# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROCESS OF THE MOZAMBICAN INTEGRATED TRANSMISSION BACKBONE SYSTEM (STE PROJECT) – PHASE 1: VILANCULOS - MAPUTO

ENVIRONMENTAL IMPACT STUDY

**FINAL REPORT**

**VOLUME II – IMPACT ASSESSMENT AND MITIGATION MEASURES**

ELECTRICIDADE DE MOÇAMBIQUE, E.P.

Illuminating the Transformation of Mozambique

**February 2019**

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## FINAL REPORT

## VOLUME II – IMPACT ASSESSMENT AND MITIGATION MEASURES

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| | |
|---|---|
| AII | Area of Indirect Influence |
| ANE | National Administration of Roads |
| BAT | Best Available Technology |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| DINAB | National Directorate of Environment |
| DPTADER | Provincial Directorates of Land, Environment and Rural Development |
| DUAT | Land Use and Development Right |
| EDM | *Electricidade de Moçambique, E.P.* |
| EHS | Environmental, Health, and Safety |
| EIS | Environmental Impact Study |
| ENH | National Company of Hydrocarbons |
| EPDA | Environmental Pre-Feasibility and Scope Definition Study |
| ESIA | Environmental and Social Impact Assessment |
| ESMP | Environmental and Social Management Plan |
| ESMS | Environmental and Social Management System |
| GHG | Greenhouse Gases |
| GWP | Global Warming Potential |
| HVAC | High-Voltage Alternating Current |
| I&APs | Interested and Affected Parties |
| ICE | Inventory of Carbon & Energy |
| IFC | International Finance Corporation |
| IPCC | Intergovernmental Panel on Climate Change |
| MGtP | Mozambique Gas-to-Power Project |
| MITADER | Ministry of Land, Environment and Rural Development |
| $N_2O$ | Nitrous Oxide |
| NGO | Non-Governmental Organization |
| $NO_X$ | Nitrogen Oxides |
| NTS | Non-Technical Summary |

| | |
|---|---|
| PM10 | Particulate Matter (with diameter smaller than 10 µm) |
| PPP | Public Participation Process |
| RAP | Resettlement Action Plan |
| RoW | Right-of-way |
| RP | Resettlement Plan |
| SAPP | Southern African Power Pool |
| SDAE | District Services of Economic Activities |
| SDEJT | District Services of Education, Youth and Technology |
| SDPI | District Services of Planning and Infrastructure |
| $SF_6$ | Sulphur Hexafluoride |
| $SO_2$ | Sulfur Dioxide |
| STE Project | Mozambican Integrated Transmission Backbone System |
| ToR | Terms of Reference |
| TSP | Total Suspended Particles |
| VECs | Valued Environmental Components |
| VOCs | Volatile Organic Compounds |
| WB | World Bank |
| WBG | World Bank Group |

# 7 Impact Assessment and Mitigation Measures

## 7.1 Introduction

### 7.1.1 General Considerations

This Chapter provides an assessment of the potential biophysical and socio-economic impacts, direct and indirect, positive and negative, that will result from the implementation of the Mozambican Integrated Transmission Backbone System Project (STE Project) – Phase 1: Vilanculos - Maputo.

Potential impacts of the Project are assessed for each component of the biophysical and socio-economic environment described in Chapter 6 (see **Volume I**), for which relevant impacts were identified. Impact identification was based on the preliminary impact scoping developed in the Environmental Pre-Feasibility and Scope Definition Study (EPDA), and was updated considering the findings of the specialist studies and other more detailed analysis undertaken for this Environmental Impact Study (EIS).

It should be noted that impact assessment is based on the specialists understanding of the Project to be implemented, as per the Project Description provided in Chapter 4 of **Volume I**. For some Project components, in particular the construction phase auxiliary infra-structure (construction camps, temporary accesses and burrow pits), the available information is insufficient to support a detailed impact assessment. To ensure that no significant impacts result from the construction of auxiliary infra-structure, guidelines for their location and management are provided in the Environmental and Social Management Plan (ESMP) (see **Volume III**).

For each identified impact, an impact description is provided and its significance is assessed according to a standardized impact assessment methodology, as described in Section 7.1.2. Considering the significance rating, mitigation measures are then defined, with the goal to reduce the significance of the residual impact to acceptable levels. For positive impacts, and where relevant, enhancement measures are proposed.

The significance of each potential impact is also rated after the application of mitigation/enhancement measures, so as to assess the residual impact significance. The impact assessment for each impact is summarized in table format, including the pre-mitigation assessment, the key proposed mitigation measures and the residual impact assessment.

Mitigation, enhancement and monitoring measures resulting from the impact assessment are then organized in thematic programs in the ESMP (see **Volume III**).

### 7.1.2 Impact Assessment Methodology

The assessment of impacts is based on specialists' expertise and professional judgment, field observations and desktop analysis. The significance of potential impacts that may result from the proposed Project is determined in order to assist decision-makers (typically a designated authority or state agency, but in some instances, the Proponent).

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in the table below.

**Table 7.1 – Criteria used to determine the Consequence of the Impact**

| Rating | Definition of Rating | Score |
|---|---|---|
| **A. *Extent*** *– the area over which the impact will be experienced* | | |
| Local | Confined to Project or study area or part thereof (e.g. site) | 1 |
| Regional | The region, which may be defined in various ways, e.g. cadastral, catchment, topographic | 2 |
| (Inter) national | Nationally or beyond | 3 |
| **B**. ***Intensity*** *– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources* | | |
| Low | Site-specific and wider natural and/or social functions and processes are negligibly altered | 1 |
| Medium | Site-specific and wider natural and/or social functions and processes continue albeit in a modified way | 2 |
| High | Site-specific and wider natural and/or social functions or processes are severely altered | 3 |
| **C**. ***Duration*** *– the timeframe over which the impact will be experienced and its reversibility* | | |
| Short-term | Up to 2 years | 1 |
| Medium-term | 2 to 15 years | 2 |
| Long-term | More than 15 years | 3 |

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

**Table 7.2 – Method used to determine the Consequence Score**

| ***Combined Score* (A+B+C)** | 3 – 4 | 5 | 6 | 7 | 8 – 9 |
|---|---|---|---|---|---|
| ***Consequence Rating*** | Very low | Low | Medium | High | Very high |

Once the consequence is derived, the probability of the impact occurring is considered, using the probability classifications presented in the table below.

**Table 7.3 – Probability Classification**

| ***Probability*** *– the likelihood of the impact occurring* | |
|---|---|
| Improbable | < 40% chance of occurring |
| Possible | 40% - 70% chance of occurring |
| Probable | > 70% - 90% chance of occurring |
| Definite | > 90% chance of occurring |

The overall **significance** of impacts is then determined by considering consequence and probability using the rating system prescribed in the table below.

**Table 7.4 – Impact significance ratings**

| | | Probability | | | |
|---|---|---|---|---|---|
| | | Improbable | Possible | Probable | Definite |
| Consequence | Very Low | **INSIGNIFICANT** | **INSIGNIFICANT** | **VERY LOW** | **VERY LOW** |
| | Low | **VERY LOW** | **VERY LOW** | **LOW** | **LOW** |
| | Medium | **LOW** | **LOW** | **MEDIUM** | **MEDIUM** |
| | High | **MEDIUM** | **MEDIUM** | **HIGH** | **HIGH** |
| | Very High | **HIGH** | **HIGH** | **VERY HIGH** | **VERY HIGH** |

Finally the impacts are also considered in terms of their nature (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering the nature of the impacted confidence (in assessment) is laid out in the table below.

**Table 7.5 – Impact status and confidence classification**

| ***Status of impact*** | |
|---|---|
| Indication whether the impact is adverse (negative) or beneficial (positive). | (+) - positive – a 'benefit' |
| | (-) - negative – a 'cost' |
| ***Confidence of assessment*** | |
| The degree of confidence in predictions based on available information and specialists judgment and knowledge. | Low |
| | Medium |
| | High |

Different types of impacts will also be considered in the impact ratings, as listed in the table below.

**Table 7.6 – Types of impacts**

***Direct*** – impacts that result from the direct interaction between a Project activity and the receiving environment.

***Indirect*** – impacts that result from other (non-Project) activities but which are facilitated as a result of the Project or impacts that occur as a result of subsequent interaction of direct Project impacts within the environment.

***Cumulative*** – impacts that act together with current or future potential impacts of other activities or proposed activities in the area / region that affect the same resources and / or receptors.

There is no statutory definition of 'significance' and its determination is therefore necessarily partially subjective. In addition to the criteria laid out in **Table 7.1,** the assessment of impact significance also takes into consideration the following key elements:

- Status of compliance with relevant local legislation, policies and plans, any relevant or industry policies, environmental standards or guidelines and internationally accepted best practice;
- The consequence of the change to the biophysical or socioeconomic environment (e.g. loss of habitats, decrease in water quality) expressed, wherever practicable, in quantitative terms. For socioeconomic impacts, the consequence must be viewed from the perspective of those affected, by taking into account the likely perceived importance of the impact and the ability of people to manage and adapt to the change; and

- The nature of the impact receptor (physical, biological, or human). Where the receptor is physical (e.g. a water resource) its quality, sensitivity to change and importance must be considered. Where the receptor is biological, its importance (e.g. its local, regional, national or international importance) and its sensitivity to the impact must be considered. For a human receptor, the sensitivity of the household, community or wider societal group must be considered along with their ability to adapt to and manage the effects of the impact.

The impact significance rating also reflects the need for mitigation. While low significance impacts may not require specific mitigation measures, high significance negative impacts demand that adequate measures be put in place, to reduce the residual significance (impact significance rating, after mitigation), as described in the following table.

**Table 7.7 – Impact significance rating and mitigation requirements**

| Significance rating | Mitigation requirements |
|---|---|
| *Insignificant* | The potential impact is negligible and no mitigation measures or environmental management is required. |
| *Very Low & Low* | No specific mitigation measures are required, beyond the implementation of standard environmental good management practices. |
| *Medium - High* | Specific mitigation measures should be devised, to reduce the impact significance to an acceptable level. If mitigation is not possible, compensation measures should be considered. |
| *Very High* | Specific mitigation measures should be identified and implemented, to reduce the impact significance to an acceptable level. If such mitigation is not possible, very high significance negative impacts should be considered in the Project's decision-making process. |

For each impact, practicable mitigation and enhancement measures is recommended, and impacts are rated in the prescribed way both with and without the assumed effective implementation of the proposed mitigation / enhancement. A summary impact assessment table is provided for each impact. To allow a more readily perception of the nature (positive/negative) and the significance rating of the assessed impacts, the impact summary table is colour-coded as shown in **Table 7.8**.

**Table 7.8 – Colour code of impact nature and significance**

| Negative Impacts (Significance) | Positive Impacts (Significance) |
|---|---|
| Insignificant | Insignificant |
| Very Low | Very Low |
| Low | Low |
| Medium | Medium |
| High | High |
| Very High | Very High |

Finally, section 7.11 provides a summary of all impacts assessed, including pre and post-mitigation assessments, in tabulated form, in order to facilitate a global perception of the Project's impacts.

# 7.2 Air Quality

## 7.2.1 Construction Phase

### 7.2.1.1 Impact-Generating Activities

The construction phase of the STE Project will include a wide range of construction works necessary for the establishment of the line's right-of-way (RoW) and towers, for construction of the proposed substations and auxiliary infra-structure, such as access roads, as described in the Project Description section (see Chapter 4 – **Volume I**).

In terms of air quality, the main construction activities that potential may generate impacts are:

- Vegetation clearing and land modelling – required to prepare the land associated with the RoW, substations, construction camps, access roads, etc. This activity will mainly generate the emission of dusts, due to the exposure of soil to wind erosion and vehicle entrainment;
- Earthworks – including the cuts and fills required for the towers' and substations' foundations. This activity will also mostly generate the emission of particulate matter, for the same reasons noted above;
- Construction of substations and access roads – fugitive dust emissions and air pollutants emissions are expected from the different land construction activities associated with the substations and new access roads, such as land modelling, vegetation clearing, machinery operations and transportation activities;
- Movement and operation of vehicles and machinery associated with construction activities – it is expected that the towers and other materials will be delivered by road by means of heavy trucks. Ground works will involve the use of excavators, front-end loaders, rippers, dozers, graders, rollers, water trucks and dump trucks that will operate in the construction sites. The movement of vehicles and the operation of machinery will be a source of atmospheric pollutants emissions, namely exhaust gases from all equipment equipped with internal combustion engines. Fugitive dusts emission due to vehicle entrainment can be also expected during transportation operations.

Air quality impacts are likely to be most relevant near the substation construction sites considering that access roads, transmission lines and substation construction works may occur simultaneously at a specific same location, especially where sensitive receptors are in close proximity.

Additionally, air quality impacts are also expected to result from the construction phase auxiliary infra-structure, namely the construction camps and temporary access roads. As the location of this infra-structure is not known at the present time, these impacts are not assessed below. However, guidelines regarding the location and layout of this infra-structure are provided in the ESMP, to ensure that no significant air quality impacts result from the auxiliary infra-structure.

Considering the discussed above, the key air pollutants of interest include:

- Particulate matter emissions, arising from construction activities; and

- Combustion gases emissions, including nitrogen oxides ($NO_x$), carbon monoxide (CO), sulphur dioxide ($SO_2$) and carbon dioxide ($CO_2$), associated with the operation of fuel based equipment, such as cranes and generators, and the circulation of light and heavy vehicles.

The significance of the Project's air quality impacts are assessed below, taking into consideration the proximity of sensitive receptors to the different construction sites. To support this assessment, an evaluation and quantification of the construction equipment overall emissions is also provided.

### 7.2.1.2 Impact Assessment – Construction Phase

***Impact: Increase in dust emissions near sensitive receptors***

*Impact Assessment*

The more common impact on air quality resulting from civil works is the emissions of particulate matter that could result in air quality degradation near sensitive receptors. Civil construction activities that involve vegetation clearing and earth movements result in this type of emissions, which can be significant during the dry season if no control measures are put in place. The intensity of these emissions is a function of several parameters, such as:

- The nature of the specific construction activity under way (construction methodology, number and type of vehicles and equipment in operation, etc.);
- The duration of the activity;
- The size of the work front;
- Meteorological conditions during the activity (wind speed and direction, rain events);
- The proximity of sensitive receptors to the work site;
- Adequacy of the control measures in place;
- The sensitivity of the receptors to the emitted pollutants.

The magnitude of the impacts of each specific work front will thus be dependent of the parameters listed above. The dust emissions resulting from the construction of the transmission line and the substations is assessed below.

***Substations construction activities***

According with the emission factors proposed by the Environmental Protection Agency of the United States (USEPA, 2009), construction operations generate Total Suspended Particles (TSP) emissions which are presumed to be proportional to the area of land disturbed by construction activity, as per the following equation:

TSP = 2.69 Mgram / hectare / month of activity

This emission factor is particularly applicable to construction with average levels of activity on land exposed to semi-arid climates types. Considering the application of the previously stated emission factor, and the total areas of the planned Project substations, **Table 7.9** shows the estimated total emissions of PTS/month associated with the substations construction.

**Table 7.9 – Total dust generation during substations construction activities**

| Construction phase dust emissions (tons/month) | |
|---|---|
| No mitigations measures applied | 496.11 |

Analysing each substation specific location according with dust potential impacts over sensitive receptors, it can be concluded that:

- At the **Vilanculos substation**, receptor sensitivity is determined as negligible as there are no farms or residential settlements within 500 m of the proposed substation. Air quality impacts are anticipated to be insignificant, even with no mitigation;
- At **Matalane substation**, receptor sensitivity is determined as very low as there are no receptors identified within 200 m of the substation, but some residential settlements have been identified between 200 m and 500 m of the substation. Globally, air quality impacts are anticipated to be negative, but temporary and minor (even with no mitigation), occurring mostly during site preparation and site enabling works;
- At **Chibuto substation**, scarce residential settlements and farms are found between 150 m and 200 m from the proposed substation. Therefore, construction works are anticipated to cause temporary minor adverse air quality impacts, especially during the site preparation and site enabling works phases.
- At **Maputo substation**, residential settlements are found at distances of roughly 120 m from the proposed expansion area. Therefore, construction works are anticipated to cause temporary and minor adverse air quality impacts, during site preparation and site enabling works.

***RoW construction activities***

Dust emissions are also expected to occur during construction of the overhead transmission line, essentially during site preparation works such as vegetation clearance, soil disturbance for tower foundation works and the movement and transport of soil and other materials by heavy vehicles. These impacts, however, will only be relevant for sensitive receptors located in the immediate vicinity of the RoW, which are scarce along the STE corridor, with the exception of the final segment between Matalane and Maputo substations.

The construction of access roads also has the potential to result in high dust emissions, mainly because of road opening activities, acquisition of material from borrow pits, transportation of materials on unpaved roads and road consolidation works.

Given the expected amounts of dust emissions over the construction period, in the non-mitigated scenario, and the location of the closest sensitive receptors, the global air quality impact associated with dust emissions from the construction of all Project's infrastructure is rated as *negative*, *direct*, of *short term* duration, *local* extent and *medium* intensity, resulting in a *very low* significance.

*Mitigation Measures*

Despite the low significance expected, dust emissions may promote some degree of annoyance to the surrounding communities. As such, mitigation measures will be implemented to reduce the potential nuisance effects caused by dusts on nearby receptors.

In particular, dust control measures will be implemented in the construction corridor throughout the construction phase, namely by sprinkling of water by water-trucks over the exposed land, whenever working near isolated dwellings or residential areas. According to USEPA (2009), this control measure has an efficiency of control in the order of 75% (in terms of reduction of emitted dusts). With the implementation of this measure, total dust generation per month, in what regards substation construction, will be approximately 124.0 tons as per **Table 7.10**.

**Table 7.10 – Total dust generation during substation construction activities with mitigation measures**

| Construction phase Dust emissions (Tons/month) | |
|---|---|
| With mitigation measures applied | 124.0 |

Additionally, good environmental management practices, of standard application to any major civil construction works, will be implemented, namely:

- Vegetation clearing and earthworks will be minimized as much as possible and limited to the strictly needed areas;
- All unpaved surfaces where vehicle movement is to be expected near residential areas will be kept moist (e.g., through a water sprinkler truck), in particular during dry and windy conditions, to minimize the dust emitted by vehicle entrainment;
- Set speed limits for construction heavy vehicles (such as trucks used in the transportation of materials) for all construction circuits, since the emission of dusts by vehicle entrainment increases linearly with speed. This speed limit will not exceed 30 km/h in critical segments, such as when near residential areas;
- Circulation of construction heavy vehicles (such as trucks used in the transportation of materials) will be limited to pre-approved construction routes;
- Heavy trucks transporting granular construction materials (such as sand, soil and gravel, etc.) will not be loaded to full capacity. A free edge of approximately 0.2 m will be kept to avoid spills during transportation;
- Trucks carrying dusty materials will have the load conveniently covered, preventing the emission of particulate matter and fugitive dusts;
- Stockpiles of granular materials will be regularly sprinkled with water, to minimize windborne dusts.

*Impact Summary*

With the application of the mitigation measures, the impact's intensity is reduced to *low*, resulting in a *very low* residual significance. The impact summary is provided in the following table.

| Impact: Increase in dust emissions near sensitive receptors | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Vegetation clearing and earthworks will be limited to the strictly needed areas;<br>- All unpaved surfaces will be kept moist, in particular during dry and windy conditions, when working near residential areas;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h in critical segments, such as when near residential areas;<br>- Circulation of construction heavy vehicles will be limited to pre-approved construction routes;<br>- Heavy trucks transporting construction materials will not be loaded to full capacity. A free edge of approximately 0.2 m will be kept to avoid spills during materials transport;<br>- Stockpiles of granular materials will be regularly sprinkled with water, to minimize windborne dusts;<br>- Trucks carrying dusty materials will have the load adequately covered. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very Low | 4 | | Very low | 3 |
| Probability | Definite | | | Probable | |
| **Significance** | **Very Low** | | | **Very Low** | |

***Impact: Increase in atmospheric concentrations of exhaust gases from the operation of heavy vehicles and equipment***

*Impact Assessment*

The construction vehicles and machinery will inevitably emit pollutant gases, namely exhaust gases from the internal combustion engines. These pollutant gases include CO, $NO_x$, $SO_2$, volatile organic compounds (VOCs) and TSP, among other residual pollutants, such as heavy metals, aldehydes and other minor organic compounds. It is estimated, conservatively, that several hundred litres of gasoline and diesel fuel will be required on a monthly basis to operate all the required construction machinery and vehicles. For reference, **Table 7.11** lists typical emission factors of construction equipments.

**Table 7.11 – Average air pollutants emission factors of civil works equipment**

| Equipment | Equipment Horsepower | Load Factor | CO | VOC | $NO_X$ | $SO_X$ | PM10 |
|---|---|---|---|---|---|---|---|
| | (BHP) | (%) | (g/hr) | (g/hr) | (g/hr) | (g/hr) | (g/hr) |
| Air Compressor | 37 | 48 | 88.5 | 16.3 | 145.2 | 16.3 | 8.2 |
| Backhoe | 79 | 47 | 249.9 | 49.9 | 366.5 | 33.1 | 16.8 |
| Compactor | 99 | 58 | 180.5 | 51.7 | 516.7 | 51.7 | 25.9 |
| Concrete Mixer | 11 | 56 | 28.1 | 5.4 | 67.1 | 5.4 | 2.7 |
| Crane | 194 | 43 | 340.7 | 113.4 | 870.5 | 75.8 | 56.7 |
| Dozer | 103 | 59 | 303 | 54.9 | 633.2 | 54.9 | 27.7 |
| Front End Loader | 147 | 47 | 341.1 | 62.1 | 713.1 | 62.1 | 30.8 |
| Gas Welding Machine | 19 | 51 | 6501 | 237.2 | 8.6 | 2.7 | 0.9 |
| Generator | 22 | 74 | 81.2 | 15 | 132.9 | 15 | 7.3 |
| Grader | 157 | 58 | 326.6 | 122.5 | 857.8 | 81.6 | 40.8 |
| Hand Vibrator Plate | 8 | 43 | 3183.4 | 1399.8 | 0.9 | 0.9 | 13.2 |
| Pile Hammer | 161 | 62 | 905.4 | 135.6 | 1086.8 | 90.7 | 68 |

| Equipment | Equipment Horsepower | Load Factor | CO | VOC | $NO_X$ | $SO_X$ | PM10 |
|---|---|---|---|---|---|---|---|
| | (BHP) | (%) | (g/hr) | (g/hr) | (g/hr) | (g/hr) | (g/hr) |
| Roller | 99 | 58 | 180.5 | 51.7 | 516.7 | 51.7 | 25.9 |
| Rubber Tire Loader | 147 | 54 | 396 | 72.1 | 828.3 | 72.1 | 54 |
| Scraper | 267 | 66 | 878.6 | 79.8 | 1517.3 | 159.7 | 119.8 |
| Truck Mounted Vertical Drill | 209 | 75 | 1422 | 213.2 | 1706.4 | 142.4 | 106.6 |
| Vibrator /compactor | 99 | 58 | 180.5 | 51.7 | 516.7 | 51.7 | 25.9 |
| Well Driller | 209 | 75 | 1422 | 213.2 | 1706.4 | 142.4 | 106.6 |

**Source:** South Coast Air Quality Management District CEQA Air Quality Handbook, November 1993, Tables A9-8-B, A9-8-C and A9-8-D, Adapted.

Total pollutant gases emissions generated by construction equipment depend on several variables, such as maintenance status of the equipment, equipment technical specifications, number of hours of operation and number of equipments working simultaneous in a specific work front.

However, considering that the expected number of machines needed in simultaneous operation will not be very high (considering the nature of the Project), it is expected that the emissions of $SO_2$, $NO_x$, CO and VOCs will result in a minor increase of the concentration of these pollutants during a limited period. As such, this impact is rated as *negative*, *direct*, of *short term* duration, *local* extent and *low* intensity, resulting in a *very low* significance.

*Mitigation Measures*

Given the impact's significance rating, no specific mitigation is required. However, standard good environmental practices during construction activities will still be observed, namely:

- All internal combustion machinery and equipment will be kept in good maintenance conditions in order to minimize combustion gases exhaust emissions. This includes preventive maintenance of machines, equipment and vehicles and operator training, as well as internal monitoring program of proper maintenance of vehicles;
- Speed limits will be set for construction heavy vehicles. This speed limit will not exceed 30 km/h in critical segments, such as when near residential areas.

*Impact Summary*

The impact summary is provided in the following table.

| **Impact: Increase in atmospheric concentrations of exhaust gases from vehicle and equipment operation** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - All internal combustion machinery and equipment will be kept in good maintenance conditions in order to minimize combustion gases exhaust emissions;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h in critical segments, such as when near residential areas. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very low | 3 | | Very low | 3 |
| Probability | Definite | | | Definite | |
| **Significance** | **Very Low** | | | **Very Low** | |

### 7.2.2 Operational Phase

During the operational phase of the Project, no significant atmospheric emissions are expected. Maintenance activities, and in particular the continued vegetation control along the RoW, will result in some dust emissions and gaseous emissions, due to fuel consumption of the equipment and vehicles used for those maintenance operations.

However, vehicle emissions associated with maintenance activities are expected to be intermittent and of low intensity. As such, atmospheric emissions during the operational phase can be considered to be insignificant, with negligible air quality impacts.

## 7.3 Climate Change

### 7.3.1 Methodology

The World Bank Group (WBG) General Environmental, Health and Safety (EHS) Guidelines (IFC, 2007a) advise that greenhouse gases (GHG) emissions should be evaluated for projects where emissions are estimated to be more than 100,000 tonnes $CO_2$. WBG's EHS Guidelines for electric power transmission and distribution (IFC, 2007b) does not provide any specific guidance on GHG emissions associated with the construction or operation of transmission and distribution projects, although it does note that the use of sulphur hexafluoride ($SF_6$) in insulating high-voltage equipment should be minimised where possible as $SF_6$ is a potent greenhouse gas if it escapes to atmosphere.

The World Bank Energy and Mining sector board discussion paper named "*Impacts of Transmission and Distribution Projects on Greenhouse Gas Emissions. Review of Methodologies and a Proposed Approach in the Context of World Bank Lending Operations*" (Madrigal & Spalding-Fecher, 2010) proposes specific methodologies for GHG accounting from electrical transmission and distribution projects, which were adopted as baseline method in the present study.

GHG emissions resulting from electric transmission line projects are considerably lower than those of other fossil fuel energy based projects. Transmission lines have emissions in a maximum order of magnitude of tens of $CO_2$/MWh. Given that typical oil and coal power stations would have life-cycle emissions reaching 870–1335 kg $CO_2$/MWh (DeLuchi, 1991), all the transmission line GHG sources are likely to represent less than 10 percent of typical power generation emissions, with land clearing being the most representative GHG source. Land clearing emissions are highly variable since they depend on local land conditions (due to the variable amount of vegetation to be cleared) by contributing to an increase in the overall emissions computation.

GHG emissions generated by the STE Project will be associated mainly with the construction phase, although lower level emissions can also occur during the Project's operational phase. During construction, Project GHG emissions includes not only emissions from fuel used for construction (from internal combustion construction vehicles and machinery), but also the embodied $CO_2$ emissions of the materials used in the infrastructures to be erected (suspension, tension and terminal towers, conductor cables and concrete for towers foundations). These GHG emissions are classified as direct non-generation GHG emissions (Madrigal & Spalding-Fecher, 2010). During the operational

phase, $SF_6$ is not expected to be emitted but nitrous oxide gas ($N_2O$) can be released, contributing to the overall GHG emissions due to their high Global Warming Potential (GWP).

The main GHG emissions sources from transmission projects include the following:

Construction phase:

- **Embodied emissions from construction materials** - aluminium, steel, concrete, ceramic from isolators and other building materials are applied in the transmission line projects. All of these materials have embodied emissions as a result of the energy used to produce them, creating upstream $CO_2$ emissions;
- **Energy use during the construction phase of the Project** - fuel used in construction machinery and vehicles are a source of $CO_2$ emission. These emissions are considered only when there are sufficient Project data on fuel usage in the construction phase. Nevertheless, it is expected that this is likely to represent a small source of emissions;
- **Land clearing emissions** - land clearing can be a significant source of emissions, depending on the vegetation type intercepted by the RoW of the Project. The area to be cleared and the carbon density of the biomass to be cleared is assessed based in the flora stratums intercepted by the RoW alignment and converted to $CO_2$ emissions.

Operational phase:

- **$SF_6$ fugitive emissions** – $SF_6$ is used in insulation and current interruption applications in energy transmission systems (IPCC, 2006). $SF_6$ may escape as fugitive emissions during the manufacturing, installation, use, maintenance, and disposal of this equipment. These emissions are generally small, but could be significant for projects that install new high-voltage equipment. However, there will be no normal operational releases of $SF_6$ from the present Project as no gas insulated switchgear is proposed. Abnormal releases may arise during maintenance of circuit breakers contained within the substations although these are considered to be of no significance to overall GHG emissions;
- **$N_2O$ emissions resulting from the corona effect** – high-voltage transmission lines can create $N_2O$ from an effect called “corona discharge”. Corona is a phenomenon associated with all energized transmission lines. Under certain conditions, the localized electric field near an energized conductor can be sufficiently concentrated to produce a tiny electric discharge that can ionize the air close to the conductors and promote $N_2O$ releases. The electric discharge is called corona discharge. Production rates of this gas are heavily dependent on weather conditions. As such, calculated values must be read as a worst-case maximum conservative and estimative value only;
- **GHG emissions from maintenance activities** - Emissions associated with routine maintenance of the towers and substations are considered to be short-term and intermittent and therefore not expected to be significant.

Methodologies and databases consulted for the Project’s GHG evaluation were retrieved from the following data sources: Madrigal & Spalding-Fecher (2010), Dones *et al.* (2007) and USEPA (2006). Other data sources included:

- IFC Carbon Emissions Estimator Tool (IFC, 2014) - this tool includes a section on land clearing that can be applied for any project type. Land clearing emissions were calculated as the product of the estimated total area to cleared and biomass density (mainly above ground) converted to Carbon. This tool also includes a table of emission factors (above ground biomass density) for a large variety of vegetation types, sourced from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories;
- Inventory of Carbon & Energy (ICE) Version 2.0, Sustainable Energy Research Team Department of Mechanical Engineering, University of Bath, UK.

These methodologies were applied in the present Project with the purpose to calculate GHG emissions ($CO_2$eq) and to estimate the Project's impact, in the context of Mozambique's total GHG emissions. These calculations, and subsequent impact assessment, are provided below.

## 7.3.2 Construction Phase

### 7.3.2.1 Estimation of GHG Emissions

The construction of power transmission projects consumes mainly considerable quantities of aluminium, steel and concrete. Other building materials are also used, but at lesser scale. These materials have embodied emissions resulting from the energy used to produce them, meaning that the implementation of the new transmission line Project will create some upstream GHG emissions due to the materials used in the construction phase of the Project.

The embodied emissions from materials such as steel and aluminium are likely to be significant, especially in long distance energy transmission projects which involve extensive infrastructure relative to the amount of power delivered, as is the case of the present Project. For projects with long line lengths, the materials in the lines conductors and steel towers to be erected will far outweigh the materials in substations and other equipment. For this reason, this assessment focuses on the former.

***Towers***

As described in the Project Description, an estimated total of 1683 steel towers will be required to support the overhead line (see Table 4.2, section 4.3.2.1, **Volume I**). For embodied emissions, considering the number of towers to be erected, and assuming 15 000 kg of steel for each suspension tower and 20 000 kg for each angle tower, total steel applied would be 25 500 tons. Using an embodied carbon factor of 3.19 t$CO_2$e/ton steel (IFC, 2014), this yields a total of **81 345 tons of $CO_2$e**.

***Conductor cables***

This Project involves a field implantation of 561 km length of conductor lines. The conductor's transmission cables are the largest material component, and are composed of aluminium and steel. Assuming a configuration of quad ACSR-Tern conductors per phase, with specific weights of

1.120 kg/m for aluminium and 0.220 kg/m for steel (NORCONSULT, 2015), this amounts to a total of 7 540 tons of aluminium and 1 481 tons of steel for the entire transmission line length.

For embodied emission factors, the ICE inventory provides 10.6 $tCO_2e/t$ for aluminium and the IFC Carbon Emissions Estimator Tool provides 3.19 $tCO_2e/t$ for steel. The overall expected $CO_2e$ emissions from the conductors will reach **84 647 tons $CO_2e$**.

***Concrete tower foundations***

The production of the cement component in concrete requires energy that in turn results in the generation of $CO_2$. For the most part, during the cement manufacturing process, $CO_2$ is generated mainly from two different sources *(i)* the use of fossil fuels during the burning process; and *(ii)* from calcination, when calcium carbonate is heated and broken down to calcium oxide with $CO_2$ release.

Even though there is no specific data regarding the amount on concrete to be used in each tower foundation, an estimate can be produced, based on the tower footprint and foundation requirements, as described in the Project Description (see Table 4.3, section 4.3.2.1, **Volume I**).

Assuming an average of 40 $m^3$ of concrete for each tower foundation, and a concrete density of about 2.3 $ton/m^3$, a total of 154 836 tons of concrete will be required to build the towers foundations. According with IFC (2014), an average of 367 kg of $CO_2eq$ are emitted for every 1 ton of reinforced concrete produced. The overall $CO_2$ emissions associated with the concrete applied in towers foundations may reach a total of **56 825 tons $CO_2e$**.

***Insulators***

Ceramic or glass insulators are to be applied in each angle and suspension tower. These are normally composed of porcelain or glass and their embodied $CO_2$ emissions associated with production can be estimated. There's no specific data regarding the type and geometry of insulators to be applied but assuming at least 3 main insulators V-Type per tower with an average weight of 100 kg each and considering an emission factor of 700 kg $CO_2e$/ton ceramic (sourced from ICE inventory) this will lead to **353.4 ton $CO_2e$.**

***Land clearing***

Vegetation clearing along the line RoW will result in a one-time release of the carbon stored in the vegetation that can be converted and translated to $CO_2e$ emissions according with the IPCC Land Use Change & Forestry proposed methodology. A 100 m corridor (50 m to each side of the center line) will be established as the line RoW, but vegetation will only be cleared in a 30 m corridor, with select cutting of larger trees in the 100 m corridor. The standards for vegetation clearance are described in the Project Description (see Table 4.5, section 4.3.2.3, **Volume I**).

The impact associated with $CO_2$ emissions from land clearing becomes more significant when transmission lines cross areas with high forest cover, that is, areas with highly dense carbon stock. However, it is important to notice that some of the biomass will grow back after the construction, although the amount and density would depend on the climate and maintenance procedures for the line (it is anticipated that regrowth vegetation will be cut as necessary), as well as on how high the line is. According with the Land Cover map intercepting RoW with the existing vegetation cover, it

can be observed that the transmission line will cross along its path roughly 290.1 km of natural dry land forest area, 95.3 km of crop land area, and 175.6 km of grassland area.

IPCC (2006) gives an above ground biomass content of 70 ton/ha for Mozambican dry land natural forest, 19.1 ton/ha for cropland and 2.0 ton/ha for grassland. In order to estimate the change in the carbon stocks impacted by the land use change, i.e, $CO_2$ releases from land clearing, emissions are expressed in $CO_2$ per unit area of land change being the biomass content expressed in tonnes of carbon dioxide per hectare (tons $CO_2e$ /ha), according with the following general expression:

$$PELC = A_{def} \times BD$$

Where,

***PELC***=*Direct non-generation $CO_2$ emissions from land clearing ($tCO_2$)*

***$A_{def}$***= *Area of land deforested (ha)*

***BD***= *Biomass density per unit area (aboveground) ($tCO_2$/ha)*

Assuming a land clearing width of 30 m, along 561 km of length, this results in a total area of 870 ha of Mozambican dry land natural forest, 286 ha of cropland and 526.5 ha of grassland to be cleared above the ground. Considering the specific biomass density per unit of area for each different vegetation stratums converted to C, a total one-time $CO_2e$ emission of **116 216 $CO_2e$ tons** is to be expected due to the land change operation.

### 7.3.2.2 Impact Assessment – Construction Phase

***Impact: Greenhouse gas emissions during construction phase***

*Impact Assessment*

The construction phase total emissions are estimated as 339 386 tonnes of $CO_2e$, as per the assessment provided in section 7.3.2.1. The majority of this impact is from the embodied emissions of the required materials required, and from land clearing activities. Fuel consumption will also generate GHG emissions, but these were not accounted for, given that no estimates for fuel consumption during construction are available. Note, however, that GEE emissions from fuel consumption will, in any case, constitute a minor fraction of the Project's total emissions. **Table 7.12** summarizes total GHG emissions expected from the Project's construction phase.

**Table 7.12 – Estimate of GHG emissions from the Project's construction phase**

| Emission Source | GHG emissions ($CO_2e$ tons) | GHG emissions annualised (kg $CO_2e$ /year) |
|---|---|---|
| Embodied emissions from materials | 223 170 | 7 439(*) |
| Land Clearing | 116 216 | 3 874(*) |
| **TOTAL** | **339 386** | **11 313** |

**Note:** (*) Total emissions annualized considering a Project lifetime of 30 years.

The total impact can be annualised based on the expected lifetime of the Project of 30 years leading to a total equivalent impact per year calculated as 11 313 t $CO_2e$/year. This represents a small fraction of Mozambique's current national emissions (less than 0.1% of the known annual emissions, as discussed in the baseline section – see section 6.1.2.5, **Volume I**).

The impact generated from GHG in the construction phase is thus rated as *negative*, *direct*, of *short term* duration, *regional* extent and *low* intensity, resulting in a *very low significance*.

*Mitigation measures*

As the key impacts on GHG emissions are mostly confined to the construction phase, potential measures to reduce those impacts are important in improving performance. The applicable mitigation measures are the following:

- Source as much as possible materials from sustainable sources such as environmental certified companies;
- Use materials from local sources as much as possible;
- Minimize, as feasible, distance from construction camps to work fronts;
- Adopt measures to minimize fuel consumption such as adopting low velocities and turning off vehicles and equipment while idle;
- Promote proper and regular maintenance of vehicles and motorized equipment;
- Ensure efficiency in construction and planning including siting of construction camps, laydown and other work areas; and
- Use materials which can be reused easily.

*Impact Summary*

The impact assessment summary is provided in the table below. The mitigation will reduce the overall GHG impact, but the residual significance is not changed, remaining *very low*.

| **Impact: Greenhouse gases emissions during construction phase** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Source materials from sustainable sources;<br>- Use materials from local sources, as much as possible;<br>- Minimize, as feasible, distance from construction camps to work fronts;<br>- Adopt measures to minimize fuel consumption;<br>- Regular maintenance of vehicles and motorized equipment;<br>- Ensue efficiency in construction planning including sitting of construction camps, laydown and other work areas; and<br>- Use materials which can be reused easily. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Regional | 2 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very low | 4 | | Very low | 3 |
| Probability | Definite | | | Definite | |
| **Significance** | **Very Low** | | | **Very Low** | |

## 7.3.3 Operational Phase

### 7.3.3.1 Estimation of GHG Emissions

Direct impacts of GHG emissions in the operational phase are anticipated to be negligible. Eventual $N_2O$ release due to the corona effect and fuel consumption from traffic movements associated with routine maintenance of the lines and substations are the only sources of GHG that can be expected,

but are not anticipated to be significant. The following subsections analyse in detail each of these potential emissions sources during the operational phase of the Project.

***$N_2O$ emissions***

High-voltage transmission lines may generate $N_2O$ due to an effect called "corona discharge". Under certain meteorological conditions, such as rain or fog, and due to the very high voltage values passing through the transmission line cables, there's current leakage to the surrounding air that becomes ionized. In these specific conditions, the transmission cable appears surrounded by a bluish light halo, with accompanying noise generation and release of $N_2O$ gas. This phenomenon is called the corona discharge effect. Dones *et al.* (2007) suggest that $N_2O$ emissions of electricity high voltage transmission due to corona effect are about 5 kg $N_2O$ / GWh. Considering that the GWP of $N_2O$ is 210, this is equivalent to 1.05 kg $CO_2e$/MWh.

Assuming an average energy flow along the Maputo-Vilanculos transmission line of more than 7 000 MW per day (specific average annual energy flow values not provided at this phase), the maximum annual GHG emissions from $N_2O$ (in a worst-case scenario) could reach several hundreds of $CO_2e$ tonnes a year.

However, it is important to notice that $N_2O$ emissions are not entirely directly proportional to electricity transmitted. Corona discharge depends on a variety of site-specific factors, from voltage levels to the specific technical characteristics and shape of components so the previous calculations must be faced as an estimate and a conservative maximum value only.

***$SF_6$ emissions***

$SF_6$ is a gas used in insulation and current interruption applications in both transmission and distribution systems (IPCC, 2006). $SF_6$ is used in gas-insulated switchgears and substations, gas circuit breakers, and can also be used in high-voltage gas-insulated lines. $SF_6$ may escape as fugitive emissions during the manufacturing, installation, use, maintenance, and disposal of this kind of equipment. Transmission equipment often requires periodic refilling and so has higher fugitive emissions during use. The amount of $SF_6$ emissions during operation and decommissioning is related to the number and type of equipment used, as well as to the maintenance and recycling procedures.

At a national level, countries report $SF_6$ emissions from the power sector in their national emissions inventories, so this provides one approach for estimating their magnitude. USEPA (2006) estimates the total $SF_6$ emissions from the power sector by country and region throughout the world. This estimate includes all transmission line components, as well as $SF_6$, from manufacturing to disposal. Comparing these data to electricity supply in selected countries, the emission factor for developing countries appears to be 2 to 3 kg $CO_2e$/MWh.

From the Project description, normal operational releases of $SF_6$ are not expected as no gas insulated switchgear is proposed. Abnormal releases may eventual arise during maintenance of circuit breakers contained within the substations although this is considered to be of no significance to overall GHG emissions and therefore is not accounted in this assessment.

***Maintenance activities***

Emissions associated with routine maintenance of the towers and substations may arise from fuel consumption during access to substations and/or to eventual towers repairs activities. These are short-term and intermittent in nature and therefore not expected to be significant in what concerns global GHG emissions.

#### 7.3.3.2 Impact Assessment – Operational Phase

Operation phase GHG emissions are considered to be as short-term and intermittent in nature and therefore not expected to be significant. The potential indirect impact as a result of the $N_2O$ release due to the corona discharge has been assessed and can be associated with the use of the transmission line, but would occur only in specific meteorological conditions such as rainy or foggy days. Therefore, the discussed figures for $N_2O$ emissions should be considered as an indicative estimate only.

It can then be concluded that the Project's operational phase will have no significant direct impacts, in what regards GHG emissions.

## 7.4 Noise

### 7.4.1 Construction Phase

#### 7.4.1.1 Impact-Generating Activities

During the Project's construction phase, noise will be generated mainly by the operation of construction vehicles and machinery and from the activities carried out in each specific work front. The main construction activities likely to generate relevant noise emissions include:

- Opening of access roads – noise emissions associated with the new access opening and road construction are to be expected. Land preparation and vegetation's clearing (site enabling), machinery operations and transportation activities are due to generate intermittent noise. Sub base works, surface works, are predicted to generate the highest noise levels, and may affect receptors located as far as 200 m from the Project site;
- Clearance of Right-of-Way (RoW) – vegetation in the RoW will be mowed or cut using adequate equipment like mowers and/or chainsaws;
- Erection of transmission towers – transmission towers are constructed by first using a standard drill rig to bore a hole to the required depth. Concrete trucks carry concrete to the boreholes to construct the tower's foundations. Cranes then erect the towers on the foundations. Finally, the wire is strung between towers using large pulleys;
- Substation construction – temporary noise impacts associated with the construction of a substation often include machinery noise. Noise emissions can be caused by the large equipment used to excavate the area of the substation and access road, concrete and gravel trucks that haul in materials for the foundation, and tractor trailers to bring in the electrical

equipment. Land clearing and earthworks necessary to implement the substations foundations are activities predicted to generate the highest noise levels;

- Movement and operation of vehicles and machinery – the movement of vehicles and the operation of machinery, at the work fronts, construction camps or in transit, will be also an expected temporary noise source. Typical construction vehicles include bucket trucks, cranes or digger derricks, backhoes, pulling machines, pole trailers, or dumpsters. Ground works will involve the use of excavators, front-end loaders, rippers, dozers, graders, rollers and water trucks. Heavy-duty trucks will be used to haul away material that can't be stockpiled or disposed on-site and to bring in necessary construction materials and substation equipments. The truck journeys associated with the overhead installation and other equipment's to be deployed in the substations location will result also in temporary noise emissions.

The noise impact of these construction activities is described and evaluated below.

### 7.4.1.2 Impact Assessment – Construction Phase

***Impact: Noise impact from construction activities***

*Impact Assessment*

All of the construction activities and equipment operations described in the previous section will result in temporary noise emissions with potential annoyances to the community when the construction activities take place in the vicinity of existing settlements.

Of the construction activities with the potential to generate impacts on ambient noise, some are clearly noisier, such as earthworks. Other activities, such as transportation of materials and the movement of heavy vehicles from the yards to the work fronts and back, will still generate noise, but of lower levels.

It is also worth noting that some activities are very limited in time and space (such as earthworks) while others will be more continuous (such as the movement of machinery). The latter, however, will not generate very high average levels of noise.

The dispersion of the sound energy from the construction activities with distance is done in a spherical geometry. Noisy equipment emits spherical sound waves, for which the decay of sound energy is inversely proportional to the square of the distance, that is to say, it decreases in 6 dB for each doubling of distance, as per the equation presented in **Figure 7.1**. To this attenuation effect with distance, other sound attenuation effects must be added, such as the ground attenuation of the terrain, atmospheric attenuation and the effect of the dominant winds or other effects resulting from temperature variations or atmospheric turbulence.

$$L_{p2} = L_{p1} - 20\log\left(\frac{r_2}{r_1}\right)$$

**Figure 7.1 – Noise propagation equation for point sources**

It should also be noted that the sound levels generated by the construction activities will depend on several other factors, such as the type and number of equipment mobilized for a construction work, the duration of their operation and the topography of the surrounding terrain. These factors could contribute to an increase or to an attenuation of the noise levels that may be felt at the sensitive receptors closer to a work front.

Given all these changing variables, the noise levels generated by the construction phase are not easily quantified, since they are subject to high variability and randomness. As such, the noise impacts of construction activities are usually assessed in a qualitative way. Nevertheless, **Table 7.13** lists the average noise levels perceived at varying distances from typical construction equipment, like the ones required for the transmission line deployment, access roads opening and substations construction.

**Table 7.13 – Typical sound levels at several distances from civil works equipment in dB(A)**

| Equipment | Distance to noise source | | | | | |
|---|---|---|---|---|---|---|
| | 15 m | 30 m | 60 m | 120 m | 250 m | 500 m |
| Excavators | 85 | 81 | 75 | 67 | < 58 | < 52 |
| Heavy trucks | 82 | 78 | 72 | 64 | < 55 | < 49 |
| Generators | 77 | 73 | 67 | 59 | < 50 | < 44 |
| Compressors | 80 | 76 | 70 | 62 | < 53 | < 47 |

**Source**: Geosolve & Certiprojecto (2009).

The table above shows that excavators and heavy trucks generate LAeq sound levels of respectively 81 and 78 dBA(A) at a distance of 30 m. These levels decrease to 75 and 72 dB(A) at 60 m, and to 67 and 64 dB(A) at 120 m. Note that these levels refer to sound propagation in free space, i.e., without the consideration of obstacles to sound propagation, and to a continuous operation at full power, in what regards fixed equipment, or to the recorded level when the vehicle passes by at the indicated distance, in what regard mobile machinery. However, as previously noted, normal construction activities do not usually present a continuous operation regime.

As such, it will be expected that the generated noise will be confined to the local surrounding and the impact will be of short-term duration. The potential changes in sound quality over local roads resulting from the increased vehicle traffic during construction are not expected to be significant.

The non-mitigated noise impact is rated as *negative*, *direct*, of *short term* duration, *local* extent and *medium to high* intensity (depending on the relative proximity of sensitive receptors to the work sites), resulting in a *low significance*.

*Mitigation Measures*

Despite the expected low significance of the noise impacts, some sensitive receptors may experience annoyance effects, due to construction noise. Best practice construction measures are therefore required, to efficiently reduce the potential nuisance effects caused by noise on nearby receptors.

The mitigation to be applied refers mostly to the application of good environmental management practices, of standard application to any major civil construction works such as:

- Vegetation clearing and earthworks will be minimized as much as possible and limited to the strictly needed areas;
- Circulation of construction heavy vehicles (such as trucks used in the transportation of materials) will be limited to pre-approved construction routes. These routes must be defined in order to avoid crossing residential areas, whenever feasible;
- Speed limits will be set for construction heavy vehicles, for all construction circuits. This speed limit will not exceed 30 km/h in critical segments, such as when near residential areas;
- Place traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely;
- The location and organization of the construction camps will be carefully defined, taking into account the location of sensitive receptors, and the noise impacts resulting from induced road traffic and activities to be undertaken;
- Construction activities, in particular the noisier ones, will be limited to the daytime period only (between 07:00 and 22:00) and to working week days, avoiding working during the night-time and on weekends, whenever construction activities take place near residential or other community use areas. The adoption of these procedures will limit the annoyance affect generated by the noise impact;
- If noise complaints are received from local communities in the morning or evening periods, despite compliance with the previous measure, and if the following investigation confirms the noise impact, then further reduce the work schedule in those periods. In such cases, the work schedule will be defined in a participatory manner, through consultation with affected communities;
- The contractor will avoid, whenever possible, placing fixed equipment (such as cranes or compressors) in proximity to sensitive receptors;
- Use of portable screens during substations construction if situated near inhabited places, where possible;
- Inhabitants of local communities nearby the construction locations will be previously informed by the contractor regarding the upcoming construction activities, including information on the planned start of activities, their nature and duration. This communication will also include information regarding the Project nature and goals;
- Any noise complaint will be addressed and resolved through the Project's Grievance Redress Mechanism (see details on **Volume III**). Any noise complaint will be investigated and resolved through adequate mitigation, to be defined case by case, but following best practices in terms of noise mitigation, i.e., first acting on noise source (by stopping the activity or using less noisy technologies or methods), then on the noise propagation path (by installing temporary noise screens or similar action) and then, and only if no other option is available, on the noise receptor (such as noise insulation of buildings or temporary lodging, in extreme cases).

*Impact Summary*

Assuming the application of the proper mitigation measures, as stated above, the residual impact intensity will be lowered to *medium*, resulting in a *very low* residual significance. The impact summary is provided in the following table.

| **Impact: Noise impacts from construction activities** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Vegetation clearing and earthworks will be minimized as much as possible and limited to the strictly needed areas;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h near residential areas;<br>- The location and organization of the construction camps will be carefully defined, taking into account the location of sensitive receptors;<br>- Construction activities will be limited to the daytime period of working week days, whenever near residential areas;<br>- Circulation of construction heavy vehicles will be limited to pre-approved construction routes. These will avoid crossing residential areas, whenever possible;<br>- The contractor will avoid, whenever possible, placing fixed equipment in proximity to sensitive receptors;<br>- Inhabitants of local communities nearby the construction fronts will be previously informed regarding the upcoming construction activities;<br>- Place traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium/High | 3 | | Medium | 2 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Low | 5 | | Very low | 4 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Very Low** | |

## 7.4.2 Operational Phase

### 7.4.2.1 Impact-Generating Activities

During the operational phase of the Project different types of noise can be produced, namely:

- Wind induced noise, generated by the interaction between the wind and transmission line components, under specific weather conditions;
- Noise emissions due to the corona effect, occurring in the transmission cables under specific meteorological conditions, as further detailed below;
- Noise emissions from the operation of substations.

Further to the noise emissions listed above, operation maintenance activities may also generate Project noise, as vehicles will be used to perform vegetation control along the corridor. These vehicles will generate noise emissions but these will be intermittent and sporadic in nature. The associated noise impacts can be considered insignificant and are not further assessed here.

The operational phase noise impacts are assessed in the following section.

### 7.4.2.2 Impact Assessment – Operational Phase

***Impact: Wind-generated noise emissions***

*Impact Assessment*

Wind-generated noise over a high-voltage line occurs during specific wind conditions, when wind interacts with certain components of the power transmission line (such as the supports, insulators, conductors or signalization spheres) in such a way that noise is generated.

Wind-generated noise does not depend only on the level of tension, but rather on the speed and direction of the wind, in which the different components of the line give rise to different types of noise (conductors, insulators and signalization spheres) (Union of the Electricity Industry, 2003).

Wind noise generation from high-voltage lines is infrequent, since the conditions under which the noise occurs are very specific, occurring only for relatively high wind speeds. Even under those conditions, the generated noise levels are low (barely perceptible to the human ear) and rarely noticeable.

Noise generated from insulators may be perceptible but will occur only under specific conditions of high wind speeds, when its direction focuses on certain angles of incidence, and only to some types of insulators applied in high voltage lines.

Location signalization spheres (when installed in on top of the cable lines) for daytime aeronautic signalling are also a component of the transmission line that can be a source of noise.

Power transmission line induced wind noise is difficult to predict, occurring very rarely and depending on the speed of the wind. This type of induced noise is also more frequent if the conductor mounting equipment is loosened or has loosened slightly over the years. This is a maintenance issue that can be easily identified and repaired if necessary.

In the Project's region the annual frequency of high speed winds can be considered as uncommon, reason to infer that impacts generated by the wind acting over the transmission line components can be considered as *negative*, *direct*, of *long-term* duration but of intermittent character, *low intensity*, with a *low probability* of occurrence leading to an impact with a *low significance*.

*Mitigation Measures*

Regular maintenance of the transmission line components will reduce the probability of wind-generated noise.

*Impact Summary*

The impact summary is provided in the following table. Regular maintenance should lower the probability of the impact occurring, reducing the residual significance to *very low*.

| Impact: Wind-generated noise emissions | | | | | | |
|---|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | | |
| Nature | Negative | | - Regular maintenance of the transmission line components. | Negative | | |
| Type | Direct | | | Direct | | |
| Extent | Local | 1 | | Local | 1 | |
| Intensity | Low | 1 | | Low | 1 | |
| Duration | Long-term | 3 | | Long-term | 3 | |
| Consequence | Low | 5 | | Low | 5 | |
| Probability | Probable | | | Possible | | |
| **Significance** | **Low** | | | **Very Low** | | |

***Impact: Noise emissions from corona discharge***

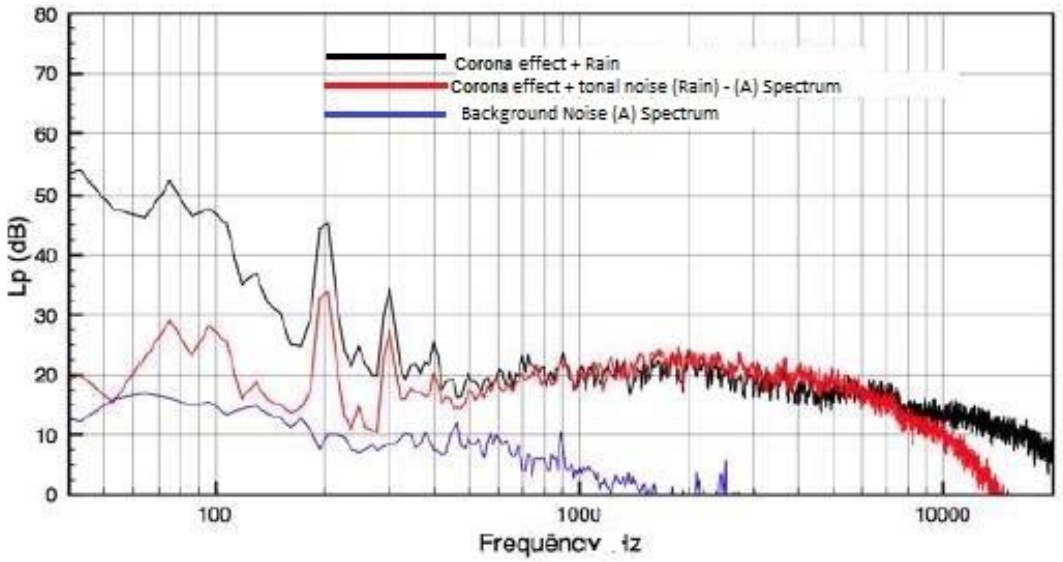
*Impact Assessment*

During the operational phase, an occasional potential disruption of the local sound environment can be caused by a phenomenon called corona discharge. Corona discharges are caused by micro electrical discharges around the conductors. The frequency and intensity of this phenomenon is influenced by the geometrical characteristics of the conductors, the thread tension and by the weather conditions, which need to be favourable to the generation of this kind of noise.

High voltage transmission lines use conductors exposed to the atmospheric conditions. In certain conditions, such as rain and fog, when very high voltage values pass through the transmission lines conductors there's some current leakage to the air. The air, which when dry is a perfect insulator but when moist becomes a conductor itself, is then ionized. In this situation, the electric field turns higher and it begins to appear a bright, effluvia producing a light crackle, where there are sharp edges or protrusions. From a given tension value, and when observed in the darkness, all the driver appears surrounded by a bluish light halo, which produces noise. This phenomenon is called the corona effect or corona discharge.

For this reason, specific weather conditions such as rainfall or high relative humidity are likely to lead to significant variations in the intensity of the "corona discharge", especially in high voltage lines (above 220 kV). Under ideal conditions (for corona discharges), the noise generated by this effect can reach relatively high sound levels (approximately 30 dB(A)), which are noticeable to the human ear and therefore may generate annoyances to people who live in the vicinity of high voltage overhead lines.

**Figure 7.2** below represents the experimental results of acoustic measurements in wet conditions for evaluation of acoustic levels obtained from corona effect (Peralta *et al*., 2009). In these experiments, the sound-level meter integrator was located immediately under the axle of a high-voltage line, operating at 400 kV and at an approximate height of 16 meters from the ground. In addition to the sound spectrum produced by the corona effect, the background noise spectrum from the natural environment is also illustrated in the graphic, without any effect or influence from the transmission line or from some other mechanical noise sources.




**Source:** Adapted from Peralta *et al.* (2004).

**Figure 7.2 – Corona discharge induced noise spectrum**

The figure shows that the 100, 200 and 300 Hz harmonic components of the sound spectrum are already noticeable. The noise from the corona discharge features enough energy in the frequency range of 2-4 kHz, after filtered to A-spectrum to be heard. This is where humans are particularly sensitive to sound. Psychoacoustic studies (Jones, 2007) seem to indicate that the high-frequency components, i.e., broadband noise generated by the corona discharge, can generate more human annoyance than those of the low-frequency tonal components (Peralta *et al*., 2009).

The analysis of the figure above also allows to verify that the corona discharge contribution plus the tonal components of the rain is responsible for an overall noise emission of about 30-35 dB (A) in the 2 kHz frequency range.

Pinto (2008) showed through computational modelling that transmission lines with voltage of 400 kV, at 16 m above the ground, can generate noise levels of 35.7 dB (A) at ground level at 30 m from the line. These levels are attenuated to 32.9 dB(A) at about 50 m from the source.

From the above, and considering that the heights of the proposed towers are greater than 20 meters (ranging between 20-35 meters high) and that the closest receptors near the transmission line would be at distances greater than 50 m (considering the RoW width and the towers height), it can be concluded that the noise produced by the corona effect may be perceptible at the nearest receptors but will be of low magnitude. Therefore is not likely that the corona discharges will generate high enough noise levels to produce significant annoyance effects over the populations residing in the vicinity of the transmission line.

The expected impact from corona discharge induced noise is then considered as being *negative*, *direct*, of *local* extent and *low* intensity, albeit of *long term* duration, resulting in a *low significance*.

*Mitigation Measures*

No specific mitigation is required, other than regular maintenance of the transmission line components, such as insulators.

*Impact Summary*

The impact summary is provided in the following table.

| Impact: Noise emissions from corona discharge | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Regular maintenance of the transmission line components, such as insulators. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Long term | 3 | | Long term | 3 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Low** | |

***Impact: Noise emissions from substation operations***

*Impact Assessment*

Residential houses located in the close proximity to a substation area could be potentially impacted by the noise emissions associated with the substation normal operation. In fact, the noise produced by an operating substation can be potentially heard in the immediate vicinity of the substation fence. A constant humming or buzzing noise may be potentially audible especially during night-time hours when ambient noise levels are lower and if houses are located at distances less than 75 to 100 m from the substation external perimeter fence.

Literature refers that the installation of acoustic barriers/panels (screening devices) surrounding the projected transformers and other noisy plant items can decrease noise emissions up to 15-20 dB(A) (Chen *et al*., 2014). Other technique is the installation of a barrier of mature trees or tall soil berms between the substation and eventual nearby residences, so as to minimize the noise impacts (PSCW, 2013). Noise can also be minimised by implementing Best Available Technology (BAT), namely the use of low noise equipment, where necessary and feasible.

Sensitive receptors were identified in the vicinity of the future Chibuto and Maputo substations, as described in the baseline section. However, the nearest receptors are located at distances greater than 100 meters from the external perimeters of the proposed substations' areas. It is then expected that the substations operational noise will not generate annoyances to the nearest inhabitants. No sensitive receptors were identified in the vicinity of the proposed locations for the Vilanculos and Matalane substations.

The noise impact induced by the substation operation is rated as *negative*, *direct*, of *local extent*, *long term* duration and *low* intensity, resulting in a *low significance.*

*Mitigation Measures*

Given the low significance, no specific mitigation is required. Good environmental practices are still required, both in the design and operation of the substations, to minimize operational noise emissions from the substations, namely:

- Within the substation projected area, locate noisy equipment's away, as much as possible, from the identified nearby residential areas;
- Conduct regular maintenance of the substation transformers in order to minimize noise emissions as much as possible;
- Implement, as feasible and necessary, low noise equipment according with BAT.

In case of eventual complains from the nearby community due to noise emissions from the substation operation, additional measures, such as the installation of a barrier of mature trees or tall soil berms between the substation and eventual nearby residences or the installation of acoustic barriers/panels (screening devices) surrounding the projected transformers and other high noisy equipment's, will be considered and implemented as required.

*Impact Summary*

The impact summary is provided in the following table.

| **Impact: Noise emissions from substation operations** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Within the substation projected area, locate noisy equipment's away, as much as possible, from the identified nearby residential areas;<br>- Implement, as feasible and necessary, low noise equipment according with BAT for this sector;<br>- Conduct regular maintenance of the substation transformers in order to minimize noise emissions as much as possible. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Long term | 3 | | Long term | 3 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Low** | |

# 7.5 Geology and Geomorphology

## 7.5.1 Construction Phase

### 7.5.1.1 Impact-Generating Activities

The geological impact assessment aims to assess the impact that the proposed Project will have on the geological environment, which includes the parent rock and the natural soil profile. This section discusses potential impacts on geology and geomorphology during construction of the proposed powerline and associated mitigation measures to be adopted.

The excavations required for the tower foundation are the only Project activity with the potential to interfere in the geological substrate. The excavations could impact on geological heritage or mineral resources, if any geological formation of interest is interfered with. During tower foundation

excavation, bush clearing and earth grading will be done in order to provide vehicle access to the towers. Depending on location, this may encourage soil erosion. This will be localized rather than an extended linear disturbance. If in close enough proximity to streams and other water courses, erosion or poor management of stockpiles or materials may impact directly on the river in the form of siltation and pollution.

### 7.5.1.2 Impact Assessment – Construction Phase

***Impact: Adverse effects on geological heritage or mineral resources***

*Impact Assessment*

No sites of importance relating to geological heritage or geomorphology have been identified within the RoW. Impacts on geology and geomorphology are expected to be very limited, as no significant earthmoving activities is currently expected to be necessary during construction of the proposed powerline and substations. However, geology and topography will affect the transmission line in terms of engineering, construction costs, and accessibility. It is assumed that a detailed geotechnical assessment or survey will be required. Also it will be important to confirm the geological and soil conditions during the detailed design for the towers, particularly on steeper terrain close to rivers and streams, and in irrigated areas.

Regarding mineral resources, Mozambique has a wide range of geological resources which are at various stages of identification and development. In general, powerline routes should seek to avoid sterilising known mineral or aggregate reserves which are currently being exploited, or could potentially be, at some point in the future. No known mineral resources will be intercepted by the power line, so no impacts are expected in this regard.

Considering the above, this impact is assessed as *negative*, of *local* extent, *low* intensity and *short-term* duration, and of low probability of occurrence (*improbable*), resulting in an *insignificant* rating.

*Mitigation Measures*

The geotechnical assessment or survey for the detailed design of the towers and substation will ensure the stability of the bedrock during each phase of the life of the Project and measures to reduce potential impacts from removal of superficial/bedrock deposits from the site. The results and recommendations of the geotechnical investigations shall be incorporated into the final powerline and substations design.

During construction the impact may need to be re-assessed in light of any newly identified natural heritage site or mineral resource occurrence and special measures could be undertaken.

*Impact Summary*

The impact assessment summary is provided in the following table.

| Impact: Adverse effects on geological heritage or mineral resources | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Conduct a geotechnical assessment or survey for the detailed design of the towers and substation;<br>- Restrict earthmoving activities to the strictly needed areas of construction. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very low | 3 | | Very low | 3 |
| Probability | Improbable | | | Improbable | |
| **Significance** | **Insignificant** | | | **Insignificant** | |

***Impact: Changes in erosion, transport and sedimentation processes***

*Impact Assessment*

With land clearing and earth moving actions, the geological material will be exposed to weathering agents. In the Project area, this aspect takes on a special importance given the occurring geological formations, i.e., quaternary deposits - especially unconsolidated sands, which are particularly sensitive to wind action.

During the construction phase, there could also be an increase in water erosion where vegetation is cleared, thus exposing sands to rainfall and surface runoff. In this context, it is expected that, in situations of intense rainfall, the transport of solids to the watercourses will increase with a resulting increase in turbidity. However, the water erosion effect will not be very significant given the high permeability of the soils that determine the infiltration of rainwater, and no significant water flows resulting from surface runoff will occur.

This impact is assessed as *negative*, of *local* extent, *low* intensity and *short-term* duration, and of low probability of occurrence (*improbable*), resulting in an *insignificant* rating.

*Mitigation Measures*

Despite the significance rating, the following mitigation is proposed, as best practice:

- Limit vegetation clearance and topsoil stripping to the areas strictly necessary for the execution of the works;
- Soils excavated for pylon foundations will be used for backfilling excavations and not be left exposed to wind or water for long periods;
- Keep to existing roads, where practical, to minimize impacts on undisturbed ground;
- Construction traffic will follow defined temporary access routes to be established as part of the works so as to avoid damaging the soil structure in the wider area. The contractor will minimise and avoid as far as possible tracking over steep terrains during the transportation of construction materials or during way-leave clearance. Repairs to access roads will be undertaken to maintain the surfacing and prevent soil erosion:
- Degraded areas will be re-planted with local species to improve ground cover;

- Ensure that all power line and substations construction areas have adequate review by geotechnical engineers and geologists for expansive/collapsible soils and for potential areas of slope instability prior to construction.

*Impact Summary*

The impact assessment summary and the main mitigation measures are provided in the following table.

| Impact: Changes in erosion, transport and sedimentation processes | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Limit vegetation clearance and topsoil stripping to the strictly necessary areas;<br>- Keep to existing roads, where practical, to minimize impacts on undisturbed ground;<br>- Minimize soil exposure during periods of heavy rain during excavations and earth moving activities;<br>- Ensure that all power line and substations construction areas have adequate review by geotechnical engineers and geologists for expansive/collapsible soils and for potential areas of slope instability prior to construction. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very low | 3 | | Very low | 3 |
| Probability | Improbable | | | Improbable | |
| **Significance** | **Insignificant** | | | **Insignificant** | |

### 7.5.2 Operational Phase

The operational phase is not expected to affect, or be affected by, geology and geomorphology. No impacts on geology or geomorphology were thus identified for the operational phase.

## 7.6 Soils

### 7.6.1 Construction Phase

#### 7.6.1.1 Impact-Generating Activities

Electric power transmission lines could have significant impacts on soil resources and land use, namely through the following activities:

- Vegetation clearance for establishment of RoW: although the RoW is relatively narrow, it can interfere with, or fragment, existing land uses along the RoW (such as irrigation). The removal of vegetation cover can also enable the increase of soil erosion;
- Land modeling and movement of vehicles and machinery: these construction activities can lead to soil erosion by removing vegetation cover and compacting soils. Erosion can reduce soil fertility and lead to siltation, which affects water quality and productivity in aquatic and wetland ecosystems;
- Waste generation and handling of hazardous substances: inadequate management or handling of wastes and hazardous substances could lead to accidental spills or leaks, with potential contamination of soils.

The potential effects of these impacts and their significance area are described below.

### 7.6.1.2 Impact Assessment – Construction Phase

***Impact: Impacts on irrigation lands and on soils with suitability for irrigation***

*Impact Assessment*

The loss of high value farm land and/or the associated food security production loss as a result of developments is of particular concern in Gaza and Inhambane Provinces, since there is some scarcity of high potential agricultural land suitable for irrigation and land crop production on these provinces. Therefore, areas which can sustainably accommodate irrigated land production need to be protected from non-agricultural land uses.

The lands with irrigation suitability are described in the baseline chapter and the biggest area is located on the floodplain of Limpopo River, namely at Chokwe and Xai-Xai. The placement of transmission structures can cause soil/agricultural impacts, namely create problems for turning field machinery and maintaining efficient fieldwork patterns.

The impacts are related to the construction activities and the defined location for the placement of the towers (the impact extends to the operation phase). However, at the present stage of the Project, the location of the towers is not yet defined, so their individual consideration in irrigated areas or in soils suitable for irrigation can not be assessed in detail. Nevertheless, it is expected that there will be some destruction to farmland and the Project should repair most of the damage that can occur during construction and provide monetary compensation for damages that cannot be easily repaired. The compensation procedures are extensively described in the Ressetlement Plan (which accompanies this EIS report). Efforts should also be made to ensure that some of the access roads required during Project implementation do not become permanent.

Also, it must be highlighted that there are certain types of irrigation systems that can be dangerous on a transmission line RoW, such as water from stream gun irrigators that must not make direct contact with transmission line towers or poles, and should not encroach on exclusion distances from the conductors (electricity wires) or any live parts. However most of the irrigation systems in Limpopo floodplain are depending on high groundwater levels (free superficial aquifer), but some pump the water directly from the Limpopo river.

Considering the above, this impact is assessed as *negative*, *local* (as the interference between the Project and irrigation land only occurs in the Limpopo floodplain), of *medium* intensity (as the irrigation practices are only partially affected, in the RoW) and of *long-term* duration (as some restrictions to irrigations within the RoW will continue throughout the operational phase), resulting in a *medium significance*.

*Mitigation Measures*

Because of the very nature of the work and the equipment used, it isn't possible to completely eliminate disturbances on irrigated farms. However, by applying the following protective, remedial and restoration measures, certain problems can be prevented and Project impacts can be limited.

In the final design of the Project the sitting of transmission facilities will seek to avoid to the maximum extent possible areas of high irrigation suitability:

- Using transmission structures with longer spans to clear fields;
- Using special transmission designs to span existing irrigation systems;
- Locating the line along field lines, or adjacent to roads so as to minimize field impacts;
- Orienting the structures with the plowing pattern to make farm equipment less difficult to use;

Also,

- Avoiding construction activities during times when soils are saturated;
- Learning about individual farm field activities, such as planting, tillage, and crop rotations so that construction methods and timing can be adapted to the timing of crop work.

*Impact Summary*

The impact assessment summary and the main mitigation measures are provided in the following table. The mitigation reduces the intensity of impact to *low*, lowering the residual significance to *low*.

| **Impact: Impacts on irrigation lands and on soils with suitability for irrigation** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - The siting of transmission facilities will seek to avoid to the maximum extent possible areas of high irrigation suitability;<br>- Avoid construction and maintenance activities during times when soils are saturated;<br>- Learn about individual farm field activities, such as planting, tillage, and crop rotations so that construction methods and timing can be adapted to the timing of crop work. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Definite | | | Probable | |
| **Significance** | **Medium** | | | **Low** | |

***Impact: Increased soil erosion and compactation***

*Impact Assessment*

Soil mixing, erosion, rutting, and compaction are interrelated impacts commonly associated with transmission construction and can greatly affect future crop yields and vegetation regeneration. Soils may be mixed during the excavation of pole foundations or during the undergrounding of electrical lines (the excavation depth for transmission structure foundations can vary greatly). Further to excavations, soil erosion and compaction can also result from the movement of heavy construction machinery and vehicles, both at the work sites and work camps and on the access routes to the work sites, whenever unpaved roads are used.

Excavated parent material or subsoils should not be mixed with topsoils and spread on the surface of the RoW. Significant rutting can occur when soils become saturated, which may impact agricultural lands. The degree to which soils are compacted by heavy construction equipment depends on the type of soil and its saturation level. Ineffective erosion controls may wash valuable topsoils downhill and impact wetlands and waterways. Agricultural soils that have been improperly protected or

mitigated may suffer decreased yields for several years after the construction of the transmission line is completed.

Considering the nature of the construction activities, the impact is assessed as *negative*, of *local* extent (as this impact is restricted to the tower sites and other localized areas where earth movements or intense movement of heavy machinery are expected), of *medium* intensity, and *medium-term* duration (as affected soils were recover slowly after construction is concluded), resulting in a *low significance*.

*Mitigation Measures*

To minimize soil compaction during construction in low-lying areas, saturated soils, and/or suitable irrigation soils, low-impact machinery with wide tracks can be used. When construction of the line is complete, the soil in the RoW in fields that were accessed by heavy construction traffic should be checked for compaction with a soil penetrometer and compared to penetrometer readings on soils outside of the RoW, especially in irrigated areas. If compaction within the RoW is detected, appropriate equipment should be used to restore the soil tilth. A soil with good tilth has large pore spaces for adequate air infiltration and water movement. Also:

- Prioritize the use of existing paths to access work sites. If new accesses are opened or existing ones are improved, avoid impacts on adjacent areas;
- Restrict vegetation clearing and topsoil removal to the areas strictly required for construction;
- Strip and store topsoil prior to earth moving activities for later reuse in rehabilitation works;
- Protect temporarily stored soils with a waterproof cover and adequate height to ensure stability;
- Ensure that all cleared and impacted land is rehabilitated and re-vegetated, as appropriate.

*Impact Summary*

The impact summary is provided in the table below.

| **Impact: Increased soil erosion and compactation** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Prioritize the use of existing paths to access work sites;<br>- Restrict vegetation clearing and topsoil removal to the areas strictly required for construction;<br>- Strip and store topsoil prior to earth moving activities for later reuse in rehabilitation works;<br>- Protect temporarily stored soils;<br>- Decompact soils following construction with appropriate equipment until the degree of soil compaction on the RoW is similar to soils of the RoW (especially in irrigated areas). | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Medium-term | 2 | | Short-term | 1 |
| Consequence | Low | 5 | | Very low | 3 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Very Low** | |

***Impact: Potential soil contamination***

*Impact Assessment*

Soil contamination may result from unsound waste management practices. Hazardous waste can be easily ignited, corrosive, reactive, or toxic. They can also have other physical, chemical, or biological characteristics that pose a potential risk to human health or the environment, if improperly managed. Contractors and sub-contractors will be required to develop and implement waste management plans that comply with relevant waste management guidelines to ensure that various types of waste produced during the construction phase (sanitary, non-hazardous and hazardous) are adequately recovered, stored and disposed of.

Inadequate handling or management of hazardous substances, or bad maintenance of vehicles and machinery, can also lead to spills or leaks of contaminants, with potential soil contamination.

This impact is assessed as *negative,* of *local* extent, *medium* intensity (in particular if soils of good agricultural quality are affected) and *medium term* duration. It is, however, an impact with a low probability of occurrence (*possible*), as it will only manifest in the event of accidental spills or if inadequate management of wastes and hazardous substances is verified. As such, the significance is rated as *very low*.

*Mitigation Measures*

Given the risk of soil contamination, construction activities will be managed according to industry best practices, namely in what regards control of accidental leaks and spills and waste management, including:

- Adopt good housekeeping to prevent spillages and contamination;
- Store oils, fuels and other hazardous and potentially pollutant products safely in order to prevent its spillage in soil and/or water resources. The storage of these materials will be done in the construction camps, in dedicated impervious areas, with cover and containment structures;
- Machinery will be properly maintained to keep oil leaks in check;
- Provide in the construction camps a designated area for refuelling, washing and maintenance of equipment and vehicles with impervious floor and containment structures. Place these facilities away from rivers, wetlands and water bodies, manage runoff according to the effluent management plan;
- In the event of a spill of pollutant material, respond to it immediately, namely (additional information is provided in the Emergency Response Plan – **Volume III**):
  - If a spill occurs on a permeable surface (e.g. soil), a spill kit must be used to immediately reduce the potential spread of the spill. All work fronts will have readily available spill kits;
  - If a spill occurs on an impermeable surface such as cement or concrete, the surface spill must be contained using oil absorbent materials;
- Prohibit the discharge of any type of non-treated residual water in the soil and/or water resources (rivers, streams, springs, lagoons, aquifers, etc.);

- Develop a Waste Management Plan, following the guidelines provided in the ESMP (see **Volume III**).

Contaminated remediation materials must be carefully removed from the area of the spill so as to prevent further release of hazardous chemicals to the environment, and stored in adequate containers until appropriate disposal in a licensed landfill site.

*Impact Summary*

The impact assessment summary is provided in the following table. The mitigation reduces the residual significance of the impact to *insignificant*.

| **Impact: Potential soil contamination** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - If a spill occurs, a spill kit must be used to immediately reduce the potential spread of the spill;<br>- Prohibit the discharge of any type of non-treated residual water in the soil and/or water resources (rivers, streams, springs, lagoons, aquifers, etc.);<br>- Develop a Waste Management Plan, following the guidelines provided in the ESMP. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Medium-term | 2 | | Short-term | 1 |
| Consequence | Low | 5 | | Very Low | 3 |
| Probability | Possible | | | Improbable | |
| **Significance** | **Very Low** | | | **Insignificant** | |

### 7.6.2 Operational Phase

During the operations phase, no relevant impacts on soils are expected. Nevertheless, the risk of soil contamination from accidental oil spills from maintenance vehicles and machinery cannot be completely discarded. Oil spills could result from equipment breakdown at the substation sites and lead to soil contamination in proportion with the magnitude of these accidental events. Response to accidental spills during the operational phase should follow the same procedures described in the previous section, and detailed in the Emergency Response Plan (see **Volume III**). To this effect, spill kits should be made available at all substations.

Moreover, specific attention must be given to the proper management of hazardous waste, particularly waste oil and substation equipment such as transformers. The application of general mitigation measures and of the waste management plan will help reducing this risk significantly.

## 7.7 Water Resources

### 7.7.1 Construction Phase

#### 7.7.1.1 Impact-Generating Activities

The proposed transmission line route intercept a great number of rivers and water lines along its length, which can be divided into four major hydrographic basins: Govuro, Limpopo, Incomati and

Matola. The crossing of four major rivers stands out, namely: Changane, Limpopo, Incomati, and Matola rivers. Also, the Project alignment crosses the Limpopo and Incomati floodplains, in areas with cycle flood problems in the wet season. In general, floods occur between January and March.

During the Project's construction phase, the main construction activities likely to generate impacts on water resources include:

- Vegetation clearance on river banks, flood plains and wetland areas;
- Excavations for the construction of towers on river banks, flood plains and wetland areas,
- Construction of access roads, with potential interferences with river banks, flood plains and wetland areas;
- Location and operation of construction camps, with potential interferences with river banks, flood plains and wetland areas (if sited wrongly) and potential water pollution impacts, due to inadequate management and disposal of solid waste, wastewater and hazardous materials (oils, fuel, lubricants, etc.).

These activites could generate two different potential impacts on water resources:

- Changes on natural run-off patterns – caused by the changes to topography and hydrography resulting from vegetation clearance, excavations and construction of access roads;
- Pollution of surface water – potentially caused by accidental releases or spills of toxic substances and inadequate waste management.

Due to the nature and extent of the Project, the impacts on water resources will be more relevant during the construction phase. The following chapter presents the assessment and mitigation measures for each of the identified impacts.

### 7.7.1.2 Impact Assessment – Construction Phase

***Impact: Potential changes to natural run-off patterns***

*Impact Assessment*

During the construction phase, changes on natural run-off can occur mainly due to:

- Vegetation clearance on river banks, flood plains and wetland areas;
- Excavations for the construction of towers on river banks, flood plains and wetland areas;
- Construction of access roads.

Vegetation clearance and excavations in river banks, flood plains and wetland areas can increase soil erosion and the dragging of sediments into the water bodies, especially during rain events. Ultimately, this can modify the river sedimentation patterns and the natural flow dynamics.

The construction of access roads over river banks can interrupt or constrain the river flow, creating temporary and permanent changes, including: reduction of flow section, changes on the sedimentation characteristics and increased erosion of river banks.

Due to the nature and extent of the construction activities it is expected that this *negative* impact will have *short term* duration, as once the construction activities are completed the watercourses will

mostly resume their normal flow conditions. Note that no permanent impacts are expected, as the Project will not construct permanent infrastructure in river beds or banks.

The extent of this impact is rated as *local*, as changes to natural flow can be relevant only in the river section where the construction activities will take place. This impact is assessed as having *medium* intensity (river flow will continue, albeit in a modified way), resulting in a *very low significance* impact.

*Mitigation Measures*

Even though the impact was assessed as of low significance, the following measures will be adopted:

- Avoid affecting river beds and floodplain areas by the construction activities (including movement of machinery), as much as possible;
- Whenever possible, carry out works on river banks, flood plains and wetland areas, in the dry season, during the months of lower flow;Whenever possible, locate the towers outside river banks and floodplains;
- Do not block or constrain river flow in the construction of access roads, even if temporary. Ensure that suitable transversal drainage (culverts, viaducts, etc.) are in place;
- Minimize the clearance of riparian vegetation. The affected areas will be rehabilitated;
- The Contractor is required to submit a method statement for every river and wetland crossing for EDM approval.

These mitigation measures are included, and expanded, in the ESMP through the Water Resources Management Program (see **Volume III**).

*Impact Summary*

The impact assessment summary and the main mitigation measures are provided in the following table. The mitigation measures will lower the intensity and probability of occurence of the impact, reducing the residual significance to *insignificant.*

<table>
<tr><th colspan="5">Impact: Potential changes to natural run-off patterns</th></tr>
<tr><th>Criteria</th><th colspan="2">Pre-mitigation assessment</th><th>Mitigation Measures</th><th colspan="2">Post-mitigation assessment</th></tr>
<tr><td>Nature</td><td colspan="2">Negative</td><td rowspan="9">- Avoid affecting river beds and floodplain areas by the construction activities, as much as possible;<br>- Whenever possible, carry out works on river banks, flood plains and wetland areas, in the dry season;<br>- Whenever possible, locate the towers outside river banks and floodplains;<br>- Do not block or constrain river flow in the construction of access roads, even if temporary. Ensure that suitable transversal drainage (culverts, viaducts, etc.) are in place;<br>- Minimize the clearance of riparian vegetation. The affected areas will be rehabilitated.</td><td colspan="2">Negative</td></tr>
<tr><td>Type</td><td colspan="2">Direct</td><td colspan="2">Direct</td></tr>
<tr><td>Extent</td><td>Local</td><td>1</td><td>Local</td><td>1</td></tr>
<tr><td>Intensity</td><td>Medium</td><td>2</td><td>Low</td><td>1</td></tr>
<tr><td>Duration</td><td>Short term</td><td>1</td><td>Short term</td><td>1</td></tr>
<tr><td>Consequence</td><td>Very Low</td><td>4</td><td>Very Low</td><td>3</td></tr>
<tr><td>Probability</td><td colspan="2">Probable</td><td colspan="2">Possible</td></tr>
<tr><td>Significance</td><td colspan="2">Very Low</td><td colspan="2">Insignificant</td></tr>
</table>

***Impact: Potential pollution of surface waters during the construction phase***

*Impact Assessment*

Water pollution is any physical, chemical or biological change in water quality that renders it unfit for its intended purpose or causes damage to living organisms. The main potential causes of pollution of surface water during the construction phase include:

- Vegetation clearance on river banks, flood plains and wetland areas,
- Excavations for the construction of towers on river banks, flood plains and wetland areas,
- Inadequate management and disposal of waste (hazard and non hazard) produced in the construction activities, at the construction yard and at campsites,
- Inadequate management or accidental spills of hazard material (oils, fuel, lubricants, etc.) used for construction equipment and vehicles and construction activities,
- Inadequate management, treatment and disposal of wastewater produced in construction activities (concrete wash), at the construction yard and campsites (bathrooms, showers, laundry facilities, food service, vehicles and equipment wash, etc).

The removal of vegetation and excavations in riparian areas, flood plains or wetland areas can increase soil erosion and the dragging of sediments into the water resources, especially during rain events. Eventually, this could lead to the deterioration of water quality, through the increase of Suspended Solids and associated Turbidity. High turbidity can affect water colour. High concentration of suspended solids decreases the passage of light through water, limiting photosynthesis of aquatic plants and the production of Dissolved Oxygen. Additionally, water temperature increases, since suspended particles absorb more heat. Thus, Suspended Solids increase can also affect aquatic life. Suspended materials can clog fish gills, reduce fish resistance to disease, lower growth rates, and affect roe and larval development. As the particles settle on river beds, especially in calm waters, they can suffocate fish eggs and benthic macro-invertebrates.

Wastewater produced at refuelling, maintenance and washing areas of equipment and vehicles are rich in oil and greases (oils, fuel, and lubricants) and detergents. These organic chemicals can affect human health and damage aquatic life.

Domestic wastewater is rich in organic matter and suspended solids. It can also contain relevant concentrations of nitrogen (nitrates, ammonia) and phosphate (phosphates). The increase of organic matter in water reduces the concentration of dissolved oxygen, due to its decomposition by aerobic bacteria, and can affect aquatic communities. The presence of nutrients such as nitrites, phosphates and ammonia, promote excessive growth of algae and aquatic plants, potentially leading to imbalances in aquatic ecosystems and in extreme cases to the eutrophication of water bodies. Domestic wastewater contains human faeces and as such is rich in bacteria, and can also contain pathogenic micro-organisms (Virus, Salmonella, Vibrio cholera). Infectious agents are the major concern associated with domestic wastewater pollution.

If not adequately managed, construction activities can lead to the contamination of surface water that, in turn, can have adverse indirect impacts in the aquatic communities and affect the health of the population that uses the water.

The potential impact of water pollution is assessed as a *direct negative* impact, of *short-term* duration (the source of contamination will disappear with the end of the construction phase), *regional* extent (as pollutants can disperse downstream) and *medium intensity*, resulting in a *low significance*.

*Mitigation Measures*

Even though the impact was assessed as of low significance, the following measures will be implemented:

- Whenever possible, carry out works on river banks, flood plains and wetland areas, in the dry season, during the months of lower flow;
- Minimize the clearance of riparian vegetation. The affected areas will be rehabilitated;
- Avoid the movement of machinery on river beds and floodplain areas, as much as possible;
- Whenever possible, locate the towers outside river banks and floodplains;
- Locate campsites and work yards 100 m away from riverbanks, floodplains and wetlands;
- Do not discharge untreated effluents or wastewaters into soil or natural water masses. Collect all effluent produced (sanitary facilities, kitchens, canteens, baths, washing, etc.) and process in suitable wastewater treatment facilities. The treated effluents must be in compliance with quality emission limits defined in national legislation, namely Decree no. 18/2004 (as amended by Decree no. 67/2010), which regulates the Environmental Quality and Effluent Emission Standards, or applicable international standards (namely the WBG EHS Guidelines (IFC, 2007a)), whichever is stricter;
- Treated wastewater discharge locations must be agreed and approved by district authorities;
- Install portable temporary toilets with septic tank in the construction sites. These must be properly fixed to the ground to avoid tipping over. The facilities require periodic maintenance to empty the tanks and cleaning routines to ensure the hygiene of the facilities. The collected effluent should be taken for treatment at the nearest treatment facility. Place sanitary facilities 100 m away from river banks, floodplains and wetlands, and residential and community use areas;
- Do not use natural water resources, including sources, streams or open water bodies, for equipment or vehicle washing. This activity can only take place in properly dedicated washing areas, with waterproof floor and effluent collection and treatment;
- Prohibit workers to use natural water ways for recreational purposes, bathing or washing;
- Store oils, fuels and other hazardous and potentially pollutant products safely in order to prevent its spillage in soil and/or water resources. The storage of these materials should be made in impervious areas, with cover and containment structures;
- Provide parking spaces for machinery and vehicles. Inspect periodically these areas to verify occurrence of spillage and if necessary proceed with cleaning;
- Maintain equipment and machinery in good running condition, including brakes, mufflers and silencers, catalyzers and clean (power washed), free of leaks, excess oil and grease;
- Provide a designated area for refuelling and maintenance of equipment and vehicles with impervious floor and containment structures. Place these facilities away from water courses and from residential and community use areas (minimum 100 m);

- Install pre-treatment of oil and grease containing effluents (e.g. grease trap) in vehicles and equipment washing, refuelling and maintenance areas;
- Develop and implement a Waste Management Plan for the construction phase including the following measures (see additional guidelines in the ESMP):
  - Provide adequate areas (waterproofed and sealed) to accommodate temporary storage facilities of hazardous and non-hazardous waste;
  - Define the appropriate final destination for the waste of the Project in coordination with municipal authorities. The non-hazardous waste can be deposited in a municipal landfill. The hazardous waste should be deposited in a facility duly licensed by the Ministry of Land, Environment and Rural Development (MITADER);
  - Promote the recycling and recovery of waste, in coordination with municipal authorities and private entities;
  - The transport of hazardous waste out of the producer facilities can only be performed by an entity licensed by MITADER and shall comply with the basic regulations and procedures stipulated in Annex IX of Decree nº13/2006;
  - Prohibit the burial or dump of waste (including vegetation, soil or construction materials) in soil, water resources or sea;
  - Prohibit the burning and burial of waste.

These mitigation measures are included, and expanded, in the ESMP through the Water Resources Management Program and Waste Management Plan (see Volume III).

*Impact Summary*

The impact assessment summary is provided in the following table. The defined mitigation reduces the impact intensity to *low*, resulting in a *very low* residual significance.

| **Impact: Potential pollution of surface waters during the construction phase** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Whenever possible, carry out works on river banks, flood plains and wetland areas, in the dry season;<br>- Avoid the movement of machinery on river beds and floodplain areas, as much as possible;<br>- Whenever possible, locate the towers outside river banks and floodplains;<br>- Minimize the clearance of riparian vegetation. The affected areas will be rehabilitated;<br>- Implement adequate management and treatment of wastewater;<br>- Implement adequate storage and management of oils, fuels and toxic substances;<br>- Develop and implement a Waste Management Plan for the construction phase | Negative | |
| Type | Direct | | | Direct | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Short term | 1 | | Short term | 1 |
| Consequence | Low | 5 | | Very Low | 4 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Very Low** | |

## 7.7.2 Operational Phase

### 7.7.2.1 Impact-Generating Activities

During the operational phase, the Project will have little interaction with surface water resources. The only relevant activity will be the regular maintenance of the substation sites, as well as waste generation at those sites. Inadequate management of waste and toxic materials could lead to accidental spill events, with potential impacts of water contamination.

### 7.7.2.2 Impact Assessment – Operational Phase

***Impact: Potential pollution of surface waters during the operational phase***

*Impact Assessment*

During the operation phase, accidental oil spills resulting from equipment breakdown and maintenance at the substation sites, can lead to soils and surface water contamination in proportion with the magnitude of these accidental events.

Also, inadequate management and disposal of waste (hazard and non hazard) and hazardous materials produced in the substations can lead to soils and surface water pollution.

The potential impact of water pollution is assessed as a *direct negative* impact, of *long* duration, *local* extent and *low* intensity (as the substations are located away from river banks and floodplains), resulting in a *low significance*.

*Mitigation Measures*

Even though the impact was assessed as of low significance, the following measures will be implemented:

- Maintain substation equipment in good running condition, free of leaks, excess oil and grease;
- Regularly inspect all equipment at the substations that may contain contaminants, such as transformers;
- Develop and implement a Waste Management Plan for the operational phase.

*Impact Summary*

The impact assessment summary and the main mitigation measures are provided in the following table. The defined mitigation lowers the probability of occurrence of this impact, lowering the residual significance to *very low*.

| Impact: Potential pollution of surface waters during the operational phase | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Maintain substation equipment in good running condition, free of leaks, excess oil and grease;<br>- Regularly inspect all equipment at the substations that may contain contaminants, such as transformers;<br>- Develop and implement a Waste Management Plan. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Long term | 3 | | Long term | 3 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Probable | | | Possible | |
| **Significance** | **Low** | | | **Very Low** | |

# 7.8 Landscape and Visual Impacts

## 7.8.1 Construction Phase

### 7.8.1.1 Impact-Generating Activities

The construction of the Project will involve several activities that will potentially affect the landscape of the area of influence of the Project. The activities that are expected to have greater influence on the visual component during construction will be:

- Vegetation clearance in the RoW;
- Temporary construction camps and presence of associated equipment and vehicles;

These actions will result in visual impacts for observers who circulate in the surrounding areas. This is a temporary effect that will impact only in the short time span of the construction. This impact can be described as a temporary degradation of landscape at worksites, due to:

- Temporary degradation of scenic value in woodland and forested areas;
- Change in tranquility of the surrounding landscape;
- Localized light pollution;
- Changing wilderness character and creating dominant visual elements.

This impact is assessed in the following section.

### 7.8.1.2 Impact Assessment – Construction Phase

***Impact: Temporary degradation of landscape at worksites***

*Impact Assessment*

Aesthetic impacts during the construction phase will be limited to the work areas. Deforestation of the RoW will alter the landscape. Vegetation clearance and the movement and presence of vehicles and equipment will contribute to visual confusion, spatial disorganization and consequently to the reduction of landscape quality.

The extent of the impact is *local* as the impact will only be felt along the RoW and access roads. The intensity is assessed as *medium*, in particular in areas where undisturbed woodlands are interfered

by the RoW, as these have some scenic quality (in more humanized areas, the intensity is assessed as *low*). The impact duration, in global terms, is *medium term*, as it will be felt over a period of time equivalent to the construction phase (note however, that the duration at each specific work front will be significantly shorter). The significance of the impact on the landscape during the construction phase is thus assessed as *low*.

*Mitigation Measures*

Even though the impact was considered to be of low significance, some mitigation measures, in the form of standard good practices, should still be applied, namely:

- Prioritize the use of existing access roads to access work sites. If new accesses are opened or existing ones are improved, avoid impacts on adjacent areas;
- Promote the selection of areas with less of a need for tree cutting for temporary work and storage areas;
- All temporary access roads and work areas will be rehabilitated after construction is concluded (this does not include the RoW, where vegetation needs to be controlled), namely:
  - Revegetate areas of bare and disturbed soils as soon as possible with native species;
  - Rehabilitate and revegetate temporary access road and work areas as soon as possible.

*Impact Summary*

The application of the mitigation measures limits the intensity of the impact on the landscape during the construction phase. With the implementation of the mitigation measures, the residual significance is assessed as *very low*.

| **Impact: Temporary degradation of landscape at worksites** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Prioritize the use of existing access roads to access work sites. If new accesses are opened or existing ones are improved, avoid impacts on adjacent areas;<br>- Promote the selection of areas with less of a need for tree cutting for temporary work and storage areas;<br>- Revegetate areas of bare and disturbed soils as soon as possible with native species;<br>- Rehabilitate and revegetate temporary access road and work areas as soon as possible. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Medium term | 2 | | Medium term | 2 |
| Consequence | Low | 5 | | Very Low | 4 |
| Probability | Definite | | | Probable | |
| **Significance** | **Low** | | | **Very Low** | |

## 7.8.2 Operational Phase

### 7.8.2.1 Impact-Generating Activities

During the operational phase, the Project will generate visual impacts on the landscape due to the presence of new landscape elements, namely:

- Presence of infrastructures (towers, power line, buildings);
- Presence of permanent right of way (RoW) under the overhead line.

This impact can be characterized as a permanent alteration to the landscape, due to:

- Change in tranquility of the surrounding landscape;
- Localized light pollution;
- Changes to wilderness character due to the creation of dominant visual elements.

This impact is assessed in the following section.

### 7.8.2.2 Impact Assessment – Operational Phase

***Impact: Permanent alteration to the landscape***

*Impact Assessment*

The overall aesthetic effect of a transmission line is likely to be negative to most people, especially where proposed lines would cross natural landscapes. The tall steel structures may seem out of proportion and not compatible with agricultural landscapes, vast plains or luxuriant hills. Substations will generally have a more subtle impact on the landscape as they will blend better with the urban or peri-urban areas in which they will be installed.

Research and experience shows that reaction to aesthetic of transmission lines vary. Some residents do not notice them or find them objectionable from an aesthetic perspective. To some, the power transmission lines or other utilities may be viewed as part of the infrastructure necessary to sustain everyday lives and activities and are therefore acceptable. To others, new transmission lines may be viewed in a positive way as they are associated with economic development.

The extent of the impact is *local*, as the impact will be felt in the immediate vicinity of the transmission line. The impact duration is *long term* as it will be felt continuously for the lifetime of the transmission line. The intensity of the impact on the landscape during the operation phase is considered *medium*. The significance of the impact is thus assessed as *medium*.

*Mitigation Measures*

The mitigation to be implemented includes the following:

- Use existing access roads optimally so as to reduce the need for new deforestation;
- Minimize the number of permanent access roads to and in the RoW, when possible, proceed to early closing and rehabilitation of access roads near sensitive scenic areas;
- Allow tree and shrub species whose height is limited to 3 m to grow within the RoW (outside of the full clearance 30 m corridor);
- If complaints are received, from local communities or other stakeholders, regarding a negative visual impact created by the transmission line, create visual barriers to reduce line visibility in sensitive areas, if feasible.

*Impact Summary*

The application of the mitigation measures limits the impact on the landscape during the operation phase to a *low* significance.

| Impact: Permanent alteration to the landscape | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Minimize the number of permanent access roads to and in the RoW, when possible, proceed to early closing and rehabilitation of access roads near sensitive scenic areas;<br>- Allow tree and shrub species whose height is limited to 3 m to grow within the RoW (outside of the full clearance 30 m corridor);<br>- If complaints are received, from local communities or other stakeholders, regarding a negative visual impact created by the transmission line, create visual barriers to reduce line visibility in sensitive areas, if feasible. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Long term | 3 | | Long term | 3 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Definite | | | Definite | |
| **Significance** | **Medium** | | | **Low** | |

# 7.9 Biodiversity

## 7.9.1 Construction Phase

### 7.9.1.1 Impact-Generating Activities

The construction phase of the STE Project will include all required works for the establishment of the transmission line and substations, thus encompassing a wide range of construction activities. The main activities that could generate impacts on biodiversity are the following:

- Vegetation clearing and land modeling – required to establish the RoW and to prepare the land for construction of the tower foundations, substations, access roads, and construction camps. This will lead to direct loss of habitats and vegetation, with subsequent impact on the fauna communities that depend on those habitats;
- Earthworks – mainly excavations, required to build the tower foundations and substations, but also some cut and fills that may be required to construct the access roads. This activity will also lead to direct loss of habitats, as above, and will result in an increase in dust emissions, with potential smothering of vegetation in the areas surrounding the construction areas;
- Movement and operation of vehicles and machinery – the movement of vehicles and the operation of machinery can cause further degradation of vegetation units, is a source of potential contaminant leaks and spills to the soil and water and is also a source of light and noise emissions, which coupled to the more intense human presence will cause a disturbance effect on terrestrial fauna, potentially causing displacement of fauna from areas near construction. The movement of machinery and vehicles also increases collision risks with animals, with increasing risk of fauna mortality. The potential import of construction vehicles, which might be contaminated with alien plant seeds, could lead to spread of alien plants causing habitat degradation; and
- Presence of large construction workforce – the presence of a large construction force, and the potential population influx of people looking for work, could lead to an increase of risk of fire and an increase of harvesting of natural resources (e.g., wood, charcoal, fish, bushmeat,

etc.), with the resulting impacts on habitats and vegetation and an increase in fauna mortality (due to hunting).

These impacts are assessed in the following section.

### 7.9.1.2 Impact Assessment – Construction Phase

***Impact: Direct loss of vegetation units and habitats***

*Impact Assessment*

The construction of access roads, transport line and substations will require the clearing of vegetation. In the case of the line corridor, vegetation will be cleared in a 30 m corridor along the full length of the alignment, in order to establish the RoW. This constitutes a direct loss of the vegetation units affected, as well as a loss of habitat for the fauna communities that depend on these habitats. Please note that while the full width of the RoW is 100 m, vegetation will only be fully cleared on a 30 m corridor – 15 m to each side of the line, as per the vegetation clearance standards presented in the Project Description (see Table 4.5; Chapter 4, **Volume I**). Outside of this full clearance corridor, only selective trimming or cutting of larger trees will be done.

Using the vegetation units map, the areas lost as a result of the Project were calculated in a GIS environment, and are provided in **Table 7.14** below.

**Table 7.14 – Areas of vegetation units impacted by the line and substations (in hectares)**

| Vegetation units | Area cleared in the 30m corridor | | Area (ha) within the substation area | | | |
|---|---|---|---|---|---|---|
| | (ha) | (%) | Maputo | Matalane | Chibuto | Vilankulos |
| Miombo forest | 3.4 | 0.2% | - | - | - | - |
| Miombo woodland | 51.2 | 3.0% | - | - | - | - |
| Undifferentiated woodland | 1 080.4 | 64.1% | - | 38.0 | 16.0 | 11.5 |
| Savanna | 146.1 | 8.7% | - | - | - | - |
| Thicket | 6.6 | 0.4% | - | - | - | - |
| Rivers and wetlands | 49.6 | 2.9% | - | - | - | - |
| Waterbodies | 4.3 | 0.3% | - | - | - | - |
| Subsistence agriculture | 260.4 | 15.5% | 14.2 | 66.8 | - | 0.31 |
| Irrigation agriculture | 65.1 | 3.9% | - | - | - | - |
| Disturbed areas | 17.5 | 1.0% | 0.1 | 1.0 | - | - |

The vegetation unit that will be more affected by the line corridor will be the undifferentiated woodland (1145.9 ha), but this is also the most representative vegetation unit in the study area. As discussed in the baseline, undifferentiated woodland is the most abundant vegetation unit in the region crossed by the line, particularly in the northern part of the alignment, in Inhambane Province, where it forms vast extensions of mostly unfragmented woodlands, as can be seen in **Figure 7.3** below.

**Figure 7.3** also shows that, considering the location and general alignment of the proposed transmission line (with start in Vilanculos Substation, and need to connect to Chibuto Substation),

the interference with woodland habitats is unavoidable, given their dominance in the region crossed by the northern half of the proposed transmission line.

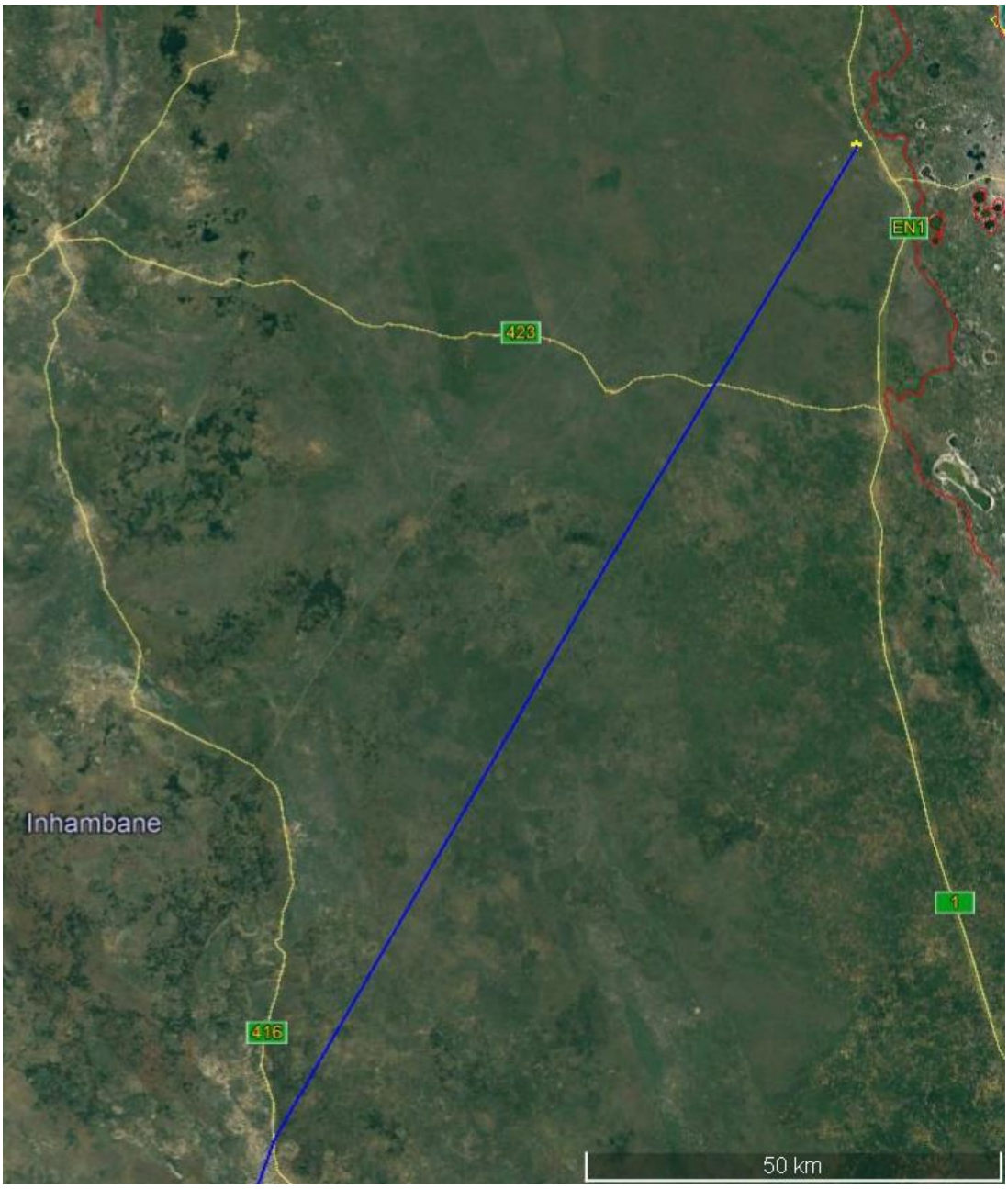



**Figure 7.3 – Section of the alignment between Vilanculos Substation and Funhalouro (in Inhambane Province): the areas in the picture in green correspond to vast extensions of miombo and undifferentiated woodlands**

While regional estimates on the total area occupied by undifferentiated woodlands aren't readily available, in Inhambane Province alone that number is likely to be in the order of hundreds of thousands of hectares. For perspective, **Figure 7.4** below shows a 10 km buffer to each side of the line segment shown in the figure above, between the Vilanculos Substation and Funhalouro (total length of roughly 140 km). In this area alone, shown in **Figure 7.4** as a yellow rectangle, the area occupied by undifferentiated woodlands is over 200 000 ha.

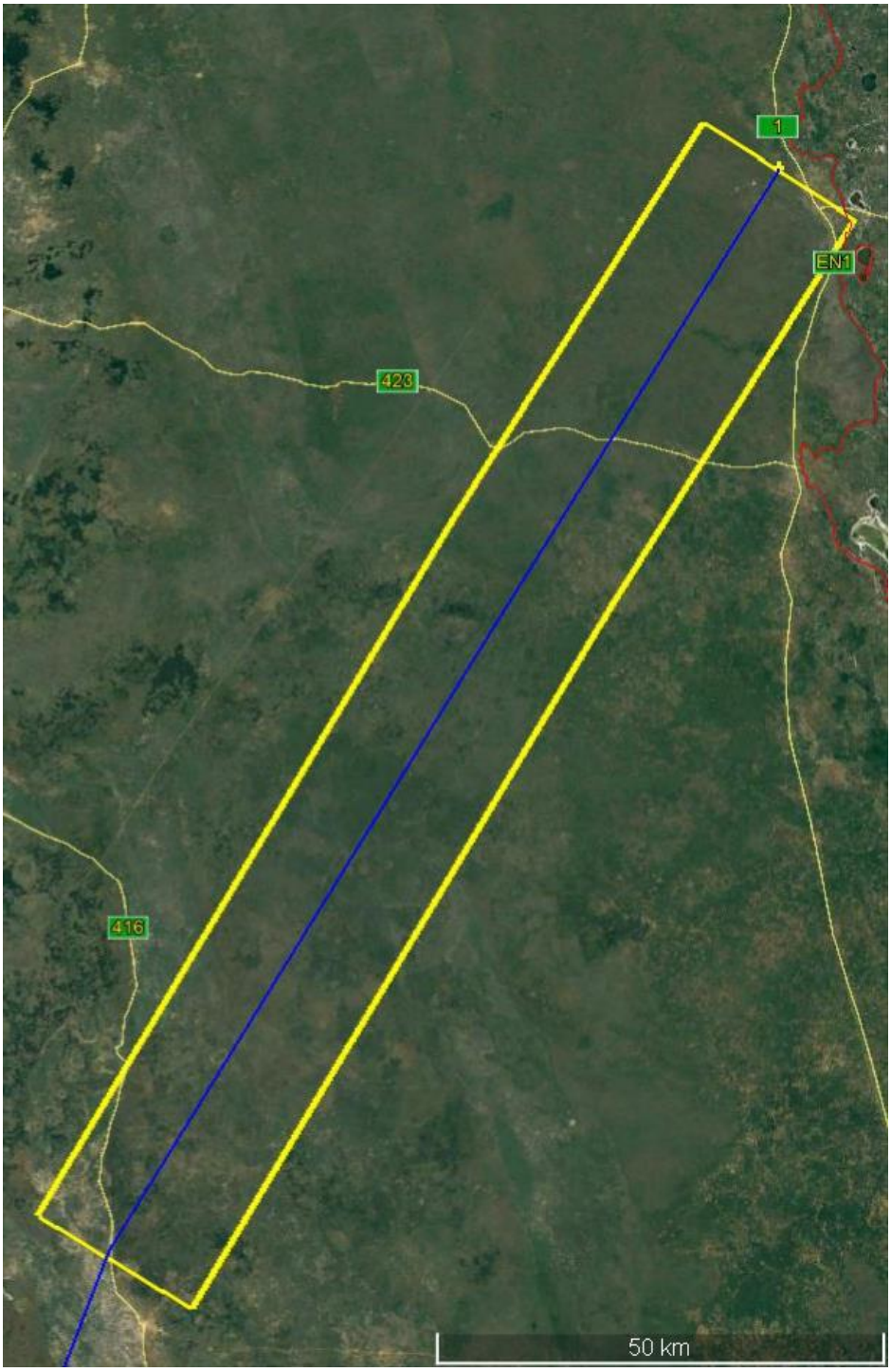



**Figure 7.4 – 10km buffer to each side of the line section from Vilanculos to Funhalouro, showing the predominance of woodland habitat in this segment**

The total area of woodland habitats lost by the clearance of the Project's RoW is thus roughly 0.5 % of the available area of that habitat in just a 10 km buffer around the first 140 km of the proposed line. This habitat loss is thus not considered to be a significant impact, at regional level, given the vast availability of similar habitat. Additionally, unlike miombo woodlands, undifferentiated woodlands don't have a high conservation value. While they are classified as natural habitat, they don't possess

the integrity of miombo woodland and represent a degree of degradation from the climacic regional forests and woodlands.

It is worth noting, however, that two precious wood tree species were confirmed as occurring in low density in study area (*Spirostachys africana* and *Guibourtia conjugate*) with a third species (*Berchemia zeyheri*) considered to be potential. It is thus likely that some individuals of these species are affected by the planned clearance.

The second most affected vegetation unit is also the second most representative in the study area: subsistence agriculture, with a total of 260.4 ha affected. From a biodiversity perspective, the loss of this vegetation unit is not a relevant impact.

Miombo forest will be the less affected habitat, with only 3.4 ha to be affected, located in a single patch in the north of the study area, between Vilanculos and Chibuto substation, in Massinga District, Chicomo Administrative Post (see location in **Figure 7.5** below).

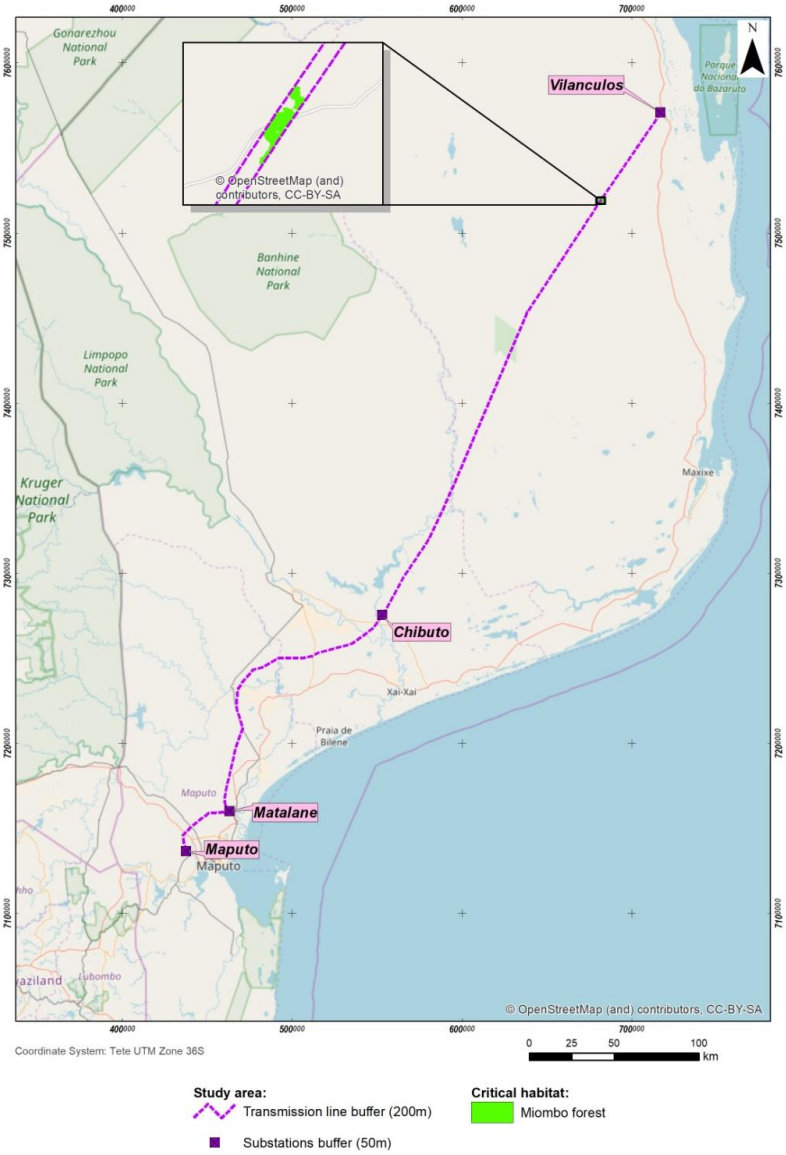



**Figure 7.5 – Location of the miombo forest (critical habitat) affected by the alignment**

This is the only occurrence of this habitat in the study area (200 m to each side of the alignment). This habitat is characterized by the dominance of *Brachystegia torrei* and *Brachystegia spiciformis* (miombo trees), with medium to high coverage density. This vegetation unit has been classified as a Critical Habitat as per IFC PS6 (see this assessment in the biodiversity baseline – section 6.26, **Volume I**). Given this classification, the loss of 3.4 ha of this habitat is considered to be a significant impact, despite the small area affected.

Waterbodies is the second less affected habitat with only 4.3 ha to be affected. This affected area is mostly made up of very small and dispersed patches. As long as no tower is placed in the waterbody bed or banks, this habitat should not be very affected since aquatic vegetation and reed banks will not be cleared.

In the case of rivers and wetlands, the area affected is 49.6 ha. This area corresponds to the floodplains of the major rivers crossed, namely the Limpopo, Changane and Incomati. **Figure 7.6** below illustrates the line intersection with these rivers.

It is important to note, as discussed in the baseline, that no other wetland is crossed by the project, other than these river floodplains. These river floodplains are not avoidable, given the regional hydrography and the overall alignment of the Vilanculos – Maputo line. The regional river network develops in an overall NW-SE direction, while the overall transmission line alignment develops in a NE-SW direction. Their intersection is thus unavoidable.

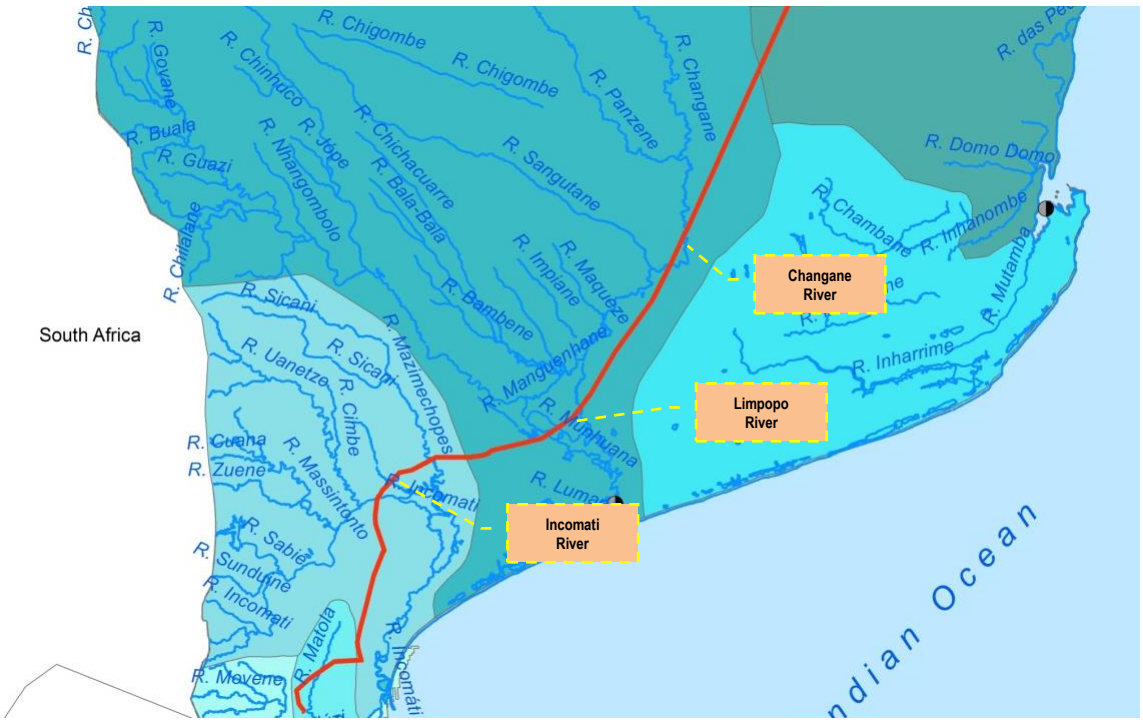



**Figure 7.6 – Intersection between the proposed line and the major rivers in the study area**

Due to the width of some of these river floodplains it is considered probable that towers will be placed in river banks or even in the floodplain itself (e.g., in the case of the Limpopo floodplain crossing, which will likely require placing some towers in the floodplain). This will affect not only riverine vegetation, but also aquatic vegetation and fauna.

Regarding the substations, the Maputo and Matalane substations will only affect modified habitats (subsistence agriculture and disturbed areas) in a disturbed area so from an ecological point of view the impact is not very relevant. The Chibuto and Vilanculos substations will affect areas of undifferentiated woodland but essentially small patches.

This loss of vegetation units also correspond to a direct loss of habitats for fauna, both foraging and roosting habitat. This impact in especially relevant for woodland species, like hornbills and turacos, since most of the lost habitat will be woodlands.

Considering the above, this impact is assessed as *negative*, *local extent* (considering the relatively low amount of natural areas that will be lost), but of *high intensity*. This high intensity rating derives exclusively from the fact that a small patch of Critical Habitat (miombo forest) is affected. The intensity rating for the other affected habitats is *medium*, considering their abundance in the region and lower biodiversity value. The impact duration is rated as *long term* for woodland habitats, as the RoW will be routinely subjected to vegetation control (the growth of trees won't be allowed), and of *medium-term duration* for other habitats (as most of these habitats will naturally regenerate within 2 to 15 years, depending on the habitat). The resulting *significance*, for the worst case impact (miombo forest), is rated as *high*.

*Mitigation Measures*

Given the high significance of the assessed impact, mitigation measures will need to be implemented so as to reduce the residual impact significance. The impact's high significance derives mostly from the impact on a small patch of miombo forest (which has been classified as Critical Habitat). As such, this patch of miombo forest will be avoided, through a line reroute to be designed in the detailed design phase, based on the requirements defined below.

In order to better inform this reroute, additional field work was conducted in March 2018, so as to fully map the extension of the miombo forest patch intercepted by the Project and to identify any other social or environmental sensitive values on the area surrounding the miombo forest, which need to be avoided in the reroute design.

**Figure 7.7** below shows the full extent of the Miombo Forest, following the findings of the additional field work. The figure shows the patch initially mapped in red, and the full extent of the patch in green. The proposed transmission line alignment is represented in blue.

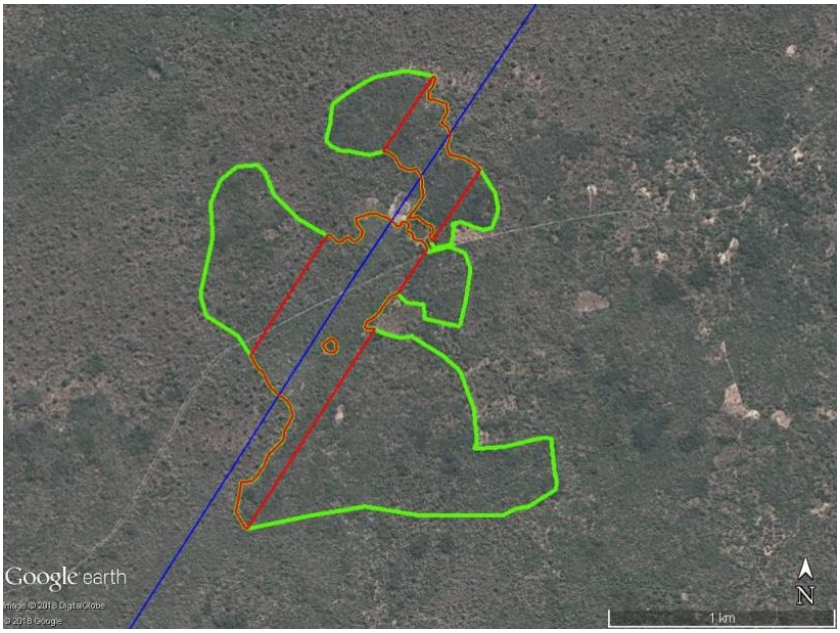



**Figure 7.7 – Full extent of the miombo forest patch intercepted by the Project**

Other environmental and social sensitive values that will be taken into consideration by the engineering team, when designing the required reroute, include:

- Two small settlements, composed by only a few households, located in the surrounding area to this segment. If at all possible, the line will avoid crossing these areas to prevent additional resettlement impacts. These small settlements are illustrated in yellow in **Figure 7.8** below;
- A very dense forest patch, located roughly 2 km northwest of the identified miombo forest patch. This will be avoided, as it is likely another area of miombo forest. This dense forest is contoured in red in **Figure 7.8** below.

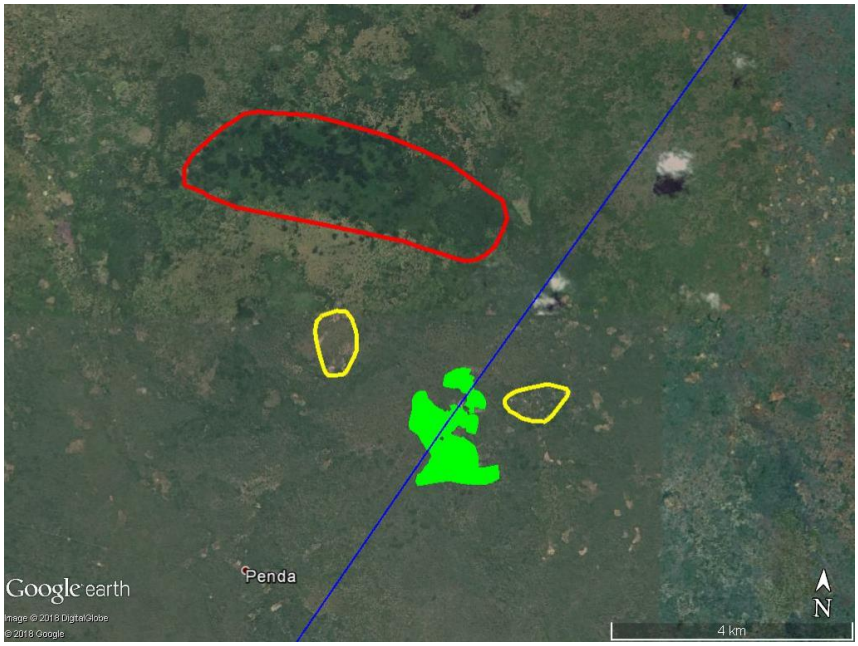



**Figure 7.8 – Other environmental and social sensitive areas to be avoided**

Given the impact assessment provided above, as well as the additional baseline data collected in March 2018, the following mitigation will be applied:

- During the detailed engineering phase, the line route will be slightly realigned, to avoid the identified patch of miombo forest and all other sensitive areas identified above. **Figure 7.9** below illustrates one possible corridor for this rerouting (white corridor), that would successfully avoid all identified environmental and social sensitive values and areas.

However, it should be noted that the realignment route will be developed by the engineering design team, taking into consideration the requirements stated in this section. Whatever the detailed route defined by the engineering team, a buffer distance of at least 150 m will be kept from the miombo forest, to avoid potential impacts related to clearance of the right-of-way, opening of accesses, movement of machinery, etc.

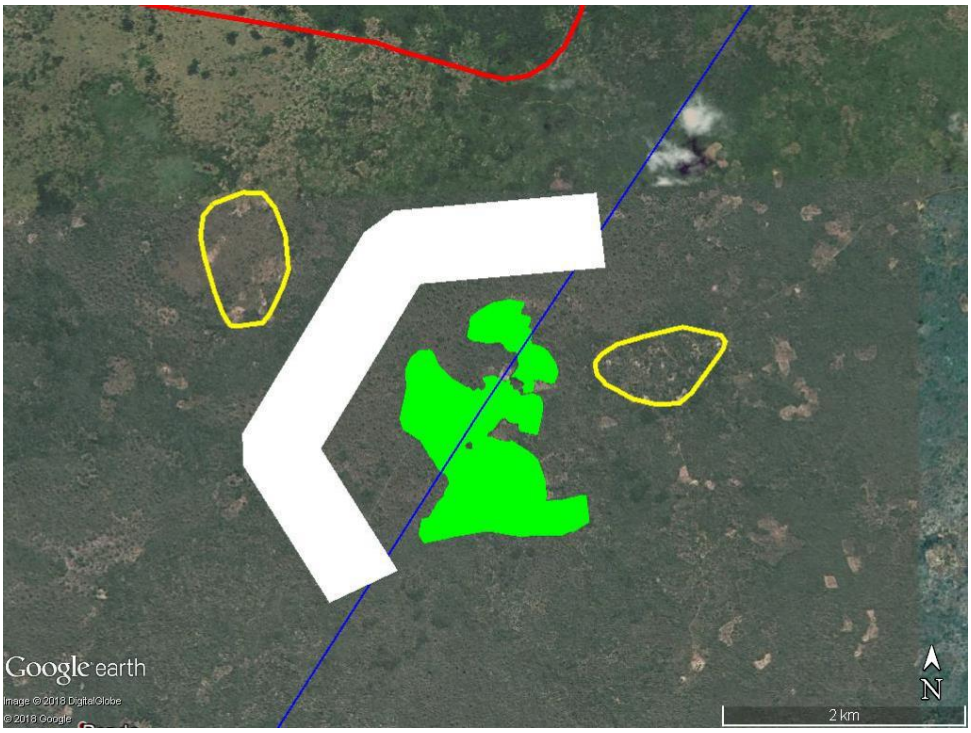



**Figure 7.9 – Possible corridor for the alignment reroute**

After the miombo forest, the more relevant impacts are those on woodland habitats (miombo and undifferentiated). For these woodland habitats, avoidance is not possible, given their dominance in the region crossed by the transmission line. As discussed above, the intensity rating of the impact on these woodland habitats was rated as *medium*. Further to the avoidance measure defined above, the following mitigation will also be implemented so as to minimize the impact:

- Strictly limit the clearing of vegetation to the required areas, particularly in areas of natural habitats;
- Whenever possible, make the cut trees available for pick-up by the local communities, to be used as construction materials or other uses;
- Avoid locating construction camps and burrow pits in natural habitats;

- Avoid locating towers and access roads in waterbodies, wetlands and river bed, and whenever possible also in river banks;
- Vegetation clearance activities in natural habitat areas will be accompanied by vegetation experts, to identify endemic flora species patches (typically small patches) that may require additional mitigation: e.g., some shrub or grass endemic species patches may be left uncut, within the RoW, if they present no risk to the infra-structure;
- Whenever possible, new and temporary accesses will be created based in existent accesses. If the opening of new accesses is required, effort should be made to avoid affecting areas of natural habitats, as much as possible;
- All temporary access roads and work areas (construction camps, burrow pits, etc.) will be rehabilitated after construction is concluded (this does not include the RoW, where vegetation needs to be controlled). To that effect, the Contractor will develop a Rehabilitation and Revegetation Plan and submit it for EDM approval, detailing all restoration and rehabilitation activities, which will include at the minimum:
  - Revegetate areas of bare and disturbed soils as soon as possible with native species;
  - Rehabilitate and revegetate temporary access road and work areas (including construction camps and burrow pits) as soon as possible.

*Impact Summary*

The impact summary is provided in the table below. With the proposed realignment, no areas of critical habitats will be affected, lowering the overall intensity of the impact to *medium*. The residual significance is rated as *medium*.

| **Impact: Direct loss of vegetation units and habitats** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Realign the line route, to avoid the area of Critical habitat (miombo forest);<br>- Strictly limit the clearing of vegetation to the required areas, particularly in areas of natural habitats;<br>- Whenever possible, make the cut trees available for pick-up by the local communities, to be used as construction materials or other uses;<br>- Avoid locating construction camps and burrow pits in natural habitats;<br>- Avoid locating towers and access roads in waterbodies, wetlands and river bed, and whenever possible also in river banks;<br>- Vegetation clearance activities in natural habitat areas will be accompanied by vegetation experts, to sign endemic flora species patches that may require additional mitigation;<br>- Whenever possible new and temporary accesses will be created based in existent accesses;<br>- Rehabilitate and revegetate temporary access road and work areas as soon as possible. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | High | 7 | | Low | 6 |
| Probability | Definite | | | Definite | |
| **Significance** | **High** | | | **Medium** | |

***Impact: Degradation of nearby vegetation units during construction***

*Impact Assessment*

Construction activities, such as earth movements and movement of machinery, will contribute to the expansion of ruderal and invasive flora species throughout the construction areas, thus degrading habitats quality in areas adjacent to the construction sites, especially in the north were vegetation is less disturbed by human activities.

The opening of new access roads can potentially increase natural resources exploration by local people, both of flora (wood and charcoal) and others (quarries). This can lead to vegetation degradation though unmanaged cutting and litter.

High rate of movement of machinery and vehicles associated with vegetation clearance and soil movements will lead to dust suppression of nearby vegetation. This can affect plants evapotranspiration and photosynthesis rate, generally affecting vegetation health.

Considering the above, this impact is assessed as *negative*, of *local* extent (considering that only vegetation units very close to the construction area would be affected), *medium* intensity and *medium-term* duration (as most of these habitats will naturally regenerate within 2 to 15 years, depending on the habitat), resulting in a *low significance*.

*Mitigation Measures*

Despite the low significance, the following mitigation is required:

- Limit disturbance outside site boundaries;
- Limit non-Project vehicles entrance in the construction area, to avoid invasive and ruderal species dispersion and entrance of people that can exploit illegally natural resources;
- Strictly limit the clearing of vegetation to the required areas;
- Dust suppression on dry and windy conditions (e.g. watering);
- Forbid people and vehicle movements outside Project accesses;
- Whenever possible new and temporary accesses will be created based in existent accesses. If the opening of new accesses is required, effort will be made to avoid affecting areas of natural habitats, as much as possible.

*Impact Summary*

The impact summary is provided in the table below. The mitigation measures reduce the impact intensity, lowering the residual significance to *very low*.

| Impact: Degradation of nearby vegetation units during construction | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Limit disturbance outside site boundaries;<br>- Limit non-Project vehicles entrance in the construction area to avoid invasive and ruderal species dispersion and entrance of people that can exploit illegally natural resources;<br>- Strictly limit the clearing of vegetation to the required areas;<br>- Dust suppression on dry and windy conditions (e.g. watering);<br>- Forbid people and vehicle movements outside Project accesses;<br>- Whenever possible new and temporary accesses will be created based on existent accesses. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Low | 5 | | Very low | 4 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Very Low** | |

***Impact: Impacts on wetlands and riverine areas***

*Impact Assessment*

The construction activities will generate wastewater, solid wastes and will involve the use of oil, fuel and other pollutants. Inadequate handling and/or management of wastes and hazardous substances could result in leaks or spills to the soil and waters, potentially leading to water quality degradation on rivers, wetlands and water bodies. In the case of the main rivers, such as Limpopo, Changane and Incomati, spills can affect a wide area in the river basin affecting directly both aquatic flora and fauna, as well as indirectly terrestrial fauna that feed and roost close by, like aquatic birds and bats.

The construction of towers in river bed or banks will affect water turbidity and quality causing impacts in fishes and other fauna. Soil movement will also affect invertebrates' habitat, cause injuries and death, especially to sediment invertebrates.

Considering the above, this impact is assessed as *negative*, *regional*, of *medium* intensity (considering the impact can extent to all or to a significant part of the rivers basin) and of *medium-term* duration (since pollutants can accumulate in sediments for several years). The probability of the impact occurring is assessed as *possible* (as this impact will only occur in the event of unplanned spills and leaks or inadequate management of wastes and polluting substances), resulting in a *low significance*.

*Mitigation Measures*

Despite the low significance, mitigation is required in order to lower the probability of an accidental spill and to ensure good environmental practices in handling and management of wastes and toxic substances:

- Adopt good housekeeping to prevent spillages and contamination;
- Localize tower structures in such a way as to minimize impacts / areas of disturbance in wetlands, river banks, river beds and water bodies;
- Avoid movement of heavy machinery in wetlands, river banks, river beds and waterbodies, as much as possible;
- Delimitate the perimeter of rivers, wetlands and water bodies close to construction areas with construction tape, and forbid activities inside the delimited areas;

- Store oils, fuels and other hazardous and potentially pollutant products safely in order to prevent its spillage in soil and/or water resources. The storage of these materials will be done in the construction camps, in dedicated impervious areas, with cover and containment structures;
- Provide a designated area for refueling and maintenance of equipment and vehicles with impervious floor and containment structures. Place these facilities away from rivers, wetands and waterbodies;
- Develop and implement a Waste Management Plan for the construction phase (guidance for this is provided in the ESMP);
- Forbid people and vehicle movements outside Project accesses.

*Impact Summary*

The impact summary is provided in the table below. With the defined mitigation, the residual significance is rated as *very low*.

| **Impact: Wetlands and riverine areas degradation** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Adopt good housekeeping to prevent spillages and contamination;<br>- Localize tower structures so as to minimize impacts / areas of disturbance in wetlands, river banks, river beds and water bodies;<br>- Avoid movement of heavy machinery in wetlands, river banks, river beds and water bodies;<br>- Delimitate the perimeter of rivers, wetlands and water bodies close to construction areas with construction tape;<br>- Implement adequate storage and management of oils, fuels and toxic substances;<br>- Develop and implement a Waste Management Plan;<br>- Forbid people and vehicle movements outside Project accesses. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Possible | | | Improbable | |
| **Significance** | **Low** | | | **Very Low** | |

***Impact: Reduction of feeding, breeding and roosting areas***

*Impact Assessment*

Clearance of vegetation will destroy feeding, breeding and roosting areas for fauna species, especially for birds and mammals. Since most of the area affected is woodland, species that depend on trees will be specially affected, such as tree frogs, reptiles, rodents and bats that use the inside of trees as roosts; but also most of birds species in the study area, because they nest in trees (most of the small birds, nocturnal birds and raptors); and even bigger mammals that roost in trees, like monkeys and leopard.

Feeding areas will also be lost by vegetation clearance, although since the vegetation clearance strip is narrow, animals should be able to feed in similar nearby areas.

Considering the above, this impact is assessed as *negative*, *local*, of *medium* intensity (considering the total amount of feeding, roosting and breeding areas that will be lost) and of *medium-term*

duration (as most of these habitats will naturally regenerate within 2 to 15 years, depending on the habitat, regenerating into new feeding, roosting and breeding areas), resulting in a *low significance*.

*Mitigation Measures*

The described reduction of feeding, breeding and roosting areas results directly from the construction of the Project infrastructure, so it is not avoidable. The following mitigation is required:

- Limit areas to be cleared or disturbed to the footprint of the development;
- In areas of natural woodland habitats, the vegetation clearance activities will be accompanied by an ecology/biology specialist, to make an inventory of bird roosting and nesting sites prior to site clearance, so as to detect any bird roosting and/or nesting sites close to the clearance areas;
- If significant areas of bird roosts/nests close to the clearance area are found during construction, implement the following:
  - Reduce machinery movements and noise to minimum in places close by birds roosts or nests;
  - Whenever possible avoid vegetation removal close to raptors nesting site when there are eggs or chicks/juveniles, delaying vegetation removal in those places to after the birds leave;
  - Other site-specific measures may be proposed by the ornithologist, depending on the specificities of the inventory.
- Whenever possible new and temporary accesses should be created based in existent accesses.

*Impact Summary*

The impact summary is provided in the table below. The proposed mitigation measures lower the probability of the impact occurring, but this does not reduce the residual significance which remains rated as *low.*

| **Impact: Reduction of feeding, breeding and roosting areas** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Limit areas to be cleared or disturbed to the footprint of the development;<br>- Vegetation clearance activities will be accompanied by an ecology/biology specialist; so as to detect any bird roosting and/or nesting sites close to the clearance areas and implement cautionary measures;<br>- Whenever possible new and temporary accesses should be created based on existent accesses. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Definite | | | Probable | |
| **Significance** | **Low** | | | **Low** | |

***Impact: Increased fauna mortality and decreased species diversity***

*Impact Assessment*

Vegetation clearance will lead to death of some animals and potential decreasing in species diversity in the study area. Organisms that are sessile during the day and roost in trees, such as bats, tree frogs and reptiles, will most likely be affected, since theses animals typically don't leave roosting sites during the day and so won't run away and therefore will die during vegetation removal activities. Also birds that nest in trees, especially nocturnal ones, that are not so vigilant during the day, can die during this activity.

An increase in machinery and vehicles movements will also lead to a high risk of run over. Animals that move slower, like reptiles and amphibians, are probably the most affected by this impact, because they have difficulties in moving away rapidly and also are difficult to detect.

Considering the above, this impact is assessed as *negative*, *local*, of *medium* intensity (considering that most of the area is woodland and therefore a large number of trees and animals can be affected) and of *medium-term* duration (as most species reproduction success takes several years), resulting in a *low significance*.

*Mitigation Measures*

The following mitigation is proposed:

- Strictly limit the clearing of vegetation to the required areas;
- Limit speed limit to 30km/h to reduce risk of run over;
- Place signs along access roads informing speed limits and possible animal presence;
- During induction sessions inform workers of biodiversity importance and commitment of the Project to it, in order to avoid run over of animals on purpose;
- Forbid workers to hunt animals, or to buy bush meat, and inform them of this restriction in the induction sessions;
- Limit access by outsiders (signs, patroling, fences) to work areas;
- Vegetation removal activities will be accompanied by an ecology/biology specialist, to minimize as much as possible mortality of tree roosting animals (through active search and removal) minimizing species destruction;
- Use of a propane exploder to frighten birds from roosting sites, before vegetation clearance, in order to avoid birds death;
- Whenever possible new and temporary accesses will be created based in existent accesses.

*Impact Summary*

The impact summary is provided in the table below. The proposed mitigation lowers the intensity of the impact, resulting in a *very low* residual significance.

| Impact: Increased fauna mortality and decreased species diversity | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Strictly limit the clearing of vegetation to the required areas;<br>- Limit speed limit to 30km/h to reduce risk of run over;<br>- Place signs along access roads informing speed limits and possible animal presence;<br>- During induction sessions inform workers of biodiversity importance and commitment of the Project to it;<br>- Vegetation removal activities will be accompanied by an ecology/biology specialist, to minimize as much as possible tree roosting animals death;<br>- Use of a propane exploder to frighten birds from roosting sites in order to avoid birds death;<br>- Whenever possible new and temporary accesses will be created based on existent accesses;<br>- Forbid workers to hunt animals, or to buy bush meat, and inform them of this restriction in the induction sessions;<br>- Limit access by outsiders (signs, patroling, fences) to work areas. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Low | 5 | | Very low | 4 |
| Probability | Probable | | | Probable | |
| **Significance** | **Low** | | | **Very Low** | |

***Impact: Possible introduction or spread of invasive species in the Project area***

*Impact Assessment*

Construction activities, in particular new access road opening, soil movement and movement of machinery, will contribute for the expansion of ruderal and invasive flora species along the line corridor, especially in the north were vegetation is less disturbed by human activities. This impact is even more likely since there are already invasive species present in the study area (*Achyranthes aspera, Ricinus communis, Lantana camara* and *Xanthium strumarium*) although their distribution in the study area is not wide.

Since access roads come from more urban areas, which typically host a higher number of invasive species, it is possible that the number of invasive species in the study area will increase, increasing also the risk of expansion to non-affected areas.

Considering the above, this impact is assessed as *negative*, *regional*, of *medium* intensity (considering the present restricted distribution of invasive species) and of *medium-term* duration (as even if invasive species are controlled, the ecosystem will still need a few years to recover), resulting in a *medium significance*.

*Mitigation Measures*

The following mitigation is proposed:

- Limit disturbance outside site boundaries;
- Limit non-Project vehicles entrance in the construction area;
- Strictly limit the clearing of vegetation to the required areas;
- Forbid people and vehicle movements outside Project accesses;
- Whenever possible new and temporary accesses will be created based in existent accesses;

- Rehabilitate and revegetate temporary access roads and work areas, and all areas temporarily degraded by construction activities, as soon as possible. To that effect, the Contractor will develop a Rehabilitation and Revegetation Plan and submit it for EDM approval, detailing all restoration and rehabilitation activities (additional guidance is provided in the ESMP – **Volume III**);
- Monitor and control the presence and expansion of invasive flora species along the RoW (additional guidance for the monitoring and control procedures is provided in the ESMP).

*Impact Summary*

The impact summary is provided in the table below. The required mitigation lowers the impact's probability of occurrence, resulting in a *low* residual significance.

| **Impact: Possible introduction or spread of invasive species in the Project area** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Limit disturbance outside site boundaries;<br>- Limit vehicles entrance in the construction area;<br>- Limit vegetation clearance to the area required;<br>- Forbid people and vehicle movements outside Project accesses;<br>- Whenever possible new and temporary accesses will be created based on existent accesses;<br>- Rehabilitate and revegetate temporary access roads and work areas, and all areas temporarily degraded by construction activities, as soon as possible;<br>- Monitor and control the presence and expansion of invasive flora species along the RoW. | Negative | |
| Type | Indirect | | | Direct | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Medium | 6 | | Medium | 6 |
| Probability | Probable | | | Possible | |
| **Significance** | **Medium** | | | **Low** | |

## *Impact: Exclusion of fauna species due to increase of disturbance*

*Impact Assessment*

All construction activities will result in increasing noise, movement and disturbance in general. This will result in disturbance of fauna species and consequent potential exclusion of fauna around the study area. This impact is especially relevant to more sensitive species, like forest bird species in undisturbed woodland areas, and during breeding period. This can also lead to abandon of roosting sites and congregation sites, especially for water birds in more undisturbed wetland areas.

Considering the above, this impact is assessed as *negative*, *local*, of *medium* intensity (considering the species potentially present) and of *short-term* duration (as disturbance will end after construction and fauna will tend to return to these areas), resulting in a *very low significance*.

*Mitigation Measures*

Even though the impact's significance was rated as very low, some mitigation will be implemented, namely:

- Strictly limit the clearing of vegetation to the required areas, particularly in areas of natural habitats;

- Whenever possible new and temporary accesses will be created based in existent accesses;
- In areas of natural woodland habitats, the vegetation clearance activies will be accompanied by an ecology/biology specialist, so as to detect any bird roosting and/or nesting sites close to the clearance areas;
- If significant areas of bird roosts/nests close to the clearance area are found during construction, implement the following:
  - Reduce machinery movements and noise to minimum in places close by birds roosts or nests;
  - Whenever possible avoid vegetation removal close to raptors nesting site when there are eggs or chicks/juveniles, delaying vegetation removal in those places to after the birds leave;
- Avoid construction works during the night;
- Minimize illumination in construction camps, if close to natural habitats;
- Develop and implement a Waste Management Plan. Avoid leaving garbage unattended, in order to avoid disturbing nocturnal animal and attracting nocturnal carnivores;
- To minimize the impact on migratory birds, avoid vegetation clearance activities in natural habitats and near large water masses between October and March, as much as possible.

*Impact Summary*

The impact summary is provided in the table below.

| **Impact: Exclusion of fauna species due to increase of disturbance** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Strictly limit the clearing of vegetation to the required areas, particularly in areas of natural habitats;<br>- Whenever possible new and temporary accesses will be created based on existent accesses;<br>- Vegetation clearance activities will be accompanied by an ecology/biology specialist; so as to detect any bird roosting and/or nesting sites close to the clearance areas and implement cautionary measures;<br>- Avoid construction works during the night;<br>- Minimize illumination in construction camps, if close to natural habitats;<br>- Develop and implement a Waste Management Plan;<br>- Avoid vegetation clearance activities in natural habitats and near large water masses between October and March, as much as possible. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very low | 4 | | Very low | 4 |
| Probability | Definite | | | Probable | |
| **Significance** | **Very Low** | | | **Very Low** | |

## 7.9.2 Operational Phase

### 7.9.2.1 Impact-Generating Activities

The main activities that could generate impacts on biodiversity during the Project's operational phase are the following:

- Presence and maintenance of the RoW – the presence of the RoW will enable easier access to previous hard to access areas, potentially leading to the expansion of ruderal and invasive species along the power line corridor and to the increase of natural resources exploitation, due to the increased ease of access along the RoW. The RoW will also result in habitat fragmentation;
- Presence of towers and power line – the presence of the overhead power line will introduce a collision risk for birds and bats, leading to increased mortality of these animals, with potential impacts on species diversity.

These impacts are assessed in the following section.

### 7.9.2.2 Impact Assessment – Operational Phase

***Impact: Indirect degradation of vegetation units and habitats along the RoW***

*Impact Assessment*

During the operational phase, the RoW will be maintained, through selective trimming of vegetation in the 30m clearance strip, thus avoiding the recovery of woodland habitats.

Frequent maintenance operations will facilitate the expansion of ruderal and invasive flora species along the RoW. This will lead to habitat degradation along the margins of the RoW, in particular in the northern part of the study area, where the power line develops along mostly natural habitats.

The presence of the RoW, as well as of access roads to the corridor, towers and substations, can also increase natural resources exploration by local people, both of flora (wood and charcoal), fauna (hunting) and others (quarries). This is again particularly true in the northern part of the alignment, where currently access to most of these areas is in general difficult. The easier access to the woodland habitats in the northern part of the alignment, granted by the RoW presence, will likely result in an influx of people along the RoW, looking to explore the now more easy to access areas. This can lead to increased clearance of woodland for sale of timber and charcoal, building material and boat making and settlement and agriculture.

Considering the above, this impact is assessed as *negative*, *local*, of *high* intensity (considering that the overall impacts on natural woodland habitats may be higher than the loss of habitats directly resulting from Project implementation) and of *long-term* duration (as it is likely that this degradation will continue to manifest in the long term, as population slowly accesses new areas through the RoW), resulting in a *high significance*.

*Mitigation Measures*

The impact of the RoW maintenance on the adjacent habitats is relatively easy to manage, through the following mitigation:

- Limit disturbance outside maintenance area boundaries;
- Limit vegetation clearance to the area required;
- Limit non-Project vehicle entrance and circulation along the RoW, as much as possible, through the placement of signalization;

- Monitor and control the presence and expansion of invasive flora species along the RoW.

The indirect impacts associated with the easier access to currently isolated woodland areas, due to the presence of the RoW, however, are much harder to manage. Population influx and associated natural resource over-use is practically inevitable given the easier access to these areas. Mitigation for these induced impacts of the RoW will require effective local government support, in order to prevent establishment of new settlements in sensitive areas (such as areas of Miombo forest) and to control overexploitation of natural resources, in particular clearance of woodlands and forests.

It should be stressed that these measures fall outside of the strict competence of EDM, as their implementation will depend on governmental action. Nevertheless, EDM will engage with local and provincial authorities, to encourage the authorities to control unregulated population expansion along the Project's RoW and support the authorities in this task, to the possible extent (e.g., by reporting new settlement creation along the RoW).

As such, the following will be implemented:

- EDM will approach the Provincial Governments of Gaza of Inhambane to discuss this issue (note that the critical segment is the one between Chibuto and Vilanculos substations, where more dense woodlands still exist);
- With the support of the Provincial governments, the goal will be to create an inter-district committee to monitor and control population expansion along the RoW. Relevant districts include Chibuto, Panda, Funhalouro, Massinga and Vilankulos;
- Incorporate in the normal maintenance procedures of the RoW the monitoring of creation of new settlements or cutting or burning of woodland areas in adjacent areas along the RoW, and report these occurrences to the local authorities;
- EDM will discuss with this inter-district committee the procedure to monitor population expansion along the RoW. The Districts will be consulted in terms of what they wish to be reported. A specific and detailed reporting protocol will then be defined;
- This protocol will be implemented by EDM, as part of the normal operational inspection activities of the RoW and line components;
- Following reporting of occurrences to the Districts, EDM will engage with district authorities to discuss and coordinate a possible response. EDM will support, as possible, local authorities in their response.

*Impact Summary*

The impact summary is provided in the table below. Assuming coordinated government action to restrict influx and uncontrolled settlement on the areas along the RoW, the residual impact will be reduced to *medium* significance.

| Impact: Indirect degradation of vegetation units and habitats along the RoW | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Limit disturbance outside maintenance area boundaries;<br>- Limit vegetation clearance to the area required;<br>- Limit non-Project vehicle entrance and circulation along the RoW, as much as possible, through the placement of signalization;<br>- Monitor and control the presence and expansion of invasive flora species along the RoW;<br>- Incorporate in the normal maintenance procedures of the RoW the monitoring of creation of new settlements or cutting or burning of woodland areas in adjacent areas along the RoW, and report these occurrences to the local authorities.<br>- Coordinated intervention by relevant Government Departments to enforce restrictions on uncontrolled settlement and agricultural expansion, clearance of woodland, and enforcement on controls on hunting, charcoal and timber cutting. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | High | 7 | | Medium | 6 |
| Probability | Probable | | | Probable | |
| **Significance** | **High** | | | **Medium** | |

***Impact: Increased mortality of bird and bat species due to collisions and electrocution***

*Impact Assessment*

Bird collision occurs in all kinds of suspension lines (power, communications, railways, etc.), including suspension guyed V-tower support lines, because birds do not see the cables. The risk of collision is higher with reduced visibility (like at night and with fog) or with small diameter cables (ICNB, 2010).

In high voltage lines there are two types of cables: conduction cables and ground cables. Ground cables cause most of bird mortality since they are located higher than conduction cables and are of smaller diameter. The risk of collision is also related with the number of horizontal plans in which cables are stretched, being higher as the number of horizontal plans increase. Mortality risk is also higher in vertical track frames than in horizontal track frames (ICNB, 2010).

Congregatory, nocturnal, migratory, juveniles and both slow (like vultures) and very fast (like swallows, swifts and martins) manoeuvre, thin wings, diving, poor fliers (Otidae) and water birds have higher risk of collision with lines, because of their behaviour (ICNB, 2010; Bevanger, 1998). In what regards migratory birds, no known specific migration routes are crossed by the Project. However, and as discussed in the baseline, several species of Paleartic birds occur in the study area. These species engage in annual migrations between Europe and Southern Africa, in a general North-South direction. Given that the STE Project develops in a NE-SW direction, it is likely that the proposed transmission line will cross the migration pathway of some Paleartic birds. This potential interference is not avoidable, given the line's starting and end points.

The risk of collision with lines is especially relevant for threatened species like the wattled crane (*Grus carunculata*), for which mortality in lines is the most important non-natural cause of death, and bustards, which are significantly affected by this mortality cause (Ferrer, 2012). Therefore the groups of birds were collision risk is higher are: Ciconidae, Anatidae, Phasianidae, Rallidae, Gruidae, Otidae, Charadriidae, Scolopacidae, Columbidae and Strigiformes (see **Table 7.15**).

There are few records of bat mortality due to collision with power lines, since echolocating bats can easily avoid them, but for non-echolocating fruit bats (Pteropodidae family) the risk exists and its even higher for migratory species, such as African straw-coloured fruit-bat (*Eidolon helvum*) (Kipeto Energy Limited, 2013).

A bird's death through electrocution occurs when the bird touches two conducting elements allowing energy current to circulate in the bird's body. Electrocution occurs close to the towers and not in the suspended lines (as the distance between cables is too large) (ICNB, 2010). Electrocution thus happens mainly when birds rest in the towers, but also when they try to hunt another bird that is sitting in a tower. This risk is higher in tension towers, since the pole and the conductor are closer. Electrocution risk is also high in substations due to the presence of transformer towers.

Electrocution is a particular problem for storks, vultures and big raptors, such as martial eagle (*Polemaetus bellicosus*) (Ferrer, 2012), given their longer wing span. The groups of birds for which electrocution risk is higher include: Ciconidae, Accipitridae, Falconidae and Corvidae (**Table 7.15**). The risk of electrocution for Ciconidae is compounded by the fact that they tend to build nests in towers, and droppings can create an electrical arch that can lead to electrocution. It is also important to refer that dropping and other particles from nests can damage the line and lead to breakdowns (ICNB, 2010).

Electrocution risk for bats is higher for fruit bats, since their wingspan is larger (Kipeto Energy Limited, 2013). But if the distance between cables is larger than bat wingspan the risk should be residual.

**Table 7.15 – Collision and electrocution risk for bird groups**

| Groups | Collision risk | Electrocution risk |
|---|---|---|
| Podicipedidae | Medium | - |
| Phalacrocoracidae | Medium | Low |
| Ardeidae | Medium | Low |
| Ciconidae | High | High |
| Phoenicopteridae | Medium | - |
| Anatidae | High | - |
| Accipitridae | Medium | Medium to high |
| Falconidae | Medium | - |
| Phasianidae | High | - |
| Rallidae | High | - |
| Gruidae | High | - |
| Otidae | High | - |
| Charadriidae | High | Low |
| Scolopacidae | High | Low |
| Laridae | Medium | Low |
| Columbidae | High | Medium |
| Cuculidae | Medium | - |
| Strigiformes | High | Low to medium |
| Caprimulgidae | Medium | - |

| Groups | Collision risk | Electrocution risk |
|---|---|---|
| Apodidae | Medium | - |
| Upudidae | - | Low |
| Alcedinidae | - | Low |
| Meropidae | - | Low |
| Coraciidae | Medium | Low |
| Psittacidae | Medium | Low |
| Picidae | Medium | Low |
| Corvidae | Medium | Medium to high |
| Small birds | Medium | Low |

**Source:** Adapted from ICNB (2010).

Considering the above, this impact is assessed as *negative*, *local*, of *high* intensity (considering the length of the corridor and the number of species present) and of *long-term* duration (as the impact will occur during all operation phase), resulting in a *high significance*.

*Mitigation Measures*

The described increased mortality of bird and bat species due to collisions and electrocution with high voltage power line results directly can be controlled through the adoption of adequate engineering solutions, as follows:

- During detailed engineering, tower and line design will be developed in compliance with the following guidelines:
  - Preference will be given to tower designs with a minimum number of collision plans, preferring self-supporting suspension towers to suspension guyed V-towers, especially in natural habitats, rivers, wetlands and waterbodies;
  - Use exclusively towers with horizontal track frames (self-supporting suspension tower, suspension guyed V-tower and self-supporting tension Y-tower);
  - BFD (Bird Flight Diverters) will be used to signal the line. Red and white BFD with a 35cm diameter will be used. BFD's will be installed in the following line segments:
    - Vilanculos substation – Chibuto substation segment – this segment develops along mostly large unfragmented woodland areas. In this segment, the BFD signalling scheme will be alternating colours in each ground cable with 10 m between each, resulting in a 20 to 20m distance between BFD's in each ground cable;
    - In the crossings of the Changane, Limpopo and Incomáti floodplains (from 1 km before the crossing to 1 km after the crossing) the signalling scheme will be of 1,5m between each alternating BFD resulting in a 3 to 3m distance between BFD's in each ground cable;
  - Isolation of all conductors, to avoid electrocution;
  - Ensure the distance between cables, especially in tension towers, is greater than 3 m, to avoid electrocution;

- Install anti-landing devices in towers close to wetlands, river and waterbodies, to avoid storks nesting there.

The reduction of collision plans and signalling lines are the most effective ways to minimize mortality though collision. The implementation of these measures will not completely avoid the impact but will significantly reduce mortality rates.

Further to the mitigation defined above, a bird and bat mortality monitoring program is included in the ESMP (see **Volume III**). Monitoring of fauna mortality will support an adaptive management approach: if monitoring detect spots of disproportionate mortality (when compared against the averages along the line), additional measures to minimize collision and electrocution deaths will be studied and proposed.

*Impact Summary*

The impact summary is provided in the table below. The proposed mitigation lowers the impact's intensity, reducing the residual significance to *medium*.

| **Impact: Increased mortality of bird and bat species due to collisions and electrocution** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Adopt control measures in the design of line and towers, namely:<br>o Prefer the use of towers with a minimum number of collision plans;<br>o Use exclusively towers with horizontal track frames;<br>o Signal lines with 35cm diameter BFD near rivers and wetlands and along large undisturbed forest or woodland areas;<br>o Isolation of all conductors, to avoid electrocution;<br>o Ensure the distance between cables, especially in tension towers, is higher than 60cm;<br>o Install anti-landing devices in tower close to wetlands, river and waterbodies.<br>- Monitor bird and bat mortality and adopt an adaptive management approach. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | High | 7 | | Medium | 6 |
| Probability | Probable | | | Probable | |
| **Significance** | **High** | | | **Medium** | |

***Impact: Habitat fragmentation due to the presence of the RoW***

*Impact Assessment*

The establishment and maintenance of the RoW will imply the creation of a linear long corridor with modified vegetation, which will likely be composed of secondary shrub (as the growth of larger trees will be controlled through maintenance activities). Where the RoW crosses large areas of unfragmented habitats, the RoW will induce an effect of habitat fragmentation.

Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into a greater number of smaller patches of lower total area, isolated from each other by a matrix of dissimilar habitats (Didham, 2010).

Habitat fragmentation has several ecological effects. The greater the fragmentation, the greater the edge effects will result in decline in population density and species richness, and significant alterations to community composition, species interactions and ecosystem functioning.

Habitat fragmentation can also result in impacts in fauna populations, if the fragmentation causes a significant hurdle to animal mobility. In the case of the RoW, if the presence of a cleared corridor inhibits animal movement from one side to the other, this will result in a sub-division of the animal populations. In extreme cases, this might cause populational decline, if the sub-populations are not large enough to be viable, resulting in a decrease in diversity.

In what regards the STE Project under assessment, habitat fragmentation impacts are relevant only for the northern part of the alignment, roughly between Vilanculos and Chibuto substations, where the line develops along mostly unfragmented woodland habitats. From Chibuto substation to the south, the landscape is already heavily fragmented by human activities, in particular agriculture, and the additional fragmentation effect introduced by the power line is expected to be irrelevant.

This is reflected in **Figure 7.10** below, repeated from the biodiversity baseline section, which shows the classification of habitat along the alignment into natural and modified habitats. The section of the line north of Chibuto substation develops mostly in natural habitats (woodland habitats, as shown above in **Figure 7.3** and **Figure 7.4**), while south of Chibuto the habitat is mostly modified, with some fragmented patches of natural habitats.

In terms of fragmentation effects at landscape level, the STE RoW will not cause a significant increase in fragmentation of the existing habitat mosaic. As can be seen in **Figure 7.3** above (page 47), the northern half of the alignment of the proposed power line develops in an area dominated by vast extensions of miombo and undifferentiated woodlands. While the presence of the RoW will introduce fragmentation, the remaining patches of unfragmented woodlands are vast enough to allow the continued maintenance of the regional species diversity (i.e., the available remaining habitat is large enough to allow the viability of flora and fauna populations). The extensive stretches of unfragmented woodlands also mean that the edge effects introduced by the cleared RoW will be relatively small.

The presence of the RoW could also result in fragmentation of fauna populations, for those species for which the presence of the RoW (of a deforested corridor) constitutes a barrier to movement. The barrier effect generated by a transmission line RoW will vary significantly from species to species. However, available data shows that relatively few animals find the RoW to be a barrier (Berger, 2010).

The vast majority of bird species are not hindered by the presence of the transmission line RoW (which is made obvious by the fact that transmission lines have a mortality impact on birds that collide with the line). Some small forest specialists may be inhibited to cross a cleared area.

For large mammals in general, narrow linear clearings do not seem to act as barriers to movements (Bartzke *et al.*, 2014; 2015). Data from both North America and Europe show that large mammals, both herbivores and carnivores, do not avoid crossing transmission line RoWs and are even commonly seen feeding and travelling along RoWs.

The barrier effect to smaller mammals and other small animals, such as reptiles or amphibians, will also vary depending on their ecology. Species which prefer woodland or forested habitats will avoid the cleared areas, while other species will be even benefited by the presence of a clear habitat (e.g.:

some smaller birds of prey, such as falcons, will usually nest in forested areas but hunt on more open areas).


**Figure 7.10 – Natural and modified habitat mapping**

As such, the majority of fauna species will not suffer a significant barrier effect due to the presence of the RoW. The RoW may displace or impede movements of some birds and small mammals, reptiles and amphibians that inhabit small territories or home ranges in mature forest or that have difficulty crossing nonforested gaps. However, the remaining extensions of woodland habitats in the study area assures that the populations of those species will remain viable, with no expected reduction in species diversity.

Considering the discussed above, this impact is assessed as *negative*, *regional*, of *medium* intensity (for the woodland habitats in the northern part of the alignment, as in the southern part the degree of

habitat fragmentation is already high) and of *medium-term* duration (as animals will tend to get used to the line), resulting in a *medium significance*.

*Mitigation Measures*

To minimize habitat loss and fragmentation, and the barrier effect to fauna, the following mitigation will be implemented:

- Limit disturbance outside maintenance area boundaries;
- Limit vegetation clearance to the area required. Complete vegetation clearance should be restricted to the 30 m corridor;
- Outside of the 30 m full clearance corridor, allow tree and shrub species whose height is limited to 3 m to grow. Apply selective removal of tall-growing tree species only;
- Avoid clearing in riparian areas, thus allowing rivers to maintain their function as ecological corridors.

*Impact Summary*

The impact summary is provided in the table below.

| **Impact: Habitat fragmentation due to the presence of the RoW** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Limit disturbance outside maintenance area boundaries;<br>- Limit vegetation clearance to the area required. Complete vegetation clearance should be restricted to the 30 m corridor;<br>- Outside of the 30 m full clearance corridor, allow tree and shrub species whose height is limited to 3 m to grow. Apply selective removal of tall-growing tree species only;<br>- Avoid clearing in riparian areas, thus allowing rivers to maintain their function as ecological corridors. | Negative | |
| Type | Indirect | | | Direct | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Medium | 6 | | Medium | 6 |
| Probability | Probable | | | Possible | |
| **Significance** | **Medium** | | | **Low** | |

# 7.10 Socioeconomy

Following the establishment of the socioeconomic description, this chapter presents the assessment of the potential socioeconomic impacts resulting from the construction and operation of the future STE Project.

## 7.10.1 Construction Phase

### 7.10.1.1 Impact-Generating Activities

The construction phase of the STE Project will include all construction works necessary for the establishment of the powerline and associated infrastructure, thus encompassing a wide range of construction activities, such as vegetation clearing, earthworks, construction of temporary

construction accesses and setting up temporary construction camps, and the general operation of construction machinery as well as the movement of heavy vehicles, among other activities.

All of these construction activities will imply changes to the current land use in the Project's footprint area. The clearing of the construction areas, and associated temporary infrastructure areas, will imply the demolition of any built structure in that area, which may result in physical displacement of people.

The construction activities will also imply the mobilization of workforce. This will result in direct positive impacts, due to the creation of employment opportunities, but could also result in indirect negative impacts, associated with the potential influx of migrants from other districts, provinces or even countries.

The construction phase will thus include several activities with several potential social impacts, of which the more relevant are the following:

- Vegetation clearing and land modeling – the clearance of the Project footprint, required to prepare the land for the Project construction, as well as access roads, construction camps, etc. This change to land use will lead to loss of houses, other built structures and farm land;
- Mobilization of workforce – the hiring and mobilization of the construction workforce will result in direct positive impacts, due to the creation of employment, and indirect negative impacts, associated with the potential influx of migrants and other associated pressures on the social fabric;
- Earthworks and movement and operation of vehicles and machinery – the construction activities will generate noise, light and air emissions, which will result in annoyance effects to the local populations.

The relevant potential social impacts generated by these Project activities are discussed and assessed below, divided into:

- Socioeconomic impacts, i.e., impacts that affect the daily life practices or the economic livelihood of families and communities;
- Cultural heritage impacts, i.e., impacts affecting cultural heritage sites, resources and values; and
- Community health and safety impacts, i.e., impacts affecting community health (such as from noise or environmental quality degradation) or safety (such as increased safety and security risks).

### 7.10.1.2 Impact Assessment – Socioeconomic Impacts

***Impact: Loss of dwellings and other built infrastructure in the RoW***

*Impact Assessment*

The construction of the STE Project will require the clearing of any built structure that currently exists in the Project's RoW (100 m corridor centered in the alignment). The proposed alignment for the transmission line was designed with the general philosophy of avoiding crossing villages as much as possible, to minimize the number of structures affected by the Project's footprint. Nevertheless, based on the undertaken census survey, Project implementation will require the relocation of the

main house of 415 families, 141 houses under construction, three public infra-structures (boreholes) and 16 business infra-structures (mostly small shops)[1]. The relocation of five small (mostly rudimentary) church buildings, 16 family graves and two community cemeteries is also expected to be required. The resources and procedures to implement these relocations with the particpation and agreeement of the affected communities and families will also be included in the RAP.

The vast majority of these impacts occur in the southern part of the alignment, between the substations of Matalane and Maputo, where the Project crosses more developed areas, in the outskirts of the greater Maputo and Matola areas. North of Chibuto, impacts are much lower, as the line mostly develops along areas with lesser human presence.

This impact is assessed as *negative*, of *local* extent (the impacts only occur within the Project's footprint), but of *high* intensity (as the social dynamics of the affected families are highly disturbed) and *long term* duration (as in the non-mitigated scenario, the loss is permanent). This results in a *high significance*.

*Mitigation Measures*

Given the high significance of the assessed impact, mitigation will be required in order to reduce the residual impact to acceptable significance levels. The general principle of mitigation is that all losses are fully compensated for, in such a way as to ensure that the current quality of life of the affected families are at least maintained and if possible improved. This will be achieved through the development and implementation of a Resettlement Action Plan (hereinafter referred to as the "RAP") by EDM. A preliminary RAP[2] will be disclosed as an attachment to the ESIA for information only.

The RAP will ensure achievement of the general principle of mitigation: all losses will be compensated for in order to maintain or improve the current life conditions of the affected families. As such, the following guidelines must be considered for RAP development and implementation:

- Before the start of activities, put into effect in the affected communities, in coordination with the district authorities and local community leaders, an awareness and information program concerning the Project, so as to avoid the construction of new dwellings in the Project area;
- Implement an encompassing compensation program, to be developed and implemented in compliance with current Mozambican Legislation (namely, Decree 31/2012 of 8th of August, Ministerial Diploma 155/2015 of 19th of September and Ministerial Diploma 156/2014 of 19th September) and with the WB Operational Policy on Involuntary Resettlement, O.P 4.12.

This program will be driven by the principle of improvement of current conditions of the affected families. The fundamental guidelines include:

- To avoid or minimize loss of dwellings whenever possible, exploring Project alternatives such as minor adjustments to the alignment;

[1].These figures will be updated during the final RAP, to confirm the undertaken census and also to include the PAPs within the proposed area for the Matalane substation, which were not included in the scope of the preliminary census. According to information from EDM, PAPs within the Matalane substation area will likely include an additional 25 families.

[2] The preliminary RAP is a preparatory document for informatin only which will be replaced by the final RAP once it is cleared by the WBG and disclosed before appraisal,and will also include an Ancillary Facilities RPF as an Annex.

- To make sure that the vacating of the Project area is done according to a just process negotiated between both parties and all compensation, assistance and benefits are provided prior to initiation of the works;
- To improve, or at least restore, the life style of the affected families by providing adequate replacement housing, at a minimum in accordance with local law requirements, including the provision of basic infrastructure (water, sanitation, energy, road access, connectivity, access to public and commercial services);
- To relocate the affected households within the same communities they currently reside, on sites that have equivalent characteristics, and with the agreement of the resettled and host communities and households;
- To create participation mechanisms that involve the Provincial Government, the District Administrations, the Local Leaders and the Affected Communities at the various stages of the process so as to identify the beneficiaries (including a gender perspective) and define the rights and mitigation measures in a participatory manner;
- To implement communication and redress mechanisms to reply to complaints and grievances and ensure accountability and transparency;
- To implement livelihood restoration strategies, to guarantee a smooth return of the households to normality, including productive activity.
- All monetary compensation must be at full replacement value.

*Impact Summary*

The impact assessment summary is provided in the following table. The implementation of the RAP will allow for relocation or compensation of all affected infrastructure, lowering the residual impact's duration, thus resulting in a *medium* significance residual impact.

| **Impact: Loss of dwellings and other built infrastructure in the RoW** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Before the start of activities, put into effect an encroachment control program, in articulation with local authorities, to avoid the construction of new dwellings in the Project area;<br>- Develop and implement a comprehensive RAP compliant with Mozambican Legislation and WB OP 4.12;<br>- All loss of infrastructure and any assets or access to resources will be identified and duly compensated for in kind or at full replacement value;<br>- All transitional losses and disturbances will be compensated for. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | High | 3 |
| Duration | Long-term | 3 | | Medium-term | 2 |
| Consequence | High | 7 | | Medium | 6 |
| Probability | Definite | | | Definite | |
| **Significance** | **High** | | | **Medium** | |

***Impact: Disturbance to farming areas due to powerline construction and establishment of right-of-way***

*Impact Assessment*

Unlike built structures, the impact of the powerline construction on farming will be mostly temporary. Once built, annual cultures may still be cropped in the RoW, under the powerline. Fruits trees, however, will be cut in the 30 m vegetation clearance corridor, and will not be allowed to be replanted

in that corridor. During the fieldwork, a total of 88 farmlands, mostly small scale sustenance farming, and 1 520 fruit trees were identified within the RoW.

Given the above, the impact is rated as *negative*, of *local* extent, *medium* intensity (even if the number of farming areas to be affected is not very high, and that affections will be marginal, this will still imply relevant changes to the social processes of the affected farmers) and *long-term* duration (this refers only to the fruit trees that will be cut, as once the construction is concluded annual crops farming may be resumed without any constraint), resulting in a *medium* significance.

*Mitigation Measures*

Given the impact's significance rating, mitigation measures are required. Any loss to farming fields will be adequately compensated, namely:

- As the engineering design is still not final, it is still possible to minimize the number of interferences with farming fields. As such, during the detailed engineering design phase, the STE alignment will be optimized in order to minimize as much as possible the need to affect any agricultural area;
- Any impact on agriculture, even temporary, will be compensated according to market / replacement cost - the national rate presented by the Provincial Directorate of Agriculture can be used as a starting point but will have to be validated by a market study. The compensation figures will be the highest between the market study figures and the official governamental figures. This will be achieved through the RAP;
- Provide early warning to farmers, to avoid plantation of new crops on the areas to be disturbed, and compensate for lost income for the corresponding crop cycle;
- Whenever possible, perform the vegetation clearing activities during the fallow season, in order to reduce the loss of planted crops;
- Support crop reestablishment once construction is completed.

*Impact Summary*

The impact summary is provided in the following table. The compensations will lower the impact's duration to the *medium term* (as the lost fruit trees will be compensated for), lowering the residual significance to *low*.

| **Impact: Disturbance to farming areas due to powerline construction and establishment of right-of-way** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Optimize the STE alignment during the final engineering design phase, in order to minimize as much as possible the interference with farming areas;<br>- Develop and implement a compensation plan, to adequately compensate for any losses of crops due to powerline construction,<br>- Inform the people about the construction so they can harvest their crops,<br>- Whenever possible, perform the vegetation clearing activities during the fallow season. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Long-term | 3 | | Medium-term | 2 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Definite | | | Definite | |
| **Significance** | **Medium** | | | **Low** | |

***Impact: Creation of employment opportunities during the construction phase***

*Impact Assessment*

The construction phase will generate direct employment opportunities, the majority being unskilled work. Estimates provided by EDM indicate that a total of 250 workers, including specialized and non-specialized workers, will likely be involved in the transmission line construction works, while roughly 50 to 100 workers will be needed to install the substation equipment and instrumentation.

It should be noted that EDM will not hire these workers directly, but instead will retain construction contractors, which will mobilize the adequate workforce. Most of this workforce will likely be recruited locally, i.e., at provincial level, with a smaller percentage of specialized workers likely to be mobilized from other provinces or from abroad.

At present, employment opportunities for the communities in the Project area are very scarce. Thus, the jobs created by the Project, both directly and indirectly, will lead to an increase in family income of the workers hired locally, and the improvement of the wellbeing of their families. Note, however, that these are temporary jobs (the construction phase is expected to last four years).

This is a *positive* impact, of *local* extent, and *low* intensity (given the relative small number of workers employed) and *short-term* duration (restricted to the construction phase), resulting in a *very low significance*.

*Enhancement Measures*

The Contractor will develop and implement a Local Recruitment Plan. This plan should abide by the following (see additional guidance in the ESMP):

- During the process of contracting workers, priority will be given to the local population, provided applicants have the necessary skills for the created employment opportunity;
- Employment opportunities will be adequately advertised, so as not to limit application opportunities; and
- The process of contracting staff will be transparent and follow pre-established and accepted criteria.

*Impact Summary*

The impact summary is provided in the following table. The enhancement measures do not increase the significance rating, mostly given the low number of jobs created.

| Impact: Creation of employment opportunities during the construction phase | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Enhancement Measures** | **Post-mitigation assessment** | |
| Nature | Positive | | - Give priority to hire local workers, provided applicants have the necessary skills for the created employment opportunity;<br>- Employment opportunities will be adequately advertised, so as not to limit application opportunities;<br>- The process of contracting staff will be transparent and follow pre-established and accepted criteria. | Positive | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very Low | 3 | | Very Low | 3 |
| Probability | Definite | | | Definite | |
| **Significance** | **Very Low** | | | **Very Low** | |

***Impact: Transfer of skills to local communities due to mobilization of construction workforce***

*Impact Assessment*

Unskilled local people that will be employed by the Project will benefit not only from increased yields but also the development of training, including technical / professional issues and also general issues (e.g. awareness about health and safety). This will result in a transfer of know-how and skills to the local communities and will naturally improve the chances of the trained personnel in obtaining employment in the future, with associated benefits for their families and dependents, resulting in an indirect very long-term benefit.

This is a *positive* impact, which is assessed as *indirect*, of *long term* duration (as the gained skills will benefit these workers beyond the limit of this specific job), of *local* extent and of *medium* intensity (given the overall lack of worker specialization and know-how in the Project region), resulting in a *medium significance*.

*Enhancement Measures*

Even though a significant positive impact is already expected, some enhancement measures can be developed to increase the effectiveness of the skill transfer process, namely:

- The construction Contractor will develop and implement a Training and Skill Transfer Program, with the following main goals:
  - Provide technical training programs for unskilled workers, with the objective of improving their job performance and giving them the skills to compete for other positions;
  - Provide environmental and social awareness training to all workers, including matters related to the code of conduct, non-discrimination and sexual harassment, abuse and exploitation;
- The construction Contractor will develop a Health and Safety Management Program. This program will include provision of training in health and safety issues for all workers.

*Impact Summary*

The impact assessment summary is provided in the following table. The enhancement measures defined above increase the impact probability, although this does not change the rating of the residual significance which remains *medium*.

| **Impact: Transfer of skills to local communities due to mobilization of construction workforce** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Enhancement Measures** | **Post-mitigation assessment** | |
| Nature | Positive | | - The construction contractor will provide technical training programs for unskilled workers, with the objective of improving their job performance and giving them the skills to compete for other positions;<br>- The construction contractor will provide environmental and social awareness training to all workers;<br>- The construction contractor will provide health and safety training to all workers. | Positive | |
| Type | Indirect | | | Indirect | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | Medium | 6 | | Medium | 6 |
| Probability | Probable | | | Definite | |
| **Significance** | **Medium** | | | **Medium** | |

***Impact: Local and regional economic stimulation due to construction expenditure and increased workforce income***

*Impact Assessment*

The construction of the STE Project will create direct and indirect opportunities for the stimulation of the local economy, associated with:

- The procurement of services, goods and materials needed for the construction works. Although some specialized services will need to be sourced at national or international levels (as they are not available locally), many goods and services will be procured locally, namely those associated with housing, catering, etc.;
- The increased income of the hired workforce will lead to an increase of levels of consumption due to the concentration of workers and the influx of people from other areas looking for work.

This will lead to an increase in demand for consumer products, goods and services. Greater demand will develop the local markets, especially in the food sector, which will benefit the local, district and provincial economies, stimulating the creation of businesses and jobs. Informal commercial activities will also likely arise, benefiting some residents with increased family income.

This is a *positive* impact, which is assessed as *indirect*, of *short-term* duration (the stimulation will only occur during the construction phase), of *regional* extent and of *medium* intensity, resulting in a *low significance*.

*Enhancement Measures*

Even though a positive impact is already expected, some enhancement measures can be developed to increase the local and regional economy stimulation during the construction phase:

- The procurement of goods and services by the Contractor will give priority to sourcing from the local and provincial markets, whenever possible. The Contractor will:
  - Identify the goods and services required by the Project that can be supplied locally (e.g. meals and cleaning) and encourage and support local companies in the production and supplying of these goods and services;
  - Before the start of the activities of the STE Project the Contractor will identify and disclose the types of services they will require, to enable local entrepreneurs the possibility of training, improvement of skills and services to offer;
  - Before the beginning of activities, ask the local authorities and community leaders to get involved in empowering residents interested in developing small businesses.

*Impact Summary*

The impact assessment summary is provided in the following table. The enhancement measures raise the impact probability, but the residual significance rating remains as *low*.

| **Impact: Local and regional economic stimulation due to construction expenditure and increased workforce income** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Key Enhancement Measures** | **Post-mitigation assessment** | |
| Nature | Positive | | - The procurement of goods and services by the construction contractor will give priority to sourcing from the local and provincial markets, whenever possible. | Positive | |
| Type | Indirect | | | Indirect | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Probable | | | Definite | |
| **Significance** | **Low** | | | **Low** | |

### 7.10.1.3 Impact Assessment – Cultural Heritage Impacts

***Impact: Loss of cultural heritage sites***

*Impact Assessment*

The clearing of the STE Project RoW will lead to the loss of cultural heritage. As part of the full census developed for the preparation of the RAP, a cultural heritage survey was conducted, aiming to identify all archaeological or other cultural heritage sites, such as sacred sites, cemeteries, religious temples, or any other site or asset of cultural heritage relevance.

As a result, 18 cemeteries and five churches were identified within the RoW that will thus be affected by the Project. The religious temples are Zionist churches (see section 6.3.5.2 of **Volume I** for additional details). In what regards the cemeteries, of the 18 identified within the RoW, 16 are family's cemeteries or graves and two are communal cemeteries.

No archaeological sites, sacred sites or other cultural heritage sites were identified within the RoW. Most of the community leaders did mentioned having a sacred place where they reside, but none of those sites will be affected by the Project.

In the pre-mitigation scenario, Project construction would lead to the loss of these cultural heritage sites. This impact is assessed as *negative*, of *local extent* (the impact only occur within the Project's footprint) but of *high* intensity (given the high cultural and social value of these religious and sacred sites) and *long term* duration (as in the non-mitigated scenario, the loss is permanent). This results in a *high significance*.

*Mitigation Measures*

Given the high significance of the assessed impact, mitigation will be required in order to reduce the residual impact to acceptable significance levels. As such, the loss of these sites will need to be avoided through relocation, or compensation where adequate. This should be done through the RAP to be developed and implemented for the Project.

Specifically, the following guidelines are recommended for RAP development and implementation, in what regards these cultural heritage sites:

- The affected religious temples should preferably be relocated to a new site, to be agreed with the communities. If compensation in kind is not possible, the affected structure will be compensated for at full replacement value;
- Affected cemeteries will be relocated to a new location: the affected graves will be exhumed and translocated to a new location. The new location will be agreed with the community and this activity will be monitored by local authorities. EDM will support all costs for exhumation and translocation of the graves including professional services as agreed with the community. Each community will organize a ceremony for the removal and translocation of graves according to local religious beliefs and / or customs. These rituals are led by spiritual leader and / or community leader.

Additionally, the Contractor will implement a Chance Find Procedure during the construction activities that require earthmoving or clearing of vegetation. Even though no archaeological site has been found within the RoW, the possibility of existence of underground remains cannot be excluded. The implementation of a Chance Find Procedure will allow the safeguard of any archaeological site or finding that may be uncovered during construction.

*Impact Summary*

The impact assessment summary is provided in the following table. The implementation of the mitigation measures above will allow for relocation or compensation of all affected sites or assets, and also allow for the safeguard of any chance findings, lowering the residual impact's intensity and duration, thus resulting in a *low* significance residual impact.

| Impact: Loss of cultural heritage sites | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Key Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Affected religious temples will be relocated or compensated for;<br>- Affected cemeteries will be relocated to a new location, in agreement with local communities, and following all required cerimonies and traditional practices;<br>- The Contractor will implement a Chance Find Procedure, to safeguard any archaeological finding that may be uncovered during construction. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Long-term | 3 | | Medium-term | 2 |
| Consequence | High | 7 | | Low | 5 |
| Probability | Definite | | | Definite | |
| **Significance** | **High** | | | **Low** | |

### 7.10.1.4 Impact Assessment – Community Health and Safety Impacts

***Impact: Disturbance of local communities' daily activities due to the nuisance factor of construction (increased noise, light and dust emissions and traffic interference)***

*Impact Assessment*

Further to direct impacts on built structures and farm plots, the construction activities will generate a number of environmental disturbances that result in a combined nuisance effect on the communities surrounding the construction areas. These include increased light, noise and dust emissions, as well as traffic interferences caused by the STE Project construction.

Detailed impact assessments for noise and air quality are provided elsewhere. Those assessments are not repeated in this section, which focuses on the nuisance effects of these environmental disturbances on the daily activities of the local communities. Nevertheless, a brief summary of the main findings of those assessments is provided below:

- In what regards noise emissions, the construction phase noise impact was assessed as being of very low significance, after mitigation. Noise emitted by construction machinery will be in the normal range of heavy equipment, similar to the noise levels that are already recorded in the areas closer to roads, and will be of short-term duration;
- Atmospheric emissions in the construction phase will be mainly of dust, caused by earth movements. This impact was assessed as of very low significance, after mitigation.

As these specific assessments did not identify significant impacts on noise or air quality, no public health issues are expected to result from these environmental disturbances. However, the combined effects of these low significance environmental disturbances will still result in a nuisance factor to the local communities.

This nuisance effect is, however, minimized by the relatively small size of the construction activities to be undertaken. The linear nature of the Project also minimizes the disturbance effect, as construction activities at each given segment will be of short duration.

Because of this, the impact is rated as *negative*, of *local* extent, *medium* intensity and *short-term* duration, resulting in a *very low significance*.

*Mitigation Measures*

The mitigation measures provided in the noise and air quality sections are applicable, in order to ensure the maximum reduction of the nuisance effect. Of those mitigation measures, the following are particularly relevant to mitigate this impact:

- Construction activities will be limited to the daytime period (between 07:00 and 22:00) of working week days, whenever near residential or other community use areas. If noise complaints are received from local communities in the morning or evening periods, despite compliance with the above, and if the following investigation confirms the noise impact, then further reduce the work schedule, in consultation with affected communities;
- The Contractor will develop, and submit for EDM approval, a Traffic Management Plan, detailing the management procedures and mitigation measures to minimize traffic related impacts. That plan will include the mitigation provided below;
- Construction heavy vehicles must abide by a 30 km/h speed limit near residential areas;
- Circulation of construction heavy vehicles will be limited to pre-approved construction routes. These routes must be defined in order to avoid crossing residential areas, whenever feasible;
- Place traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely;
- All unpaved surfaces will be kept moist, in particular during dry and windy conditions;
- Inhabitants of local communities nearby the construction fronts will be previously informed regarding the upcoming construction activities.

*Impact Summary*

The impact summary is provided in the following table.

| **Impact: Disturbance of local communities' daily activities due to the nuisance factor of construction (increased noise, light and dust emissions and traffic interference)** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Construction activities will be limited to the daytime period of working week days, whenever near residential areas;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h in critical segments, such as when near residential areas;<br>- All unpaved surfaces will be kept moist, in particular during dry and windy conditions;<br>- Inhabitants of local communities nearby the construction fronts will be previously informed regarding the upcoming construction activities. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very Low | 4 | | Very Low | 3 |
| Probability | Definite | | | Definite | |
| **Significance** | **Very Low** | | | **Very Low** | |

***Impact: Security concerns increase due to the traffic volume increase***

*Impact Assessment*

The increased traffic also increases the risk of road accidents with vehicles and with pedestrians. These security risks are a concern particularly around the residential areas adjacent to the main routes that will be used by heavy vehicles and particularly during the night period. Many of these roads have no crosswalks or formal lighting, which increases this risk.

This increase in community hazard risk is considered of *high* intensity (as any death or serious injury caused by construction traffic would cause serious disruption of social functions and impact the Project and EDM's reputation), although of *short-term* duration (the increased risk will be limited to the construction phase) and *local* extent. The significance is thus evaluated as *low*.

*Mitigation Measures*

Despite the low significance, all relevant mitigation will be implemented in order to mitigate the security risks of the construction phase. The same mitigation measures described to reduce traffic impacts will also lower the associated security risks. To this effect, the Contractor will develop and submit for EDM approval a Traffic Management Plan, detailing the management procedures and mitigation measures to minimize traffic related impacts. Among other issues, setting and enforcing speed limits for construction vehicles is essential, especially within and adjacent to residential areas, as well as placing traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely. Prior to the construction phase proper information of the relevant speed limits and speed control mechanisms must be given to drivers. Additionally, where possible, install and maintain official traffic signs on new accesses that may be created to support the STE construction, before and after the execution of the work, in conjunction with local transit authorities.

Further to the measures above, which were already discussed elsewhere to mitigate traffic impacts, the following additional measures will also be implemented:

- EDM will develop a Community Awareness Program. Include in this plan community awareness actions dealing with risks associated with Project road traffic and the adequate preventative behaviours and cautions that should be adopted when near Project accesses;
- If an existing road or pedestrian access is cut as a result of Project construction activities, alternative routes will be provided, to restore pedestrian and road accessibility.

*Impact Summary*

The impact summary is provided in the following table. The mitigation measures will lower the probability of occurrence of accidents, lowering the residual significance to *very low*.

| Impact: Security concerns increase due to the traffic volume increase | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Construction heavy vehicles must abide by a 30 km/h speed limit near residential areas;<br>- Inform drivers of the set speed limits and enforce them as appropriate;<br>- Restrict the use of heavy vehicles to primaries roads and avoid the use of roads not designed for heavy loads;<br>- Install temporary official traffic signs on local roads around the work fronts before and during the execution of the works together with local transit authorities;<br>- Place traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely<br>- Develop a community awareness program, dealing with community risks associated with road traffic and the adequate preventative behaviours and cautions that should be adopted when near Project accesses;<br>- If an existing road or pedestrian access is cut as a result of Project construction activities, alternative routes will be provided, to restore pedestrian and road accessibility. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | High | 3 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Probable | | | Possible | |
| **Significance** | **Low** | | | **Very Low** | |

***Impact: Potential increase of community conflicts due to the influx of migrant workers***

*Impact Assessment*

The analysis of the potential Project impact discussed in this section is related to the possibility that during the implementation of the Project activities, an influx of people seeking work may occur because of anticipated job opportunities. As discussed in the Project Description section (see **Volume I**), based on similar developments it is expected that a peak total of 250 workers, including specialized and non-specialized workers, will be required for the construction phase.

This size of the construction workforce is not vey large, when compared with more labour intensive developments, such as a road construction. However, it is still likely to attract work seekers. Migrant workers will likely come mainly from other villages, which are crossed by the Project, but the construction activities may also attract workers from other districts. Construction work requires a low set of skills thus being appealing to the majority of the provincial population. Given the general lack of formal employment in the Project region, the influx of people looking for employment may be relevant.

The influx of outside people seeking employment tends to develop behavior often disapproved of by the receiving local communities. These perceived antisocial behaviors can include criminal activities, alcohol and drug abuse. These impacts may lead to resentment and friction between established residents and the incoming people.

This potential for increased community conflicts is a *negative* impact, which is assessed as *direct*, of *short term* duration (construction phase), of *regional* extent and *high* intensity (as the disruption of the social dynamics can lead to relevant social disturbance), resulting in a *medium significance*.

*Mitigation Measures*

Mitigation of this impact will focus on minimizing the influx of workers and on establishing a communication relationship with the local communities. The following measures will be implemented:

- The Contractor will develop and implement a Local Recruitment Plan, to maximize hiring of local community members and minimize the influx of migrant labor and outside workers. This plan will include the following principles:
  - Create mechanisms to ensure that the recruitment and hiring procedures are conducted in a transparent and just manner and coordinated with the community leaders and District Administration;
  - Adopt recruiting methods and practices that maximize local employment including for women and young workers;
  - Provide basic training and local transportation to facilitate access to work sites.
- The Contractor will develop a Camp and Housing Management Plan, detailing the proposed location of the construction camps and the management procedures of the camps. This plan will be submitted for EDM approval, prior to start of construction and will abide by the following guidelines:
  - When planning the location of the main construction camps, preferentially select major cities for their placement. The more urban nature of the major cities will minimize the disturbance effect to local communities, as the mixture of people from different geographical origins and socioeconomic backgrounds is already a feature of these urban communities;
  - If there is a need to contract workers from outside the Project region, provide adequate housing for these workers, either in dedicated camps or in urban areas of major cities, to minimize the potential for conflicts with local communities.
- For all workers, local or otherwise, include in the worker contracts the requirement to sign a Code of Conduct. This code, to be drafted by the Contractor and approved by EDM prior to Project start, will capture all the behavioral good practices that are expected from the Project worker, including a statement that workers are expected to keep and promote good standards of social interaction with the local communities, are expected not to be under the influence of alcohol or other intoxicating substances during work hours, interdiction of sexual harassessment, gender based violence, and sexual abuse or exploitation, including involving minors, etc.. Failure to abide by the Code of Conduct will be contractual grounds for contract termination. Inform all hired workers of these restrictions and the consequences of breaking them;
- EDM and the Contractor will work together to assess risks and identify and implement prevention, response and referral processes with respect to any cases involving Sexual Abuse and Exploitation / Gender Based Violence (SAE/GBV). This will focus on: (i) training of EDM and Contractor personnel, (ii) community and worker awareness, (iii) making available safe and confidential channels of communication and complaints, and (iv) a referral system and mechanism for survivors of SAE/GBV;

- EDM will develop a Community Awareness Plan. This plan will include community awareness actions dealing with the community risks associated with the influx of workers, informing them on the Code of Conduct that Project workers have signed and of the grievance mechanism available to them;
- EDM will develop and implement a Project Grievance Redress Mechanism, as per the guidance provided in the ESMP. Local communities will be informed of its existence and the channels available to them to lodge a complaint regarding any potential conflict with Project workforce;
- EDM will develop a Stakeholder Engagement Plan, in compliance with IFC PS1 requirements. As part of this plan, EDM will develop a Communication Plan, to be able to interact with the communities, informing them of the nature and timing of the activities, and establishing communication channels to manage any social conflicts that may arise. This plan will consider the following:
  - Inform communities about the nature and timing of construction activities, especially those that may change the daily life of communities;
  - Develop a policy of interaction between the local community, employees, suppliers, local, regional and migrants to reduce the differences between the different groups;
  - Interact with the local administration and the police to implement control mechanisms in public places to prevent crime.

*Impact Summary*

The impact assessment summary is provided in the following table. The mitigation measures will lower the impact's intensity, resulting in a *low* residual significance.

| **Impact: Potential increase of community conflicts due to the influx of migrant workers** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Key Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - The Contractor will develop a Camp and Housing Management Plan, to minimize potential community conflicts associated with construction camps location and worker housing;<br>- The Contractor will implement a Local Recruitment Plan, to ensure that hiring processes are conducted in a transparent and fair manner and maximize local employment to the extent possible;<br>- EDM will develop a Communication Plan, to be able to interact with the communities, informing them of the nature and timing of the activities, and establishing communication channels to manage any social conflicts that may arise;<br>- EDM will develop a Community Awareness Plan, including community awareness actions dealing with the community risks associated with the influx of workers;<br>- EDM will develop and implement a Project Grievance Mechanism. Inform local communities of its existence and the channels available to them to lodge a complaint. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Probable | | | Probable | |
| **Significance** | **Medium** | | | **Low** | |

***Impact: Increased risk of transmission of STDs due to workforce mobilization***

*Impact Assessment*

HIV/AIDS is a concern in Mozambique; there is a lack of institutional capacity for their prevention and treatment. Existing high levels of stigma around HIV negatively affects people's willingness to undergo testing and receive treatment, for fear of being stigmatized. Such stigma also affects people's ability, especially women's, to initiate discussions around practicing safe sex. Such stigmas and associated negative consequences are associated with increased transmission rates.

The construction of the STE Project will concentrate a significant number of workers. This influx of workers, probably mostly men, can stimulate an increase in risky social behavior in local communities (such as unprotected sex between workers and locals). Therefore, there can be an increase in rates of HIV/AIDS and other sexually transmitted diseases (STDs) in the Project workers and local communities.

Any increase in the prevalence of STDs or HIV/AIDS in the study area is a risk to the health of members of the community. There is little access to treatment for STDs including HIV/AIDS in the communities. Treatment is only available at the larger urban centers, which can be difficult to access. A lack of access to treatment could also affect the long term health of those who contract STDs other than HIV, including fertility, damage to internal organs and long term disability or even death. The stigma and taboos around STDs may also affect people accessing treatment in a timely manner which may also affect health outcomes.

This potential impact of increased risk of transmission of STDs is assessed as *negative*, *indirect*, of *short-term* duration (the risk increase is limited to the construction phase), of *regional* extent (as disease transmission is likely to occur across provinces, although the risk will be greatest in communities closest to the STE Project alignment, especially more urban areas) and of *high* intensity (as relatively large numbers of people could be affected and there may be long-term consequences, such as serious illness or deaths), resulting in a *medium significance* prior to mitigation.

*Mitigation Measures*

Given the impact's significance, mitigation is required to lower the residual significance of impacts associated with any increase in STDs, including HIV/AIDS. The following is recommended:

- For all workers, local or otherwise, include in the worker contracts the requirement to sign a Code of Conduct. This code, to be drafted by the Contractor and approved by EDM prior to Project start, will capture all the behavioral good practices that are expected from the Project worker, including a statement that workers are expected to keep and promote good standards of social interaction with the local communities, are expected not to be under the influence of alcohol or other intoxicating substances during work hours, interdiction of sexual harassessment, gender based violence, and sexual abuse or exploitation, including involving minors, etc.. Failure to abide by the Code of Conduct will be contractual grounds for contract termination. Inform all hired workers of these restrictions and the consequences of breaking them;

- The Contractor will develop a policy and management plan to reduce the transmission of STIs, including HIV / AIDS. This strategy will:
  - Make provision for awareness, counseling and testing for all Project personnel, including voluntary testing for STDs and HIV/AIDS as part of any health screening program (workers will not be denied employment or discriminated against in any way based on their HIV status; no pre-employment testing should take place);
  - Provide guidance and counselling to workers with HIV/AIDS to access treatment through existing health facilities or Non-Governmental Organizations (NGO) campaigns or programs;
  - Ensure there is access to free condoms at all worker sites and accommodation;
  - Ensure that all Project personnel are given specific HIV and STD prevention training;
  - Undertake information, education and communication campaigns around safe sexual practices and transmission of STDs and HIV/AIDS as well as condom distribution at stopping locations on key transport routes targeting commercial sex workers and truck drivers;
  - Undertake, under the Community Awareness Program, community awareness campaigns around safe sexual practices and transmission of STDs and HIV/AIDS;
  - Support public health or NGO initiatives to reduce STD transmission, including working through schools, women's and youth groups;
  - The Contractor will encourage and allow specialized expatriate labour, or specialized labour mobilized from other provinces, to move with their families;
  - The Contractor will provide non-local workers with a schedule and transportation that limits off-time activities at nearby communities.

*Impact Summary*

The impact summary is provided in the following table. It is expected that the intensity of the impact will decrease to *medium* as while the measures will raise awareness around transmission and symptoms and improve access to treatment, due to the existing prevalence levels and predicted changes there is still a high likelihood of the number of cases of STDs and HIV/AIDS increasing. This thus results in a *low* residual significance.

| **Impact: Increased risk of transmission of STDs due to workforce mobilization** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Key Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - The Contractor will develop a management plan for the prevention of HIV / AIDS and STD and implement awareness campaigns for counselling, testing, care, treatment and prevention (condom distribution) among the workforce;<br>- EDM will interact with the Provincial and District Directorates of Health and local NGOs specialized in the subject, to support similar campaigns among local communities in general. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Probable | | | Probable | |
| **Significance** | **Medium** | | | **Low** | |

***Impact: Risk of social conflicts elicited by the Project security personnel***

*Impact Assessment*

One of the potential impacts associated with major developments is the potential risk of conflicts arising from the interactions of local communities with security workers, hired to safeguard developer's personnel and property.

However, for the STE Project this risk is considered to be generally low. Given the linear nature of the project (which will make it hard to establish large concentrated construction camps in a single location) and the relatively low intensity and man-power requirements of the construction works, security arrangements will likely be contracted to local security companies. No use of police or military personnel, or even para-military security is planned or likely.

Local security companies are staffed almost exclusively with national personnel, which helps minimize the risk of social conflicts with local communities. So, while it is likely that security personnel will be deployed in the construction camps, this will be unarmed, national workers, whose main functions will be guarding the camps against thefts and similar issues. The risk of conflicts with local communities will be very small.

As such, this risk is assessed as *negative*, *indirect*, of *short-term* duration (the risk increase is limited to construction phase), of *local* extent (limited to the camp locations) and of *medium* intensity, resulting in a *very low significance*, even prior to mitigation.

*Mitigation Measures*

Despite the very low significancy rating, best practices are still applicable in what regards the risks associated with security personnel. As such, the following mitigation will be implemented:

- The Contractor will develop a Security Management Plan, detailing the security arrangements to be deployed at camps, material storage and construction sites, or any location with Project presence. This plan will be compliant with IFC's PS 4, and with the Voluntary Principles on Security and Human Rights, and will be submitted for EDM approval, prior to start of construction;
- This plan will include mandatory training for all security personnel, in what regards human rights, proportionate force use and adherence to the Contractor's code of conduct.

*Impact Summary*

The impact summary is provided in the following table. It is expected that the intensity of the impact will decrease to *low*, with the application of the mitigation. The residual significance remains as *very low*.

| Impact: Risk of social conflicts elicited by the Project security personnel | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - The Contractor will develop a Security Management Plan, detailing the security arrangements to be deployed at camps, material storage and construction sites, or any location with Project presence;<br>- All security personnel shall have mandatory training in what regards human rights, proportionate force use and adherence to the Contractor's code of conduct. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Medium | 2 | | Low | 1 |
| Duration | Short-term | 1 | | Short-term | 1 |
| Consequence | Very Low | 4 | | Very Low | 4 |
| Probability | Probable | | | Probable | |
| **Significance** | **Very Low** | | | **Very Low** | |

***Impact: Potential impacts on workers' health and safety during the construction phase***

*Impact Assessment*

As previously stated, the Project's construction phase will likely require the mobilization of roughly 250 workers. Impacts on worker's health and safety could manifest as a result of inadequate implementation of existing labor standards by the Contractor or from work related injury or health effects. Work accidents could occur during several of the planned construction activities, such as site preparation, excavations, vegetation clearance, waste and hazardous materials management, transportation and circulation or worksite restoration.

The main common causes of accidents in construction are:

- Working at height;
- Working in an unsecured excavation;
- Working on slippery surfaces;
- Accidentally falling objects;
- Moving heavy loads;
- Bad working positions, often in confined spaces;
- Working on or near water (drowning);
- Encounters with dangerous fauna (i.e. venomous snakes);
- Working near live electrical wires and equipment (electrocution).

All workers could be exposed to accidents at the worksite. However, implementation of suitable health and safety procedures should help preventing or reducing the probability of accidents from occurring.

Child labour is also a risk during construction work that should be avoided at all costs. Child labour is described as having workers below 18 years of age. Therefore, child labour shall be strictly prohibited and any case thereof should be reported to EDM by the individuals responsible for surveillance. The ultimate responsibility for preventing child labor lies with the Contractor.

This potential impact on workers' health and safety is assessed as *negative*, *direct*, of *medium-term* duration, of *local* extent (only the workers at the construction sites are potentially impacted) but of

*high* intensity (as work accidents could result in serious injuries or even fatalities), resulting in a *medium significance* prior to mitigation.

*Mitigation Measures*

To mitigate the impact described above, it must be ensured that the labor and working conditions are of an acceptable standard. Specifically, the following mitigation will be implemented:

- The Contractor will develop and implement an Emergency Response Plan (as per the guidance given in the ESMP);
- All contractors and sub-contractors will be required to comply with relevant WB health and safety requirements and EDM's corporate policy;
- The Contractor will develop and implement a Health and Safety Management Plan to protect every worker involved in construction activities, even temporary workers. This plan will comply with national legislation and address all aspects of labor standards relevant to the project as specified by WBG General EHS Guidelines and WBG Industry Sector Guideline for Electric Power Transmission. Sub-contractors will be contractually required to comply with labor and health and safety legislation. Specific provisions must be included for:
  - Supply drinking water and maintain its quality and ensure sanitation at the construction sites;
  - Provision of sanitation at camps, substations and tower erection points;
  - Provision of separate accommodation and sanitation facilities in worker camps, in order to satisfy both gender needs;
  - Declaration of accidents through an accident reporting mechanism;
  - Handling domestic and specialized waste, as well as dangerous goods;
  - Procedures in case of injuries and accidents;
  - Use of personal protective equipment (e.g.: helmets, fall protection equipment)
  - Secure equipment and demarcate any excavation works areas;
  - Sign and fence construction areas, where necessary;
  - Maintain construction camps in a clean and healthy condition as prescribed by international worker health standards.
- Implement a long-term training program throughout the construction phase to ensure adequate training and qualification of all staff employed for the project. Specific training must be provided for:
  - Working around live power lines;
  - Working at heights.
- Provide medical facilities throughout the construction phase for the use of workers where required;
- Ensure reasonable working hours, wages and other benefits;
- Provide suitable and safe accommodation and sanitation facilities, including available drinking water and improved latrines;
- Provide and ensure the use of personal protective equipment (PPE);
- Establish a ‘grievance mechanism’ for workers.

*Impact Summary*

The impact summary is provided in the following table. The proposed mitigation lowers the intensity and probability of impact occurrence, resulting in a *very low* residual significance.

| **Impact: Potential impacts on workers' health and safety during the construction phase** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - The Contractor will develop and implement an Emergency Response Plan;<br>- The Contractor will develop and implement a Health and Safety Management Plan to protect every worker involved in construction activities, even temporary workers. This plan will comply with national legislation and WBG General EHS Guidelines and WBG Industry Sector Guideline for Electric Power Transmission. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Medium-term | 2 | | Medium-term | 2 |
| Consequence | Medium | 6 | | Low | 5 |
| Probability | Probable | | | Possible | |
| **Significance** | **Medium** | | | **Very Low** | |

## 7.10.2 Operational Phase

### 7.10.2.1 Impact-Generating Activities

The operational phase will have few activities with the potential to impact the socioeconomic environment. The main positive impact will be the increase in power supply in the Southern region of Mozambique, which will help to stimulate other industries in the region.

### 7.10.2.2 Impact Assessment – Socioeconomic impacts

***Impact: Creation of employment opportunities during the operational phase***

*Impact Assessment*

The number of direct employment opportunities created by the Project during the operational phase will be very low. The operation of the overhead line will mostly be performed by EDM's existing personnel. Further to this, local teams may be employed to perform maintenance clearance of the RoW and each substation may have four permanent workers.

While *positive*, this impact will be of *local* extent and *low* intensity, although of *long-term* duration. The resulting rating, considering the direct application of the adopted standardized impact assessment methodology, is *low*. However, given the very low number of jobs created, this impact is considered to be of *very low* significance.

*Enhancement Measures*

The same enhancement measures defined for the construction phase are also applicable to the operational impact.

*Impact Summary*

The impact summary is provided in the following table. The enhancement measures do not increase the significance rating, mostly given the low number of jobs created.

| Impact: Creation of employment opportunities during the operational phase | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Enhancement Measures** | **Post-mitigation assessment** | |
| Nature | Positive | | - Give priority to hire local workers, provided applicants have the necessary skills for the created employment opportunity;<br>- Employment opportunities will be adequately advertised, so as not to limit application opportunities;<br>- The process of contracting staff will be transparent and follow pre-established and accepted criteria. | Positive | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | Low | 1 | | Low | 1 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | Low | 5 | | Low | 5 |
| Probability | Definite | | | Definite | |
| **Significance** | **Very Low*** | | | **Very Low*** | |

**Note**: * the significance rating has been downgraded to Very Low, given the discussed above.

***Impact: Regional economic stimulation, due to increase in power availability***

*Impact Assessment*

The STE Project will connect the central and southern regions of Mozambique, easing the evacuation of power generated in the central region, such as the future Temane Power Plan, to the southern region, where the power demand is higher, and the future distribution of power along the STE alignment, through the substations of Vilankulos, Chibuto, Matalane and Maputo. Note that the STE Project does not include a distribution component, but it will facilitate the development of future distribution schemes, from the new substations fed by the transmission line.

This increased power availability, created by the STE Project, will have a positive impact on the regional economy. On current conditions, the power supply in some areas is weak or nonexistent. The STE Project will allow for the increase of power supply in the southern region of Mozambique and will allow a better distribution of power in areas which are currently not electrified, through the construction of substations, from which distribution schemes can be developed at a later date.

The development of the STE Project could also create business opportunities in the industrial sector, as developers will know that the STE Project will both increase the quantity and robustness of power supply, enabling a larger number of viable industrial projects. All these vectors of economic stimulation will in turn result in the creation of jobs.

This is thus a *positive indirect* economic impact, of *long term* duration, of *regional* extent and of *medium* intensity, resulting in a *high significance*.

*Enhancement Measures*

No enhancement measures are required for this positive impact. EDM will ensure the standard maintenance program for this powerline.

*Impact Summary*

The impact assessment summary is provided in the following table.

| Impact: Regional economic stimulation, due to increase in power supply | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Key Enhancement** | **Post-mitigation assessment** | |
| Nature | Positive | | - EDM will ensure the standard maintenance program for the STE Project. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Regional | 2 | | Regional | 2 |
| Intensity | Medium | 2 | | Medium | 2 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | High | 7 | | High | 7 |
| Probability | Probable | | | Probable | |
| **Significance** | **High** | | | **High** | |

### 7.10.2.3 Impact Assessment – Community Health and Safety

***Impact: Risks to community health and safety due to encroachement into the RoW***

*Impact Assessment*

As previously discussed, during the operational phase a 100 m wide RoW along the power line will be maintained, in order to minimize risks to the transmission infrastructure but also to protect neighboring communities in the event of an accident (e.g., the fall or a tower or the disconnection of a power cable).

One common phenomenon, however, is the progressive encroachment in the RoW. If uncontrolled, people will tend to start encroaching into the apparently unoccupied RoW, including building houses and other structures in the RoW. This in turn increases the risk of being affected by a power line malfunction or accident.

This risk is assessed as a *negative* impact, *indirect*, of *long-term* duration, of *local* extent (applicable only to any house that encroaches into the RoW), of *high* intensity (as any incident could result in serious injuries or even fatalities), but of *low probability* (possible) resulting in a *medium significance*.

*Mitigation Measures*

This risk can be effectively mitigated by enforcing the restrictions to building houses in the RoW. As discussed in the Project Description chapter of **Volume I**, the encroachment of new infra-structure into the RoW that may constitute a risk to the OHL is already one of the aspects that will be monitored during the planned technical inspections to the power line. As such, no further mitigation is required. The restrictions to new buildings in the RoW will be strictly enforced, in order to also safeguard community health and safety.

*Impact Summary*

The impact summary is provided in the following table. With periodic inspection of the RoW and control of encroachment, the intensity drops to low, resulting in a *very low* residual significance.

| Impact: Risks to community health and safety due to encroachement into the RoW | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Monitor encroachment of infrastructure into the RoW and strictly enforce the RoW restrictions. | Negative | |
| Type | Indirect | | | Indirect | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Low | 1 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | High | 7 | | Low | 5 |
| Probability | Possible | | | Possible | |
| **Significance** | **Medium** | | | **Very Low** | |

***Impact: Potential impacts on workers' health and safety during the operational phase***

*Impact Assessment*

During the operational phase, risks to workers' health and safety will mostly be associated with maintenance works in the transmission line, with the normal operations of the substations, transportation and circulation of workers and waste and hazardous materials management. The activities accomplished during maintenance and repair activities could be a source of accidents, the most common being:

- Falls from working at height;
- Slips and trips;
- Being struck by falling objects;
- Bad working positions, often in confined spaces;
- Encounters with dangerous fauna (e.g., venomous snakes); and
- Electrocution.

EDM workers could be exposed to these accidents at the worksite. However, EDM already operates many similar infrastructure (both substations and transmission lines) across Mozambique, and as such already has suitable health and safety procedures and practices in place to address these health and safety risks. The application of the same existing procedures to the STE Project should help prevent or reduce the probability of accidents from occurring.

In the non-mitigated scenario, the potential impact on workers' health and safety during operations is assessed as *negative*, *direct*, of *long-term* duration, of *local* extent but of *high* intensity (as work accidents could result in serious injuries or even fatalities), resulting in a *high significance*.

*Mitigation Measures*

As stated above, EDM already has suitable health and safety procedures and practices in place to address the health and safety risks of the operation of substations and transmission lines, as they already operate similar infrastructure. These procedures and practices will be applied to the STE Project Phase 1. No additional mitigation is required.

*Impact Summary*

The impact summary is provided in the following table. The mitigation lowers the intensity and probability of impact occurrence, resulting in a *low* residual significance.

| **Impact: Potential impacts on workers' health and safety during the operational phase** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Pre-mitigation assessment** | | **Mitigation Measures** | **Post-mitigation assessment** | |
| Nature | Negative | | - Implement EDM's existing health and safety policies and procedures for the operation of substations and transmission lines. | Negative | |
| Type | Direct | | | Direct | |
| Extent | Local | 1 | | Local | 1 |
| Intensity | High | 3 | | Medium | 2 |
| Duration | Long-term | 3 | | Long-term | 3 |
| Consequence | High | 7 | | Medium | 6 |
| Probability | Probable | | | Possible | |
| **Significance** | **High** | | | **Low** | |

## 7.11 Impact Assessment Summary

This section presents a summary of all impacts assessed for the STE Project, including pre and post-mitigation assessments. It further presents the key mitigation in order to facilitate a global perception of the Project's impacts. The impact assessment summary is presented in tabulated form, separated by environmental component and per Project phase, as follows:

- **Table 7.16** – impacts associated with the construction phase;
- **Table 7.17** – impacts associated with the operational phase.

**Table 7.16 – Summary of Project impacts – Construction Phase**

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| ***Air Quality*** | | | | | |
| 1. | Increase in dust emissions near sensitive receptors. | **VERY LOW** | **VERY LOW** | (-) | - Vegetation clearing and earthworks will be limited to the strictly needed areas;<br>- All unpaved surfaces will be kept moist, in particular during dry and windy conditions;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h in critical segments, such as when near residential areas;<br>- Circulation of construction heavy vehicles will be limited to pre-approved construction routes;<br>- Heavy trucks transporting construction materials will not be loaded to full capacity. A free edge of approximately 0.2m will be kept to avoid spills during materials transport;<br>- Stockpiles of granular materials will be regularly sprinkled with water, to minimize windborne dusts;<br>- Trucks carrying dusty materials will have the load adequately covered. |
| 2. | Increase in atmospheric concentrations of exhaust gases from the operation of heavy vehicles and equipment. | **VERY LOW** | **VERY LOW** | (-) | - All internal combustion machinery and equipment will be kept in good maintenance conditions in order to minimize combustion gases exhaust emissions;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h in critical segments, such as when near residential areas. |
| ***Greenhouse gases emissions*** | | | | | |
| 3. | Greenhouse gases emissions during construction phase. | **VERY LOW** | **VERY LOW** | (-) | - Source materials from sustainable sources;<br>- Use materials from local sources, as much as possible;<br>- Minimize, as feasible, distance from construction camps to work fronts;<br>- Adopt measures to minimize fuel consumption;<br>- Regular maintenance of vehicles and motorized equipment;<br>- Ensue efficiency in construction planning including sitting of construction camps, laydown and other work areas; and<br>- Use materials which can be reused easily. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| ***Noise*** | | | | | |
| 4. | Noise impact from construction activities. | **LOW** | **VERY LOW** | (-) | - Vegetation clearing and earthworks will be minimized as much as possible and limited to the strictly needed areas;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h near residential areas;<br>- The location and organization of the construction camps will be carefully defined, taking into account the location of sensitive receptors;<br>- Construction activities will be limited to the daytime period of working week days, whenever near residential areas;<br>- Circulation of construction heavy vehicles will be limited to pre-approved construction routes. These will avoid crossing residential areas, whenever possible;<br>- The Contractor will avoid, whenever possible, placing fixed equipment in proximity to sensitive receptors;<br>- Inhabitants of local communities nearby the construction fronts will be previously informed regarding the upcoming construction activities;<br>- Place traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely. |
| ***Geology and Geomorphology*** | | | | | |
| 5. | Adverse effects on geological heritage or mineral resources | **INSIGNIFICANT** | **INSIGNIFICANT** | (-) | - Conduct a geotechnical assessment or survey for the detailed design of the towers and substation;<br>- Restrict earthmoving activities to the strictly needed areas of construction. |
| 6. | Changes in erosion, transport and sedimentation processes | **INSIGNIFICANT** | **INSIGNIFICANT** | (-) | - Limit land clearing, vegetation clearance, soil cleaning and topsoil stripping to the strictly necessary areas;<br>- Keep to existing roads, where practical, to minimize impacts on undisturbed ground;<br>- Minimize soil exposure during periods of heavy rain during excavations and earth moving activities;<br>- Ensure that all power line and substations construction areas have adequate review by geotechnical engineers and geologists for expansive/collapsible soils and for potential areas of slope instability prior to construction. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| ***Soils*** | | | | | |
| 7. | Impacts on irrigation lands and on soils with suitability for irrigation | **MEDIUM** | **LOW** | (-) | - The sitting of transmission facilities will seek to avoid to the maximum extent possible areas of high irrigation suitability;<br>- Avoid construction and maintenance activities during times when soils are saturated;<br>- Learn about individual farm field activities, such as planting, tillage, and crop rotations so that construction methods and timing can be adapted to the timing of crop work. |
| 8. | Increased soil erosion and compactation | **LOW** | **VERY LOW** | (-) | - Prioritize the use of existing paths to access work sites<br>- Restrict vegetation clearing and topsoil removal to the areas strictly required for construction;<br>- Strip and store topsoil prior to earth moving activities for later reuse in rehabilitation works;<br>- Protect temporarily stored soils;<br>- Decompact soils following construction with appropriate equipment until the degree of soil compaction on the RoW is similar to soils of the RoW (especially in irrigated areas). |
| 9. | Potential soil contamination | **VERY LOW** | **INSIGNIFICANT** | (-) | - If a spill occurs, a spill kit must be used to immediately reduce the potential spread of the spill;<br>- Prohibit the discharge of any type of non-treated residual water in the soil and/or water resources (rivers, streams, springs, lagoons, aquifers, etc.);<br>- Develop a Waste Management Plan, following the guidelines provided in the ESMP. |
| ***Water Resources*** | | | | | |
| 10. | Potential changes to natural run-off patterns. | **VERY LOW** | **INSIGNIFICANT** | (-) | - Avoid affecting river beds and floodplain areas by the construction activities, as much as possible;<br>- Whenever possible, carry out works on river banks, flood plains and wetland areas, in the dry season;<br>- Whenever possible, locate the towers outside river banks and floodplains;<br>- Do not block or constrain river flow in the construction of access roads, even if temporary. Ensure that suitable transversal drainage (culverts, viaducts, etc.) are in place;<br>- Minimize the clearance of riparian vegetation. The affected areas will be rehabilitated. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 11. | Potential pollution of surface waters during the construction phase. | **LOW** | **VERY LOW** | (-) | - Whenever possible, carry out works on river banks, flood plains and wetland areas, in the dry season;<br>- Avoid the movement of machinery on river beds and floodplain areas, as much as possible;<br>- Whenever possible, locate the towers outside river banks and floodplains;<br>- Minimize the clearance of riparian vegetation. The affected areas will be rehabilitated;<br>- Implement adequate management and treatment of wastewater;<br>- Implement adequate storage and management of oils, fuels and toxic substances;<br>- Develop and implement a Waste Management Plan for the construction phase |
| ***Landscape and Visual Aspects*** | | | | | |
| 12. | Temporary degradation of landscape at worksites. | **LOW** | **VERY LOW** | (-) | - Prioritize the use of existing access roads to access work sites. If new accesses are opened or existing ones are improved, avoid impacts on adjacent areas;<br>- Promote the selection of areas with less of a need for tree cutting for temporary work and storage areas;<br>- Revegetate areas of bare and disturbed soils as soon as possible with native species;<br>- Rehabilitate and revegetate temporary access road and work areas as soon as possible. |
| ***Biodiversity*** | | | | | |
| 13. | Direct loss of vegetation units and habitats. | **HIGH** | **MEDIUM** | (-) | - Realign the line route, to avoid the area of Critical habitat (miombo forest patch located in Massinga District – please see the impact assessment on section 7.9.1.2 for more information on the line reroute to be implemented);<br>- Strictly limit the clearing of vegetation to the required areas, particularly in areas of natural habitats;<br>- Whenever possible, make the cut trees available for pick-up by the local communities, to be used as construction materials or other uses;<br>- Avoid locating construction camps and burrow pits in natural habitats;<br>- Avoid locating towers and access roads in waterbodies, wetlands and river bed, and whenever possible also in river banks;<br>- Vegetation clearance activities in natural habitat areas will be accompanied by vegetation experts, to sign endemic flora species patches that may require additional mitigation;<br>- Whenever possible new and temporary accesses will be created based in existent accesses;<br>- Rehabilitate and revegetate temporary access road and work areas as soon as possible. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 14. | Degradation of nearby vegetation units during construction. | **LOW** | **VERY LOW** | (-) | - Limit disturbance outside site boundaries;<br>- Limit non-Project vehicles entrance in the construction area to avoid invasive and ruderal species dispersion and entrance of people that can exploit illegally natural resources;<br>- Strictly limit the clearing of vegetation to the required areas;<br>- Dust suppression on dry and windy conditions (e.g. watering);<br>- Forbid people and vehicle movements outside Project accesses;<br>- Whenever possible new and temporary accesses will be created based on existent accesses. |
| 15. | Impacts on wetlands and riverine areas | **LOW** | **VERY LOW** | (-) | - Adopt good housekeeping to prevent spillages and contamination;<br>- Localize tower structures so as to minimize impacts / areas of disturbance in wetlands, river banks, river beds and water bodies;<br>- Avoid movement of heavy machinery in wetlands, river banks, river beds and water bodies;<br>- Delimitate the perimeter of rivers, wetlands and water bodies close to construction areas with construction tape;<br>- Implement adequate storage and management of oils, fuels and toxic substances;<br>- Develop and implement a Waste Management Plan;<br>- Forbid people and vehicle movements outside Project accesses. |
| 16. | Reduction of feeding, breeding and roosting areas | **LOW** | **LOW** | (-) | - Limit areas to be cleared or disturbed to the footprint of the development;<br>- Vegetation clearance activities will be accompanied by an ecology/biology specialist; so as to detect any bird roosting and/or nesting sites close to the clearance areas and implement cautionary measures;<br>- Whenever possible new and temporary accesses will be created based on existent accesses. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 17. | Increased fauna mortality and decreased species diversity | **LOW** | **VERY LOW** | (-) | - Strictly limit the clearing of vegetation to the required areas;<br>- Limit speed limit to 30km/h to reduce risk of run over;<br>- Place signs along access roads informing speed limits and possible animal presence;<br>- During induction sessions inform workers of biodiversity importance and commitment of the Project to it;<br>- Vegetation removal activities will be accompanied by an ecology/biology specialist, to minimize as much as possible tree roosting animals death;<br>- Use of a propane exploder to frighten birds from roosting sites in order to avoid birds death;<br>- Whenever possible new and temporary accesses will be created based on existent accesses;<br>- Forbid workers to hunt animals, or to buy bush meat, and inform them of this restriction in the induction sessions;<br>- Limit access by outsiders (signs, patroling, fences) to work areas. |
| 18. | Possible introduction or spread of invasive species in the Project area | **MEDIUM** | **LOW** | (-) | - Limit disturbance outside site boundaries;<br>- Limit vehicles entrance in the construction area;<br>- Limit vegetation clearance to the area required;<br>- Forbid people and vehicle movements outside Project accesses;<br>- Whenever possible new and temporary accesses will be created based on existent accesses;<br>- Rehabilitate and revegetate temporary access roads and work areas, and all areas temporarily degraded by construction activities, as soon as possible<br>- Monitor and control the presence and expansion of invasive flora species along the RoW. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 19. | Exclusion of fauna species due to increase of disturbance | **VERY LOW** | **VERY LOW** | (-) | - Strictly limit the clearing of vegetation to the required areas, particularly in areas of natural habitats;<br>- Whenever possible new and temporary accesses will be created based on existent accesses;<br>- Vegetation clearance activities will be accompanied by an ecology/biology specialist; so as to detect any bird roosting and/or nesting sites close to the clearance areas and implement cautionary measures;<br>- Avoid construction works during the night;<br>- Minimize illumination in construction camps, if close to natural habitats;<br>- Develop and implement a Waste Management Plan;<br>- Avoid vegetation clearance activities in natural habitats and near large water masses between October and March, as much as possible. |
| ***Socioeconomy – Socioeconomic impacts*** | | | | | |
| 20. | Loss of dwellings and other built infrastructure in the RoW | **HIGH** | **MEDIUM** | (-) | - Before the start of activities, put into effect an encroachment control program, in articulation with local authorities, to avoid the construction of new dwellings in the Project area;<br>- Develop and implement a comprehensive RAP compliant with Mozambican Legislation and WB OP 4.12;<br>- All loss of infrastructure and any assets or access to resources will be identified and duly compensated for in kind or at full replacement value;<br>- All transitional losses and disturbances will be compensated for. |
| 21. | Disturbance to farming areas due to powerline construction and establishment of right-of-way | **MEDIUM** | **LOW** | (-) | - Optimize the STE alignment during the final engineering design phase, in order to minimize as much as possible the interference with farming areas;<br>- Develop and implement a compensation plan, to adequately compensate for any losses of crops due to powerline construction,<br>- Inform the people about the construction so they can harvest their crops,<br>- Whenever possible, perform the vegetation clearing activities during the fallow season. |
| 22. | Creation of employment opportunities during the construction phase | **VERY LOW** | **VERY LOW** | (+) | - Give priority to hire local workers, provided applicants have the necessary skills for the created employment opportunity;<br>- Employment opportunities will be adequately advertised, so as not to limit application opportunities;<br>- The process of contracting staff will be transparent and follow pre-established and accepted criteria. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 23. | Transfer of skills to local communities due to mobilization of construction workforce | **MEDIUM** | **MEDIUM** | (+) | - The construction contractor will provide technical training programs for unskilled workers, with the objective of improving their job performance and giving them the skills to compete for other positions;<br>- The construction contractor will provide environmental and social awareness training to all workers;<br>- The construction contractor will provide health and safety training to all workers. |
| 24. | Local and regional economic stimulation due to construction expenditure and increased workforce income | **LOW** | **LOW** | (+) | - The procurement of goods and services by the construction contractor will give priority to sourcing from the local and provincial markets, whenever possible. |
| ***Socioeconomy – Cultural heritage impacts*** | | | | | |
| 25. | Loss of cultural heritage sites | **HIGH** | **LOW** | (-) | - Affected religious temples will be relocated or compensated for;<br>- Affected cemeteries will be relocated to a new location, in agreement with local communities, and following all required cerimonies and traditional practices;<br>- The Contractor will implement a Chance Find Procedure, to safeguard any archaeological finding that may be uncovered during construction. |
| ***Socioeconomy – Community health and safety impacts*** | | | | | |
| 26. | Disturbance of local communities' daily activities due to the nuisance factor of construction (increased noise, light and dust emissions and traffic interference) | **VERY LOW** | **VERY LOW** | (-) | - Construction activities will be limited to the daytime period of working week days, whenever near residential areas;<br>- Speed limits for construction heavy vehicles will not exceed 30 km/h in critical segments, such as when near residential areas;<br>- All unpaved surfaces will be kept moist, in particular during dry and windy conditions;<br>- Inhabitants of local communities nearby the construction fronts will be previously informed regarding the upcoming construction activities. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 27. | Security concerns increase due to the traffic volume increase | **LOW** | **VERY LOW** | (-) | - Construction heavy vehicles must abide by a 30 km/h speed limit near residential areas;<br>- Inform drivers of the set speed limits and enforce them as appropriate;<br>- Restrict the use of heavy vehicles to primaries roads and avoid the use of roads not designed for heavy loads;<br>- Install temporary official traffic signs on local roads around the work fronts before and during the execution of the works together with local transit authorities;<br>- Place traffic control staff on Project access routes that are near communities, to enforce the speed limits and help pedestrians and non-Project traffic to use the accesses safely<br>- Develop a community awareness program, dealing with community risks associated with road traffic and the adequate preventative behaviours and cautions that should be adopted when near Project accesses;<br>- If an existing road or pedestrian access is cut as a result of Project construction activities, alternative routes will be provided, to restore pedestrian and road accessibility. |
| 28. | Potential increase of community conflicts due to the influx of migrant workers | **MEDIUM** | **LOW** | (-) | - The Contractor will develop a Camp and Housing Management Plan, to minimize potential community conflicts associated with construction camps location and worker housing;<br>- The Contractor will implement a Local Recruitment Plan, to ensure that hiring processes are conducted in a transparent and fair manner and maximize local employment to the extent possible;<br>- EDM will develop a Communication Plan, to be able to interact with the communities, informing them of the nature and timing of the activities, and establishing communication channels to manage any social conflicts that may arise;<br>- EDM will develop a Community Awareness Plan, including community awareness actions dealing with the community risks associated with the influx of workers;<br>- EDM will develop and implement a Project Grievance Mechanism. Inform local communities of its existence and the channels available to them to lodge a complaint. |
| 29. | Increased risk of transmission of STDs due to workforce mobilization | **MEDIUM** | **LOW** | (-) | - The Contractor will develop a management plan for the prevention of HIV / AIDS and STD and implement awareness campaigns for counselling, testing, care, treatment and prevention (condom distribution) among the workforce;<br>- EDM will interact with the Provincial and District Directorates of Health and local NGOs specialized in the subject, to support similar campaigns among local communities in general. |

| # | Impact Description – Construction Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| 30. | Risk of social conflicts elicited by the Project security personnel | **VERY LOW** | **VERY LOW** | (-) | - The Contractor will develop a Security Management Plan, detailing the security arrangements to be deployed at camps, material storage and construction sites, or any location with Project presence;<br>- All security personnel shall have mandatory training in what regards human rights, proportionate force use and adherence to the Contractor's code of conduct. |
| 31. | Potential impacts on workers' health and safety during the construction phase. | **MEDIUM** | **VERY LOW** | (-) | - The Contractor will develop and implement an Emergency Response Plan<br>- The Contractor will develop and implement a Health and Safety Management Plan to protect every worker involved in construction activities, even temporary workers. This plan will comply with national legislation and WBG health & safety guidelines for electric power transmission projects. |

## Table 7.17 – Summary of Project impacts – Operational Phase

| # | Impact Description – Operational Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| ***Noise*** | | | | | |
| 32. | Wind-generated noise emissions. | **LOW** | **VERY LOW** | (-) | - Regular maintenance of the transmission line components. |
| 33. | Noise emissions from corona discharge. | **LOW** | **LOW** | (-) | - Regular maintenance of the transmission line components, such as insulators. |
| 34. | Noise emissions from substation operations. | **LOW** | **LOW** | (-) | - Within the substation projected area, locate noisy equipment's away, as much as possible, from the identified nearby residential areas;<br>- Conduct regular maintenance of the substation transformers in order to minimize noise emissions as much as possible;<br>- Implement, as feasible and necessary, low noise equipment according with the Best Available technology for this sector. |
| ***Water Resources*** | | | | | |
| 35. | Potential pollution of surface waters during the operational phase. | **LOW** | **VERY LOW** | (-) | - Maintain substation equipment in good running condition, free of leaks, excess oil and grease;<br>- Regularly inspect all equipment at the substations that may contain contaminants, such as transformers;<br>- Develop and implement a Waste Management Plan. |
| ***Landscape and Visual Aspects*** | | | | | |
| 36. | Permanent alteration to the landscape | **MEDIUM** | **LOW** | (-) | - Minimize the number of permanent access roads to and in the RoW, when possible, proceed to early closing and rehabilitation of access roads near sensitive scenic areas;<br>- Allow tree and shrub species whose height is limited to 3 m to grow within the RoW (outside of the full clearance 30 m corridor);<br>- If complaints are received, from local communities or other stakeholders, regarding a negative visual impact created by the transmission line, create visual barriers to reduce line visibility in sensitive areas, if feasible. |

| # | Impact Description – Operational Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| ***Biodiversity*** | | | | | |
| 37. | Indirect degradation of vegetation units and habitats along the RoW | **HIGH** | **MEDIUM** | (-) | - Limit disturbance outside maintenance area boundaries;<br>- Limit vegetation clearance to the area required;<br>- Limit non-Project vehicle entrance and circulation along the RoW, as much as possible, through the placement of signalization;<br>- Monitor and control the presence and expansion of invasive flora species along the RoW;<br>- Incorporate in the normal maintenance procedures of the RoW the monitoring of creation of new settlements or cutting or burning of woodland areas in adjacent areas along the RoW, and report these occurrences to the local authorities.<br>- Coordinated intervention by relevant Government Departments to enforce restrictions on uncontrolled settlement and agricultural expansion, clearance of woodland, and enforcement on controls on hunting, charcoal and timber cutting. |
| 38. | Increased mortality of bird and bat species due to collisions and electrocution | **HIGH** | **MEDIUM** | (-) | - Adopt control measures in the design of line and towers, namely:<br>o Prefer the use of towers with a minimum number of collision plans;<br>o Use exclusively towers with horizontal track frames;<br>o Signal lines with 35cm diameter BFD near rivers and wetlands and along large undisturbed forest or woodland areas;<br>o Isolation of all conductors, to avoid electrocution;<br>o Ensure the distance between cables, especially in tension towers, is higher than 60cm;<br>o Install anti-landing devices in tower close to wetlands, river and waterbodies.<br>- Monitor bird and bat mortality and adopt an adaptive management approach. |
| 39. | Habitat fragmentation due to the presence of the RoW | **MEDIUM** | **LOW** | (-) | - Limit disturbance outside maintenance area boundaries;<br>- Limit vegetation clearance to the area required. Complete vegetation clearance should be restricted to the 30 m corridor;<br>- Outside of the 30 m full clearance corridor, allow tree and shrub species whose height is limited to 3 m to grow. Apply selective removal of tall-growing tree species only;<br>- Avoid clearing in riparian areas, thus allowing rivers to maintain their function as ecological corridors. |

| # | Impact Description – Operational Phase | Significance Rating | | Nature of Impact | Mitigation / Enhancement Measures |
|---|---|---|---|---|---|
| | | Pre-mitigation | Post-mitigation | | |
| ***Socioeconomy – Socioeconomic impacts*** | | | | | |
| 40. | Creation of employment opportunities during the operational phase | **VERY LOW** | **VERY LOW** | (+) | - Give priority to hire local workers, provided applicants have the necessary skills for the created employment opportunity;<br>- Employment opportunities will be adequately advertised, so as not to limit application opportunities; and<br>- The process of contracting staff will be transparent and follow pre-established and accepted criteria. |
| 41. | Regional economic stimulation, due to increase in power availability | **HIGH** | **HIGH** | (+) | - EDM will ensure the standard maintenance program for the STE Project. |
| ***Socioeconomy – Community health and safety*** | | | | | |
| 42. | Risks to community health and safety due to encroachement into the RoW | **MEDIUM** | **VERY LOW** | (-) | - Monitor encroachment of infrastructure into the RoW and strictly enforce the RoW restrictions. |
| 43. | Potential impacts on workers' health and safety during the operational phase | **HIGH** | **LOW** | (-) | - Implement EDM's existing health and safety policies and procedures for the operation of substations and transmission lines. |

## 7.12 Cumulative Impacts

### 7.12.1 Potential Cumulative Effects on Valued Environmental and Social Components

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity in combination with other existing, planned, and/or reasonably anticipated future ones.

According to IFC (2013), a cumulative impact assessment is the process of:

- Analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on chosen Valued Environmental and Social Components (VECs) over time; and
- Proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risks to the extent possible.

Because it is unrealistic to think that every environmental and social component can be subjected to a cumulative impact assessment, it is good practice to focus on VECs. VECs are sensitive or valued receptors of impact. In other words, they are environmental and social attributes that are considered to be important in assessing risks and may include physical features, biodiversity (e.g., habitats or wildlife populations), ecosystem services, natural processes (e.g. water and nutrient cycles, microclimate), social conditions (e.g. health, economics), or cultural aspects (e.g. traditional spiritual ceremonies).

The key analytical task is to discern how the potential impacts of a proposed development might combine, cumulatively, with the potential impacts of other human activities and other natural stressors such as droughts or extreme climatic events. Other human activities of greatest importance in a cumulative impact assessment are those that (a) will occur in the future, or, if already existing, have ongoing influences on the environment in the future, and (b) are expected to interact with the same VECs in the future as does the development under assessment.

The selection of the VECs to consider in this assessment was based on *(i)* their biophysical and/or socioeconomic importance in the areas crossed by the proposed Project, *(ii)* the degree of impact on the VEC resulting from the STE Project and *(iii)* the findings of the ESIA public consultation activities. As the goal is to assess cumulative impacts, only VECs which are expected to be significantly affected by the proposed Project were considered (VEC's on which the Project is expected to generate negative impacts of low or very low residual significance were excluded from the analysis). The only exceptions to this were impacts associated with habitat fragmentation and labor infux, which were assessed to be of low residual significance, but were included in the analysis, given expressed concerns from stakeholders regarding cumulative impacts with the Temane Power Plant.

A total of 3 VECs have been selected for the current assessment: They are listed below, together with the indicative aspects that will be considered for the evaluation of cumulative aspects (the indicative aspects reflect the way in which the STE Project impacts the VEC):

- Flora and vegetation. Indicative aspect: loss of habitats and habitat fragmentation;

- Local communities. Indicative aspects: resettlement impacts and potential increase of community conflicts due to worker influx;
- Avifauna. Indicative aspect: decrease of populations (increased mortality).

The cumulative impact assessment also requires that a realistic area and time period be established within which present and future projects are identified, i.e., the definition of spatial and time boundaries, as per IFC (2013). These were defined as follows:

- Spatial boundary - the Project's Area of Indirect Influence (AII), i.e. the territory of the Districts crossed by the alignment, was selected (please see a more detailed description of the Project's AII in Chapter 5 of **Volume I**). This is the widest area where Project impacts will be felt, and thus that cumulative impacts with other projects can be expected;
- Time boundary - a period of 5 years was selected, as the predictions of new projects and developments beyond that timeframe are very uncertain.

As far as planned new developments, only two were identified for the area of interest (Districts crossed by the Project):

- The Temane Power Plant (also known as "Mozambique gas-to-Power (MGtP)" project). This development includes a 400 MW gas fire power generation plant in Temane, and an exit power line, roughly 25 km long, connecting to the Vilanculos substation. According to information provided by EDM, both the MGtP's technical studies and environmental impact assessment process (Golder, 2018) are currently in their final stages of preparation;
- The Chibuto heavy sands mining project, located in the District with the same name. This project was delayed in the past due to the absence of robust power supply, so it is reasonable to assume that it will be restarted, after the STE Project is completed.

No other major development is known to be planned for these districts. In what regards linear infrastructure, no major road development program is currently planned by ANE, and no other major high-voltage power lines are planned, other than the exit line from the MGtP (note that the other phases of the STE Project are likely to be implemented in the near future, but these do no overlap geographically with Phase I). However, it is likely that the STE Project will enable the development of the distribution electricy grid, and as such the following development was considered:

- Continuous development of the secondary electric grid, enabled by the new substations.

In terms of existing vectors of human development, which may have cumulative impacts with the STE Project, these include:

- The continuous expansion of the major urban centers in these districtrs, both from natural growth and from migration from rural areas;
- The increasing clearance of woodlands, due to the expansion of slash and burn agricultural practices and the exploitation of natural resources, namely fire wood collection and charcoal production. This occurs in all concerned districts

The potential effects of these planned projects and development vectors on the selected VECs are listed in **Table 7.18**.

**Table 7.18 – Potential effects of planned development and vectors of development on VECs**

| Planned developments and vectors of development | Effects on VECs | | |
|---|---|---|---|
| | Flora and vegetation | Local communities | Avifauna |
| Temane Power Plant* | Local loss of habitats<br>Habitat fragmentation (exit line) | No resettlement anticipated for the plant footprint. Local resettlement impacts likely for the power line RoW.<br>Increased pressure on social dynamics from labor influx | Loss of habitats<br>Increased avifauna mortality (exit line). |
| Chibuto Heavy Sands Mining | Local loss of habitats | Resettlement is highly likely, given that this is an area project. No estimates available. | Loss of habitats, but no direct impact on avifauna mortality. |
| Development of secondary electric grid | Localized loss of vegetation | No relevant impact, as the RoW for the secondary grid is much smaller and typically low voltage power lines alignments follow existing roads. | Some increased impact on avifauna mortality, but much smaller than that caused by high-voltage and extra high-voltage power lines. |
| Expansion of major urban centers | Increased loss of natural habitats | Not applicable. | Loss of habitat, but no direct impact on avifauna mortality. |
| Clearance of woodlands due to farming and natural resources exploitation | Increased loss of woodland habitats | Not applicable. | Loss of habitat, but no direct impact on avifauna mortality. |

**Note:** * - information regarding the Temane Power Plant was sourced from its EIS (Golder, 2018).

## 7.12.2 Evaluation of Cumulative Effects on VECs

Evaluation of cumulative effects takes into consideration the potential impacts that could be generated by the STE Project (Phase 1: Vilanculos – Maputo) and adds those generated by the identified planned developments and vectors of human development.

### 7.12.2.1 Flora and Vegetation

Relevant impacts on flora and vegetation resulting from the STE Project include:

- Direct loss of natural habitats (mostly woodland habitats) during the construction phase, due to the clearance of the RoW. This negative impact was assessed to be of *high* significance, prior to mitigation, with a residual *medium* significance impact remaining after mitigation;
- Indirect degradation of natural habitats (mostly woodland habitats) along the RoW during the operational phase, in particular due to the expanse of agriculture and natural resources exploitation along the RoW, given the increased ease of access to presently inaccessible areas. This negative impact was assessed to be of *high* significance, prior to mitigation, with a residual *medium* significance impact remaining after mitigation;
- Fragmentation of habitats, caused by the maintenance of a cleared RoW during the operational phase. This negative impact was assessed to be of *medium* significance, prior to mitigation, with a residual *low* significance impact remaining after mitigation.

The identified projects and vectors will affect this VEC as follows:

- The two area projects (Temane Power Plant and Chibuto Heavy Sands Mining) will result in local loss of habitats, within these projects respective footprints (plant site, power line RoW, mining infrastructure areas and mine pit). The Temane Power Plant's exit line will also fragment habitats along its RoW;
- The development of the secondary grid may result in localized loss of vegetation, but no relevant impact at habitat level is expected, as typically the secondary grid develops along existing roads;
- The expansion of urban areas, and of agriculture and natural resources exploitation, will result in a progressive loss of natural habitats, in particular woodland habitats, in the areas surrounding urban centers. Depending on the way these areas expand, they could also cause fragmentation of habitats. This aspect, however, is impossible to assess without the knowledge on how exactly will human presence expand in this territory.

The direct loss of habitats caused by the STE Project will have a cumulative effect with the losses of habitat caused by the listed developments. In what regards the Temane Power Plant and the Chibuto Heavy sands, this cumulative effect will be minor, as the impact will be localized. The Temane Power Plant's exit line will also have a cumulative impact of habitat fragmentation with the STE Project. It will essentially extend the fragmentation corridor roughly 25 km to North, from the Vilanculos substation to the selected location to the Temane Power Plant. This cumulative impact is not expected to be significant, as in this region there are large extents of continuous non-fragmented woodlands, able to support local fauna populations, even considering this cumulative fragmentation impact.

However, the STE Project has a synergistic effect with the loss and degradation of natural habitats due to the expansion of urban areas, and of agriculture and natural resources exploitation, as the establishment of the RoW will enable population access to woodland areas which currently are very hard to access (as no roads exist within these large unfragmented areas of woodland). This is applicable to the northern part of the STE Project's alignment, between Chibuto and Vilanculos. In this case, as the STE Project enables and potentiates the expansion of the population, the cumulative effect is significant, in particular in the long term.

#### 7.12.2.2 Local communities

Impacts of the STE Project on local communities that were selected for this cumulative impact assessment include:

- Ressetlement impacts, namely the loss of dwellings and other built infrastructure, due to the clearance of the RoW. This negative impact was assessed to be of *high* significance, prior to mitigation, with a residual *medium* significance impact remaining after mitigation;
- Potential increase of community conflicts due to the influx of migrant workers (labor influx impacts). This negative impact was assessed to be of *medium* significance, prior to mitigation, with a residual *low* significance impact remaining after mitigation.

The identified projects and vectors will affect this VEC as follows:

In what regards resettlement impacts, of the identified projects and vectors of development, only two will likely result in resettlement, namely the Temane Power Plant and the Chibuto Heavy Sands Mining projects. According to the Temane Power Plant EIS (Golder, 2018a) no resettlement is anticipated for the plant footprint (located in Inhassoro District), but local resettlement impacts are likely for the power line RoW (which crosses over to Vilanculos District) and water pipeline RoW. According to Golder (2018), in the worst-case scenario, a total of 53 households will need to be resettled (11 due to the the transmission line RoW and 42 due to the water pipeline RoW). As for the Chibuto mining project, although no estimates are available, resettlement impacts are highly likely, as this project's planned location is relatively close to the town of Chibuto, in an area with significant human presence, both in terms of built structures and agricultural activities.

The resettlement cumulative impact of the STE Project, however, is expected to be minor. The STE Project resettlement impacts occur mostly in Maputo Province, on the final segment approaching Maputo substation, where human presence is very dense. No households are expected to be affected by the STE Project in Vilanculos District (and as such, no cumulative impacts with the Temane Power Plan project are expected). In what regards Chibuto District, 28 households are expected to be affected by the STE Project, and thus some cumulative resettlement impact with the Chibuto mining project will occur, the significance of which will depend on the mining project resettlement impacts, which aren't known at this stage.

In what regards labor influx impacts, the Temane Power Plant project may result in cumulative impacts with the STE Project, as their construction phases are expected to overlap. In what regards the Chibuto mining project, it is unkown if or when major construction works may be developed for this project, so it isn't possible to assess cumulative impacts with the STE Project.

In what regards the Temane Power Plant Project, and according to its EIS (Golder, 2018), it is expected that it will will employ between 690-850 people during the construction phase, depending on the final technology option selected. This mobilization might result in cumulative impacts with the mobilization of 250 workers planned for the STE Project construction phase, if that mobilization overlaps in terms of timing and location. In this regards it is noted that:

- The Temane Power Plant EIS (Golder, 2018a) notes that its construction phase will last 18 to 24 months, but doesn't indicate when construction is planned to start. Assuming that the plant's construction phase starts in the next two years (a reasonable assumption, given that its ESIA process is almost completed), there will likely be a time overlap with the STE Project's construction phase, which is expected to last 4 years, with start in 2019 and conclusion in 2023. However, it should be noted that this 4 years construction period is for the full 561 km length of line. The STE Project workforce will not be stationed at a single location during those 4 years, but will move down the line as construction progresses. As such, the construction period for the STE Project infrastructure located in Vilanculos District (Vilanculos substation and line segment within the district), that could result in cumulative impacts with the Temane Power Plan, will be much shorter, likely 6 months;
- In terms of geographical overlap, according to Golder (2018a) the Temane Power Plan workforce will be housed in a construction camp located near the existing Temane gas

processing plant, in Inhassoro District, roughly 25 km from the Vilanculos Substation and 38 km from Vilanculos town. As for the STE Project, it is unkown at this stage where the construction camps will be located, but this EIS recommends that they are placed in urban areas (which is possible, given the relatively low number of workers), and as such its location in Vilanculos would be a reasonable assumption. Golder (2018b) developed an Influx Management Framework for the Temane Power Plant, where the previous influx impacts from the existing Temane gas Central Processing Facility were assessed. In this document, Golder (2018b) notes that an influx of work and opportunity seekers has been observed over the past years in Mangungumete and Maimelane (two villages in Inhassoro District, near Sasol's facilities) because of Sasol's growing presence in the area. Note that these impacts are much higher than expected for both the Temane Power Plant or the STE Project, since that was the first industrial facility being built in an otherwise rural area. These two villages are located roughly 5 km from Sasol's current facilities and from the planned Temane Power Plant. Golder (2018b) further notes that these are the two communities where labor influx impacts are expected from the Temane Power Plant, and that the size of these communities is expected to increase if in-migration is not effectively managed, monitored and evaluated. Labor influx from the STE Projects, on the other hand, will be likely experienced either in Vilanculos village (where the location of the construction camp is more likely), or nearer to the Vilanculos Substation (where there will be a greater concentration of labouring workers), which is more than 20 km away from Mangungumete and Maimelane. As such, little or no geographically overlapping labor influx impacts are expected for the Temane Power Plant and the STE Project, as it is highly unkilely that any experienced influx from these two projects would affect the same communities.

As such, cumulative labor influx impacts from the Temane Power Plant and the STE Project are not assessed as significant, taking into consideration the discussed above, summarized below:

- The overlap in time will be relatively short (likely 6 months);
- Labor influx impacts from both projects will not affect the same communities, given the distance between them.

It would also be noted that the labor influx impacts from each of these two projects by themselves (non-cumulative) were assessed to be of low significance, both in this EIS and in Golder (2018a). Given the discussed above, their cumulative impact is also expected to be low. No specific mitigation or strategy is required to mitigate labor influx cumulative impacts. The implementation of the mitigation required for each of these Projects in their respective EIS will be sufficient to manage impacts related to labor influx.

#### 7.12.2.3 Avifauna

Relevant impacts on the STE Project on avifauna include the following:

- Increased mortality of birds (particularly birds with large wing spans), due to collisions and electrocution with the overhead line and towers. This negative impact was assessed to be

of *high* significance, prior to mitigation, with a residual *medium* significance impact remaining after mitigation.

This impact, the increased mortality of birds (and also bats), is one of the major impacts of high-voltage power lines, and is typical of this project typology. The exit line from the Temane Power Plant will have a cumulative impact with the STE Project, although a relatively minor one (considering that that line will only be 25 km long).

No other considered planned project or vector of development has a similar direct impact on bird mortality. The secondary electric grid may result in a small increase of bird mortality, but of a much lesser intensity than that of high-voltage power lines, due to the different characteristics of the line infrastructure. All the other listed developments result in loss of habitats, which could result in an indirect cumulative effect on bird populations, but this effect is minor.

# 8 Public Participation Process

## 8.1 Introduction

Public participation is a key component of an Environmental and Social Impact Assessment (ESIA) process. It involves those interested in or affected by the proposed development in highlighting opportunities, risks and issues of concern. Public participation thereby assists the Project team to take account of locally relevant conditions rather than imposing designs that are potentially insensitive, socially and environmentally, onto an environment. Fulfilling the basic requirements of public participation is a legal requirement, and failure to address this aspect can create significant risks to Project development.

The Public Participation Process (PPP) undertaken in this ESIA process was developed according to Mozambican ESIA Regulations and international best practice, namely WB OP 4.01. The relevant documents that guided the PPP were the following:

- General Guidelines for Public Participation Process in the ESIA process, Ministerial Decree No. 130/2006 - provides the guidelines to be followed in any PPP undertaken as part of an ESIA process, as regulated by Decree No. 54/2015;
- WB OP 4.01 (Environmental Assessment): OP 4.01 states that for Category A projects, consultation with project-affected groups, to take their views into account, should start as early as possible and at least twice: shortly after environmental screening and before the terms of reference for the ESIA are finalized, and once a draft ESIA report is prepared;
- IFC Performance Standards (PS): PS 1 (Assessment and Management of Social and Environmental Risks and Impacts) states that adequate engagement with affected communities, throughout the project cycle, on issues that could potentially affect them must be provided and that grievances from affected communities and external communications from other stakeholders must be responded to and managed appropriately.

In accordance with Ministerial Decree No. 130/2006, the PPP for this ESIA included consultation in two phases: early in the ESIA process (in the EPDA Phase, before the terms of reference for the ESIA were finalized, as required under WB OP 4.01) and again in the EIS Phase, after the preparation of a draft ESIA report.

The overall PPP strategy includes:

- The disclosure and availability of documentation for a 30 day period (15 days prior to and post public meetings);
- Public meetings and other stakeholder engagement activities; and
- Inclusion of issues raised in the public meetings on the ESIA process reports.

The EPDA phase PPP for the STE Project (Phase 1: Vilanculos – Maputo) was undertaken in May 2017. The main activities of the EPDA phase PPP are described in section 8.3 below.

The PPP for the EIS phase was undertaken in November 2018. **Volume V** of this EIS includes the PPP report, which describes and documents the PPP activities developed for the EIS phase. The approach and methodology for the EIS PPP are also summarized in section 8.4 below.

Section 8.5 below includes a comments register table, which provides a summary of all the main comments and issues raised by Interested and Affected Parties (I&APs), including both the EPDA and EIS PPP, and a respone on the way they were considered or addressed in the ESIA process.

## 8.2 Objectives of the Public Participation Process

The main objective of the PPP is to inform all I&APs of the activities to be carried out, and of the predicted impacts of such activities, and to grant them an opportunity to voice their opinions, concerns and expectations regarding the Project. The PPP is based on the following principles:

- Understanding the social and environmental context of the overall Project area is key to a successful impact assessment. The I&APs are a valuable source of information on this;
- The development and promotion of confidence in the PPP are fundamental to a positive and effective involvement of I&APs and to ensure a successful ESIA process. The key element to establish such trust is to provide an open and transparent process;
- The involvement of I&APs allows a richer and more comprehensive ESIA process, through the comments received and views expressed;
- The I&APs have the right to express their views and to obtain feedback to their concerns;
- Information disclosure and availability, regarding the Project and ESIA process, is a legal requirement and complies with industry best practices.

Based on such principles, and in accordance to the guidelines referred to above, **Table 8.1** summarizes the main goals of the STE Project ESIA Process PPP.

**Table 8.1 – Main objectives of the ESIA Process PPP**

| Objective | Motivation |
|---|---|
| Identify all I&APs for the Project. | Involving as many I&APs as possible facilitates good communication and the capture of a wide range of issues and concerns. |
| Distribute accurate Project information. | Ensuring that I&APs, particularly those directly affected by the proposed development, have information at their disposal with which to make informed comments and which would enable them to plan for the future, thereby reducing levels of uncertainty and anxiety. Information should allow affected parties to develop an understanding of potential impacts, risks and benefits. |
| Gather information that will contribute to the environmental and technical investigations. | Identifying issues through people familiar with the local environment and incorporating these into the scope of the assessment meets legislative requirements and ensures that specialists focus on all relevant issues. It is also critical in ensuring the most appropriate Project design and management possible. |
| Form partnerships to promote constructive interaction amongst all parties. | Developing relationships of trust between the developer and I&APs will contribute to proactive interactions and avoid, where possible, unnecessary conflicts based on rumor and misinformation. Identifying structures and processes through which to deal with conflicts and grievances would allow the Project a better understanding of stakeholder concerns and expectations, thereby increasing the opportunities to enhance the Project's value to local stakeholders. |
| Record and address public concerns, issues and suggestions. | Documenting I&AP issues allows Project decisions to be traced and motivated and allows stakeholders to see where their input has been incorporated into planning and design. This approach addresses potential concerns that public participation may be a token gesture by the developer in order to meet legislative requirements. |

| Objective | Motivation |
|---|---|
| Manage I&APs expectations. | Expectations, both positive and negative, are often out of proportion to the realities of a project. This is particularly so in areas of extreme poverty and limited development and service provision. Ensuring that expectations are kept at realistic levels (e.g. around job opportunities, provision of local infrastructure, social development, disruption) limits the disappointment and frustration of directly affected parties at later stages of project implementation. Frustration and unfulfilled expectations are key triggers of conflict and require mitigation and management that might otherwise be avoided. |
| Comply with legal requirements and international best practices | Ensuring regulatory compliance can avoid potential Project delays based on procedural issues rather than substantive ones. |
| Provide feedback to participants as to their inputs | Disclose final documents and a summary of how inputs were integrated in the project or if not why not and provide a final opportunity for feedback and referral of remaining issues. |

## 8.3 Public Participation Process of the EPDA Phase

The PPP activities undertaken during the EPDA phase are summarized in **Table 8.2**. These activities, as well as the PPP main findings and the public meetings minutes, were documented in the EPDA report, which was submitted to MITADER's approval, and are also summarized in the EIS PPP Report (see **Volume IV**).

**Table 8.2 – Summary of the PPP activities undertaken for the EPDA**

| Activity | Objective | Date |
|---|---|---|
| Compilation of I&APs database. | To identify the I&APs to be included in the consultation process. | 28 March to 19 April 2017 |
| Disclosure of the Draft EPDA report. | To allow the authorities and general public to comment on the Project and the EPDA. | 19 April 2017 |
| Media advertisement for the public meetings. | To convoke the I&APs to participate in the public meetings. | 19 April to 3 May 2017 |
| Delivery of invitations to the public meetings (letters and faxes) | | 24 to 28 April 2017 |
| Telephone follow-up calls to confirm the reception of invitations. | | 1 to 3 May 2017 |
| Public meetings | To receive and document comments and questions from the participants. | 4 and 5 May 2017 |
| Written comments reception period. | To receive written comments to the Project or EPDA. | 8 to 22 May 2017 |
| Compilation of the PPP Report and its integration in the EPDA Final Report. | For review, comment and approval of MITADER. | 22 to 29 May 2017 |

A total of three public meetings were held for the EPDA PPP, as listed in **Table 8.3**.

**Table 8.3 – Public meetings held for the EPDA PPP**

| Location | Venue | Date | Number of registered participants |
|---|---|---|---|
| Inhambane | Escola Superior de Hotelaria e Turismo | 04.05.2017 | 27 |
| Xai-xai | Kapulana Restaurant | 05.05.2017 | 31 |
| Matola | Matola Hotel | 05.05.2017 | 41 |

The results of the EPDA PPP were documented in the EPDA Report, which was submitted to MITADER for approval.

## 8.4 PPP in the EIS Phase

### 8.4.1 Main Types of PPP Activities

During the EIS Phase, public consultation activities were developed at two different levels:

- Provincial / district level: public consultation efforts at provincial / district level included the disclosure of a draft EIS Report and public meetings at the relevant provincial capitals (Inhambane, Xai-xai and Matola), directed at authorities, institutional stakeholders and the civil society in general;
- Community level: public consultation efforts at community level included two rounds of meetings in the communities that will be crossed by the Project's RoW.

**Volume V** of this EIS Report provides the PPP Report, describing and documenting the full range of PPP activities developed for the EIS report. The following sections provide a brief summary of these activities.

### 8.4.2 Identification of I&APs

For the EIS PPP, the I&AP database compiled during the EPDA Phase was updated, considering the more detailed information regarding the environmental and socio-economic context and the Project potential impacts. Local communities along the Project's alignment were included in this stakeholder dabatase.

### 8.4.3 Release of Draft EIS for Comment

The Draft EIS, together with a Nontechnical Summary (NTS) was made available to I&APs to allow public analysis and comments. These were made available at the following venues:

- National Directorate of Environment (DINAB), in Maputo;
- DPTADERs of Inhambane, Gaza and Maputo;
- EDM's offices in Maputo;

- Other local offices or locations requested by local communities and agreed during the PPP process.

Additionally, the EIS Draft Report was also made available on EDM's website (www.edm.co.mz) throughout the consultation period. The Draft EIS was made available to I&APs for comment 15 days prior to the public meetings (see Section 8.4.5), so as to allow enough time for people to review the EIS and effectively participate in the public meetings.

### 8.4.4 Advertisement and Notifications

Concurrent with the disclosure of the Draft EIS, public advertisements were made using two methods: media and individual letters, faxes and emails. Media advertisements included newspaper advertisements and radio broadcasting. Advertisements were made in Mozambique's main newspaper (*Jornal Notícias*) once a week, in the two weeks preceding the public meetings. The public consultation meetings were announced on the local radio (Mozambique Radio) once a week, in the same two weeks.

In addition, individual invitation letters, faxes and e-mails were sent to all I&APs on the stakeholder database. During the week prior to the consultation meetings, telephone calls were made as a follow up.

### 8.4.5 Public Meetings

As in the EPDA phase, three public meetings were held as part of the EIS PPP, namely one in the capital city of each Province crossed by the Project: Inhambane (Inhambane Province), Xai-xai (Gaza Province) and Matola (Maputo Province). **Table 8.4** indicates the location and dates of these consultation meetings, and the number of registered participants in each meeting.

**Table 8.4 – Consultation meetings held as part of the EIS PPP**

| Location | Venue | Date | Number of registered participants |
|---|---|---|---|
| Inhambane | Escola Superior de Hotelaria e Turismo | 28.11.2018 | 31 |
| Xai-xai | Platinum Hotel | 29.11.2018 | 49 |
| Matola | Matola Hotel | 30.11.2018 | 35 |

Additionally, as part of the RAP consultation, community level meetings were held in the communities located along the Project alignment (please see the PPP report – **Volume V** – for additional details).

The PPP report (**Volume V** of this EIS) provides additional information and documentation regarding these meetings, including the attendance register, meeting minutes and photographs.

Following the public consultation meetings, another period of 15 days was given to I&APs to provide additional inputs for inclusion in the Final EIS Report.

### 8.4.6 Summary of PPP Activities

The PPP activities undertaken in the EIS phase are documented in the PPP Report, which constitutes **Volume V** of this Final EIS Report. **Table 8.5** presents a summary of the PPP activities undertaken in the EIS Phase. The issues raised during the EIS Phase, and the way in which they were considered either in the Project or the EIA process, are described in **Table 8.6** (see section 8.5).

**Table 8.5 – Summary of Public Consultation in the EIS Phase**

| Activity | Purpose | Date of activity |
|---|---|---|
| Updating of the stakeholder database. | Identify stakeholders to be included in the consultation process. | October and November 2018 |
| Release Draft EIS Report for public review. | Allow authorities and the public to comment on the project and draft Report. | 14 November - 14 December 2018 |
| Distribution of invitations to public meetings (letters and faxes). | To invite stakeholders to public meetings. | 19 - 23 November 2018 |
| Press and radio advertisements for public meetings | To invite stakeholders to public meetings. | 14 - 23 November 2018 |
| Consultation meetings at provincial level | To present the proposed ESIA process and Project to the public and to allow the public to identify issues of concern | 28 – 30 November 2018 |
| Consultation meetings at community level | To present the Project and main potential impacts with relevance to the communities directly affected by the RoW | First round: 4 - 24 July 2017<br>Second round: 17 August – 17 September 2018 |
| Written comments received | Written comments received during the EIS PPP | Up to 14 December 2018 |

## 8.5 Comments and Response Register

**Table 8.6** presents a summary of I&APs comments and queries to the Project and ESIA process, raised during the EPDA and EIS PPP activities. The table also indicates the responses to the received comments and suggestions.

**Table 8.6 – Main comments received throughout the ESIA's Public Participation Process**

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| **Project Design / Project Description** | | | | |
| 1. | Criteria used to define the transmission line alignment and the substations locations. | 04.05.2017<br>05.05.2017<br>30.11.2018 | - Provincial Directorate of Land, Environment and Rural Development (DPTADER) of Inhambane;<br>- District Services of Education, Youth and Technology (SDEJT) of Vilanculos;<br>- Mandlakaze Permanent Secretary;<br>- Provincial Directorate of Public Works, Housing and Water Resources (DPOPHRH) of Matola. | As discussed in section 4.2.3.1 of the EIS Report (Volume I), the proposed alignment for the Vilanculos – Maputo transmission line is the result of a number of studies undertaken by EDM in the past 8 years, which have assessed several different alternatives for the transmission backbone system. These studies included several engineering reports and a full ESIA, developed in 2011 for the full extension of the STE Project. Please refer to section 4.2.3.1 of the EIS Report (Volume I) for more information. |
| 2. | Inclusion of the Temane power plant and/or the Temane – Vilanculos power line (exit line for the planned Temane power plant) in the ESIA scope. | 04.05.2017 | - National Company of Hydrocarbons (ENH). | The scope of this ESIA is Phase 1 of the STE Project, which includes the Vilanculos – Maputo transmission line and four substations, as described in Chapter 4 of the EIS Report (Volume I). Although the desirability of this Project is partially associated with the planned Temane power plant (as discussed in section 4.2.1 of Volume I), that plant and its exit line are outside of the scope of this ESIA. The Temane project, which includes a 400 MW gas-fed power plant and the power line connecting the plant to Vilanculos substation, is being subjected to a separate ESIA process. |
| 3. | Does the STE Project include the electrification of communities along the transmission line alignment? | 04.05.2017<br>28.11.2018 | - Permanent Secretaries of Vilanculos, Funhalouro and Panda Districts;<br>- Member of Massinga Consulting Council. | The Project under assessment includes a high-voltage (440 kV) transmission line and four high-voltage substations, which will be a part of the national transmission backbone system. The Project does not include any distribution component, and as such will not directly result in the electrification of any areas. However, the new substations to be created by the Project will facilitate the development by EDM of new distribution lines and electrification initiatives in the future. |
| 4. | What is the Project's investment budget? | 04.05.2017 | - Petromoc. | The Project's estimated investment budget is 600 million USD, as stated in section 4.3.6 of the EIS report (Volume I). |
| 5. | What is the planned schedule for the construction phase? | 04.05.2017<br>05.05.2017 | - SDEJT of Funhalouro District;<br>- Mandlakaze Permanent Secretary. | As per section 4.4 of the EIS Report (Volume I), the construction phase will have a total duration of up to 4 years, with planned start in end of 2019 and conclusion in 2023. |

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| 6. | How many workers will be involved in the construction phase? | 04.05.2017 | - SDEJT of Funhalouro District. | As stated in section 4.3.3.4 of the EIS report (Volume I), a total of 250 workers will likely be involved in the transmission line construction works, while roughly 50 to 100 workers will be needed to install the substation equipment and instrumentation. |
| 7. | Reasons for defining the transmission line's right-of-way as 25 m to each side of the line, when the Land Law states that the partial protected zone applicable to power lines extends 50 m to each side of the line. | 05.05.2017 | - District Services of Planning and Infrastructure (SDPI) of Bilene;<br>- District Services of Economic Activities (SDAE) of Chokwe;<br>- Provincial Directorate of Public Works, Housing and Water Resources of Xai-xai. | The Land Law (Law 19/97) and its regulation (Decree 66/98) define partial protected zones, which are buffer areas meant to protect infrastructure or natural features, within which land use titles may not be granted, and where activities cannot be implemented without a license (see section 2.4 of the EIS report for a more detailed analysis of the legal framework). In what regards power lines, the Land Law regulation states that the partial protected zone includes a corridor with 50 m to each side of the line (100 m width total).<br>However, Decree 57/2011, of 11 November, which deals specifically with safety standards for power line design, states in article 28 that the maximum width for the protection zone (RoW) for high voltage power lines (over 66 kV) should be 50 m (25 m to each side of the line). This is in line with industry practice and relevant regional guidelines (namely the Southern Africa Power Pool – SAPP – guidelines) and is enough to ensure the infrastructure safety. A narrower RoW also helps minimize the Project's impacts on the territory and its users, in particular those associated with physical and economic resettlement. Based on this, the RoW for the proposed power line was initially (in the EPDA) defined as a 50 m wide corridor.<br>It should be noted that, given this comment, MITADER also questioned EDM regarding the RoW's width in the review report to the EPDA (see **Annex II**).<br>Given these concerns, EDM formally requested opinions to MITADER and to the General Attorney, in order to completely clarify the RoW issue. The General Attorney's opinion stated that the RoW should be defined in reference to the Land Law.<br>As such, EDM has revised the Project definition, and has defined the line's RoW as a 100 m wide corridor (50 m to each side of the alignment). This EIS report was then developed and compiled based on a 100 m wide RoW. |
| 8. | Interferences between the transmission line alignment and existing infrastructure (including road network, gas pipelines and civil aviation fields) and methodology for their resolution. | 04.05.2017<br>05.05.2017<br>30.11.2018 | - National Administration of Roads (ANE);<br>- Civil Aviation Institute;<br>- ENH;<br>- DPASA Maputo. | The resolution of any potential interference between the alignment and existing infrastructure will follow the standardized approach to these issues: during detail design, EDM will engage the managing entities of that infrastructure (such as ANE, for national and regional roads, for example) and include their requirements in the Project design. All interferences will be resolved taking into consideration the applicable guidelines (such as the SAPP guidelines, among others). |
| 9. | What is the design capacity of the new transmission line? | 05.05.2017 | - Matola Gas Company. | As indicated in section 4.3.1 of the EIS report (see Volume I), the capacity of the new transmission line will be approximately 950 MW. |

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| 10. | Were natural risks, like cyclones and earthquakes, taken into consideration for the Project design? | 28.11.2018 | - DIPREME Inhambane | Yes. Risks associated with natural disasters are taken into consideration by the engineering team during the design process. |
| 11. | Does EDM already have the Land Use and Development Right (DUAT) for the new substations areas? | 05.05.2017<br>29.11.2018 | - DPTADER Maputo;<br>- Chibuto District Administration. | EDM already has the DUAT's for the Vilanculos, Chibuto and Maputo substations. The process to get the DUAT for the Matalane substation is currently ongoing. |
| 12. | The maps in the EIS do not show the Limpopo District, a District recently created in 2016, through the rearrangement of the Bilene and Xai-xai districts. Was this District considered in the study? | 29.11.2018 | - Administrator of Bilene District | The EIS maps in the Draft EIS were not up to date, and still showed the administrative division as it were prior to the 2016 changes. The location maps in the EIS were now updated, including the representation of Limpopo District (see for example Figure 4.1 in Volume I). It is, however, important to note that the Limpopo District is not crossed by the proposed Project, and as such is outside of the scope of the assessments and analyses produced in the EIS. |
| 13. | Is there a plan for periodic maintenance of the STE Project, to allow the project to operate beyond the 30 years design horizon? | 29.11.2018 | - Community leader of Coca Missava Neighborhood (Xai-xai) | Yes. EDM already has standard maintenance protocols for its transmission network, that will be applied to the STE Project – Phase 1. |
| **Biophysical impacts** | | | | |
| 14. | Will the planned vegetation clearance affect precious wood tree species? | 04.05.2017 | - DPTADER Inhambane | The vegetation clearance needed for Project implementation will impact woodland habitats, and this impact was assessed in the EIS (see section 7.9.1). According to the biodiversity baseline (see section 6.2.2.2, Volume I), two precious wood tree species were confirmed as occurring in study area (*Spirostachys africana* and *Guibourtia conjugate*) with a third species (*Berchemia zeyheri*) considered to be potential. Some individual of these species may thus be affected by vegetation clearance. |

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| 15. | Impacts on vegetation and fauna resulting from the opening of new access roads during construction. | 30.11.2018 | - DPTADER Maputo. | As discussed in the Project Description (see section 4.3.2.3 of **Volume I**), during construction, road access will be required to each tower location. Where possible, access will be via existing roads or through the RoW. Where this is not possible, new temporary accesses may be built. The location and alignment of these potential access roads is not known at present, and as such it is not possible to provide a specific impact assessment for these access roads.<br>To minimize uncertainty, the ESMP requires that the contractor will have to develop an Access Roads Location and Management Plan, with the proposed route of construction accesses, and submit this plan for EDM approval. The ESMP also provides some guidance regarding the minimum requirements that the contractor will have to abide to, when defining accesses, so as to minimize their environmental and social impacts (see section 4.1 of **Volume III**), including their potential impacts on biodiversity.<br>Note, however, that new accesses may require additional environmental licensing, if their design triggers the criteria defined in the ESIA Regulation for road ESIA assessment. If additional environmental licensing is required, this will be the responsibility of the Contractor, under EDM supervision. |
| **Socioeconomic impacts** | | | | |
| 16. | Will the Project impact on cultural heritage sites and/or sacred sites? How will these impacts be minimized? | 04.05.2017<br>29.11.2018 | - DPTADER Inhambane;<br>- Community leader of Patrice Lumumba neighborhood (Xai-xai) | In what regards cultural heritage, this issue was considered in the socioeconomic baseline (see section 6.3.5, Volume I), and all potential impacts were assessed in section 7.10. The Project activities, namely the establishment of the RoW, will result in some impacts, namely on five Zion churches and 18 family and communal cemeteries, which are located within the RoW. This impact will be minimized through the relocation of these sites, as described in the RAP. No other sacred site, such as sacred forests, was identified within the Project's RoW. |
| 17. | Will the Project result in improvements in terms of energy quantity and quality, that is to say, will it minimize the issue of black-outs? | 04.05.2017<br>29.11.2018 | - SDAE Chokwe;<br>- Administrative Post of Incaia (Bilene) | The main goal of the STE Project is to connect and integrate the current two isolated power systems in Mozambique. This integration will improve the capability of EDM to manage power transmission and distribution across the territory and to develop the transmission and distribution networks to account for redundancy.<br>Further to this, the STE Project will enable the development of new generation projects, including a thermal power plant currently being planned by Sasol and EDM in Temane.<br>In this way, the STE Project will allow EDM to improve the quality of energy supply. |
| 18. | Potential impacts during construction, associated with workers influx, increased risk of transmission of infectious diseases and social conflicts. | 05.05.2017 | - SDPI Mandlakaze;<br>- ENH. | These potential impacts were identified and assessed in the EIS. Please refer to section 7.10 for details. EDM and the contractor will work closely with communities, maintain constant communication and provide channels for presenting and resolving concerns and complaints. |

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| 19. | Local manpower should be used in the Project's construction phase. | 05.05.2017<br>29.11.2018 | - ENH;<br>- Mazivila Administrative Post. | Construction manpower will be managed by the contractors to be retained by EDM. The ESMP (see **Volume III**) includes guidelines for the contractors, indicating that the use of local manpower should be prioritized, whenever possible, in coordination with local leaders and authorities, including employment for women and training for local workers. The ESMP requires the Contractor to develop a Local Recruitment Plan and a Training and Skill Transfer Program, detailing how it will comply with these requirements. |
| 20. | Will EDM use local suppliers, or international ones? | 05.05.2017 | - MIDAL Cables. | EDM's strategy is to use local resources, whenever feasible. The ESMP (see **Volume III**) includes guidelines for the contractors, indicating that the use of local suppliers should be prioritized, whenever possible. |
| 21. | Project impacts on irrigated farming. | 29.11.2018 | - Chokwe District's Consulting Council | The potential impact of the project in irrigated lands was assessed in the EIS (see section 7.6.1.2, **Volume II**), specifically the irrigation lands in Chokwe and Xai-xai. Adequate mitigation was proposed, namely the optimization of the project's design, during the detailed engineering phase, to minimize impacts on irrigated lands. With the proposed mitigation in place, the impact was considered to be of low residual significance. |
| **Resettlement process** | | | | |
| 22. | What is the phasing of the resettlement process? When will the final resettlement plan be compiled? | 30.11.2018 | - Community leader of Mulotane Locality;<br>- SDPI Moamba. | The phasing of the resettlement process is defined by the national legal framework, namely Decree 31/2012. Please see section 3.2.2 of the preliminary RAP report, which accompanies this EIS, for a detailed description of the resettlement process and procedures. Briefly, the development of the resettlement plan is divided into two main phases:<br>- The first main phase happens concurrently with the ESIA process, and includes the development of a socioeconomic census survey, that supports the development of the EIS and a preliminary Resettlement Plan, which provides preliminary information on the resettlement approach, compensation methods, etc.;<br>- The second phase happens after the ESIA is concluded (after the EIS is approved). Then the final Resettlement Action Plan is developed, including a confirmation of the census survey, and the detailed definition of all actions to be undertaken to implement the resettlement.<br>Only after the final Resettlement Action Plan is approved by the District Authorities does the resettlement process moves to the implementation phase. |

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| 23. | Methods of compensation for assets (houses, farming plots, fruit trees, natural resources, etc.) that may need to be removed from the Project's RoW. | 04.05.2017<br>05.05.2017<br>28.11.2018<br>29.11.2018 | - SDPI Bilene;<br>- Mandlakaze Permanent Secretary;<br>- SDPI Marracuene;<br>- District Services of Health, Women and Social Action (SDSMAS) of Massinga;<br>- SDPI Mandlakaze;<br>- Consulting Council of Chibuto District;<br>- Magude Sede Administrative Post. | All losses of socioeconomic resources caused by the Project construction will be identified and compensated for, as per legal requirements and international best practice. The compensation will take place prior to the start of the construction. The method of the compensation will be done as per the standing law, in articulation with the proper authorities, through negotiation and consultation with the affected people, and in accordance with international best practice with respect to valuation methodology and standards. The proposed methods of compensation are detailed in the RAP. |
| 24. | Will the compensation house be similar to all affected households, independently of their current housing conditions? | 29.11.2018 | - INGC Xai-xai. | Decree 31/2012 states that all affected houses must be compensated in kind, with a house with a minimum of three bedrooms, 70 $m^2$, built in a plot of 800 $m^2$ in urban areas and 5 000 $m^2$ in rural areas. If the house to be compensated is larger than this, what is proposed in the RAP is to compensate for those houses monetarily, at full replacement value. An option of standard replacement structure plus monetary compensation for the difference in value may be offered to the affected household. Additional information on the proposed resettlement package is available in the RAP. |
| 25. | How will the resettlement plan take into consideration the natural population growth that takes place from the time of the census up to resettlement implementation? | 28.11.2018 | - Massinga Permanent Secretary | In compliance with applicable legislation, the elaboration of the resettlement plan is divided into two phases. The first phase happens concurrently with the ESIA, and includes the undertaking of a full census, in order to assess the resettlement impacts. After the EIS approval, the second phase of the resettlement plan elaboration will start. This will include a confirmation of the census undertaken for the EIS. Any natural growth between these two dates will be included in the resettlement scope. |
| 26. | Implementation of a cut-off date and communication to affected populations on restrictions for additional constructions or developments in the Project area. | 28.11.2018<br>29.11.2018 | - DIPREME Inhambane;<br>- Massinga Permanent Secretary;<br>- Administrative Post of Mazivilia (Bilene) | A cut-off-date can only be established after the approval of the EIS and the confirmation of the census, to be undertaken during the elaboration of the Resettlement Plan. After the confirmation of the census, and in articulation with local authorities, an awareness program will be developed, warning the affected people and communities that further constructions and developments in the Project area will not be eligible for compensation. |
| 27. | Is information available on the number of affected families per administrative unit? | 29.11.2018 | - Administrator of Bilene District | Section 6.3.4.2 of Volume I provides information on the number of affected families, per administrative post and locality. Additional information is provided in the RAP. |

| Issues / Comments | | Date | Stakeholder | Answers / Comments |
|---|---|---|---|---|
| 28. | Methodology for the selection of the resettlement host area and provision of basic infrastructure in the host area. | 29.11.2018 | - INGC Xai-xai. | The selection of the resettlement host area will only be undertaken during the development of the final Resettlement Action Plan, following the approval of the EIS. Given that the project is a linear infrastructure, for the most part only a few households will be affected in each community. As such, the overall strategy currently proposed is to relocate the affected households to the same community they now live in, to avoid impacts of social displacement. If this proves to be feasible (during the development of the final Resettlement Action Plan), there won't be the need to define a new resettlement host area, as families will just be relocated within their current community.<br>If this is proven to be unfeasible a new host area will have to be defined in the RAP, and all basic infrastructure and required transitional assistance will have to be provided in the new host area, as required by Decree 31/2012 and OP4.12. |
| 29. | If people are moved to a new area, far away from their current communities, their cost of life will increase, due to additional transport costs. How will this be compensated for? | 30.11.2018 | - Moamba District Consulting Council. | The overall strategy currently proposed is to relocate the affected households to the same community they now live in, to avoid additional social impacts, such as increase transport costs. However, if this is not feasible, and people need to be moved away from their communities, the RAP will have to include livelihood restoration programs, designed specifically to address the needs of each resettled household. |
| 30. | Resettlement people sometimes return to their original lands. How is that going to be managed? | 29.11.2018<br>30.11.2018 | - SDPI Mandlakaze;<br>- Provincial Directorate of Agriculture and Food Security (DPASA) of Maputo. | As part of the line maintenance protocol, EDM will undertake inspections of the line's corridor. It should be noted that under the Land Law the 100 m RoW is a partial protected zone, where no DUATs can be issued. As such, in the event of new constructions encroaching into the RoW, EDM will engage with the authorities to have those constructions removed. Note that EDM's policy is to allow the continuation of annual crop farming within the RoW. |
| 31. | Good communication with local authorities and local communities is essential to ensure a successful resettlement process. | 29.11.2018 | - Chibuto District Administration;<br>- Community leader of the Missava neighborhood | Good communication practices are being implemented as part of the methodology to develop and implement the resettlement action plan. This includes public consultation activities, establishment of district supervision committees that include representatives of local communities, creation of a community grievance response mechanism, among other measures. |

# 9 Conclusions and Requirements

EDM proposes to implement the STE Project (Phase I: Vilanculos – Maputo), a 561 km long HVAC transmission line between Vilanculos and Maputo. This report presents the findings of the impact assessment of the proposed Project, developed in compliance with the ToR for the EIS, defined in the EPDA phase. All expected positive and negative impacts on the receiving biophysical and socioeconomic environment were identified and evaluated both in the pre-mitigation scenario and following the implementation of the mitigation and enhancement measures (the residual impacts).

The construction and operation of a 561 km long transmission line, as well as the construction of three new substations and the upgrade of a fourth substation, implies a wide range of different impacts on the receiving environment. In the construction phase, these are mostly related, directly or indirectly, to the changes to land use in the construction sites, the clearance of the RoW and the construction activities themselves, which require the mobilization of approximately 250 workers and the operation of heavy machinery and equipments along the linear construction area. In the operation phase, most transmission line impacts are associated with the presence of the overhead line itself, as well as with the maintenance of the RoW.

The results of the impact assessment exercise conducted in this EIS are summarized in tabulated form in section 7.11. Assuming the implementation of the mitigation requirements, the vast majority of the STE Project's impacts (37 out of 43 total assessed impacts) were rated as of insignificant, very low or low significance in the post-mitigation scenario.

A few impacts (six) were rated as of medium significance in the mitigated scenario and only one residual impact was rated as having a high significance. These medium and high significance residual impacts are the Project's more relevant impacts and are briefly referred to below (a detailed discussion of these impacts is provided in Chapter 7).

In what regards ***negative impacts***, no high significance residual impacts were identified. However, some medium significance residual impacts were assessed, most of them associated with the clearance and establishment of the RoW, namely:

- The direct loss, degradation and fragmentation of important habitats and vegetation (mostly woodland habitats) caused by vegetation clearance in the RoW, particularly in the northern half of the alignment, closer to Vilanculos, where unfragmented large areas of woodland habitats still exist;
- The indirect additional degradation of natural habitats (mostly woodland habitats), along the RoW during the operational phase, in particular due to the expanse of agriculture and natural resources exploitation along the RoW, given the increased ease of access to presently inaccessible areas. This is again more relevant to the northern half of the alignment, as currently these areas are mostly inaccessible by local populations; and
- The direct ressetlement impacts caused by the establishment of the RoW, generating the need to relocate 415 families and compensate for affected built structures, farm lands and fruit trees.

Additionally, one medium significance residual impact was assessed for the operational phase, associated with the presence of the overhead line itself, namely:

- Increased mortality of birds (particularly birds with large wing spans), due to collisions and electrocution with the line and towers.

Mitigation measures were defined to avoid or minimize the impacts described above, of which the more relevant include a minor realignment of the line, to avoid a patch of critical habitat (miombo forest), the development of a RAP and the adoption of control measures in the design of line and towers, to minimize bird collisions. The mitigation of the indirect impact (expansion of population along the RoW during the operational phase) will require coordinated effort by several government agencies, to avoid the establishment of settlements in more sensitive areas and to control human activities with the potential to impact on biodiversity, such as hunting, harvesting, farming, etc.

In what regards ***positive impacts***, two significant impacts were identified, both regarding the socioeconomic environment, which can be essentially summarized as follows:

- The transfer of know-how and skills to the unskilled local workers that will be employed by the Project will result in a long-term benefit for these families, and for the local workforce in general. This was assessed as a medium significance residual positive impact;
- The increased power availabilty created by the STE Project will have a positive impact on the regional economy. On current conditions, the power supply in some areas is weak or nonexistent. The STE Project will allow for the increase of power supply in the southern region of Mozambique and will enable a better distribution of power in areas which are currently not electrified, through the construction of substations, from which distribution schemes can be developed at a later date. The development of the STE Project could also create business opportunities in the industrial sector, as developers will know that the STE Project will both increase the quantity and robustness of power supply, enabling a larger number of viable industrial projects. All these vectors of economic stimulation will in turn result in the creation of jobs. This indirect effect, which is indeed the main goal of the Project, was assessed as a high significance residual positive impact.

The STE Project (Phase 1: Vilanculos – Maputo) will thus result in both positive and negative significant residual impacts on the receiving environment, which was to be expected given the magnitude of the Project. Its construction and operation will result, in one hand, on significant negative impacts on biodiversity, and on the other, on significative positive socioeconomic impacts. However, it should be noted that no residual negative impacts of high significance were identified and as such the STE Project is considered to be environmentally feasible.

The Project's ESMP (**Volume III**) summarizes and structures all management, mitigation and monitoring requirements defined in this EIS. The ESMP will be further developed by EDM into a Project Environmental and Social Management System (ESMS), so as to ensure that the Project is conducted and managed in a sustainable manner. EDM will also ensure that its contractors abide by the ESMP, by making it a part of the contractors' contractual obligations, whenever applicable and pertinent.

# References

Bartzke, G. S.; R. May, K. Bevanger, S. Stokke and E. Røskaft. (2015). *The effects of power lines on ungulates and implications for power line routing and rights-of-way management*. International Journal of Biodiversity and Conservation.

Bartzke, G. S.; R. May, E. J. Solberg, C. M. Rolandsen, and E. Røskaft. (2015). *Differential barrier and corridor effects of power lines, roads and rivers on moose (Alces alces) movements*. Ecosphere 6(4):67. http://dx.doi.org/10.1890/ES14-00278.1

Berger, R.P. (2010). *Fur, Feathers, Fins & Transmission Lines. How transmission lines and rights-of-way affect wildlife*. Third Edition. Manitoba Hydro.

Bevanger, K. (1998). *Biological and conservation aspects of bird mortality caused by electricity power lines: a review*. Biological Conservation 86: 67-76.

Chen, C.; Gao, Y. & Liu, S. (2014). *Study on Noise Prediction Model and Control Schemes for Substation*. The Scientific World Journal, vol. 2014, Article ID 696429, 7 pages, 2014.

DeLuchi, M. A. (1991). *Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity*. ANL/ESD/TM-22. Center for Transportation Research, Argonne National Laboratory, Argonne, IL, November.

Didha, R.K. (2010). *Ecological Consequences of Habitat Fragmentation*. November, 2010. John Wiley & Sons, Ltd.

Dones, R. *et al*. (2007). *Life Cycle Inventories of Energy Systems: Results for Current Systems in Switzerland and Other UTCE Countries*. Final report EcoInvent data v2.0, No. 5. Dübendorf: EcoInvent Swiss Centre for Life Cycle Inventories. www.ecoinvent.ch.

Ferrer, M. (2012). *Birds and power lines – from conflict to solution*. ENDESA, SA & Fundácion MIGRES.

Geosolve & Certiprojecto (2009). *EN1 Nacional Road upgrade between Vila Franca Xira/Carregado, Portugal - Environmental Impact Assessment Report*. Estradas de Portugal, E.P., Portugal.

Golder (2018a). *Central Térmica de Temane Project – Environmental and Social Impact Assessment. Volume 1: ESIA Report and Non-Technical Summary*. Golder Associados Moçambique Limnitada, November 2018.

Golder (2018b). *Central Térmica de Temane Project – Influx Management Framework.* Golder Associados Moçambique Limnitada, November 2018.

ICNB. (2010). *Manual de apoio à análise de projectos relativos à instalação de linhas aréreas de distribuição e transporte de energia elétrica*. Componente Avifauna. Instituto da Conservação da Natureza e Biodiversidade.

IFC (2007a). *Environmental, Health, and Safety General Guidelines*. International Finance Corporation, World Bank Group, April 30, 2007.

IFC (2007b). *Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution*. International Finance Corporation, World Bank Group, April 30, 2007.

IPCC (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

Jones, R.F. (2007). Aeroacoustics of Aeolian Tones and Effects of Periodic Holes. 16th Australasian Fluid Mechanics Conference, Crown Plaza, Gold Coast, Australia, 2-7 December 2007.

Kipeto Energy Limited. (2013). Bat Study for the proposed Kipeto Transmission Line Project, Kenya. Kipeto Energy Limited.

Madrigal, M. & Spalding-Fecher, R. (2010). *Impacts of Transmission and Distribution Projects on Greenhouse Gas Emissions. Review of Methodologies and a Proposed Approach in the Context of World Bank Lending Operations*. Energy and Mining Sector Board Discussion Paper, Paper nº 21, November 2010. World Bank.

Peralta, J.C.A. *et al*. (2009). *Ruído de Linhas Eléctricas de Muito Alta Tensão: Um Estudo Experimental e previsional*. XIII ERIAC - Décimo Tercer Encuentro Regional Ibero americano de Cigré.

Pinto, A.M. (2008). *Análise e Mitigação do Ruído Acústico nas Linhas de Muito Alta Tensão da Rede Nacional de Transporte*. Tese de mestrado integrado. Engenharia Electrotécnica e de Computadores (Major Energia). Faculdade de Engenharia. Universidade do Porto.

USEPA (2006). *Global Anthropogenic Non-$CO_2$ Greenhouse Gas Emissions: 1990–2020*. U.S. Environmental Protection Agency, Washington.

USEPA (2009). *AP-42. Compilation of Air Pollutant Emission Factors PA AP 42*. 2009 Fifth Edition, Volume I, Chapter 1 and 3. U.S. Environmental Protection Agency, Washington.