Mocuba Solar Project

Simplified Environmental Study

Client: Scatec Solar, Norfund & EDM

Prepared by: ERM, in partnership with Impacto

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IMPACTO
PROJECTOS E ESTUDOS AMBIENTAIS

Scatec Solar, Norfund and EDM (Sponsors of the Project)

ERM & Impacto

Simplified Environmental Study

20th of October 2015

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	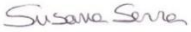	
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LIST OF ACRONYMS

Acronym	Description
AC	Alternative current
ADI	Area of Direct Influence
AII	Area of Indirect Influence
EIA (AIA)	Environmental Impact Assessment (Avaliação de Impacto Ambiental)
APA	Agência Portuguesa de Ambiente (Portuguese Environment Agency)
ARA-Sul	Administração Regional das Águas do Sul (Regional Administration of Southern Waters)
ASR	Air Sensitive Receptors
CFM	Caminhos de Ferro de Moçambique (Mozambique Railways)
CO	Carbon Monoxide
dB (A)	Decibel
DC	Direct Current
DEM	Digital Elevation Module
DTA	Departamento de Terras e Águas (Department of Lands and Waters)
DLM	Digital Land Module
DNPC	Direcção Nacional de Património e Cultura (National Directorate of Heritage and Culture)
DPCA	Direcção Provincial de Coordenação Ambiental (Provincial Directorate of Environmental Coordination)
DPACZ	Direcção Provincial de Coordenação Ambiental da Zambézia (Zambezia Provincial Directorate of Environmental Coordination)
DUAT	Direito de Uso e Aproveitamento da Terra (Right to the Use and Exploitation of the Land)
SES (EAS)	Simplified Environmental Study (Estudo Ambiental Simplificado)
EASD	Estratégia Ambiental para o Desenvolvimento Sustentável (Environmental Strategy for Sustainable Development)
EIS (EIA)	Environmental Impact Study (Estudo de Impacto Ambiental)
EDM	Electricidade de Moçambique (Mozambique Electricity)
EPC	Engineering, Procurement and Construction contractor (empreiteiro de Engenharia, Aprovisionamento e Construção)
EPDA	Estudo de Pre-viabilidade Ambiental e Definição de Âmbito (Pre-Viability Study and Scope Definition)
ERM	Environmental Resources Management
GEG (GEE)	Greenhouse Effect Gases (Gases de Efeito de Estufa)
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectare
HCB	Hidroeléctrica de Cahora Bassa (Hydroelectric of Cahora Bassa)
IBA	Important Bird Conservation Area
ICP	Inductively Coupled Plasma Spectroscopy
IDF	Intensity-Duration-Frequency
IEA	Instituto de Estudos Avançados (Institute of Advanced Studies)
IFC	International Finance Corporation
INE	Instituto Nacional de Estatística (National Statistics Institute)
M amsl	Meters above Mean Sea Level
MAP	Mean Annual Precipitation
MITADER	Ministério da Terra, Ambiente e Desenvolvimento Rural (Ministry of Land, Environment and Rural Development)

MWp	Megawatts at peak
NOx	Nitrogen Oxides
NO_2	Nitrogen Dioxide
PGA /EMP	Plano de Gestão Ambiental (Environmental Management Plan)
WHO /OMS	World Health Organization (Organização Mundial da Saúde)
PM	Particulate Matter suspended in the air PM_{10} is airborne particulate matter with an aerodynamic diameter less than 10 microns (μm); $PM_{2.5}$ is less than 2.5 μm.
PV	Photovoltaic
PPA	Power Purchase Agreement
PPP	Processo de Participação Pública (Public Participation Process)
SANS	South Africa National Standards
SDAE	Serviços de Actividades Económicas (Economic Activity Services)
SCS	Serviços de Conservação do Solo (Soil Conservation Services)
SRTM	Shuttle Radar Topography Mission
SO_2	Sulphur Dioxide
TdR	Termos de Referência (Terms of Reference)
USDA	United States Department of Agriculture
ULSD	Ultra-Low Sulfur Diesel
UNEP	United Nations Environmental Program
UNESCO	United Nations Education, Science and Culture Organization
ZEE	Zona Económica Especial (Special Economic Zone)

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INTRODUCTION

Environmental Resources Management (ERM) in partnership with *Projectos e Estudos de Impacto Ambiental Lda* (Impacto) was contracted by Scatec Solar, *Electricidade de Moçambique* (EDM) and Norfund (the Sponsors of the Project) to undertake a Simplified Environmental Study (SES) for the proposed construction and operation of the Mocuba Solar Photovoltaic (PV) Power Plant with an electrical power production capacity of approximately 30 MW AC. The plant will be located in the locality of Mogonda, Administrative Post of Mocuba Sede, District of Mocuba, Province of Zambezia, in Mozambique.

The proponents of the project developed a joint accord for the construction and operation of the solar PV plant which will operate under a Power Purchasing Agreement (PPA) for 25 years where EDM will be the sole off-taker.

In accordance with Decree No. 45/2004 of 29th of September, which regulates the procedure for Environmental Impact Assessment (EIA) in Mozambique, the EIA process commenced with the submission of project registration proceedings to the Zambezia Provincial Directorate of Environmental Coordination (*Direcção Provincial para a Coordenação da Acção Ambiental* (DPCAZ) *da Zambézia*), in Quelimane, on the 10th of June 2015. This resulted in the categorization of the activity by the DPCA who issued an official letter categorizing the activity as Category B.

Thereafter, the Terms of Reference (ToR) for the Simplified Environmental Study was prepared and submitted to the DPCAZ on the 7th of August 2015. They issued an official letter (N/REF402/GD/DPCAZ/023/ 2015) approving the ToR and provided recommendations which were considered in the preparation of the Simplified Environmental Study (SES).

SUMMARY DESCRIPTION OF THE PROJECT

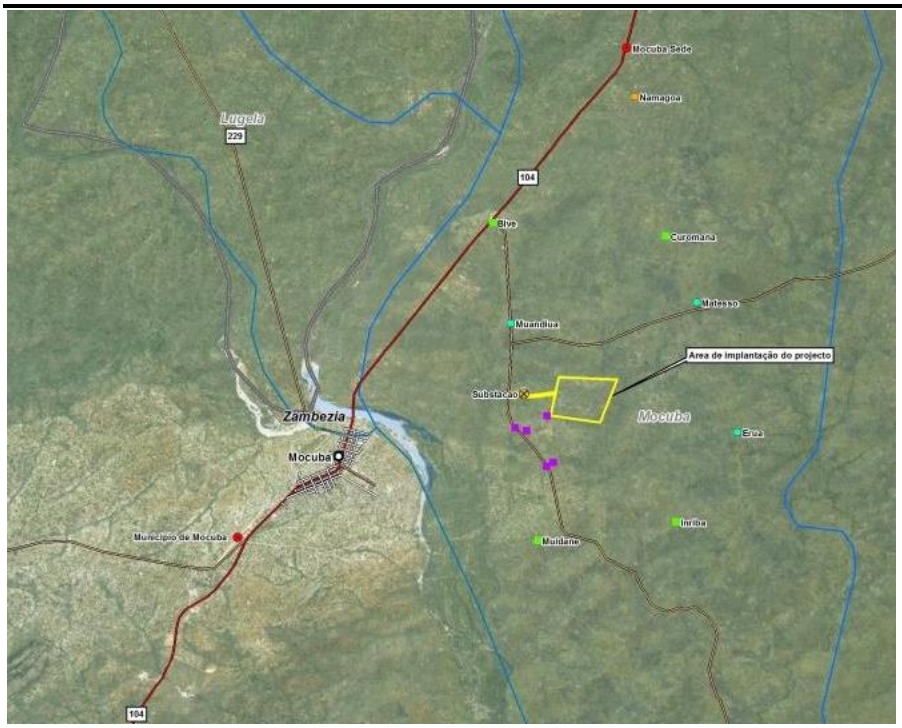
The Sponsors intend to design, construct and operate a solar PV plant with 30 MW AC capacity. The solar panels will be mounted using a steel substructure embedded into the ground. The power plant will use solar panels with a tracking system which follows the sun and optimizes power generation.

Solar PV plants use solar cells to capture and convert the sun's energy into electrical power through a process known as the 'photovoltaic effect'. This effect refers to the creation of electrical voltage or a corresponding electrical current in a material, after it is exposed to light.

The power plant will be built on 126 hectares (ha), near the existing substation in Mocuba, 13 km from the center of the city of Mocuba, in the Zambezia

province, Mozambique. The proposed site is located in the Special Economic Zone of Mocuba (Zona Económica Especial de Mocuba (ZEE)).

Figure 0.1 Location of the Project



NEED FOR THE PROJECT

The project is being developed in the context of the strategic initiatives of EDM. EDM is developing the implementation of a limited program for the development of renewable energy with specific projects linked to the grid which may address the following targets of their energy strategy:

- Security of supply;
- Diversification of energy supply mix;
- Rural electrification, and
- Environmental awareness and sustainability.

During the second semester of 2014, EDM completed a least-cost supply study with the objective of responding to the fast growth of present and future energy demand in the northern area of Mozambique. The study was triggered by the fact that the supply and distribution capacity existing in the northern transmission corridor ("Center-North Line") was already reached, which increased the existing supply deficit in the areas of the northern parts of the country.

While a long term plan was approved to expand the capacity of the transmission system of the Center-North line by means of the construction of a new 400 kV transmission grid, this important initiative will take time to

implement, and it is not expected to make any contributions to power supply and increase of energy to the north of Mozambique, during the next five or more years.

The recommended least-cost plan for supply to the north of Mozambique consists of a portfolio of complementary initiatives, including short term debottlenecking solutions for the central-north transmission grid, as well as the establishment of new local generation at important sites along the transmission grid, to augment supply, including both renewable and conventional thermal power options. The objective for generation of renewable energy in terms of supply of solar PV electricity was identified as part of the recommended solution, with solar energy projects expected to be implemented in Mocuba, as well as Metoro further north.

The site of Mocuba is also viewed as critical in supporting the Government of Mozambique's economic and social development initiatives, with Mocuba having been declared a rapid special economic development zone by the Government in May 2014.

In this context, EDM signed a memorandum of understanding with Scatec Solar and Norfund on the 22nd of December 2014 to prepare a pre-feasibilty study for the establishment of an independent solar energy production project in Mocuba with a capacity of up to 30 MW AC, while ensuring the achievement of the broader strategic objectives of the energy sector, and also responding to the recommended least-cost supply strategy for the north of Mozambique.

It is expected that the project will expand the renewable energy generation capacity in Mozambique, diversify its energy mix and strengthen private sector investment in one of Mozambiques targeted development areas.

MAIN IMPACTS IDENTIFIED

An undertaking like this always produces changes in the several elements that compose the environment, and these changes can, in the majority of cases, be minimized by means of a set of mitigating actions which can be adopted during the construction and operation of the project.

Based on the impact assessment performed in the Simplified Environmental Study (SES), the impacts of the Project as well as their significance were presented and described. This exercise identified the mitigation measures for the impacts and culminated in the preparation of an Environmental Management Plan for the main issues identified. This plan includes requirements for management on site of the environmental and social aspects, during the construction, operation and deccomissioning of the Project.

As for the positive impacts resulting from the implementation of the project, these relate mainly to the social component of the project and includes the creation of jobs and the improvement of the local economy through the

empowerment of the services, the higher movement of people to the area and an increase in the State's fiscal income.

The main negative impacts identified are related to the following aspects:

- Occupation of 126 ha of area presently used for farming plots (machambas);
- Potential erosion due to clearing of vegetation and potential increase of sediment in water lines near the site;
- Impeding the movement of people due to the fencing of the site;
- Change to the local landscape due to the existence of "strange" new infrastructure;
- Impacts on animals that presently use the project area (mainly birds);
- Changes to the air quality and noise baseline, and
- Potential traffic accidents due to construction traffic.

The Environmental Management Plan (EMP) contains the main mitigation measures to minimize identified impacts. The proposed mitigation measures include:

- Prioritize local labour for contracting people to work on the project;
- Prepare a compensation plan for people affected by the occupation of their farming plots by the project;
- Control construction noise so it will minimally interfere with neighboring communities by not producing noise during the night and on Sundays and holidays;
- Controlling the speed of construction vehicles;
- Create conditions for birds to avoid the project installation site.

Due to the proximity of some populated areas, a plan was defined for the monitoring of noise, to be implemented in the construction and operation phases of the project.

CONCLUSIONS AND THE NEXT STEPS

Based on the evaluation of impacts and the environmental management plan that was prepared, it was concluded that there are no environmental or social fatal flaws or major impacts. This study shall be delivered to MITADER who will provide their opinion on the assessment performed by ERM and Impacto. Subsequent to this we expect that an environmental license for the project will be issued which will allow construction to commence.

Should you have any comments about the issues identified above, please send them to ERM at the following contacts:

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1 INTRODUCTION

Environmental Resources Management (ERM) in partnership with *Projectos e Estudos de Impacto Ambiental Lda* (Impacto) was contracted by Scatec Solar, *Electricidade de Moçambique* (EDM) and Norfund (the Sponsors of the Project) to undertake a Simplified Environmental Study (SES) for the proposed construction and operation of the Mocuba Solar Photovoltaic (PV) Power Plant with an electrical power production capacity of approximately 30 MW AC. The plant will be located in the locality of Mogonda, Administrative Post of Mocuba Sede, District of Mocuba, Province of Zambezia, in Mozambique.

This document presents the results of the Simplified Environmental Study (SES).

In accordance with Decree No. 45/2004 of 29th of September, which regulates the procedure for Environmental Impact Assessment (EIA) in Mozambique, the EIA process commenced with the submission of project registration proceedings to the Zambezia Provincial Directorate of Environmental Coordination (*Direcção Provincial para a Coordenação da Acção Ambiental* (DPCAZ) *da Zambézia*), in Quelimane, on the 10th of June 2015. This resulted in the categorization of the activity by the DPCA who issued an official letter categorizing the activity as Category B. (see Appendix I).

Thereafter, the Terms of Reference (ToR) for the Simplified Environmental Study was prepared and submitted to the DPCAZ on the 7th of August 2015. They issued an official letter (N/REF402/GD/DPCAZ/023/ 2015) approving the ToR and provided recommendations which were considered in the preparation of the Simplified Environmental Study (SES).

1.1 PROJECT JUSTIFICATION

The project Sponsors have developed a joint accord for the construction and operation of a solar PV plant with an electrical power production capacity of approximately 30 MW AC ("proposed project"). The Project will operate under a Power Purchase Agreement (PPA) for 25 years where EDM will be the only client (sole off-taker).

The solar panels will be mounted using a steel substructure embedded into the ground.. The power plant will use solar panels with a tracking system which follows the sun and optimises power generation.

Solar PV plants use solar cells to capture and convert the sun's energy into electrical power through a process known as the 'photovoltaic effect'. This effect refers to the creation of electrical voltage or a corresponding electrical current in a material, after it is exposed to light. In the "photovoltaic effect", electrons are ejected from the surface of the solar PV panel after exposure to sun radiation. Theses electrons are then transferred between different bands

(i.e., from the valence bands to the conduction bands) within the solar panel material itself, resulting in the development of electrical voltage between two electrodes.

A PV cell is made of silicon which acts as a semiconductor used to produce the photovoltaic effect. Due to the structure of the silicone's semiconductor, the electrons are forced in one direction, creating a flow of electric current (direct current). The PV cell is positively charged on one side and negatively charged on the other side, and electric conductors are connected to both sides to form a complete circuit. This circuit will then capture the electric current. An inverter is needed to change the direct current to alternative current (AC). Electricity is then distributed through a power line to the national grid.

The power plant will be built on 126 hectares (ha) of land, near the existing substation in Mocuba, 13 km from the center of the city of Mocuba, in the Zambezia province, Mozambique. The proposed site is located within the Special Economic Zone of Mocuba (*Zona Económica Especial de Mocuba* (ZEE)).

1.2 NEED AND OBJECTIVE OF THE PROJECT

The project is being developed in the context of the strategic initiatives of EDM. EDM is pursuing the development and implementation of a limited renewable energy development program with specific grid-connected projects which can address the following energy strategy goals:

- Security of supply;
- Diversification of energy supply mix;
- Rural electrification, and
- Environmental awareness and sustainability.

During the second half of 2014, EDM completed a least-cost supply study in respect of meeting current and future rapid energy demand growth in the northern parts of Mozambique. The study was triggered by the realization that the existing power supply and transfer capacity of the central – north transmission corridor ("Linha Centro-Norte") had been reached, increasingly causing supply deficits and load shedding in the northern parts of the country.

While a long-term plan has been approved to expand the capacity of the central-north transmission system by construction of a new 400kV transmission grid, this important initiative will take time to implement and is not expected to make any contributions to power supply security and growth in northern Mozambique over the next five years of more. The least cost study objective was to establish a short to medium-term supply expansion plan but in such a way that initiatives implemented to augment supply constraints in the short term do not lead to any stranded investment in the longer term.

The recommended least-cost plan for supply to northern Mozambique consists of a portfolio of complementary initiatives, including short-term debottlenecking of the central-north transmission grid as well as establishment of new local generation at important nodes in the transmission grid to augment supply, including both renewable and conventional thermal power options. The scope for renewable energy generation in terms of solar PV electricity supply was identified as part of the recommended solution, with solar PV projects envisaged to be implemented in Mocuba as well as Metoro further north.

The Mocuba location is also viewed as critical in supporting the Government of Mozambique's economic and social development initiatives, with Mocuba having been declared a special rapid economic development zone by Government in May 2014.

In this context, EDM signed an Memorandum of Understanding (MoU) with Scatec Solar and Norfund on the 22nd December 2014 to undertake a pre-feasibility investigation into the potential establishment of an independent solar power production project at Mocuba in north-central Mozambique with capacity up to 30MW AC, while ensuring the achievement of the broader energy sector strategic goals referred to above and responding to the recommended least-cost supply strategy for northern Mozambique.

The Project is expected to expand Mozambique's renewable energy generating capacity, diversify its energy mix, and strengthen private sector investment in one of Mozambique's targeted development areas.

1.2.1 Energy Security of Supply

This Project will contribute to the energy security of supply for Mozambique by creating additional average 70,000MWh (megawatt hours) (1MWh is one million watts of power produced / used in one hour) per year generation capacity for the national grid over the 25-year design lifetime of the facility.

The four provinces of Zambézia, Nampula, Niassa and Cabo Delgado are supplied with electricity by EDM's central northern transmission system via a single 220kV line which runs from Caia and Chimuara northward towards Nampula. When there is a problem with this transmission line (due to servicing requirements or faults on the line), as happened during the major floods in January and February 2015, then the four provinces of Zambézia, Nampula, Niassa and Cabo Delgado do not receive any electricity whatsoever. There is very limited generation capacity within these provinces, which consists only of a diesel power plant which should only be used in case of emergency.

This project will introduce a new electricity generation capacity for these provinces, in case they will again be isolated from the center-north transmission system.

The lack of local generation capacity within Zambézia, Nampula, Niassa and Cabo Delgado provinces as well as the long transmission lines result in a limited power transfer capacity of the system due to stability considerations. The main central to northern transmission line system has reached its current capacity limit which is preventing economic growth in this part of Mozambique. This is having a significant negative impact on economic activity levels and near-term growth prospects, particularly impacting growth of small and medium scale enterprises.

The proposed Project will make an important contribution to mitigate against the current and near-term supply constraints within the Zambézia, Nampula, Niassa and Cabo Delgado provinces. The integration of the proposed 30MWac PV power renewable energy facility at Mocuba will bring more stability to the EDM transmission network and it will result in a 7% improvement in the fault level and an expected 15% reduction in overall transmission losses (implying a reduction of between 5% and 7% in the overall MWh energy losses).

Figure 1.1 EDM's energy transmission system

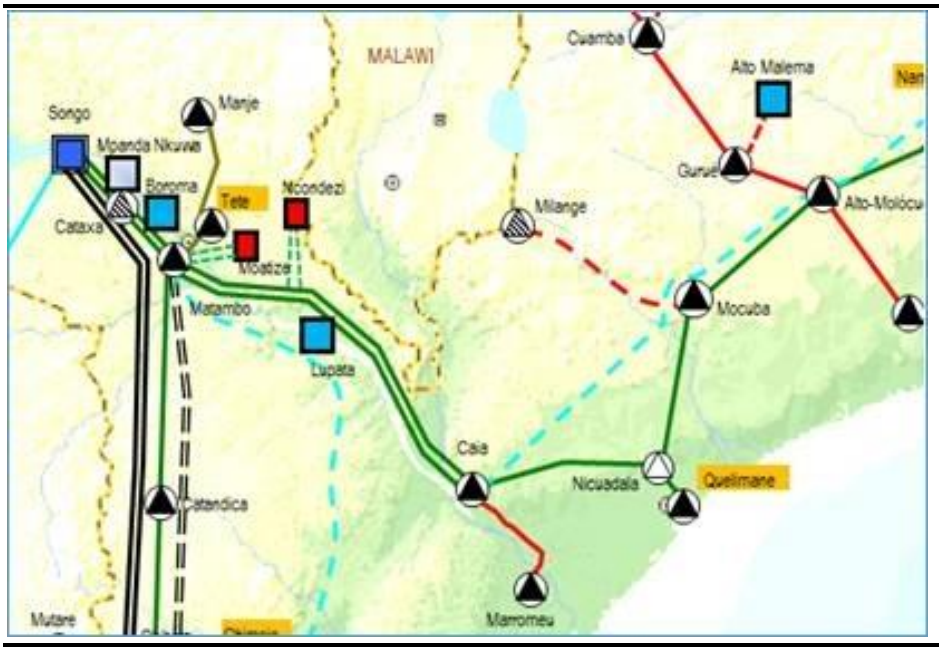
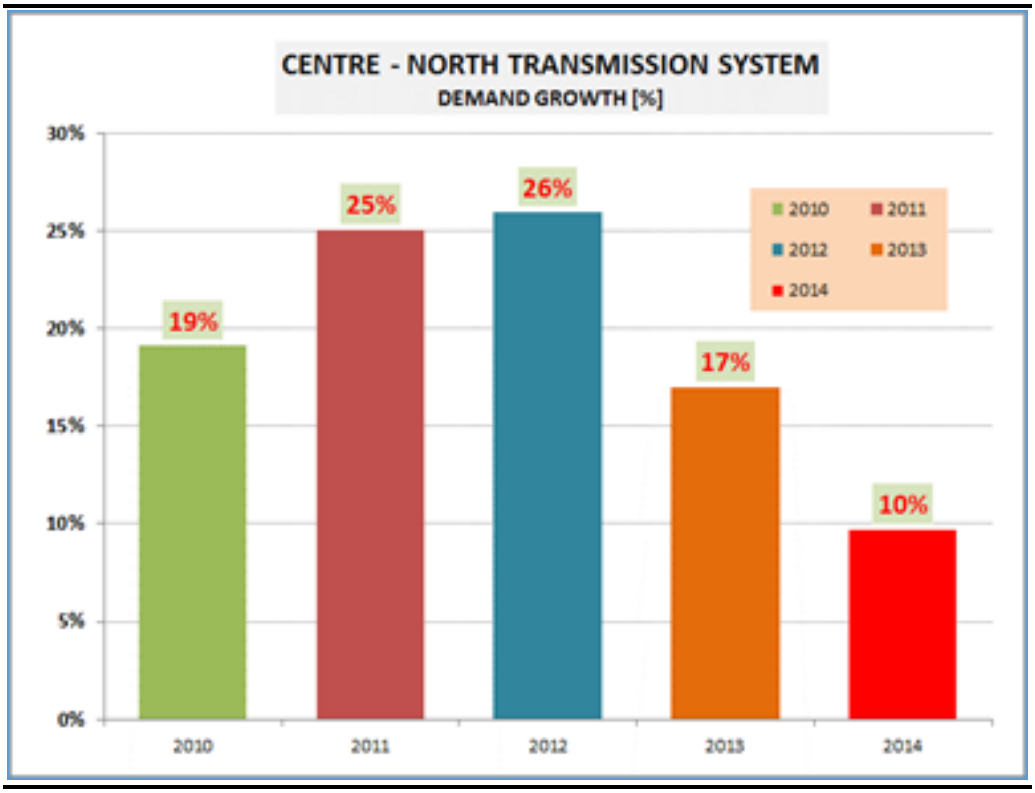


Figure 1.2 Demand on the center-north transmission line (%)



1.3 *PROPONENT OF THE PROJECT*

The proponent of the project is a joint venture between EDM, Scatec Solar and Norfund.

Electricidade de Moçambique is a Mozambican state-owned electricity company, established in 1977 which generates, distributes and sells electricity within Mozambique.

Scatec SA (Pty) Ltd, a subsidiary of Scatec Solar AS (Norway), specialises in solar power renewable energy facilites. The company has offices in South Africa, Jordan, Honduras, United States and Norway, among others, and operates facilities in eight countries throughout the world. Scatec Solar is an independent energy producer which aims to make solar energy a sustainable and accessible energy source worldwide.

The Norwegian Investment Fund for Developing Countries (Norfund) invests in the establishment and development of profitable and sustainable enterprises in developing countries by contributing to the development of local businesses, jobs and economic growth. Norfund's main investment regions are Southern and Eastern Africa. Norfund has offices located in Kenya (Nairobi), South Africa (Johannesburg) and Mozambique (Maputo).

2 LOCATION AND DESCRIPTION OF THE ACTIVITY

2.1 LOCATION

The PV plant will be built approximately 13 km from the center of the city of Mocuba in the province of Zambezia, Mozambique. The site is located near the existing EDM substation of Mocuba (*Table 2.1*). The proposed area will be approximately 126 ha in etxtent.

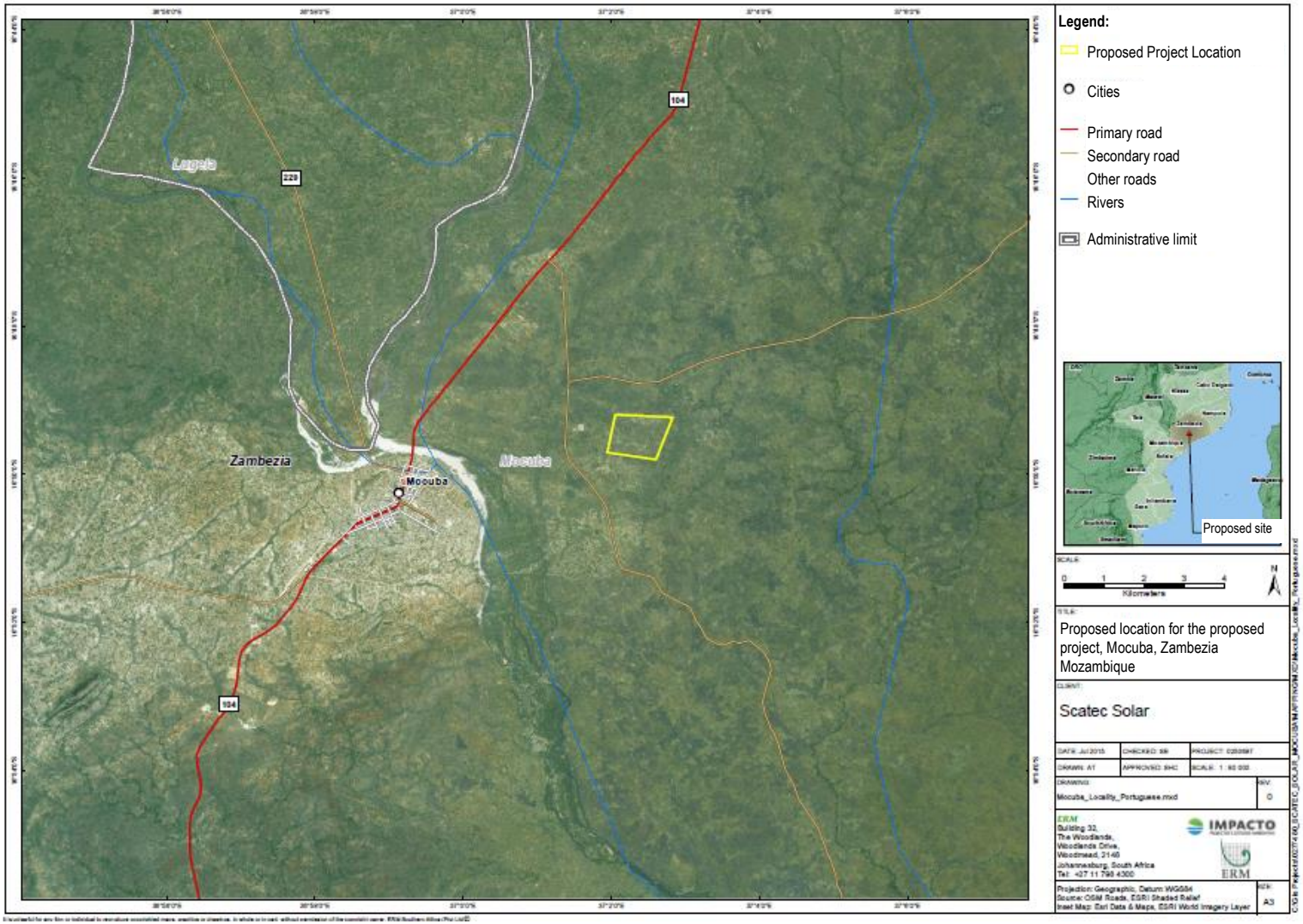
The approximate coordinates of corner points of the proposed project area are given in the following table (Table 2,1):

Table 2.1 Coordinates of the Project Area

Corner	Latitude	Longitude
A	16° 49' 11.88"S	37° 2' 3.37"E
B	16° 49' 13.78"S	37° 2' 49.65"E
C	16° 49' 47.97"S	37° 2' 36,26"E
D	16° 49' 42.29"S	37° 1' 56.64"E

The location is within the Special Economic Zone (Zona Económica Especial (ZEE)) of Mocuba (as established in May 2014). The ZEE of Mocuba is an initiative of the Government of Mozambique to attract investment and contribute to the development of the province of Zambezia.

Figure 2.1 Location of the Proposed Project



2.2 *SUMMARY OF THE PROCESS*

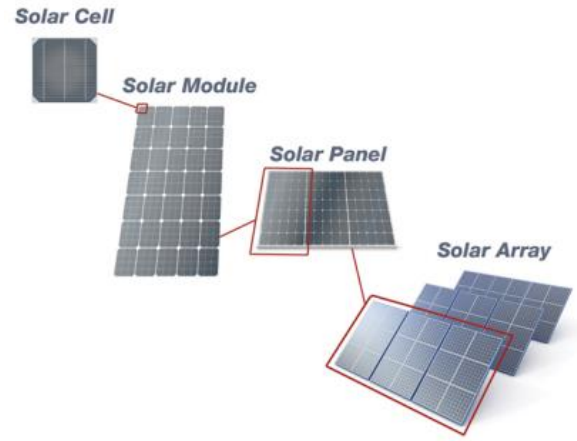
Solar energy systems produce energy by converting solar radiation into electricity or heat. The proposed project will use photovoltaic solar technology (PV) to generate electricity. The photovoltaic solar technology chosen for this project consists of the following main components:

- PV cell: The PV cell is the device that generates electricity when exposed to solar radiation. The absorbed solar energy excites the electrons inside the PV cell and produces electrical energy. The PV cells are usually built with polycrystalline silicon. All PV cells produce direct current (DC);

- Photovoltaic (PV) module and panel: The PV module is the set of interconnected photovoltaic cells. In the case of crystalline silicon cells, after tests and screening to match the current and the voltage, the cells are interconnected and encapsulated between a transparent front (usually glass) and a support material. The PV module is normally mounted on an aluminum structure. Photovoltaic panels include one or more PV modules mounted as an unit, with the wiring already installed; and

- PV array: The PV array is the integrated assembly of modules together with support structures to form a DC energy production unit. The project will use anti-reflection photovoltaic modules located on several arrays. The supply of electric energy to the grid requires the transformation of PV array DC current into alternative current (AC) by means of an inverter.

Figure 2.2 Cell, module and photovoltaic array



Source: Photovoltaic Array Fundamentals, etap.com

2.3 *COMPONENTS OF THE PROJECT*

The project involves the construction and operation of a solar PV power plant.

The project consists of the following components:

- PV modules;
- Inverters to convert DC into AC and step-up transformers;
- Electrical conduits above- and underground, and cables to connect the modules to the inverters and transformers, as well as to link the PV plant to the existing substation in Mocuba;
- Existing substation in Mocuba to link to the national electric grid;
- Office and operations and maintenance building;
- Access road with (6 to 8 meters wide), starting at the existing road and ending at the site for construction and operations;
- Internal access paths for site maintenance; and
- Perimeter security fence and landscaping.

2.3.1 Photovoltaic Modules (PV)

The solar power plant will compose of panels of polycrystalline PV modules each one with a nominal voltage of 1,500 V. There will be 32 modules per string. Each PV module power rating will be 320 Wp and the number of strings will be 3952 (equaling a total number of modules of 126,464).

The PV modules will be mounted on a racking frame supported by posts driven into the ground, installed in regular arrays. The total number of AC installed power will be 30MW AC. The total DC power will be approximately 40MW. The plant will occupy approximately 70 ha of the 126 ha site.

Each array will be approximately 128 m x 4 m (6 tables make an array) and a total of 494 arrays will be installed.

The PV modules will be mounted on a system which tracks the sun's movement. There are various tracking systems. A 'single axis tracker', which is the preferred option, will track the sun from east to west, while a dual axis tracker tracks the seasonal waning of the sun. These systems utilise moving parts and complex technology programmed according to a pre-calculated algorithm to optimise the exposure of the PV modules to sunlight. The single axis tracker alone can increase output by up to 25 percent. A typical setup consists of 6 PV tables driven by a single motor to form an array.

Figure 2.3 Solar modules section

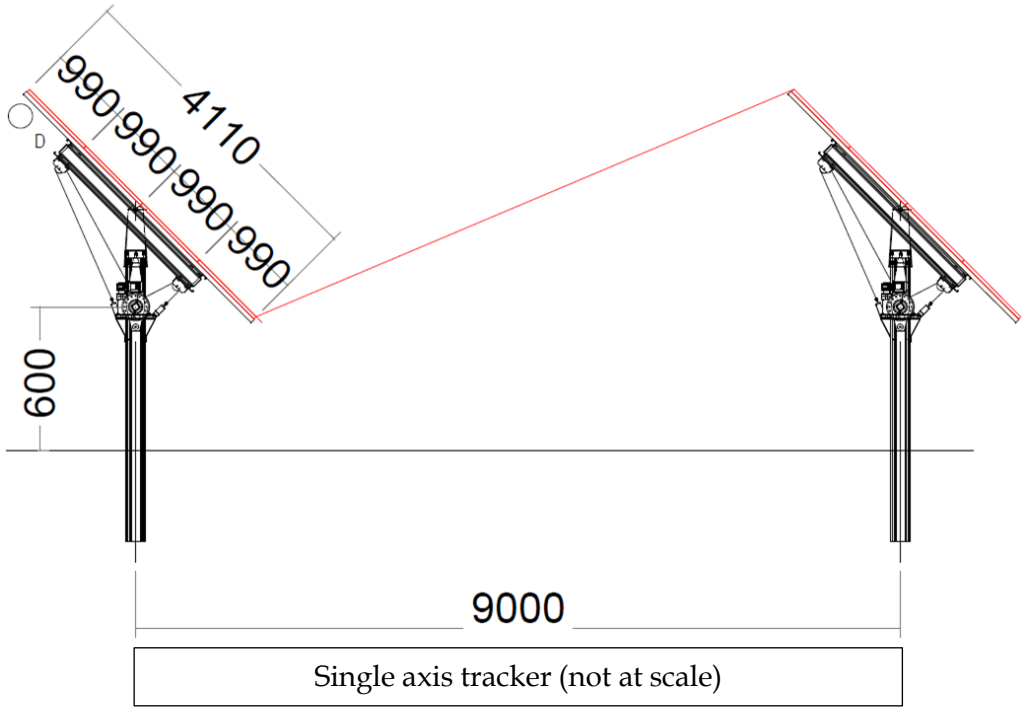


Figure 2.4 Typical configuration of a solar power plant with tracker technology

Figure 2.5 Detailed development of the site including solar modules, transformers and buildings

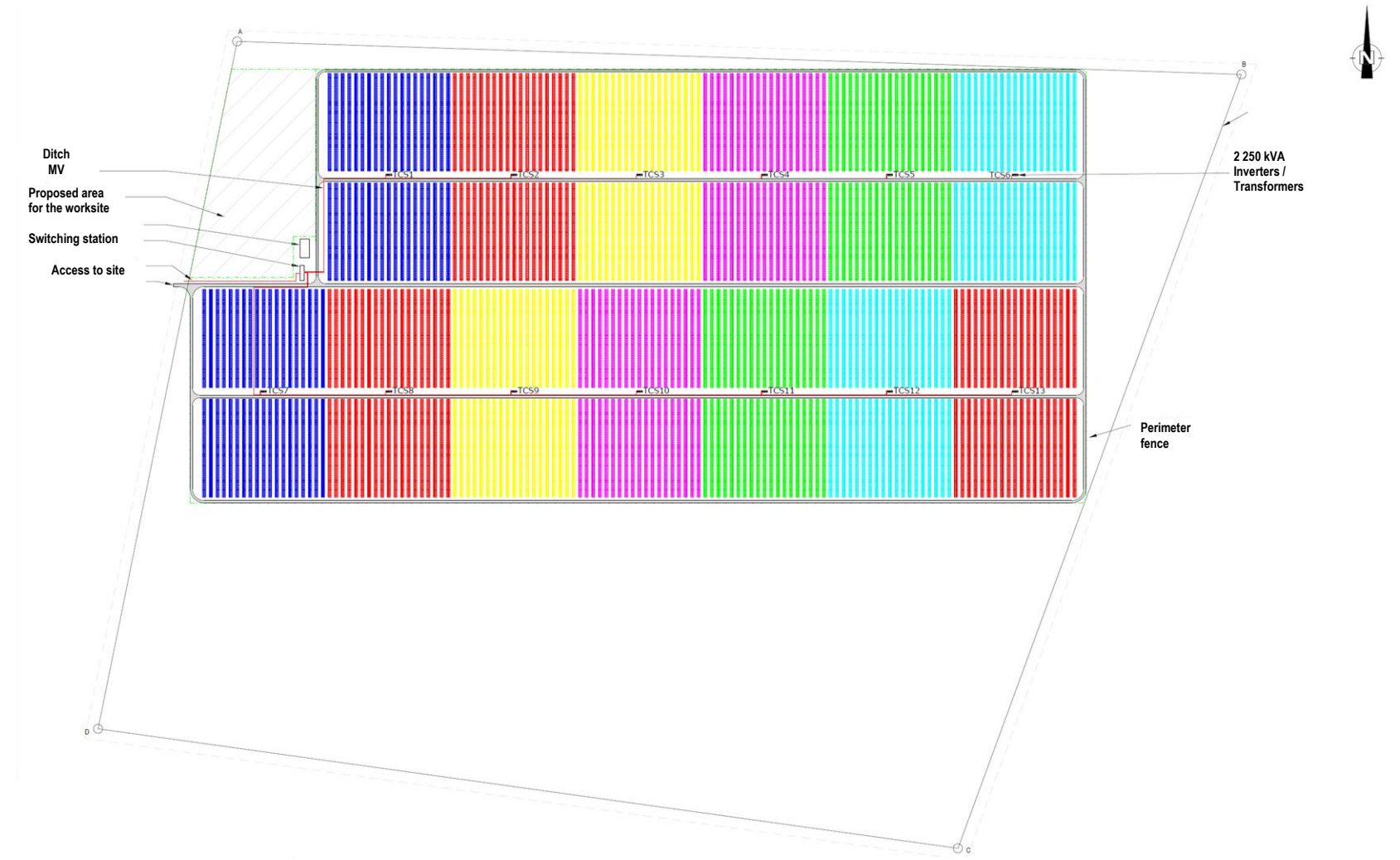
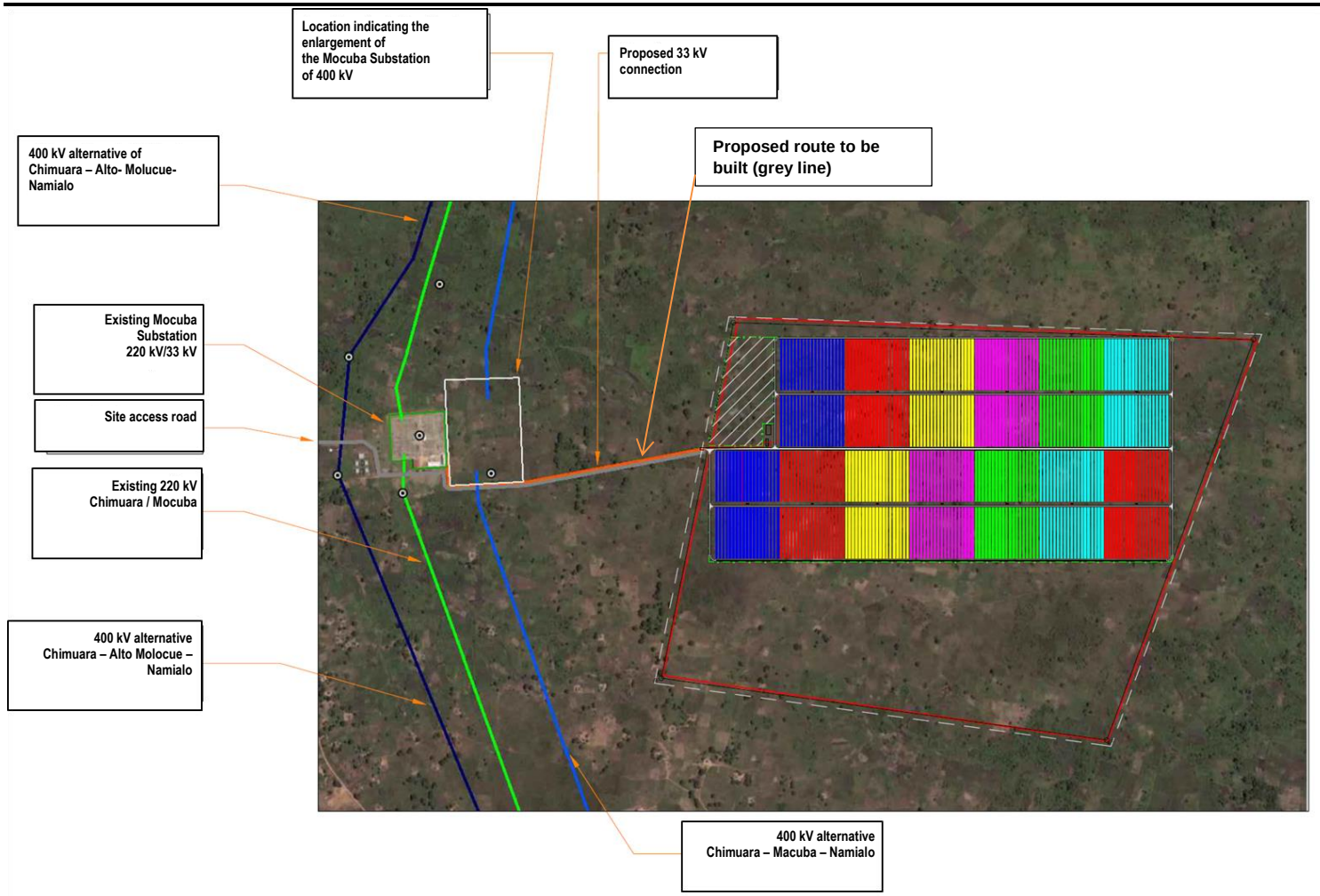


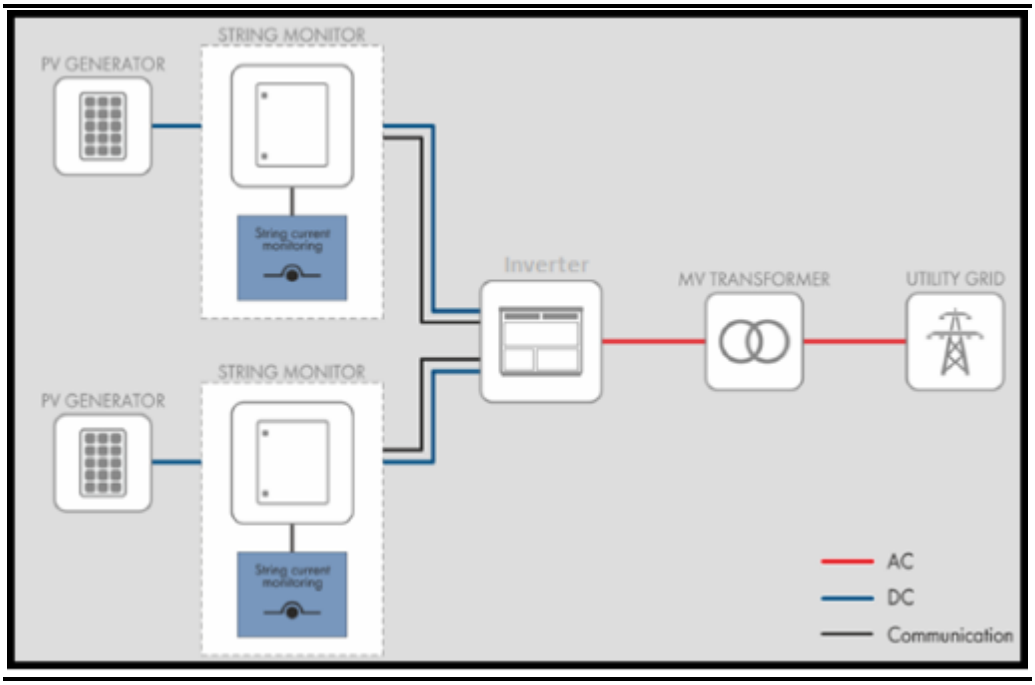
Figure 2.6 Development of the site relative to the existing Mocuba substation



2.3.2 *Electrical Control and Connections*

The PV modules will be connected cables to array enclosures mounted underneath the PV module mounting structures. Each array enclosure will occupy an area of approximately one square metre. The power generated by many PV arrays is combined in the array enclosure and transmitted via DC cables to an inverter and transformer enclosure (Figure 2.7).

Figure 2.7 Simplified connection diagram



The inverter converts the DC current to AC. A maximum of 2,500 kVA will be produced per inverter from the 1,500 V DC. The inverter is approximately 3 m x 2.5 m x 1.5 m and weighs approximately 4,000 kg. The transformers transform the low voltage AC from the inverter to medium voltage. The transformer is approximately 4.5 m x 2.5 m x 2.5 m and weighs approximately 9,150 kg. The inverter and transformer will be housed in a station or on top of a skid . The inverter will be connected to a medium voltage switching station on site.

The nominal transformer power will be 2 250kVA and the total nominal transformer voltage 33kV. Thirteen transformers will be installed.

An internal electrical network will be use to provide power to the ancillary infrastructure on site.

Figure 2.8 Standard inverter unit

Figure 2.9 Standard transformer unit

2.3.3 Connection to the Grid

The electricity generated by the plant will be connected to the national grid using the existing 33 kV electrical busbar in the Mocuba substation. This will be achieved by connecting the medium voltage switching station on the site to the Mocuba 220 kV/33kV substation via a 33kV transmission line.

2.3.4 *Additional Electrical Equipment*

The following additional electrical equipment will be installed:

- Photovoltaic monitoring equipment and associated telecommunications;
- Weather monitoring equipment (precipitation, wind direction, solar radiation, atmospheric humidity, temperature);
- Air conditioning equipment inside the inverters and transformers enclosures, which will regulate the temperature and operation of the inverters; and
- A 20 kVA diesel generator will supply energy for the security and monitoring systems in case of power failure.

2.3.5 *Roads and Internal Lanes*

A gravel access road (6 to 8 meter wide) will be created to allow access to the site. Internal lanes will be created to allow access within the plant.

A minimum spacing of 9 m will be kept between each row of solar PV arrays to minimize shadowing of the panels by adjacent rows, however, these spaces will not be gravelled or paved. Access will be needed primarily for light service vehicles entering the site for maintenance, inspection and PV panel cleaning purposes.

2.3.6 *Additional Infrastructure*

The permanent additional infrastructure will include:

- Office;
- Perimeter fence comprised of an electrified fence approximately 2.5 m high, including access gates; and
- Lighting at the main entrance only.

2.4 *PHASES OF THE PROJECT*

2.4.1 *General Project Schedule*

The estimated construction period is 9 months. The peak of the construction period will be reached after approximately 3 months.

2.4.2 Construction Phase

The main steps for construction of the power plant will be the following:

- Construction and power plant equipment will be transported to the site. The solar arrays will be built by rows of solar panels, inverters, transformers, cables and substructures all sent by ships and trucks. Imported material will be sent to Quelimane and transported by road on trucks to the site (approximately 175 km). The sources will be China, Europe, South Africa (depending on the suppliers);

- Construction of the access roads and preparation of the site. Site preparation includes clearance of vegetation, removal of surface layer of soil and of large trees and leveling of the ground. Depending on the density of vegetation and characteristics of the soil, the removal of surface layer of soil may not always be mandatory;

- A laydown area will be prepared consisting of 2 to 4 ha of levelled land with the top 10 cm of soil compacted;

- Construction of inner roads and fence construction;

- Digging of trenches;

- Laying of cables (low and medium voltage);

- Construction of foundations for support structures of the solar modules;

- Installation of the steel structure (on the foundations) to support the solar panels. The structure will include moving parts, as well as cables and control units (see following Figure);

- Positioning and laying of cables for medium voltage converters and transformers;

- Installation of solar modules and alignment of the modules;

- Installation of monitoring equipment for meteorological data and power plant performance;

- Construction of buildings, including permanent office, monitoring room, warehouse building, water reservoir and switching station;

- Commissioning and tests of solar park; and

- Cleaning of site and deactivation of machines and of labour.

2.4.3 *Operation Phase*

Once the power plant is operational, it will require little attention. Routine activities will include maintenance, site security, maintenance of vegetation and replacement of equipment as necessary.

The panels will be cleaned an average once a year, however this may be increased to twice a year, depending on weather conditions.

2.4.4 *Decommissioning Phase*

The plant is expected to operate for at least 25 years. Once the plant reaches the end of its life, PV modules may be refurbished or replaced to continue operations or the facility may be closed and decommissioned. If decommissioned, all components would be removed and the site rehabilitated. The PV modules and electrical equiepment would be recycled as appropriate.

Of the photovoltaic solar system, several components of the plant can be recycled. As a question of principle, project components should be recycled, whenever possible, instead of being discarded to waste elimination installations. It is expected that solar modules can be recycles as well as electrical cables. Steel structures can also be recycled even if not directly through Scatec Solar (e.g., steel bars can be sold as scrap).

A business specialized in recycling of photovoltaic solar systems can be contracted, such as "First Solar" which specializes in recycling similar plants and is certified as ISO 14001 for environmental management, ISO 9001 for quality and OHSAS 18001 for safety and occupational health.

2.5 *LABOUR*

2.5.1 *Construction*

During the construction phase approximately 250 workers will be employed. Of these workers ninety percent (90%) will be of local Mozambican origin and ten percent (10%) will be qualified expatriate workers. From the 90%, the workforce is expected to be 60% skilled or semi-skilled and 40% non-skilled. Local workers will be sourced from Mocuba or other local districts.

There will be no temporary or permanent worker camps on the site during the construction phase. Workers will be housed in Mocuba and will be transported to and from the work site from an agreed meeting point in Mocuba or the local district (depending on number and origin of the labour force).

Local labour will be trained according to the EPC requirements and especially in terms of health and safety, quality, and specific assembly and processes

tasks to be followed on the construction site. Training will be both prior and during construction to promote diversification of tasks and duties of the local work force throughout the construction of the plant.

2.5.2 Operation

It is expected that six personnel would be employed to support routine operations and maintenance on and off site. The personnel will either be based in Mocuba or Maptuto to continuously monitor the plant performance and undertake visual inspections of the plant when required.

2.6 ENVIRONMENTAL MANAGEMENT

2.6.1 Water Requirements

Water usage during construction will be approximately 10,000 litres per day on average for all activities such as road construction, dust control, drinking water, and sanitary. Estimate peak usage during construction will be approximately 40, 000 litres per day.

During operations, estimated water consumption shall be approximately 4,000 litres per week. During a cleaning cycle approximately 400,000 litres of water will be needed. Water will be sourced locally and the relevant authorization will be obtained from the municipality.

2.6.2 Amounts of Fuels and Lubrication Oils

Hazardous materials will include primarily fuels and lubricating oils. Biodegradable oil will be used in the transformers at medium voltage level.

Petrol/Diesel will be the main type of fuel used during the construction period. It is estimated that approximately 1200 litres of fuel will be used during the peak construction period. An average of 600 litres of fuel will be used per week during the construction period of 6 months.

Above ground fuel storage tanks will be installed for the construction phase. Installation requirements will comply with local regulatory requirements. Drip trays will be placed underneath all vehicles during routine maintenance. Oil and hydrocarbon spillages will be cleaned up using best environmental practice.

2.6.3 Residue and Effluents

Waste generated during the construction phase will include cardboard boxes, paper, steel trash, wood, soiled water and sewage, plastic, wood pallets and paper products, and general residue.

All other waste will be separated on site, collected in appropriate way (stockpiled, bags, waste containers) and disposed to local waste dump.

Sewerage will need to be collected on a regular basis by private contractors/municipality. Chemical toilets will be used during the construction phase. The number of temporary chemical toilets needed shall depend on the peak number of workers and local regulations.

2.6.4 Traffic

It is estimated that approximately 600 trips will be required from Quelimane to Mocuba to transport equipment to the site. Traffic around the project site will include daily traffic to transport personnel and materials to and from the site

During the operational phase, traffic impacts will be less, with vehicles only required to transport infrastructure during routine maintenance and upgrading phases.

3 LEGAL FRAMEWORK

3.1 CONSTITUTION OF THE REPUBLIC OF MOZAMBIQUE

The Constitution of the Republic of Mozambique defines the right of all citizens to live in a balanced natural environment, and their duty to protect it (Art. 90). The constitution also establishes that "*The State and the local authorities, in cooperation with the environmental protection organizations, will adopt policies to protect the environment and assure the rational use of natural resources.*"

3.2 ENVIRONMENTAL LAW

The Environmental Law (*Decree No. 20/1997 of October 1st*) was approved by the National Assembly of the Republic of Mozambique in July 1997. The objective of this law is to establish a juridical framework for the correct use and management of the environment and its components. In accordance with articles 15 and 17 of that law, any activity that, by nature of its location, presentation or scale, can cause significant environmental impacts, requires an Environmental License, to be issued by the competent authorities. The authorities can only issue their final decision about the granting of the license based on the results of the Environmental Impact Assessment (EIA) process.

3.3 NATIONAL ENVIRONMENTAL POLICY

The National Environmental Policy, approved by Resolution No. 5/95, of December 6th, establishes the basis for all environmental legislation. According to Article 2.1, the main objective of this Policy is to ensure sustainable development, in order to maintain an acceptable relationship between socio-economic development and environmental protection. To attain this objective, the Policy shall guaranty, among other requirements, the management of natural resources and of the environment, to preserve its functional and productive capacity for present and future generations.

The Policy and the Environmental Law include general principles that direct the environment management process at all levels. Of these principles, the following are emphasized:

- Environmental management shall aim to improve the quality of life of the citizens and the protection of biodiversity and ecosystems;
- It shall acknowledge and value the traditions and knowledge of local communities;
- The priority ascribed to the systems that prevent the degradation of the environment;

- The comprehensive and integral perspective of the environment;
- The importance of public participation;
- The principle "the polluter pays"; and
- The importance of international cooperation;

As per the Environmental Law, the environmental impact study is an instrument that supports the process of decision making about the granting of environmental licenses. The issuance of an environmental license shall precede any other necessary legal licenses.

3.4 REGULATION OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

In Mozambique, the EIA process is regulated by *Decree No. 45/2004 of September 29th, altered by Decree 42/2008 of November 6th*, which in its article 3 establishes the requirements for the categorization of any public or private project, in order to determine the level of the Environmental Impact Assessment that the nature of the project requires. In the terms of the EIA regulation, three levels of environmental categorization are applicable:

- **Category A –** applied to projects that may have significant impacts due to the proposed activities or to the area's sensitivity, therefore requiring an Environmental Impact Study (EIS), including an Environmental Management Plan (EMP). The list of these activities is included in Appendix 1 of *Decree No. 45/2004 of September 29th, altered by Decree 42/2008 of November 6th.*
- **Category B –** applied to projects that would have negative impacts with less duration, intensity, extension, magnitude and/or importance, requiring a Simplified Environmental Study (SES) and an Environmental Management Plan (EMP).
- **Category C –** Projects in this category are exempt of executing environmental impact assessments, but are subject to the fulfillment of the rules included in specific directives. The list of these activities is included in Appendix 1 of *Decree No. 45/2004 of September 29th, altered by Decree 42/2008 of November 6th.*

The Environmental Law and the Regulation of the environmental assessment process compose the main legal instruments that will guide the entire process of the Simplified Environmental Study (SES) for the solar PV power plant.

In the case of this project, the proceedings were submitted to the DPCAZ in, Quelimane, who, on the 10th of June 2015, categorized the activity as Category B (see Appendix I).

However, other specific legislation shall be consulted, and it is described below in summary form.

3.5 *AIR QUALITY STANDARDS*

The potential impacts of the emissions from the project on human health were assessed by comparison to national and international air quality standards and guidelines. The potential impact on sensitive habitats is assessed through comparison with relevant critical levels, these being the concentration in the atmosphere above which direct adverse effects on ecological receptors may occur. The assessment criteria for this assessment are set out in this section.

There are a number of air quality standards specific to Mozambique and where these are available they have been used to define significance. Where there were no available standards, international standards and guidelines have been used. These are those proposed and advocated primarily by the IFC (International Finance Corporation) and based upon guidelines set out by the World Health Organization (WHO)[1]. However, the IFC and WHO do not set standards or guidelines for protection of vegetation or for dust deposition, and therefore guidelines and standards from the European Union, and the UK Department of Environment [2] are used.

The IFC Environmental, Health and Safety (EHS) standards are considered throughout the assessment and provide the overarching guidance and principles for undertaking the assessment. The key documents considered are:

- IFC (2007) Environmental, Health, and Safety Guidelines: General Environmental, Health and Safety (EHS) Guidelines; and

- IFC (2007) Environmental, Health, and Safety Guidelines General Guidelines: Environmental Air Emissions and Ambient Air Quality.

Within these documents the principles for undertaking the assessment of impacts to air quality are set out. In addition, air quality standards are also set out, along with, where appropriate, emission limits and guidelines for specific technologies and operations.

The Regulations on the Emission of Effluents and Environmental Quality Standards (Decree 18/2004 dated June 2) and Decree No. 67/2010, dated December 31 (amendments to Appendix I and inclusion of Appendices 1A and 1B to Decree No. 18/2004) have been used to define the air quality standards and guidelines specific to Mozambique. Where these regulations do not cover a pollutant of interest, the air quality guidelines for the protection of

[1] IFC (2007) Environmental, Health and Safety guidelines: General EHS Guidelines: Environmental: Air Emissions and Ambient Air Quality

[2] Department of Environment (1995). The Environmental Effects of Dust from Surface Mineral Workings. Summary Report. Arup Environmental, HMSO, May 1995

human health are based upon those set out by the IFC, which follow the WHO Guidelines, and have been used.

The IFC Guidelines are intended to confer a maximum degree of protection of human health. However, these also include a degree of pragmatism in recognizing that achievement of the guidelines may not be achievable in all circumstances; in these cases, for some pollutants interim targets are identified. These are designed to confer a degree of protection of human health, with the aim that regulators should work towards the achievement of the Guideline.

Both Mozambique national air quality standards and WHO standards have been incorporated in the assessment. This approach was adopted to ensure that the results are robust, and also because the Mozambique standards do not cover impacts associated with particulate matter (PM_{10} and $PM_{2.5}$)[1]. Table 3.1 presents the air quality standards and guidelines that will be used in this assessment.

Table 3.1 Air Quality Standards and Guidelines

Pollutant	Averaging Period	Guideline Value (μg/m³)	
		WHO	Mozambique Decree No. 67/2010
Sulfur Dioxide (SO_2)	1-year mean		40
	24-hour maximum	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)	100
	1-hour maximum		800
	10-minute maximum	500 (guideline)	500
Nitrogen Dioxide (NO_2)	1-year mean	40 (guideline)	10
	24-hour maximum		-
	1-hour maximum	200 (guideline)	190
Total Suspended Particulate (TSP)	1-year mean		60
	24-hour maximum		150
Particulate Matter (PM_{10})	1-year mean	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)	-
	24-hour assessed as the third highest 24 hour period (99th percentile)	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)	-

[1] Abbreviation for particulate matter suspended in the air. PM_{10} is airborne particulate matter with an aerodynamic diameter less than 10 microns (μm); $PM_{2.5}$ is less than 2.5 μm.

Pollutant	Averaging Period	Guideline Value (µg/m³)	
		WHO	Mozambique Decree No. 67/2010
Particulate Matter ($PM_{2.5}$)	1-year mean	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)	-
	24-hour maximum	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)	-

With regards to sensitive ecological and agricultural receptors, impacts relating directly to air quality (i.e. NO_x, SO_2) are not habitat or species specific and are the same for all sites. NO_x and SO_2 are especially relevant in this context as they both play a role in the acidification of water and soil and NO_x also contributes to eutrophication (where water bodies receive excess nutrients that stimulate excessive plant growth). Neither the Mozambique standards nor the IFC set out standards for the protection of habitats. Instead the criteria used in this assessment are derived from European Directives[1], and are set out in *Table 3.2.*

Table 3.2 Air Quality Critical Levels used for the Assessment of Impacts on Sensitive Ecological and Agricultural Receptors

Pollutant	Averaging Period and Statistic	Assessment Criterion (µg/m³)
NO_x	Annual mean	30
SO_2	Annual mean	20

The principal international documents referenced in the assessment are those from the IFC guidelines. However, these documents in themselves refer to good practice and statutory guidance from a number of sources from, for example, the United States, Australia and the United Kingdom. Where appropriate, non-IFC guidance has been utilized to inform best practice and, in particular, to inform mitigation and emission control.

There is very little information available on the sensitivity of specific plants to dust soiling; however the information that is available suggests that the guidelines for identifying the deposition rate at which nuisance at human sensitive receptors may occur is also appropriate for use as a metric for assessing the point at which significant impacts on plants may arise[2].

Dust, *per se,* does not pose a specific risk to human health and as such the IFC and WHO guidelines (which are focused around human health) do not include guidelines for nuisance dust.

[1] WHO (2000) Air Quality Guidelines for Europe; 2nd Edition. WHO Regional Publications, European Series, No. 91.

[2] Farmer A. (1993) The effects of dust on vegetation – a review *Environmental Pollution 79*

There is no clear consensus by the scientific community as to the level of dust deposition that is likely to result in disturbance issues. However, the upper limit of acceptability through soiling has been cited in literature as being 25 soiling units/week[1].

3.6 *STANDARDS FOR MANAGEMENT OF URBAN SOLID RESIDUE AND HAZARDOUS RESIDUES*

The new Regulation on Management of Urban Solid Residues was approved by Decree No. 94/2014, which replaces the Regulation on Management of Residues (Decree No.13/2006). The objective of this regulation is to establish standards for the production, management and storage of residues, in order to avoid or minimize its negative impacts on health and the environment.

The Regulation on Management of Hazardous Residue was approved by Decree No. 83/2014. This regulation establishes the rules for the production and management of hazardous residues and assigns to MITADER the power over the management of these residues, including licensing of enterprises that are dedicated to the management of hazardous or toxic residues.

3.7 *STANDARDS FOR WATER USE AND QUALITY*

The management of hydro resources in Mozambique is defined by the National Water Policy and by the Water Law (Law No.16/91 of August 3rd). As per Article 18º of the Water Law, the Regional Water Administrations (ARA), organized based on the watersheds, are the institutions responsible for water management. The area of influence of the project being analyzed is under the jurisdiction of ARA-SUL.

The Water Law defines as the base for the management of hydro resources the principle "user pays" and "polluter pays" and the concessions and licenses system. These factors are based on environmental sustainability principles.

Water quality standards for human consumption are included in the Regulation for Water Quality for Human Consumption, approved by Ministerial Decree No.180/2004. This regulation is applied to potable water supply systems, including surface and subsurface waters used for direct consumption or for the production of water for consumption. The Health Ministry is the entity responsible for ensuring water quality for human consumption.

[1] Arup Environmental Ove Arup & Partners. (1995) "The Environmental Effects of Dust from Surface Mineral Workings", Report on behalf of the Department of the Environment, 1995, HMSO.

3.8 STANDARDS ASSOCIATED WITH NOISE MANAGEMENT

Concerning noise, the Regulation on Environmental Quality and Emission of Effluents Standards states that MITADER will approve noise standards (but to the date for preparation of this study, those standards had not yet been published).

Since no existing standards are available, standards and directives of the IFC (International Finance Corporation) and of the World Health Organization (WHO) were used, namely the document - *Environmental, Health, And Safety (EHS) Guidelines - General EHS Guidelines: Environmental Noise Management*, which state the noise level limits allowed for activities, during day and night periods.

3.9 STANDARDS ASSOCIATED WITH MANAGEMENT OF CULTURAL HERITAGE

For archaeological studies, the guidance of the Ministry of Culture and National Directorate of Cultural Heritage was observed, which establishes the standards and directives for the preparation of the diagnostic of the archaeological potential by means of specific legislation. Standard legislation and documentation regarding cultural heritage existing within the country and internationally were used. These are described as follows:

- Law No. 10/88 of December 22nd, which determines the legal protection of the material goods of Mozambican cultural heritage. This Law applies to goods of cultural heritage owned by the State, by public right organizations or by singular or collective persons, without detriment to the property rights that belong to the respective owners;

- Decree No. 27/94 of July 20th, which establishes the Regulation for the Protection of the Archaeological Heritage. This regulation defines concepts relative to conservation of the archaeological heritage and the procedures that aim at obtaining licenses to perform archaeological work;

- National Inventory of Monuments, Ranges and Sites of 2003, which contains the systematic survey of some properties of the cultural heritage. It incorporates the Standards for Conservation and Criteria for Classification of Monuments, Ranges and Sites;

- Law No. 13/2009 of February 25th, which establishes the legal framework that aims to protect, preserve and value the heritage of the Fight for National Liberation with emphasis for the bases and deployments of the Liberation Front of Mozambique, the educational centers and places where the main meetings took place during the Fight for National Liberation, the monuments of the

Liberation Front of Mozambique, the headquarters and prisons of the International and State Defense Police (*Policia Internacional de Defesa do Estado* (PIDE)) and the General Security Directory (*Direcção Geral de Segurança* (DGS)); and

- UNESCO Convention for the Protection of World Cultural and Natural Heritage, 1972. In this convention Mozambique commits to ensure the identification, protection, conservation and presentation of the cultural and natural heritage located on its territory.

3.10 LAND LAW

As per the Constitution, and as reflected in the Land Law,land within Mozambique is the property of the State, however, the rights to use and occupy the land acquired by inheritance or occupation are recognized. No documented title is necessary for those rights to be recognized and protected by the Law. The Land Law (Law No. 19/95, of October 1st) provides the legal directives related to:

- Procedures for the acquisition of the Right to Use and Exploit the Land (*Direito de Uso e Aproveitamento da Terra* (DUAT)) (Article 24);
- Pre-existing rights to the use and exploit land, especially for the local communities;
- Zoning and planning of the use of the land for economic and social purposes; and
- Agricultural use and use of natural resources, etc.

3.11 INSTITUTIONAL FRAMEWORK

The Government of Mozambique created the Ministry for the Coordination of Environmental Action (MICOA), in 1994, which has been perfecting its approach to deal with environmental management, adopting short and long term strategies and policies. The new government that resulted from the general elections of 2014, created a new ministry, the Ministry of Land, Environment and Rural Development (MITADER) who replaced MICOA. MITADER is the competent authority relevant to the Environmental Impact assessments (EIA) and is represented at provincial level by the Provincial Directorate for Coordination of Environmental Action (DPCA).

In recent years the focus of MICOA (now MITADER) has been:

i. the integration of the planning of land use into decentralized planning,
ii. the reduction of the number of people living in areas of environmental risk and sensitivity,
iii. environmental education and promotion, and

iv. regulation and supervision of natural resource management activities.

These aspects are consecrated in the Environmental Strategy for Sustainable Development 2007-2017 (EADS).

3.12 ENERGY LEGISLATION

EDM was created in 1977 and was transformed into a public enterprise in 1995 after the public enterprise law was approved in 1991 (Law No. 17/91). The Electric Energy Law (Law No. 21/97) was subsequently passed in 1997 and thereafter the electricity regulations in the year 200 (Decree No. 08/2000).

EDM was designated as Manager of the National Grid for Transmission of Electrical Energy in 2005 and then in 2009 the Government of Mozambique approved the Policy for the Development of Renewable Energies (Resolution No. 62/2009). In 2011 a law was passed which allowes private partnerships for infrastructure and in the same year the State approved the Strategy for the Development of Renewable Energies as well as the Regulation that establishes the Tariff Regimen for New and Renewable Energies (Decree No. 58/2014).

4 BIOPHYSICAL AND SOCIO-ECONOMIC BASELINE

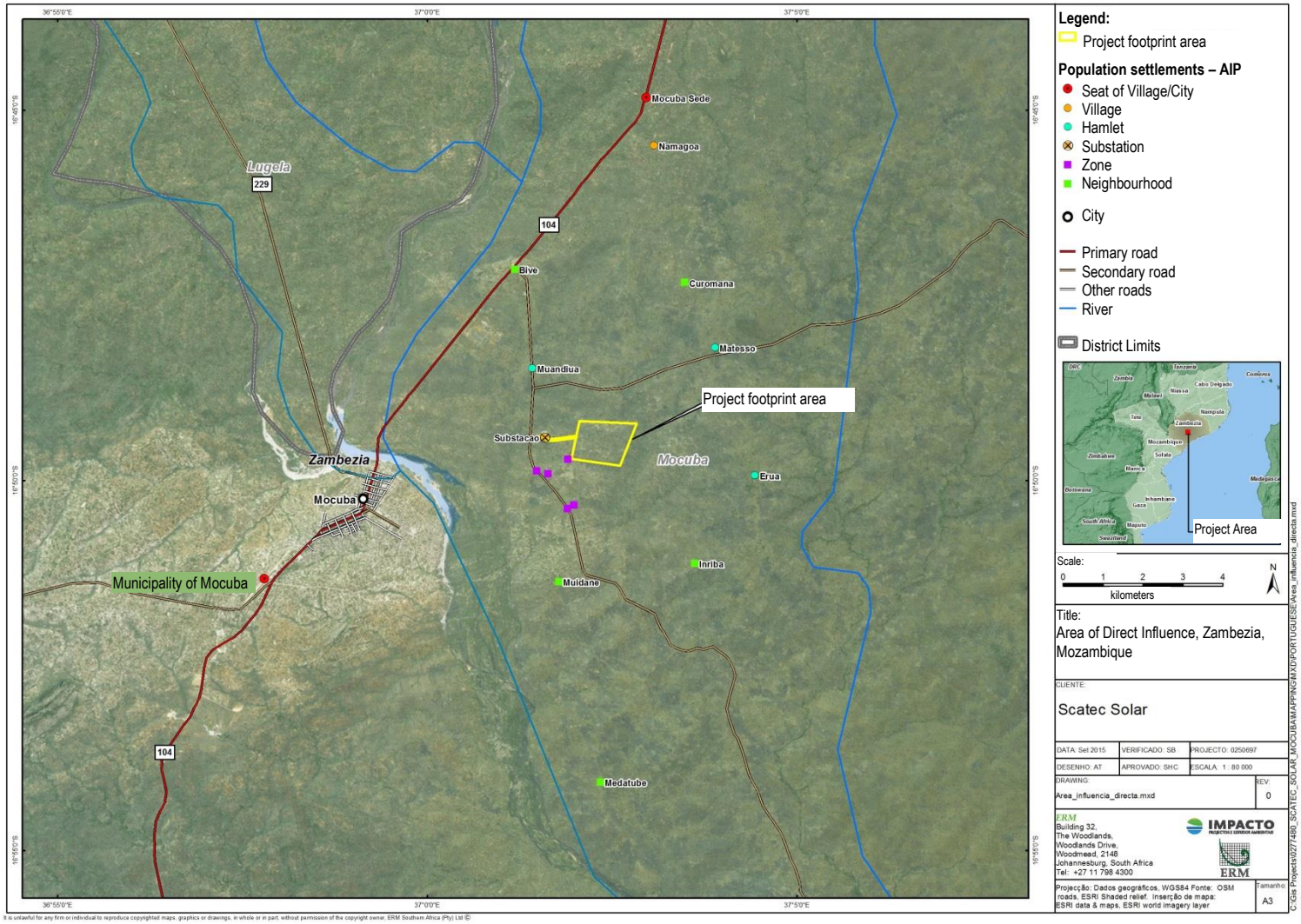
4.1 PROJECT AREA OF INFLUENCE

The Area of Influence comprises two areas, the direct and indirect. Both are described below in greater detail.

4.1.1 Area of Direct Influence

The Area of Direct Influence (ADI) can be defined as the physical project footprint area and includes the actual solar PV plant site (126 hectares) as well as access roads (from the main road to the facility) and 50 m servitude for the short transmission line from the solar PV plant to the existing Mocuba substation, as illustrated in Figure 4.1.

Figure 4.1 Area of Direct Influence of the Project



4.1.2 Area of Indirect Influence

The Area of Indirect Influence (AII) is the area where the effects of the construction and operation of the solar PV plant will be felt in a less pronounced way. The AII comprises the **Province of Zambezia and the District of Mocuba**, where mainly macroeconomic positive effects will be feltresulting from the production of energy by the PV plant (see Figure 4.2), as well as the **Administrative Post of Mocuba,** where the following are located:

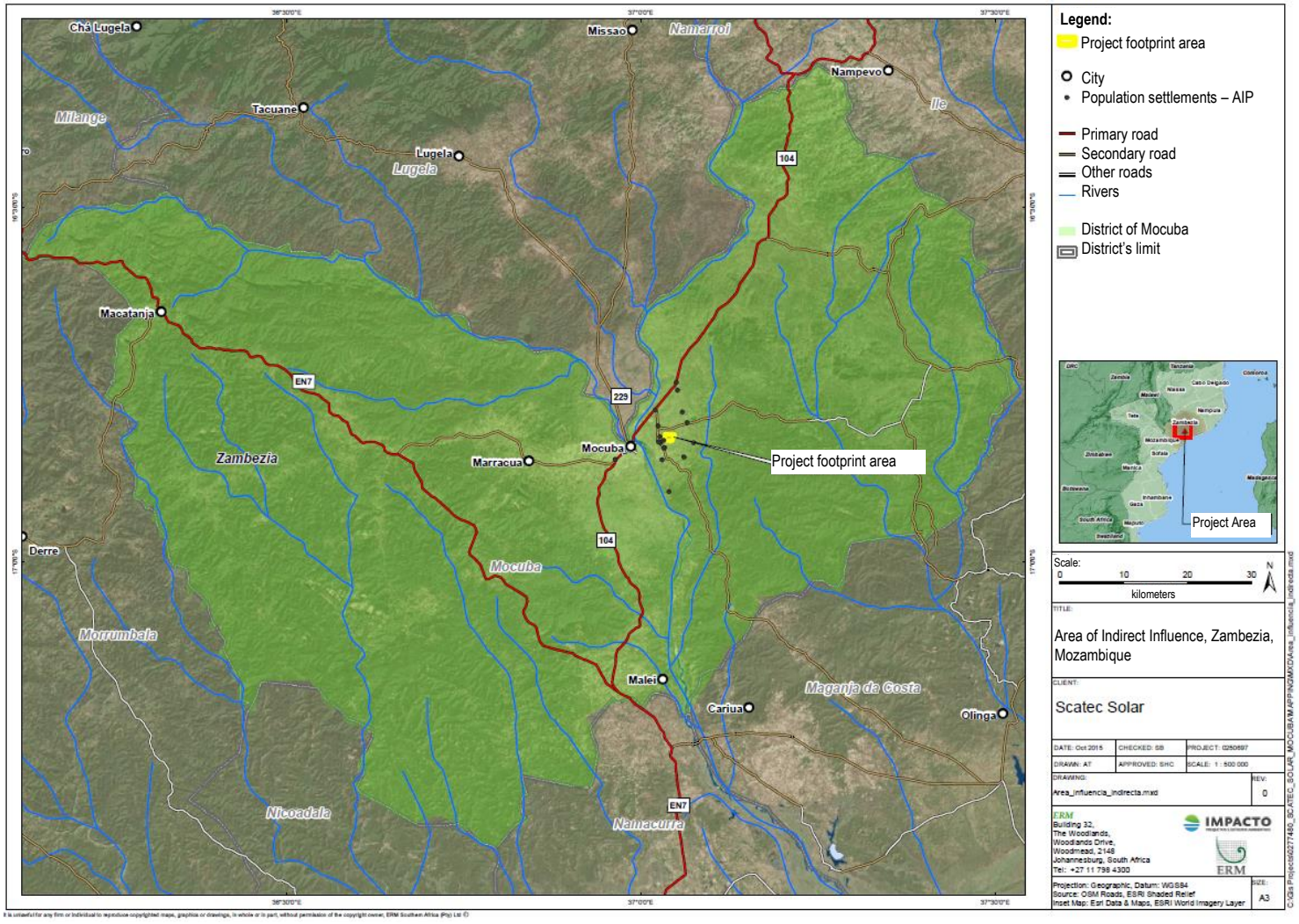
- The **Special Economic Zone**, created by the Government of Mozambique to facilitate the installation of investment projects,

- The **Municipality of Mocuba**, the urban zone that has houses the state and private services, and where the Government of the District of Mocuba is also seated; and

- The **Locality of Mocuba Sede**, where the project footprint is located.

All areas within 500 m of the limit of the project footprint is also included in the AII. .

Figure 4.2 Area of Indirect Influence of the Project: the District of Mocuba



4.2 *CLIMATE AND AIR QUALITY*

A desktop evaluation has been undertaken of existing information to assess climatic data, review air quality data and identify potential Air Sensitive Receptors (ASRs). Local monitoring data is not available and therefore modelled MM5 data[1] was used to establish wind direction and generate wind roses and to supplement publically available information. Potential impacts associated with the construction, operation and decommissioning of the project were identified and their significance assessed. Where impacts were considered significant, mitigation measures have been proposed to reduce the impact to an acceptable residual risk. Given the nature of the solar project activities, the expected impacts are associated with construction and decomissioning activities only.

4.2.1 *Area of Influence (AoI) and Air Sensitive Receptors (ASR)*

The Area of Influence identified the locations of Air Sensitive Receptors (ASR) close to the Project Site. ASRs are split into three categories as described below:

- Human – these are locations where people are present in the long term, and include villages and towns, isolated dwellings, schools, hospitals, clinics and government offices. The pollutants of interest for sensitive human receptors are particulate matter as dust, PM10 and PM2.5, NO2 and SO2. Note that there are no schools, hospitals, clinics or government offices near the project site, and there are only isolated dwellings located towards the southwest of the project are which fall outside of the physical project footprint. A review of aerial photography, coupled with a ground truthing site visit, resulted in the identification of approximately 35 residential properties as potential ASRs within 500m from the project fenceline south west of the proposed development site (Figure 4.3) in the Mugonda neighbourhood;

- Ecological – in general these are locations where there are local, national or internationally protected habitats. The pollutants of interest for sensitive ecological receptors are particulate matter as dust, NO_x and SO_2. No ecological sites of importance have been identified within 100 km of the Project Site, therefore ecological ASRs are not considered further in this assessment; and

[1] The MM5 model uses global macro-scale meteorology to predict local meteorological conditions at any given location in the world. The model is extensively validated using actual observations to ensure the best possible accuracy and precision. In detail, the MM5 model is the Fifth-Generation NCAR / Penn State Mesoscale Model designed to simulate or predict mesoscale atmospheric circulation. MM5 data was sourced for a different study. The Mocuba site is located on the boundary of the previous study area and therefore the MM5 data is considered representative of regional meteorological conditions.

- Agricultural -these are locations where there are crop growing activities, as crop growth may be detrimentally affected and crops soiled as a result of project activities. The pollutants of interest for sensitive agricultural receptors are particulate matter as dust, NO_x and SO_2. The site is surrounded by agricultural activities, with crops such as rice, cassava and beans being observed. These locations are also considered as potential agricultural ASRs.

Taking into account the nature of the activities during the construction, operation and decommissioning phases, an AoI distance of 500 m from the Project Site boundary has been considered. This is generally considered best practice for the assessment of construction impacts.

4.2.2 Climate Characterization

In order to fully define the baseline meteorology and climate, sequential meteorological data is required for wind speed, wind direction, precipitation, relative humidity, temperature and cloud cover. IFC recommends a five year monitoring period to capture year on year variability. Information on the climatic conditions, meteorology and air quality within the Project area has been sourced from publicly available information and MM5 model data.

Mozambique has a tropical climate with two seasons; a wet season from October to March and a dry season from April to September. Climatic conditions vary depending on altitude. Cyclones are also common during the wet season.

Figure 4.4 shows the average monthly temperature in Mocuba. Average temperature in the summer months range between 19 – -28 ˚C and 15 – -23 ˚C during winter months.

Figure 4.3 Area of Influence for Air Quality and identified Air Sensitive Receptors

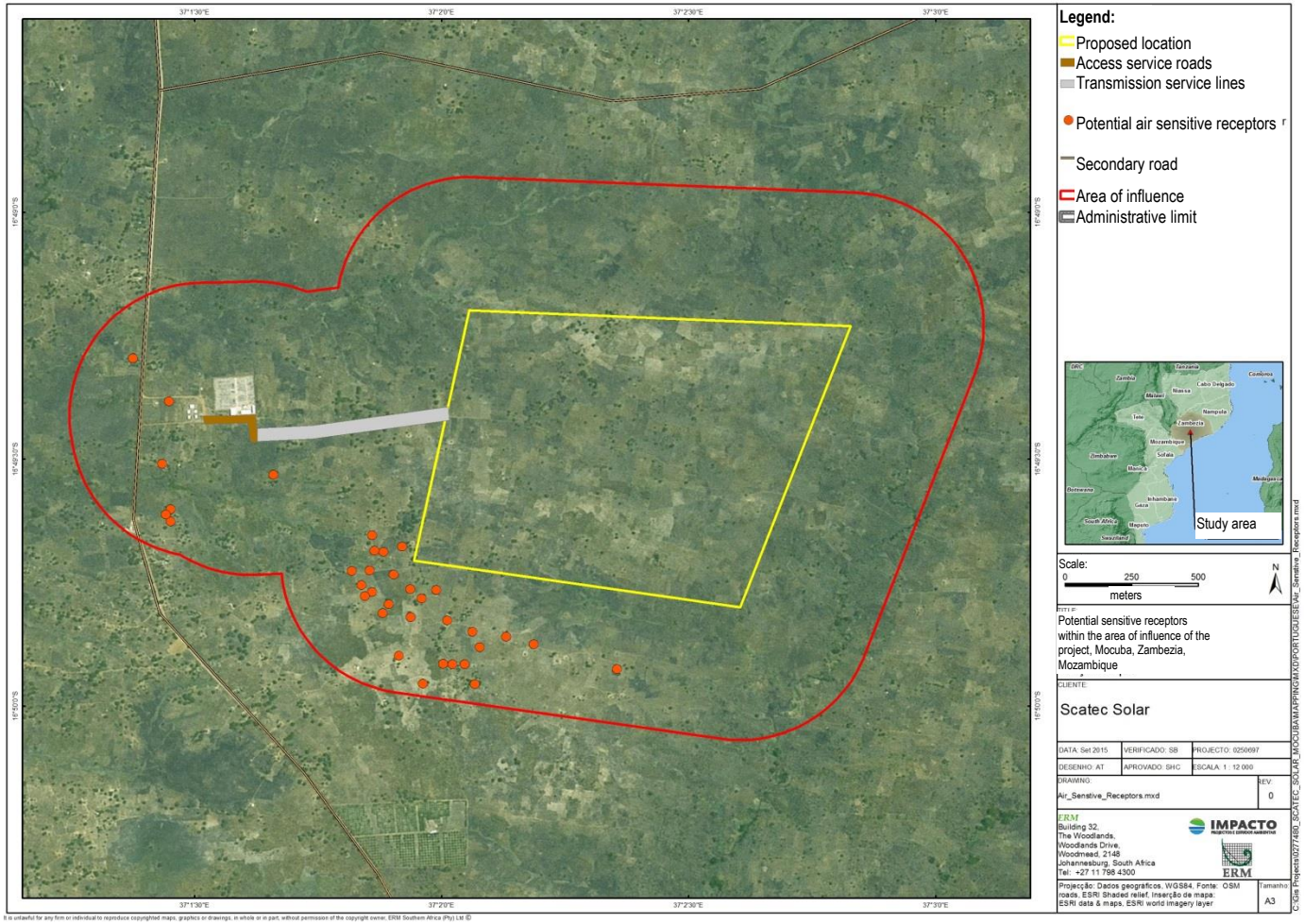
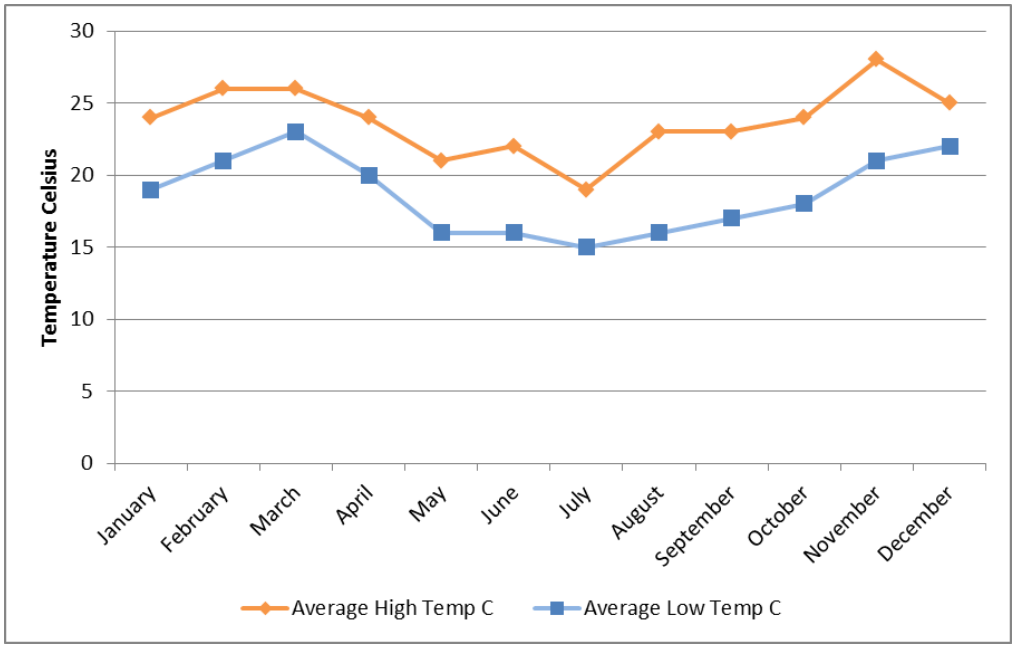


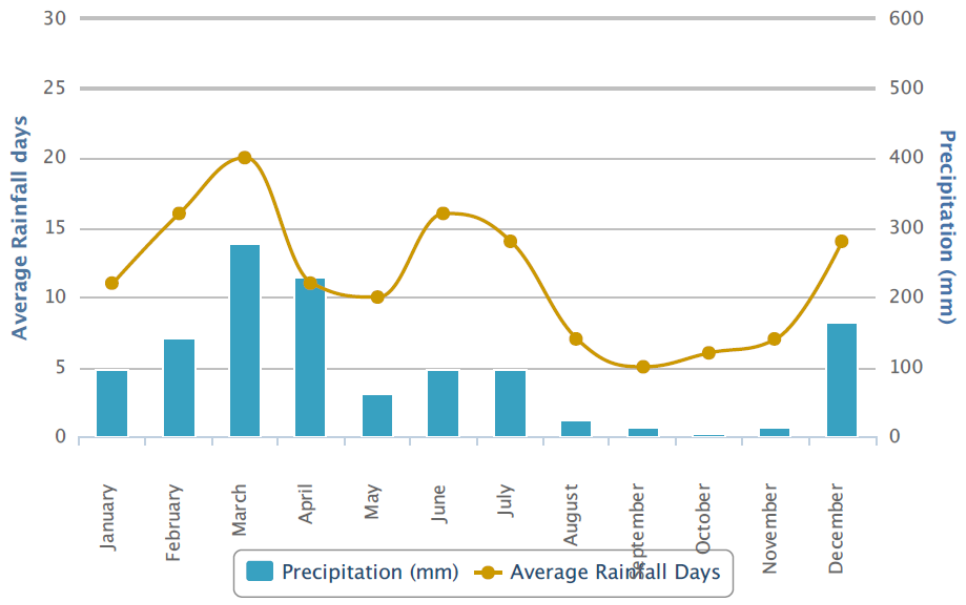
Figure 4.4 *Average Monthly Temperature for Mocuba*



(Source: worldweatheronline.com, from 2000 – 2012)

The data from World Weather Online indicates that the rainy season in Mocuba stretches from December to April, with the mean monthly rainfall ranging from 20 mm to 280 mm per month (Figure 4.5).

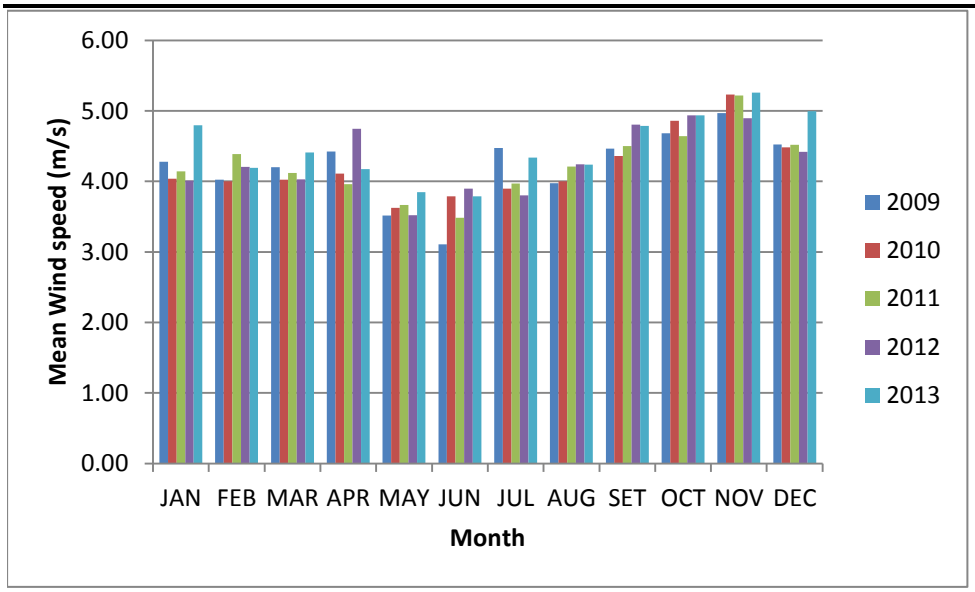
Figure 4.5 *Mean monthly rainfall and rainfall days for Mocuba*



(Source: worldweatheronline.com, from 2000 – 2012)

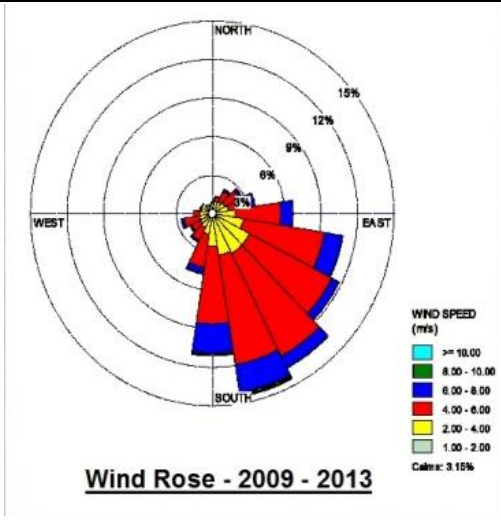
Mean wind speed data from the MM5 model for the past five years is presented in Figure 4.6. Figure 4.7 shows that the wind direction is dominated by southeasterly winds averaging at ~ 4.3 m/s, with a maximum of 11.8 m/s. Wind direction and wind speed are both important factors when considering air pollution dispersion. Prevailing winds mean receptors downwind are more likely to be exposed to increased concentrations with higher wind speeds leading to increased dispersion.

Figure 4.6 ***Mean Wind Speed from 2009 to 2013***



(Source: MM5 data acquired from Lakes Environmental)

Figure 4.7 ***Wind Rose for 2009 – 2013***



(Source: MM5 data acquired from Lakes Environmental)

Emissions of dust are only likely to occur from open exposed surfaces (such as stripped ground and open areas) at wind speeds of greater than 5.3 m/s [1]. The

[1] United States Environmental Protection Agency (1995) AP-42 Section 13.2 Fugitive Dust Sources. [Online] Available from: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s02.pdf [Accessed 30th September 2015]

data indicates that the wind speed is equal to or greater than 5.3 m/s for the majority of the time. This means that Air Sensitive Receptors to the north and north west of the site would be impacted the most as a result of construction activities.

There is limited information available on air quality conditions in Mozambique, with monitoring not yet being undertaken for ambient air quality conditions.

Sources of air pollution in Mozambique derive from activities including vegetation fires, domestic biomass burning, road traffic, open burning of municipal solid waste and industrial processes. Air quality conditions in Mozambique are a concern as there is no specific legislation for the prevention and control of air pollution and increased industrial activities have led to emissions of pollutants NO_2, SO_2 and CO. Likewise vehicle usage in the cities is growing, which has contributed to local air pollution. In both urban and rural areas, indoor air quality is also likely to be poor, with households relying on the burning of firewood and charcoal for domestic energy supply, which can result in exposure to elevated breathable particulate matter (PM_{10} and $PM_{2.5}$) [1].

The site visit demonstrated that visibility was very good at the Project Site and in the surrounding areas. Signs of occasional burning were observed on site, attributed to the slash and burn agriculture practiced. This would contribute local, temporary atmospheric emissions. There may also be dust generated from the gravel road to the site, from road R 479.

4.3 *GREENHOUSE EFFECT GASES*

Production of electricity can result in different quantities of emissions of greenhouse effect gases (GEG), depending on the source of the electricity. Burning fossil fuels such as diesel, coal or natural gas used in thermal power plants, produces significant emissions of greenhouse effect gases as compared to renewable technologies (eolic or solar) which produce little or almost no emissions during operation (*Nelson et al., 2014*). As such, the carbon intensity of the electrical grid of a country will vary, depending on how the electricity is produced.

It is widely recognised that solar photovoltaic (PV) technologies are likely to play an important role in decarbonising the power sector, globally. Although the manufacture of PV cells results in GHG emissions, the use phase is associated with very low (near-zero) emissions, making solar PV a much

[1] INE (Instituto Nacional de Estatistica), Inquerito aos agregados familiares (Survey of Family Households), INE, Mozambique,
http://www.ine.gov.mz/, retrieved on 2007-11-25 quoted in Cumbane et al Rapid Urban Assessment (RUA): A cost effective tool for air quality monitoring in less developed countries. Available online at: http://www.ddrn.dk/filer/forum/File/Rapid_urban_air_quality_assessment_a_cost-effective_tool_for_air_qualuity_managment.pdf accessed 22/09/2015.

'cleaner' energy source than other carbon intensive energy sources such as coal and gas.

In order to assess the GHG impacts of the Project, GHG emissions associated with the production of a certain amount of electricity by the Project (using solar PV) can be compared with emissions associated with the production of an equivalent amount of grid electricity (according to the technologies used to produce electricity for the Mozambican grid). Until recently, hydroelectric power has been responsible for approximately 95% Mozambique's grid electricity (*UNEP, 2013*). Since GHG emissions from hydroelectric power plants are significantly lower than GHG emissions from thermal power plants (in terms of tCO_2e per kWh electricity produced), Mozambique's latest published grid emissions factor is very low, at just 0.001 kg CO2e per kWh in 2011 (this compares to an African average factor of 0.596 kg CO2e per kWh for the same year) (*IEA, 2013*).

4.4 GEOLOGY AND GEOMORPHOLOGY

4.4.1 Methodology

The geological characterization of the project area was based on the Geological Chart of the District of Mocuba. The study took into account the characterization of relevant aspects such as the regional and local geologic framework and the geomorphology, and the potential presence of mineral resources. This characterization, performed at micro and macro scales, enabled the analysis of the project's impacts on the local geology and geomorphology.

4.4.2 Baseline

The District of Mocuba is characterized by a slightly undulating rolling hills, with some dispersed orographic features which are higher than 400 m and have rocky summits. These features are known as *inselbergs* (*Perfil Distrital de Mocuba, MAE, 2005*).

Mocuba is part of the erosion peneplain of Zambezia with a gradually diminishing altitude along the northwest/southeast axis up to the coastline in the east. This peneplain was formed by the gradual removal of vegetation, soil and rocky material, resulting in an almost level landscape. The landscape is only interrupted by the occurrence of inselbergs and small hills. There are also some sandy plains, which is the remnants of older relief eroded down to the present level.

The plains in Mocuba are crossed by deep V-shaped valleys in the more drier and rugged areas, and by shallow valleys or depressions which are mostly flat and prone to flooding (these areas are known to locals as *dambos*).

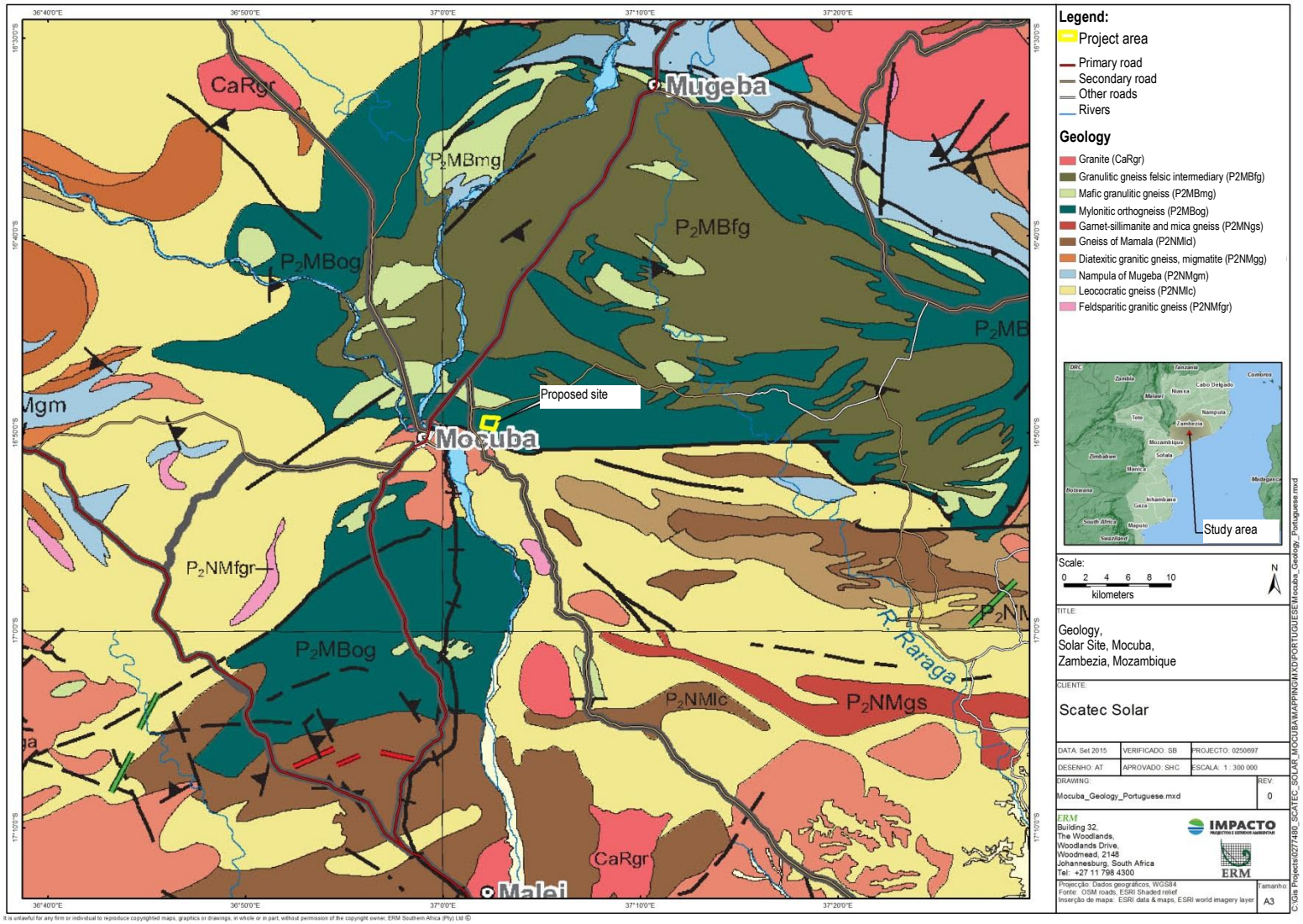
The project area is located on a relatively flat area. It is mostly underlain by rocks, the majority of which are classified as mylonitic orthogneiss (P_2MBog).

The geology of Mocuba area is relatively uniform and consists mostly of intrusive rocks of the Mesoproterozoic era, of the *Mugeba* complex. This complex (with rocks of about 1300 million years old), is characterized by mylonitic orthogneiss (P_2MBog) and granolithic gneiss felsic (P_2MBfg)[1].

Within the District of Mocuba there are some areas where minerals occur, some of them precious and semiprecious. Beryllium, tantalite, aquamarine and emeralds are the most well known.

[1] Geologic legend of the north of Mozambique

Figure 4.8 Geology of the Project Area



4.5 SOILS AND LAND USE

4.5.1 Methodology

A field survey was undertaken on 6 July 2015 during which boreholes were made to assess the profile of the soil, using a hand-operated auger, and soil samples were collected. Soil profiles were examined to a diagnostic depth of 1.5 m, unless restrictive soil obstacles, such as rock, were observed at shallower depths. Thirty-five field observations points were evaluated (Figure 4.9), and three chemical sampling points were completed. Cold 10% hydrochloric acid solution was used to test for the presence of carbonates within the soil. The survey points were logged using a Global Positioning System (GPS).

Soils were classified using the legend of the National Mozambican Soil Map produced by the Department of Land and Water (DTA, 1995) (1).

At the three chemical sampling points, six soil samples were collected for lab analysis (one topsoil and one subsoil sample), which represent various soil profiles within the study area. These samples were submitted to Nvirotek Laboratories in South Africa in sterile plastic containers for analysis. The analysis undertaken determined the baseline fertility status and physical properties of the soil (2). Results obtained are included in *Appendix B*.

Two soil samples (MS01 and MS02) were also subjected to inductively coupled plasma spectroscopy (ICP) metal scan to determine baseline metal levels within the study area (3).

Following the indications in the Legend of the National Soil Map (Department of Land and Water, 1995), land capability classification was undertaken using the land capability classes outlined by the United States Department of Agriculture (USDA). In order to undertake land capability classification, the study area was classified into soils groups (once soil properties were identified) and then these different soil groups were grouped together according to the following criteria:

- Limitations of the soil for the production of field crops (excluding crops adapted to extreme conditions or with special growth requirements);

- The risk of soil deterioration should a soil group be used for crop production; and

(1) This classification system defines soil units by using the following properties: geology, parent material, soil texture, soil color, base saturation, clay cation exchange capacity, drainage and topography.
(2) Parameters analyzed: soil pH (KCl), exchangeable cations, electrical conductivity on a water extract, extractable phosphorus (Bray 1), exchangeable aluminum, organic carbon (Walkley Black), particle size distribution (sand, silt and clay) and bulk density.
(3) Metals tested: silver (Ag); aluminum (Al); arsenic (As); boron (B); barium (Ba); cadmium (Cd); cobalt (Co); chromium (Cr); copper (Cu); iron (Fe); magnesium (Mg); manganese (Mn); molybdenum (Mo); nickel (Ni); lead (Pb); antimony (Sb); selenium (Se); tin (Sn); titanium (Ti); vanadium (V); zinc (Zn); and zirconium (Zr).

- The response of the soil group to management measures (such as adding fertilizer).

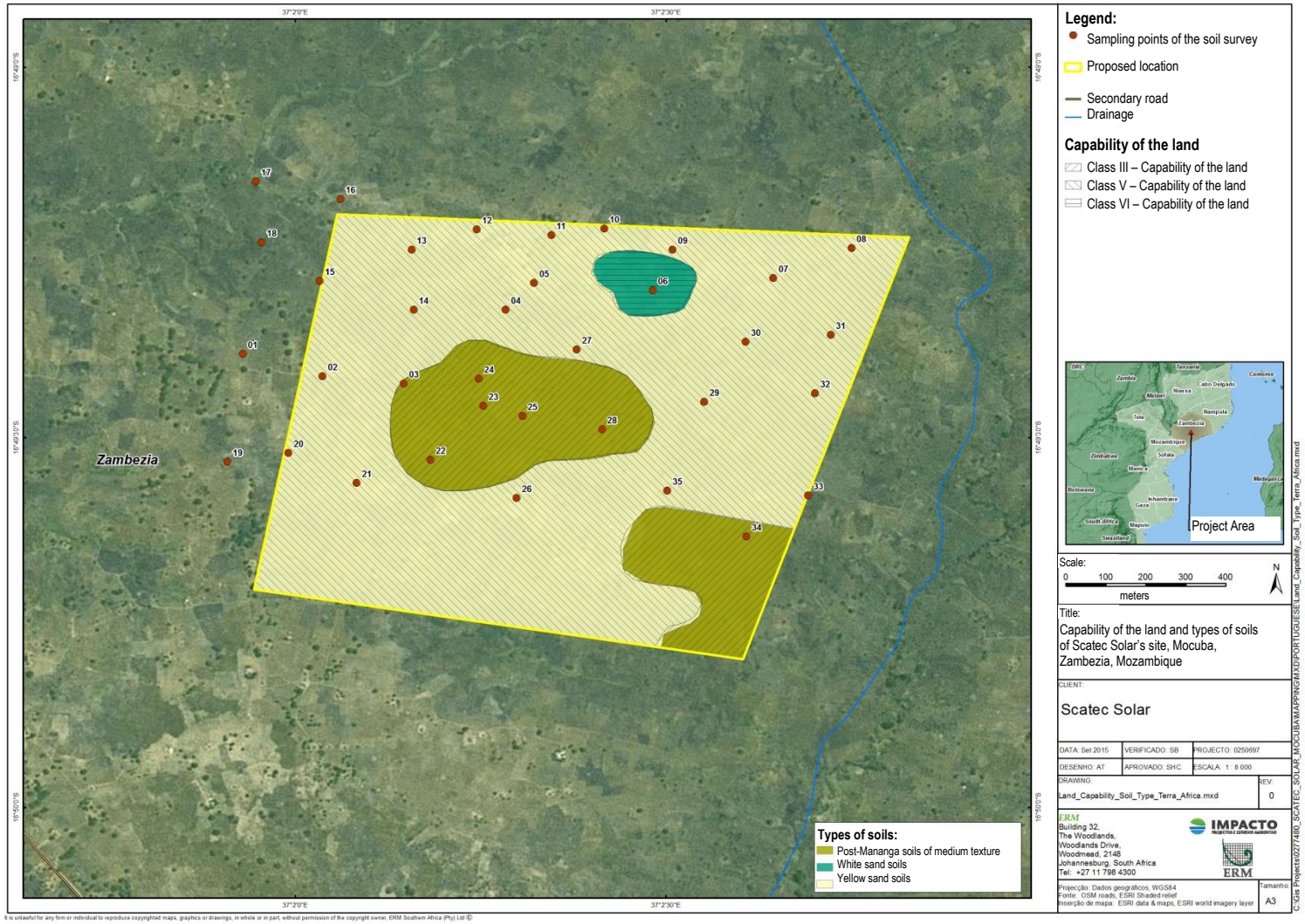
The USDA classification system defines eight different land capability classes (Klingebiel and Montgomery, 1961) [(1)].

Current land uses [(2)] were observed throughout the study area. These land uses were then associated with specific soil groups and land capabilities to determine whether any project activities will impact negatively on land use.

(1)Class I (1) soils are very suitable for crop production; Class II (2) soils are suitable for crop production and may only have a few minor limitations for crop production; Class III (3) soils are moderately suitable for crops and this reduce the choice of plants or require special conservation practices, or both; Class IV (4) soils are only marginally suitable for crop production which restricts the choice of plants or requires very careful management, or both; Class V (5) soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly for grazing since it has good grazing capacity; Class VI (6) soils have severe limitations that make them generally unsuitable for cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover; Class VII (7) soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife; and Class VIII (8) soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for aesthetic purposes.

(2) Land use should not be confused with land cover. Land cover illustrates the physical land type, such as forest or semi-natural vegetation, while land use indicates how people use the land i.e. human settlements and crop production.

Figure 4.9 Soil Types, Land Use Capability and Soil Sample Locations



4.5.2 Soil Baseline

Three soil groups were identified within the study area (Figure 4.9):

1. Yellow sandy soils (100 ha);
2. Post-Mananga coarse textured soils (23 ha); and
3. Yellow sandy soils (3 ha).

Yellow sandy soils dominate the study area with 100 ha, and consist of medium deep to very deep yellowish-brown sandy soil profiles. This soil group is found in flat areas where the slope gradient is not more than 2%. The soil profiles observed are mostly deeper than 1.5 m and very well to excessively drained of any moisture. pH levels are strongly acidic (topsoil has a pH of 5.01 and the subsoil a pH of 5.16). The texture of this sandy profile is dominated by more than 80% sand particles and contains only 8% to 10% of clay.

The post-mananga coarse textured soils occupy an area of approximately 26 ha within the study area and occur in two specific areas within the site boundary. The soils have sandy clay-loam texture and are moderately drained of moisture. The soil has dark reddish to brown color. All the profiles observed were deeper than 1.5 m. This soil group is underlain by a hardened ironstone layer (called a *petroplinth)* (Figure 4.10). pH levels range between 5.28 and 5.62 and the topsoil was found to contain 1.27% organic carbon and the subsoil 0.53%. The organic carbon content is significantly higher than the other two sandy soil forms present on site.

Figure 4.10 Hardened Ironstone Layer Present in Post-Mananga Coarse Textured Soil

The white sandy soil group occurs in only one small portion, 3 ha of the study area, and consists of shallow to medium deep white coarse-textured sand overlying an impermeable quartzite rocky layer. The soil profiles observed are very well to excessively well drained of moisture. pH levels are very acidic in both the topsoil (pH 4.45) and subsoil (pH 4.54) and the texture of this sandy profile is dominated by 85% to 87% sand particles with only 6% clay and 7 to 9% silt particles.

Figure 4.11 White Sandy Soils

4.5.3 Land Use Capability Baseline

It is important to note that, even though the soil may have limited capability for agricultural production, due to facts such as low capacity to retain water, the local land users can still use it for the production of food. Land use capability is shown in Figure 4.11. Yellow sandy soils have low capability for agricultural production and can be considered as soils appropriate for pasture, as per the classification system. Productivity of crops in this type of soil is limited by acid pH and low fertility. However, it is still used for cultivation of beans, corn, manioc and sweet potato with very limited success.

The area where post-Mananga coarse textured soils occur is moderately adequate for farming and is presently used for growing manioc and thatch. These soils are more difficult to cultivate than sandy soils because of the coarse structure of the soil.

Though sandy white soils have no use for cultivation, and a very limited aptitude for pasture, the local community tries to produce food. Corn and beans cultivated in this type of soil, observed during the survey, showed clearly a stunted growth as a consequence of the low depth of the soil and the low fertility. No signs of cattle were observed on natural or cultivated pastures.

4.5.4 Land Use Baseline

In spite of the types of soils identified in the study area having different capabilities, the project site is presently used for the production of subsistence farming with variable success on different types of soil.

The production technique generally used is agro- forestry, where the seeds and legumes are planted in dispersed places, surrounded by fruit trees that will supply shade for these crops during extreme heat conditions. Crops include manioc, maize, beans and sweet potatoes (Figure 4.12 and Figure 4.13). Fruit and nut crops include banana, pineapple, papaya, mango, orange and cashew nuts. There were no signs of cattle farming and grass is harvested for thatch (Figure 4.14).

Figure 4.12 Typical Cultivated Field with Beans (Example A)

Figure 4.13 Typical Cultivated Field with Manioc (Example B)

Figure 4.14 Example of Grass Harvested for Thatch

4.6 SURFACE WATER

4.6.1 Methodology

Baseline data collection was undertaken using a combination of secondary data collected during a desktop study and actual field observations and sampling during a field survey. During the desktop study, existing hydrological information and modeling data for the study area were used and expanded with additional climatic data (specifically rainfall data) obtained from public domain sources (e.g., Accuweather and World Weather Online), as well as other publicly available studies. Where long-term mean rainfall and

daily rainfall records were not available, the rainfall distribution from more recent short-term rainfall records were used to interpolate the required information. A digital terrain model (DTM) was developed for the study area using a combination of detailed topographical data (received from the Project Sponsors) and digital elevation model (DEM) data obtained from public domain sources (Shuttle Radar Topography Mission: Worldwide Elevation Data). The digital terrain model (DTM) was used to delineate watersheds and to determine different catchments.

A site visit was undertaken during August 2015 to observe actual site conditions and to collect data to support the desktop work. A better understanding of the site conditions, topography, condition of soil and land cover, local drainage lines and other surface water features were obtained.

Water samples were collected at accessible water sources and the samples were delivered to Eco Analytica laboratory at the North West University for chemical and heavy metals analysis. The aim was to characterize the water sources and to establish a baseline for pollution control purposes. Results are included in Appendix A.

Hydrological modeling was undertaken to determine runoff volumes, flood peaks and flood zones for specific points or areas where the project may affect the surface water or vice versa. Land cover mapping and soil classification were used, together with visual observations during the site investigation, to develop the soil and land use parameters needed for the calculation of runoff and flood peaks.

4.6.2 Baseline

The Licungo River Basin

The proposed project is located within the Licungo River basin *(Figure 4.15 Bacia do Rio Licungo)* which flows into the Indian Ocean at Tomodo, approximately 50 km northeast of Quelimane.

The average elevation of the Licungo basin is 570 m and varies from sea level to 1886 m. A catchment basin covers an area of approximately 27.700 km^2 and the main drainage line has a length of approximately 336 km (Francisco Tauacale, 2002). The mean annual precipitation over the whole catchment is 1290 mm per year (based on a ten year record from 1998 to 2008) (M.R. Minihane, 2012). Historical records indicate that the flow rate can reach up to 1500 m^3/s with average floods ranging from 500 to 800 m^3/s (M.R. Minihane, 2012).

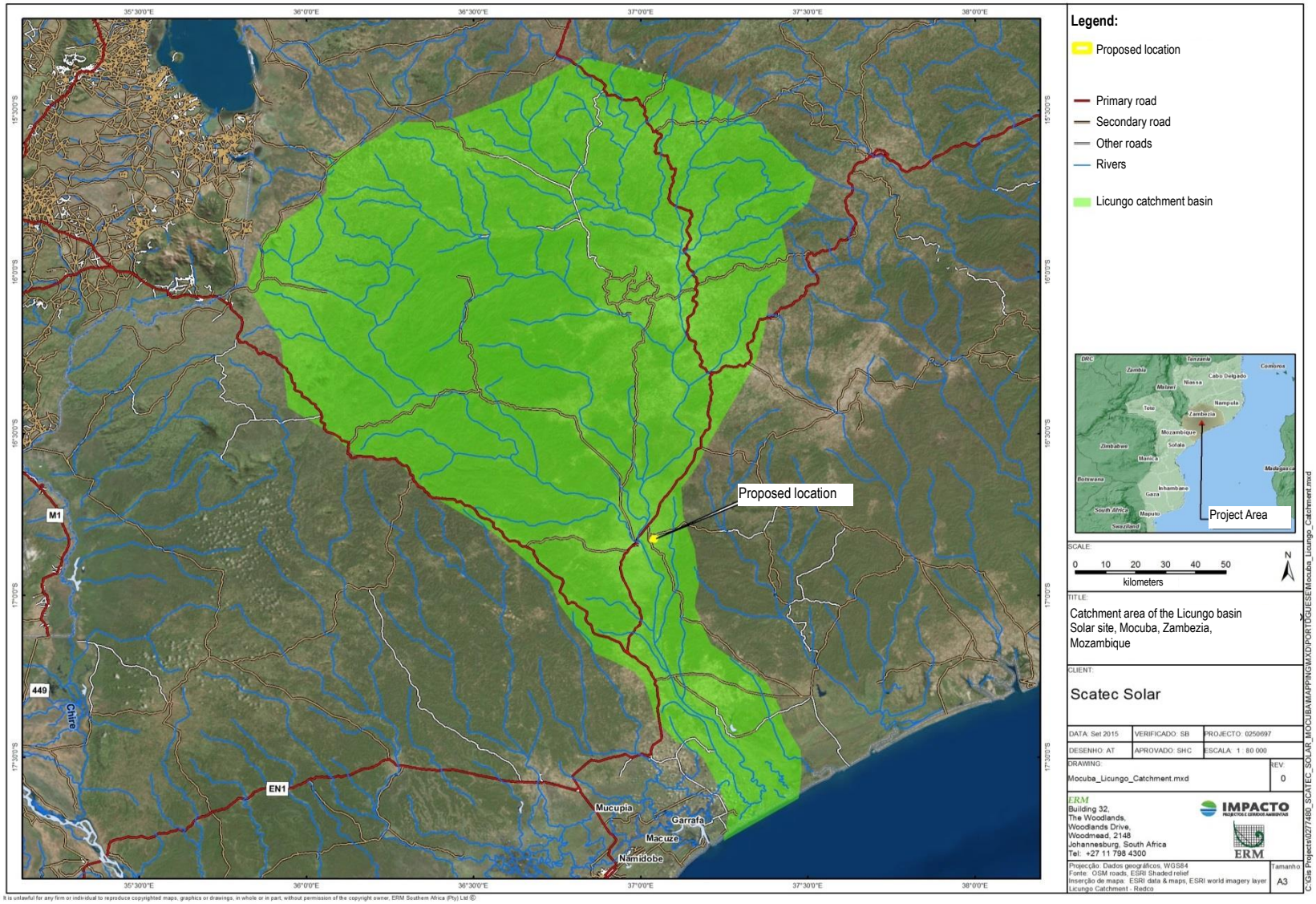
Mozambique is also the drainage point of nine major river basins from southeastern Africa and is therefore very prone to floods. Tropical cyclones also often hit the area and cause major wind and rain storms throughout the country (Hellmuth et al., 2007). The rainy season stretches from October to March where, after the discharge patterns from the nine major river basins, as

mentioned above, those increases cause extended high flow periods in Mozambique (UNEP, 2007).

Historical and Recent Flood Events

Flooding within the Licungo River basin is caused by high intensity rainfall events which occur in the high mountains areas (Guruè and Milange) upstream, which then feed the river and its main tributary, the Lugela River. After the confluence of these two rivers, near Mocuba, the river enters into a low lying area in the Maganja da Costa district. Due to the large extension of the flood plain, the water level does not rise much during small and intermediate floods but, during extreme flood events, such as the floods of 2001 and 2013, the water levels were much higher and caused significant damage to infrastructure, which isolated many communities and villages. The 2013 flood was the largest ever recorded until the flood of January 2015. The 2015 flood developed extremely fast and resulted in more than 100 casualties and extensive damage to infrastructure and agricultural fields within the bigger region. The project site was not affected.

Figure 4.15 The Licungo River Basin



Topography and Drainage

The Licungo River is a major river system with a flow area of about 500 to 900 m wide near Mocuba. The nearest point from the project area is about 2.5 km from the eastern bank of the Licungo River. There is therefore an insignificant interaction and impact between the project and the Licungo River. The Egaro River is closer to the project area and is located directly adjacent to the site towards the east. The closest point is approximately 100 m away and the furthest point more than 300 m.

Figure 4.15 indicates the project area in relation to local watersheds which were identified. Elevations range from 136 m above mean sea level (amsl) to 143 m amsl. The area has low gradient slopes and runoff will be mostly overland flow and dispersed due to the local topography, low slope gradients and position of the local watersheds.

A well defined watershed divides the project site into two major drainage areas. Catchment A (333 ha) drains to the west into an unnamed stream originating further north of the project area. The latter is a tributary of the Licungo River with the confluence about 3 km south of the project area. Catchment B (873 ha) drains to the east to the Egaro River (Figure 4.16). The Egaro River drains to the south and is a tributary of the Licungo River. The confluence of the Egaro River with the Licungo River is approximately 6 km further south of the outflow of the indicated catchment. Catchments A and B are the receiving catchments that will be affected by the project.

Figure 4.16 Egaro River

Catchments A and B can further be divided into more sub-catchments A1, A2, B1 and B2 (Figure 4.17). Sub-catchment A1 is located in the southern portion of the catchment A and originates on the watershed on the project area. Sub-catchment A2 originates to the north of the project area where the north-

western portion of the project area drains into this sub-catchment (Figure 4.17). Only a small portion of the project area drains to this sub-catchment and it will not be affected by the planned activities. Sub-catchment A3 is a further sub-catchment of catchment A2 and is located immediately downstream of the drainage line that may be affected the most by the project activities.

Sub-catchment B1 is the remainder of the Egaro River sub-catchment. Runoff from the eastern portion of the project area will drain east as overland or dispersed flow to the Egaro River. Sub-catchment B2 includes the portion of the project area that drains south to a poorly defined drainage line flowing east to the Egaro River, but will not be affected by the planned activities.

Flow peaks were calculated to determine the impact of the project activities on surface water drainage before and after construction of the project. The results are indicated in Table 4.1. Sample locations are shown in Figure 4.17 Surface Water Catchments and Drainage.

Table 4.1 Flow Peaks at Selected Points

Location	Before Construction (m^3/s)	After Construction (m^3/s)
Point Q1	11.6	14.7
Point Q2	18.3	21.6
Point Q3	1.8	3.2

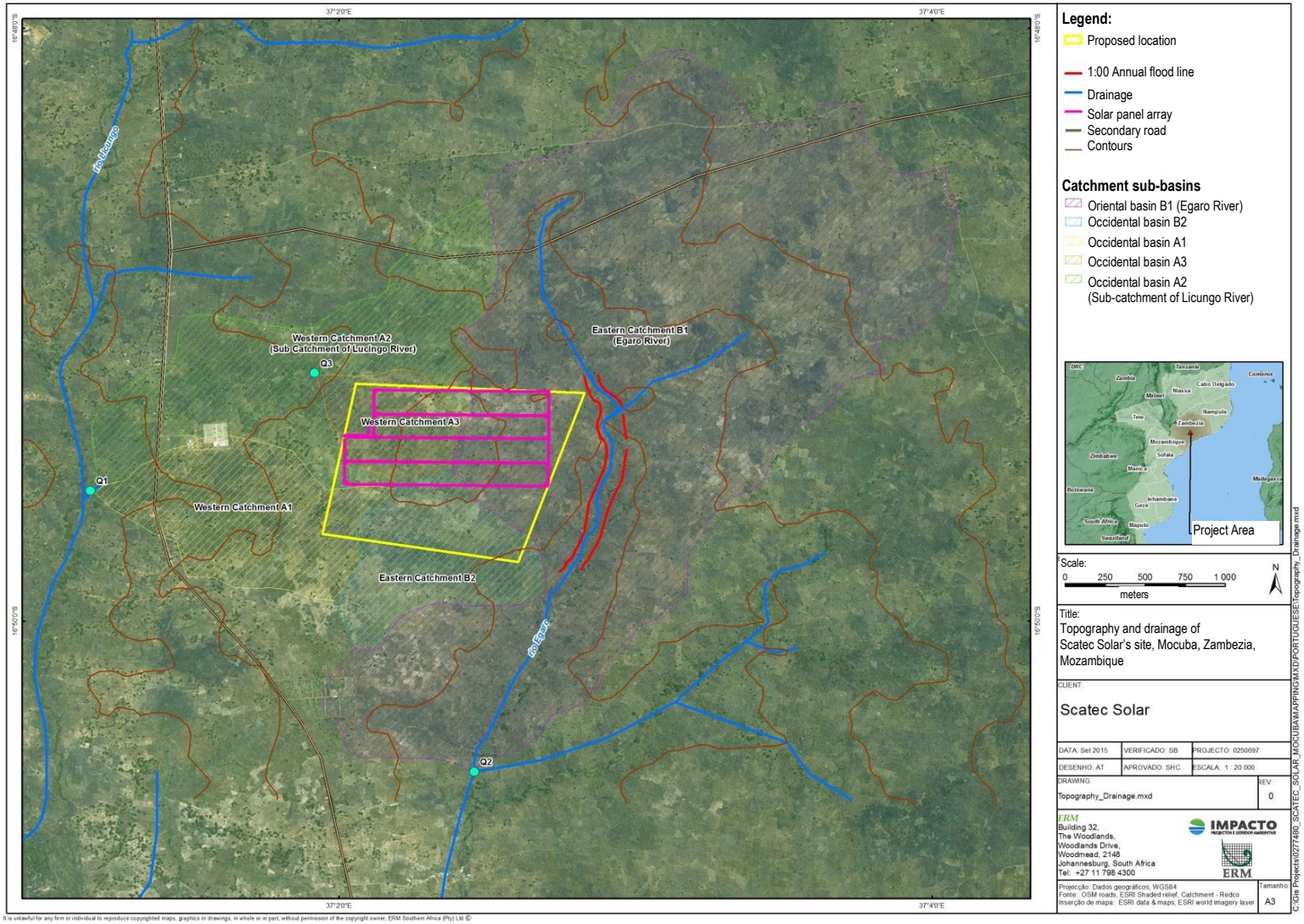
The 50 year return period was chosen because of the high rainfall of the area, the history of flooding near the area and the lack of a good spread of rainfall stations and long term records of daily rainfall data. The increase in the flood peak at the receiving catchment is of low significance.

Flood Zones

The project area is located well outside the flood zone of the Licungo River. The flood zone along the north-western drainage line falls outside of the project area and is not considered a risk.

The flood zone for the Egaro River is indicated in Figure 4.17. The flood zone is located east of the site and falls outside the project area. It is considered to be a safe distance away from the nearest PV panels and supporting infrastructure. No access roads will be affected.

Figure 4.17 Surface Water Catchments and Drainage



Water Quality

Water samples were collected in the Egaro River (just east of the north-eastern corner of the project area) and in two wells; one is used for washing water (Figure 4.18) and the other for drinking water by local population (Figure 4.19). Both are located approximately 1.7 km north of the site. The Egaro River was barely flowing due to typical conditions of dry season. Only small puddles of almost standing water were available for sampling. Other surface water sources in the project area were also not flowing.

Figure 4.18 Well used for Washing Water

Figure 4.19 Drinking Water Well

The results of the water analysis were compared with the standards for non-treated water for human consumption (Ministerial Order No. 180/2004). The results for heavy metals and physical parameters indicate that all components that were tested are within the relevant water quality parameters. Consult *Appendix IV* for the results of the water analysis

4.7 NOISE

4.7.1 Methodology

The characterization of the noise environment in the project footprint area was based on information included in existing publications about the region and detailed evaluation of maps and aerial photographs. The main aim was to identify potential existing sources of sound pollution, as well as potential existing sensitive receptors.

The assessment of impacts was based on the WHO – World Health Organization (Table 4.2) directives, which define that levels of noise shall not exceed the following values:

Table 4.2 Directives of the WHO for Noise Levels

	LAeq dB(A) one hour	
	Daytime 07:00 – 22:00 hours	**Night time 22:00 – 7:00 hours**
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

For identification and analysis of sensitive receptors we considered the project footprint area plus the indirect area of influence of 500 m from the borders of the project footprint area. Two additional points were included which are outside the 500 m radius, in order to include in the assessment the area associated with the construction of the access road to the project site.

4.7.2 Main Existing Sources of Sound Pollution

The project footprint area is located in the Special Economic Zone (ZEE) of Mocuba, an area defined by the Government of Mozambique to attract investments and contribute to the development of Zambezia Province. The Special Economic Zone is in a populated area with the presence of certain communities and diversified farming fields associated with subsistence agriculture.

Even though there are farming plots in the project area, no existing sources of noise were identified and no dwellings or shelters were identified in the plots. The farming work done on these plots does not use machinery that could generate sound pollution sources.

Within the area of influence there are existing residential settlements as well as the existing Mocuba substation which belongs to EDM. The substation is 700 m away from the project area. None of these sources emit significant noise levels.

Another potential sound pollution source exists in the form of the Road Number 479. This road is outside the 500 m radius that was considered. At a distance of 1 km from the project boundary it is not considered a relevant significant noise emission source.

4.7.3 Baseline

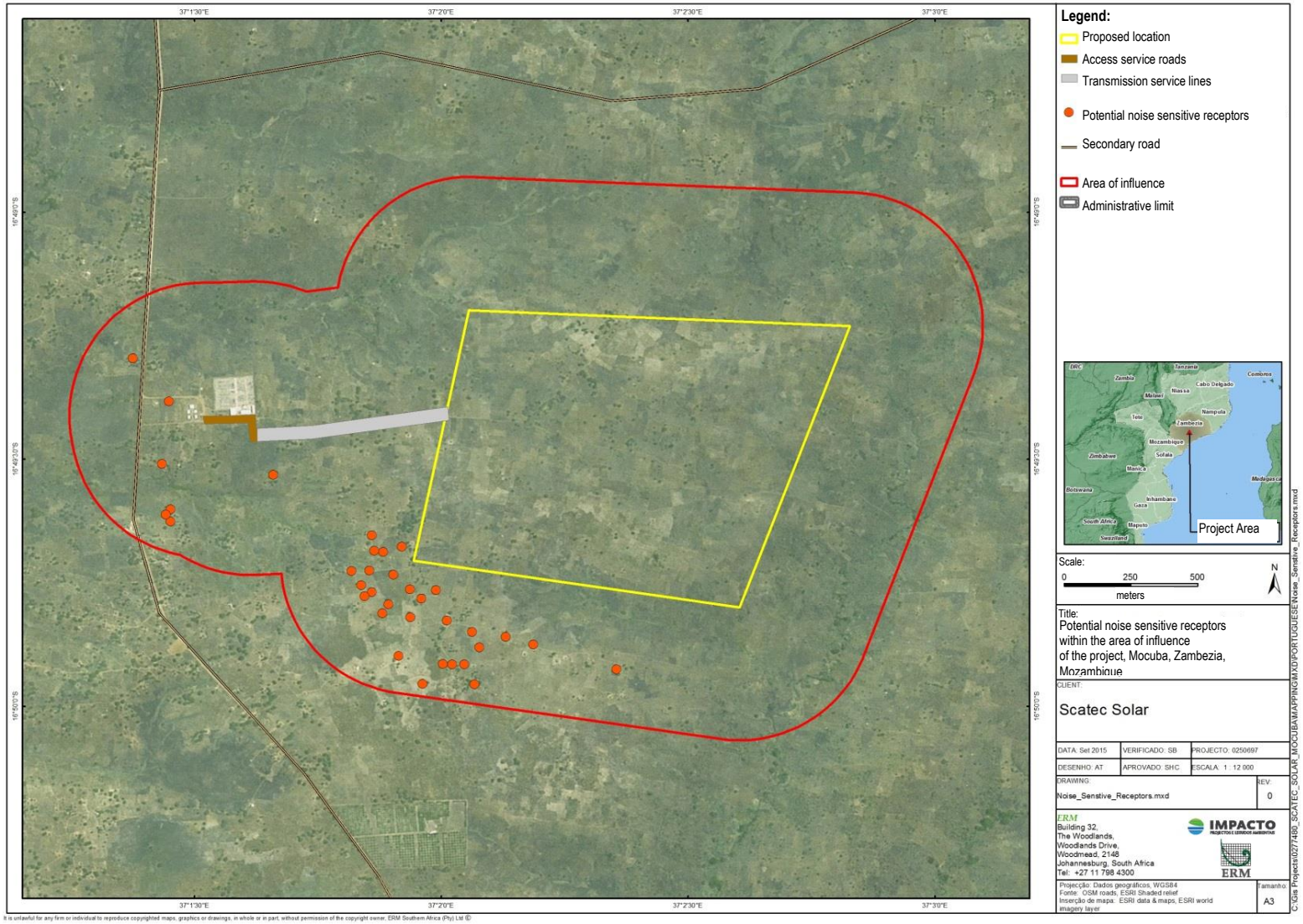
Generally speaking the acoustic environment of the project area is influenced mainly by subsistence agriculture and some road traffic within the vicinity as well as the activities performed at the Mocuba Substation. None of these are considered relevant sound pollution sources. Therefore existing receptors are not negatively affected by these activities.

4.7.4 Noise Sensitive Receptors

The identification of potential noise sensitive receptors is directly associated with noise emission sources. Taking into consideration that in the Project area there are no residential settlements, potential noise sensitive receptors were identified in the indirect influence area within the 500 m buffer zone.

Figure 4.20 shows the sensitive receptors identified in a radius of 500 m from the limits of the project footprint area, as well as two additional receptors related to the construction of the access road to the project site. As can be seen, sensitive receptors are small residential settlements as well as the installations of the electric substation of Mocuba.

Figure 4.20 Location of the Noise Sensitive Receptors



4.7.5 Main Sources of Sound Pollution Associated with the Project

Noise emission sources will exist mainly during the construction and decommissioning phases of the project. During the construction phase noise sources will be associated with the circulation of construction vehicles and the operation of machines and equipment necessary for the construction work. The same will apply to the decommissioning phase.

These type of noise sources are called punctual sound sources[1] and their attenuation occurs in the order of 6 dB(A) by doubling the distance to the source (APA, 2010).

The following table shows the approximate average levels of sound, in dB(A), emitted by some equipment usually used in construction, as a function of the distance to the respective source, taking into account the attenuation or divergence effects of the type of noise.

Table 4.3 Attenuation of average levels of sound pressure, expressed in dB(A), and distance to source for construction equipment

Type of equipment	*Distance to source*					
	15	30	60	120	240	480
Excavator	85	79	73	67	61	55
Trucks	82	76	70	64	58	52
Concrete plants	80	74	68	62	56	50
Cranes	75	69	63	57	51	45
Generators	77	71	65	59	53	47
Compressors	80	74	68	62	56	50

Source: APA, 2010.

Therefore, considering a source of 85 dB(A), we can conclude that, in a 500 m radius from the limits of the project land and from the access route, the equivalent sound levels experienced would be close to or below 55 dB, an acceptable value as per the directives of the WHO for residential areas.

Accordance with the above table and with the applicable directives of the WHO for noise levels (namely for residential areas) critical sensitive receptors are those that are at a distance of less than 480 m from the emitting noise source.

General data on the noise generation capacity of solar PV plants during operation indicates the possibility of generating up to 60 dB of noise at the source. Taking into account the attenuation associated with the distance, since the project installation activities are developed further north on the land, expected impacts are considered negligible.

[1] Punctual sound sources are considered all those whose sound energy spreads uniformly.

This analysis must take into account that the installation area of the solar PV plant has not yet been defined exactly, and will always be smaller than the Project area (DUAT area). Therefore this analysis is conservative, and no sound sources associated with heavy machinery are expected to operate within the limits of the Project Area.

Special attention shall be given to the two additional points related to the construction area of the access road to the project footprint site (respectively the substation of Mocuba and the point RS_RU29), because even though they are about 700 m from the limits of the project footprint area, they are close to the access road to be built (less than 30 m).

4.8 LANDSCAPE

Landscape can be defined as a non-renewable natural resource. Its study comprises to main aspects:

- Consideration of the landscape as a total form and identifying it as a whole, where interrelations between inert (soil, water and air) and living (fauna, flora and man) elements are the indicators; and

- Considering the scenic effect of the landscape, focusing on the expression of the ethical and emotional values of the natural environment. From this point of view, the landscape is interpreted as the spacial and visual expression of the environment.

In situations where the territory is characterized by human intervention the landscape is defined as the expression of a continuing human action, which confers cultural individuality and authenticity to certain places or regions. These landscapes are considered modified habitats. Modified habitats are areas that can contain a large proportion of plant and/or animal species of non-native origin, where human activity substantially modified the primary ecologic functions and the composition of species. These habitats can include areas used for agriculture.

4.8.1 Methodology

To characterize the landscape of the study area the existing Units of Landscape were considered. This refers to the corresponding to types of landscapes aggregated in more or less homogeneous units, defined from the morphologic characteristics and from the use of the land, which gives each unit a specific character.

The characterization was done by reviewing topography maps of the project site and its surrounding area and by doing a desktop review about the landscape of the site and area.

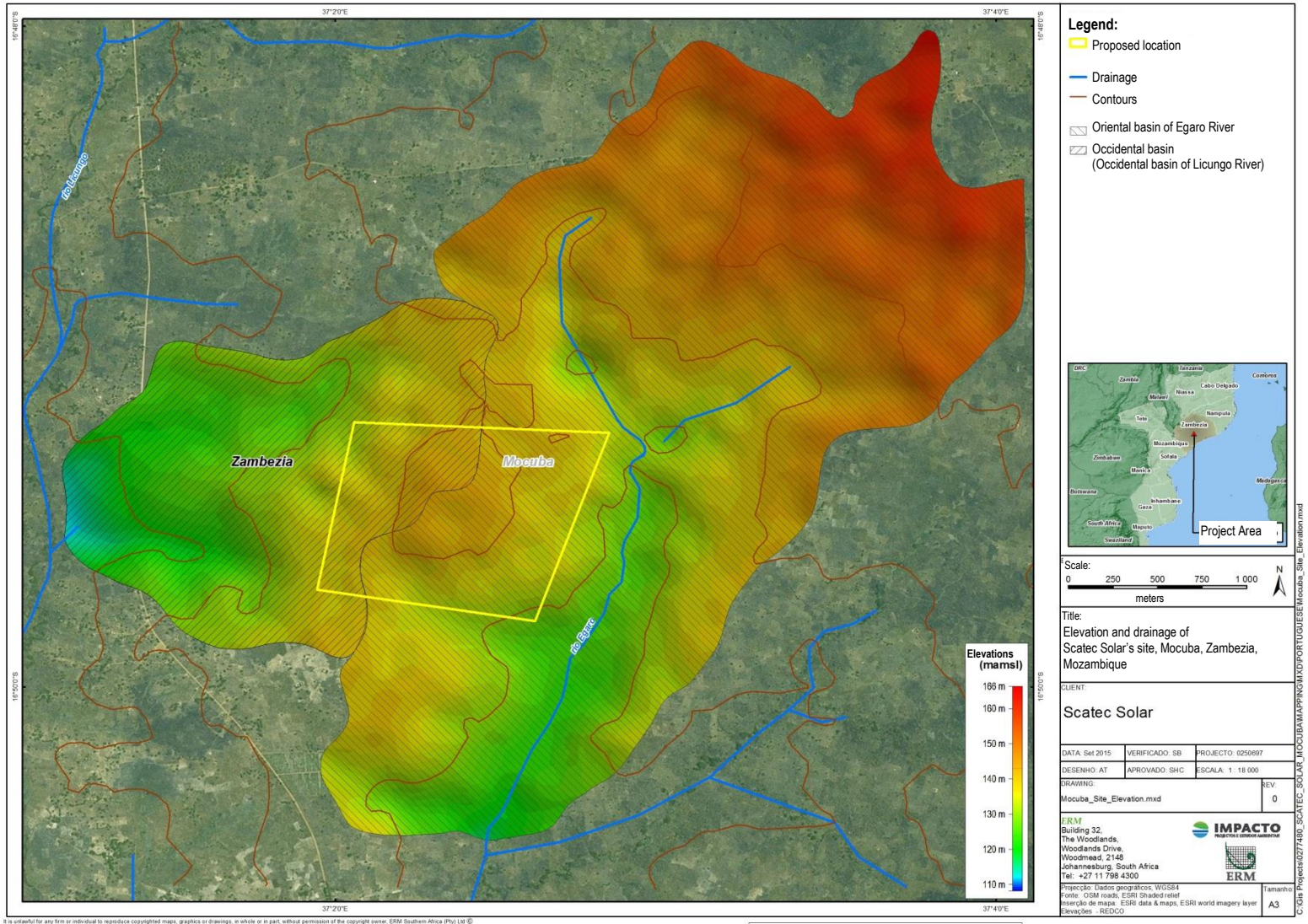
4.8.2 Baseline

Landscape Units existing in the Study Area

The region's landscape is essentially characterized by agricultural and grazing activites with human population scarcely present, with the exception of the center of Mocuba. The landscape is characterized by the valley associated with the Licungo River, its slopes and plateaus.

The valley has, as expected, the lowest elevation above mean sea level (between 136 to 143 m amsl). Along the valley slopes the elevations vary between 150 and 200 meters which is a characteristic of the types of rainfall and runoff within this area as well as the hot climate. The plateaus are situated at elevations of 130 to about 140 meters. (Figure 4.21)

Figure 4.21 Map of the existing Landscape in the Study Area



The analysis of the landscape morphology shows that the land is flat with little height difference within the ara. In the project implementation area the relief is actually flat with gentle slopes with elevations between 130 and 140 meters.. Slopes are less than 2%.

Within the indirect area of influence there are singular elements (shown in the following photographs) which also characterize the area.

Figure 4.22 ***Substation of Mocuba***

Figure 4.23 Licungo River

Figure 4.24 Predominant vegetation

Figure 4.25 Residences and farms (machambas)

4.9 BIOLOGICAL ASPECTS

4.9.1 Methodology

A site assessment was conducted in August 2015 to acquire photographs of the vegetation and any prominent faunal species. Thereafter the site was assessed based on aerial imagery and available secondary data during a desktop study assessment.

4.9.2 Proximity to Protected Areas

There are no protected areas close to the project site. The closest protected area is named the Derre Forest Reserve and is located approximately 100 km southwest of the site. (1) There are no Important Bird Areas (IBA) within the greater vicinity of the project site (2), and the project is not expected to have any impact on protected areas.

Description and State of Habitats

The majority of the project site and surrounding areas have been cultivated. Many small crop fields occur that appear to be cultivated on a subsistence basis. There is no evidence of any natural habitat and the entire project site is classified as a modified habitat. Examples are presented in Figure 4.26.

(1) http://www.protectedplanet.net/
(2) http://www.birdlife.org/datazone/geomap.php

Figure 4.26 Examples of Modified Habitats in the Project Area

The grass layer is dominated by *Urochloa mossambicense* and Imperata cylindrica which are typically associated with disturbed sites. Other grasses present include species *Pennisetum sp*. (alien invasive), *Hyparrhenia* and *Melinis*. Sedges (*Cyperus* sp.) and legumes are associated with the herbaceous layer. Trees present include *Combretum* sp., *Gardenia* sp., *Bauhinia thonningii*, *Diplorhynchus condylocarpon*, *Lannea* sp., *Vitex* sp. and *Mangifera indica* (Mango – planted).

Occurrence of Fauna

The human presence and influence within the project site and surrounding areas are high. Only fauna that is tolerant of human activity is expected to be present. Mammals that may be present would include rodents and possibly squirrels. Birds that have adapted to human presence may also be present, such as crows, cattle egrets (associated with livestock), doves, starlings, sparrows, weavers and various seed-eating bird species. Agama lizards and skinks are likely to represent the common reptile fauna, while toads are expected to dominate the amphibian group.

Occurrence of Aquatic Environments

Aerial imagery revealed that at least one small ephemeral water pan occurs within project boundary. Ephemeral pans in the area are surrounded by agricultural developments and are not expected to support sensitive aquatic ecology. Loss of these pans is expected to affect the temporary water provision to locally occurring fauna only.

The Licungo River is located nearby and would provide permanent access to water over a far greater area. It is located approximately 2.5 km from the project site, however, the section in the proximity of the project is associated with intensive urban development. Human habitation occurs close to the river banks and there is no important riparian vegetation visible on aerial imagery. The river is prone to severe flooding which would remove much of the established riparian vegetation.

Occurrence of Species of Conservation Concern

The likelihood of occurrence of any threatened floral or faunal species is considered to be low, although the unexpected presence of any threatened (vulnerable, endangered or critically endangered) or protected species cannot be discounted due to mobility of some species such as large raptors. If present, such species are unlikely to be fully dependent on any habitat associated with the project site, and the proposed development does not represent a risk to survival of any species.

The project site is not expected to be within any north-south migratory flyways as the terrain is flat and the coastline is located approximately 100 km in a southeast direction. The Licungo River flows in a south-easterly direction and is unlikely to serve as a migratory flyway, but there is potential for this river to serve as a movement corridor, which may be regionally important for bird species. There is therefore a possibility for a broad diversity of bird species passing by the project area.

4.10 SOCIO-ECONOMIC

4.10.1 Methodology

The study was based on secondary data collected during desktop studies and primary data collected during field work. The baseline describes the present situation of the socio-economic context of the communities adjacent to the proposed site and its associates infrastructure. The baseline socio-economic study contains:

- Demographic data, population dynamics, and patterns of human settlement;
- Administrative and political organization and hierarchy of power (including traditional);
- Identification and analysis of socio-demographic metrics for health and other related statistical data;
- Access to social services and other infrastructure;
- Patterns of land use;
- Patterns of natural resource use;
- Activities and economic subsistence agriculture and employment strategies;
- Vulnerable groups; and

- Cultural traditions and ceremonial (including sacred and cultural sites).

The main methods for *data collection and analysis* were:

- Questionnaires were provided to families / households who have resources within the project area,

- Semi-structured interviews with state leaders and community members, and

- Meetings with local government officers and non-governmental organizations.

A model of questionnaire was developed that addresses the information needs of the socio-economic study and the simplified lan-use and compensation plan. Scripts were also developed for the semi-structured meetings with the Administrative Chief, and Local and Community Leaders of the villages, settlements and neighbourhoods located in the vicinity of the project footprint area.

A group of surveyors were recruited to present the questionnaires, with the support of local guides. Impacto performed the interviews.

The work was suppoted by a *Serviços de Actividades Económicas* (SDA) (Economic Activity Services) technician whose main job was to monitor the work undertaken by Impacto.

Data entry for the questionnaires was done using CS PRO software. The data was then exported to SPSS software for *data analysis*.

The census and asset survey of agricultural plots was performed using a handheld GPS. All the data were anylised using GIS to confirm that there weren't any overlaps between plots.

During the last days of the survey the number of households who arrived to be surveyed started decreasing and certain households whose names were on the list of land owners did not arrive to be surveyed. These households were contacted with the assistance of community leaders and radio notices broadcast on the Community Radio of Mocuba.

4.10.2 Baseline

Political and Administrative Organization

The project is located in the Mocuba District between the lowlands of the Nicoadala, Namacurra and Maganja Districts on the Coast (Lower Zambezia) and the highlands of the Ile, Lugela and Milange Districts

(High Zambezia). The Mocuba District is divided into three administrative posts (see *Table 4.4*).

The project area is located in the Mocuba Administrative Post which includes the territory of Mocuba Municipality and two villages, namely Munhiba and the Village of Mocuba Sede. The project is located in the Settlement of Bive, the Village of Muandiua and the neighbourhood of Mugonda.

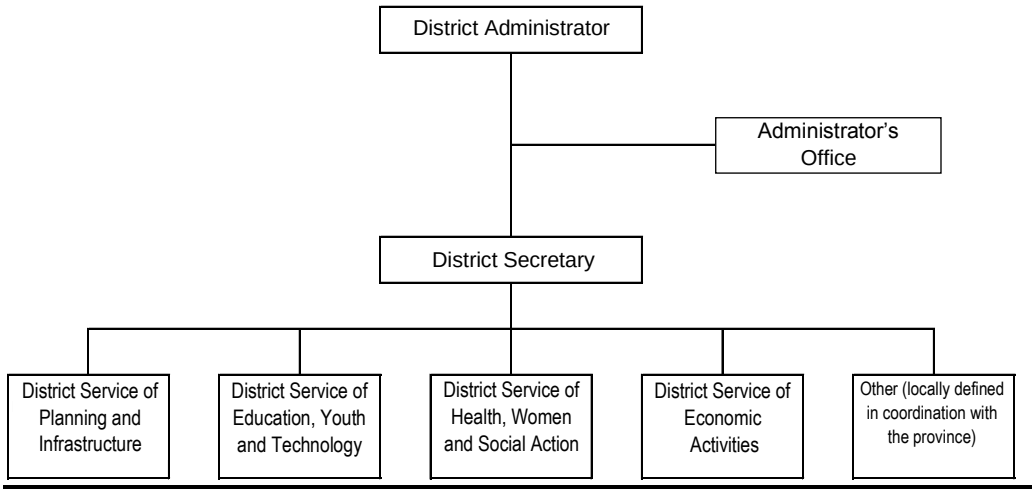
Table 4.4 ***Administrative Organisation of the Project Area***

Administrative Post	Locality /Municipality	Village	Settlement	Neighbourhood
Mocuba	Mocuba Municipality			
	Mocuba Sede	Bive	Muandiua	Mugonda
	Munhiba			
Mugeba	Mugeba Sede			
	Muaquiua			
Namanjavira	Namanjavira Sede			
	Alto Benfica			

The current political and administrative organization of the State in the Zambezia Province and ***District*** of Mocuba results from the decentralization process initiated by the Government of Mozambique in the year 2003 (1).

Figure 4.27 represents the typical organization chart of a district government, which is governed by the District Administrator supported by a Permanent Secretary and by the directors of the district services. The minimum number of directors for district services is four.

Figure 4.27 ***Organization Chart of District Government***



(1) The main legal instruments that fall into this process are Law 8/2003 of the Local Organs of the State- LOLE, Decree 11/2005, LOLE Regulation, and Decree 11/2012, which updates Law No. 8/2003 of May 19.

The ***Administrative Post*** and the ***Locality*** are governed by the Chiefs of the Administrative Post and of the Locality, who are supported by a Common Secretary. The government of the Administrative Post and of the Locality is made up of the Post or Locality Chief and by the Administrative Board, with the participation of the sector representatives of the State who are present at those territory levels (see Table 4.5).

Until the publication of Decree No. 11/2012, the formal authority of the state at district level ended at the locality level, however, their authority has now extended to the level of the ***Village*** though the appointment of the Village Chief by the District Administrator (who is also supported by an Administrative Secretary). This legal decree is, however, not being implemented at practical level and the workings of the village is still being managed by the community organization and Village Chief.

Table 4.5 ***Members of the Administrative Boards of the Administrative Post and Locality Sede de Mocuba***

Administrative level	Full members	Guests
Mocuba Administrative Post	Coordinators of ZIPs Directors of Health Centers Agriculture/extension technicians SDPI technician PRM Post Chief	Director of Secondary School Leaders of the 1st Tier
Locality Sede de Mocuba	Coordinators of ZIPs Directors of Health Centers Agriculture/extension technician	

Source: Impacto, Interviews Field Research (August and September 2015)

In the year 2000, just before the approval of the Law of Local Organs of the State in 2003, the State started the process of interaction with the community authorities, recognizing the traditional leaders as community authorities, and simultaneously recognizing other actors as community authorities as in the case of the "Secretaries of neighbourhoods and villages and other legitimate leaders … quo exercise any economic, social, religious or cultural function that is accepted by the social groups they belong to" (1). Community authorities can be of the 1st, 2nd or 3rd tier according to their geographic scope of action.

The appointment of leaders or community authorities appeared after the Peace Accord (1992). At that time communication with rural communities was done by the secretaries and/or the chieftains (régulos) or their representatives. The secretary as a structure originated during single party rule), whereas the chieftain (régulo) originated in the traditional structure, which had been marginalized during the phase of single party rule. Both types of authority

(1) The three main instruments are (1) Decree 15/2000, which defines the interaction between the local organs of the State and the community authorities; (2) the Ministerial Diploma 107-A/2000, which establishes the corresponding regulation and (3) the Guide of the Community Participation and Consultation Institutions (IPCC) published by the Order of 13.10.2003, BR nº42, I Series, on 15.10.2003. Recently, the Decree 35/2012 revokes Decree 15/2000 and its regulation (Diploma 107-A2000).

was legitimized by the State. Local forums and consulting boars were also added to the political and administrative organization.

Figure 4.28 summarizes the type of configuration of the political and administrative organization.

Figure 4.28 Configuration of the Political and Administrative Organization of the Mocuba District

Level of the Territory	Government	State Apparatus	Authority / Community Leader	Civil Society Community Management	Consulting Structure
District	Administrator Permanent Secretary Directors of District Services	Administrative Office District Secretary District Services		Local Forums NGOs Associations	Consulting Board of the District
Administrative Post	Chief of the Administrative Post Administrative Board	Common Secretary Sector Technicians		Local Forums Associations	Consulting Board of the Administrative Post
Locality	Chief of the Locality Administrative Board	Common Secretary Sector Technicians	1st Tier: Chieftain (Régulo) Secretary	Associations Community Committees (OBCs)	Consulting Board of the Locality
Village	Chief of the Village (not implemented)		1st Tier: Chieftain (Régulo) Secretary	OBCs: Water Committee GMR School Board	Consulting Board of the Village
Village			2nd Tier: Samassoa (Chief of Village) Secretary	OBCs: Water Committee GMR School Board	
Zones/Neigh-borhoods			3rd Tier: Kafumo (Chief of Neighbourhood/Zone) Representative of the Régulo Secretary	OBCs: Water Committee GMR School Board	

Source: Impact, Interviews Field Research (August and September 2015)

In the ***Indirect Influence Area*** of the Project the villages are subdivided into ***Settlements***, ***Neighbourhoods and Zones***. In each of these zones there is a responsible community leader, who generally belongs in the 2nd tier in the villages and in the 3rd tier in the neighbourhoods and zones.

The mapping of the community authorities in the Administrative Post and Locality Sede de Mocuba shows the presence of leaders of the three tiers derived from the traditional structure or from those who were elected (Table 4.6).

Table 4.6 Community Authorities at the Administrative Post and the Locality Sede de Mocuba (ADI)

Admin.Post/Locality	**1st tier**		**2nd tier**		**3rd tier**	**Consulting**
	Chieftain (Régulo)	Elected	*Samassôa*	Elected	*Kanfumo*	**Board**
Admin.Post Mocuba	8	8	74		105	40
Locality Mocuba Sede	4	4	12	12		20

Source: Impact, Interviews Field Research (August and September 2015)

At the State and Government level, the communications generally follow a path from top to bottom. The Chief of the Administrative Post and Locality Sede de Mocuba govern the territory through Administrative Board meetings.

The consulting activities are assured by means of the participation of the community leaders in the meetings of the Administrative Board, as guests, as well as by meetings of the Consulting Board. The dissemination of information is also undertaken during rallies and meetings with the local population, when it becomes necessary.

The operation at the level of the villages overlaps with the institution of the chieftain (régulo), which works as a hierarchy going from the Chieftain (Régulo) (1st tier) to the *kanfumo* (3rd tier), which ensures day-to-day management. In spite of the top to bottom hierarchy, the leaders of the 2nd tier (*samassoas*) and 3rd tier (*kanfumos*) have the power to resolve matters and problems related to the land and to social conflicts. In cases of difficult solution, the problems can move in succession to the upper tiers (2nd and 1st tier), Locality and Administrative Post. In case a problem is of criminal nature, it will go to the community court, police or district court. The chieftain (régulo) system also has a consulting structure where there is participation of religious leaders and members of Ametramo, the organization of traditional medics.

Population Distribution

Table 4.7 summarizes the estimated population in 2015 by sex and age groups of the Mocuba District where the project is located. The Administrative Post of Mocuba represents about 56% of the total district population, due to the influence of the urban center as a base in the Mocuba Municipality with a population representing about 30% of the district population. The Sede Locality makes up approximately 24% of the district's population.

Table 4.7 Estimated Population of 2015 in the Mocuba District by Sex and Age Group

	Total	Sex		Age group		
		Men	Women	0 - 14	15 - 64	65 +
AREA OF INDIRECT INFLUENCE						
Total for District	385,902	187,383	198,519	180,528	197,135	8,240
Admin.Post Mugeba	112,666	53,880	58,800	55,253	54,453	2,559
Admin.P. Namajavira	56,637	27,208	29,434	27,418	27,719	1,363
AREA OF DIRECT INFLUENCE						
Admin.P. Mocuba	216,598	106,295	110,285	97,857	114,963	4,317
Mocuba Municipality	99,882	50,003	49,955	41,746	57,727	1,257
Loc. Sede Mocuba	93,236	45,091	48,147	44,636	45,969	2,504
Loc Munhiba	23,380	11,201	12,182	11,475	11,267	556

Source: Statistics of Mocuba District, November 2012, INE 2012

Table 01 in Annex VII summarizes the main characteristics of the population in Mocuba District and in the Administrative Posts, namely for sex and age groups.

In the period 2007-2015 the district's population increased at a rate of 3.17% per year. The proportion of women is a higher than that of man except for Mocuba Municipality, which may be due to the fact that in rural zones there is

emigration of males to other provinces, other districts and urban centers in the province, while in the Mocuba Municipality there is higher concentration of male workforce due to employment opportunities and development of informal activities. The age structure of the population shows a high proportion of young population: about 47% in the age group of zero to fourteen years (0 – 14 years) and an extremely low proportion with an age of 65 years or more (2%).

The proportion of the population which is economically active (from 15 to 64 years of age) varies between 48 and 51%, with the exception of the Mocuba Municipality (58%), due to the work opportunities and the performance of self-employed activities possible in the urban environment.

The Municipality and the localities that form the Mocuba Administrative Post have several population centers such as the neighbourhoods in the Municipality and the villages in the localities. As mentioned earlier, the villages are made of settlements and these are made of neighbourhoods and zones.

The households who own resources and farm plots within the project footprint area come from these neighbourhoods, village and settlements. The majority are from the neighbourhood of Bairro Samora Machel, in the Mocuba Municipality, and from several zones in Bairro de Mugonda, from the Locality of Mocuba Sede (1). Other households reported that they live in the village of Bive or Muandiua.

Information collected during the field survey indicates that the majority of households that live in neighbourhoods of the municipality and own agricultural land in the project footprint area used to live in different zones of Bairro de Mugonda. They established a residence in the municipality to benefit from the nearby services (e.g., energy, potable water, high schools, health center and hospital) but still maintain their properties (*machambas*) in Mugonda.

Table 4.8 summarizes the population centers that form the Administrative Post of Mocuba.

Table 4.8 Population Centers of the Administrative Post of Mocuba and that Own Resources in the Project Area Footprint

Urban neighbourhood/Village	Zone	No. of Fam.Househ. resources in the Proj.Ftp.Area
LOCALITY OF MOCUBA SEDE		
•Village of Bive		13
–Village of Muandiua		20
Bairro de Mugonda	Zone A,B,C,D	61
–Village of Matesso		
Murraba Zone		2
–Village of Macuaia		

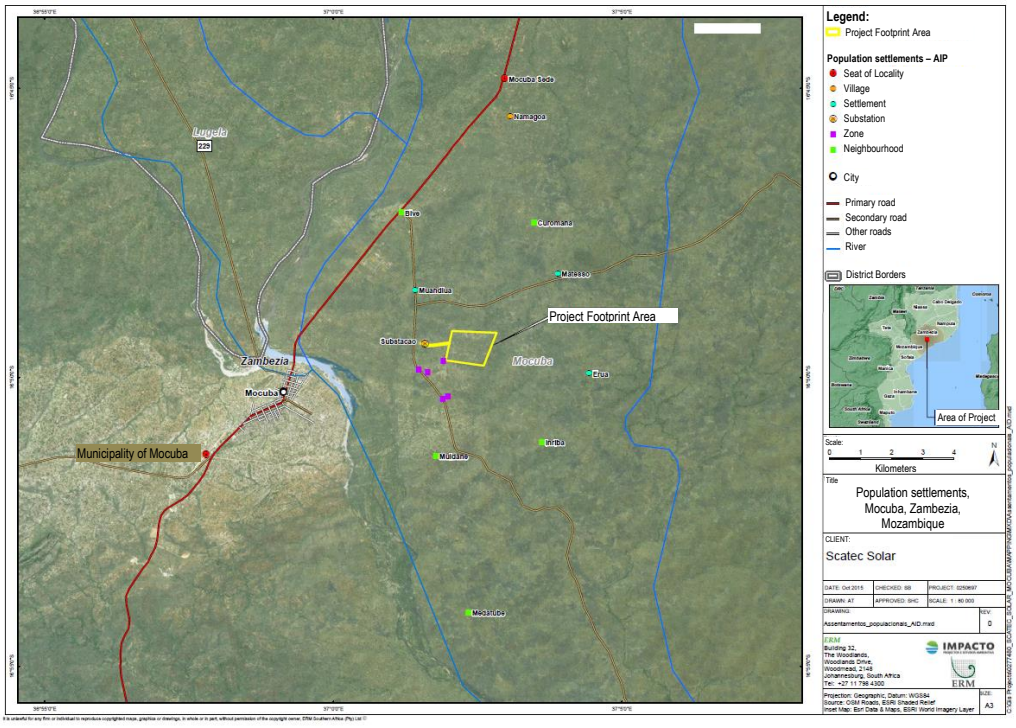
(1) As iustrated on Table 4.5, Bairro de Mugonda belongs to Muandiua Village and Bive Village, at Locality Mocuba Sede.

Urban neighbourhood/Village	Zone	No. of Fam.Househ. resources in the Proj.Ftp.Area
Damião Zone (total 9 settlements in the Village of Bive)		1
•Village of Namagoa –Village of Nadala		1
•Village of Lobua		
•Village of Chingoma		
MUNICIPALITY OF MOCUBA		
•Bairro Samora Machel		97
•Bairro Marmanelo		8
•Bairro 16 de Junho		1
•Bairro 25 de Setembro		1
•Bairro CFM		1
•Bairro Sacras (total 17 neighbourhoods/bairros)		1
LOCALITY OF MUNHIBA		
•Caiave		
•Mataia		
•Nhawanda		

Source: Impact, Interviews Field Research (August and September 2015)

Figure 4.Figure 4.9 illustrates the most important population centers that the Consultant mapped during the field survey (1) .

Figure 4.29 Population Centers Mapped in the Indirect Influence Area



(1) the mapping criteria were to record when possible the population centers where Fam. Househ. reside that were questioned as well as others who are somehow related to the Project Footprint Area in terms of access and use of natural resources.

Population dynamics

In the Mocuba District the emigration rate is slightly higher than the immigration rate, which means that the general balance shows more people exiting than entering (negative migration balance). Even though the Mocuba District is one of the destinations for people immigrating seasonally, the migratory balance in the entire district is negative for the period 2002-2007 (-0,2%). The same is observed in the Province of Zambezia which presents a negative migratory balance in the same period. (Table 4.9 shown below)

The Province of Zambezia is a province with a migration tradition to other provinces in the country (especially Sofala, Manica and even the southern provinces of the country, such as Maputo).

Table 4.9 Migration Indicators in the Period 2002 – 2007 According to 2007 Census

Migration indicators	Province of Zambezia	District of Mocuba
Immigration Rate	1.8	2.5
Emigration	5.4	2.7
Migratory balance	-3.9	-0.2

Source: Statistics of Mocuba District, November 2012, INE 2012

In the ***Direct Area of Influence*** the migration phenomena was also observed. Community members within the settlements originate from the other districts within the Province of Zambezia, such as Gurué, Ile, Alto Molocué, Gilé and Maganja da Costa. Some of the people settled down permanently (the majority) and others only seasonally. The reasons for immigration are informal businesses, people looking for employment and the opening of plots (*machambas).* The locations preferred for the settlement of people are Village of Bive, Chingoma and Lóbua.

The *emigration phenomena* was also observed. Generally people depart the area to go to destinations in nearby districts and urban centers such as Quelimane, Beira and Maputo. The majority of people are looking for employment and better living conditions.

Socio-demographic and health profile

In the whole district the average number of people per household is smaller (4.5) which is due to the influence of rural areas where older sons tend to marry early and leave the parents' home, whereas most of the households surveyed live in the area of influence of the urban zone of Mocuba, where households tend to be larger because they receive family members coming from distant zones to benefit from services rendered by the urban zone (e.g., high school, employment, schools, hospitals).

Table 4.10 Average Number of People per Family Household

	District of Mocuba (AII)	Fam. Households surveyed (ADI) (n=208))
Number of people per family household	4.5	6.1

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007
Impact, Interviews Field Research (August and September 2015)

Data from 2007 Census indicate that in 2007 about 26% of the family households were headed by women, and the survey of family households with resources in the Project Footprint Area revealed a similar value of 24% (Table 4.11).

Table 4.11 Family Households Headed by Women

	District of Mocuba (AII)	Fam. Households surveyed (ADI) (n=208))
Percentage of Fam. Households headed by women	25.8	24.0

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007, Impacto, Interviews Field Research (August and September 2015)

It should be noted that the main reasons for the family household to be headed by a woman in the Mocuba District and in the households surveyed are divorce/separation and widowhood. The results of the census and asett survey showed that 56% of women heading a family household are widows, and it was also noted that about 58% of the women are more than fifty years of age (see *Table 2, Annex VIII*).

Elomwe is the language most frequently spoken in the District of Mocuba, followed by Portuguese, whereas in the Administrative Post and Locality of Mocuba the languages most spoken are Manhaua (with influence of the language spoken in the District of Lugela), Elomwe, Loló (mixture of Mahuaua and Sena), Echuabo and Nharinga (mostly spoken on the frontier with Maganja da Costa).

Table 4.12 Main Languages of Mocuba District in the Surveyed Population

District of Mocuba (AII) Language most spoken at home	%	Interviews (ADI) Language spoken by the most people	Importance
Portuguese	21.3	Manhaua	1
Elomwe	39.2	Elomwe	2
Echuabo	10.9	Loló	3
Not known	27.2	Echuabo	4
Other	3.4	Nharinga	5

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007
Impact, Interviews Field Research (August and September 2015)

The Christian catholic religion involves the most people both in the District of Mocuba and in the Administrative Post of Mocuba**.** Islamic and protestant churches also have an important role in this administrative post.

Table 4.13 Main Religions in the Project Area of Influence According to the 2007 Census

District of Mocuba (AII)		**Interviews (ADI)**	
Religions practiced	**%**	**Religions practiced**	**%**
Catholic	42.4	Catholic	1
Islamic	3.0	Islamic	2
Zione/Siam	14.2	Adventist	3
Evangelic	7.2	New Apostolic	4
Without religion	5.9		
Other	27.3		

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007
Impact, Interviews Field Research (August and September 2015)

Educational indicators

Data from the 2007 Census indicate that in that at the time a little more than 50% of the population was illiterate. Women's illiteracy rates were twice the men's rate. A similar situation was observed relative to school attendance of women; about 64% of them having never attended school.

The education level of the family household members surveyed was also very low, and it was reported that about 59% of their members did not complete any school level.

Table 4.14 Educational Indicators According to 2007 Census

	District of Mocuba (AII)			**Fam. Households surveyed (ADI) (n=1104))**		
	Men	**Women**	**Total**	**Men**	**Women**	**Total**
Illiteracy rate (1)	31.9	68.7	51.0	-	-	-
Status of school attendance	35.6	64.4	32.8			
Never attended (2)						
No level of schooling completed				51.3	66.5	59.1

(1) Population 15 or more years of age. Question not asked in Fam. Households survey
(2) Population 5 or more years of age.

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007
Impact, Interviews Field Research (August and September 2015)

Health indicators

Table 4.15 below summarizes three indicators to measure the health condition of a certain population, in this case the District of Mocuba, and as a comparison, it shows the data for the Province of Zambezia.

The mortality rate for the District of Mocuba is larger than the one for the Province of Zambezia only by half a percentage point, being, together with two other districts of the province, the lowest mortality rate. This is probably due to the estimated life expectation for the District of Mocuba (50.8 years) being the third highest in the Province of Zambezia, after the Districts of

Milange and Gilé. But the childhood mortality rate is quite high in absolute terms (138.5 children in one thousand die in their first year of life), though in relative terms it is the seventh lowest among a total of 17 districts in the Province of Zambezia.

Table 4.15 *Main Health Indicators of the District of Mocuba, According with the 2007 Census*

	Province of Zambezia	**District of Mocuba (AII)**
Crude mortality rate	14.5	15
Infant mortality rate	101.6	138.5
Life expectancy at birth	52.3	50.8

Crude mortality rate: number of deaths per thousand inhabitants in the last twelve months
Infant mortality rate: number of deaths per thousand children in the first year of life
Life expectancy at birth: number of years that individuals born in 2007 expect to live

Source: INE, District Sociodemographic Indicators, 2012

The national health system identified eight Illnesses of Obligatory Notification whose cases are diagnosed and recorded in the national health network. Table 4.16 below summarizes the Illnesses of Obligatory Notification in the five localities of the District of Mocuba in the year 2014. Malaria is the illness that presented a high number of cases, followed by diarrhea and dysentery. These last two being illnesses related to the use of water, household sanitation and the practice of hygiene.

Table 4.16 ***Illnesses of Obligatory Notification Diagnosed in 2014 in the District of Mocuba***

	Area of Direct Identif.		**Area of Indirect Identif.**				
	Mocuba Sede	**Munhiba**	**Mugeba**	**Muaquiua**	**Namanjavira**	**Alto Benfica**	**Total for District**
Tetanus (1)	**26**	**4**	**6**	0	0	12	48
Malaria							
0 – 4 years	15,483	1,825	2,242	1,198	1,813	1,096	23,657
5 + years	12,609	1,539	1,231	970	895	549	17,793
Total Malaria	28,092	3,364	3,473	2,168	2,708	1,645	41,450
Diarrhea							
0 – 4 years	1,737	186	276	109	321	50	2,679
5 – 14 years	479	50	153	28	57	14	781
15 + years	931	80	131	37	235	156	1,570
Total Diarrhea	3,147	316	560	174	613	220	5,030
AFP (2)	25	0	0	0	0	0	25
Rabies	69	6	12	2	2	0	91
Meningitis	0	0	0	1	0	0	1
Dysentery	1,019	256	156	33	0	66	1,530
Measles							
9 months	1	0	0	0	0	0	1
9 – 23 months	0	1	0	0	0	0	1
24 months	0	0	0	0	0	0	0
Total Measles	**1**	**1**	**0**	**0**	**0**	**0**	**2**

(1) Neonatal Tetanus
(2) Acute Flaccid Paralysis

Source: Impact, Collection of Information District Health Service, Woman and Social Action: Field Research (August and September 2015)

The Locality of Sede de Mocuba is where the most cases of illnesses of obligatory notification was recorded, however, this must be seen within the context of it being the locality where 50% of the population is concentrated within the district, and it is also where the District Hospital is located. The capacity to diagnose chronic and neglected illnesses is very limited. Table 4.17 shows the number of these cases diagnosed in 2014.

Table 4.17 Chronic and Neglected Illnesses Diagnosed in the District of Mocuba in 2014

Chronic	**Up to 15 years**	**15 – 20 years**	**20 + years**	**Total**
Hypertension	0	0	47	47
Diabetes	0	0	2	2
Bronchial asthma	311	287	403	1001
Epilepsy	0	2	4	6
Neglected Illnesses	**Up to 5 years**	**5 – 14 years**	**15 + years**	**Total**
Bilharzia/Schistosomiasis	163	268	317	748
Elephantiasis	0	0	0	0
Scabies	13	11	7	31
Tungiasis	1	3	2	6
Pediculosis	0	0	0	0
Trachoma	0	0	0	0
Tripossomiasis	0	0	0	0

Source: Impact, Collection of Information District Health Service, Woman and Social Action: Field Research (August and September 2015)

Table 0.3 in *Annex VIII* indicates that in 2014 a total of 5275 patients were enrolled in the Anti Retro Viral Treatment (ARVT) system, in most cases people 15 years or older (4841 people) and females (3400 people).

Vulnerable Groups

The Ministry of Gender, Children and Social Action is the State sector responsible to support vulnerable groups. At the district level the District Health Service is responsible (there is normally a office dedicated to woman).

Social support programs in Mocuba District are implemented by the Office of the INAS, a regional scope office which covers several neighboring districts and acts in the Mocuba District.

Support to vulnerable groups is implemented through the Basic Social Subsidy Program and the Direct Social Support Program, described below in terms of target groups and number of beneficiaries (Table 4.18).

The **elderly**, **handicapped**, **chronically sick** and **family households with undernourished children** are the groups with the highest number of beneficiaries. *Table 4* in *Annex II* also shows that, in all cases (except handicapped and chronically sick), women are the target group with the highest number of beneficiaries.

Table 4.18 Vulnerable Groups Supported by the Programs Managed by INAS of Mocuba in 2015

Support Programs	Target groups	# of beneficiaries ADI	# of beneficiaries AII
Basic Social Subsidy Program	Elderly	4247	6,188
	Handicapped	326	430
	Chronically sick	290	401
	Total	**4863**	**7019**
Direct Social Support Program	Fam. Households headed by children (12 – 18 years)	26	42
	Chronic/degenerative illnesses (bedridden)	89	142
	Person in Anti Retro Viral Treatment (ARVT)	10	10
	Heads of Fam. Households temporarily incapacitated	270	273
	Fam. Households with undernourished children	434	512
	Total	**829**	**979**

AII: District of Mocuba
ADI: Mocuba Administrative Post

Source: Impact, Collection of Information INAS Mocuba: Field Research (August and September 2015)

The survey of the family households who own resources within the project footprint dentified that about 17% of the affected household members are considered vulnerable. This corresponds to 236 members of surveyed family households, as described in Table 4.19 below.

Table 4.19 Surveyed Members of Family Households Considered Vulnerable

	No. of members	%
Physical handicap	19	1.5
Mental handicap	8	0.6
Unwed mother	33	2.6
Widow	31	2.4
Woman heading family	12	0.9
Orphan child	45	3.5
Elderly person (more than 60 years)	28	2.2
Person with chronic illness	28	2.2
Visual handicap	1	0.1
Several vulnerabilities	11	0.9
Auditory handicap	6	0.5
Does not know/Did not respond	1	0.1
Total	**223**	**17.4**

Source: Impact, Interview Field Research (August and September 2015)

Access to social services and infrastructure

School network

The school network in the District of Mocuba did not have a considerable growth in the period 2010 – 2013, being based mostly on grade school teaching at 1st Level (EP1) whose teaching goes up to 5th Grade. Schools that teach up to Grade 7 make up a smaller number. This situation is worse at secondary and professional technical level where the number of schools do not rise above

one digit. These schools are located in the Seat of the District and in the seat of another administrative post.

Table 4.20 School network of Mocuba District

	2010	2011	2012	2013
Primary school 1st Level (EP1)	136	141	144	146
Complete primary school (EPC)	50	52	54	56
Secondary school 1st cycle	6	6	6	5
Secondary school 2nd cycle	1	1	1	2
Professional Technical School	1	1	2	3
Higher education (college)	1	2	2	2
Literacy schooling and Adult Education	171	169	152	120

Source: Strategic Plan for Development of Mocuba District 2013-2020, Government of the District of Mocuba.

Within the ***Indirect Area of Influence*** there are six EP1 schools and five EP2 primary schools. The absence of secondary level schools results in many children not going on to study at secondary level because of the distance involved to travel to the school.

Figure 4.30 Present Primary School of EP1 and of EPC under Construction in Bairro de Mugonda

Network of sanitary units

The sanitation network in the District of Mocuba is more developed in the Administrative Post and Municipality of Mocuba. This is in part due to the larger population numbers and also due to a higher concentration of infrastructure in the seat of the District and Municipality of Mocuba, where the District Hospital is located (1).

Even in the Administrative Post of Mocuba, most of the health centers are Urban C and Rural Type II, where the rendered services are less (2), a situation

(1) Even though it is classified as district, this hospital receives patients transfered from nearby districts which do not have a district hospital (e.g., districts of Lugela, Ile, Maganga da Costa, Gilé)

(2) Sanitary units Urban C and Rural Type II have maternities and medical visits, but do not offer inpatient services for children or adults. Only Health Centers Type I have all the services provided by a health center.

that also exists in other administrative posts, which offer health services based fundamentally on health centers Type II.

Table 4.21 Sanitary network in the District of Mocuba

	Mocuba Administrative Post	Mugeba Administrative Post	Namanjavira Administrative Post
District Hospital	1	-	-
Urban B Health Center	2	-	-
Urban C Health Center	3	-	-
Rural I Health Center	-	1	-
Rural II Health Center	6	3	4
Total	12	4	4

Source: Impact, Collection of Information District Health Service, Woman and Social Action: Field Research (August and September 2015)

Within close proximity to the site there is only the **Mugonda Health Post** which operates as a community agent in a tent. It receives daily visits by a nurse who comes from the municipality. Health Centers with maternity and in-patient services for children and adults only exists in the neighbourhoods of the municipality. The nearest one being the Bairro Samora Machel.

Water, sanitation and energy

Data from 2007 Census indicate that the access to electric energy, safe water sources (in piped water distribution systems or in scattered sources) and safe basic sanitation is quite low, especially in rural zones.

Table 4.22 Access to Water, Sanitation and Energy in the District of Mocuba as per 2007 Census

	Total	Urban zone	Rural zone
Fam. Households with access to electric energy	7.1	12.4	0.2
Fam. Households with access to safe water sources:			
Piped water	0.3	0.6	0.1
Public fountain	6.7	10.9	1.4
Manual pump	5.9	5.9	5.8
Fam. Households with access to safe basic sanitation:			
Septic tank	1.1	1.1	0.1
Improved latrine	3.8	3.8	0.1

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007

In the ***Project Footprint Area*** and nearby zones there is no electric energy, in spite of the nearby substation. Firewood, battery and oil lamps are the energy sources for lighting used by most of the family households.

The domestic sanitation system is based on the traditional latrine or, in its absence, human needs occur outside in the bush. In the villages, settlements, neighbourhoods and zones around the Project Footprint Area four perforated water wells exist which are not sufficient to supply all residents.

Residents of Bairro de Matebe and Mugonda, located near the Project Footprint Area, use the Ígaro River to bath and wash clothes. They have to cross the project footprint area to walk to the river.

Figure 4.31 Open Well and Traditional Latrine in one of the Settlements Near the Project Footprint Area

Road network and transportation

Access to the project site is by means of the Non-Classified Road which starts at the crossing with N1 and extends in the direction of districts Maganja da Costa and Pebane until it reaches R644 and R645. Other access is gained by a network of paths that cross the project footprint area and connect this area to nearby areas.

People using the access path and footpath network were surveyd to obtain data on where they come from. Data showed that most of the people travel on foot and some had bicycles and mopeds. Their main destination was the farm plots (machambas) or their workplace in the Municipality. There were also people transporting wood, coal and bamboo for sale in the inland areas of the Municipality. Studens and teachers were also using the footpath network to travel to school. The majority of road and footpath users came from the nearby districts of Pebane, Maganja da Costa and from other localities in the district of Mocuba such as Muaquia. There were also people from nearby communities of Erua, Mitalane, Bive, Muidane and Bairro Samora Machel.

Figure 4.32 Accesses in the Project Footprint Area and Transportation by Bicycle

Use of natural resources

Table 4.23 summarizes the natural resources that the surveyed family households reportedly to use**.** The most important resources are grasses (capim), trees, medicinal plants and stakes. During the interviews with affected households a great deal of emphasis was placed on the importance of self-construction (of their homes) and being able to make improvements to their residences using natural resources found within the project footprint area. People also expressed the importance of being able to sell natural resouces (obtained in the project footprint area) to obtain an income.

It should be noted that people from other villages, settlements and neighbourhoods such as Erua, Mugonda, Bive, Namagoa, Muandiua, Samora Machel, Marmarelo and CFM were also observed using the project footprint area to obtain natural resources. See Figure 4.33 for the type of natural resources used.

Table 4.23 Natural Resources Used in the Project Footprint Area by the Surveyed Family Households

Natural Resource (1)	**Survey of Fam.Households (%)**	**Interviews with Community Leaders**
Grasses for roofing and construction	95.7	For covering houses and for sale
Palm leaves	3.8	
Trees for artisan arts	25.0	
Other materials for artisans	18.3	
Stakes for construction	49.0	For use in construction
Tree for ropes	61.1	For use in construction
Trees for coal	67.8	For use or sale
Trees for firewood	95.2	
Medicinal plants	59.6	For household use
Trees for production of honey	4.8	
Animals for hunting	20.2	
(1) Independent variables (n=208)		

In interviews with community leaders it was found that these resources also exist and are collected in areas near the project footprint area (such as Inriba, Munamane, Matocapi, Medatube and Damião) by the family households that reside there and by others coming from the previously mentioned zones.

It was stated that the paths existing in the project footprint area are widely used for access to these resources.

Figure 4.33 Collecting Grasses and a Tree Used to Make Pestles

Land use and exploitation of the land

The field survey identified 208 family households that own resources within the Project Footprint Area. For most of them the resources are land plots used for agriculture (*machambas*) and planting fruit trees.

The total number of *machambas* mapped was 232, the surveyed family households having an average 1.1 *machambas* in the Project Footprint Area with an average area of 0.7 hectares of agriculture land per family household. Most of the family households (95%) have *machambas* located in the upper area.

Table 4.24 Main Characteristics of Land Parcels Existing in the Project Footprint Area

	Measure	Result
# of *machambas* mapped in the Project Footprint Area	No.	232
Average # of *machambas* per Fam. Household	No.	1.12
Average size of *machambas* owned by the fam. household (1)	Hectare	0.7
Location of the *machambas* (1)		
Fam. Households with *machambas* in the upper zone	%	94.7
Fam. Households with *machambas* in the lower zone	%	1.4
Fam. Households with *machambas* in both zones	%	3.8

(1) Value that aggregates all *machambas* property of Fam. Households

Only a few residual cases were found of ownership of support structures in the *machamba (*four family households registered the property of support structures such as a well, kitchen and porch).

In the past, several family households resided and practiced agriculture in the Project Footprint Area, belonging to the Bairro de Mugonda. Later they established residence in neighbourhoods of the municipality, where they built new residences, but they continue maintaining the *machambas* for agricultural production (1).

(1) Traces of those residences are still visible, now abandoned.

About 25% of the family households reported that they obtained the agricultural plots by inheritance and a further 38% reported that they obtained it by means of occupation.

It should be noted however that the ownership of agricultural plots through purchasing it (informally) or borrowing it was raised by 37% of the households. This indicates a relatively high number of people who had access to land through the families who had original ownership of the land.

Table 4.25 Ways to Access the Machambas of Family Households

Means by which the family household obtained the *machamba* (1)	%
By inheritance	25.0
By occupation	38.0
By purchase	34.6
By borrowing	2.4
By yielding outright	3.8

(1) Percentages of independents that aggregate all *machambas* property of Fam. Households

The field survey further recorded that out of a total of 232 parcels mapped only one parcel was undergoing preparation and about 47% of the machambas had crops on the land and 22% showed signs of crops from the previous season (2014-2015). About 11% of the plots had no trace of crops from the previous season (2014-2015) and 20% were identified as fallows.

The survey occurred at the end of August - beginning of September, which corresponds to the end of the crop season for 2014-2015. It was therefore difficult to evaluate the use of the agricultural plots based on field observations alone. The agricultural calendar of the four most important crops means that at the end of August the harvesting of all other crops should have been completed, except soya beans and cassava (which is the only crop that could have been present on the field). In October and November the farming season for beans, peanuts and rice starts, as shown in Figure 4.34.

Another factor to consider is that August is often use to brun agricultural fields. This makes it difficult to observe the existence (or not) of traces of harvested crops.

The data obtained during the field survey shows that agricultural practices within the project footprint area is mainly for subsistence. Surplus crop is sold for extra income. Subsistence farming has a fundamental role in the food security of the affected households, whether they are residents in rural areas around the Project Footprint Area, or residents in neighbourhoods of the municipality (urban zone).

Figure 4.34 Agricultural Calendar of the Main Crops in the Project Footprint Area

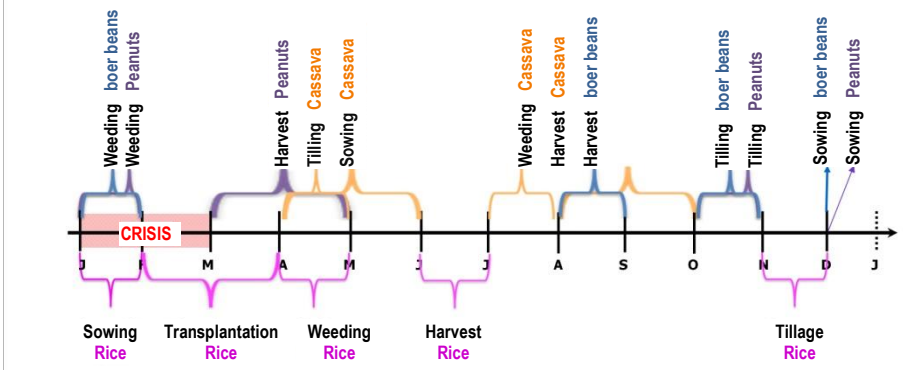


Figure 4.35 Agricultural Parcels with Visible Traces of Crops of the 2014-2915 Season

Economic activity and means of subsistence

Even though the District of Mocuba harbors a municipality, most of the people (70%) make a living by means of either agriculture, forestry or fishing. Subsistence agriculture dominates the economic activity with more than 93% of people making a living by means of this. See Table 4 of Annex IV. Approximately 8% of people work in the commerce and finance sector. Other economic activity relates to working for others (permanent or temporary), professional services and self-employment or informal commerce.

Income activities based on subsistence agriculture (the sale of food crops, fruits and animals) is similar across many family households, whether they reside in neighbourhoods of the municipality or in the villages, settlements and neighbourhoods of rural type located in the vicinity of the Project Footprint Area.

Table 4.26 Income activities performed by Family Households Surveyed

	Survey of Fam.Households n=208 [1]	**Interviews to community leaders** [2]
Permanent work	14.4	
Temporary work	44.7	2
Sale of food crops	39.4	1
Sale of income crops	26.9	
Sale of fruits	35.1	
Sale of animals	11.1	3
Sale of traditional beverages	5.3	
Informal commerce (banking- fixed, itinerant)	14.9	4
Specialized work (carpenter, mason, smith, painter)	13.5	
Sale of prepared food products	9.6	
Production and sale of artisan art	2.4	
Sale of medicinal plants	1.9	
Sale of stakes/reeds/grasses	6.7	6
Production and sale of coal	15.4	5
Artisan production of construction materials	1.9	8
Transportation of passengers	3.8	7
Fishing	1.4	
Money transfers	6.3	

[1] Percentages of independents
[2] By order of priority

Figure 4.36 Income Activities of Family Households

4.11 ARCHAEOLOGICAL, HISTORIC, ETHNOGRAPHIC AND CULTURAL HERITAGE

4.11.1 *Methodology*

The study started with preliminary research and desktop review of archaeological research performed by the team of the Archaeological and Anthropological Department of the Eduardo Mondlane University (Departamento de Arqueologia e Antropologia da Universidade Eduardo Mondlane) since 1980 and a few publications from before 1975. The study also included the review of documentation from the Historic Archive of the Project itself, as well as materials such as maps, aerial photos and satellite images, as necessary.

1. Field prospecting was undertaken during which a systematic recording was done of relevant traces for archaeology, ethnography, paleontology and cultural heritage. Any possible archaeological

findings or other traces of the cultural heritage in the project area were mapped and described and logged using a photographic record of the sites and artifacts. Interviews were also conducted with community leaders and people who have knowledge about the study area.

4.11.2 Results of Field Work

There are no publications about archaeology or cultural heritage of the Mocuba area. In the years 1980s some archaeological sites were recorded between the Lugela and Licungo Rivers or near Mocuba, but up to the present day the traces and reports were not published (*com. pessoal G. Liesegang*). Therefore the desktop study was concentrated on the study of publications from nearby areas and of the entire province of Zambezia (Liesegang 1989, Lobato 1960, Ramos 1973, Rodrigues 2004 , 2006, Adamowicz 2014) .

As per the bibliographic data, many archaeological sites were recorded in nearby districts of this province. One of the richest is the site located in Gurué District which is considered to be a site occupied by the Bantu people of southern Africa during their initial expansion into the subcontinent. Ceramics collected there and traces of iron manufacturing allow for the hypothesis related to the spread of the Bantu language in communities in this area at the beginning of the 1st millennium AD.

In compliance with the legislation, the work to be undertaken was subject to prior authorization of DNPC by means of the presentation of an Archaeological Work Plan which provided a legal framework for the work to be undertaken and a description and map of the project and areas to be prospected.

Field work was undertaken between 9 and 13 August 2015. During this time the study focused on understanding aspects for which secondary information was not available. One of the objectives was also to collect information about the characteristics of the project implementation area, from the anthropological, ethnolinguistic and ethnographic points of view.

The investigation of vertical cuts in the soil existing at several locations within the project area and neighbouring areas did not reveal any traces of ancient human occupation. The project area is rich in hematite which was generally used in the Lower Iron Age to melt iron. However , in spite of thorough prospecting no traces were found of smelting (furnaces, slags, ash or coal) or exploitation of this ore.

In summary, during the bibliographic studies and the field prospection, no cultural (archaeological, historic, ethnographic, spiritual or landscaping) heritage of any type was identified in the project area.

Figure 4.37 View of the Project Area

Figure 4.38 Vertical cuts existing in several points of the project area

Figure 4.39 Map of Archaeological Prospection on the 10th, 11th and 12th of August 2015

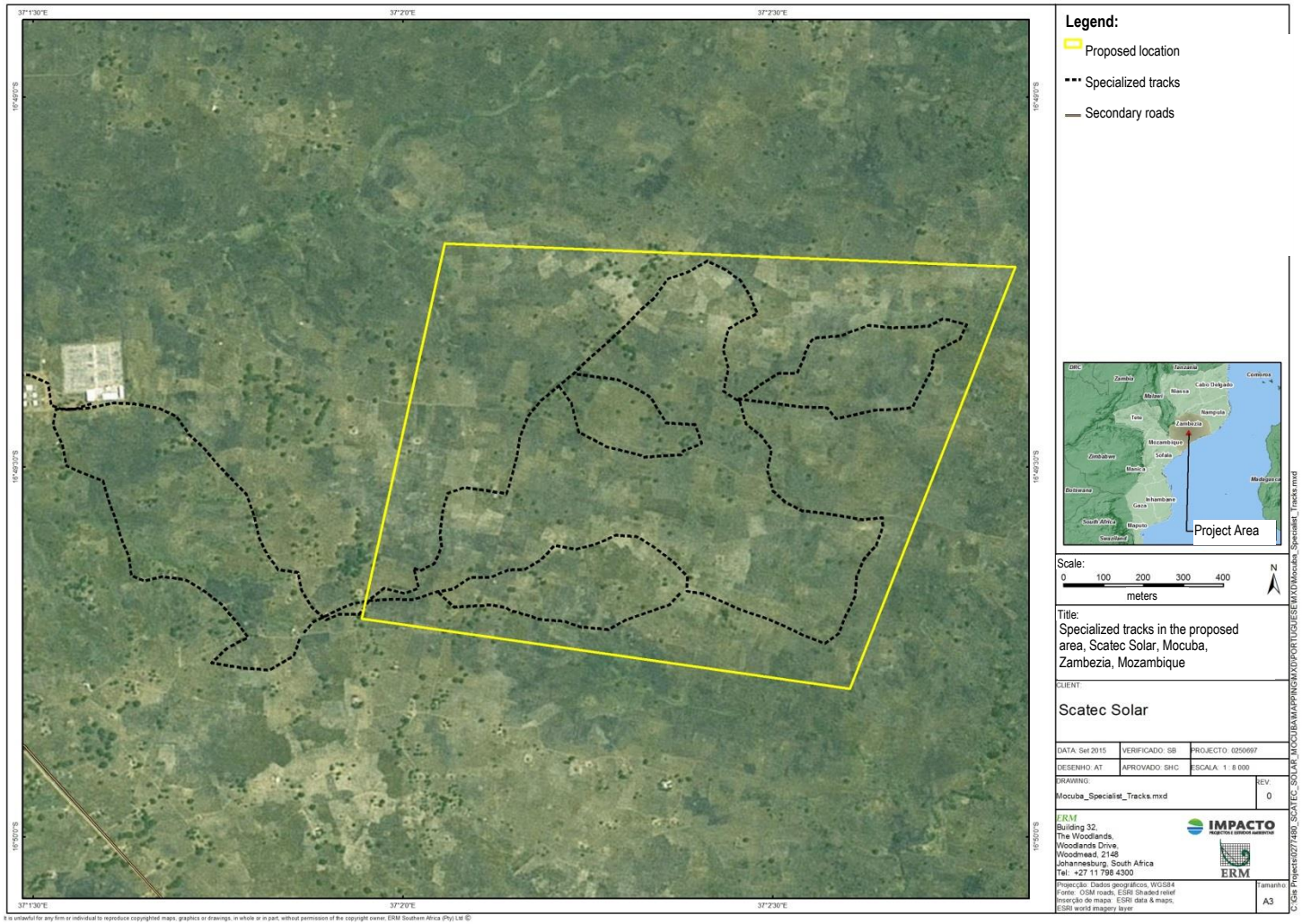


Figure 4.40 Occurrence of iron oxide in the project area

5 IMPACT ASSESSMENT

The impact assessment methodlogy was described in Chapter 9 of the Terms of Reference document, which was approved in a letter from the DPCA on 25 August 2015 (reference N/Ref402 / GD / DPCAZ / 023 / 2015). This chapter present the results of the impact assessment.

5.1 CLIMATE AND AIR QUALITY

5.1.1 *Impact from increase of dust from Construction Activities (clearance and earthworks)*

Development of the Project Site will require clearance of a maximum of 126 hectares (ha) of land, however the area for the location of the PV plant will require less clearance (approximately 80 ha to the north of the project area). The site preparation and construction activities (e.g. clearance of vegetation, levelling and digging of trenches) have the potential to generate fugitive dust emissions which have the potential to cause annoyance to human Air Sensitve Receptors (ASRs) and health impacts. Visibility may also be impacted by localised dust emissions.

The potential negative impacts identified due to airborne emissions at the Project Site relate to fugitive dust emissions and the finer PM_{10} and $PM_{2.5}$ fractions from construction activities on site. It is understood that construction will take approximately 9 months with peak constuction occurring approximately after 3 months.

The quantity of dust emitted from construction operations will be related to the area of land being worked and the construction activity (nature, magnitude and duration). Emissions from construction vehicles passing over unpaved ground can also be important and are related to the silt content in the soil as well as the speed and weight of the vehicles, soil moisture content, distance covered and frequency of vehicle movements [1]. In addition, trackout[2] may occur up to 500m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit (assuming no site specific mitigation)[3]. For this project we have used a conservative approach and used an area of influence of 500m.

(1) Holman et al (2014). IAQM Guidance on the assessment of dust from demolition and contstruction, Institute of Air Quality Management, London. www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

(2) Trackout is defined as wen the transport of dust and dirt from the construction site onto the public road network. This arises when lorries leave the consutrction site with dusty materials, which may then spill onto the road and/or when lorries transfer dust and dirt on to the road having travelled over muddy ground on site

3 Institute of Air Quality Management, 2011, IAQM Guidance on Construction Impacts, available online, accessed 22/09/2015 http://iaqm.co.uk/text/guidance/construction_guidance_2011.pdf

The actual dust impacts will depend on the exact location of construction activities relative to the air sensitive receptors, and the weather conditions, where stronger winds and dry conditions will enhance the transfer of dust and damp or wet conditions reducing the impacts. The impact of construction dust is expected to be localised due to the relatively high mass of dust particles, the deposition of which tends to be confined within 100 m of the source. Similarily, for PM_{10} and $PM_{2.5}$ research undertaken in the US suggests that 85% to 90% by weight of the fugitive dust emissions of PM_{10} from construction sites are in the $PM_{2.5}$ to PM_{10} fraction and 10% - 15% are in the $PM_{2.5}$ fraction[1]. There are ASRs within 100m of the Project site boundary, (the closest being 60m from the southern most boundary).

The wind direction, wind speed and rainfall at the time of construction will also influence whether there is likely to be a dust impact. South easterly prevailing winds means that any ASRs located in the north west of the Site are most likely to be affected by construction activities. There are no human ASRs within 500m of the project activities in the northern section. There are ASRs located within 100m of the southern boundary, however as the prevailing winds are in the south easterly direction, these ASRs are not likely to be affected. Futher more, there will be no site clearance activities in the southern portion of the Site and therefore impacts air quality impacts during construction activities are considered **negligible**.

Potential direct impacts on the agricultural receptors will be limited to the short period of construction activities (up to 9 months) and are considered temporary. The impacts will be local to the agricultural fields to the north and north west of the Project Site. Whilst the sensitivity of the receptors is considered of medium importance, the magnitude of the impact is considered negligible and therefore air quality impacts from construction activities is also considered **negligible**.

Table 5.1 ***Impact from increase of dust from Construction Activities (clearance and earthworks)***

Impact	Dust from construction activities (clearance and earthworks)			
Impact type	**Negative**	Positive	Neutral	
	Impact on human and agricultural ASRs is negative.			
Impact type	**Direct**	Indirect	Induced	
	The emission of air pollutants is direct.			
Impact	**Temporary**	Short-term	Long-term	Permanent

(1) Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors Prepared by Midwest Research Institute (Chatten Cowherd, MRI Project Leader), For Western Governors' Association Western Regional Air Partnership (WRAP), MRI Project No. 110397, Finalized November 1, 2006 . Referenced in the IAQM Guidance on Construction Impacts (availabel online: http://www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf)

duration	Impacts will be during construction activities only				
Impact extent	**Local**	Regional	International		
	Fugitive dust emissions are local				
Impact scale	The scale of the impact is within 500 m of the Project Site (most conservative)				
Frequency	Continuous throughout the construction activities				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Magnitude of the impact to human and agricultural ASRs is negligible.				
Receptor Sensitivity	**Low**	**Medium**	High		
	Sensitivity is classified as medium.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is considered to be **Negligible.**				

Mitigation Measures

Although the significance of the potential impact is considered negligible, best practice measures can be implemented as follows:

- Locate machinery and dust causing activities away from sensitive receptors;
- Ensure there is the maximum possible distance between stockpiles and the receptors;
- Cover all stockpiles of dusty materials such as excavated spoils, dredged materials, filling materials to avoid fugitive dust emissions;
- Provide site hoarding panels or fences along the Project site boundary;
- Control the height of unloading of fill materials during filling as far as possible. Where possible, this should be below the height of the hoarding around the Project site boundary;
- Totally enclose any skips for material transport with impervious sheeting
- Keep stockpiles for the shortest possible time;
- Construction debris should be disposed of in properly designated and designed areas;
- Use water as a dust suppressant; and
- Waste from construction should not be burned.

5.1.2 Impacts from Vehicle Exhausts

Vehicle exhaust emissions will arise from vehicle movements such as cars and heavy goods vehicles (HGVs) and light goods vehicles (LGVs) travelling to and from the Project Site. Imported material will be transported via road from Quelimane to Mocuba, principally on the national road network via the EN 470 and 104 and local road 479. A

gravel access road will connect R 479 to the Project Site. It is estimated that approximately 600 round trips will be required from Quelimane to Mocuba to transport equipment to site; equivalent to just over 2 trucks per day during the 9 month construction period.

Construction staff will be housed in Mocuba and will be transported to and from the work site from an agreed meeting point in Mocuba or the local district (depending on the number and origin of labour force).

Air emissions impacts from vehicles decrease rapidly with increasing distance from the source and are not considered at a distance of more than 200m [1]. from the source.

An additional 2 vehicles per day is not likely to be significant, however, there are potential human and agricultural ASRs within 200 m either side of the local 479 road that could be affected by vehicle emissions and dust recirculation. The potential impacts will be local in nature and temporary. As such the significance impact is considered **negligible** and no additional mitigation measures are needed.

Table 5.2 Impacts from Vehicle Exhausts

Impact	Impacts from vehicle exhausts during construction activities				
Impact type	**Negative**	Positive	Neutral		
	Impact on human and agricultural ASRs is negative.				
Impact type	**Direct**	Indirect	Induced		
	The emission of air pollutants from vehicle emissions is direct.				
Impact duration	**Temporary**	Short-term	Long-term	Permanent	
	Impacts will be during construction activities only				
Impact extent	**Local**	Regional	International		
	Exhaust emissions are local to the construction traffic route				
Impact scale	The scale of the impact is within 200 m of the roads used				
Frequency	Continuous throughout the construction activities				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Magnitude of the impact to human and agricultural ASRs is negligible.				
Receptor Sensitivity	**Low**	**Medium**	High		
	Sensitivity is classified as medium.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is considered to be **Negligible.**				

Mitigation Measures

Even though the impact is considered negligible, best practices measures can be implemented to reduce vehicle emissions.

- Minimize movement of construction vehicles and enforce a speed limit around the construction site;

(1) Design Manual for Roads and Bridges (DMRB) Guidance (May 2007). Available online, accessed 23/09/2015

- Where available, use ultra-low sulfur diesel (ULSD) in HGVs and diesel powered equipment, together with best management practices;
- Hard surfacing and effective cleaning of haul roads;
- Vehicle / equipment air emissions should be controlled by adopting simple good practice procedures (such as turning off equipment when not in use); and
- Vehicle / equipment exhausts observed to be emitting significant black smoke in their exhausts should be serviced;
- No site run off of water and mud;
- Provide wheel washing facilities for vehicles entering and leaving the site; and
- All loads entering and leaving the site to be covered.

5.1.3 *Impacts from Use of Mobile Non Road Machinery (NRMM) on Site*

The site clearance activities and preparation will involve the use of NRMM for leveling the site and clearing the vegetation. The equipment can have an impact on local air quality by leading to an increase in ambient levels of NO_x, SO_2, PM_{10}, $PM_{2.5}$ and CO.

At this stage the quantities of the NRMM required are not known, however, it is likely that bulldozers and dump trucks will be used on site during the clearance and construction phase.

International guidance suggests that exhaust emissions from onsite NRMM plant are unlikely to make a significant impact on local air quality and in the vast majority of case do not need to be quantitatively assessed [1]. Modeling is not appropriate for assessing construction plant emission impacts as emission rates vary depending on the construction activity and meteorological activity and therefore cannot be reliably predicted [2]. The risk of increasing levels of pollutants is greatest at receptors very close to the site boundary. The closest human ASRs are approximately 60 m from the southernmost boundary. Agricultural receptors are immediately adjacent to the boundary. As there are no site clearance activities within the southern portion of the Site, there will not be any NRMM within close proximity to the human ASRs. The prevailing wind direction will also transport any emissions away from the human ASRs. The risk of increasing levels of pollutants at Agricultural ASRs is greatest at

1 Holman et al (2014). IAQM Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management, London. www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

2 Environmental Protection UK (2010) Development Control: Planning for Air Quality (2010 Update). Updated guidance from EPUK on dealing with air quality concerns within the development control process. Available online, accessed 07/02/2013 http://www.environmental-protection.org.uk/assets/library/documents/Air_Quality_Guidance_2010_(final2).pdf

ASRs very close to the boundary at the north and northwest of the site boundary. The significance of the potential impacts is considered **negligible**.

Table 5.3 Impacts from Use of Non Road Mobile Machinery (NRMM) on Site

Impact	Impacts from use of NRMM on site				
Impact type	**Negative**	Positive	Neutral		
	Impact on human and agricultural ASRs is negative.				
Impact type	**Direct**	Indirect	Induced		
	The emission of air pollutants from vehicle emissions is direct.				
Impact duration	**Temporary**	Short-term	Long-term	Permanent	
	Impacts will be during construction activities only				
Impact extent	**Local**	Regional	International		
	Exhaust emissions from NRMM are local to the Project Site only				
Impact scale	The scale of the impact is small, with the risk of increasing levels of pollutants greatest at receptors very close to the boundary. No human ASRs are expected to be affected.				
Frequency	Continuous throughout the construction activities				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Magnitude of the impact to human and agricultural ASRs is negligible.				
Receptor Sensitivity	**Low**	**Medium**	High		
	Sensitivity is classified as medium.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is considered to be **Negligible.**				

Mitigation Measures

- Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NO_x, PM_{10} and SO_2; and
- All non-road mobile machinery to use ultra-low sulfur diesel where available.

5.2 GREENHOUSE EFFECT GASES

It is recognized that Mozambique will have to explore new sources of energy in the future, in order to increase the capacity of the grid and the access in the entire country, as well as the export of electricity to neighboring countries (UNEP, 2013). According to a study, it is expected that the production of electricity in Mozambique will double from about 16 GWh in 2011 to 37 GWh in 2030, and that natural gas and coal will be ever more used for the generation of electricity (with an estimate of 20-40% of the electricity production in Mozambique from coal and gas in 2030) (Mahumane & Mulder, 2015).

In the context of an energy grid ever more dependent from fossil fuel sources, solar energy PV projects offer significant benefits by adding capacity to the grid without increasing the grid's intensity. Even though it is difficult to quantify those benefits in the absence of reliable data, current, updated and

future (projections) about the intensity of the emissions of the grid in Mozambique, the addition of 70,000 kWh of electricity per year to the grid, with close to zero emissions, presents a significant environmental benefit introduced by this project.

5.3 GEOLOGY AND GEOMORPHOLOGY

5.3.1 *Geologic changes resulting from earthworks*

Earthworks will occur only during the construction phase. No earthmoving is expected during the operation phase, and during the decommissioning phase the movements will be minimal. These actions will slightly affect the geologic formations, causing superficial alterations on the geomorphology of the project area.

Impact Significance

Earthworks will be generally of a small scale and therefore the induced impacts are of low to negligible significance.

Table 5.4 Geologic changes resulting from earthmoving

Impact	Geologic changes resulting from earthmoving				
Nature	**Negative**	Positive	Neutral		
	The impact on the local geology is negative.				
Type	**Direct**	Indirect	Induced		
	Impact occurs directly in the project area.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact is temporary.				
Extent	**Local**	Regional	International		
	The impact is restricted to the site of the project.				
Scale	The impact is restricted to the place where earthmoving is performed, that is the project site.				
Frequency	Mainly during the construction phase and possibly during decommissioning.				
Magnitude	Positive	Negligible	Low	**Medium**	High
	Impact is of low magnitude.				
Receptor sensitivity	Low	Medium	**High**		
	The receptor is of low sensitivity.				
Significance	Negligible	**Low**	Moderate	High	
	Impact is of **Low** significance.				

Mitigation Measures

Potential impacts on the geology of the project area are more related to the construction phase, and therefore earthmoving will have to:

- Be reduced to a minimum in terms of affected area, so as to minimize the instability and collapse of soil; and

- In case unstable soils are identified, it is important to implement measures to reinforce the support capacity of those soils, at the time of excavation work.

Residual Impact

If the mitigation measures indicated above are implemented, it is expected that the impact becomes of negligible significance.

5.4 SOILS AND LAND USE

5.4.1 Soil erosion

Soil erosion is caused by the removal of soil particles from the landscape because of water movement. Considering the soil types present within the study area, all soil forms will be prone to erosion where vegetation is going to be removed. The post-Mananga medium textured soils (23 ha) will be the least susceptible to soil erosion. The highest impact of erosion is anticipated for the areas where yellow sandy soils (100 ha) and white sandy soils (3 ha) have been identified.

During the construction phase, all soil forms will be susceptible to erosion to some extent because the natural vegetation will be cleared before construction takes place. During the operational phase, topsoil stockpiles, as well as service roads, will still be susceptible to erosion. Runoff from PV panels will be accumulated in a line at the bottom of the panels, which can result in increased erosion. Soil surfaces with infrastructure such as inverters or buildings will not be exposed to erosion any longer. During the decommissioning phase, it is assumed that all recently modified surfaces will be susceptible to potential soil erosion.

The main potential consequences of soil erosion will be the reduction of the soil quality and the reduced water-holding capacity of eroded soils. The indirect consequences of soil erosion include disturbance to ecosystems and degradation of the land.

Significance of impacts

Soil erosion impacts will be direct and indirect. Direct impacts will include the reduction in soil quality due to the loss of the nutrient-rich upper layers of the soil and the reduced water-holding capacity of eroded soils. Indirect impacts may include the movement of eroded soil particles to waterways, which leads to disruption of riparian ecosystems and reduced water quality of the Egaro and Licungo Rivers.

Soil erosion is a permanent impact. Once the resource has been lost from the landscape, it cannot be recovered. Although there are off-site indirect impacts

associated with this, the impact is mainly considered to be local. The impacts may continue after decommissioning in the case of insufficient vegetation re-establishment. The magnitude of the impact is considered as medium and of moderate significance.

Table 5.5 Impacts of Soil Erosion

Impact	Soil erosion				
Nature	**Negative**	Positive	Neutral		
	Impact on soils is negative.				
Type	**Direct**	Indirect	Induced		
	Impact on soils is direct.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long-term, as the impacts will continue past closure with only a very slow recovery rate.				
Extent	**Local**	Regional	International		
	Impacts on soils are local to the PV power plant installation site.				
Scale	The scale of the impact is estimated to be restricted to the areas cleared for roads and infrastructure.				
Frequency	Throughout the life time of the PV Power Plant as well as after decommissioning if left unmitigated.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Impact magnitude is considered medium.				
Receptor Sensitivity	Low	Medium	**High**		
	Receptor sensitivity is considered as high.				
Significance	Negligible	Minor	**Moderate**	Major	
	Significance of impact is considered to be **Moderate.**				

Mitigation Measures

The following mitigation measures will reduce the significance of soil erosion:

- Clearance of vegetation should not be conducted earlier than required (maintain vegetation cover for as long as possible) in order to prevent erosion;

- Soil removed from the foundation pits of the panels can be used to build basins to retain rain water running from the panels;

- Areas between and under the photovoltaic panels should be re-vegetated with low growing grass species to limit raindrop and wind energy, which will reduce soil erosion. This is highly recommended in order to maintain the natural biological soil life associated with the indigenous vegetation;

- Roads used to access the facility must be well drained in order to limit soil erosion.

The project area has distinct rainy and dry seasons. As a result, it is recommended that the erosion monitoring program include two evaluation

cycles per year to determine if any seasonal variations do occur. Thereafter, annual monitoring should take place, preferably at the end of the dry season before the start of the rainy season. Monitoring should include physical observation and reporting on the evidence of erosion or land degradation, and the condition of access roads and cleared areas.

Residual Impact

With proper mitigation measures and the embedded controls as recommended above, it is anticipated that the significance of this impact can be reduced to minor.

5.4.2 Soil compaction

Soil compaction will take place due to heavy construction vehicles traversing the area and thus changing the soil structure by reducing the micropores between soil structure units (peds). However, the project site is dominated by soils of sandy texture for which soil compaction will have minor to negligible impacts.

In order to manage this negligible impact, the following mitigation measures are recommended, especially for the project area with post-Mananga medium texture soils that contain a larger amount of clay.

- Restrict access of vehicles and construction vehicles to existing roads, where possible; and

- Stockpiles should be established in demarcated areas only, and once they have been established they should not be moved around to other areas.

Residual Impact

With appropriate mitigation measures, it is expected that the significance of this impact will remain negligible.

5.4.3 Loss and Sterilization of Topsoil Layer

Even though present capability of the land is very limited for agriculture and pasture, this capability will be lost once the topsoil is stripped and stored, and the remaining of the site used for permanent infrastructure. There will be no change during the operational phase, since the change to land capability will occur during the construction phase, and there is no available information about future use after the decommissioning phase.

Table 5.6 Impacts on Topsoil Layer

Impact	Loss and sterilization of fertile topsoil layer		
Nature	Negative	Positive	Neutral
	Impact on soils is negative.		

Type	Direct		Indirect		Induced
	Impact on soils is direct.				
Duration	Temporary	Short-term		Long-term	Permanent
	Impacts are considered long-term and rehabilitation after decommissioning might restore the soil fertility to a large extent.				
Extent	Local		Regional		International
	Impacts on soils are local to the PV power plant installation site.				
Scale	The scale of the impact is estimated to be restricted to the areas used for infrastructure as well as areas where topsoil is stockpiled, and additional roads constructed.				
Frequency	This impact will last until proper remediation has been conducted.				
Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude is considered small as soil will be stripped and stockpiled only where roads and buildings will be constructed.				
Receptor Sensitivity	Low		Medium		High
	Receptor sensitivity is considered low, as small volumes of soil will be displaced, and some topsoil will inevitably be lost in the process.				
Significance	Negligible	Minor		Moderate	Major
	Significance of impact is considered to be **Minor.**				

Mitigation Measures

The following mitigation measures will reduce the significance of loss and sterilization of topsoil:

- In areas where soil was stripped, replace the soil layers as much as possible;
- Improve the soil and re-vegetate as soon as possible, with natural vegetation; and
- After removing the photovoltaic panels, plough the soil to neutralize compaction and re-vegetate as soon as possible.

Residual Impact

It is possible that areas where arable land capability was lost will be remedied to such an extent that the land capability will return. With proper mitigation measures as recommended above, it is anticipated that the significance can be mitigated to minor.

5.4.4 Loss of current Land Capability

Arable and grazing land capability will be changed because topsoil will be stripped and stockpiled and the remainder of the site will be used for permanent infrastructure. There will be no change during the operational phase since the change in land capability occurred during the construction phase and there´s no information available regarding future use after decommissioning phase.

Table 5.7 Loss of Land Capability

Impact	Loss of current land capability				
Nature	Negative	Positive	Neutral		
	Impact on soils is negative.				
Type	Direct	Indirect	Induced		
	Impact on soils is direct.				
Duration	Temporary	Short-term	Long-term	Permanent	
	Impacts are considered long-term, as the life of the plant is estimated to be 25 years or longer.				
Extent	Local	Regional	International		
	Impacts on soils are local to the PV power plant site.				
Scale	The scale of the impact is dependent on the nature of the disturbance but would mainly be restricted to the PV power plant site.				
Frequency	Throughout the lifetime of the operations.				
Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude is considered medium.				
Receptor Sensitivity	Low	Medium	High		
	The receptor sensitivity is considered as High because of the high number of households that will lose use of the land.				
Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be **Major.**				

Mitigation measures, management and monitoring

The following mitigation measure will reduce the significance of land capability loss:

- On areas where topsoil was stripped, replace the soil layers as far as possible;
- Ameliorate the soil and re-vegetate as soon as possible with natural vegetation;
- After removal of the photovoltaic panels, rip the soil to counteract the compaction and re-vegetate as soon as possible.

Significance of residual impacts

It is possible that areas where arable land capability was lost will be remediated to such an extent that the land capability will return. With proper mitigation measures as recommended above, it is anticipated that the significance can be mitigated to minor.

5.4.5 Change of Land use

The land use of the study area will change from natural vegetation and agriculture (grazing and crop production) to industrial during the construction phase. During operational phase, there will be no change but

during decommissioning phase, infrastructure will be removed and soil rehabilitation will be undertaken. This could have a potential positive impact on the reversal of land use to agriculture.

The study area will in all likelihood be rehabilitated for crop production again. Livestock farming will be possible as soon as the perimeter fence is removed since most of the area will be covered by natural grass species.

Significance of impacts

The loss of arable soil will have a negative impact on current land users. The duration of arable and grazing land loss is long term. It is considered to have medium receptor sensitivity and be of moderate significance as the loss of arable soil and grazing land will have a negative impact on the livelihood of the community.

Table 5.8 Change of Land use

Impact	Change of land use			
Nature	Negative	Positive	Neutral	
	Impact on soils is negative.			
Type	Direct	Indirect	Induced	
	Impact on soils is direct.			
Duration	Temporary	Short-term	Long-term	Permanent
	Impacts are considered long-term, as the impacts will continue for the life of the plant.			
Extent	Local	Regional	International	
	Impacts on soils are local to the PV power plant site.			
Scale	The scale of the impact is dependent on the nature of the change but would mainly be restricted to the PV power plant site.			
Frequency	Throughout the lifetime of the operations and during closure phase.			
Magnitude	Positive	Negligible	Small	Medium	Large
	Impact magnitude is considered medium depending on the nature of the disturbance			
Receptor Sensitivity	Low	Medium	High	
	The receptor sensitivity is considered as Medium.			
Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered to be **Moderate.**			

Mitigation measures, management and monitoring

The following mitigation measure will reduce the significance of the change in land use:

- Rehabilitate the compacted area in such a way that the land use can change in order to allow for livestock grazing; and

- During decommissioning organic material should be ripped into the soil to improve fertility of the soil and alleviate compaction and re-vegetate as soon as possible.

Significance of residual impacts

It is anticipated that areas where land was used for crop production, will be remediated to such an extent that the land could again be used for crop production after decommissioning. With proper mitigation measures as recommended above, it is anticipated that the significance can be mitigated to negligible.

5.5 NOISE

Noise will be generated during construction and decommissioning phases of the proposed project. During construction phase, noise will be generated by the circulation and transportation of material and labourers as well as the movement of construction vehicles and machinery. Construction for the proposed project is expected to last nine (9) months. During the decommissioning phase, noise will be generated by the scrapping of material and the movement of machinery and vehicles.

The potential consequences of noise were assessed using a defined methodology which is able to evaluate the likely extent and significance on identified receptors and resources.

Significance of Impact

The increase in traffic will have a direct negative impact on noise sensitive receptors who include communities close to the access road. It is considered to have medium receptor sensitivity and be of minor significance as even though noise levels will decrease from construction to decommsioning however, this impact will be long-term.

5.5.1 *Increase of traffic from the movements of vehicles and disturbance of communities close to the access road*

During the construction phase it is expected that there will be an increase in traffic, due to the circulation of vehicles for the transportation of materials and other resources related to the construction work (to and from the site) and the resulting increase in noise due to their circulation.

It is estimated that approximately 600 trips will be necessary from Quelimane to Mocuba to transport the equipment to the site.

During the project operation phase, traffic is expected to be reduced from the construction phase levels and consequently the noise emitted

by vehicle circulation will be less, with only those vehicles necessary for routine maintenance and update phases of the project.

Table 5.9 Increase of traffic from the movements of vehicles and disturbance of communities close to the access road

Impact	Traffic increase				
Impact type	Negative	Positive	Neutral		
	Traffic increase is a negative impact				
Impact type	Direct	Indirect	Induced		
	The noise impact is direct.				
Impact duration	Temporary	Short-term	Long-term	Permanent	
	The impact is considered long-term, as impacts will continue for the life of the project.				
Impact extent	Local	Regional	International		
	Traffic increase is considered local, since it will happen on the access road				
Impact scale	Impact scale is considered local				
Impact frequency	During the entire project lifetime.				
Impact Magnitude	Positive	Negligible	Minor	Medium	Major
	Impact magnitude is considered minor				
Sensitive recipients	Low	Medium	High		
	Receptor sensitivity is considered medium, though the project construction activities are located to the north of the area of direct influence, away from the sensitive receptors				
Impact significance	Negligible	Minor	Moderate	Major	
	Impact significance is considered minor				

Mitigation Measures

To minimize and control noise levels so that noise sensitive receptors are not exposed to noise that exceeds the project noise criteria. The following mitigation measures will implemented:

- Control heavy and light vehicle circulation speed (allocated to the project) on the routes used for installation of the project; and

- Devise a periodic maintenance program of vehicles allocated to the project to check their operating conditions.

Residual Impact

The significance of the traffic increase is ascribed mostly to transportation of materials and other resources necessary during the construction and operation phases of the project.

Traffic increase will have its peak during the construction phase of the project, with a significant reduction during the operations phase. The mitigation measures mentioned above can reduce the intensity and the magnitude of the impact, and therefore this impact is considered negligible.

5.5.2 Emission of noise associated to machines / equipment for construction and disturbance of nearby communities

During the construction phase of the project noise emission will be expected due to the use of machines and equipment associated with construction work (including clearance of vegetation) such as excavators, trucks, concrete plants, cranes, generators, compressors, etc.

The same is expected for the decommissioning phase, during which the power plant will be scrapped.

Since there is a presence of receptors near the project area, namely within the 500 m limit from the project, these actions, if not controlled, will disturb the receptors.

During the operation phase the noisiest emissions will be greatly reduced, which originated with the use of machinery and equipment to complete the construction work.

Table 5.10 Emission of noise associated to machines / equipment for construction and disturbance of nearby communities

Impact	Disturbance to nearby communities due to noise emissions associated with construction machines/equipment				
Impact type	Negative	Positive	Neutral		
	Disturbance to nearby communities due to noise emissions associated with construction machines/equipment is a negative impact				
Impact type	Direct	Indirect	Induced		
	The noise impact is direct				
Impact duration	Temporary	Short-term	Long-term	Permanent	
	The impact is considered temporary since it will happen only during the construction and decommissioning phases of the project				
Impact extent	Local	Regional	International		
	Disturbance of nearby communities is considered as local since it is restricted to the communities located near the project footprint area				
Impact scale	Impact scale is considered local				
Impact frequency	During the construction and decommissioning phases of the project				
Impact Magnitude	Positive	Negligible	Minor	Medium	Major
	Impact magnitude is considered minor due to the location of the sound sources relative to potential sensitive receptors				
Sensitive recipients	Low	Medium	High		
	Recipient sensitivity is considered high				
Impact significance	Negligible	Minor	Moderate	Major	
	Impact significance is considered Moderate				

Mitigation Measures

The following mitigation measures shall be implemented in order to reduce the impacts on the acoustic environment of the traffic increase caused by the installation of the project:

- Careful positioning of stationary equipment, such that it is oriented away from sensitive receptors and/or shielded from receptors by other non-noisy equipment or structures;.

- Implement a communication plan about the development of construction activities that will give the sensitive receptors information on the possible disturbances that may occur.

- Implement traffic control measures aimed at reducing noise by restricting traffic volumes and reducing vehicle speeds.

- Prepare a program of the work to be performed, where near the most critic receptors the noisy activities will be prohibited between 18h00 and 07h00 and Sundays and holidays. The most noisy operations should also be performed during daylight periods when they cause the least disturbance;

- Do periodic preventive maintenance of machines and equipment to verify their operating conditions;

- Whenever work is performed at distances of less than 150 meters from residences, isolation panels shall be used to screen the work, in order to reflect part of the noise emitted by the operating equipment; and

- Conduct noise monitoring surveys whenever work takes place near populated areas.

Residual Impact

Implementation of the above measures will reduce the significance of noise impacts throughout the lifecycle of project. Therefore, it is anticipated that the significance can be mitigated to negligible.

5.5.3 Emission of noise associated with operational phase

During the operation phase of the project the possibility shall be considered of the occurrence of non-planned events capable of causing disturbance.

Table 5.11 Emission of noise associated project operation and disturbance of nearby communities

Impact	The disturbance of nearby communities due to the emission of non-planned noise associated with project operation				
Impact type	Negative	Positive	Neutral		
	Disturbance to nearby communities due to noise emissions associated with project operation is a negative impact				
Impact type	Direct	Indirect	Induced		
	The noise impact is direct				
Impact duration	Temporary	Short-term	Long-term	Permanent	
	The impact is considered temporary.				
Impact extent	Local	Regional	International		
	Disturbance of nearby communities due to noise emissions associated with project operation is considered as local since it is restricted to the communities located near the project footprint area				
Impact scale	Impact scale is considered local				
Impact frequency	During the operation phase of the project				
Impact Magnitude	Positive	Negligible	Minor	Medium	Major
	The magnitude of the impact is considered negligible, since it will not occur during normal operation of the project				
Sensitive recipients	Low	Medium	High		
	Recipient sensitivity is considered high				
Impact significance	Negligible	Minor	Moderate	Major	
	Impact significance is considered negligible				

Mitigation/Leveraging Measures

In order to ensure that no non-planned events will occur that are capable of causing significant noise emissions, the following mitigation measures shall be carried out:

- Regular maintenance of significant noise-generating equipment to verify their operating conditions; and

- Do monitoring surveys of the noises produced by the operation activity.

Residual Impact

The significance of noise emissions associated with the operation of the project and the consequent disturbance of nearby communities is associated with the occurrence of non-planned events capable of causing significant emissions of noise. The mitigation measures mentioned above significantly reduce the intensity and the magnitude of the impact. This impact is considered temporary since it will happen only during the periods of occurrence of non-planned events. This impact is considered negligible, since the construction activities of the project are located to the north of the area of direct influence.

5.6 *LANDSCAPE*

For the evaluation of impacts on the landscape we proceeded to identify and evaluate the actions that:

- Produce significant changes in intrinsic characteristics of landscaping units and/or single elements;

- Produce changes in the value of the landscape, considering the characteristics of the project and the value of the new elements to be created; and

- Interfere with the view of adjacent areas which have better visual accessibility.

Landscape is a concept that contains the idea of 'see a territory', and cannot be dissociated from the human presence. Therefore, the significance of the visual incidences will depend on the allocation of the vision of adjacent zones, and in the project area there are no zones with the potential of being affected.

However, the vision is easily limited by constraints that vegetation, rugged terrain or other landscape elements provide.vIt is considered that very significant negative visual impacts are those that, in spite of the application of minimization measures, will result in a significant visual change and strong contrast with existing conditions.

5.6.1 *Loss of landscaping structure by clearance of vegetation on the land*

The main negative impacts on the landscape occur in the construction phase, since it is during this phase of the works that the biggest land transformations happen, with permanent character. To this phase are also associated a series of impacts with temporary character, with the occurrence of human activity that contrasts greatly with the present one.

The project activity area affects a total area of about 120 hectares. As per the developed analysis, it is realized that the proposed project covers open fields with dispersed vegetation as well as zones with farming plots (machambas).

For the evaluation of impacts during the construction phase, we proceeded to identify and evaluate the actions to be taken with impacts on the landscape, and the measures envisioned in the project in order to avoid or minimize negative effects.

To assess the impacts on the landscape in the operation phase, an evaluation was done of the changes that will occur in the value of the landscape and in the vision, with the insertion of new elements resulting from the installation of the project, in comparison with the baseline situation described in the previous chapter.

The deployment of new built-up zones will change the visual structure, creating a contrast of sight, volumetric and chromatic, which will produce a final visual change in the landscape, besides also increasing the extent of waterproofed areas. However, the integration and occultation of built-up zones by development of green zones for their framing, will allow, in the operation phase, to reduce the apparent scale and the geometric nature of the structures.

However, the efficiency of the rehabilitation measures and the landscaping integration of the buildings, infrastructures and equipments, in order to minimize the impacts created by the construction actions, namely the actions on the plant cover, are dependent, during the operation phase, on the adequate maintenance and development of plant material.

Follows the listing of operations that result from the installation of the project, for which we describe the expected impacts.

Table 5.12 Loss of landscaping structure by clearance of vegetation on the land

Impact	Elimination of trees, bushes and grasses, altering the plant structure and leaving the soil naked and therefore poorer in visual terms. Possibility of opening new vision angles for the project zone				
Impact type	Negative	Positive	Neutral		
	Negative impact due to the alteration of the plant structure which will be caused by the project				
Impact type	Direct	Indirect	Induced		
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term	Long term	Permanent	
	Impact is long term.				
Impact extent	Local	Regional	International		
	It will occur in the project footprint area.				
Impact scale	Will occur on the 120 ha of the project				
Impact frequency	Impact will occur in the construction phase but maintained for the duration of the project				
Impact Magnitude	Positive	Negligible	Low	Medium	Large
	Medium, since the soil is sandy and used for farming plots and open land, as described in the characterization of the type of local soils				
Receptor sensitivity	Low	Medium	High		
	There are residential settlements in the envelope of the area of direct influence which are sensitive to project installation activities				
Impact significance	Negligible	Minor	Moderate	Major	
	Moderate, taking into account the types of soils and their use as described in the local characterization, and the existence of receptors with low significance in the area of direct influence				

Mitigation Measures

- The vegetation, bushes and trees, existing in the areas not disturbed by earthworks shall be protected, in order not to be affected by the location of the worksite, deposits of materials, personnel quarters and other, and by the movement of machines and vehicles; and

- Temporary deposits shall be installed in places where they do not interfere with the existing tree cover.

Residual Impact

The protection of vegetation, bushes and trees, will avoid conditions of bare soil and therefore poorer in visual terms.

Restricting clearance of trees to the areas of installation of structures confers a medium significance to the impact, since not all the 120 ha of land will be cleared, avoiding unnecessary impacts.

5.6.2 Alteration of the landscaping structure by the installation of worksite, support infrastructures and accesses

The localized introduction of alien elements in the traditional environment, giving the landscape a more humanized aspect and producing an impression of visual degradation and disorganization, are characteristics of the worksite environment.

Table 5.13 Alteration of the landscaping structure by the installation of worksite, support infrastructures and accesses

Impact	Alteration of the landscaping structure by the installation of worksite, support infrastructures and accesses				
Impact type	Negative	Positive	Neutral		
	Negative impact due to the change of landscaping structure caused by the project				
Impact type	Direct	Indirect	Induced		
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term	Long term	Permanent	
	Impact is temporary and restricted to the construction phase.				
Impact extent	Local	Regional	International		
	It will occur in the project footprint area.				
Impact scale	Will occur on the 120 ha of the project				
Impact frequency	Impact will occur only in the construction phase				
Impact Magnitude	Positive	Negligible	Low	Medium	Large
	There are no residential settlements considered significant in the area of direct influence of the project				
Receptor sensitivity	Low	Medium	High		
	No significant residences exist				
Impact significance	Negligible	Minor	Moderate	Major	
	Minor, taking into account the types of soils in the areas of direct and indirect influence, as described in the local characterization, and the existence of receptors with low significance in the area of direct influence				

Mitigation Measures

- Proceed to dissimulate the worksite and the machinery park with adequate plant barriers or screens; and

- The existing access routes should be used and, inside the site and on the accesses to the site, the circulation areas shall be limited, trying this way to reduce the area of soil subject to compaction.

Residual Impact

The dissimulation of the worksite and the use of existing accesses will keep the impact on this issue low.

Earthmoving

Increase of the concentration of dust in the air and its deposition on vegetation, housing and other nearby elements, reducing visibility and changing the landscape colors. Affecting and removing a layer of soil. Modification of the original morphology of the land, interfering with the runoff flow conditions and causing the appearance of zones of visual discontinuity.

Table 5.14 Earthmoving

Impact	Earthmoving				
Impact type	Negative	Positive	Neutral		
	Negative impact due to the modification of the original morphology of the land				
Impact type	Direct	Indirect	Induced		
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term	Long term	Permanent	
	Impact is temporary and restricted to the construction phase.				
Impact extent	Local	Regional	International		
	It will occur in the project footprint area.				
Impact scale	Will occur on the 120 ha of the project				
Impact frequency	Impact will occur only in the construction phase				
Impact Magnitude	Positive	Negligible	Low	Medium	Large
	There are no residential settlements considered significant in the area of direct influence of the project				
Receptor sensitivity	Low	Medium	High		
	No significant residences exist				
Impact significance	Negligible	Minor	Moderate	Major	
	Minor, taking into account the types of soils in the areas of direct and indirect influence, as described in the local characterization, and the existence of receptors with low significance in the area of direct influence				

Mitigation Measures

- Topsoil shall be stored in stockpiles, of trapezoid shape, narrow and long, with the top slightly convex to allow a good infiltration of water, and shall remain in areas adjacent to those where the soil will later be applied. The accumulated topsoil shall not be stepped on or compressed;

- Periodic water spraying of areas of earthmoving, circulation of vehicles and machines, mainly during the summer period, in order to reduce deposition of dust and other materials on vegetation and on other surrounding elements; and

- Adaptation of the project, as much as possible, to the morphology of the land. Perform a natural integration in the morphology of the land, so that once finished the works, the earth movements will not be or will hardly be noticed.

Residual Impact

Taking into account the small volume of earth to be moved, due to the character of the land, after the minimization measures prescribed, the residual impact will be of low significance.

5.6.3 Alteration of the landscaping structure by the installation of the power plant, equipment and accesses

Alteration of the visual structure, creating a strong sight contrast, volumetric and chromatic on the landscape, establishing a visually subdivided structure, very organized and with a more humanized character. Increase of the extent of waterproofed areas and reduction of open space.

Table 5.15 Alteration of the landscaping structure by the installation of the power plant, equipment and accesses

Impact	Alteration of the landscaping structure by the installation of the power plant, equipment and accesses				
Impact type	Negative		Positive		Neutral
	Negative impact due to the increase of the extent of waterproofed areas caused by the project				
Impact type	Direct		Indirect		Induced
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term		Long term	Permanent
	Will occur during the life of the project, being dismantled in the decommissioning phase				
Impact extent	Local		Regional		International
	It will occur in the project footprint area.				
Impact scale	Will occur at the most on the 120 ha of the project				
Impact frequency	The impact will be permanent.				
Impact	Positive	Negligible	Low	Medium	Large

Magnitude	Medium, taking into account the use of soils in the areas of direct and indirect influence, as described in the local characterization, and the existence of receptors with low significance in the area of direct influence			
Receptor sensitivity	Low	Medium	High	
	No significant settlements exist			
Impact significance	Negligible	Minor	Moderate	Major
	Medium, taking into account the use of soils in the areas of direct and indirect influence, as described in the local characterization, and the existence of receptors with low significance in the area of direct influence			

Mitigation Measures

- Perform landscape integration, allowing the reduction of apparent scale, geometrism and sight contrast, volumetric and chromatic on the landscape, partially or totally shielding the infrastructures using modeling and plantation models.

Residual Impact

The impact from the implementation of new structures on the landscape will last the entire life of the project and, with the correct landscape integration, shall be minimized for the observers located near the area of the project.

5.6.4 Landscaping integration of the project

Connection of the project area with the surrounding landscape and visual compatibility of the new infrastructures with the environment where they are inserted, partially hiding the infrastructures that cause a larger contrast in the visual aspect. Reduction of the areas of bare soils, avoiding the risk of erosion. Reestablish the plant structure characteristic of the site, with increase of landscape complexity and diversity at short and medium term.

Table 5.16 Landscaping integration of the project

Impact	Landscaping integration of the project				
Impact type	Negative	Positive	Neutral		
	Reestablishing the plant structure characteristic of the site is a positive impact of the project				
Impact type	Direct	Indirect	Induced		
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term	Long term	Permanent	
	Occurs during the entire life of the project				
Impact extent	Local	Regional	International		
	The impact will occur in the project footprint area.				
Impact scale	The impact will occur in the zones targeted for landscaping integration. Around the support buildings and the panels zone				
Impact frequency	The impact will be permanent.				
Impact	Positive	Negligible	Low	Medium	Large

Magnitude	Taking into account the implementation of new buildings, their integration is considered a positive aspect of the project			
Receptor sensitivity	Low	Medium	High	
	No significant residences exist The integration of the site will therefore be of low visibility			
Impact significance	Negligible	Minor	Moderate	Major
	Moderate, taking into account the present use of the soil.			

Mitigation Measures

- The Green Structure shall be correctly and thoroughly implemented, with control of the quality of materials used and work to be performed; and

- In affected areas, assigned for landscaping rehabilitation, the soils used shall be first deeply ploughed and reconstructed, as much as possible, for structure and balance.

Residual Impact

With the correct implementation of a green structure and the use of native species, the impact of landscape integration is leveraged, acquiring characteristics of major significance as compared to the presently existing solution.

5.6.5 *Deployment of new built-up structures, infrastructure, equipment, roads and vehicle parking*

Alteration of the visual structure, with sight contrast, volumetric and chromatic on the landscape, establishing a visually subdivided structure, organized and with a more humanized character. Increase of the extent of waterproofed areas and reduction of open space.

Table 5.17 ***Deployment of new built-up structures, infrastructure, equipment, roads and vehicle parking***

Impact	Deployment of new built-up structures, infrastructure, equipment, roads and vehicle parking				
Impact type	Negative	Positive	Neutral		
	Positive, taking into account the allocation of an organized structure to the landscape				
Impact type	Direct	Indirect	Induced		
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term	Long term	Permanent	
	The impact is permanent				
Impact extent	Local	Regional	International		
	The impact will occur in the project footprint area.				
Impact scale	The impact will occur in the 120 ha of project area				
Impact frequency	The impact will only occur in the operation phase of the project				
Impact	Positive	Negligible	Low	Medium	Large

Magnitude	Low, taking into account the almost nonexistence of receptors in the area of direct influence			
Receptor sensitivity	Low	Medium	High	
	No significant residences exist The new structures will therefore be of low visibility			
Impact significance	Negligible	Minor	Moderate	Major
	Minor, taking into account the present use of the soil.			

Mitigation Measures

- Points of light shall be integrated through the use of vegetation, so as to avoid long range nocturnal visibility that could affect neighboring natural and residential areas; and

- Adaptation of the urban design to the natural geographic characteristics of the land, namely morphologic support.

Residual Impact

The impact of organizing the landscape vs. the disorderly aspect it presently has, will have a positive effect for observers who exist around the area of direct influence, who will then observe a landscape with a more humanized character.

5.6.6 Implementation of a green structure

Composing a green structure for integration of the project.

Table 5.18 Implementation of a green structure

Impact	Implementation of a green structure				
Impact type	Negative	Positive	Neutral		
	Positive, taking into account the allocation of a green structure of landscape integration				
Impact type	Direct	Indirect	Induced		
	The impact is direct. It will occur in the project footprint area.				
Impact duration	Temporary	Short term	Long term	Permanent	
	The impact is permanent				
Impact extent	Local	Regional	International		
	The impact will occur in the project footprint area.				
Impact scale	The impact will occur in the 120 ha of project area				
Impact frequency	The impact will only occur in the operation phase of the project				
Impact Magnitude	Positive	Negligible	Low	Medium	Large
	Landscape integration will contribute to less aggressiveness of the new structures on the existing landscape, but also for erosion control in the area of direct influence				
Receptor sensitivity	Low	Medium	High		
	No significant residences exist The integration of the site will therefore be of low visibility				
Impact	Negligible	Minor	Moderate	Major	

significance	Moderate, taking into account the present use of the soil and the non-existence of significant receptors

Residual Impact

The impact of implementation of a green structure and its subsequent maintenance will make the observers notice a preserved landscape leveraging the preservation of the plant cover and stabilization of the soil.

5.7 SURFACE WATER (RUNOFF)

5.7.1 Alteration of runoff patterns and drainage characteristics, and catchment yield

The construction of the project will result in the alteration of the catchments and drainage patterns due to the disturbance of the land during site clearing, earthworks and construction of access roads, solar PV array and associated infrastructure. This is likely to result in increased runoff and mobilization of sediment. Flow velocity of runoff is likely to increase, and the water will be concentrated which could lead to increased erosion. The stream flow characteristics will also change and there will be an increased likelihood of standing or ponding of water due to the unnatural drainage lines which will be created.

During the operational phase, impacts will arise from runoff being concentrated, because it drains from impermeable solar panel surfaces. A lack of maintenance of storm water infrastructure and roads could result in obstructions due to debris being collected in storm water control structures. Inadequate storm water drainage systems which could lead to alteration of catchment yield and drainage patterns and a decrease in runoff volumes due to obstructions or drainage diversions. This could result in increased soil erosion due to inadequate storm water control systems and a loss of vegetation which leads to increased erosion and siltation of watercourses. The presence of the solar PV array will result in an increase in runoff volumes because the solar panels will cover a large area where rainwater used to infiltrate into the ground. This runoff will now be diverted to the nearest drainage canal causing an increase in flood peaks and increased flow velocity, which will lead to a loss of functionality of storm water infrastructure.

During decommissioning there will be a removal of water control structures such as drains, culvert or sediment handling infrastructure and the general decommissioning and rehabilitation of roads and infrastructure. This will result in the increase and mobilization of sediment and increased soil erosion on open bare areas which could result in the loss of vegetation which leads to increased erosion and siltation of watercourses as well as the potential standing or ponding of water.

These impacts will occur mainly during the construction and decommissioning phases. During the operational phase the impact can be managed and after decommissioning the drainage patterns will be reinstated or improved. The impact on catchment yield can also be seen as positive because runoff may increase due to the impermeability of the panels. This is however insignificant in relation to the larger receiving catchments and the high yield of the larger catchment. The increase in yield can, on the other hand, also have other negative effects like flooding.

Table 5.19 Alteration of runoff patterns and drainage characteristics, and catchment yield

Impact	Alteration of runoff patterns and drainage characteristics, and catchment yield				
Impact type	Negative	Positive	Neutral		
	Nature of the impact is considered to be Negative				
Impact type	Direct	Indirect	Induced		
	Impact type is direct.				
Impact duration	Temporary	Short-term	Long-term	Permanent	
	This will be a short term impact				
Impact extent	Local	Regional	International		
	Extent is considered to be local				
Impact scale	The scale of the impact is estimate to be <15% of the sub-catchment				
Frequency	Several events per year and mainly during the construction and decommissioning phases				
Magnitude	Positive	Negligible	Small	Medium	Large
	The magnitude of the impact is considered to be negligible				
Receptor Sensitivity	Low	Medium	High		
	Receptor sensitivity is low				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be Negligible.				

Mitigation Measures

- Minimize disturbance of the natural topography and catchment characteristics by limiting large scale earthworks, vegetation removal and soil compaction where possible;
- Construct adequate storm water diversion structures to route runoff around affected areas;
- Rehabilitate the affected areas as close as possible to the natural condition during the decommissioning phase; and
- Ensure sediment traps are in place and maintained regularly.

5.7.2 Increased sediment load

During the construction phase the disturbance of the soil profile, land clearing operations and general construction of infrastructure (water control structures such as drains and culverts) will result in increased runoff from construction

site and stockpile areas. This will increase the mobilization of sediment and result in increased turbidity. Inadequate storm water management and soil stabilization measures will result in more suspended solids within watercourses which could lead to a reduction of water quality and reduction in dissolved oxygen levels. This has the potential to affect the suitability of water for human consumption and aquatic biology.

In the operational phase impacts could arise from a lack of maintenance of water control structures such as drains, culverts or sediment handling infrastructure and inadequate storm water management and soil stabilization measures. Potential consequences will be the reduction of capacity of water control structures and potential damage to storm water infrastructure. This could lead to the increased mobilization of sediment and increased turbidity. More suspended solids in the watercourse could result in the reduction of water quality and reduction in dissolved oxygen levels which will affect the suitability of water for human consumption and aquatic biology.

During the decommissioning phase impacts could arise from the removal of water control structures or sediment handling infrastructure and the decommissioning of roads. Inadequate storm water management and soil stabilization measures in cleared areas during decommissioning operations could result in the increased mobilization of sediment, increased turbidity and suspended solids which will result in the reduction of water quality and dissolved oxygen levels. This will affect the suitability of water for human consumption and aquatic biology.

The majority of impacts will occur during the construction and decommissioning phases until the bare areas have stabilized. During the operational phase impacts can be managed by means of embedded control measures. This impact has a negative impact on the downstream physical, biological and the social environment.

Table 5.20 Increased sediment load

Impact	Increased sediment load				
Impact type	Negative	Positive	Neutral		
	Nature of the impact is considered to be Negative				
Impact type	Direct	Indirect	Induced		
	Impact type is direct.				
Impact duration	Temporary	Short-term	Long-term	Permanent	
	This will be a long term impact				
Impact extent	Local	Regional	International		
	Extent is considered to be regional				
Impact scale	The scale of the impact is estimate to be <50% of the sub-catchment				
Frequency	Several events per year and mainly during the construction and decommissioning phases				
Magnitude	Positive	Negligible	Small	Medium	Large
	The magnitude of the impact is considered to be small				
Receptor Sensitivity	Low	Medium	High		
	Receptor sensitivity is low				
Impact	Negligible	Minor	Moderate	Major	

Significance	Significance of impact is considered to be Minor.

Mitigation Measures

- Avoid or reduce sediment load at the source (e.g., stockpiles and roads), by installing silt screens or constructing bunded areas;
- Sediment handling facilities must be constructed as part of the storm water control system;
- Parking areas and roads should be sealed / paved if possible;
- Dust suppression operations are recommended;
- Large areas should not be exposed for long periods of time and should be rehabilitated as soon as possible by establishing adequate vegetation to reduce increased sedimentation;
- If possible then the construction and decommissioning phases should be scheduled to take place during the dry season;
- Pluvial water on the surface shall be discharged in more than one point, to reduce the concentration of runoff at the surface;
  Road traffic on exposed areas or off the designated roads shall be limited;
- Clean storm water and other streams should be diverted around disturbed areas; and
- Monitoring of sedimentation should be done as an ongoing action at discharge points, especially during and after rain events.

Residual Impact

5.7.3 Impact on Surface Water Quality

During the construction phase, impacts will arise from cleaning chemicals and other solvents, used during maintenance operations and washing of equipment, potentially entering waterways. Leakage of hazardous materials, including chemicals and hydrocarbons such as fuel and oil, could potentially enter nearby surface water resources through storm water flows or directly into the sandy soils within watercourses.

The disposal of sewage and waste water from campsites for construction workers or the lack of provision of adequate sanitary facilities and ablutions for campsites could result in the reduction of water quality by means of direct or indirect fecal pollution of surface water resources. This could have a negative effect on the pH levels of the water and the chemical alteration of water will affect the suitability of water for human consumption. Standing or

ponding of contaminated water may infiltrate into the ground and cause secondary pollution of groundwater as well.

During the operational phase, impacts could result from potential spills of cleaning chemicals and other solvents used during maintenance operations and washing of equipment and solar panels, potential oil spillages from transformer maintenance if needed, or the disposal of waste water from solar panel cleaning operations. Potential consequences could include a reduction in dissolved oxygen levels and chemical alteration of water or a change in pH levels.

Decommissioning phase impacts are expected to arise from the cleaning chemicals and other solvents used during decommissioning operations and potential hydrocarbon spillages or the runoff of surface water with increased sediment load from site. Disposal of sewage and waste water from campsites or the lack of provision of adequate sanitary facilities and ablutions for campsites during decommissioning could also result in the reduction of water quality. Potential consequences will include the increase and mobilization of sediment, increased turbidity and suspended solids which will lead to a reduction in the dissolved oxygen levels and overall reduction in water quality.

Table 5.21 Impact on Surface Water Quality

Impact	Surface water quality				
Impact type	Negative	Positive	Neutral		
	Nature of the impact is considered to be Negative				
Impact type	Direct	Indirect	Induced		
	Impact type is indirect.				
Impact duration	Temporary	Short-term	Long-term	Permanent	
	This will be a short term impact				
Impact extent	Local	Regional	International		
	Extent is considered to be local				
Impact scale	The scale of the impact may occur beyond the project area's sub-catchments, although unlikely.				
Frequency	Several events per year but can be reduced during the construction, operational and decommissioning phases				
Magnitude	Positive	Negligible	Small	Medium	Large
	The magnitude of the impact is considered to be small				
Receptor Sensitivity	Low	Medium	High		
	Receptor sensitivity is low				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be Minor.				

Mitigation Measures

Surface water quality needs to be monitored during all three phases even though this impact is considered to be minor. Inadequate management could increase the significance of this impact and the negative impact it has on the

physical, biological and social environment. The following mitigation measures are proposed:

- Avoid or reduce contamination through unplanned spillages implementing a spills prevention and management program;
- Ensure all hazardous materials, chemicals and hydrocarbons are used only within designated areas (e.g., bunded areas);
- The use of drip trays are recommended for maintenance works that take place on site and parking areas;
- Implement oil separation facilities at parking area;
- Ensure proper clean and dirty water separation structures;
- Untreated waste water should not be allowed to discharge from site;
- Sufficient temporary ablution and sanitation facilities during construction and decommissioning should be supplied and serviced on a regular basis;
- Ensure that all waste material on site is handled according to specified waste handling procedures and regulations; and
- Implement sediment handling measures and monitor discharge positions on a regular basis.

Residual Impact

As minimal reshaping and disturbance of the soil profile is expected, therefore the significance of the residual impacts is considered to be of negligible significance after the implementation of the proposed mitigation measures. Very fine sediment particles may remain suspended for longer periods of time and may still have an impact in nearby water resources after remedial actions were taken. Over time rehabilitated areas will become more stable and sedimentation and erosion impacts will be reduced. The low gradient of catchment slopes and drainage lines together with wide flow areas of drainage lines and normally good vegetation cover in drainage lines drastically reduce any possible residual impacts.

5.8 BIOLOGICAL ASPECTS

5.8.1 Loss of habitat including trees

Habitats associated with the project site have been modified from their natural state through subsistence cultivation of crops. These habitats have low

biodiversity sensitivity with a low likelihood of occurrence of any species of conservation concern. There are a number of large trees present within the project site, which serve as habitats for several species and therefore a reduction is expected in the species of fauna present, associated with anthropogenic disturbances. Loss of the existing habitat will displace these birds, mammals and reptiles, although the significance of this loss is classified as low.

The loss of vegetation and transformation of habitats will occur during the construction phase. Small animals may be exposed during vegetation clearing and have no means of escape. Loss of habitat will not occur during the operational phase, however, the presence of the project may inhibit the movement of lesser fauna.

Impacts during the decommissioning phase will be similar to the operational phase, although the significance might be reduced.

Table 5.22 Loss of Habitat and Trees

Impact	Loss of Habitat and Trees				
Impact type	**Negative**	Positive	Neutral		
	Impact on habitats is negative.				
Impact type	**Direct**	Indirect	Induced		
	Impact on habitats is direct.				
Impact duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long-term, as the impacts will continue for the life of the plant.				
Impact extent	**Local**	Regional	International		
	Impacts on habitats are local to the PV power plant site.				
Impact scale	The scale of the impact is dependent on the nature of the change but would mainly be restricted to the PV power plant site.				
Frequency	Throughout the life time of the operations and during closure phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered medium depending on the nature of the disturbance				
Receptor Sensitivity	**Low**	Medium	High		
	Habitats were modified prior to development of the project, and sensitivity of this receptor is classified as Low.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be **Minor.**				

Mitigation Measures

Mitigation measures are proposed to reduce impact significance:

- Safe procedure for the translocation of animals is needed, particularly during the construction phase. Animals that are exposed during vegetation clearing must be safely captured and released into nearby areas where they

are safe from human disturbance and/or do not pose the risk or threat to the activities of people.

- A general awareness of biodiversity and the natural environment needs to be generated among staff and contractors during construction, operation and decommissioning phases. Induction programs must include the importance of protecting the natural environment, and ongoing activities must be implemented to raise awareness, such as putting up posters and brief talks about nature conservation.

- The movement of lesser fauna in and out of the site must not be prevented. Fencing should allow the safe underpass of small mammals, reptiles and amphibians.

Residual Impact

Raising awareness, safe translocation of any affected fauna and allowing the movement of small terrestrial fauna will provide an effective approach towards reducing this impact. It is anticipated that the significance can be mitigated to negligible with commitment towards these simple mitigation measures.

5.8.2 Potential Impacts to Birds

Concerns do exist about the impact of solar power generation on birds. A review of literature has revealed a Royal Society for Protection of Birds (RSPB) policy document (1) which states that there is little scientific evidence for fatality risks to birds associated with solar PV arrays. A Birdlife South Africa (BLSA) Position Statement (2) states that there is a low collision risk with reflective surfaces and a Scientific American article (3) states that losses of rare bird species have been associated with large solar PV arrays in desert areas within the United States.

However, as stated, the project site is not located within any known migratory flyways, and the surrounding habitats are not expected to support sensitive avifaunal communities. The site is within close proximity of a large river which may serve as an ecological corridor, and a broader diversity of birds may pass over the site than is observed using the surrounding habitats. Therefore, the significance of this impact is considered to be low.

The BLSA position statement states that there is a collision risk associated with power lines that are required to evacuate electrical power generated by the solar PV arrays. In this instance the solar PV array is located less than 1 km from an electrical substation at Mocuba and the significance of this impact is considered to be low.

(1) https://www.rspb.org.uk/Images/Solar_power_briefing_tcm9-273329.pdf
(2) http://www.birdlife.org.za/conservation/policy-and-advocacy
(3) http://www.scientificamerican.com/article/solar-farms-threaten-birds/

No specific impacts to birds are expected during the construction phase. There is a risk that birds passing over the site may mistake reflective surfaces as water bodies, and then attempt to land accordingly, which can be fatal to the birds and potentially destructive to the panels. However, as stated above, there is little scientific evidence and few effective mitigation measures are available to address the potential impact.

Removal of solar panels will occur rapidly during the decommissioning phase and the impact on birds is expected to be greatly reduced.

Table 5.23 Potential Impacts to Birds

Impact	Potential Impacts to Birds				
Impact type	**Negative**	Positive	Neutral		
	Impact on birds is negative.				
Impact type	Direct	Indirect	**Induced**		
	Impact on birds is potentially induced				
Impact duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long-term, as the impacts will continue for the life of the plant.				
Impact extent	**Local**	Regional	International		
	Impacts on birds are local to the PV power plant site.				
Impact scale	The scale of the impact is dependent on the nature of the change, but would mainly be restricted to the PV power plant site.				
Frequency	Throughout the life time of the operations and partially during the closure phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Magnitude of the impact to birds is classified as medium				
Receptor Sensitivity	Low	**Medium**	High		
	A wide diversity of bird species could flyover the site, including low and high sensitivity species. On average the sensitivity is classified as medium.				
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered to be **Medium.**				

Mitigation Measures

Mitigation measures are proposed to reduce impact significance:

- The site should be made unattractive to birds to reduce the occurrence of bird collisions with reflective surfaces. It is recommended that all the trees within the project site be removed. Ephemeral pans with water, if they occur within the footprint, must be filled in.

- All overhead power lines, wires and supports should be designed to minimize electrocution and collision risk. It is recommended that insulation devices and bird deflectors be installed.

- Monitoring of bird fatalities associated with the project must be conducted. All observed bird deaths must be recorded with the date, location and identification of the bird species. Where identification is uncertain, a photograph of the carcass must be retained together with feather samples.

- Monthly inspections of all facilities are to be conducted to search for bird fatalities and all incidents must be recorded. Records are to be shared with relevant Mozambican entities and the Conservation Advocacy group of Birdlife South Africa (BLSA).

Residual Impact

Mitigation measures can be implemented to reduce the potential risks to birds, however the risk that over-flying birds will mistake the solar panel arrays for water bodies cannot be altered, and the risk of bird mortalities will remain for as long as the solar panel arrays remain in place. Mitigation measures associated with increasing the visibility of power lines can be effective, and it is anticipated that the overall significance of the impact to birds can be reduced to a Minor level.

5.8.3 Infestation of Alien and Invasive Species

Vegetation will be cleared for establishment of the project. Any vegetation disturbance will be associated with the appearance of pioneer plants species, commonly referred to as weeds. These plants to not present a risk to surrounding areas, however, the occurrence of invasive plants can be problematic. Invasive species, if source populations are established on the site, could invade surrounding areas leading to displacement of naturally occurring species. Additional control efforts could be required on surrounding cultivated land.

The project site is surrounded by cultivation, which represents an ongoing vegetation disturbance and is also associated with a similar risk of establishing alien invasive species. The significance of this impact is therefore considered to be low.

A buildup of alien and invasive species could develop at the site, and if not mitigated, could serve as a source population that inhibits the control of these plants in the greater area.

The construction phase will be associated with initial removal of the vegetation, and will be associated with the highest risk of invasive species establishment. Ongoing control of vegetation will be required during the operations phase to allow access through the site, to prevent shading of the panels and to avoid the build-up of dry flammable material that presents a fire risk. Soil disturbances will occur during the decommissioning phase and the risk of alien and invasive plant species establishing is expected to increase.

Table 5.24 Infestation of Alien and Invasive Plant Species

Impact	Infestation of Alien and Invasive Plant Species			
Impact type	**Negative**	Positive	Neutral	
	Impact of increased alien and invasive plants is negative.			
Impact type	Direct	**Indirect**	Induced	
	Impact of increased alien and invasive plants is indirect.			
Impact duration	Temporary	Short-term	**Long-term**	Permanent
	Impacts, if unmitigated, could last for the duration of the plant and are therefore classified as long-term.			
Impact extent	**Local**	Regional	International	
	Impacts of increased alien and invasive plants are local to the PV power plant site.			
Impact scale	The scale of the impact is dependent on the nature of the change, but would mainly be restricted to the PV power plant site.			
Frequency	Throughout the life time of the operations and partially during the closure phase.			
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude of the impact on plants is classified as medium				
Receptor Sensitivity	**Low**	Medium	High	
	Alien and invasive plants already occur in the area, and the sensitivity is classified as low.			
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered to be **Minor.**			

Mitigation Measures

Mitigation measures are proposed to reduce impact significance:

- Actively plant a locally occurring grass species, such as *Cynodon dactylon*, that provides good ground cover between solar panels. This will discourage the growth of weeds and alien invasive plants and it will minimize the occurrence of soil erosion. The grass species will remain short and will present a low fire risk.

- Maintain grass in a short cropped state through mowing and/or controlled grazing by livestock between the solar panels.

- Once grass is established, the area must be weeded and any invasive species that do appear must be removed.

Residual Impact

Control of weeds and establishing a stable vegetation cover is easily achieved and will effectively reduce the significance of this impact to a negligible level.

5.8.4 Contamination of Aquatic Environments

The Licungo River is located approximately 2.5 km from the project site. It is vulnerable to contamination from unnecessary discharges of effluents.

Chemicals to be used during construction and operation of the power plant may include pesticides used to control vegetation, and cleaning chemicals used for cleaning the solar panels. For example panels will need to be cleaned to prevent a build-up of dust, bird feces or other items that might reduce their efficiency. Various cleaning materials may be used, which may have an adverse effect if entering aquatic ecosystems. Adhesives and other glue materials used during the construction phase may be toxic to aquatic environments.

In the case of accidents associated with spills, hazardous chemicals may impact soils. It should be noted that the quantities of hazardous chemicals to be used on site will be limited to necessary amounts and there will not be storage of large amounts of chemicals on site. Solar panels will lead to extensive runoff during heavy rainfall events and there is a potential that storm water runoff including affected soils could be transported into river system through existing creeks and water bodies, located closer to site. Taking in consideration the distance to the Licungo River, the small amounts of chemicals to be used on site and dilution factors on heavy rainfall episodes, this impact is considered negligible.

Table 5.25 Contamination of Aquatic Environments

Impact	Contamination of Aquatic Environments				
Impact nature	**Negative**	Positive	Neutral		
	Impact of contamination is negative.				
Impact type	**Direct**	Indirect	Induced		
	Impact of contamination to aquatic environment is indirect, as it might result of dilution of potential contaminated soils during heavy rains runoff events.				
Impact duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts, if unmitigated, could last for the duration of the plant and are therefore classified as long-term.				
Impact extent	Local	**Regional**	International		
	Aquatic contamination, if severe, could spread downstream and far beyond, nevertheless taking in consideration the amounts of chemicals, dilution factor and management measures, it is therefore classified as Local.				
Impact scale	The scale of the impact is dependent on the nature of the change, but would mainly be restricted to the PV power plant site.				
Frequency	Throughout the life time of the operations and partially during the closure phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Likelihood of the impact is low and therefore the Magnitude is classified as Small				
Receptor	Low	**Medium**	High		

Sensitivity	The Licungo is a large river but is heavily impacted in the area close to the site, so the sensitivity is therefore classified as Low.			
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered to be **Minor.**			

Mitigation Measures

Mitigation measures are proposed to reduce impact significance:

- All ephemeral pans within the footprint of the project site are to be filled in so that there is no standing water.
- Maintain a stable vegetation cover between solar panels (Section *5.2.1*) to encourage the infiltration of rainwater into the soil and minimize the surplus water runoff.
- Solar panels will result in a lot of runoff during heavy storm events and a method of managing storm water runoff is required. The approach should encourage as much infiltration of water into the soil as possible and minimize the discharge into the Licungo River.
- Vegetation within the project site must be controlled through mechanical means rather than the use of chemicals.
- Reduce the amounts of chemicals managed on site to a minimum; and
- Maintain a hazardous materials management plan, including procedures to manage potential spills of hazardous chemicals.

Residual Impact

Adherence to proper waste management, storm water control and encouraging infiltration of rainwater will effectively reduce the likelihood of contaminants from the site reaching the Licungo River, and the residual significance of this impact is considered to be negligible.

5.9 SOCIO-ECONOMIC IMPACTS

5.9.1 Loss of access to available natural resources in the Project Footprint Area and adjacent areas

The natural resources existing in the 126 hectares to be occupied by the solar PV plant will no longer be available to the population that uses this area to gather natural resources. Data collected during field research determined that resources such as grass, medicinal plants, trees for firewood, charcoal production, materials for farming and rope are used by more than 50% of the family households surveyed. Individuals from villages, towns and districts

such as Erua, Mugonga, Bive, Namagoa, Muandiua, Samora Machel, Maramarelo and CFM also make use of the existing resources in the Project Footprint Area.

The restriction that the 126-hectare Project Footprint Area will place on locals will also impede access for family households that make use of existing roads to access natural resources in areas adjacent to the Project Footprint Area. For example this would impact people that use paths in the area to gain access to the Ígaro River where they bath and wash laundry.

*Table 5.26 **Loss of access to available natural resources in the Project Footprint Area and adjacent areas***

Impact	Loss of access to available natural resources in the Project Footprint Area and adjacent areas				
Impact type	**Negative**	Positive	Neutral		
	This impact is negative.				
Impact type	Direct	**Indirect**	Induced		
	Indirect.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Permanent, during the construction phase and project operation.				
Impact extent	**Local**	Regional	International		
	Local, restricted to the area of direct project influence.				
Impact scale	High.				
Impact frequency	Once at the start of the project construction phase.				
Impact Magnitude	Positive	Negligible	Less	Average	Greater
	High, since a high percentage of family households use existing natural resources in the Project Footprint Area, or adjacent areas, for household activities (cooking, lighting) and to harvest construction materials for housing.				
Sensitive recipients	Low	Medium	**High**		
	High due to the high dependence of family households on natural resources.				
Impact significance	Negligible	Minor	Medium	**Major**	
	Major				

Mitigation Measures

Through field research it was observed that in the areas adjacent to the Project Footprint Area there are natural resources available for use by households who currently utilise natural resources within the Project Footprint Area. Other family households may, depending on where they live, use areas outside of the Project Footprint Area to collect natural resources.

The greatest difficulty will be experienced by those family households who previously collected natural resources within the Project Footprint Area that will now have to use adjacent and neighboring areas. People who use the existing roads and access paths within the fooprint area to gain access to

adjacent areas will also experience some difficulty resulting from reduced access. The principal mitigation measures proposed are:

- Together with the community leaders and State administrators at the local level, map the areas for the use and collection of natural resources located in neighboring regions that were accessed via existing roads in the Project Footprint Area; and

- Construct footpaths, which may also be used by bicycles and motorcycles, on the perimeter of the Project Footprint Area to permit easy access to the natural resources located in neighboring regions.

Residual impact

The significance of the loss of access to available natural resources in the Project Footprint Area and adjacent areas is largely associated with the access restrictions associated with the Project Footprint Area. This impact is permanent. The aforementioned mitigation measures however reduce the magnitude of the impact. With the implementation of these measures, this impact is considered to be of minor significance.

5.9.2 Loss of crop areas and fruit trees and consequent reduction in food security

Field research has identified 208 family households with a total of 232 agricultural parcels within the Project Footprint Area. Farming is practiced on a subsistence basis, with each household on average having only one farm plot. The average size of each plot is 0.7 hectares.

Thirty seven percent of households have fruit trees on their plots (with mango trees being the most common with an average of three present on the plots that possess fruit trees). Other fruit trees occurring on land owned by a large number of households include banana (21%, average of 22 banana trees per plot) and cashew (22%, average of four cashew trees per plot).

Construction of the solar PV plant will result in the definite loss of these areas with clear negative effects for food security and means of subsistence for those households affected. The impact is rated as being of high significance given that it extends over the entire life of the Project (construction and operation phases).

Aspects relating to the agricultural calender, compensation for loss of land, and vulnerability among the family households and their members (discussed in socio-economic baseline *Section 4.10*) were taken into account in the impact assessment.

Table 5.27 Loss of crop areas and fruit trees and consequent reduction in food security and subsistence levels

Impact	Loss of crop areas and fruit trees and consequent reduction in food security and subsistence levels				
Impact type	**Negative**	Positive	Neutral		
	It is a negative impact because the 208 family households surveyed will lose their agricultural parcels and fruit trees.				
Impact type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Considered permanent, since the agricultural parcels will be permanently lost.				
Impact extent	**Local**	Regional	International		
	Local, restricted to the affected family households residing in the districts of the city and towns, villages and districts located near the Project Footprint Area				
Impact scale	The impact scale is local.				
Impact frequency	Once, at the start of the project construction phase.				
Impact Magnitude	Positive	Negligible	Less	Average	**Greater**
	Greater, since it represents the permanent loss of possession of crop areas and fruit trees.				
Sensitive recipients	Low	Medium	**High**		
	High, due to the dependence between agricultural production land in terms of food security and source of additional income				
Impact significance	Negligible	Minor	Medium	**Major**	
	Major, due to the interference of food security and means of subsistence of family households, with greater intensity for those considered vulnerable.				

Mitigation Measures

The principal mitigation measure proposed is the design and implementation of a plan to compensate for the loss of land used for agriculture and the planting of fruit trees and a plan to restore the means of subsistence for those households affected.

This plan must pay special attention to the following aspects:

- Family households that are vulnerable or that have vulnerable members; and

- The need to allocate replacement land on a timely basis so that affected households possess land for cultivation in time for the 2015-2016 Agricultural calendar.

Residual impact

The significance of the loss of crop areas and fruit trees and the consequent reduction in food security and subsistence levels is associated with the acquisition of land for Project development and it is an impact that extends over the entire Project lifetime. The mitigation measures mentioned above however significantly reduce the magnitude of the impact. The effective implementation of the Plan for Compensation and Land Use and Restoration of Means of Subsistence will render this impact insignificant.

5.9.3 Loss of auxiliary infrastructure

Only four family households report having well and shed type auxiliary infrastructure. Of these, only three households will lose auxiliary infrastructure due to construction of the solar energy photovoltaic plant.

Typical auxiliary infrastructure located in the Project Footprint Area includes structures like wells in the agricultural parcels which are used irrigation or bathing. A shed was also identified on the access road and appears to have been recently renovated.

Construction work in the Project Footprint Area and on the access road will result in the permanent loss of these auxiliary structures for the family households that own them. The impact will extend over the entire life of the Project.

Table 5.28 Loss of auxiliary infrastructure

Impact	Loss of auxiliary infrastructure				
Impact type	**Negative**	Positive	Neutral		
	It is a negative impact.				
Impact type	**Direct**	Indirect	Induced		
	This impact is direct, having identified three family households that will lose the auxiliary structures in the Project Footprint Area and access roads.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	The impact is permanent since the auxiliary structures will be permanently lost.				
Impact extent	**Local**	Regional	International		
	In terms of scope, the impact is local.				
Impact scale	Local, since of the 208 households that have been identified, only three have auxiliary infrastructure.				
Impact frequency	Once, at the start of the Project construction phase.				
Impact Magnitude	Positive	Negligible	**Less**	Average	Greater
	Low, since of the 208 households that have been identified, only three have auxiliary infrastructure.				
Sensitive	Low	**Medium**	High		

recipients	It is considered medium, since auxiliary structures represent an important resource among the resources owned by a subsistence farmer.			
Impact significance	Negligible	**Minor**	Medium	Major
	Minor since of the 208 households that have been identified, only three possess auxiliary infrastructure.			

Mitigation Measures

- The principal mitigation measure proposed is the design and implementation of a plan to compensate for the loss of identified auxiliary structures.

Residual impact

The significance of the loss of auxiliary infrastructure is associated with the acquisition of land for Project implementation and it is an impact that will occur over the entire lifetime of the Project. The mitigation measures mentioned above significantly reduce the magnitude of the impact. The effective implementation of the compensation plan, combined with the number of affected individuals, results in an impact of negligible significance.

5.9.4 Job creation and improved standard of living

Some 225 jobs will be made available for domestic labour as a result of the Project, comprising 135 skilled and semi-skilled positions, and 90 unskilled positions.

Skilled and semi-skilled domestic labour will be sourced from various parts of the country and from the Province of Zambezia, while a small portion of these roles will be recruited locally. All unskilled labour will be recruited in the Project ADI. In terms of skilled labour it is likely that these positions will be sourced from outside the Project area or from Quelimane.

Despite the proximity of the city of Mocuba, only a small portion of the population in the area are formally employed, this number is even smaller in the towns, villages and districts belonging to the Mocuba Administrative Post. The creation of jobs, even those temporary jobs created during the construction phase, represents an important impact in the economy of household families. These households will now have a fixed monthly income that they otherwise would have been unable to attain through subsistence agriculture, short-term work or informal work for themselves (refer to *Table 4.26*). Limited job creation is anticipated during the Project operation phase.

Table 5.29 Job creation and improved standard of living

Impact	Job creation and improved standard of living		
Impact type	Negative	**Positive**	Neutral

	The impact is positive				
Impact type	**Direct**	Indirect	Induced		
	Direct.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Long-term during the construction and Project operation phases.				
Impact extent	Local	**Regional**	International		
	Regional.				
Impact scale	Medium.				
Impact frequency	Several times during the construction and Project operation phases.				
Impact Magnitude	**Positive**	Negligible	Small	Medium	Large
	Positive.				
Sensitive recipients	Low	**Medium**	High		
	The sensitivity of recipients is considered average, unemployment is high, since the wages of salaried workers constitute a significant contribution to a household's income, even temporarily.				
Impact significance	Negligible	Minor	Medium	**Major**	
	Impact significance is considered Major.				

Mitigation measures

- Disclose the policy and procedures for recruiting domestic labour and employment opportunities with the local State and community authorities;

- Define a policy and procedures for recruiting domestic labour that gives priority to the local population in terms of accessing unskilled jobs, and whenever possible, skilled and semi-skilled jobs;

- Establish, with the local State and community authorities, a mechanism that gives priority to residents of communities neighboring the Project in terms of access to unskilled jobs;

- Employment opportunities must be equally distributed between men and women;

- Raise awareness around the documentation requirements relating to civil and tax identification with employees and coordinate with the relevant State authorities to establish quick and easy mechanisms for allocating civil and tax identification documents to selected job candidates; and

- Establish a system of coordination with local State and community leaders in order to monitor the recruitment process and introduce corrections when necessary.

Residual impact

The significance of job creation and improved standards of living is largely attributed to employment generation associated with the Project construction

phase and on a limited scale during the Project operation phase. Job creation will be short-term, occurring mainly during the Project construction phase. The aforementioned empowerment measures increase the magnitude of the impact, resulting in an impact of major significance.

5.9.5 Conflicts and social tension due to competition for access to jobs

The Project will create only a limited number of jobs, a fact that may create conflicts.

The origins of these potential conflicts and the ways in which they might manifest are described below:

- The Mocuba Administrative Post is a region in which there is a tradition of individual in-migration (permanent or seasonal) from neighboring districts (refer to *Section 4.10.2* of the social baseline which describes population distribution and population dynamics in greater detail);

- It is likely that some in-migration will occur as a result of individuals being attracted by reports of available jobs. This may result in job seekers competing with the local population for jobs in various ways, some of which may be illegal;

- The potential for conflict will be greater if in-migrants succeed in gaining access to unskilled jobs;

- There is a perception among the local communities that "people from outside" are able to gain access to skilled and semi-skilled jobs, when people within the communities possess similar skill levels, giving rise to feelings of frustration and animosity with respect to State authorities, community leaders and Scatec itself;

- There is a perception among the local communities that some community leaders are sacrificing the local community's interests in favor of familiar and well-known individuals, creating an attitude of mistrust toward the community leadership;

During the operation phase, a significant reduction of this impact is anticipated, due to the consequent reduction in the quantity of labour required for Project development.

Table 5.30 Conflicts and social tension due to competition for access to jobs

Impact	Conflicts and social tension due to competition for access to jobs.				
Impact type	**Negative**	Positive	Neutral		
	The impact is negative.				
Impact type	Direct	**Indirect**	Induced		
	This impact is indirect. Social conflicts and tensions may arise as a result of the need to engage labour for the Project or subcontracted companies.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Temporary, since the construction phase is limited.				
Impact extent	**Local**	Regional	International		
	Local.				
Impact scale	Local.				
Impact frequency	Several times during the labour hiring period.				
Impact Magnitude	Positive	**Negligible**	Small	**Medium**	Large
	Medium				
Sensitive recipients	Low	**Medium**	High		
	Recipient sensitivity is considered average since even with the view that available jobs are limited, access to employment is a sensitive issue for the local population.				
Impact significance	Negligible	Minor	**Medium**	Major	
	Impact significance is considered Medium.				

Mitigation Measures

Scatec or subcontractors are responsible for defining and implementing a policy and procedures for hiring labour that gives priority to local and provincial labour in accessing jobs.

Implementation of the labour contracting policy is the responsibility of Scatec or subcontractors, with the participation of the State authorities and community leaders at the local level.

The principal aspects of the local labour contracting policy and procedures may be:

- For unskilled labour, complete priority must be given to individuals living in the towns, villages and districts neighboring the Project Footprint Area, including the district of Mugonga, town of Muandiua and village of Bive;

- For semi-skilled labour, priority must be given to individuals living in the city, towns, villages and districts neighboring the Project Footprint Area. Recruiting will only take place in neighboring districts and the city of Quelimane in the event that jobs are not filled locally;

- The hiring of unskilled and semi-skilled labour must include the participation of community leaders;

- When hiring skilled labour, priority must be given in successive order, beginning in the city and areas neighboring the Project, followed by neighboring districts and then the city of Quelimane;

- Avoid practice of recruiting labour at the "project door," instead establishing two recruiting sites: one site located in the town of Bive, and another in Quelimane (for recruiting skilled labour only);

- Disclosing the hiring policy and procedures to the local State and community leaders;

- Establish a system of coordination with local State and community leaders in order to monitor the process and introduce corrections when necessary.

Residual impact

The significance of conflicts and social tension deriving from competition for access to jobs is associated with expectations as to the availability of jobs, especially during the plant construction phase. The mitigation measures proposed above significantly reduce the potential for conflict and social tensions due to access to employment, thus the significance of the impact is reduced to negligible.

5.9.6 Conflicts and disruption of the community and family organization due to the presence of a contingent of salaried labour

During the construction phase, 250 jobs will be available, 25 of which will be occupied by expatriates and 225 by nationals. Domestic labour will be distributed between local workers and others arriving from various places in the province or country. Expatriate workers and those originating from other parts of the country will live in the city since the installation of a worker residence camp is not anticipated.

Expatriates and Mozambique workers originating from other provinces of the country are likely to possess significantly higher levels of income than the local population. It is also anticipated that workers hired locally will obtain a higher social status as compared to other members of the community, due to the prestige of having a job and of earning a higher monthly incomes than the community in general.

Attitudes and behaviors may arise amongst the non-local workforce that are not consistent with social norms and the local culture and this may degenerate into conflicts between hired labour (expatriate and national) and the local community and family leaders residing in the Project area of influence (who are not familiar with the culture and specific social norms governing the non-

local workforce). The local population is likely to present their complaints to community leaders and seek their involvement in resolving problems and conflicts that might arise.

The likelihood of this impact is projected to decline significantly during the Project operation phase given the reduction in labour required by the Project.

Table 5.31 Conflicts and disruption of the community and family organization due to the presence of a contingent of salaried labour

Impact	Conflicts and disruption of the community and family organization due to the presence of a contingent of salaried labour				
Impact type	**Negative**	Positive	Neutral		
	The occurrence of situations of conflict and disruption of the community organization resulting from negative attitudes and behavior by hired workers is a negative impact.				
Impact type	Direct	**Indirect**	Induced		
	This impact is indirect.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	Temporary, reflected in the project construction phase.				
Impact extent	**Local**	Regional	International		
	Local, at the Project ADI.				
Impact scale	Local				
Impact frequency	Several times during the project construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The magnitude of this impact is considered average.				
Sensitive recipients	Low	**Medium**	High		
	Recipient sensitivity is medium. The local population and community leaders are expressing the need for, and importance of, individuals from outside respecting local culture and social norms.				
Impact significance	Negligible	**Minor**	Medium	Major	
	Minor				

Mitigation Measures

- Schedule periodic meetings with local State and community leaders to analyze issues concerning the relationship between workers hired within the scope of the Project and the local community;

- Organize an induction of each expatriate worker or worker coming from other locations of the country, to inform them of local social organization and culture, expected standards of behavior and attitudes, and behaviors to be avoided due to the high levels of conflict they may cause; and

- Periodically organize talks with all workers to raise their awareness of respect for the local community, its culture and habits in order to avoid conflicts.

Residual impact

The significance of conflicts and disruption to the community and family organization by the presence of a salaried labour contingent is associated with failure of contracted labour to respect the local culture and social norms. This may result in conflicts with the local population and community leaders. The mitigation measures mentioned above significantly reduce the magnitude of the impact. Thus, with the implementation of these measures, the impact significance is considered negligible.

5.9.7 Increase in taxes and tax revenue by the State

Project implementation will create economic benefits, particularly at the provincial level, resulting from an increase in tax revenues.

Local industry is relatively undeveloped and the local economy remains extremely dependent on subsistence agriculture, which limits the volume of revenue the State may capture from business activity.

During the construction phase the principal sources of income will be derived from taxes paid by the Project bidder and by companies subcontracted for construction tasks or to provide transport services for materials and equipment (some 600 trips from Quelimane to Mocuba), as well as construction materials, fuels and other services necessary for implementation of the set of activities provided for in the construction phase.

Upon project demobilization, this impact will cease to exist.

Table 5.32 Increase in taxes and tax revenue by the State

Impact	Increase in taxes and tax revenue by the State				
Impact type	Negative	**Positive**	Neutral		
	The increase in State taxes and tax revenue is a positive impact.				
Impact type	Direct	**Indirect**	Induced		
	Indirect.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Long-term, during the construction and project operation phases.				
Impact extent	Local	**Regional**	International		
	Regional, since it influences the district and provincial economy.				
Impact scale	The impact scale is local.				
Impact frequency	Several times during the construction and Project operation phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Large				
Sensitive recipients	Low	**Medium**	High		
	Recipient sensitivity is considered average.				
Impact significance	Negligible	**Minor**	Medium	Major	
	Impact significance is minor.				

Empowerment measures

- The principal measure for increasing this positive impact will be the subcontracting of domestic companies under an appropriate tax regime, with tax headquarters in Zambezia Province.

Residual impact

The significance of the increase in State tax revenues is associated with the taxes paid by the Project bidder and by the companies subcontracted for construction or the provision of transport services for materials and equipment during the construction and operation phases. As the empowerment proposed above increases, so too does the magnitude of the impact. Along these lines, this impact is considered as being of medium significance.

5.9.8 Local and regional economic development opportunities

The Third National Poverty Assessment carried out in 2008-2009 identified Zambezia Province as the poorest in the country, with 70.5% of its population living below the poverty level. The majority of the population of Zambezia Province and Mocuba District are subsistence farmers (see *Section 4.10.2* of the social baseline and Table 4 of *Appendix II* for further detail on economic activity and means of subsistence).

In general, the business sector of the province and district is under-developed and is facing difficulties of growth in a context of weak economic development in the province. The manufacturing business sector is very small and the commercial agricultural farming sector (based on growing coconuts and tea) is facing structural difficulties limiting growth, with the exception of companies growing cotton, soy and boer beans, and the Portucel Forestry Project of Mozambique ([1]).

The construction phase may be an opportunity for small and medium-sized companies (SMEs) to jump-start their business. The Project will need to subcontract companies for construction, the provision of various types of services (transportation, lodging, meals), as well as supplies of some products such as construction materials and fuel. Other services may be required in the city and communities of the project area to meet the needs of the labour hired by the project (some 250 workers).

During this operation phase, it is anticipated that the Project will contribute to the energy security of the provinces of Zambezia, Nampula, Niassa and Cabo Delgado to the north, creating an additional average of 70,000 MWH (megawatt hours) of energy generation capacity per year. A portion of that energy may also be used in the Mocuba special economic zone in which the

[1] Eucalyptus planting project for future transformation into a manufacturing unit for the production of paper pulp.

Project is located, with the goal to generate manufacturing initiatives that contribute to the provincial and regional economy.

Although Project demobilization is not anticipated, should it occur, this impact would cease to exist.

Table 5.33 Local and regional economic development opportunities

Impact	Local and regional economic development opportunities.				
Impact type	Negative	Positive	Neutral		
	The impact is positive, since it creates business opportunities for SMEs and promotes new investments and industrial units that in turn generate economic development.				
Impact type	Direct	Indirect	Induced		
	Indirect.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Long-term during the construction and Project operation phases.				
Impact extent	Local	Regional	International		
	Regional.				
Impact scale	The scale of the impact is medium, the business opportunities promote SMEs and create opportunities for the appearance of new SMEs, new investment and manufacturing establishments.				
Impact frequency	During the entire project lifetime.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Positive.				
Sensitive recipients	Low	Medium	High		
	Medium.				
Impact significance	Negligible	Minor	Medium	Major	
	Impact significance is Major.				

Empowerment measures

In meetings with municipal, district and provincial authorities, and with the business community:

- Disclose the business opportunities associated with the Project;
- Increase the awareness of State authorities around creating a business environment that facilitates and enhances the competitiveness of the local national business sector (province, district, municipality);
- Whenever possible, subcontract domestic companies with particular attention to those established in Zambezia Province and Mocuba District and City; and
- The Project and the subcontracted companies must give priority to the establishment of contracts for the provision of services and supply of

products to domestic SMEs established in Zambezia Province and in Mocuba District and City.

Residual impact

The significance of the creation of local and regional economic development opportunities is partially a result of the Project's necessity to subcontract companies for construction, the provision of various types of services (transportation, lodging, meals), as well as the supply of some products such as construction materials and fuel, as well as labour, with greater impact generated during the construction phase.

During the Project operation phase the contribution to the energy security of Zambezia Province as well as other provinces such as Nampula, Niassa and Cabo Delgado will attract increasing volumes of investment to those areas.

The increase in local and regional economic development opportunities will be short-term. The empowerment measures mentioned above will increase the magnitude of the impact. Thus, the impact is considered as being of major significance.

5.9.9 Increased risk of traffic accidents on access roads and streets

Access to the Project Footprint Area is facilitated via an unclassified road that begins at the intersection of National Highway N1 toward the detour to the Electricidade de Moçambique substation, where an access road to the Project Area will be constructed.

During the construction phase, some 600 trips from Quelimane to Mocuba are projected (a distance of 135 km), and from Mocuba to the Project Area in order to transport equipment. On this final leg, daily passenger and cargo traffic for the transport of personnel and materials to the Project Area must also be factored in.

The field survey identified the uses of the access road beginning at the intersection with N1 and continuing toward the Maganja da Costa District and Pebane until the intersection with the R644 and R645. These uses are described below:

- The road facilitates the movement of vehicles and persons travelling from the neighboring districts of Pebane, Maganja da Costa and other areas of Mocuba District, such as Muaquia. As well as persons from the neighboring communities of Erua, Mitalane, Bive, Muidane and some peripheral districts of the city, such as Samora Machel District.

- The principal specific uses of the road reported by users include:

    - Travel to the fields;

- Travel to jobs in the city;
- Transport of wood from Erua, Muaquiua and other sites to the N1 and from there to other destinations;
- Student travel to schools;
- Teacher travel to schools located in surrounding towns and villages; and
- Transport of charcoal, firewood and bamboo from the interior regions for sale in the city.

The increase in traffic that will be experienced on the non-classified road and on the access road to the Project Area will interfere with current users, increasing the risk of traffic accidents.

It is estimated that the interference will however decline during the plant operation phase, as fewer trips to and from the site will be necessary.

In the event of Project demobilization it is anticipated that road traffic will briefly increase before declining upon completion of the demobilization activity.

Table 5.34 Increased risk of traffic accidents on access roads and streets

Impact	Increased risk of traffic accidents on access roads and streets				
Impact type	Negative	Positive	Neutral		
	This impact is negative.				
Impact type	Direct	Indirect	Induced		
	This impact is indirect.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Short-term, during the construction phase.				
Impact extent	Local	Regional	International		
	The impact is local, limited to the non-classified road connecting N1 to the EDM substation and the access road to the Project Footprint Area.				
Impact scale	Medium				
Impact frequency	Daily, during the construction and demobilization phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Medium				
Sensitive recipients	Low	Medium	High		
	Recipient sensitivity is average, as the population is not prepared to avoid traffic accidents.				
Impact significance	Negligible	Minor	Medium	Major	
	Medium				

Mitigation Measures

The proposed mitigation measures apply particularly to traffic on the non-classified road linking National Road N1 to the EDM substation and to the access road to the Project Footprint Area. The measures proposed include the following:

- Subcontracted transport companies must be licensed to transport merchandise and possess experienced drivers with professional driver and public service licenses;

- Training courses must be organised for drivers of contracted companies on topics of road safety and defensive driving (mandatory short-term courses);

- Set speed limits for Project vehicles or subcontracted companies driving on the non-classified road and the access road to the Project Area; and

- Hold talks on road safety in local schools, and in the towns, villages and districts in the vicinity of the non-classified road and the access road to the project area.

Residual impact

The significance of the increase in the risk of traffic accidents on local roads and access ways is largely attributable to the increase in traffic associated with the 600 trips projected for the transport of equipment and other resources during the construction phase. The mitigation measures proposed above reduce the magnitude of the impact. This impact is considered short-term, as it has a higher likelihood of occurrence during the construction phase. With implementation of the measures proposed above, the impact is considered to be of low significance.

5.9.10 Increased pressure on the use of public and private services

During the construction phase 250 workers will be hired, 25 of whom will be expatriates. It is anticipated that a portion of the domestic labour to be hired will be recruited from outside Mocuba City and District and will remain living in the city.

Some private operators providing services to the Project or subcontractors will also establish themselves in Mocuba City or in neighboring areas. It is also anticipated that some new small and medium-sized companies, formal and informal, will be created, which will seek to provide services to this contingent of salaried workers and will also establish themselves in the city or in neighboring areas.

As a whole, the increased number of individuals residing and living in Mocuba City and neighboring areas will increase the pressure on public services such as civil identification, the tax authorities, health, education (in the case of families of workers that include children and parents), restaurants and banks.

The greater pressure on these services may result in inability to address the new demand and a decline in the services provided to the local population in terms of quality and quantity.

Special attention must be given to the health sector, which is currently under pressure due to insufficiencies in the existing health network and the lack of human and material resources ([1]).

Table 5.35 Increased pressure on the use of public and private services

Impact	Increased pressure on the use of public and private services.			
Impact type	Negative	Positive	Neutral	
	The impact is negative because it reduces the quality and quantity of public and private services due to the increased pressure on public and private services.			
Impact type	Direct	Indirect	Induced	
	Indirect.			
Impact Duration	Temporary	Short-term	Long-term	Permanent
	Short-term, during the construction phase.			
Impact extent	Local	Regional	International	
	Local, at the project ADI.			
Impact scale	High. Increase in the number of individuals using the available public and private services.			
Impact frequency	Continues during the construction phase.			
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Medium.			
Sensitive recipients	Low	Medium	High	
	Medium			
Impact significance	Negligible	Minor	Medium	Major
	Major			

Mitigation Measures

- The winning bidder and the construction subcontractors must provide the workers with preventive and emergency healthcare during the construction phase through dedicated facilities at the worksite (temporary clinic), in order to avoid the use of the local population's resources. They should also establish agreements with the healthcare sector for the transfer of serious cases and admittances to the Provincial Hospital.

Residual impact

The significance of the increased pressure on the use of public and private services is largely attributable to the possibility of a portion of the domestic

[1] During the field survey, the Consultant visited some health units, witnessing the high number of patients seeking treatment

labour (contracted from outside of Mocuba City and District) coming to reside in the area and thus causing pressure on the existing public and private services.

The implementation of the mitigation measures mentioned above reduces the magnitude of the impact, resulting in a reduction of the impact significance to negligible.

5.9.11 Loss of access to family and social infrastructure

The Project Footprint Area is currently occupied by agricultural parcels and contains some roads that permit access to various points within the area, as well as to population centers and social infrastructure such as schools and health stations located around the Project Footprint Area. Similarly, individuals living in these population centers also use these roads for access to residential areas and infrastructure located in parts of Mugonda and the non-classified road.

The closure of the Project Footprint Area will result in the closing of those roads and the loss of easy access to the residential areas and social infrastructure. The Erua Primary School was pointed out as an example of infrastructure that will be affected as currently people gain access through existing roads in the Project area.

Table 5.36 Loss of access to family and social infrastructure

Impact	Loss of access to family and social infrastructure.			
Impact type	Negative	Positive	Neutral	
	The impact is negative.			
Impact type	Direct	Indirect	Induced	
	Indirect.			
Impact Duration	Temporary	Short-term	Long-term	Permanent
	The impact from the loss of access to family and social infrastructure is permanent, since the closure of 126 hectares will result in the elimination of existing roads used by the local population for access to residential areas and social infrastructure.			
Impact extent	Local	Regional	International	
	Local, project ADI.			
Impact scale	High, since all the existing roads within the ADI will be lost.			
Impact frequency	Once at the start of the project construction phase.			
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Medium			
Sensitive recipients	Low	Medium	High	
	Recipient sensitivity is considered average.			
Impact significance	Negligible	Minor	Medium	Major
	Medium			

Mitigation Measures

- Together with the community leaders and State administrators at the local level, map the principal residential areas and social infrastructure reached through existing roads in the Project Footprint Area; and

- Construct footpaths, which may also be used by bicycles and motorcycles, on the perimeter of the Project Footprint Area to permit easy access to those areas.

Residual impact

The significance of the loss of access to family and social infrastructure is largely attributable to the restricted access caused by Project Footprint Area. This impact will be permanent and will occur at the start of the Project construction phase. The measures proposed above reduce the magnitude and significance of the impact, rendering it negligible.

5.9.12 Increase in cases of sexually transmitted infections and of HIV-AIDS

The increase in sexual contact with sex workers and heterosexual partners, due to the presence of a contingent of the salaried labour force with permanent income levels above the local average may cause an increase in cases of STDs and HIV-AIDS.

Data collected in the health sector during field research indicated that in 2014 a total of 5,275 patients were registered on the Anti-Retroviral Treatment (ARVT) system, of which 4,841 individuals were aged 15 or over and 3,400 were females (refer *Table 3* of *Appendix II*).

Despite general knowledge of STDs and the ways of preventing them, the risk of the spread of STDs and HIV/AIDS is aggravated by the insufficient knowledge of at least one sexual partner, or the difficulty of imposing or demanding preventive behavior of a sexual partner. This can result in high risk sexual contacts.

Table 5.37 Increase in cases of sexually transmitted infections and of HIV-AIDS

Impact	Increase in cases of sexually transmitted infections and HIV-AIDS.				
Impact type	Negative	Positive	Neutral		
	The increase in cases of sexually transmitted infections and HIV-AIDS is a negative impact.				
Impact type	Direct	Indirect	Induced		
	Indirect.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Temporary.				
Impact extent	Local	Regional	International		
	Local. In the city, towns, villages and districts populated by workers contracted for the Project.				
Impact scale	High.				
Impact frequency	Continues during the project construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Medium				
Sensitive recipients	Low	Medium	High		
	Recipient sensitivity is considered average.				
Impact significance	Negligible	Minor	Medium	Major	
	Medium				

Mitigation Measures

- Hold talks or informal sessions, post signs and distribute brochures, with a view to raising the awareness of workers as to the ways and HIV/AIDS can be transmitted, including through risky behavior. Provide an approach to the risks associated with the disease, based on clear and easily understood language and recourse to personnel properly qualified for that purpose;

- Advise workers to submit to voluntary HIV testing;

- Workers should be encouraged to submit to STD treatment in the initial phases of the Project, to minimize the risk of HIV infection;

- Supply free contraceptives at the worksite;

- Workers must be directed to the temporary clinic for the early treatment and monitoring of opportunistic infections such as coughs, flu or pneumonia;

- Establish and implement a code of conduct for workers on the Project or subcontracting companies, which must include, among other aspects, the promotion of safe sexual contact and the discouragement of prostitution; and

  Establish partnerships with the healthcare sector, NGOs, community-based organizations, religious denominations and other organizations to hold talks (at schools, districts and church facilities, for example) to raise awareness of the ways of transmitting and preventing STDs and HIV/AIDS, including through risky behavior. As above, provide an approach to the risks associated with the disease, based on clear and easily understood language and recourse to personnel properly qualified for that purpose.

Residual impact

The significance of the increase in cases of sexually transmitted infections and HIV-AIDS is largely attributable to the probability of sexual contacts with sex workers and heterosexual partners due to the presence of a contingent of the labour force in the Project Area. The mitigation measures proposed above significantly reduce the magnitude and significance of the impact. Implementation of these measures will result in an impact of negligible significance.

5.9.13 Establishment/ increase of prostitution and child abuse

The standard of living of the labour force contracted by the Project in general and the lifestyles of the expatriate and domestic work force coming from outside the Project ADI may increase the population of sex workers in the Project area. There may also be an increase in the cases of the sexual abuse of minors.

Table 5.38 Establishment/ increase of prostitution and child abuse

Impact	Establishment/ increase of prostitution and child abuse			
Impact type	Negative	Positive	Neutral	
	The establishment / increase of prostitution and child abuse is a negative impact.			
Impact type	Direct	Indirect	Induced	
	Indirect.			
Impact Duration	Temporary	Short-term	Long-term	Permanent
	Permanent during the construction phase.			
Impact extent	Local	Regional	International	

	Local.				
Impact scale	High.				
Impact frequency	Continuous during the construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Medium				
Sensitive recipients	Low		Medium		High
	Medium.				
Impact significance	Negligible	Minor	Medium		Major
	Medium				

Mitigation Measures

- Promote awareness through talks with contracted workers and subcontracted companies on issues of HIV AIDS and prostitution, and criminal penalties for child abuse;

  Establish partnerships with NGOs, community-based organizations, religious denominations and other organizations (through talks at schools, church districts for example) and other activities to raise awareness and advise women and girls about prostitution. In addition raise awareness among residents as to the need to anonymously report cases of child abuse to the local authorities; and

- Advice and orientation activities should include a component on STDs and HIV/AIDS.

Residual impact

The significance of the establishment of / increase in prostitution and child abuse is largely associated with and attributed to the appearance of sex workers in the Project area, as well as from other parts of the district and province. The aforementioned mitigation measures reduce the magnitude of the impact. With their implementation the impact significance is negligible.

5.9.14 Increase in criminal activity and other deviant behavior (alcoholism and drugs)

The existence of 250 Project workers, as well as the presence of subcontractor companies, and the increase in small businesses associated with Project, will result in an increase in the number of individuals with money to spend on consumer products, clothing and the acquisition of goods and equipment of value for their homes. There will also be goods of higher value in circulation in the local economy, such as vehicles, machinery and various types of equipment.

Overall, these aspects may lead to an increase in criminal activity in the area, either by attracting outside individuals connected to illegal activities, or

through deviant behavior on the part of the local population, such as alcohol and drug abuse, theft and embezzlement, and physical attacks.

This impact may have a greater dimension due to the Project's location in the city of Mocuba, where there is a concentration of a number of people coming from various parts of the district and province, and the fact that worker lodging will be accommodated in the city and not in separate, closed areas such as a workers camp.

Table 5.39 Increase in criminal activity and other deviant behavior (alcoholism and drugs)

Impact	Increase in criminal activity and other deviant behavior (alcoholism and drugs)				
Impact type	Negative	Positive	Neutral		
	This impact is negative.				
Impact type	Direct	Indirect	Induced		
	The impact is indirect, caused by the living conditions and lifestyles of the contracted labour and the small and medium-sized companies associated with the Project, which may contribute to the increase in criminal activity and deviant behavior.				
Impact Duration	Temporary	Short-term	Long-term	Permanent	
	Permanent during the construction phase.				
Impact extent	Local	Regional	International		
	Local. In the city, towns, villages and districts populated by workers contracted for the Project.				
Impact scale	High.				
Impact frequency	Continuous during the construction phase.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Sensitive recipients	Low	Medium	High		
	Medium.				
Impact significance	Negligible	Minor	Medium	Major	
	Moderate.				

Mitigation Measures

- Promotion of awareness talks among workers contracted by the Project and subcontracted companies on issues of alcoholism and drugs and prohibiting this behavior;

  Raising awareness, at meetings with the State authorities, of the need for the police sector to control public and citizen safety, This should take into consideration the actual conditions created by the Project in terms of new residents, ensuring the control and combat of criminal activity and taking measures to strengthen the local police force;

- Involving local community structures in identifying suspicious individuals/situations locally and reporting them to the competent authorities and creating channels of communication between the two levels of authority; and

- Establishing partnerships with NGOs, community-based organizations, religious denominations and other organizations, in order to raise awareness of these issues and provide advice to residents in the towns and schools, and to Project workers and subcontracted companies, as to the harmful effects of alcohol and drugs.

Residual impact

The significance of the increase in criminal activity and other deviant behaviors (alcoholism and drugs) is associated with the increase in small consumer product businesses associated with the Project (related to clothing and goods and equipment of value). New, consumer driven lifestyles may result in deviant behavior on the part of the local population. This impact will be permanent.

The mitigation measures mentioned above however significantly reduce the magnitude of the impact, resulting in an impact of negligible significance.

5.10 ARCHAEOLOGICAL, HISTORIC, ETHNOGRAPHIC AND CULTURAL HERITAGE

Desktop studies and the field inspection revealed that no cultural (archaeological, historic, ethnographic or spiritual) heritage of any type occur in the Project Area. Therefore, there was no need to conduct a quantitative or qualitative assessment of the impacts associated with archaeology, ethnography and cultural heritage.

6 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is focused on the management of the main environmental, socio-economic and health impacts identified in each project phase. The EMP identifies a set of measures, with responsibilities for each mitigation proposed.

6.1 SCOPE AND OBJECTIVES OF THE ENVIRONMENTAL MANAGEMENT PLAN

The EMP is regulated by a series of laws, namely the Constitution of Mozambique, the Environment Law (Law No. 20/97, of October 1st) and the Environmental Impact Assessment Regulations (Decree No. 45/2004, of September 29th, with amendments introduced by Decree No.42/2008, of November 4th).

The objective of the EMP is to ensure that the project activities are exececuted in a environmentally and socially responsible manner.

The plan presented here has the specific objectives of establishing practical procedures for the mitigation of negative impacts expected and significant. It shall also address and identify actions, responsibilities and monitoring measures of the key issues, including social aspects related to the health and safety of all collaborators and people involved in the project, in order to ensure that his activity is developed in a sustainable way.

In all, this document shall answer the following objectives:

- Supply Scatec Solar clear and mandatory instructions relative to their environmental responsibilities in all phases of the project; and

- Give the Ministry of Land, Environment and Rural Development (MITADER) a tool that helps assess the proposed measures to minimize the studied impacts, taking into account the national environmental legislation, specifically related to the project.

6.2 ENVIRONMENTAL POLICY AND LEGAL FRAMEWORK

In accordance with the operational policy of the company:

"Scatec Solar is composed of several operational divisions, each of them considered a specialist in its respective field.

Each aspect of its sustainable development integrated with success its collaborators, installations and infrastructures in a firm network capable of offering solutions for the management of residues that are really holistic. The

solutions are based on proven systems and practices, that are simultaneously cost efficient and environmentally correct."

It should be underscored that Chapter 3 of the SEA presents the legal framework of the project.

6.3 *ENVIRONMENTAL MANAGEMENT STRUCTURE*

The organizational structure for the environmental management of the Project identifies and defines the responsibilities and authority held by the various organizations and individuals involved in the Project. The Project will possess an organizational structure and associated personnel sufficient to assure the required standards of environmental performance are attained.

6.3.1 *Organizational Structure and Responsibilities*

Responsibilities of MITADER

MITADER is the entity responsible for coordinating all environmental activities at the national level and is therefore the main driver for promoting environmental and social sustainability in all projects and for all national resources.

This entity will have the responsibility to establish, via the application of new legislation, the standards of acceptance for relevant environmental indicators and shall coordinate, assess and monitor the set of measures and actions proposed in the EMP. When MITADER deems necessary Project proponents will be required to submit to environmental audits.

Responsibilities of the Proponent – Scatec

Scatec commits to ensuring that the Project is developed in accordance with the recommendations provided in Social and Environmental Impact Assessment Report and always guided by respect for environmental components. All operations shall be managed so as to ensure the protection of the environment, health and safety of the workers, and of all other stakeholders in the Project.

Scatec shall:

- Adopt this Environmental Management Plan (EMP), respecting and practicing the recommendations contained herein;
- Assume general responsibility for the implementation of the EMP, ensuring accordance with any legal and contractual requirements;
- Ensure that any issue which is not in compliance with the EMP is completely corrected through the implementation of corrective measures;

- Convey the EMP to all parties involved in the activity including contractors, subcontracted companies and workers in general;

- Ensure that the relationships between Project stakeholders occurs in accordance with the principles of cordiality and mutual interest expected in Mozambican legislation;

- Assure that managers, supervisors, workers and visitors are informed of safety, health and environment requirements; and

- Monitor and assess the performance of contractors, subcontractors and workers in general so as to ensure the protection of the environment, and the health and safety of employees and subcontractors.

Responsibilities of the Contracted Contractor

The contractor hired to perform the activities related to the construction of the power plant, as well as its decommissioning, shall fulfill the following duties:

- Ensure a connection with Scatec's representatives and answer before them on all issues that are pertinent to the implementation of the EMP;

- Implement mitigation measures stated on the present Environmental Management Plan (EMP) and carry out operational techniques and methods to guarantee compliance with it. The contractor shall make all efforts to minimize environmental damage, control residues, avoid pollution and all other aspects that may endanger the environment;

- Organize work plans, transportation logistics and the necessary equipment to perform the activities, in a manner that is in conformity with environmental requirements;

- Prevent or minimize the occurrence of accidents and incidents that may cause damage to the environment;

- Comply with environmental audits carried out by Scatec and by relevant government entities, and always supply the necessary information to facilitate the audits;

- If government authorities consider that operational activities developed by the contractor cause damage to the environment, the contractor shall consult Scatec and the competent authorities to reach consensus on the minimization measures to be implemented. The agreed measures shall be implemented as soon as possible in order to avoid subsequent damage, and repair any damage that may have occurred; and

- Ensure the contracting of personnel with experience and a high sense of responsibility to address issues and activities related to the environment, health and safety.

Responsibilities of the Environment and Safety Supervisor

The Environment and Safety Supervisor assigned to the Project has the following responsibilities:

- Certify the compliance with the measures set in the Environmental Management Plan (EMP) and report to Scatec and to MITADER whenever necessary on the degree of implementation of the EMP;
- Ensure that the companies subcontracted during the construction and operation phases be informed and take responsibility for the application of the recommendations presented in the EMP;
- Ensure that the power plant has an Emergency Response Plan;
- Certify that the power plant is equipped to fulfill the Environmental Management Plan (EMP);
- Ensure and facilitate permanent links between relevant institutions, such as MITADER among others;
- Provide monthly reports that include the assessment of the compliance with the EMP, which shall be delivered to Scatec and MITADER;
- Generate an Environmental Management Report at the end of each phase of the project, providing an account of the degree of compliance of the recommendations presented in the EMP; and
- Establish the procedures for collection and forwarding of complaints presented during the construction and operation phases.

6.3.2 Procedures, Coordination and Reports

The structure of all communications, correspondence and delivery of reports between the stakeholders in the project shall be defined at the beginning of the Project with the contractors.

All records of monitoring results, monitoring reports, records of incidents and audit reports shall be maintained by Scatec.

All requirements for the presentation of reports shall be agreed at the beginning of the Project with the contractors.

6.4 MEASURES AND MONITORING OF ENVIRONMENTAL MANAGEMENT

This section presents the main impacts identified for the environmental and social aspects associated with the Project and the mitigation measures recommended to manage those impacts.

For each phase of the Project, the measures for the control and/or mitigation, management and monitoring are presented together with the specific actions necessary to implement those measures, as well as deadlines and means of verification.

7 ENVIRONMENTAL MANAGEMENT PLAN

Table 7.1 Measures for the Minimization and Responsibilities

Impact	Mitigation and Management Actions	Project Phase	Responsibility
Impacts on air quality from dust emissions during construction	• Locate machinery and dust causing activities away from sensitive receptors; • Provide site hoarding panels or fences along the Project site boundary and on work fronts; • Control the height of unloading of fill materials during filling as much as possible. Where possible, this should be below the height of the hoarding around the Project Site boundary • Completely wrap any containers for transportation of materials in order to prevent the generation of dust; • Construction residues shall be appropriately managed by enterprises certified for that work; • Keep stockpiles for the shortest possible time; • Ensure there is the maximum possible distance between soil and dusty material stockpiles and receptors; • Cover all stockpiles of dusty materials such as excavated soils, dredged materials, and filling materials to avoid fugitive dust emissions; • Use water as a dust suppressant; and • Waste from construction should not be burned.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Impacts on air quality from vehicle exhaust emissions on local road network	• Minimize movement of construction vehicles and enforce a speed limit around the construction site; • Where available, use ultra-low sulfur diesel (ULSD) in heavy transport vehicles and diesel powered equipment; • Ensure hard surfacing and effective cleaning of haul roads; • Vehicle / equipment air emissions should be controlled by adopting simple good practice procedures (such as turning off equipment when not in use); and • Vehicle / equipment exhausts observed to be emitting significant	All phases	**EPC (Engineering, Procurement and Construction) contractor**

Impact	Mitigation and Management Actions	Project Phase	Responsibility
	black smoke in their exhausts should be serviced; • Ensure no site run off of water and mud occurs; and • Provide wheel washing facilities for vehicles entering and leaving the site; and • All loads entering and leaving the site to be covered.		
Impacts on air quality from exhaust emissions from Non Road Mobile Machinery (NRMM) on site	• Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NOx, PM_{10} and SO_2; and • All non-road mobile machinery to use ultra-low sulfur diesel where available.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Geologic changes resulting from earthworks	• Reduce excavation and earth movements during rain periods; • Reinforce support capacity of unstable/soft land.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Change in permeability of soil, support capacity and dynamics of subsoil water	• Maintain permeable areas within the Project Area to allow for the recharge of aquifers;	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Change in permeability of soil, support capacity and dynamics of subsoil water	• Maintain permeable areas (green areas) within the Project Area to allow for the recharge of aquifers; and • Paved locations should be restored to their initial condition.	Operation and decommissioning phases	**Proponent**

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Increase of traffic from the movements of vehicles and disturbance of communities close to the access road	• Reduce and control heavy and light vehicle circulation speed (allocated to the project) on the access routes used for installation of the project; and • Devise a periodic maintenance program of vehicles to check their operating conditions.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Emission of noise associated to machines / equipment for construction and disturbance of nearby communities	• Implement a communication plan during construction activities, providing sensitive receptors with information about the possible disturbances that may occur; • Reduce and control heavy vehicle speed on routes used to access the Project and on routes located near residential settlements. • Prepare a program of the work to be performed, when near sensitive receptors noisy activities will be restricted to between 18h00 and 07h00 and on Sundays and holidays. The noisiest operations should also be performed during daylight periods when they cause the least disturbance; • Periodic preventive maintenance of machines and equipment must be undertaken to verify their operating conditions; • Whenever work is performed at distances of less than 150 meters from residences, isolation panels shall be used to screen the work, in order to reflect part of the noise emitted by operating equipment; and • Devise a monitoring plan for noise and undertake monitoring surveys for noise produced at the worksite, whenever this takes place near populated areas.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Emission of noise associated with project operation	• Devise a periodic maintenance program for machines and equipment associated with the operation of the Project to check their operating conditions; and • Undertake monitoring surveys relating to the noises produced by operation activities.	Operation Phase	**Proponent**

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Loss of landscaping structure by clearance of vegetation on the land	• The vegetation, bushes and trees, existing in the areas not disturbed by earthmoving shall be protected, in order not to be affected by the location of the worksite, stockpiles of materials, personnel camps/quarters and other, and by the movement of machines and vehicles; and • Temporary stockpiles shall be installed in places where they do not interfere with the existing tree cover.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Alteration of the landscaping structure by the installation of worksite, support infrastructures and accesses	• Conceal the worksite and the machinery park with adequate plant barriers or screens; and • The existing access routes should be used and, inside the site and on the accesses to the site, vehicle circulation areas shall be limited in order to reduce the area of soil subject to compaction.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Earthmoving	• Topsoil shall be stored in stockpiles, of trapezoid shape, narrow and long, with the top slightly convex to allow a good infiltration of water, and shall remain in areas adjacent to those where the soil will later be applied. The accumulated topsoil shall not be stepped on or compressed; • Periodic spraying of water must be undertaken in areas where earthmoving will take place or over which vehicles will move, particularly during the summer period, in order to reduce the deposition of dust and other materials on vegetation and on other surrounding elements; and • The Project should be adapted and integrated as much as possible to the morphology of the land so that once finished Project works will be reduced from the view of surrounding visual receptors.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Alteration of the landscaping structure by the installation of the power plant, equipment and accesses	• Perform landscape integration by partially or totally shielding infrastructures using planting models to reduce apparent scale geometrism and volumetric and chromatic visual contrast.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor**
Landscaping integration of the project	• The Green Structure shall be correctly and thoroughly implemented, with control of the quality of materials used and of the work to be performed; and • In affected areas assigned for landscaping rehabilitation, the soils used shall be first deeply ploughed and reconstructed as much as possible for structure and balance.	Construction and Operational Phases	**EPC (Engineering, Procurement and Construction) contractor**
Deployment of new built-up structures, infrastructure, equipment, roads and vehicle parking	• Electric light emissions will be integrated through the use of vegetation, so as to avoid long range nocturnal visibility that could affect neighboring natural environments and residential areas; and • Adapt urban design to the natural geographic characteristics of the land.	Construction and Operational Phases	**EPC (Engineering, Procurement and Construction) contractor**
Implementation of a green structure	• Areas to receive plant cover shall be maintained, in order to ensure the preservation of plant cover and land stabilization.	Operation Phase	**Proponent**

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Loss of Habitat and Trees	• Develop a safe procedure for the translocation of animals, documenting with testimony (photos) those animals translocated.	All phases	**EPC (Engineering, Procurement and Construction) contractor** (Environmental Control Officer)
	• Encourage an awareness of biodiversity and the natural environment among staff and contractors through awareness programs.	All phases	**EPC (Engineering, Procurement and Construction) contractor** (Environmental Control Officer and Training Manager)
	• Allow the movement of lesser fauna in and out of the site by installing underpasses in perimeter fencing.	All phases	**EPC (Engineering, Procurement and Construction) contractor** (Environmental Control Officer)
Potential Impacts to Birds	• Make the site locally unattractive to birds through removal of trees and ephemeral pans of water	Construction and Operational Phases	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control Officer)
	• Design power lines to be raptor friendly, namely made of wood.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control Officer)

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
	• Monitor bird losses including identification and sharing of records with Birdlife SA.	All phases	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control Officer)
Infestation of Alien and Invasive Plant Species	• Maintain grass in a short cropped state through mowing and/or controlled grazing by livestock.	All phases	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control & Gardening Services Officer)
	• Maintain the project site in a weed free state.	All phases	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control & Gardening Services Officer)
Contamination of Aquatic Environments	• Facilitate infiltration of rain water by means of stable grass cover.	All phases	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control Officer)

Impact	Mitigation and Management Actions	Phases of the Project	Responsibility
Management of residue and toxic products	• Ensure that during the use of toxic products, all workers are duly protected through the use of appropriate personal protection equipment; and • Contract a suitably licensed company or entity to undertake the removal and recycling of all components made of toxic materials (solar panels, batteries and inverters).	All phases	**EPC (Engineering, Procurement and Construction) contractor & Proponent** (Environmental Control Officer)

Impact	Mitigation and Management Measures	Phases of the Project	Responsibility
Loss of farmed areas and of fruit trees and consequent reduction of food safety and subsistence levels	• Design and implement a compensation plan for the loss of land used for agriculture and the planting of fruit trees; and • Design and implement a restoration plan for the loss of subsistence practices that takes into consideration: (1) Household vulnerability (2) The timely allocation of land.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Loss of auxiliary infrastructure	• Design and implement a plan to compensate for the loss of identified auxiliary structures	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Conflicts and social tension from the competition for the access to jobs	• Define and implement policies and procedures for hiring labor that gives priority to local and provincial job seekers; • With respect to unskilled labour complete priority must be assignedto individuals living in the towns, villages and districts neighboring the Project Footprint Area, including priority to the neighbourhood of Mugonga, the settlement of Muandiua, and village of Bive; • For semi-skilled labour priority must be assigned to individuals living in the municipality and villages neighboring the Project Area, only resorting to the recruitment of individuals from neighboring districts and the city of Quelimane in the event that jobs are not filled; • The hiring of unskilled and semi-skilled labour must involve the participation of the community leaders;	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**

Impact	Mitigation and Management Measures	Phases of the Project	Responsibility
	• When hiring skilled labour, priority must be assigned firstly to the municipality and areas neighboring the Project, then to neighboring districts and finally to the city of Quelimane; • Practices of hiring at the "project door" must be avoided. At least two hiring sites must be established: one located in the village of Bive, and another in Quelimane (for skilled labour only); • The hiring policy and procedures must be disclosed to the local State and community leaders; • Establish a system of coordination with local State and community leaders in order to monitor the process and introduce corrections when necessary; and • Gender equality must be taken itno account in recruitment processes.		
Conflicts and disturbance of community and family organization due to the presence of a contingent of wage earners	• Schedule periodic meetings with the local State and community leaders to analyze issues concerning the relationship between workers hired within the scope of the Project and the local community; • Organize the induction of each expatriate worker or worker arriving from other parts the country, to inform them of the local social organization and culture, emphasise expected standards of behavior and attitudes and behaviors to be avoided due to the high level of conflict they could cause; and • Periodically organize talks with all workers to raise their awareness around showing respect to the local community, its culture and habits, in order to avoid conflicts.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Increase of taxes and of fiscal income of the State	• Subcontract domestic companies with an adequate fiscal regime and fiscal headquarters in the Province of Zambezia.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Opportunities for local and regional economic development	• In meetings with municipal, district and provincial authorities, and with the business community: – Disclose the business opportunities associated with the Project; – Increase the awareness of State authorities in creating a	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**

Impact	Mitigation and Management Measures	Phases of the Project	Responsibility
	business environment that facilitates and enhances the competitiveness of the local and national business sectors (province, district, municipality) • Whenever possible, subcontract domestic companies with particular emphasis on those established in Zambezia Province and Mocuba District and City; and • The Project and the subcontracted companies must give priority to the establishment of contracts for the provision of services and supply of products to domestic SMEs established in Zambezia Province and in Mocuba District and City.		
Creation of jobs and improvement of life conditions	• Disclose the policy and procedures for recruiting domestic labour and employment opportunities to local State and community authorities; • Define a policy and procedure for recruiting domestic labour that assigns priority to the local population in accessing unskilled jobs, and whenever possible, skilled and semi-skilled job opportunities; • Establish with the local State and community authorities a mechanism that assigns priority to residents of communities neighboring the Project in terms of access to unskilled jobs; • Distribute employment opportunities equally between men and women; • Raise the awareness of, and coordinate with, the relevant State authorities to establish quick and easy mechanisms for allocating civil and tax identification documents to selected job candidates; and • Establish a system of coordination with local State and community leaders in order to monitor the process and introduce corrections when necessary.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Loss of access to natural resources available in the Project Footprint Area and bordering areas	• Together with the community and State leaders at the local level, map the main areas located in neighboring regions that were used for the collection of natural resources and which were reached through existing roads inside the Project Area; and • Construct footpaths, which may also be used by bicycles and motorcycles, on the perimeter of the Project Area to permit easy access to natural resources.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**

Impact	Mitigation and Management Measures	Phases of the Project	Responsibility
Risk increase of vehicle accidents on roads and access routes	• Subcontract transport companies licensed to transport merchandise with experienced drivers and professional driver and professional service licenses; • Organize training courses for drivers of contracted companies on topics of road safety and defensive driving (mandatory short-term courses); • Set speed limits for Project vehicles or subcontracted companies driving on non-classified roads and on the access road to the Project Area; and • Hold talks on road safety in the schools, and in the centers of towns, villages and districts in the vicinity of the access road to the Project Area.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Increased pressure on the use of public and private services	• Present the Project to the municipal, district and province authorities and business community, identifying the main services that could experience increased demand, and discuss how they can adjust to this demand; and • Establish agreements with the health sector for the transfer of serious cases and inpatients to the Province Hospital.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Loss of access to family and social infrastructures	• Together with community leaders and State administrators at the local level, map the principal residential areas and social infrastructure previously reached through existing roads in the Project Area; • Constructing footpaths, which may also be used by bicycles and motorcycles, along the perimeter of the Project Area to permit easy access to natural resources.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Increase of cases of infection and sexual transmission of HIV AIDS	• Establish partnerships with the health care sector, NGOs, community-based organizations, religious denominations and other organizations through holding talks (at schools, districts and church facilities, for example) in order to raise awareness about the transmission and prevention of STDs and HIV/AIDS, including through risky behavior. This should provide an approach to manage the risks associated with the disease, based on clear and easily understood language and recourse to personnel properly qualified for that purpose;	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**

Impact	Mitigation and Management Measures	Phases of the Project	Responsibility
	• Hold talks or informal sessions, in addition to posting signs and distributing brochures, with a view to raising the awareness of workers around the contraction of STDs and HIV/AIDS, including through risky behavior. Provide an approach to manage the risks associated with the disease, based on clear and easily understood language and recourse to personnel properly qualified for that purpose; • Advise workers to submit to voluntary HIV testing; • Provide a free supply of contraceptives at the worksite; • Workers must be directed to the temporary clinic for the early treatment and monitoring of opportunistic infections such as coughs, flu or pneumonia; and • Establish and implement a code of conduct for Project workers and subcontracted companies, which must include, among other aspects, the promotion of safe sex practices and the discouragement of prostitution.		
Establishment/ increase of prostitution and situations of abuse of minors	• Establish partnerships with the health care sector, NGOs, community-based organizations, religious denominations and other organizations through holding talks (at schools, districts and church facilities, for example) in order to raise awareness and advise women and girls about prostitution; – Advising and orientation activities should include a component on STDs and HIV/AIDS; • Establish partnerships with NGOs, community-based organizations, religious denominations and other organizations to raise awareness among residents as to the need to anonymously report cases of child abuse to the local authorities; and • Promote awareness among workers contracted by the Project and subcontracted companies on the issues of HIV AIDS and prostitution, and criminal penalties for child abuse.	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**
Increase in crime and other deviant behaviors (alcoholism and drugs)	• At meetings with the State authorities, raise awareness around the need to control and combat criminal activity and take measures to strengthen the local police force and for the police sector to enhance public safety, taking into consideration the actual conditions created	Construction Phase	**EPC (Engineering, Procurement and Construction) contractor & Proponent**

Impact	Mitigation and Management Measures	Phases of the Project	Responsibility
	by the Project such as the arrival of new residents; • Involve local community structures in identifying suspicious individuals/situations locally and in reporting them to the competent authorities. In addition create channels of communication between the two levels of authority (community and government); and • Establish partnerships with the health care sector, NGOs, community-based organizations, religious denominations and other organizations through holding talks (at schools, districts and church facilities, for example) in order to raise awareness and provide advice to residents in the towns and schools, and to workers contracted by the Project and subcontracted companies, as to the harmful effects of alcohol and drugs.		
Opportunities for local and regional economic development	• Together with the managers of the Special Economic Zone (ZEE) and EDM, organize meetings with the Government and the private sector in the provinces of Zambezia, Nampula, Cabo Delgado and Niassa, in order to publicize the Project and convey the opportunities that exist for development initiatives based on renewable energy; • Capacitate State authorities to enable them to create a business environment that facilitates and enhances the competitiveness of national and local businesses, in order to attract international companies to establish themselves in the provinces of Zambezia, Nampula, Cabo Delgado and Niassa.	**Operation**	**Proponent**

8 CONCLUSIONS

The present Simplified Environmental Study (SES) covers the proposed construction and operation of a solar PV plant with an electric generating capacity of approximately 30 MW AC. The plant will be located in the locality of Mogonda, Administrative Post of Mocuba Sede, District of Mocuba, Province of Zambezia, in Mozambique.

The Sponsors of the project (Scatec Solar, EDM and Norfund) developed a joint accord for the construction and operation of the solar PV plant which will operate under a Power Purchasing Agreement (PPA) for 25 years where EDM will be the sole off-taker.

An undertaking like this always produces changes in the several elements that compose the environment, and these changes can, in the majority of cases, be minimized by means of a set of mitigating actions which can be adopted during the construction and operation of the project.

Based on the impact assessment performed in the Simplified Environmental Study (SES), the impacts of the Project as well as their significance were presented and described. This exercise identified the mitigation measures for the impacts and culminated in the preparation of an Environmental Management Plan for the main issues identified. This plan includes requirements for management on site of the environmental and social aspects, during the construction, operation and decommissioning of the Project.

The main negative impacts identified are related to the following aspects:

- Occupation of 126 ha of area presently used for farming plots (machambas);
- Potential erosion due to clearing of vegetation and potential increase of sediment in water lines near the site;
- Impeding the movement of people due to the fencing of the site;
- Change to the local landscape due to the existence of "strange" new infrastructure;
- Impacts on animals that presently use the project area (mainly birds);
- Changes to the air quality and noise baseline, and
- Potential traffic accidents due to construction traffic.

As for the positive impacts resulting from the implementation of the project, these relate mainly to the social component of the project and includes the creation of jobs and the improvement of the local economy through the

empowerment of the services, the higher movement of people to the area and an increase in the State's fiscal income. Another aspect to consider is the reduction of greenhouse gasses associated with the production of electricity by a solar PV plant.

The Environmental Management Plan (EMP) contains the main mitigation measures to minimize identified impacts. The proposed mitigation measures include:

- Prioritize local labour for contracting people to work on the project;
- Prepare a compensation plan for people affected by the occupation of their farming plots by the project;
- Control construction noise so it will minimally interfere with neighboring communities by not producing noise during the night and on Sundays and holidays;
- Controlling the speed of construction vehicles; and
- Create conditions for birds to avoid the project installation site.

Due to the proximity of some populated areas, a plan was defined for the monitoring of noise, to be implemented in the construction and operation phases of the project.

Based on the evaluation of impacts and the environmental management plan that was prepared, it was concluded that there are no environmental or social fatal flaws or major impacts.

This study shall be delivered to MITADER who will provide their opinion on the assessment performed by ERM and Impacto.

Subsequent to this we expect that an environmental license for the project will be issued which will allow construction to commence.

9 IDENTIFICATION OF THE TEAM OF THE ENVIRONMENT ASSESSMENT STUDY

The technical team that prepared the study is a multi-disciplinary and experienced team from ERM Moçambique, ERM South Africa and Impacto.

ERM Moçambique is the consulting company, completely dedicated to the environmental and sustainability area, established and formally registered in Mozambique. ERM Moçambique is a subsidiary of Environmental Resources Management, an environmental consulting firm which employs more than 5000 specialists in more than 145 offices in 41 countries.

IMPACTO *(Projectos e Estudos Ambientais)* is a company recognized in Mozambique by the quality of the services rendered in the environmental area.

Below are listed the contact details for ERM and Impacto in Mozambique:

ERM

ERM International Services Ltd
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IMPACTO *(Projectos e Estudos Ambientais)*
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Table 9.1 EAS Team

Position	Name
Managing Team	
Director of the Project	Henry Camp
Director of Project resident in Mozambique	Paula Gonzalez
Manager of the Project	Stephan van den Berg
Manager of Project resident in Mozambique	Ricardo Costa Pereira
Manager of Project (Impacto)	Luciana Santos
Specialists	
Climate and Air Quality	Rachel Conti
Geology and Geomorphology	Décio Camplé
Soils	Marine Pienaar
Noise	Martha Silva
Landscape	Susana Serra
Surface Water	DP van der Merwe
Biological Aspects	Andrew Cauldwell
Social Aspects	Bento Salema Rosa Luís
Archaeology	Leonardo Adamowicz
Compensation	Victor Hugo Nicolau
Public Participation	Felicidade Salgado Sandra Fernandes
Support Team	
GIS	Andrew Thurlow and Lourenço Covane
Quality Control	Susana Serra and Stephan van den Berg
Administration and Logistics	Sonia Tavares and Jose Fosse

10 REPORT OF PUBLIC CONSULTATION

In the letter from PDCA (when they categorized the project) it was recommended that meetings and community consultation be undertaken to avoid the emergence of conflict with the communities that presently use the desired area. The DPCA stated that the aim of these meetings should be to clarify the objectives of the project and the methods which will be used to the improve the situation in the area.

A stakeholder engagement plan was prepared and a database of Interested and Affected Parties was also compiled. This plan described how effective the consultation should be with the affected groups, NGOs and local communities, and describes the documentation used during consultation with the local affected population.

The plan specifies the locations of the consultation, means of communication, dates, responsibilities, etc.

Advertisements in Portuguese were placed in local newspapers to ensure the information reached the interested and affected parties. A tour of public consultation meetings was done in Mocuba district for the presentation of the environmental assessment.

A report on te public consultation and project information meeting accompanies this document and should be consulted for more details of the process.

10.1 SIMPLIFIED PLAN FOR COMPENSATION AND LAND USE

ERM / Impacto performed a census and asett survey jointly with the local authorities (Department of Agriculture, Registration and e Regulo Administration of Bivi) and a survey of properties involving all the family households including agriculture zones, fruit trees, housing and/or auxiliary structures in the project area. During the period from August 23rd to September 11th a census and a detailed inventory of properties was performed, to define the individual compensation packets to be ascribed.

The team was composed of a socio-economic specialist, an assistant and trained interviewers. Questionnaires were distributed to all families who owned agriculture fields, trees, plants and/or physical structures within the limits of the site.

A detailed inventory of the affected family households (e.g., number, age, sex, education and health, economic situation and subsistence) and of their property (e.g., housing structures, auxiliary infrastructures, trees, agricultural land and farmed crops, livestock, etc.) was prepared and vulnerable groups were identified in the affected population.

A simplified Compensation and Land Use plan was developed, which describes the institutional framework for the implementation of the compensation and defines the compensation process and the paperwork and responsibilities of different agencies in this process. This document is an attachment to the Simplified Environmental Study and will also be shared with the local authorities for its validation or authentication. The plan makes recommendations about the consultation, participation, methods and processes with the affected family households, as well as other interested and affected parties.

The plan includes a complaint management system where issues and concerns raised by affected family households and other interested parties will be treated in a culturally appropriate manner and with easy access, transparent, constructive, opportune and confidential. The system also supplies mechanisms for the registration of complaints and includes a follow-up mechanism to assess the response capacity to the resolution of complaints. The plan also includes a calendar for the execution, clearly defined tasks, task integration and execution times.

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Appendix I

Project Characterization Letter (DPCA)

REPÚBLICA DE MOÇAMBIQUE
GOVERNO DA PROVINCIA DA ZAMBÉZIA
DIRECÇÃO PROVINCIAL PARA A COORDENAÇÃO DA
ACÇÃO AMBIENTAL

À: Empresa ERM

Maputo

N/Ref 366/GD/DPCAZ/09/2015 V/Ref /DEP/2015

Data:09/07/2015 Data: / /2015

Assunto: Parecer ambiental

Junto se envia o relatório de Pré- avaliação ambiental realizada no âmbito do Projecto de Construção da Central Fotovoltaica de energia Solar de Mocuba, para os devidos efeitos.

Sem mais assunto, endereçamos as nossas cordiais saudações.-

O Director Provincial

António Osvaldo Paqueleque

/Investigador Principal /

REREPÚBLICA DE MOÇAMBIQUE
GOVERNO DA PROVINCIA DA ZAMBÉZIA
DIRECÇÃO PROVINCIAL PARA A COORDENAÇÃO DA ACÇÃO AMBIENTAL

Relatório de Pré-avaliação Ambiental

Realizou-se no dia 01 de Julho do ano de 2015 na Localidade de Mugonda, Posto Administrativo de Mocuba Sede, Distrito de Mocuba, Provincia da Zambézia, um trabalho de Pré-Avaliação Ambiental no âmbito do Projecto de Construção da Central Fotovoltaica de energia solar em parceria com a EDM-Electricidade de Moçambique para o reforço significativo do sistema de produção de energia, a fim de colocar uma linha de transporte da central até a actual subestação que abastece a cidade de Mocuba e até por vezes a Cidade de Quelimane

A equipa multisectorial era composta por três Técnicos e um motorista da DPCAZ - Direcção Provincial Para a Coordenação da Acção Ambiental da Zambézia, dois Engenheiros electrónicos da empresa Sul Africana Scatec Solar, um Técnico da Norfunde quatro influentes da comunidade (guias) da Localidade de Mugonda.

O trabalho tinha como objectivo realizar a Pré-Avaliação Ambiental de acordo com o ajuramentado no Artigo 7 do Decreto 45/2004 de 29 de Setembro (Decreto que Regula o Processo de Avaliação de Impacto Ambiental), e para tal serviram como critérios de avaliação os seguintes elementos:

1- Conhecimento prévio do local de implementação da actividade;

2- Verificação da informação de base de acordo com a ficha de pré avaliação ambiental;

3- Localização e extensão da área afectada;

4- Avaliar o número de pessoas e comunidades que serão abrangidas pelo projecto;

anexo II, é avaliado como de categoria **B**, isto é, está sujeito à realização de um EAS– Estudo Ambiental Simplificado.

Assim sendo, para dar continuidade ao processo de licenciamento ambiental, o consultor deverá elaborar um **EAS** - Estudo Ambiental Simplificado antecedido de **ToRs** - Termos de Referências a serem submetidos a esta Direcção, num total de 4 cópias em suporte de papel e uma cópia em suporte informático para a revisão e tomada de decisão.

Quelimane aos 02 de Julho de 2015

Appendix II

Terms of Reference and Approval Letter

REPÚBLICA DE MOÇAMBIQUE
GOVERNO DA PROVINCIA DA ZAMBÉZIA
DIRECÇÃO PROVINCIAL PARA A COORDENAÇÃO DA
ACÇÃO AMBIENTAL

Ao: ERM/ Impacto
Maputo

N/Ref.: 182/GD/DPCA/203/2015 Data: 25/03/2015

Assunto: **Envio do relatório**

A Direcção Provincial para a Coordenação da Acção Ambiental da Zambézia recebeu de V. Excia os TDRs do projecto Solar em Mocuba para a revisão e aprovação.

Depois da análise, a equipa técnica aprova o documento. Contudo, na fase de elaboração do EAS deverá observar todas as recomendações e constatações descritas no relatório em anexo, assim como toda a legislação em relação a este tipo de actividade.

Sem mais assunto, endereçamos as nossas cordiais saudações.-

O Director Provincial

António Osvaldo Paqueleque

/Investigador Principal /

Relatório de Revisão dos Termos de Referência (TdRs) do Projecto Solar em Mocuba

1. Introdução

O presente relatório constitui a revisão dos Termos de Referência (TdRs) do Projecto de Solar que consistira na utilização da tecnologia solar foto voltaica para gerar electricidade, situado no distrito de Mocuba.

Esforços foram envidados no sentido de trazer as observações, anotações, constatações, recomendações e outros.

2. Formação da equipa de Revisão

Para a revisão do documento constituiu-se a respectiva Comissão Técnica de Avaliação (CTA), composta pelos técnicos da Direcção Provincial para a Coordenação da Acção Ambiental.

3. Contexto dos TdRs

O presente Termo de Referencia foi realizado na fase preliminar das actividades.

4. Avaliação da Equipa de Consultores responsável pela elaboração dos TdRs

Os TdRs foram elaborados pela ERM em parceria com a IMPACTO, duas empresas de Consultoria Ambiental registadas pelo MITADER nos termos do Decreto 45/2004, de 29 de Setembro, a equipa técnica está descrita na página 10-11.

5. Comunicação dos resultados

Os TdRs cumprem com o legislado no Artigo 11 do Decreto 45/2004, de 29 de Setembro, Regulamento sobre o processo de Avaliação do Impacto Ambiental com a excepção da alinea b).

6.Constatacoes

Pág. 5-11, 2º parágrafo, refere-se que durante a fase de construção serão usados sanitários químicos. Assim, solicitamos que o estudo a ser elaborado observe todas as medidas afinentes a esta prática, para evitar que os trabalhadores fiquem expostos a estes resíduos metabólicos;

Na pág. 5-9, no que tange a fase de encerramento, no 3º período refere-se que a reciclagem dos módulos foto voltaicos e equipamentos eléctricos não será contemplado no estudo do impacto a realizar. Solicitamos que este dado seja com mais substância no estudo a ser elaborado, uma vez que o uso inadequado dos resíduos resultantes desse processo acarreta impactos negativos ao ambiente;

Pág. 6-1, 3º parágrafo, tratando-se de uma consulta comunitária, a mesma deve ser extensiva a toda população que se encontra no corredor do impacto e seus arredores, que directa ou indirectamente será afectada pelo projecto, não se subscrevendo apenas aos líderes comunitários;

Pela natureza do projecto, recomendamos que na elaboração do estudo sejam observados os seguintes aspectos:

- Emissões de produtos tóxicos durante o processo de manuseio da matéria prima para a produção dos módulos e componentes periféricos, tais como ácidos e produtos cancerígenos, além do dióxido de carbono, dióxido de enxofre, óxido de nitrogénio, e particulado;
- Ocupação da área para implantação do projecto e possível perda de habitat;
- Impactos visuais;
- Risco associado aos materiais tóxicos utilizados nos módulos fotovoltaicos (Arsénio, Gálio, Cadmio) e outros componentes, ácido sulfúrico das bacterias (incêndio, derramamento de ácido, contacto com partes sensíveis do corpo);
- Necessidade de se dispor e reciclar correctamente as bacterias (geralmente do tipo Chumbo-ácido, e com vida média de 4 à 5 anos) e outros materiais tóxicos contidos nos módulos fotovoltaicos e demais componentes eléctricos e electrónicos, sendo a vida útil média dos componentes estimada entre 20 e 30 anos.

Pag . 5.9. Mao- de –Obra (Construção) diz que não haverá nenhum acampamento de trabalhadores temporarios ou permanentes no local durante a fase de construção...serão transportados a partir de um ponto de encontro...a questao é, os trabalhadores admitidos de distitos viźinhos onde serão alojados e o material a ser utilizado onde será depositado?

7. Recomendações

- O EAS a ser elaborado deverá observar na integra o preceituado no Artigo 13 do Decreto 45/2004 de 29 de Setembro.
- Devem incluir todas as abreviaturas na lista de acrónimos:
- Na contratacao da mão –de- obra devem ter em conta a equidade do genero:

8. Conclusão

Os TDRs contêm informação suficiente para este tipo de actividades. Assim a equipa técnica de avaliação aprova o documento.

Contudo na fase de elaboração do EAS, deverá seguir todas as recomendações e constatações acima mencionadas.

9. A equipa técnica de Revisão

Nome	Categoria	Assinatura
Fátima Carlos Ernesto Mudanisse	Engª Agrónoma	
Gastão Carlos Portugal	Biólogo	
Alija Atumane Mussa	Tec. Sup. do Ambiente N1	
Felizardo Chomar	Tec. Sup. do Ambiente N1	

Quelimane, aos 20 de Agosto de 2015

Appendix III

Results of Soil Samples Analysis

NviroTek Labs

COMPANY: Terra-Africa Consult
ADRESS: P.O.Box 433
Ottosdal
2610
TELEPHONE NO: 0828283587, 0731709063

Lab No	Reference no	pH (KCl)	PBray1	K	Na	Ca	Mg	UIT H+	%Ca	%Mg	%K	%Na
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mol(+)/k	%	%	%	%
97404	M-S 01 Top Soil	5,62	1	62	6	793	106	0,00	79,04	17,29	3,14	0,52
97405	M-S 02 Sub Soil	5,28	1	22	10	451	88	0,00	73,34	23,37	1,86	1,44
97406	M-S 03 Top Soil	4,45	4	26	6	179	22	0,06	72,83	14,53	5,33	2,10
97407	M-S 04 Sub Soil	4,54	2	21	8	109	17	0,00	70,94	17,70	7,10	4,26
97408	M-S 05 Top Soil	5,01	1	24	6	339	42	0,00	79,78	16,18	2,87	1,16
97409	M-S 06 Sub Soil	5,16	1	14	9	154	24	0,00	74,10	18,63	3,45	3,82

Lab No	Reference no	Density	S AmAc	Clay	Silt	Sand	Exc Al	C	EC	S-value	Na:K	T
		g/cm3	mg/kg	%	%	%	cmol(+)/kg	%	µS/cm	cmol(+)/kg		cmol(+)/kg
97404	M-S 01 Top Soil	1,18	3,32	14	19	67	0,00	1,27	66	5,02	0,17	5,02
97405	M-S 02 Sub Soil	1,22	4,60	14	20	66	0,00	0,53	39,1	3,08	0,77	3,08
97406	M-S 03 Top Soil	1,37	7,48	6	7	87	0,00	0,55	24,6	1,17	0,39	1,23
97407	M-S 04 Sub Soil	1,27	7,67	6	9	85	0,00	0,04	19,5	0,77	0,60	0,77
97408	M-S 05 Top Soil	1,36	3,95	8	9	83	0,00	0,62	31,2	2,13	0,40	2,13
97409	M-S 06 Sub Soil	1,35	6,61	10	9	81	0,00	0,30	25,6	1,04	1,11	1,04

Lab No	Reference no	Al	Sb	As	Ba	B	Cd	Cr	Co	Cu	Fe	Pb
		g/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/kg	mg/kg
97404	M-S 01 Top Soil	8,5	<0.5	1,20	756	4	<0.5	67,00	24,50	28,30	15,50	11,70
97405	M-S 02 Sub Soil	6,3	<0.5	1,20	396	3	<0.5	33,70	21,80	22,60	11,80	11,60

Lab No	Reference no	Mn	Mo	Ni	Se	Ag	Sn	Ti	V	Zn	Zr
		g/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
97404	M-S 01 Top Soil	1,25	1,20	36,00	<0.5	<0.5	<0.5	198,00	44,1	79,9	<0.5
97405	M-S 02 Sub Soil	457,00	1,30	171,00	<0.5	<0.5	<0.5	152,00	34,2	109	<0.5

Appendix IV

Results of Water Samples Analysis

Sample No.	PO_4	SO_4	NO_3	NH_4	Cl	HCO_3
	mg/L					
Acceptable	0	-	0	0	0	-
Allowable	500	-	11	1.5	300	-
Unacceptable	600	-	20	2	600	-
Drink	<0.01	1.71	1.86	0.32	25.53	170.84
Wash	<0.01	2.20	2.48	0.29	11.34	109.83
Egaro	<0.01	1.92	2.48	0.27	32.97	134.23

Sample No.	pH	EC	TAL	TDS
		(mS/m)	*mg $CaCO_3$/L*	*mg/L*
Acceptable	5<pH<9.7	0	-	0
Allowable		170	-	1200
Unacceptable	pH<4;pH>10	370	-	2400
Drink	6.84	36.00	142.5	234
Wash	7.25	22.00	97.5	143
Egaro	7.26	32.00	110	208

	DRINK	WASH	EGARO
	ppm	*ppm*	*ppm*
Be 9	0.0005896	0.0005924	0.0005924
B 11	0.0003715	0.0004703	0.0004576
Na 23	25.92	9.116	28.27
Mg 24	13.36	3.35	8.984
Al 27	0.0003254	0.0002413	0.0002787
P 31	0.07237	0.04257	0.05103
K 39	2.741	1.96	1.38
Ca 43	16.66	23.86	13.11
Ti 47	0.008296	0.003732	0.004522
V 51	0.01039	0.006484	0.006252
Cr 53	0.03808	0.03177	0.02825
Mn 55	0.028	0.0001117	0.00006086
Fe 57	0.01251	0.02337	0.006747
Co 59	0.001684	0.001545	0.001536
Ni 60	0.0001597	0.0001591	0.0001602
Cu 63	0.0001812	0.0001658	0.0001389
Zn 66	0.004392	0.00591	0.001908
As 75	0.00001631	0.00001984	0.00001786
Se 82	0.00001327	0.000007993	0.000004912
Rb 85	0.002374	0.007201	0.004683
Sr 88	0.08252	0.07009	0.1083
Mo 95	0.00366	0.002844	0.002569
Pd 105	0.002321	0.002323	0.002158
Ag 107	0.00006087	0.01298	0.00006419
Cd 111	9.53E-07	8.36E-07	9.93E-07
Sb 121	0.004072	0.004073	0.004178
Ba 137	0.1612	0.0692	0.1132
Pt 195	0.0003266	0.0005314	0.0002865
Au 197	0.006554	0.006603	0.006526
Hg 202	0.0004553	0.0005467	0.0004665
Tl 205	0.001272	0.001272	0.001276
Pb 208	0.002887	0.002894	0.002929
Bi 209	0.01422	0.01421	0.01421
Th 232	0.006314	0.006293	0.006322
U 238	0.002134	0.001851	0.001844

Appendix V

Archaeological Prospection Coordinates

Archaeological Prospection Coordinates

Name	Dates	GPS Position	UTM	Height	Notes and/or commentaries
5	8/10/2015 12:59	S16 49 22.2 E37 01 23.8	37 K 289360 8138991	119 m	Study of a vertical profile in a pit to extract clay
6	8/10/2015 1:00 PM	S16 49 25.3 E37 01 35.0	37 K 289691 8138900	118 m	Study of vertical cut (profile)
7	8/10/2015 1:27 PM	S16 49 27.6 E37 01 42.9	37 K 289927 8138831	118 m	Observation of the occurrence of hematite (iron oxide)
8	8/10/2015 1:29 PM	S16 49 30.0 E37 01 45.0	37 K 289988 8138758	119 m	Recent constructions
9	8/10/2015 1:33 PM	S16 49 33.5 E37 01 47.7	37 K 290070 8138651	118 m	Observation of the occurrence of hematite (iron oxide)
10	8/10/2015 1:44 PM	S16 49 42.0 E37 01 53.1	37 K 290233 8138393	127 m	Interview with a group of residents
11	8/10/2015 1:51 PM	S16 49 40.0 E37 01 57.9	37 K 290373 8138455	122 m	Shards of recent ceramic without decoration
12	8/10/2015 2:09 PM	S16 49 25.3 E37 01 34.9	37 K 289688 8138899	119 m	Observation of the occurrence of hematite (iron oxide)
16	8/11/2015 11:46	S16 49 25.0 E37 02 12.1	37 K 290791 8138920	142 m	Study of a noteworthy hill (natural origin)
17	8/11/2015 11:47 AM	S16 49 36.4 E37 02 03.3	37 K 290534 8138568	128 m	Interview with Manuel about bush burns
18	8/11/2015 12:15 PM	S16 49 14.6 E37 02 21.6	37 K 291070 8139243	130 m	Shards of recent ceramic without decoration
19	8/11/2015 1:05 PM	S16 49 41.2 E37 02 26.4	37 K 291218 8138427	128 m	Study of layer of coal and ash - recent
21	8/11/2015 2:51 PM	S16 49 18.3 E37 01 23.9	37 K 289361 8139113	111 m	Observation of the occurrence of hematite (iron oxide)
W-S	8/9/2015 12:08	S16 49 42.1 E37 01 56.7	37 K 290341 8138390	130 m	Limit of the Project Area
W-N	8/9/2015 12:08	S16 49 11.9 E37 02 03.2	37 K 290522 8139321	130 m	Limit of the Project Area
W-C	8/9/2015 12:08	S16 49 23.6 E37 02 00.3	37 K 290442 8138960	118 m	Limit of the Project Area
Bush burns 2	8/10/2015 12:08 PM	S16 49 31.5 E37 02 01.8	37 K 290487 8138719	122 m	Area encompassed by the bush burns- radius of 25 m
Bush burns 3	8/10/2015 12:08 PM	S16 49 20.7 E37 02 07.1	37 K 290640 8139052	122 m	Area encompassed by the bush burns- radius of 18 m
Bush burns	8/10/2015 12:08	S16 49 36.7 E37 01 58.9	37 K 290402 8138557	122 m	Area encompassed by the bush burns- radius of 57 m
Mugonda	8/12/2015 12:08	S16 49 42.3 E37 01 49.2	37 K 290119 8138383	128 m	Observation of the occurrence of hematite (iron oxide)
EDM	8/9/2015 15:10	S16 49 26.2 E37 01 41.3	37 K 289880 8138875	118 m	Modern constructions
E-S	8/9/2015 12:08	S16 49 47.2 E37 02 36.5	37 K 291519 8138244	142 m	Limit of the Project Area
E-N	8/9/2015 4:08	S16 49 14.1 E37 02 49.8	37 K 291904 8139267	118 m	Limit of the Project Area

Appendix VI

Potential Noise Receptors

Table 0.1 Approximate distance to receptors relative to the limits of project footprint area (m)

Receptor point	*Description*	*Approximate distance to limit of project footprint area (m)*
RS_RU1	Inhabited settlement	56
RS_RU2	Inhabited settlement	92
RS_RU3	Inhabited settlement	109
RS_RU4	Inhabited settlement	95
RS_RU5	Inhabited settlement	194
RS_RU6	Inhabited settlement	220
RS_RU7	Inhabited settlement	212
RS_RU8	Inhabited settlement	238
RS_RU9	Inhabited settlement	285
RS_RU10	Inhabited settlement	171
RS_RU11	Inhabited settlement	155
RS_RU12	Inhabited settlement	122
RS_RU13	Inhabited settlement	165
RS_RU14	Inhabited settlement	191
RS_RU15	Inhabited settlement	182
RS_RU16	Inhabited settlement	142
RS_RU17	Inhabited settlement	222
RS_RU18	Inhabited settlement	278
RS_RU19	Inhabited settlement	232
RS_RU20	Inhabited settlement	208
RS_RU21	Inhabited settlement	219
RS_RU22	Inhabited settlement	223
RS_RU23	Inhabited settlement	346
RS_RU24	Inhabited settlement	361
RS_RU25	Inhabited settlement	351
RS_RU26	Inhabited settlement	347
RS_RU27	Inhabited settlement	413
RS_RU28	Inhabited settlement	445
Additional points relative to the area of construction of the access to the project footprint area		
RS_RU29	Inhabited settlement	700
RS_RU30	Substation of Mocuba	700

NOTE:
RS_RU(x) = Receptor Senitive_Noise (x)

Appendix VII

Socio-economicSocio-economic Tables

Table 0.1 Proportion of Men and Age Groups in Mocuba District and Administrative Posts

	% Men	Age groups		
		0 – 14	15 – 64	65 +
District of Mocuba	48.6	46.8	51.1	2.1
Mocuba Administrative Post	49.1	45.2	53.1	2.0
Municipality of Mocuba	50.01	41.8	57.7	1.3
Locality of Mocuna Sede	48.4	47.9	49.3	2.7
Locality of Munhiba	47.9	49.1	48.2	2.4
Mugeba Administrative Post	47.8	49.0	48.3	2.3
Namanjavira Administrative Post	48.0	48.4	48.9	2.4

Table 0.2 Reasons for the Family Household Headed by a Woman (n=50)

	District of Mocuba (AII)	% Fam. Households surveyed (ADI)		
Single	9.4	6.0	15 – 49 years	42.0
Married	6.0	2.0	50 – 65 years	26.0
Marital union	25.1	-	65 +	32.0
Divorced/separated	26.2	36.0		
Widow		56.0		
Not known		-		

Table 0.3 Number of People in Anti Retro Viral Treatment in Mocuba District in the Year 2014

	0 – 14 years		15 + years		Total
	Women	Men	Women	Men	Total
New cases registered in Anti Retro Viral Treatment (ARVT)	210	224	3400	1441	5275

Table 0.4 Main Health Indicators of the District of Mocuba, According with the 2007 Census

Branch of activity	Total	Men	Women
Agriculture, Forestry and Fishing	81.0	69.8	93.2
Mining	0.3	0.4	0.1
Manufacturing Industry	3.1	5.4	0.6
Energy	0.2	0.3	0.0
Construction	2.0	3.6	0.2
Transportation and Communications	0.4	0.8	0.0
Commerce and Finance	8.1	12.5	3.4
Administrative Services	1.0	1.5	0.5
Other Services	3.7	5.6	1.7
Unknown	0.2	0.2	0.2

Source: INE, III RGPH, Tabulation Plan, District of Mocuba, 2007

Appendix VIII

Compensation Plan and Appendixes

Appendix IX

Information Meeting Report