors) will have a clearly visible unique identification number and a sign with a telephone number for any road user that identifies reckless driving behaviour to be able to report it. Reports will be documented as grievances and investigated.	EPC	CESMP – Planning and Management
Movement of vehicles on the site	The access road will be clearly signalled and compacted (as a minimum) or tarmacked. Dust suppression measures will be conducted where and when required.	EPC	CESMP – Planning and Management
	Determine the designated access routes for delivery of equipment, site entrance points, laydown areas and parking areas, etc.	EPC	CESMP – Planning and Management
	A 30km/h speed limit will be imposed across the construction site in order to avoid direct mortality of fauna. Vehicle speeds will be restricted to 20Km/h on haul roads and unpaved areas of the site	EPC	CESMP – Planning and Management
	Post designated routes and signs for directions and speed limits onsite and along the route to access the main road.	EPC	CESMP – Planning and Management
	Specific waiting areas will be designated in suitable locations. No waiting areas	EPC	CESMP – Planning and

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	will be designate in proximity to residential units or settlements.		Management
	Inspect access and local roads (including N1) and remove construction materials	EPC	CESMP – Monitoring and Management

15.5.3 Residual Impacts

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Increased congestion on N1 roads	N1 (Casablanca -Agadir – Boujdour Route)	Negligible to Minor	Yes	Negligible
Movement of vehicles on residential areas	Residents	Moderate or Major	Yes	Minor
Movement of vehicles on the site	Site access	Minor	Yes	Negligible
Movement of vehicles on the site	Workers	Moderate or Major	Yes	Minor

15.6 Operational Assessment

The operational workforce is not likely to exceed 12 employees (including security), and the total requirements for material supplies is very low, the traffic impacts during this phase are negligible. Nevertheless, the following mitigation is proposed to aligned the management of vehicles with best practice.

Table 15-4 7 Traffic – Selected Mitigation Measures for operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Movement of vehicles along the site access road and onsite	Determine the designated access routes for collecting and delivering, site entrance points, and parking areas, etc.	O&M	OESMP – Planning and Management
	Determine requirements for regular maintenance of vehicles in line with national requirements and GIIP. Maintenance of vehicles will be undertaken in appropriate premises outside the project site.	O&M	OESMP – Planning and Management
	Specific waiting areas will be designated in suitable locations.	O&M	OESMP – Planning and Management
	The movement of vehicles along the access road will be minimized to essential operational and maintenance related activities.	O&M	OESMP – Planning and Management
	All vehicles dedicated full time for the project and circulating on roads outside the project site (owned or used by the Project Company, EPC or subcontractors) will have a clearly visible unique identification number and a sign with a telephone number for any road user that identifies reckless driving behaviour to be able to report it. Reports will be documented as grievances and investigated.	O&M	OESMP – Planning and Management
	Speed limit to be established onsite (30 km).	O&M	OESMP – Planning and Management

15.7 Decommissioning Phase

A detailed DESMP will be prepared to ensure that all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

16 ARCHAEOLOGY AND HERITAGE

16.1 Introduction

This chapter considers the potential cultural heritage and archaeology impacts which could potentially result during the construction and operational phase of the proposed Boujdour PV Project.

This cultural heritage and archaeological assessment takes into account that archaeological and cultural resources are finite and therefore consideration for their preservation will always be addressed.

For the purpose of this assessment, these resources may include, but not be limited to:

- Archaeological remains, buried and/or above ground;
- Historical structures and sites e.g. tombs or forts; and
- Any other structure of archaeological and/or cultural/historical significance.

Intangible cultural heritage has been considered in the socioeconomic section of this SESIA.

Where appropriate, mitigation measures to minimise or prevent potential risks to cultural heritage and archaeology have been provided.

This chapter provides an overview of existing information and guidelines for handling artefacts or sites of cultural and archaeological significance, which will be used in the event that such artefacts are discovered during the construction phase.

16.2 Methodology

The assessment in this chapter has been undertaken according to the relevant local and international law, regulations and standards as described earlier in this report. The assessment has included a desk-based study that included the review of the available information on the area and a site inspection.

Desk-Based Study

The purpose for conducting the desk-based assessment is to identify any relevant historic sites or the location of any artefacts on the site or the study area (including the presence or absence, character and extent, date, integrity, state of preservation and relative quality of the potential archaeological resource). The desk-based study consisted of the collation of existing written, graphic, photographic, electronic information and information from the FESIA in order to identify the likely character, extent, quality and worth of the known or potential archaeological resource at the site in a local, regional, national and international context.

Site Walkover

In order to complement the information gathered during the desk-based study, a site visit was undertaken to identify the presence of any above ground archaeological structures, deposits and /or antiquities. The results and findings are discussed below.

16.3 Baseline

The investigations from the FESIA concluded that sites of historical or cultural value where not found in close proximity to project site and no artefacts or structures of cultural or archaeological significance were observed onsite during the site visit. Equally, no archaeological sites within on nearby the Project site have been referenced in publicly held data.

However, the possibility of finding evidence of historical occupation, unknown belowground archaeological artefacts or remains of cultural conservation value (during site clearance and earthworks cannot be ruled out.

16.4 Sensitive Receptors

The table below outlines the identified receptors in relation to cultural heritage and archaeology as well as the determined sensitivity of those receptors.

Table 16-1 Culture and Archaeology - Receptors sensitivity

Receptor	Sensitivity	Justification
Potentially unidentified archaeological sites	Low	There is no evidence of any archaeological elements onsite. The area type makes archaeological findings in the plateau highly unlikely.

16.5 Construction Assessment

16.5.1 Potential Impacts

For the reasons outlined in the baseline, it is considered unlikely that potential impacts of cultural or archaeological value will occur during the construction phase.

In the event that earthworks during the construction phase uncover unidentified sources of archaeological or cultural heritage, this will result in an impact of major negative significance prior to the implementation of mitigation measures, as the archaeological resource could be destroyed.

Table 16-2 Culture and Archaeology – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Destruction of unknown archaeological remains onsite	Major	Construction activities could cause the destruction of archaeological remains onsite, resulting in permanent loses of the archaeological features.

Table 16-3 Culture and Archaeology – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Destruction of unknown archaeological remains onsite	Major	Potentially unidentified archaeological sites	Low	Moderate

16.5.2 Mitigation Measures

The EPC contractor will be required to prepare a CESMP before commencing construction works, which will consider the potential for unearthing historical sites or artefacts. The CESMP will include a Chance Find Procedure based on the Standards and Guidance for an Archaeological Watching Brief, Chattered Institute of Field Archaeologists, Version December 2014. The Archaeological Watching Brief is a formal programme of observations and investigations that are carried out for non-archaeological projects. It can be undertaken in any site where possibilities to find any archaeological deposits exist.

Training and awareness programmes will be provided to ensure that construction staff and labourers are aware of the procedures relating to the Archaeological Watching Brief will any artefacts or anthropogenic finds be uncovered. In the unlikely event of any artefacts being found/uncovered, the construction work would be ceased immediately and the Minister of Culture, via the "*Institut National des Sciences de L'Archéologie et du Patrimoine* (INSAP)" will be contacted by the EPC Site Manager. The INSAP will take charge of any archaeological investigations.

16.5.3 Residual Impacts

Given that no evidence of sites of historical or archaeological value has been observed in the area, the risk of uncovering any archaeological resources is considered very low. Equally, the implementation of the above mitigation procedures will help minimise any impact that may occur to an acceptable level.

Table 16-4 Culture and Archaeology – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Destruction of unknown archaeological remains onsite	Potentially unidentified archaeological sites	Moderate	Yes	Negligible

16.6 Operational Assessment

16.6.1 Potential Impacts

It is not considered that any significant impacts upon archaeological or cultural resources could occur during the operational phase.

16.7 Decommissioning Assessment

It is not considered that any significant impacts upon archaeological or cultural resources could occur during the decommissioning phase.

17 LANDSCAPE AND VISUAL IMPACT

17.1 Introduction

Impacts upon the landscape typically occur in situations where the visual horizon is disturbed by a development. Such impacts may include:

- The anthropogenic intrusion of the landscape by buildings or structures where no intrusion previously existed; or
- The change in the landscape character of an area, which could arise from new/out of place development or from changes in the land use.

Visual impacts may occur when the visual envelope or line of sight to and/or from a receptor (e.g. residential areas, area of natural beauty) is intersected or blocked by a development.

This chapter of the SESIA focuses upon the potential landscape and visual impacts, both direct and secondary, associated with the development and subsequent operation of the plant and associated secondary facilities.

17.2 Methodology

The assessment of the project upon the landscape and visual amenity of the surrounding area has been informed by the following:

- Desk-based assessment of existing information available, including maps, satellite images, site plans and viewpoint photographs taken at various locations, and
- Site visit undertaken to identify the existing landscape and visual character of the area.

17.3 Baseline

The proposed project site will be located on a rocky plateau 3 km away from the main road. There are no anthropogenic elements on the site other than the weather station and temporary security tents. The design of the power plant does not include any towering infrastructure and will not be noticeable from the access road or the city of Boujdour. Only people that visit the project area will notice the facility.

This section presents a number of photos that have been taken in and surrounding the proposed project site to provide an indication of the landscape and visual characteristics.

Plate 2 North View from the Northwest Corner of Project Site

Plate 3 Southeast View from the Northwest Corner of Project Site

17.4 Sensitive Receptors

The table below outlines the identified receptors in relation to landscape and visual impacts as well as the determined sensitivity of those receptors.

Table 17-1 Landscape and Visual – Receptor Sensitivity

Receptor	Sensitivity	Justification
Landscape Character	Medium	There are no specific landscape designations or other outstanding features present to make the landscape character of this particular area unique. However, the project site is located in an undeveloped area.
Visual Receptor – pedestrian/drivers within the view shed of the project site	Medium	People that frequent the adjacent area of the project site are considered a group relatively vulnerable to the visual impact resulting from the construction of the power plant.

17.5 Construction Assessment

17.5.1 Potential Impacts

During the construction of the PV plant, several buildings will be temporarily located on site, including offices and material storage. Equally some construction materials and equipment will be located on site during the entire construction program.

Night-time works will not take place but the site will likely require floodlighting for security. Glare effect is not expected to be noticed from the N1 road drivers nor the residents of Boujdour.

The construction site will not be visible from the N1 road nor from the city of Boujdour. Only people walking/driving through the neighbouring areas will be likely to notice the construction site.

Table 17-2 Landscape and Visual – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Topographical impacts to landscape	Minor	Only minor changes to the topography are anticipated to flatten the proposed project site.
New features impacting views	Minor	New features will partially impact views from receptors, however they will not result in total losses of key views from receptors and the construction will be a temporary phase. All the temporary facilities will be removed once the construction phase is completed.

Impact	Magnitude	Justification
Light Pollution	Moderate	Flood lights will increase glare effect in the project area

Table 17-3 Landscape and Visual – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Topographical impacts to landscape	Minor	Landscape Character	Medium	Minor
		Visual Receptor – pedestrian/drivers in adjacent to the construction site	Medium	Minor
New features impacting views	Minor	Visual Receptor – pedestrian/drivers in adjacent to the construction site	Medium	Minor
Light Pollution	Moderate	Visual Receptor – pedestrian/drivers in adjacent to the construction site	Medium	Moderate

17.5.2 Mitigation Measures

Table 17-4 Landscape and Visual – Mitigation Measures for Construction Phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Topographical impacts to landscape	The heights of building, fences and any other tall structures will aim to minimise their visibility from the road. The grading of the site, will aim to match the surrounding topography and avoid any sudden changes in ground height between the project boundary and surrounding landscape.	EPC	Design CESMP – Planning and Management
Light Pollution	Any flood lights required during night time construction activities will be directed	EPC	CESMP – Planning and

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	onto the site, with a maximum position angle of 30° from vertical, therefore minimising any potential light leakage and impacts at night.		Management

17.5.3 Residual Impacts

Table 17-5 Landscape and Visual – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Topographical impacts to landscape	Landscape Character	Minor	No	Minor
	Visual Receptor – pedestrian/drivers within the viewshed of the construction site	Minor	No	Minor
New features impacting views	Visual Receptor – pedestrian/drivers within the viewshed of the construction site	Minor	No	Minor
Light Pollution	Visual Receptor – pedestrian/drivers within the viewshed of the construction site	Moderate	Yes	Minor

17.6 Operational Assessment

17.6.1 Potential Impacts

The proposed design does not include the construction of towering structures, thus the impact on the landscape character will not be altered significantly. The PV plant will not be noticeable from the nearest residential area or from the N1 road.

During the operation of the proposed PV plant, glint and glare effects will not be noticeable from the city of Boujdour (~13 km) or by N1 road drivers (~3km).

Table 17-6 Landscape and Visual – Magnitude of Operation Impacts

Impact	Magnitude	Justification
New plant components in the Landscape	Minor	Only minor changes to the topography are anticipated to flatten the proposed project site.
New plant components impacting views	Minor	New features will partially impact views from walkers/drivers in the area, however they will not result in total losses of key views from receptors and the PV plant will not include towering elements.
Light Pollution	Moderate	Flood lights will increase glare effect in the project area

Table 17-7 Landscape and Visual – Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
New plant components in the Landscape	Minor	Landscape Character	Medium	Minor
		Visual Receptor – pedestrian/drivers in adjacent to the construction site	Medium	Minor
New plant components impacting views	Minor	Visual Receptor – pedestrian/drivers in adjacent to the construction site	Medium	Minor
Light Pollution	Moderate	Visual Receptor – pedestrian/drivers in adjacent to the construction site	Medium	Moderate

17.6.2 Mitigation Measures

No mitigation measures are available to reduce the visual impact of the structures that will be required for the plant. The measures designed for vegetation restoration and compensation include re-vegetation, to provide compensation for the lost habitat and reduce soil erosion, and will therefore not screen the structures built onsite. It is not considered beneficial from a water management perspective to implement a landscaping programme to plant alien species of vegetation within the site or at the project boundary

that could screen the visual impact from the project, as attracting birds to the site could result in more avian deaths.

Table 17-8 Landscape and Visual – Mitigation Measures for Operation Phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Light Pollution	Lighting provision shall not be excessive or unnecessary – Lights for the plant will be switched on only when strictly necessary	O&M	OESMP – Plant design
	Lights required during night time will be directed onto the site, with a maximum position angle of 30° from vertical, therefore minimising any potential back spill and impacts at night to avoid disturbance to fauna.	O&M	OESMP – Planning and Management
	Strictly monitor the light intensity, direction and duration. Design and install lighting such that light bulbs and reflectors are not visible from public viewing areas. Lighting should not cause reflected glare	O&M	OESMP – Planning and Monitoring

17.6.3 Residual Impacts

Table 17-9 Landscape and Visual – Residual Impacts – Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Topographical impacts to landscape	Landscape Character	Minor	No	Minor
	Visual Receptor – pedestrian/drivers within the viewshed of the project site	Minor	No	Minor
New features impacting views	Visual Receptor – pedestrian/drivers within the viewshed of the project site	Minor	No	Minor
Light Pollution	Visual Receptor – pedestrian/drivers within the viewshed of the project site	Moderate	Yes	Minor

17.7 Decommissioning Assessment

A detailed DESMP will be prepared to ensure that all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage. However, the DESMP will consider the applicable mitigation measures included in the SESIA, CESMP and OESMP.

18 SOCIOECONOMIC

18.1 Introduction

This chapter of the SESIA Report focuses on the social and economic issues, both direct and indirect, associated with the development and subsequent operation of the proposed NOOR Boujdour Project. Initially this chapter considers the existing socio-economic conditions within which the development will proceed, before examining the potential impacts of the development during the various stages of the project lifecycle. Where necessary and possible, opportunities to pursue measures to avoid, minimise or mitigate any impacts have been developed and put forward.

18.2 Methodology

This chapter looks at key indicators relating to factors such as population, the economy, the labour market and social development at a regional and local level. Where relevant, professional judgement was drawn upon, including knowledge from site visits and information collected during consultation with interested parties to gather additional the secondary baseline data.

Once this baseline was established the report considered a more detailed assessment of the impacts of the development. As the development will have different socio-economic impacts throughout the lifecycle of the project, impacts during construction and operation are discussed separately.

In reflection to the requirements of the IFC Performance Standards, core components of this analysis include:

- A review of any local communities within the proposed development site and its immediate environs;
- An assessment of local labour market impacts;
- An outline assessment of any community health, safety and security implications of the facility;
- An assessment of impact upon local services; and
- The suitability of the site in light of the social / development profile of the site environs.

18.3 Baseline

The proposed Boujdour PV Project is located in the rural community of Lamsid, in the province of Boujdour. The site is located ~13 km to the municipality of Boujdour (closest population) and ~35 Km to the village of Lamsid.

The rural community of Lamsid is sparsely populated (0.0004 inhabitants per hectare). In 2014 the population was 572 inhabitants and over 240 households. The commune has shown a population decrease of 52% between 2004 and 2014 due to migration to Boujdour, Laayoune, or other national or international cities.

In 2014 the municipality of Boujdour had a population of 42,651 and 9,511 households with 1.42 inhabitants per hectare. The population has increased 16% from 2004 to 2014.

The following tables include basic demographic and socioeconomic information on the village of Lamsid and the municipality of Boujdour:

Table 10 Demographic Data and Socioeconomic Information (Village of Lamsid)

Population			Male	Female	Total
			449	123	572
Age Distribution (%)					
<6 years			3.6	5.7	4.0
6 to 14 years			2.0	7.3	3.1
15 to 59 years			87.3	62.6	82.0
>60 years			7.1	24.4	10.8
Other Socioeconomic Data / Living Conditions					
Disability (rate)			1.3%	4.1%	1.9% (national 5.1%)
Illiteracy (rate)			33.3	54.9	37.8
Language (-read & written (% population)	Arab		49.7	63.8	51.7
	Arab and French		41.3	27.7	39.3
	Arab, French and English		7.0	8.5	7.2
	Local	Darija	66.7	5.7	53.6
		Tachelhit	30.4	2.5	24.4
		Tamazight	2.5	0.0	1.9
		Tarifit	0.4	0.0	0.4
		Hassania	30.6	94.3	44.3
School (enrolling rate from 7 to 12 years)			66.7	66.7	66.7
Employment	Active		415	62.0	477
	Inactive		34.0	61.0	95.0
	Unemployment		5.8	69.4	14.1

	rate			
Infrastructure / Services	Public Health	2 pharmacies, no medical care facilities available		
	Education	2 Primary Schools		
	Electricity	20 % of the households have access to electricity		
	Drinking Water	Groundwater and water supply via tanker trucks to meet the needs of the population. Only 16.9% of the dwellings in the municipality have access to drinking water.		
	Wastewater	17% of dwellings connected to the sewerage system		
	Solid Waste	No collected		

Source: HCP, RGPH 2014

Table 11 Demographic Data and Socioeconomic Information (Municipality of Boujdour)

Population			Male	Female	Total
			22,284	20,220	42,504
Age Distribution (%)					
<6 years			12.9	13.4	13.1
6 to 14 years			18.2	19.3	18.7
15 to 59 years			64.2	63.5	63.8
>60 years			4.7	3.9	4.3
Other Socioeconomic Data / Living Conditions					
Disability (rate)			2.9	2.6	2.8 (national 5.1)
Illiteracy (rate)			21.5	35.5	28.2
Language (-read & written (% population)	Arab		37.0	33.4	35.5
	Arab and French		43.5	46.0	44.6
	Arab, French and English		16.8	19.2	17.8
	Local	Darija	87.7	85.9	86.9
		Tachelhit	15.4	12.9	14.2
		Tamazight	1.7	1.4	1.6
		Tarifit	0.2	0.2	0.2
		Hassania	24.7	27.5	26.0
School (enrolling rate 7 to 12 years)			98.2	98.6	98.4
Employment	Active		11 895	2 464	14 359

	Inactive	10 389	17 756	28 145
	Unemployment	12.6	50.8	19.1
Infrastructure / Services	Public Health	1 Hospital		
	Education	13 Primary schools, 5 secondary schools		
	Electricity	Data not available		
	Drinking Water	Supplied from desalination plant (flow of 45 l/s). New plant planned (additional 80 l/s)		
	Sewage	Municipal treatment plant (6,500 m3 /d capacity)		
	Solid Waste	Collection system available		

Source: HCP, RGPH 2014

The population in the region is structured in sedentary population (mostly in the municipality of Boujdour) and nomadic (unevenly distributed in the rural commune). The number of pastoralists has decreased over the years (no official census available). Pastoralists often use shelters made of stones located in the commune and generally live from livestock.

Figure 18-1 Example of Typical Shelter in the Area

The most relevant economic activity in the region is fishing activities. The fishing industry extracted 35,126 tonnes in 2014 and generated 323 million dirhams. The main capture is pelagic fish species (77% of the weight), cephalopods (45%) and white fish (29.8%). Associated industries (e.g. fish packing, drying or shipment, ice production, etc.) are also important in the area.

Livestock is also an important sector in the region, mostly goats and camels herded by pastoralists. The size of this sector in the areas has decreased in the last years due to acute droughts. The agricultural sector is small given the arid conditions of the area.

18.4 Sensitive Receptors

Table 18-12 Socio-economic – Receptor Sensitivity

Receptor	Sensitivity	Justification
Employment	Medium	The project is expected to provide short and long term direct and indirect employment opportunities for the villagers and residents of the area.
Local / Regional Economy	Medium	The project will help to increase economic development in the area. The sensitivity considered is medium as the economic growth is relatively high in the region but greatly relies on only one sector (fishing industry).
National Grid	Medium	The national grid will receive electricity generated by the PV. Sensitivity is considered medium as the energy system in Morocco is well developed but highly depend on fossil sources.
Residents (municipality of Boujdour)	Low	The population is considered to have a low vulnerability to socioeconomic impacts as the socioeconomic and living conditions of the municipality of Boujdour are relatively stable.
Residents (village of Lamsid)	Medium	The population of the village of Lamsid is considered to have a high vulnerability to socioeconomic impacts as the socioeconomic and living conditions of the rural community are low and unstable.
Pastoralists	Medium	Pastoralists are considered to have a high vulnerability to socioeconomic impacts as their socioeconomic and living conditions are relatively unstable. Their economy relies mostly on cattle.

18.5 Construction Assessment

18.5.1 Potential Impacts

The primary economic positive impact during construction is likely to result from any local employment creation and the use of local businesses/services. The workforce that will be employed during the construction phase will range from 50 to 175 workers at the peak of construction. As well as the direct monetary uplift to the families of those employed, salaries to local workers will also stimulate the local economy, whereby money earned on the project expended locally will re-circulate within the local economy.

Notwithstanding the above, it is likely that the lack of some necessary skills within the immediate local population will require a proportion of work on the site to be undertaken by immigrant population. This could result in the repatriation of wages, with benefits to the local economy potentially being reduced.

Conflicts could potentially arise between communities and the project workforce due to ethnic or religious differences, mistrust of foreigners, misbehaviour by the project workforce, etc. Additionally, the interaction between the workforce and the local population can result in the proliferation of diseases, with Sexually Transmitted Diseases (STDs) being a specific risk.

In addition to the direct monetary impact of employment created during construction, there also exists the potential for the project to promote the dissemination of best practice construction skills into the local labour force. To the extent that the development proves an enabler for further regional development, any skills acquired are likely to prove readily marketable in the aftermath of the project construction. A further secondary impact is likely to arise from spending on local goods during the construction process.

It should be noted that negative impacts to the workers may result during the construction phase, due to health and safety issues related to traffic, noise and air quality. Impacts related to transport and roads are discussed in Chapter 14.

Encroachment by people looking for job opportunities. Encroachment is unlikely, as security provisions/stuff have been put forward onsite.

Finally, the presence of security on site could lead to potential conflicts between local communities and security staff.

Table 18-13 Socio-economic – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Local employment creation	Minor Positive	Temporary creation of employment relating to construction will be likely and should benefit the local/regional area. It is likely that most local employees will come from Boujdour, and the impact in relation to the total size of the local workforce will be relatively small.
Dissemination of skills	Minor Positive	Dissemination of know-how among the construction force.
Purchase goods and materials from the local / regional economy	Minor Positive	Increase in the purchase of goods and services by the workforce and of construction materials within the local/regional area.
Conflict with security	Minor	The presence of project security. There is a potential for

Impact	Magnitude	Justification
staff	Negative	conflict between residents (particularly pastoralists) and security staff. However, given the large area available for pastoralists, encounters with project staff or security staff are unlikely. The project is not within a populated area and conflict with other residents (Boujdour and Lamsid) is highly unlikely.
Conflict workforce – local population	Minor Negative	Conflicts could potentially arise between communities and the project workforce due to ethnic or religious differences, mistrust of foreigners, misbehaviour by the project workforce, etc. Foreign employees are likely to be housed in Boujdour, which is a moderately sized town and thus not unused to the arrival of people from the outside. Conflict with the population of the village of Lamsid is unlikely as it is located ~35 km to the site.
Spread of STDs	Minor Negative	The interaction between the workforce and the local population can result in the proliferation of diseases, with Sexually Transmitted Diseases being a specific risk. Boujdour has medical facilities and education centres. Interaction with the population of the village of Lamsid is unlikely as it is located ~35 km to the site.
Informal settlements and encroachment	Negligible Negative	Encroachment and informal settlements can potentially result in secondary impacts (destruction of habitat, sanitation, security risks, etc.). Encroachment is unlikely as security is planned for the onsite.

Table 18-14 Socio-economic – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Local employment creation	Minor Positive	Local Employment	Medium	Minor Positive
Dissemination of skills	Minor Positive	Local Workforce	Medium	Minor Positive
Purchase goods and materials from the local / regional economy	Minor Positive	Local / Regional Economy	Medium	Minor Positive
Conflict with security staff	Minor Negative	Pastoralists	Medium	Minor Negative
Conflict workforce – local population	Minor Negative	Residents (Municipality of Boujdour)	Low	Negligible to Minor Negative
Spread of STDs	Minor Negative	Residents	Low	Negligible to

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
		(Municipality of Boujdour)		minor Negative
Informal settlements and encroachment	Negligible Negative	Surrounding Environment	Low	Negligible to Minor Negative

18.5.2 Mitigation Measures

The mitigation and local enhancement measures provided refer to socioeconomic and labour issues. The EPC will be required to prepare the following documents aligned with national and IFC requirements:

- CESMP;
- Contract Guidance (or procedure to contractually consider E&S aspects);
- Labour and Working Conditions Management Plan, including retrenchment;
- Security Management Plan (this might be incorporated in the CESMP), and
- Emergency Preparedness and Response considering community health and safety impacts.

These documents will incorporate, as a minimum, the mitigation measures included in the table below. The documents can be prepared as standalone plans or can be merged into working documents (e.g. several aspects can be incorporated into the CESMP).

Table 18-15 Socioeconomic – Mitigation Measures - Construction Phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Employment and Accommodation	The project will seek to employ local workers where they are willing and available and have the skills required for the task. Non-specialist job opportunities will be offered to the local residents prior to hiring of employees from other areas when possible. The employment of women and vulnerable groups will be specifically targeted when possible.	EPC	CESMP – Planning
	Establish and implement a recruiting policy and ensure that the necessary measures to mitigate negative impacts associated with labour and working conditions are implemented (e.g. child and forced labour, exploitation, excessive overtime, insufficient wages, harassment, unsafe/unhygienic living and working conditions, etc.). Labour and working conditions will be aligned with IFC standards.	EPC	CESMP – Planning, Management
	Workers' accommodation (if required, as it is not envisaged at this stage) will comply with IFC standards.	EPC	CESMP – Planning
	Strict controls over the provision of housing shall prevent any unplanned settlements from developing.	EPC	CESMP – Monitoring
	A Retrenchment Plan will be prepared for moving from construction to operation.	EPC & Project Company	CESMP– Planning
Purchases	The EPC will only engage with reputable suppliers that do not use force or child labour and are capable to comply with the environmental and social standards established by the IFC for suppliers.	EPC	CESMP – Planning, Management
	The EPC will only engage with reputable subcontractors that do not use force or child labour and are capable to implement the applicable with	EPC	CESMP – Planning,

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	environmental and social measures established in the CESMP and other documents applicable to the construction of the project.		Management
	Purchase of goods and services within the local/regional area will be prioritized.	EPC	CESMP – Planning, Management
E&S and Health and Safety Risks	If any activities that have not been assessed on the SESIA are proposed, potential E&S and HS risks to the communities will be assessed prior to their implementation or development.	EPC	CESMP – Planning, Management
	The site will be fenced and access to the construction site will be controlled by the security staff.	EPC	CESMP – Planning, Management
Dissemination of Skills	Local employees will receive E&S and OHS training to enhance the development of skills. A certificate outlining the contents of the training and signed by the management of the PV plant will be provided to employees upon finalisation of the employment contract.	EPC	CESMP – Planning, Training
Conflict – workforce	Training for foreign employees will include information on the cultural background of the local population.	EPC	CESMP – Training
Security Provisions	Develop and implement a Policy on Security and a Code of Conduct for Security Personnel.	EPC	CESMP – Planning, Management
	The security provider and personnel will adhere to international human right code of conduct. Only security personnel and companies with no human right violations will be employed.	EPC	CESMP – Planning, Management

Impact/ Source	Mitigation Measure	Responsibility	Schedule
	Security personnel will undergo a dedicated training program which will include, as a minimum, information on how to exercise practices following GIIP (UN Voluntary Principles on Security and Human Rights), cultural background of the area and the workforce (main groups), and the way they should interact with local communities and workers.	EPC	Construction
Spread of Diseases	Prevention of diseases (including STDs) will be included in the training programme through toolbox talks or separate training sessions.	EPC	CESMP – Training
Informal Settlements / Encroachment	Unplanned settlements will be monitored by onsite security personnel and reported to the authorities.	EPC	CESMP – Planning, Management
	The local public security forces will be required to deal with encroachers as per national requirements.	EPC	CESMP – Planning, Management

18.5.3 Residual Impacts

Following the implementation of mitigation measure and promoting socio-economic activities, the positive significance of effects is expected to increase.

Table 18-16 Socio-economic – Residual Impacts – Construction Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Local employment creation	Local Employment	Minor Positive	Yes	Moderate Positive
Dissemination of skills	Local Workforce	Minor Positive	Yes	Minor Positive
Purchase goods and materials from the local / regional economy	Local / Regional Economy	Minor Positive	Yes	Minor Positive
Conflict with security staff	Pastoralists	Minor Negative	Yes	Minor Negative
Conflict workforce – local population	Residents (Municipality of Boujdour)	Negligible to Minor Negative	Yes	Negligible to Minor Negative
Spread of STDs	Residents (Municipality of Boujdour)	Negligible to minor Negative	Yes	Negligible to minor Negative
Informal settlements and encroachment	Surrounding Environment	Negligible to Minor Negative	Yes	Negligible Negative

18.6 Operational Assessment

18.6.1 Potential Impacts

At a strategic level the operation of the plant offers potential to support the sustainable growth of the local and national economies, through the ability to provide a renewable source of energy to the national grid.

The most significant economic impact upon nearby communities during operation are likely to result from the indirect and direct employment opportunities created by the Project. Several unskilled workers will be employed in the project during the operational phase for panel washing and general cleaning. Even though the direct impact on local employment is not as significant as during the construction phase, the increased time-scales involved offer an opportunity for greater dissemination of skills into the local workforce and via this for the role of local workers to increase over time.

It is likely that the lack of some necessary skills within the immediate local population will require a proportion of work on the site to be undertaken by immigrant population.

Conflicts could potentially arise between pastoralists and the Project workforce due to ethnic or religious differences, mistrust of foreigners, misbehaviour by the project workforce, etc. Additionally, the interaction between the workforce and the local population can result in the proliferation of diseases, with Sexually Transmitted Diseases being a specific risk.

Access to the site will remain restricted during the plant operation, so only authorised staff will be allowed to access the site. There is a potential for conflict between local communities and security forces.

Table 18-17 Socio-economic – Magnitude of Operational Impacts

Impact	Magnitude	Justification
Provision of electricity to the National Grid	Minor Positive	The project's addition to the national grid will provide a renewable power supply.
Local Employment	Minor Positive	Several unskilled opportunities for permanent local employment during the operational phase.
Conflict – workforce / local residents	Minor Negative	Potential conflicts are less likely than during the construction phase due to the small size of the workforce. Conflict with the population of the village of Lamsid is unlikely as it is located ~35 km to the site.
Conflict – Security forces	Minor Negative	Potential conflicts with the security personnel guarding the site could result in fatalities or injuries and create or exacerbate conflicts within the community, particularly pastoralists. Conflict with pastoralists is unlikely due to the large area that is used for pastoralism. The project is not within a populated area and conflict with other residents (Boujdour and Lamsid) is unlikely.
Spread of diseases	Minor Negative	The spread of STDs or other diseases could result in sickness on the communities and workers and loss work time for the project. The likelihood of this risk is lower than during the construction phase due to the small size of the workforce.

Table 18-18 Socio-economic – Significance of Operational Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Provision of electricity to the National Grid	Minor Positive	National Grid	Medium	Minor Positive
Local employment creation	Minor Positive	Employment	Medium	Minor Positive
Conflict – workforce / local residents	Minor Negative	Residents (Municipality of Boujdour)	Low	Negligible to Minor Negative
Conflict – Security forces	Minor Negative	Pastoralists	Medium	Minor Negative
Spread of diseases	Minor Negative	Residents (Municipality of Boujdour)	Low	Negligible to Minor Negative

18.6.2 Mitigation Measures

The mitigation and local enhancement measures provided refer to socioeconomic and labour issues. The O&M will be required to prepare the following documents aligned with national and IFC requirements:

- OESMP;
- Contract (supply chain and subcontractors) Guidance (or procedure to contractually consider E&S aspects);
- Labour and Working Conditions Management Plan;
- Occupational Health and Safety Management Plan (this might be incorporated in the OESMP),
- Security Management Plan (this might be incorporated in the OESMP), and
- Emergency Preparedness and Response (this might be incorporated in the OESMP).

These documents will incorporate, as a minimum, the mitigation measures included in the table below. The documents can be prepared as standalone plans or can be merged into working documents (e.g. several aspects can be incorporated into the OESMP).

Table 18-19 Socioeconomic – Mitigation Measures - Operation Phase

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Employment and Accommodation	The PV will seek to employ local workers where they are willing and available, and where appropriate. All non-specialist job opportunities will be offered to the local residents prior to hiring of employees from other areas. The employment of women and vulnerable groups will be specifically targeted when possible and monitored if possible.	O&M	OESMP – Planning, Management
Employment and Accommodation	Establish and implement a recruiting policy and ensure that the necessary measures to mitigate negative impacts associated to labour and working conditions are implemented (e.g. child and forced labour, exploitation, excessive overtime, insufficient wages, harassment, unsafe/unhygienic living and working conditions, etc.). Labour and working conditions will be aligned with IFC standards.	O&M	OESMP – Planning, Management
Purchases	The O&M will only engage with reputable suppliers that do not use force or child labour and are capable to comply with the environmental and social standards established by the IFC for suppliers.	O&M	OESMP – Planning, Management
	The O&M will only engage with reputable subcontractors that do not use force or child labour and are capable to implement the applicable with environmental and social measures established in the OESMP and other documents applicable to the construction of the project.	O&M	OESMP – Planning, Management
	Purchase of goods and services by the workforce and of construction materials within the local/regional will be prioritized	O&M	OESMP – Planning, Management
E&S and OHS Risks	Address potential E&S and H&S risks to the communities and workers	O&M	OESMP – Planning,

Impact/ Source	Mitigation Measure	Responsibility	Schedule
			Management
	The site will be fenced and access to the construction site will be controlled by the security staff	O&M	OESMP – Planning, Management
Dissemination of Skills	Local employees will receive E&S and OHS training to enhance the development of skills. A certificate outlining the contents of the training and signed by the management of the PV plant will be provided.	O&M	OESMP – Planning, Training
Conflict – workforce / local residents	Training for foreign workers will include information on the cultural background of the population.	O&M	OESMP – Training
Security Provisions	Develop and implement a Security Policy and a Code of Conduct for Security Personnel.	O&M	OESMP – Planning, Management
	The security provider and personnel will adhere to international human right code of conduct. Only security personnel and companies with no human right violations will be employed.	O&M	OESMP – Planning, Management
	Security personnel will undergo a dedicated training program which will include, as a minimum, information on how to exercise practices following GIIP (UN Voluntary Principles on Security and Human Rights), cultural background of the area and the workforce (main groups), the way they should interact with local communities and workers.	O&M	OESMP – Planning, Management
Spread of Diseases	Prevention of diseases (including STDs) will be included in the training programme.	O&M	OESMP – Planning, Management

18.6.3 Residual Impacts

Table 18-20 Socio-economic – Residual Impacts – Operation Phase

Impact	Receptor	Impact Significance	Mitigation	Residual Impact
Provision of electricity to the National Grid	National Grid	Minor Positive	No	Minor Positive
Local employment creation	Employment	Minor Positive	Yes	Minor Positive
Conflict – workforce / local residents	Residents (Municipality of Boujdour)	Negligible to Minor Negative	Yes	Negligible Negative
Conflict – Security forces	Pastoralists	Minor Negative	Yes	Negligible to Minor Negative
Spread of diseases	Residents (Municipality of Boujdour)	Negligible to Minor Negative	Yes	Negligible Negative

18.7 Decommissioning Assessment

A detailed DESMP will be prepared to ensure that the existing socioeconomic conditions are considered and all impacts are identified, assessed and addressed. It is expected that Moroccan and IFC standards will be updated in the future, and the DESMP will be compliant with the applicable requirements at the time of preparation.

Given the time lapse between the preparation of this SESIA and associated ESMP, it is not considered realistic to outline mitigation measures for the decommissioning phase at this stage.

19 MONITORING PLAN

The following table outlines the parameters that, as a minimum, need to be monitored for the project.

Additional frequency, parameters or locations might be monitored if new activities that were not covered in the SESIA are implemented onsite, or following emergency situations, incidents (e.g. spills) or requests from stakeholders.

Table 19-1 Monitoring Plan

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Construction						
Air quality - PM_{10} $PM_{2.5}$	Site boundary	Air filters or dust collectors	Weekly during site preparation activities	Dust from vehicles and earthworks	To be determined by the EPC	EPC
Air Quality - Exhausts	Equipment exhausts	Visual inspection of the smoke (follow testing equipment specifications for use)	Daily Inspections	If there is visible dark smoke, the equipment will be sent for maintenance or replaced	Not applicable	EPC/ Subcontractors
Air Quality – Exhausts	Vehicles entering to the site	Visual inspection of the smoke (follow testing equipment specifications for use)	Always	If there is visible dark smoke, the vehicles will not enter the site	Not applicable	EPC/ Subcontractors
Noise	Inside the Project Site	Standard noise monitoring methodology, as described in the baseline	Weekly during site preparation and construction of	Construction activities increase noise levels	To be covered by the EPC (indicative cost	EPC

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
		monitoring survey.	foundations. Monthly during the rest of construction.	(nuisance, disturb fauna, work hazard)	noise meter 2000-5000 MD)	
Waste management -	-	Waste log quantities and types of solid waste reuse, recycling and disposal. Include an indication if solid waste disposal has met intended construction phase recycling, recovery or reuse targets	Bi-weekly	Monitor compliance with waste management targets	Not applicable	EPC / subcontractors
Waste management	-	Waste log- quantities and types of solid waste taken off site, the approved handler, and where the waste was disposed. Special attention will be given to hazardous waste.	Every time waste is taken offsite. Statistics compiled monthly.	Monitor compliance with off-site disposal by approved subcontractors	Not applicable	EPC / subcontractors

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Wastewater management -	-	Waste log quantities and types septic tanks taken off site, the approved handler, and where the waste was disposed;	Every time sewage is taken offsite. Statistics compiled monthly.	Monitor compliance with off-site disposal by approved subcontractors	Not applicable	EPC / subcontractors
Underground Septic Tanks, identification of leakage –;	-	Waste log quantities of sewage flowing into underground septic tank compared to sewage being tankered off	Calculations undertaken monthly.	Potential leakage from underground septic tanks.	Not applicable	EPC / subcontractors
Waste Management -	Solid Waste Storage Areas	Visual inspection non-hazardous solid waste storage collection, storage and transfer areas or evidence of accidental releases and to verify that wastes are properly labelled and stored	Daily	Monitor compliance with waste storage targets	Not applicable	EPC

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Hazardous Materials -	Hazardous Materials storage collection, storage and transfer areas	Visual inspection	Daily	Monitor compliance with hazardous materials storage targets	Not applicable	EPC
Runoff system - blockages	Runoff system	Visual inspection	Weekly and in prevision of rain	Monitor compliance with overflowing	Not applicable	EPC
Runoff system - erosion prevention	Runoff system discharge points	Visual inspection	Weekly and following intense rain events	Monitor compliance with erosion objectives	Not applicable	EPC
Soil Quality	Hazardous materials and liquid and solid waste storage areas as a minimum	Sampling methodology as described in SESIA – Soil Quality section	Soil samples will be analysed following the release of hazardous substances onto the soil and the required restoration	Monitor compliance with ground pollution targets	Quotations to be obtained by the EPC.	EPC
Ecological status –	Along fence	Visual inspection of	Monthly	To ensure that there	Not applicable	EPC

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
presence of fauna and bird nesting.	line boundary and buffer zone outside of PV site.	habitat around the boundary of the site and photograph of any changes. Document and monitor bird nests.		is no loss of habitat or fauna outside of the plant boundary fence. Monitor any impacts on nests.		
Ecological status - Additionally, detect caught/trapped fauna. Specialist is not required.	Onsite	Visit trenches and other risk areas as part of the daily inspections to record any trapped animals	Daily	To avoid mortality of reptiles or small mammals	Not applicable	EPC
Traffic and Transportation	Within the site and in the access road	Speed meter device	Weekly	Monitor compliance with speed limits	Cost of speed meter	EPC
Housekeeping	Site and access roads	Visual Inspection and collection	Onsite: Daily Access roads: Weekly	Monitor good construction housekeeping practices onsite	Not applicable	EPC

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
				and at access roads		
Lighting	Boundaries of the site	Visual assessment of directional lighting	Quarterly	Minimise light spill glare and sky-glow.	Not applicable.	EPC
Recruitment policy	Not applicable	Ratio local, regional, national and international employees. Rations of women employees.	Monthly	Provide employment for local population, minimize impact immigrant labour	Not applicable	EPC
Complaints register	Point of contact to be posted at the site entrance	Register complaints and how they are addressed	Every time there is a complaint	Record, address and follow up complaints	Not applicable	EPC
Emergency monitoring	Not applicable	Register emergencies and follow-up-remediation	Every time there is an emergency	Register emergencies and follow-up-remediation	To be covered by the EPC.	EPC

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Operation						
Waste management -	-	Waste log estimated of quantities and types of solid waste reuse, recycling and disposal. Include an indication if solid waste disposal has met intended recycling, recovery or reuse targets	Quarterly	Monitor compliance with waste management targets	Not applicable	O&M / subcontractors
Waste management -	-	Waste log quantities and types of solid waste taken off site, the approved handler, and where the waste was disposed. Special attention will be given to hazardous waste.	Every time waste leaves the site. Statistics to be compiled quarterly.	Monitor compliance with off-site disposal by approved subcontractors	Not applicable	O&M / subcontractors
Waste	-	Waste log quantities and	Monthly	Monitor	Not applicable	O&M /

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
management -		types septic tanks taken off site, the approved handler, and where the waste was disposed;		compliance with off-site disposal by approved subcontractors		subcontractors
Waste Management -	Waste storage collection, storage and transfer areas	Visual inspection evidence of accidental releases and to verify that wastes are properly labelled and stored	Weekly	Monitor compliance with waste storage requirements	Not applicable	O&M
Hazardous Materials -	Hazardous Materials storage collection, storage and transfer areas	Visual inspection	Weekly	Monitor compliance with hazardous materials storage requirements	Not applicable	O&M
Runoff system - blockages	Runoff system	Visual inspection	Monthly and in prevision of rain	Monitor compliance with overflowing	Not applicable	O&M
Runoff system -	Runoff system	Visual inspection	Monthly	Monitor	Not applicable	O&M

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
erosion prevention mitigation measures	discharge points			compliance with erosion objectives		
Soil Quality	Hazardous materials and liquid and solid waste storage areas as a minimum	Sampling methodology as described in SESIA Soil Contamination chapter	If major accidental releases of pollutants take place, following remediation.	Monitor compliance with ground pollution targets	To be covered by the O&M or responsible subcontractor.	O&M / subcontractor
Ecological status – Presence of fauna. Specialist is not required.	Onsite, adjacent area (~200 m buffer)	Count of fauna species and identification of nesting areas.	Monthly	Monitor ecology around the site	Not Applicable	O&M
Ecological status – Identify bird or other fauna mortality, presence onsite and nesting onsite.	Onsite	Identification and count of fauna species	Daily inspections All O&M workers to be trained to report carcasses onsite.	Monitor ecology around the site	Not Applicable	O&M

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Lighting	Boundaries of the site	Visual assessment of directional lighting	Quarterly	Minimise light spill glare and sky-glow.	Not Applicable	O&M
Recruitment policy	Not applicable	Ratio local, regional, and Moroccan to expatriate labour and women to men	Quarterly	Provide employment for local population, minimize impact immigrant labour	Not Applicable	O&M
Complaints register	Point of contact to be posted at the site entrance	Register complaints and how they are addressed	Every time there is a complaint	Record, address and follow up complaints	Not Applicable	O&M
Emergency monitoring	Not applicable	Register emergencies and follow-up-remediation	Every time there is an emergency	Register emergencies and follow-up-remediation	To be covered by the O&M .	O&M
Supervision (during the construction and operation phases)						
Independent	-	The auditors will review the	Quarterly	Independent	Project	NOOR Boujdour

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Environmental Audits – Documentation		environmental and social documentation kept at the facility, check the adequate implementation of the environmental procedures established in the ESMP (CESMP/OESMP) and documentary evidence of the application of the mitigation and monitoring measures stated in the SESIA, including the monitoring results	(construction) Every six months (operation –first two years) Yearly (remaining operational phase)	environmental audits provide assurance of compliance with the measures included in the SESIA and the ESMP.	Company to hire independent external auditors.	Project Company The auditors will be required to have auditing experience in Morocco in renewable projects and auditing experience in projects aligned with IFC requirements

MONITORING PLAN						
What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in project budget)	Who (Is responsible for monitoring?)
Independent Environmental Audits — Site inspection	-	The auditors will visit the plant, to ensure that the environmental and social procedures are being adequately applied onsite.	Quarterly (construction) Every six months (operation –first two years) Yearly (remaining operational phase)	Independent environmental audits provide assurance of compliance with the measures included in the SESIA and the ESMP.	Project Company to hire independent external auditors.	NOOR Boujdour Project Company The Consultancy will be required to have auditing experience in Morocco in renewable projects and auditing experience in projects aligned with IFC requirements

20 REFERENCES

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APPENDIX 1 – CONSTRUCTION SCHEDULE

Task Name	Duration*	Tentative Start	Tentative Finish
Boujdour 20 MW	223 days	Sat 01-04-17	Sat 16-12-17
Engineering	52 days	Sun 09-04-17	Wed 07-06-17
Procurement	157 days	Wed 26-04-17	Wed 25-10-17
Ordering	70 days	Wed 26-04-17	Sun 16-07-17
Manufacturing Clearance, Inspection and MDCC	95 days	Mon 22-05-17	Sat 09-09-17
Transportation	85 days	Wed 19-07-17	Wed 25-10-17
Construction	112 days	Sun 02-07-17	Wed 08-11-17
PV Plant Installations	58 days	Sun 03-09-17	Wed 08-11-17
Transmission Line Works	93 days	Sun 09-07-17	Wed 25-10-17
Commissioning & Testing	37 days	Sat 04-11-17	Sat 16-12-17
*Please note that several activities will be undertaken in parallel. The addition of the duration of all tasks does note equal the duration of the construction phase.			

APPENDIX 2 – SPECIES LIST

Flora

Endemic species, rarity:

- Maroc endemic species in Morocco
- Maur, endemic species in Morocco and Mauritania
- Canary: endemic species in Morocco and the Canary Islands.
- Rare : rare species
- Rare ?: species likely to be rare onsite
- VU: Vulnerable species in Morocco.

Table 20-1 Flora species List

Scientific Name	Endemic Species	Rocky Plateau	Depressions	Graras	Pre-litoral Reg
	Coverage	10-25%	20-40%	25-40%	2-10%
Shrub 1-3m					
Euphorbia balsamifera	VU			x	
Shrub 0.5-1m					
Asparagus altissimus				x	
Antirrhinum ramosissimum				x	
Atriplex halimus				x	
Euphorbia officinarumsubspechinus				x	x
Launaea arborescens			x	x	
Lyciumin tricatum		x	x	x	x

Scientific Name	Endemic Species	Rocky Plateau	Depressions	Graras	Pre-litoral Reg
	Coverage	10-25%	20-40%	25-40%	2-10%
Ononis hesperia	Maroc	x	x	x	
Rhus albida			x		
Salsola gymnomaschala		x	x		x
Teucrium chardonianum	Maroc, Rare	x	x		
Zilla spinosa subs. pcotata	Rare			x	
Shrub <0.5m					
Asteriscus graveolens			x	x	
Deverra denudata		x	x	x	
Frankenia corymbosa		x	x	x	x
Gymnocar posdecander			x		
Helianthemum canariense	Canaries, VU	x	x	x	
Pentzia hesperdium	Maroc, Rare	x	x		
Salsola tetragona		x			x
Salsola tetrandra					x
Suaeda ifniensis	Maroc, Rare?				
Suaeda ifniensis				x	x
Suaeda monodiana	Maur, Rare?				x
Suaeda ifniensis	Maroc, Rare?				
Zygophyllum waterlottii	Maroc, Rare?	x	x		x
Grass species					
Heliotropium erosum		x	x		
Lotus sp			x		
Opophytum theurkauffii					x
Polycarpea nivea			x	x	
Total Number		**11**	**16**	**15**	**10**

Scientific Name	Endemic Species	Rocky Plateau	Depressions	Graras	Pre-litoral Reg
	Coverage	10-25%	20-40%	25-40%	2-10%
Endemic species		**5**	**5**	**5**	**3**

Fauna

Presence of species:

- FESIA: potentially present species according to the FESIA
- O: species observed or detected
- P: potentially present species
- E: extinct species in the region
- En: Endemic
- MAR: Morocco
- MAG: Maghreb
- AFN: North Africa (including the Sahara)
- SAH: Sahara (W Western part of the Sahara)

IUCN Status, 2016:

- CE Critically Endangered
- EN Endangered
- VU: Vulnerable
- NT Near Threatened
- LR Lower Risk / Minor Concern
- DD Data deficient / Insufficient data

IUCN status is assessed at the following levels: International (according to IUCN 2014): Globally, Mediterranean and National level.

The following legal information is provided:

- Protected species by the Hunting Act in Morocco.
- Species listed by Annexes I, II and III of CITES Convention (on trade of wildlife species) and CITES law in Morocco.
- Birds and mammals species listed on Annex I, II of CMS Convention (on migratory species).
- Species listed on Berne Convention (on European protected species)
- Bat species listed on EUROBAT Convention (on bat protection).

Table 20-2 Reptiles

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	UICN Morocco	Loi chasse	CITES Maroc AppIV
P	AGAMIDES	*Trapelus boehmei*	Agame de Boehm	SAH W	LC	LC	LC	x	
P		*Agama impalearis*	Agame de Bibron		LC	LC	LC	x	
P	GECKKONIDES	*Tropiocolotes algericus*	Tropiocolotès d'Algérie	MAG	LC	LC	LC	x	
P		*Saurodactylus brosseti*	Saurodactyle de Brosset	MAR	LC	LC	LC	x	
P		*Tarentola chazaliae*	Gécko casqué	MAR	VU	LC	LC	x	
O	LACERTIDES	*Acanthodact*	Acanthodact	SAH W	LC	LC	LC	x	

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	UICN Morocco	Loi chasse	CITES Maroc AppIV
		ylus aureus	yle doré						
P		*Acanthodactylus boskianus*	Acanthodactyle de Bosk		LC	LC	LC	x	
O	SCINCIDES	*Chalcides sphenopsiformis*	Seps occidental	SAH W	LC	LC	LC	x	x
P/FESIA	COLUBRIDES	*Psammophis schokari*	Couleuvre de Schokar		LC	LC	LC	x	x
P		*Rhagerhis moilensis*	Couleuvre de Moïla		LC	LC	LC	x	x
P		*Malpolon monspessulanus*	Couleuvre de Montpellier occidentale		LC	LC	LC	x	x
P		*Lytorhynchus diadema*	Lytorhynque diadème		LC	LC	LC	x	x
P		*Hemorrhois algirus*	Couleuvre algire	AFN	LC	LC	LC	x	x
P	Viperidae	*Cerastes cerastes*	Vipère à cornes		LC		LC	x	x
FESIA		*Daboia mauritanica*	Moorish Viper		NT				

Table 20-3 Birds

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	Hunting Act	CITES Maroc AppIV	CITES App I	CMS App II	Berne App II
P	BURHINIDÉS	*Burhinus oedicnemus*	Oedicnème criard		LC					x	x
O/FESIA	GLAREOLIDÉS	*Cursorius cursor*	Courvite isabelle		LC		x	x			x
E	OTIDIDÉS	*Chlamydotis undulata*	Outarde houbara		VU	VU	x		x		x
P	ALAUDIDÉS	*Eremophila bilopha*	Alouette bilophe		LC						
O		*Galerida cristata*	Cochevis huppé		LC						
P/FESIA		*Rhamphocoris clotbey*	Alouette de Clot-bey		LC						
O		*Alaemon alaudipes*	Sirli du désert		LC						
O	LANIIDÉS	*Lanius excubitor*	Pie-grièche grise		LC						x
O	SYLVIIDÉS	*Sylvia melanocephala*	Fauvette mélanocéphale		LC					x	x
FESIA		*Sylvia deserti*			NE						

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	Hunting Act	CITES Maroc AppIV	CITES App I	CMS App II	Berne App II
O		*Sylvia conspicillata*	Fauvette à lunettes		LC					x	x
O/FESIA		*Scotocerca inquieta*	Dromoïque du désert		LC					x	
P/FESIA	TIMALIDÉS	*Turdoides fulva*	Cratérope fauve		LC						
FESIA	TURDIDÉS	*White-tailed Wheatear*	White-tailed Wheatear		LC						
O/FESIA		*Oenanthe moesta*	Traquet à tête grise		LC						
O/FESIA		*Oenanthe deserti*	Traquet du désert		LC						
P	FRINGILLIDÉS	*Rhodopechys githaginea*	Roselin githagine		LC			x			x
FESIA	Passeriformes	*Ptyonoprogne obsoleta*	Pale crag martin		NE						
FESIA	Meropidae	*Merops persicus*	Blue-cheeked Bee-eater		LC						

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	Hunting Act	CITES Maroc AppIV	CITES App I	CMS App II	Berne App II
FESIA	Corvidata	*Corvus ruficollis*	Brown-necked Raven		LC						

Table 20-4 Mammals

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	UICN Morocco	Hunting Act	CITES Maroc AppIV	CITES App II	CMS App I	Berne App II	Berne App III
P	INSECTIVORES	*Crocidura tarfayaensis*	Crocidure de Tarfaya	SAH	DD								
P		*Hemiechinus aethiopicus*	Hérisson du désert		LC	DD		x	x				
P	LEPORIDES	*Lepus microtis*	Lièvre de savanne		LC								
P		*Lepus capensis*	Lièvre commun		LC	LC	LC						x
P	RONGEURS	*Jaculus jaculus*	Petite Gerboise		LC	LC							

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	UICN Morocco	Hunting Act	CITES Maroc AppIV	CITES App II	CMS App I	Berne App II	Berne App III
P		*Gerbillus henleyi*	Gerbille pygmée		LC	LC							
P		*Gerbillus tarabuli*	Gerbille de Libye		LC	LC							
P		*Pachyuromys duprasi*	Rat à queue en massue	SAH	LC	LC							
P		*Meriones crassus*	Mérione du désert		LC	LC							
P		*Eliomys melanurus*	Lérot de Berbérie	MAG	LC	LC			x				
O		*Psammomys obesus*	Rat de sable diurne		LC	LC							
P	CARNIVORES	*Canis anthus*	Loup doré d'Afrique	AFR	LC								
P		*Felis silvestris ssp libyca*	Chat ganté		LC	LC	NT	x		x			
E		*Hyaena hyaena*	Hyène rayée		NT	VU	EN	x	x				

Presence	Group	Scientific Name	Common Name	Endemic Species	Global UICN	UICN Mediterranean	UICN Morocco	Hunting Act	CITES Maroc AppIV	CITES App II	CMS App I	Berne App II	Berne App III
P		*Ictonyx libyca*	Zorille de Libye	SAH	LC	LC		x	x				
P		*Vulpes rueppellii*	Renard famélique		LC	LC			x				
E	ARTIODACTYLES	*Gazella dorcas*	Dorcas Gazele	AFN	VU	EN	EN	x			x	x	
FESIA	Vespertilionidae	*Pipistrellus rueppellii*	Rüppel's Pipistrelle		LC	LC							
FESIA	Vespertilionidae	*Eptesicus serotinus*	Serotine		LC	LC							
FESIA	Erinaceidae	*Paraechinus aethiopicus*	Desert Hedgehog		LC	LC							