Tunisia-Italy Power Interconnector Project

Environmental and Social Impact Assessment (ESIA)

Section 8 – Risks and potential impacts assessment – Terrestrial domain

Draft for Consultations

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03	2023-02-02	Draft emission for consultations	IDEACONSULT (M.S. Romdhane)	IDEACONSULT (S.Ben Jemia)	IDEACONSULT (S.Ben Jemia))
02	2023-01-23	Revision after WB's comments			
01	2022-11-30	Revision after Elmed's comments	IDEACONSULT (M.El Hrizi)		
00	2022-11-28	First emission			
Rev.	Date	Description	Prepared by	Checked by	Approved by

ELMED

Revision Approved	**Approval Date**	**Approved by**

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1. INTRODUCTION

1.1 ESIA content and structure

The present impact assessment took into account the following environmental and social components potentially impacted by the Project, in alignment with the baseline analysis (Volume 4):

Environmental risks and impacts on Physical Environment

- Air Quality
- Geology and geomorphology
- Hydrogeology and hydrology
- Noise
- Electromagnetic fields
- Landscape and Visual amenities

Environmental risks and impacts on Biological Environment

- Flora and vegetation
- Fauna and habitats
- Protected areas

Socio Economic Risks and Impacts

- Economy employment and income
- Land and livelihoods
- Infrastructure and public services
- Community Health and Safety

For each of the above components impacts have been identified and assessed for the following Project phases:

- Construction Phase
- Operation Phase
- Decommissioning Phase

The Project lifetime is estimated in 40 years: design of decommissioning works will be developed when the project will be close to its end of life: for this reason no information is presently available as to the activities related to this phase, and impact assessment is based on the extreme hypothesis of complete removal of all the works of the project.

Mitigation and prevention measures have been taken into account in the assessment and identified alongside each evaluation, where needed.

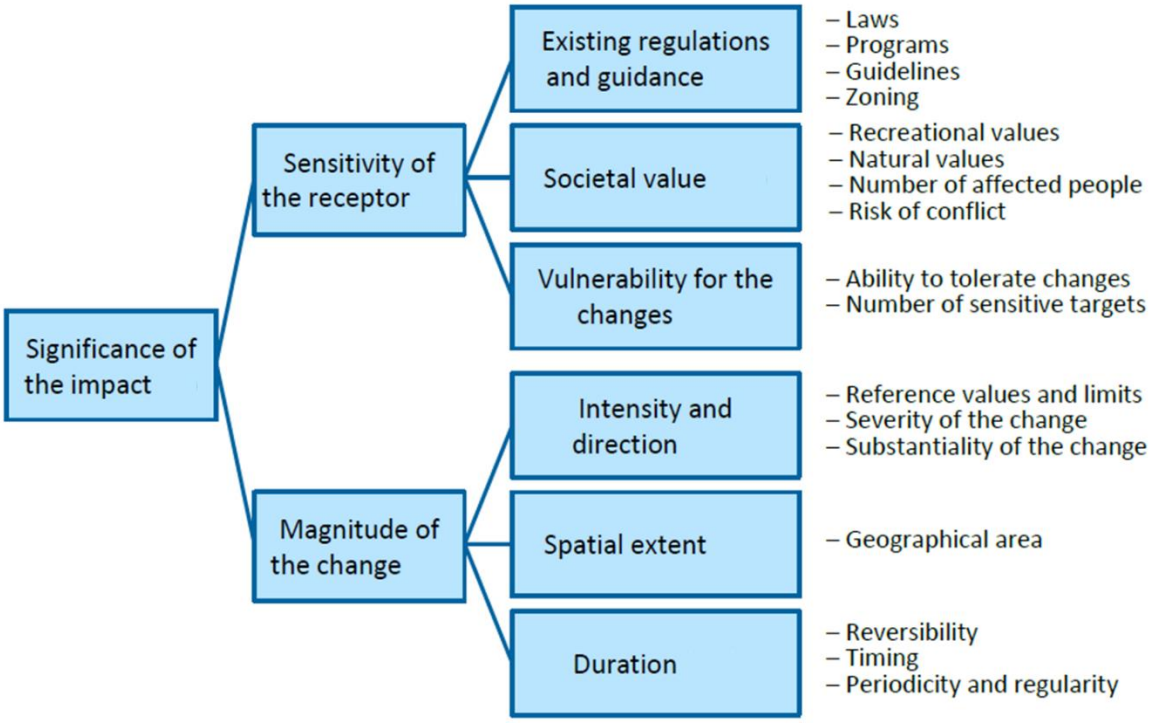
2. IMPACT ASSESSMENT METHODOLOGY

2.1 Methodological Framework

The Impact Assessment (IA) methodology adopted in the present study is based on the ARVI approach, developed within the European commission's LIFE + project, IMPERIA: "Improving environmental assessment by adopting good practices and tools of multi-criteria decision analysis"[1].

The fundamental principle of the adopted IA approach is that for each environmental and social component one first assesses the **sensitivity** of the component in its baseline state, and then the **magnitude of impact**, which would probably affect the component as a result of the proposed project. An overall estimate of the **significance of an impact** is derived from these judgments.

Both the sensitivity of the component being analysed and the magnitude of impact are evaluated systematically based on more detailed sub-criteria, as depicted in the Figure below.



2.2 Impact Assessment Process

Based on the ESIA methodology outlined above, the assessment of the Project's environmental and social impacts was performed according to the following steps:

- Definition of Sensitivity for each of the environmental and social components;

For each project phase (namely construction and operation) and each environmental and social components:

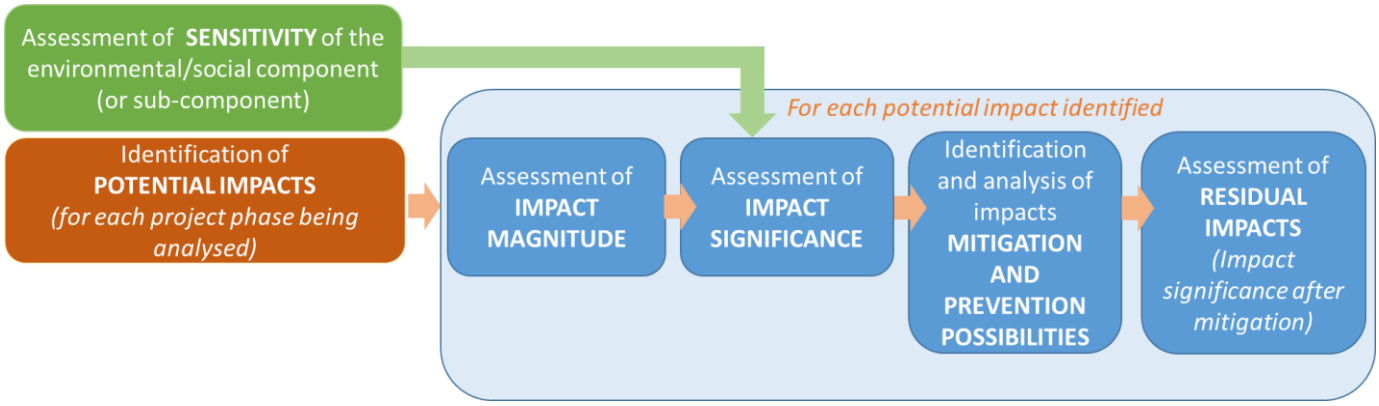
- Identification of Potential Impacts

For each potential impact identified:

- Assessment of Impacts Magnitude and Significance;

[1] IMPERIA project — Department of Biological and Environmental Science (jyu.fi)

- Identification and analysis of impacts Mitigation and prevention possibilities;
- Assessment of Residual impacts (Impact significance after mitigation).



2.3 Assessment of Impact significance

2.3.1 Assessing the Sensitivity

Sensitivity of the receptor (intended as environmental and social components analysed in the assessment) is a description of the characteristics of the target of an impact.

The sensitivity is assessed based on the following sub-criteria, as described hereinafter:

- existing regulations and guidance;
- societal value; and
- vulnerability for the change.

It is noted that the sensitivity of each environmental and social component is estimated in its current state prior to any change implied by the Project (ante-operam characterization).

2.3.1.1 Existing regulations and guidance

Existing regulations and guidance describes whether there are any such objects in the area likely to be affected by the Project, which have some level of protection by law or other regulations (e.g. prohibition against polluting groundwater and Natura areas), or whose conservation value is increased by programs or recommendations (e.g. landscapes designated as nationally valuable).

According to the adopted IA methodology, the sub-criterion "*existing regulation and guidance*" is evaluated and classified as shown in the figure below.

Very high * * * *	The impact area includes an object that is protected by national law or an EU directive (e.g. Natura 2000 areas) or international contracts which may prevent the proposed development.
High * * *	The impact area includes an object that is protected by national law or an EU directive (e.g. Natura 2000 areas) or international contracts which may have direct impact on the feasibility of the proposed development.
Moderate * *	Regulation sets recommendations or reference values for an object in the impact area, or the project may impact an area conserved by a national or an international program.
Low *	Few or no recommendations which add to the conservation value of the impact area, and no regulations restricting use of the area (e.g. zoning plans).

2.3.1.2 Societal value

Societal value describes the value to the society of the environmental or social component being analysed and depending on the type of impact may be related to economic values (e.g. water supply), social values (e.g. landscape or recreation) or environmental values (e.g. natural habitat).
Societal value measures general appreciation from the point of view of the society, but should not consider that much the point of view of individuals exposed to negative impacts. When relevant, the number of people impacted is taken into account.

According to the adopted IA methodology, the sub-criterion "*societal value*" is evaluated and classified as shown in the figure below.

Very high * * * *	The receptor is highly unique, very valuable to society and possibly irreplaceable. It may be deemed internationally significant and valuable. The number of people affected is very large.
High * * *	The receptor is unique and valuable to society. It may be deemed nationally significant and valuable. The number of people impacted is large.
Moderate * *	The receptor is valuable and locally significant but not very unique. The number of people impacted is moderate.
Low *	The receptor is of small value or uniqueness. The number of people impacted is small.

Note: For the purpose of the present IA the term "receptor" is equivalent to the environmental and social components or sub-component analysed in the assessment

2.3.1.3 Vulnerability for the change

Vulnerability for the change describes how liable the environmental and social component being analysed is to be influenced or harmed by pollution or other changes to its environment. For instance, an area which is quiet is more vulnerable to increasing noise than an area with industrial background noise.

According to the adopted IA methodology, the sub-criterion "vulnerability for change" is evaluated and classified as shown in the figure below.

Very high * * * *	Even a very small external change could substantially change the status of the receptor. There are very many sensitive targets in the area.
High * * *	Even a small external change could substantially change the status of the receptor. There are many sensitive targets in the area.
Moderate * *	At least moderate changes are needed to substantially change the status of the receptor. There are some sensitive targets in the area.
Low *	Even a large external change would not have substantial impact on the status of the receptor. There are only few or none sensitive targets in the area.

Note: For the purpose of the present IA the term "receptor" is equivalent to the environmental and social components or sub-component analysed in the assessment

2.3.1.4 Deriving the overall sensitivity

The overall sensitivity of the environmental and social component being analysed is assessed on the base of the joint evaluation of the above presented sub-criteria.

According to the adopted IA methodology, the "*sensitivity*" is evaluated and classified as shown in the figure below.

Environmental and social expert judgement should be used throughout the sensitivity assessment to derive the most appropriate level of sensitivity to assign to each environmental and social component under study, on a case by case basis.

Very high * * * *	Legislation strictly conserves the receptor, or it is irreplaceable to society, or extremely liable to be harmed by the development. Even minor influence by the proposed development is likely to make the development unfeasible.
High * * *	Legislation strictly conserves the receptor, or it is very valuable to society, or very liable to be harmed by the development.
Moderate * *	The receptor has moderate value to society, its vulnerability for the change is moderate, regulation may set reference values or recommendations, and it may be in a conservation program. Even a receptor which has major social value may have moderate sensitivity if it has low vulnerability, and vice versa.
Low *	The receptor has minor social value, low vulnerability for the change and no existing regulations and guidance. Even a receptor which has major or moderate social value may have low sensitivity if it's not liable to be influenced by the development.

Note: For the purpose of the present IA the term "receptor" is equivalent to the environmental and social components or sub-component analysed in the assessment

2.3.2 Assessing the Magnitude of impact

Magnitude of impact describes the characteristics of changes the Project is likely to cause. The direction of change is either positive or negative.

The Magnitude of impact is assessed based on the following sub-criteria, as described hereinafter:

- intensity and direction;
- spatial extent; and
- duration.

Assessment of magnitude evaluates the probable changes affecting the environmental and social component being analysed without taking into account the sensitivity.

2.3.2.1 Intensity and direction

Intensity describes the physical dimension of an impact and direction specifies whether the impact is negative ("–"/red) or positive ("+"/green). Depending on the type of impact, intensity can often be measured with various physical units and compared to reference values, such as the decibel (dB) for sound.

The assessment is intended to evaluate the overall intensity across the impact area with due consideration of the closest sensitive receptor or at the most sensitive target at the impact area.

According to the adopted IA methodology, the sub-criterion "*intensity and direction*" is evaluated and classified as shown in the figure below.

With regard to the Figure content it should be noted that:

- The term "proposal" is equivalent to the Project.
- The classification "No Impacts" is equivalent to "Negligible impacts"; the latter expression has been preferred and used in the present the assessment

Very high + + + +	The proposal has an extremely beneficial effect on nature or environmental load. A social change benefits substantially people's daily lives.
High + + +	The proposal has a large beneficial effect on nature or environmental load. A social change clearly benefits people's daily lives.
Moderate + +	The proposal has a clearly observable positive effect on nature or environmental load. A social change has an observable effect on people's daily lives.
Low +	An effect is positive and observable, but the change to environmental conditions or on people is small.
No impact	An effect so small that it has no practical implication. Any benefit or harm is negligible.
Low –	An effect is negative and observable, but the change to environmental conditions or on people is small.
Moderate – –	The proposal has a clearly observable negative effect on nature or environmental load. A social change has an observable effect on people's daily lives and may impact daily routines.
High – – –	The proposal has a large detrimental effect on nature or environmental load. A social change clearly hinders people's daily lives.
Very high – – – –	The proposal has an extremely harmful effect on nature or environmental load. A social change substantially hinders people's daily lives.

2.3.2.2 Spatial extent

Spatial extent describes the geographical reach of an impact area, or the range within which an effect is observable. In principle, spatial extent can be expressed as distance from the source, but the extent of an impact area may vary by direction due to topography, vegetation or other factors.

According to the adopted IA methodology, the sub-criterion "*spatial extent*" is evaluated and classified as shown in the figure below.

Very high * * * *	Impact extends over several regions and may cross national borders. Typical range is > 100 km.
High * * *	Impact extends over one region. Typical range is 10-100 km.
Moderate * *	Impact extends over one municipality. Typical range is 1-10 km.
Low *	Impact extends only to the immediate vicinity of a source. Typical range is < 1 km.

2.3.2.3 Duration

Duration describes the length of time during which an impact is observable and it also takes other related issues such as timing and periodicity into account. These are relevant for impacts which aren't observable all the time such as periodic impacts.

According to the adopted IA methodology, the sub-criterion "*duration*" is evaluated and classified as shown in the figure below.

It is noted that for the purpose of the present IA the "duration" assessed refers to measurable impacts on the environmental or social component being analysed (e.g. increase in noise levels, increase in water pollution etc.) and not to the duration of the cause of the impacts (e.g. release of noise emission, or pollutants into the environment. The latter can be continuous (i.e. permanent) but not necessarily induce any measurable impacts at receptors).

Very high * * * *	An impact is permanent. The impact area won't recover even after the project is decommissioned.
High * * *	An impact lasts several years. The impact area will recover after the project is decommissioned.
Moderate * *	An impact lasts from one to a number of years. A long-term impact may fall into this category if it's not constant and occurs only at periods causing the least possible disturbance
Low *	An impact whose duration is at most one year, for instance during construction and not operation. A moderate-term impact may fall into this category if it's not constant and occurs only at periods causing the least possible disturbance.

2.3.2.4 Deriving the overall magnitude of impact

The overall magnitude of impact on the environmental and social component being analysed is assessed on the base of the joint evaluation of the above presented sub-criteria, for each specific impact preliminary identified.

According to the adopted IA methodology, the "*magnitude of impact"* is evaluated and classified as shown in the figure below.

Environmental and social expert judgement should be used throughout the assessment to derive the most appropriate level of magnitude to assign to each impact, on a case by case basis.

Similarly to what reported for the "intensity and direction", with regard to the Figure content it should be noted that:

- The term "proposal" is equivalent to the Project.
- The classification "No Impacts" is equivalent to "Negligible impacts"; the latter expression has been preferred and used in the present the assessment

Very high + + + +	The proposal has beneficial effects of very high intensity and the extent and the duration of the effects are at least high.
High + + +	The proposal has beneficial effects of high intensity and the extent and the duration of the effects are high.
Moderate + +	The proposal has clearly observable positive effects on nature or people's daily lives, and the extent and the duration of the effects are moderate.
Low +	An effect is positive and observable, but the change to environmental conditions or on people is small.
No impact	No change is noticeable in practice. Any benefit or harm is negligible.
Low –	An effect is negative and observable, but the change to environmental conditions or on people is small.
Moderate – –	The proposal has clearly observable negative effects on nature or people's daily lives, and the extent and the duration of the effects are moderate.
High – – –	The proposal has harmful effects of high intensity and the extent and the duration of the effects are high.
Very high – – – –	The proposal has harmful effects of very high intensity and the extent and the duration of the effects are at least high.

2.3.3 Assessing the Significance of an impact

According to the adopted IA methodology, the assessment of significance of an impact is based on the following matrix, which combines:

- the magnitude of impact (labelled as "magnitude of change" in the figure below) affecting the environmental or social component being analysed; and

- the sensitivity of the component (labelled as “sensitivity of the receptor” in the figure below).

As previously reported for the Magnitude, the classification “No Impacts” is equivalent to “Negligible impacts”; the latter expression has been preferred and used in the present the assessment.

Impact significance		Magnitude of change								
		Very high	High	Moderate	Low	No change	Low	Moderate	High	Very high
Sensitivity of the receptor	Low	High*	Moderate*	Low	Low	No impact	Low	Low	Moderate*	High*
	Moderate	High	High	Moderate	Low	No impact	Low	Moderate	High	High
	High	Very high	High	High	Moderate*	No impact	Moderate*	High	High	Very high
	Very high	Very high	Very high	High	High*	No impact	High*	High	Very high	Very high

* Especially in these cases, significance might get a lower estimate, if sensitivity or magnitude is near the lower bound of the classification

2.4 Mitigations Hierarchy

The ESIA process is intended to reduce the negative impacts and enhance the benefits induced by the Project, by identifying impacts and benefits and the ways of dealing with them during the planning and design stages of the project. The present assessment took into account the mitigation hierarchy summarised in the following Table.

Table 2-1: Mitigation Hierarchy

Mitigation Hierarchy	
Type of mitigation	**Description**
Avoid at Source; Reduce at Source	Avoiding or reducing at source is essentially ‘designing’ the project so that a feature causing an impact is designed out (eg a waste stream is eliminated) or altered (eg reduced waste volume). Often called minimisation
Abate on Site	This involves adding something to the basic design to abate the impact - pollution controls fall within this category. Often called “end-of-pipe”.
Abate at Receptor	If an impact cannot be abated on-site then measures can be implemented off-site
Repair or Remedy	Some impacts involve unavoidable damage to a resource, eg vegetation disturbance. Repair essentially involves restoration and reinstatement type measures.
Compensate in Kind	Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate

The Project includes several “design” measures aimed at preventing and reducing environmental and social impacts. These measures have been incorporated into the design development, and constitute an integral part of the Project. They are also referred to as “embedded mitigation measures” and were taken into account in the performed impact assessment.

In addition, when the assessment showed significant adverse effects on specific environmental and social components, further mitigations have been identified throughout the assessment to offset these impacts.

Both embedded mitigation measures and component-specific mitigations are detailed for each environmental and social components. These measures have been taken into account in the impact assessment and in the evaluation of residual impacts (i.e. impact significance after mitigation) as described below.

2.4.1 Evaluation of mitigation measures

In accordance with the adopted IA methodology, when specific mitigation measures (in addition to embedded mitigations) have been identified to offset significant adverse effects potentially induced by the Project, the IA evaluated to what extent impacts can be mitigated on a scale: not at all / low / moderate / high.

Typically, mitigation measures influence the intensity of an impact and in turn its magnitude.

Mitigation and prevention possibilities
High mitigation possibilities
Moderate mitigation possibilities
Low mitigation possibilities
No mitigation possibilities

2.5 Residual significance

Where specific mitigation measures are identified and evaluated as described above, the assessment includes the estimate of residual significance, namely the significance after the specified measures are implemented.

Residual significance is estimated by plugging in new impact magnitude values to theimpact significance matrix (see Section 2.3.3).

3. ENVIRONMENTAL RISKS AND IMPACTS – PHYSICAL ENVIRONMENT

3.1 Air Quality

The following Table provides a brief overview of the potential impacts on local air quality induced by the Project.

Potential impacts for each project Phase are described in detail in the following sections, prior to presenting the mitigation measures that will be adopted by the Project. Lastly, residual impacts are presented at the end of the assessment, by taking into account the application of mitigation measures.

Table 3-1: Air quality – Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
Potential increase in atmospheric concentration of airborne pollutants due to: • Emissions of dust from earthworks, aggregate material handling, land clearing, levelling, excavation, grading, transit of vehicles on paved and unpaved road, dust resuspension from winds on exposed surfaces • Emissions of exhaust gases released by the vehicles and engine driven machinery (generators, compressors, etc.) involved in the Project construction activities	• Negligible impacts on local air quality due to do the general project maintenance. • Greenhouse gas leaks: operation of OHL line could generate ozone and nitrogen oxides (quantities released remain low) ; also sulphur hexafluoride (SF6) may leaked from gas-insulated equipment (SF6 is used as a insulator for electrical equipment and cables).	• As Operation Phase

3.1.1 Definition of Sensitivity

According to the IA Methodology presented above, the sensitivity of the receptor “Air quality” in the Project AoI has been assessed on the base of the following criteria.

- *Existing regulation and guidance*

Humans and vegetation can be adversely affected by exposure to air pollutants in ambient air. In response, regulations in force at both national and international level set air quality standards (AQS) for the protection of human health and vegetation, for a number of pollutants present in the air.

At the national level, the legislation regarding air quality is regulated by the Law N°2007-34 (4 June 2007) and the limit values of air pollutants, from stationary sources, are set by the Decree N°2010-2519 of 28 September 2010. In addition to that, the Decree N°2018-447 of May 18, 2018 and the NT 106-04 standard sets the limit values and alert threshold for ambient air quality.

At the international level, air quality standards are defined by the Environmental Health and Safety Guidelines: General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality; the latter refers to Air Quality Guidelines published by WHO (World Health Organization).

Given the above, existing regulation and guidelines has been classified as *“**high**”.*

- *Societal Value*

In general, air quality is deemed of relevant societal value given its direct influence on human health. At local scale, the Project AoI is mostly rural/agricultural and sparsely populated. For the TUNITA component of the

Project (underground cable and converter station of Mlaâbi), the majority of settlements being located in the proximity of the landfall area in Kélibia. The OHL line will pass through mostly rural areas, occupied mainly by arboriculture and large-scale crops (cereal), except for a few parts of the corridor where some settlements are located within a few hundred meters from the line.

A moderate number of people is therefore expected to be impacted by the Project, in particular those working near the industrial zone of Menzel Yahia (near the landfall area of Kélibia) and those potentially affected by the OHL line (around Beni Khalled and Grombalia delegations) and in light of the above societal value has been classified as *"**Moderate**".*

- *Vulnerability for change*

To date, no specific air quality data are available. The surroundings of the area concerned by the project's components (TUNITA and OHL line) are mostly rural with presence of some industrial areas, in particular towards the landfall area of Kélibia and near the Mornaguia converter station. These activities are not expected to generate pollutants such as NOx, Cox and PM2.5 and PM10.

Without accurate field measurements, we believe that the air quality appears to be below the thresholds set by WHO and World Bank EHS standards. In addition, considering the absence of highly sensitive subjects such as schools, hospitals in the immediate proximity of the project areas, the vulnerability for change has been classified as *"**Low**".*

Overall the Sensitivity of the receptor "Air Quality" is classified as ***Moderate.***

Air quality				
Characteristics of sensitivity				**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**		
High	Moderate	Low	→	Moderate

3.1.2 Construction Phase

3.1.2.1 Potential impacts

During Project construction, potential impacts on local air quality are related to the following activities:

- Earthworks: clearing and grubbing, and excavation, these activities are expected to generate dust.
- Opening of access roads for the installation of towers.
- Vehicle movement and other equipment (*i.e*. excavators, bulldozers, side booms, trucks, cars), in particular on unpaved roads and construction sites will create dust.
- Use of engine driven vehicles and machinery (heavy equipment, generators, etc.) will generate exhaust/flue gases (combustion) that contain pollutants, including sulphur dioxide (SO2), nitrogen oxides (NOx), and other volatile organic compounds into the atmosphere.
- Transport of raw material, personnel and wastes to and from the construction areas resulting in an increase of traffic and consequent release of exhausts into the atmosphere
- A strong greenhouse gas may leaked from gas-insulated equipment. The Sulfur hexafluoride (SF6), is used as an insulator for electrical equipment and cables (tubular conductor) and transformers. In case of using the SF6 in the converter station, potential leaks remain possible and may affect the air quality, although they occur rarely.

These emission sources involve two different types of potential direct negative impacts on air quality:

- An increase in atmospheric concentrations of dust particles due to dust emissions;
- An increase in atmospheric concentrations of air pollutants such as carbon monoxide (CO), nitrogen oxides (NO_X), sulphur dioxide (SO_2) and particulate matter (PM) from exhaust emissions. These

emissions could increase the concentrations of pollutants in the air. Other chemical pollutants expected to be emitted in lower quantities are volatile organic compounds (VOC).

These impacts may affect atmospheric properties, materials, flora and fauna, human health and in general contribute to safety hazards and interfere with the enjoyment of life and property.

3.1.2.1.1 Diffuse dust emissions

The following Table summarises the sources of diffuse dust emissions associated to the construction of the Project.

Table 3-2: Sources of diffuse dust emissions during the Project construction phase

Project Elements	Sources of Diffuse Dust Emissions
Mlaâbi Converter substation	• Excavation, levelling, compacting and gravelling of the CS site, CS access road and CS construction yard; • Aggregate material handling/stockpiling at the CS site, CS access road and CS construction yard; • Wind action on exposed surfaces; • Vehicle transit on unpaved construction areas, namely the CS site and the CS construction yard (it is noted that the CS access road will be paved).
Underground cable	• Road surface removal, excavation and cable backfilling activities; • Aggregate material handling/stockpiling at the storage areas; • Wind action on exposed surfaces • Vehicle transit on paved areas
HDD work site (Marinella di Selinunte)	• Levelling, compacting and gravelling of the work site • Aggregate material handling/stockpiling • Wind action on exposed surfaces • Vehicle transit on unpaved construction areas
OHL 400 kV line Mlaâbi-Mornaguia	• Land clearing activities, levelling, excavation, grading for the installation of towers's foundations and the needed access roads. • Aggregate material handling/stockpiling • Wind action on exposed surfaces • Vehicle transit on unpaved construction areas

The assessment of impacts associated to dust emissions during the project construction phase was supported by dust emissions estimation and subsequent comparison against emission thresholds set at the National level by the Ministry of the Environment (Decree N°2018-447 of May 18, 2018 and the NT 106-04 Tunisian standard)[2].

- Dust emission estimation methodology

Dust emissions estimation have been performed according to the factors provided by the USEPA in the AP-42 emissions database (reported in Box 3.1) and on available project design data.

Dust emissions have been estimated separately for the construction of the following project elements:

- Mlaâbi CS;
- HVDC Cable;
- HDD worksite at the marine cables' landfall in Kélibia; and
- OHL 400 kV line between Mlaâbi and Mornaguia.

[2] http://extwprlegs1.fao.org/docs/pdf/Tun181274.pdf

Calculations took into account all dust emissions attributable to the Project, with the exception of wind erosion of aggregate storage piles. This is because input data, such as the exact size, shape, surface and height of stockpiles, have not been defined yet at the current stage of project design. It is however noted that stockpiles will be humidified/covered where possible and that the contribution of wind resuspension to the overall construction dust emissions is negligible.

Box 3.1 AP-42 Emission Factors

AP-42 Chapter 13.2.3 Heavy Construction Operations
This general equation has been used to calculate the dust emissions Emission Factor (EF) from scrapers removing topsoil:

$$EF_{TSP} = 5.7\ kg/vehicle\ kilometre\ travelled$$

under the assumption that PM10 represents the 60% of Total Suspended Particle (TSP) emitted the following equation was derived for PM10:

$$EF_{PM10} = 3.42\ kg/vehicle\ kilometre\ travelled$$

AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles
This general equation has been used to calculate emissions from loading and dumping of soil and aggregate material.

$$EF = k \times 0.0016 \times \left(\frac{U(m/s)/2.2}{M(\%)/2} \right)^{1.3}_{1.4} \quad \text{kg/t}$$

Where:

- EF is the emission rate in kg/t;
- *k* = 0.74 for TSP; 0.35 for PM_{10};
- U (m/s) = mean wind speed and
- M (%) = aggregate material moisture content (%)

The above equation is valid if applied within the following ranges of source conditions that were tested in developing the equation: Silt content [%]: 0.44 ÷ 19, Moisture content [%]: 0.25 ÷ 4.8, Wind Speed [m/s]: 0.6 ÷ 6.7 m/s.

AP-42 Chapter 13.2.2 Unpaved Roads
Emissions of PM10 due to vehicles transit on unpaved roads and surfaces were calculated as follows,

$$EF = \frac{0.4536}{1.6093} \times k \times \left(s/12\right)^{a} \left(W/3\right)^{b} \quad \text{kg/VKT}$$

Where:

- EF is the emission rate in kg/VKT
- VKT stands for "Vehicle Kilometre Travelled" and is given by the number of vehicles on site (NU, i.e. number of trips to and from the site) multiplied by the average distance travelled per trip (D)
- *k* is an empirical constant expressed in lb/mile travelled equal to 0.15 for $PM_{2.5}$ and 1.5 for PM_{10}
- *s* is the surface material silt, taken to be 10% for unpaved roads
- *W* is the vehicle gross weight,
- *a* is an empirical constant equal to 0.9
- *b* is an empirical constant equal to 0.45

All roads are subject to some natural mitigation because of rainfall. Annual average emissions are inversely proportional to the number of days with measurable (more than 0.254 mm [0.01 inch]) precipitation.
The effect of natural mitigation can be taken into account as follows:

$$EF_{Natural\ mitigation} = EF\,[(365\text{-}P)/365]$$

Where:

- P: Number of days per year when rainfall >0.254 mm

In order to apply US EPA AP 42 emission factors, details on construction activities are needed, primarily excavation, backfilling and disposal volumes of soil and aggregate materials, timing of dusty activities, characteristics of vehicles transiting on unpaved surfaces. Input data for each contribution to dust emission, are presented alongside the description of the emission estimation (from section 3.1.2.1.1.1 to section 3.1.2.1.1.3).

- Dust emission thresholds

Estimated dust emissions values have been compared against national emission thresholds set at National level by the Decree N°2018-447 of May 18, 2018.

The emissions thresholds (expressed in µg/m3/day), vary according to:

- distance between emission sources and receptor;
- days of PM10 emissions per year;

The thresholds apply only to the concentrations not related to natural events (volcanic eruptions, seismic activity, high winds and atmospheric resuspension or transport of natural particles form desert).

Table 3-3: Limit values and Alert threshold for PM10 and PM2.5 (Decree N°2018-447 of May 18, 2018)

	Limit values		**Alert threshold**
	Daily average over the year (µg/m3)	Annual average (µg/m3)	
PM10	50	40	150*
PM2.5	35	20	-

**as a daily average exceeded during three (3) consecutive days (applied as of January 1, 2021).*

Table 3-4: Limit values for PM10 set by the Tunisian standard NT106-04 and by the WHO

Pollutant	**Permit to exceed**		**Limit value (related to health)** (µg/m3)	**Limit value (related to well-being)** (µg/m3)	**Limit value WHO** (µg/m3)
PM10	Annual arithmetic average	Not allowed	80	40 to 60	15
	24 hours	Once in 12 months	260	120	45

and they should be intended as guidance thresholds, to be conservatively interpreted as follows:

- when PM10 emission values are less than half of the given thresholds, it can be reliably assumed that emissions won't result in exceedances of the EU AQS; whereas:
- when PM10 emission values are above half of the given thresholds, further analysis are recommended such as monitoring during construction and/or atmospheric dispersion modelling studies; lastly:
- when PM10 emission values are above the given thresholds, induced air quality concentration are considered environmentally non-compatible/acceptable.

It is noted that the comparison of project emissions against Tunisian standard emission thresholds, is conservative because PM10 background concentrations in the project areas are expected to be lower than those assumed by Decree N°2018-447 (i.e. 20 µg/m^3).

Table 3-5: Decree N°2018-447 PM10 Emission Thresholds applicable to the Project construction phase adjusted to 8h of emissions per day

Project Elements	Months (1)	Days of PM10 emissions [m]	Emission Thresholds	
			Threshold values (µg/m3)	Description
Mlaâbi Converter substation	8	192	> 150	Non-compatible/acceptable
			50 ÷ 150	Further analysis/mitigations recommended
			< 50	Acceptable impact (in compliance with national standard)
HVDC underground cable	16	384	> 150	Non-compatible/acceptable
			50 ÷ 150	Further analysis/mitigations recommended
			< 50	Acceptable impact (in compliance with national standard)
HDD in Kélibia landfall area	1	24	> 150	Non-compatible/acceptable
			50 ÷ 150	Further analysis/mitigations recommended
			< 50	Acceptable impact (in compliance with national standard)
OHL 400 kV line	24	576	> 150	Non-compatible/acceptable
			50 ÷ 150	Further analysis/mitigations recommended
			< 50	Acceptable impact (in compliance with national standard)
(1) Assuming 24 working days per month *(2) This distance conservatively refers to the portion of the HVDC cable located in the proximity of the landfall area. It is noted that the majority of the HVDC cable is located at greater distances from sensitive receptors*				

3.1.2.1.1.1 Mlaâbi CS

- Topspoil removal/excavation

Dust emissions associated to the topsoil removal have been estimated by applying the factors provided by the US EPA AP-42, Ch. 13.2.3 Heavy Construction Operations (previously reported in Box 3.1).

Key Project data considered in the estimation of dust emissions from topsoil removal are presented in the following Table.

Table 3-6: Key Project data considered in the estimation of dust emissions from topsoil removal

Project Elements	Excavation volumes (m^3)	Days of dust emissions (1)
Mlaâbi Converter substation	155000	192
(1) Derived from the Project timeline, assuming 24 working days per month		

The following assumptions on the scraper were made:

- Digging depth = 0.52 m;
- Bulldozer width = 3.19 m.

Given the above, it results that the scraper works at a pace of 61 m/h, emitting **208 g/h of PM10**.

- Aggregate material handling (stockpile, backfilling load into trucks for disposal)

Dust emissions associated to aggregate material handling have been estimated by applying the factors provided by the US EPA AP-42, Ch. 13.2.4 Aggregate Handling and Storage Piles (previously reported in Box 3.1).

Key Project data considered in the estimation of dust emissions from aggregate material handling are presented in the following Table.

Table 3-7: Key Project data considered in the estimation of dust emissions from aggregate material handling

Project Elements	Excavation volumes (m^3)	Backfilling volume (m^3)		Volumes of soil to be sent for disposal (m^3)	Days of dust emissions (1)
		Soil	Aggregate materials		
Mlaâbi Converter substation	155000	150000	5000	5000	192
(1) Derived from the Project timeline, assuming 24 working days per month					

In addition to the project data presented in the Table above, the following input data were considered:

- Mean wind speed (U) = 3 m/s (average wind speed recorded at the met Station of Castelvetrano in the last three years 2019-2021);
- Aggregate material moisture content (M) = 3 %;
- Soil Density: 1.7 t/m3;
- Aggregate material density: 1.85 t/m^3 ;
- Working hours per day: 8.

Based on the above, the following hourly emissions have been calculated:

- Pick up of removed topsoil and dumping into stockpile (2 handling stages): 163 g/h;
- Dumping of aggregate backfilling material (from quarry) into stockpile (1 handling stage): 3 g/h;
- Backfilling of excavated soil and aggregate backfilling material (from quarry) (material pick up and dumping: 2 handling stages): 163 g/h;
- Pickup of soil to be sent to disposal and dumping into truck (2 handling stages): 5 g/h.

For a total PM10 emission of **335 g/h**.

- Vehicles on unpaved roads/surfaces

Dust emissions associated to vehicle transit on unpaved construction areas/roads have been estimated by applying the factors provided by the AP-42 Ch. 13.2.2 Unpaved Roads (previously reported in Box 3.1).

It is noted that the CS access road will be paved as early as feasible during the construction activities, and that transit of vehicles on unpaved construction areas and construction yard will be limited as much as possible.

For the purpose of the present study, it was conservatively assumed that all vehicles travelling to and from the Mlaâbi CS construction site will transit daily on unpaved surfaces.

Vehicle fleet and related traffic data considered in the estimation of wheel generated dust were derived from the Project traffic figures, and are presented in the following Table.

The unladen vehicles weight was derived from the load capacity, assuming a load capacity share (percentage of empty weight) of 200% for heavy duty trucks, and of 40 % of light duty vehicles (i.e. off road vehicles for the transport of personnel).

Table 3-8: Vehicle fleet and traffic data considered in the estimation of wheel generated dust

Type of vehicles	**N° of trips per day (laden - unladen) (1)**	**Vehicle gross weight [ton]**		
		Unladen	**Laden**	**Average Laden-unladen (2)**
Truck transporting soil to disposal	6	12.75	38.25	25.5
Truck transporting concrete	6	7.65	22.95	15.3
Trucks transporting reinforcement rods	2	10	30	20
Trucks transporting cables	4	12.5	37.5	25
Trucks transporting prefabricated elements	2	12.75	38.25	25.5
Off-road vehicles transporting personnel	10	1.4	2	1.7
(1) In the US EPA 42 equation this value represents “NU”: number of trips to and from the site (2) In the US EPA 42 equation this value represents “W”.				

In addition to the above, the following input data were considered:

- s is the surface material silt, taken to be 10% for unpaved roads;
- D: average distance travelled per vehicle per trip = 0.2 km;
- P: Number of days per year when rainfall >0.254 mm = 85 (average recorded at the met Station of Castelvetrano in the last three years 2019-2021).

The estimation considered the total number trips per day including both unladen vehicles reaching the construction site and laden vehicles leaving the site (NU). Therefore, the average of the laden and unladen vehicle weight was considered in the estimate (W, reported in Table above).

Based on the above, the following hourly emission have been calculated:

- Soil transport to disposal: 108 g/h;
- Concrete transport: 86 g/h;
- Transport of reinforcement rods: 32 g/h;
- Transport of cables: 71 g/h;
- Transport of prefabricated elements: 36 g/h;
- Transport of personnel: 53 g/h.

For a total PM10 emission of **387 g/h**. This estimate takes into account solely the effect of natural mitigations due to annual rainfall.

- PM10 hourly Emission rate – Construction Mlaâbi CS

Topspoil removal/excavation	208 g/h
Aggregate material handling	335 g/h
Vehicles on unpaved roads/surfaces	387 g/h
TOTAL	**930 g/h**

3.1.2.1.1.2 HVDC Cable

- Topspoil removal/excavation

Dust emissions associated to the topsoil removal have been estimated by applying the factors provided by the US EPA AP-42, Ch. 13.2.3 Heavy Construction Operations (previously reported in Box 3.1).

Key Project data considered in the estimation of dust emissions from topsoil removal are presented in the following Table.

Table 3-9: Key Project data considered in the estimation of dust emissions from topsoil removal

Project Elements	Excavation volumes (m^3)	Days of dust emissions (1)
HVDC underground cable	20000	384
(1) Derived from the Project timeline, assuming 24 working days per month		

The following assumptions on the scraper were made:

- Digging depth = 0.52 m;
- Bulldozer width = 3.19 m.

Given the above, it results that the scraper performs the work at a pace of 4 m/h, emitting **13 g/h of PM10**.

- Aggregate material handling (stockpile, backfilling load into trucks for disposal)

Dust emissions associated to aggregate material handling have been estimated by applying the factors provided by the US EPA AP-42, Ch. 13.2.4 Aggregate Handling and Storage Piles (previously reported in Box 3.1).

Key Project data considered in the estimation of dust emissions from aggregate material handling are presented in the following Table.

Table 3-10: Key Project data considered in the estimation of dust emissions from aggregate material handling

Project Elements	Excavation volumes (m^3)	Backfilling volume (m^3)		Volumes of soil to be sent for disposal (m^3)	Days of dust emissions (1)
		Soil	Aggregate materials		
HVDC underground cable	20000	9500	10500	10500	384
(1) Derived from the Project timeline, assuming 24 working days per month					

In addition to the project data presented in the Table above, the following input data were considered:

- Mean wind speed (U) = 10 m/s (the wind intensity is characterized by about 91% of events speeds less than 10 m/s for in Kélibia and Menzel Temime);
- Aggregate material density: 1.85 t/m^3 ;
- Working hours per day: 8.

Based on the above, the following hourly emissions have been calculated:

- Pick up of removed topsoil and dumping into stockpile (2 handling stages): 11 g/h;
- Dumping of aggregate backfilling material (from quarry) into stockpile (1 handling stage): 3 g/h;
- Backfilling of excavated soil and aggregate backfilling material (from quarry) (material pick up and dumping: 2 handling stages): 11 g/h;
- Pickup of soil to be sent to disposal and dumping into truck (2 handling stages): 6 g/h.

For a total PM10 emission of **30 g/h**.

- Vehicles on unpaved roads/surfaces

The HVDC work site will be primarily located on paved road, and the transit of vehicles on unpaved roads/surfaces is not anticipated at this stage of project design.

- PM10 hourly Emission rate – Construction HVDC cable

Topspoil removal/excavation	13 g/h
Aggregate material handling	30 g/h
TOTAL	**43 g/h**

3.1.2.1.1.3 HDD Worksite (marine cables' landfall)

- Topspoil removal

Dust emissions associated to the topsoil removal have been estimated by applying the factors provided by the US EPA AP-42, Ch. 13.2.3 Heavy Construction Operations (previously reported in Box 3.1).

Key Project data considered in the estimation of dust emissions from topsoil removal are presented in the following Table.

Table 3-11: Key Project data considered in the estimation of dust emissions from topsoil removal

Project Elements	Excavation volumes (m^3)	Days of dust emissions (1)
HDD in Kélibia landfall area	100	24
(1) Derived from the Project timeline, assuming 24 working days per month		

The following assumptions on the scraper were made:

- Digging depth = 0.52 m;
- Bulldozer width = 3.19 m.

Given the above, it results that the scraper performs the work at a pace of 0.31 m/h, emitting **1 g/h of PM10**.

- Aggregate material handling (stockpile, backfilling load into trucks for disposal)

Dust emissions associated to aggregate material handling have been estimated by applying the factors provided by the US EPA AP-42, Ch. 13.2.4 Aggregate Handling and Storage Piles (previously reported in Box 3.1).

Key Project data considered in the estimation of dust emissions from aggregate material handling are presented in the following Table.

Table 3-12: Key Project data considered in the estimation of dust emissions from aggregate material handling

Project Elements	Excavation volumes (m^3)	Backfilling volume (m^3)		Volumes of soil to be sent for disposal (m^3)	Days of dust emissions (1)
		Soil	Aggregate materials		
HDD in Kélibia landfall area	100	0	-	100	24
(1) Derived from the Project timeline, assuming 24 working days per month					

In addition to the project data presented in the Table above, the following input data were considered:

- Mean wind speed (U) = 10 m/s (the wind intensity is characterized by about 91% of events speeds less than 10 m/s for in Kélibia and Menzel Temime);
- Aggregate material density: 1.85 t/m^3 ;
- Working hours per day: 8.

Based on the above, the following hourly emissions have been calculated:

- Pick up of removed topsoil and dumping into stockpile (2 handling stages): 1g/h;
- Pickup of soil to be sent to disposal and dumping into truck (2 handling stages): 1g/h.

For a total PM10 emission of **2 g/h**.

- Vehicles on unpaved roads/surfaces

Dust emissions associated to vehicle transit on unpaved construction areas/roads have been estimated by applying the factors provided by the AP-42 Ch. 13.2.2 Unpaved Roads (previously reported in Box 3.1).

It is noted that the HDD worksite is not going to be paved. However, the number of vehicles transiting on the unpaved construction site is expected to be extremely limited, as the main construction activities to be carried out include the topsoil removal and deployment and installation of machinery.

For the purpose of the present study, it was assumed that one heavy duty vehicle per day will transit on unpaved surface, travelling an average distance of 0.1 km (the HDD working site covers an area of 1220 m^2). Vehicle fleet and related traffic data are presented in the following Table.

Table 3-13: Vehicle fleet and traffic data considered in the estimation of wheel generated dust

Type of vehicles	**N° of trips per day (laden - unladen) (1)**	**Vehicle gross weight [ton]**		
		Unladen	**Laden**	**Average Laden-unladen (2)**
Heavy duty truck	1	12.75	38.25	25.5
(1) In the US EPA 42 equation this value represents “NU”: number of trips to and from the site (2) In the US EPA 42 equation this value represents “W”:				

In addition to the above, the following input data were considered:

- s is the surface material silt, taken to be 10% for unpaved roads;
- D: average distance travelled per vehicle per trip = 0.1 km;
- W: the average of the laden and unladen vehicle weight was considered in the estimate (W, reported in Table above);

Based on the above, the following hourly emission has been calculated taking into account solely the effect of natural mitigations due to annual rainfall: 9 g/s.

- PM10 hourly Emission rate – HDD Worksite

Topspoil removal/excavation	1g/h
Aggregate material handling	2 g/h
Vehicles on unpaved roads/surfaces	9 g/h
TOTAL	**12 g/h**

3.1.2.1.1.4 OHL 400 kV Mlaâbi Mornaguia

Due to the lack of technical data for this part of the Project, we have considered the same emission rate for the HDD works in Kélibia landfall area, this value concerns each tower and its associated activities (vehicles movement, opening of access roads, etc.).

3.1.2.1.1.5 Comparison against Emission Thresholds and assessment of impacts magnitude

The following Table shows the comparison of estimated dust emissions with applicable emission thresholds set at National level.

Table 3-14: Estimated dust emissions during construction activities

Project Elements	Tunisia Emission Thresholds		Project PM10 hourly Emission rate (1) [g/h]
	Threshold values [g/h]	Description	
Mlaâbi Converter substation	> 150	Non-compatible/acceptable	930
	50 ÷ 150	Further analysis/mitigations recommended	
	< 50	Acceptable impact (in compliance with national standard)	
HVDC underground cable	> 150	Non-compatible/acceptable	43
	50 ÷ 150	Further analysis/mitigations recommended	
	< 50	Acceptable impact (in compliance with national standard)	
HDD in Kelibia (marine cables' landfall)	> 150	Non-compatible/acceptable	12
	50 ÷ 150	Further analysis/mitigations recommended	
	< 50	Acceptable impact (in compliance with national standard)	
OHL 400 kV Mlaâbi Mornaguia	> 150	Non-compatible/acceptable	12
	50 ÷ 150	Further analysis/mitigations recommended	
	< 50	Acceptable impact (in compliance with national standard)	
(1) Estimated dust emissions in absence of specific abatement measures. This estimate takes into account solely the effect of natural mitigations due to annual rainfall			

Estimated dust emissions in absence of specific abatement measures are not expected to lead to exceedances of the Tunisian standard relatively to the construction of the underground cables and HDD at the marine cables 'landfall and tower foundation and construction for the OHL line. Further analysis/mitigations are instead recommended for dust emissions associated to the construction of the Mlaâbi CS and the OHL 400 kV line.

Given the above, the **intensity** of impacts has been overall classified as **moderate.**

Dust emissions will be mostly released in the proximity construction areas; these emissions are released low to the ground and are characterized by a low buoyancy and low dispersion; they typically do not reach distances greater than 1 km from the emissions sources. Thus their impacts is expected to be extremely localized (**low Spatial extent)**.

Duration of impacts is also expected to be **low**, given that construction phases and more specifically dust production activities will be both intermittent and limited in time.

Overall the magnitude of impacts induced by diffuse dust emissions during the project construction phase has been conservatively classified as **Moderate**.

Air quality – Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in atmospheric concentration of Particulate Matter induced by dust diffuse emissions	Moderate	Low	Low	Moderate

3.1.2.1.2 Exhaust emissions

Exhaust emissions are those emissions released by combustion sources and include:

- Exhaust emissions from heavy equipment (e.g. bulldozers, graders, rollers,) and engine-driven machinery (e.g. drilling machines, pumps etc.) involved in the construction activities;
- Exhaust emissions from light and heavy duty vehicles travelling to and from the construction sites (induced traffic emissions).

The pollutants generated from these emission sources primarily include: nitrogen oxides (NO_X) and carbon monoxide (CO) and Particulate Matter (PM) and secondarily Sulphur dioxide (SO_2) and VOC.

Table 3-15: Heavy equipment and machinery involved in the Project construction phase

Project Elements	Sources of Exhaust Emissions
Mlaâbi Converter Station	Material handling • Lift trucks • Truck Excavation of foundations • Small excavator Metalwork • Circular saw • Tower crane Iron processing • Iron cutter • Tower crane Iron Laying • Tower crane Installation blocks • Tower crane Casting of concrete • Concrete pump • Concrete truk
Cables (HVDC and CC)	• Wheeled excavator • Wheeled mechanical shovel • Medium truck
HDD work site	• Horizontal drilling • Forklift
OHL 400 kV Mlaâbi Mornaguia	• Same as for CS

Table 3-16: Induced traffic volumes during the Project construction phase

Project Elements	Type of vehicles	N° of one way trips to and from the site per day	N. Days
Mlaâbi Converter Station	Truck transporting soil to disposal	6	111
	Truck transporting concrete	6	704
	Trucks transporting reinforcement rods	2	80
	Trucks transporting cables	4	720
	Trucks transporting prefabricated elements	2	540
	Off-road vehicles transporting personnel	10	840
	TOTAL	**30**	**-**
HVDC Cable	Trucks transporting soil to disposal	8	175
	Trucks transporting concrete	4	436
	Trucks transporting reinforcement rods	4	36
	Trucks transporting reels and operating machines	2	21
	Off-road vehicles transporting personnel	16	440
	TOTAL	**34**	**-**
HDD worksite	Heavy duty truck	1	24
	TOTAL	**1**	-
OHL 400 kV Mlaâbi Mornaguia	Heavy duty truck	*	*
	TOTAL	*****	*

- Exhaust emissions from heavy equipment and machinery

Construction activities involving the use of engine driven vehicles and machinery will be limited in time. Moreover, vehicles and machinery needed for the construction activities will not run continuatively within the construction period nor at full power. As a consequence, emissions of airborne pollutants will be intermittent, and lead to impacts of **low duration**.

Exhaust emissions will be mostly released in the proximity of construction areas; these emissions are released low to the ground and are characterized by a low buoyancy and low dispersion; they typically do not reach distances greater than 1 km from the emissions sources. Thus their impacts is expected to be extremely localized (**low Spatial extent)**.

In light of the temporary nature of the emission sources and their limited dispersion and with due consideration to existing baseline levels, exhaust emissions related to the Project construction phase are considered to result in **negative impacts** of **low Intensity**.

The magnitude of impacts induced by exhaust emissions during the project construction phase is therefore classified as **Low**.

- Exhaust emissions from traffic

Traffic emissions will be limited in time, as vehicles will not run continuatively to and from the site nor at full power. As a consequence, emissions of airborne pollutants will be both intermittent and temporary. Given the above, traffic emissions are unlikely to cause noticeable increase in background concentration of pollutants over long term periods (i.e. annual average), and expected impacts are of **low duration**.

Traffic emissions will be released along existing roads used to access the construction site and vehicles routes will vary depending on the exact departure and destination of each trip. For the underground cables construction vehicles route might vary depending on the exact stretch of cable being built, whereas for the Mlaâbi CS construction all vehicles will insist on the CS access road while accessing and leaving the site. HDD operation at the marine cables' landfall will induce very limited traffic volumes, as the main construction activities to be carried out include the topsoil removal and deployment and installation of machinery.

Construction activities for the OHL line will entail the use of several vehicles and machinery, which are expected to affect the ambient air quality by the emissions of pollutants, such as SOx, NOx, CO. These particles could affect visibility create smog and damage health of workers and peoples living near the AIO of the Project. Nevertheless, we expect that emissions will be low and will not exceed the limit values fixed by the Ministry of Environment.

Exhaust emissions are released low to the ground and are characterized by a low buoyancy and low dispersion, with impacts decreasing rapidly at increasing distances from the road kerbside.
In light of the above potential impacts are expected to be extremely localized (**low Spatial extent)**.

As a consequence, impacts intensity and in turn magnitude are classified as **Low**.

Air quality – Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in atmospheric concentration of macro pollutants (primarily NOx and CO) induced by exhaust emissions	Low	Low	Low	Low

3.1.2.1.3 Impact Significance

Air quality – Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Increase in atmospheric concentration of Particulate Matter induced by dust diffuse emissions	Moderate	Moderate	Moderate
Increase in atmospheric concentration of macro pollutants (primarily NOx and CO) induced by exhaust emissions	Moderate	Low	Low

3.1.2.2 Mitigation Measures

At the current stage of project design, the following **design measures** resulting in prevention of air quality impacts, are anticipated:

- Project layout definition and siting of new facilities aimed at ensuring that no direct impact on sensitive receptors occur (e.g. CS siting, cable route definition mostly on existing roads);

- Use the best available technologies for the equipment and machineries used during construction phase.

The Project will implement the following **mitigations measures specific for the management of diffuse dust emissions:**

- Watering unpaved surfaces to reduce wheel generated dust, especially in dry periods. Watering increases the moisture content, which conglomerates particles and reduces their likelihood to become suspended when vehicles pass over the surface. The control efficiency depends on how fast the road dries after water is added, which in turn depends on the watering frequency, quantities of water being used, traffic figures and local meteorological conditions. Depending on this factors, the PM10 abatement associated to watering might vary from 10% up to 74 % (WRAP Fugitive Dust Handbook).
- Vehicle speed limited to 40 km/h, reduced to 15-20 km/h on the construction site, to minimise dust generated by the transit of vehicles on unpaved construction areas; according to relevant literature (WRAP Fugitive Dust Handbook) this measure guarantees a PM10 control efficiency (or abatement factor) of 44%.
- Covering/humidifying of materials that can be transported by wind (e.g. topsoil, aggregate) where possible; this measure allow to abate by 90% dust resuspension caused by winds on active stockpiles (WRAP Fugitive Dust Handbook).

  Considering the PM10 control efficiency associated to the above measures, the mitigation and prevention possibilities for dust emissions are classified as “High” in the present assessment.

The Project will adopt the **following best practices for the management of temporary emissions of exhaust gases**:

- Use of best available technologies for equipment and machineries;
- Regular maintenance and inspection of the generators will be performed in accordance with manufacturer instructions: this action will help to avoid unnecessary pollutants emissions through early detection operation;
- Vehicles and machinery will be turned off when not in use.
- In case of using SF6 as a gas insulator for some equipment in the Mlaâbi CS, the EPC company must only use equipment with low leakage rate in order to prevent any potential risk of SF6 emission.
- All stockpile materials with high risk to produce airborne dust will be covered, in particular during windy periods;
- Monitoring actions would be undertaken for air quality parameters in case the value exceeds the limit value fixed by the Tunisian standard and the standards of WHO.

All workers and persons located in the AIO of the Project, in particular those who are directly influenced by the construction activities (Sidi Jamel Eddine and other nearby residential areas crossed by the OHL line) will be informed about the start of construction works and all potential pollutants emissions.

The above measures are aimed at preventing exhaust atmospheric emission and at ensuring emissions aligned with vehicles and equipment technical specifications. Given the above, mitigation and prevention possibilities for exhaust emissions have been classified as “**Low**”.

Air quality – Construction Phase	
Impact	**Mitigation and prevention possibilities**
Increase in atmospheric concentration of Particulate Matter induced by dust diffuse emissions	High
Increase in atmospheric concentration of macro pollutants (primarily NOx and CO) induced by vehicles exhaust emissions	Low

3.1.2.3 Residual Impacts

As presented in the following table, the residual significance of impacts on local air quality during the project construction phase would be **low**, especially with the implementation of the proposed mitigation measures to reduction dust generation and the exhaust emissions.

Air quality – Construction Phase					
Residual impacts significance					
Impact	**Sensitivity**	**Magnitude**	**Significance (prior to mitigations)**	**Mitigation and prevention possibilities**	**Impact significance after mitigation**
Increase in atmospheric concentration of Particulate Matter induced by dust diffuse emissions	Moderate	Moderate	Moderate	High	Low
Increase in atmospheric concentration of macro pollutants (primarily NOx and CO) induced by vehicles exhaust emissions	Moderate	Low	Low	Low	Low

3.1.3 Operation Phase

3.1.3.1 Potential impacts

The project operation phase will not cause any continuous release of airborne pollutants into the atmosphere. In particular, the Mlaâbi CS equipment do not produce channelled atmospheric emissions, moreover being the station remotely operated, there will not be daily traffic emissions associated to the transport of personnel to and from the site.

The operation of the OHL transmission line will not contribute to any possible atmospheric emissions. The only sources of discontinuous atmospheric emissions under normal operative conditions are attributable to the project regular maintenance, which involves the use engine driven vehicles and/or machinery with consequent exhaust emissions. In addition potential fugitive emissions of SF6 contained in the transformers insulating oil. With regard to the latter, best available technologies and equipment will be used to ensure fugitive and accidental releases are kept as low as feasible. Moreover regular test and verifications will be carried out in order to identify potential leaks and maintenance procedure aimed at preventing accidental releases during maintenance will be developed and implemented.

In case of emergency (equipment failure, CS shut-down) engine driven emergency generator will be initiated, with consequent temporary release of exhaust emissions into the atmosphere.

Considering the above, no noticeable impacts (**no impact**) on air quality related to the project.

3.2 Geology, geomorphology and soil

The following Table provides a brief overview of the potential impacts induced by the Project on geology, geomorphology and soil.

Table 3-17: Geology, geomorphology and soil– Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
• Erosion and topsoil loss due to land clearing and vegetation removal, in particular for the OHL part at tower foundations/excavations and along access roads. The vegetation removal will expose soil to precipitation and run-off makes land subject to erosion. • Potential soil contamination (potential temporary contamination of soil by hazardous and non-hazardous spill, and contamination of soil by hazardous and non-hazardous waste). • Potential soil disturbance and degradation (compaction of soils, modification of morphology, soil erosion) due to machinery operations (movement of vehicles and equipment) • Landslides as a result of the vegetation removal and the installation of towers.	• Potential contamination of soil with wastes produced by the Partanna CS operation • Landtake • Ground disturbances and damage on land in case of towers failures, if they are installed on weak foundation rock	As Construction Phase.

3.2.1 Definition of Sensitivity

➢ *Existing regulation and guidance*

Humans, flora and fauna can be adversely affected by diffusion of pollutants in the soil and subsoil by soil ingestion, dermal contact, indoor and outdoor inhalation of dust or vapours. In response, regulations in force at both national and international level set soil and subsoil quality standards for the protection of human health and environmental quality for several potential pollutants present in the soil or the subsoil after potentially polluting occurrences. At a national level, there are many laws and decrees related to the prevention of pollution, management of liquid and solid waste, in particular the Law N°96-41 of June 10, 1996 regarding the control and management of waste.

In addition, the installation of tower foundations will need the removal of topsoil from the footprint of each tower and the same for the converter station of Mlaâbi, where some excavation may be required to build it. The excavation activities will generate e up to several cubic meters of topsoil and spoil at each tower location and some amount at the substation. Without appropriate storage and protection, soil can erode and damage other land in the AOI of the Project. As a result, agricultural land and residential area may be subject to more flooding and erosion hazards. At the national level, the Tunisian regulation in terms of protection of agricultural

land include the Law N83-87 which aims to protect these lands from urbanization and the Law N95-70 of July 17, 1995 regarding the conservation of soil and water resources.

Regarding land consumption, in 2015 the UN Sustainable Development Goals (SDGs) of the Global Agenda to be achieved by 2030 included ensuring that land consumption does not exceed population growth. Achieving this goal clearly requires regulatory acts effective that can direct toward a rapid containment of land consumption.

The slope of the land where construction activities will take place is a key factor to determine the sensitivity of the area in terms of erosion and landslide risks. Based on data described in the Environmental baseline section, the OHL line will cross some areas with moderate and steep slope, in particular in El Mida, Menzel Bouzelfa and Grombalia delegations. Some areas, where towers and access roads to be installed, may be subject to erosion or landslide.

Given the above, "*existing regulation and guidelines*" has been classified as *"**Moderate**".*

- *Societal Value*

In general, soil and subsoil quality are deemed of relevant societal value given its direct influence on human health and activities such as agriculture. At local scale, the Project AoI is mostly rural and sparsely populated, with many settlements being in the marine cables' landfall area and also in some sites crossed by the OHL component (Beni Khalled, Grombalia, etc.).

The project itself also affects areas already characterized by the presence of man-made infrastructure for the laying of cables, involving more valuable lands, dedicated to agriculture, in particular between Menzel Bouzelfa, Beni Khalled and Grombalia, where some prohibited areas (irrigated perimeters, citrus plantations, forest land subject of the Forest Code).

Project activities in the landfall area (Kélibia) can affect the coastal dune, which are a protected area covered by the Law N°95-73 of July 24,1995 related to the maritim public domain (Domaine Public Maritime DPM in french) and the Decree N°2014-1847 of May 20, 2014 regarding the temporary occupation of the DPM domain.

A moderate number of people are therefore expected to be impacted by the Project; considering the above "*societal value*" has been classified as *"**Moderate**".*

- *Vulnerability for change*

The greatest vulnerability relatively to geology, geomorphology and soil is found at the Mlaâbi station and at the marine cables' landfall, where "natural" soils, used for agricultural activities or uncultivated, will be affected by the Project; the cables will instead be laid primarily on existing roadways, hence without soil removal.

For the OHL component, the project activities may affect geology and soil resources due to land clearing and vegetation removal, and excavation works for tower foundations and substation.

Therefore, considering that the majority of Project will be developed on existing roadways, the "vulnerability for change" has been classified as "*Low*".

Overall the Sensitivity of the receptor "geology, geomorphology and soil" is classified as ***Low.***

Geology, geomorphology and soil			
Characteristics of sensitivity			
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	**Sensitivity**
Moderate	Moderate	Low	Moderate

3.2.2 Construction phase

3.2.2.1 Potential impacts

During the Project construction, potential impacts on soil and subsoil quality are primarily related to the following activities:

- Use of vehicles and heavy machinery, site preparation and set up of worksites, HDD activities and production of wastes potentially resulting in accidental spills of hazardous and non-hazardous material on soil;
- Occupation of soil by equipment and machinery with limitation of soil functionalities (habitat, human activities, landscape), increase of waterproof surface and soil loss.
- Land clearing and vegetation removal along access roads and at towers foundations for the OHL component and at the converter station of Mlaâbi, excavation, transit of heavy machinery and presence of construction equipment potentially resulting in soil disturbance and degradation such as erosion and compaction;

It is important to note that existing public roads will be used during the construction phase and if needed other additional access roads will be developed in order to provide access to heavy equipment in the area crossed by the OHL line.

The above activities might induce the following potential direct negative impacts on soil and subsoil quality, assessed hereinafter:

- Potential soil and subsoil contamination (namely alteration of soil and subsoil quality characteristics);
- Soil disturbance and degradation (erosion, modification of morphology, compaction);
- Land Take.

3.2.2.1.1 Potential soil and subsoil contamination

During the Project construction phase soil may potentially be polluted by accidental fuel spills from machinery and vehicles, metalworking and welding residues (at the Mlaâbi CS and at the AOI of the OHL part) and accidental spillage of wastes and effluents.

With regard to potential spill of hazardous materials, it is noted that the Project construction does not involve the handling of substances or materials particularly harmful to the environment as produced waste consist primarily of excavated soil not suitable for backfilling.

Phenomena of soil and subsoil contamination due to accidental fuel spills from machinery and vehicles used during construction are considered highly unlikely, given that all suitable precautions to avoid such situations will be put in place (primarily regular maintenance of equipment and machinery). The presence of workers during the construction phases will generate effluent (grey water, liquid waste, etc.) that can present a contamination risk for soil resources.

Potential contaminations associated to welding and metalworking considered negligible.

With regard to accidental spills of wastes, the Project construction will primarily produce the following type of wastes:

- Soil not suitable for backfilling purposes, according to the figures reported in the Table below;

- milled asphalt produced during the construction of underground cables, which will be built on existing roadways;
- Drilling fluids (bentonite sludge) and cuttings associated to HDD operation, primarily at the landing area for the construction of the land-sea joint hole. Minor HDD interventions might also be required along the underground cable route, to overcome potential obstacles.
  During horizontal drilling, drilling fluid might leak into soft or fractured underground formations with consequent potential subsoil contamination. However, subsoil contamination by leakage of drilling mud can be reasonably considered an unlikely event given that adequate mud management will be put in place during and drilling operation (see section 3.2.2.2 on mitigations for further details)
- Excavation activities and opening borrow pits for material to be used for the installation of towers: if the volume of spoil generated at the tower foundations is not enough for the stabilization and restoration of site or if the spoil generated is not suitable for backfilling purposes (as indicated in the Table below), the solution is to bring suitable deposits (rock and spoil) from other regions/sites. Without any proper management and restoration actions in borrow pits, excavated materials can be a source of pollution for the environment.

Table 3-18: Volumes of soil and milled asphalt sent to disposal

Project Elements	**Volumes of soil to be sent for disposal (m^3)**	**Milled asphalt (m^3)**
Mlaâbi Converter substation	5000	-
HVDC underground cable	7000	3650
Kélibia HDD	100	-
OHL 400 kV Mlaâbi-Mornaguia	-	-

All wastes listed above will be sent to disposal and managed in accordance with national legislation in force and applicable international standards. Particular attention will be given to the characterisation of excavated soil and to the management and disposal of drilling muds and cuttings as reported in the mitigation/management measures section below.

Certain site materials (construction supplies, fuels, etc.), when stored in unprepared areas (without any protection from rainwater and wind), can contaminate the soil and agricultural land. Such environmental risks are directly associated to the non-respect of product storage rules as well as to an inadequate management of the site and its equipment.

Considering the accidental nature of potential soil contamination and the nature of potential spills, and taking into account standard design measures to prevent accidental soil pollution implemented by the Project, the intensity of the impact is considered ***negligible***.

The extent of the potential soil and subsoil contamination is expected to be **low**, as well as the duration, limited to the construction phase and more specifically to the potentially contaminating activities.

Overall, the impact magnitude is ***negligible***.

Geology, geomorphology and soil– Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Potential soil and subsoil contamination	Negligible	Low	Low	Negligible

3.2.2.1.2 Potential Soil Disturbance and Degradation

During the onshore construction works potential soil disturbance and degradation might arise primarily during the construction of the Mlaâbi CS.

For the TUNITA part of the project, the underground cable and its related working sites are located for the most part on existing roads (from the industrial zone of Menzel Yahia to the Tafekhsite river section to lead the Mlaâbi CS) and all machinery involved in the construction activities and goods, wastes and personnel transport to and from the site will also insist on existing roadways. Given the above, the construction of underground cables is not expected to interfere with surface soil.

The HDD worksite, which will be done on an empty land (industrial zone of Menzel Yahia), has a very limited spatial extension (approximately 1200 m^2), traffic to and from the site will be limited to the installation of drilling equipment and related utilities, and the site will be completely restored after the construction of the land-sea joint hole.

The Mlaâbi CS construction includes removal of existing vegetation (annual crops), earthmoving, levelling of the CS construction area and subsequent excavation and back-filling with re-profiling of the ground around the CS. Vegetation removal, levelling and paving works will also take place for the construction of the construction yard. Construction activities will use the existing roads that link the proposed industrial zone of Mlaâbi to the city of Menzel Temime.

For the installation of electrical equipment both masonry interventions and prefabricated will be built on site. These interventions are aimed at containing the electrical equipment, support the electromechanical equipment, act as a foundation for the station machinery, allow for the system's viability, and regulate the water (rainwater or water from services). For their realisation, given the good mechanical characteristics of the soils on site, superficial foundations, characterised by the creation of shallow excavations are anticipated at the current stage of Project Design.

The setting up of the construction site and the transit of heavy vehicles may lead to soil compaction, with soil deterioration impairing biological processes. It is noted that the CS site will be mostly paved as well as the CS access road, whereas the CS construction yard is not expected to be paved and will be restored after construction.

In particular, the Mlaâbi CS will affect permanently an area of 100 000 m^2, currently covered by an annual crops (maize to produce fodder for animal alimentation). The total area will be paved except the CS temporary construction yard (10 000 m^2).

Construction activities of the OHL line can disturb the geology and soil resources, potential impacts include the following:

- Land clearing and vegetation removal under the line corridor and at tower foundations and along road access to build. These activities may increase erosion and topsoil loss and expose the soil to precipitation and run-off, causing loss of topsoil and soil fertility, in particular on moderate and steeper slopes (areas located between Beni Ayech and Errahma, Khanguet El Hojjej and the whole section crossing the area between Grombalia and Mornag). Any Loss of topsoil and soil fertility can negatively affect soil productivity and therefore impact the agricultural sector very present in the AOI of the OHL

line, especially for citrus areas (Menzel Bouzelfa and Beni Khalled), olive plantations (Grombalia) and cereal zones (flat areas between Menzel Temime and El Mida, and in Zaghouan and Manouba). Without any mitigation measures, project activities can affect people's livelihoods.

- Excavation activities are necessary during the installation of tower foundations: in each tower location, it will be necessary to remove topsoil. The generated volume of topsoil and soil (several cubic meters) must be properly stored and protected in order to avoid disturbing other surrounding areas, considered undisturbed prior the construction phase.
- Under specific conditions, the installation of towers and the presence of heavy equipment and machinery could produce landslide. This risk can occur mainly in steep terrain, on river banks and on unstable slopes of crossed hills, where the construction activities can cause local landslides, debris flows and boulder falls.
- Machinery operations and movement of vehicles during the construction phase can lead to soil compaction and can increase the loss of soil fertility impeding vegetation recovery, in particular during rainy periods. These activities can also disturb soil and raise erosion risk in the project area.

The intensity of OHL construction activities is moderate because the duration of such works is limited to the tower footing area and its roads access. Thus, the impact of the construction of towers is considered as low, on condition that the following mitigation measures are adopted by the company in charge of the construction phase.

In light of the above the intensity and spatial extent of impacts is classified as Low and the duration, relatively to the sole construction phase, as Moderate.

Overall, the magnitude of impact is classified as ***Low***.

Geology, geomorphology and soil– Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Potential soil disturbance and degradation	Low	Low	Moderate	Low

3.2.2.1.3 Landtake

Soil is a non-renewable resource that performs many vital functions: food and other biomass production, storage, filtration and transformation of many substances including water, carbon, and nitrogen. Soil has a role as a habitat and serves as a platform for human activities, landscape and heritage and acts as a provider of raw materials. For this reason the occupation of soil is considered as a potential impact.

During the construction phase, land will be taken (soil loss) for:

- OHL access roads and construction yards;
- HDD temporary worksite;

No land take is associated to the construction of underground cables given that both cables and related working site will be primarily located on existing roadways.

Construction phase – Landtake	**m^2**
Mlaâbi CS Site	100 000
Mlaâbi CS construction yard	10000
HDD construction site	1200
OHL 400 kV Mlaâbi-Mornaguia	52 000

For the OHL line, the evaluation of the landtake is based on the following estimation: total number of towers along the line route, considering one tower every 450 meters and with a 14*14 m as a right of way (i.e. 196 m2 as the total footprint for each tower).

In light of the above the intensity and spatial extent of impacts are classified as Low and the duration, relatively to the sole construction phase, as Moderate.

Overall, the magnitude of impact is classified as ***Low***.

Geology, geomorphology and soil– Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Landtake	Low	Low	Moderate	Low

3.2.2.1.4 Impact Significance

Geology, geomorphology and soil– Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Potential soil and subsoil contamination	Low	Negligible	Negligible
Potential soil Disturbance and degradation	Low	Low	Low
Landtake	Low	Low	Low

3.2.2.2 Mitigation Measures

At the current stage of project design, the following **design measures** and **operational/management procedures** for the prevention of soil and subsoil impacts during construction, are anticipated:

- Operational procedure to prevent and manage potential soil and subsoil contamination:
  - Availability on site of emergency response kits (liquid suction pumps, biodegradable material for absorbing liquid petroleum derivatives, containment barriers, containers for absorbing drips, materials for sealing leaks, etc.);
  - Tanks, cisterns, drums for storing fuel, oil and waste will be in compliance with the law and located on an impermeable surface.
  - Use the best available technologies for the equipment and machineries and periodic maintenance of the equipment and machineries during construction phase in order to prevent accidental fuel spills.
  - Adequate management of excavated soil, part of which constitute a waste:
    - Soil stockpiles will be located in adequate areas, properly sign posted;
    - Avoid/minimize run-off from stockpiles by covering and or grassing;
    - In case of soil contamination, soil will be stocked on suitable impermeable surfaces;
    - Soil to be sent to disposal will be stocked separately from the soil to be used for backfilling;
    - Re-use of topsoil for restoration; appropriate storage and management of removed topsoil (e.g. limit stockpile height, grassing for storage longer than 2 years) in order to allow for its reuse.
  - Waste management procedure

- All materials, classified as waste, will be grouped by homogeneous categories in the 'site area and properly identified pending characterization and possible transfer to a suitable recovery or disposal facility, in accordance with national legislation in force and applicable international standards;
- Segregation of hazardous and non-hazardous waste and provision of adequate containers for each category.
- Implement a construction equipment/material inventory management system in order the minimize the oversupply of materials within the project area. This type of surveillance activities can minimize waste volumes and the presence of potential pollutants.
- Presence of first rain tank and de-oiling tank for the collection and separation of run-off waters.
- Ensure regular surveillance of any spillage on nearby proprieties: land filling must be restricted within the boundary of project's activities (HDD site, CS area and locations of towers foundations).

  - Drilling and drilling mud management procedures to prevent both soil and subsoil contamination
    - Preparation, storage, recovery and treatment of drilling mud in sealed metal tanks;
    - recovery and disposal of the sludge, by pumping the sludge onto a special truck for transport to the landfill
    - recovery of the waste material present in the mud in a special area, and periodical disposal.
    - Working pressure control: drilling will be conducted so that the pressure within the borehole cannot induce higher percussions to the surrounding soil than present.
    - Fluid flow monitoring: during drilling, continuous observation of fluid return flows is conducted, monitoring the ratio of return flows at the inlet and outlet, as well as the quality of the return flows themselves. Regular monitoring allows early detection of any fluid leakage.
    - Pressure-related calculations: pressure calculations are carried out at each section of the TOC before drilling operations begin in order to estimate the maximum allowable flow rates for the pump. These calculations are based on the drilling equipment, circulation pump, and other technical aspects.
    - Pressure monitoring: during drilling, the actual mud pressure is monitored by comparing theoretical and practical pressure levels. It will be possible to react immediately by reducing the pump flow rate, withdrawing the drill column, or carrying on drilling.
    - Pressure sensors: pressure sensors will be installed in the steering tool, which will measure the mud pressure in the borehole ring. Such sensors are specially designed for soft geological formations and help, very effectively, to prevent the occurrence of spills. A rapid increase in pressure in the ring can be observed by monitoring sensor readings and thus preventing a collapse of the borehole. Readings can also provide early warning of a mud system failure.
    - 16" sheath pipe in the borehole inlet area: The 16" sheath pipe is installed for about 200 m in length in order to prevent fluid loss in this particularly soft geological section. The length of sheath pipe installed depends on the surveys performed during pilot drilling.
    - Supervision of the workpath: The path of the borehole is regularly monitored by walking surveys or by special means (in case of crossing navigable rivers using a boat with a properly instrumented outboard motor).

- Procedure to manage and prevent potential soil disturbance and degradation during construction:
  - Creation of excavations with appropriate slopes to keep the excavation face safe.
  - The existing road system will be used for site access;

- Latest-generation machines will be used, where possible, which will allow the same work to be carried out as in the past by larger machines using more compact vehicles.
- Temporary construction yards will be restored (i.e. the CS construction yard, the HDD construction yard as well as additional construction/storage yards in support of the underground cables construction whose location has not been defined yet at this stage of Project design). All materials and paving will be removed. Prior to proceeding with the restoration of agricultural land, a deep harrowing of the soil will be carried out in order to remove the compacted layer generated by the loads induced by the work site activities.

- As indicated in the Project Description chapter, the contractor company in charge of the construction phase have to select the final location of all towers, which will help identifying the exact line route and the needed access roads. With these data (final design of the OHL part), the company should conduct more surveys in order to identify areas with high risk of erosion, geological hazards (landslide) before choosing the location of tower foundations. This work can help to avoid areas at risk and reduce erosion and landslide hazards.

With regard to potential risks of stability of the excavations, it is noted that these will be addressed during the following stages of Project design, by means of specific geognostic surveys aimed at:

- determining the geotechnical characteristics of the foundation soils;
- check the stability of the walls of the excavations and design accordingly any construction site preparations for the support of the excavations;
- define the characteristics of the foundation works.

3.2.2.3 Residual Impacts

The project design plans the implementation of the above mentioned standard measures and management plans to prevent potential impacts on geology, geomorphology and soil. These measures, being an integral part of the Project, were taken into account in the performed impact assessment.
Moreover, the analysis did not highlight the need for further specific mitigations to offset significant adverse effects, therefore, the significance of residual impacts is equal to the one presented in Section 3.2.3.1.3.

3.2.3 Operation phase

3.2.3.1 Potential impacts

During operation phase, potential impacts on geology, geomorphology and soil are attributable to the presence and operation of the Mlaâbi CS and the OHL 400 kV Mlaâbi-Mornaguia transmission line potentially resulting in the following direct negative impacts:

- Potential contamination of soil with solid and liquid waste;
- Soil compaction due to vehicular movement during maintenance activities.
- Landtake.

3.2.3.1.1 Potential soil and subsoil contamination

During the operation phase, potential soil and subsoil contamination at the Mlaâbi CS and the area crossed by the OHL 400 kV line (at tower locations) might occur in case of accidental spill of wastes (primarily first rainwaters and oily waters).

Accidental fuel spills from vehicles travelling to and from the site are deemed extremely unlikely since the CS will be remotely controlled and induced vehicle traffic in the area is anticipated to occur solely in the event of a breakdown or scheduled maintenance.

The operation of the Mlaâbi CS provides for appropriate management of water discharges, such as to exclude the accidental soil and subsoil pollution. In particular, as previously reported in the Project Description, the CS will be equipped with the following drainage systems:

- Drainage system of the CS areas not occupied by installations, providing for the collection and subsequent treatment/separation of runoff water falling on waterproof surfaces, such as roofs, roads and yards, potentially contaminated by particulate matter and other substances;
- Drainage systems of the CS areas occupied by installations, providing for the collection and subsequent treatment/separation of oily waters. This system includes foundation tanks and underground collection tank equipped with oil detection sensors for each piece of machinery, oil separator and lifting pumps.

Both drainage systems will ensure the separation of contaminated waters which will be managed as waste and disposed in accordance with national regulations in force and international standards, whereas clear waters will be dispersed on soil. It is noted that civil discharges will be routed to a dedicated sewage system.

Regular maintenance of CS equipment will follow detailed protocols in order to prevent accidental spill of oil and/or other potential contaminated materials. In the event of equipment failure/CS shutdown, emergency procedure will be put in place such as to ensure no accidental soil and subsoil pollution occurs.

During the operation phase of the OHL line, oil leaks from equipment breakdown or accidental spills from machinery used for maintenance activities could lead to soil contamination, as the case in the construction phase.

All electrical waste and used batteries resulting from maintenance activities must be collected and eliminated/recycled, in compliance with national regulations and best waste management practices.

Considering the presence of rainwaters and oily waters drainage and management systems at the converter station and with the application of appropriate management measures during maintenance activities of the OHL line, soil and subsoil pollution is considered unlikely by performing the correct routine and extraordinary maintenance operations. Therefore, the intensity of the impact is deemed **negligible**. Moreover, in the event of accidental spills, the extent and duration of impacts is expected to be **low**.

Overall, the impact magnitude is ***negligible***.

Geology, geomorphology and soil–Operation Phase					
Characteristics of magnitude					**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**		
Potential soil and subsoil contamination (Partanna CS)	Negligible	Low	Low	→	Negligible

3.2.3.1.2 Landtake

During the project operation phase the only permanent landtake of soil is associated t the Mlaâbi CS, the tower footprint areas of all towers, as reported in the following table.

No land take is associated to the construction of underground cables given that both cables and related working site will be primarily located on existing roadways. Moreover, the project envisages the complete restoration of temporary construction/storage yards.

Construction phase – Landtake	**m^2**	**Ha**
Mlaâbi CS Site	100000	10
OHL 400 kV Mlaâbi-Mornaguia	52 000	5.2

In light of the above the intensity and spatial extent of impacts are classified as Low and the duration, whereas the duration of the permanent land take is Very high.

Overall, the magnitude of impact is classified as ***Low***.

Geology, geomorphology and soil– Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Landtake	Low	Low	Very High	Low

3.2.3.1.3 Impact Significance

Geology and geomorphology –Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Potential soil and subsoil contamination	Low	Negligile	Negligile
Landtake	Low	Low	Low

3.2.3.2 Mitigation Measures

At the current stage of project design, the following **design measures** resulting in prevention of soil and subsoil quality impacts during the Project operation phase, are anticipated:

- Periodic maintenance of CS and OHL components;
- A site specific Emergency Response Plan would be prepared for soil clean-up and decontamination
- Presence of a rain water management system at the CS;
- Presence of an oily water management system at the CS.
- Appropriate management and disposal of wastes in accordance with national legislation in force and applicable international standards;
- Maintenance protocols.
- The line corridor will have to be maintained to limit the interaction between vegetation and conductor (cables) that cause damage to the installations. Vegetation cover must be maintained below the OHL line in order to reduce exposure to soil erosion and flooding. It is important to note that landowners/farmers will continue to use their agricultural land for several crops that present no problems for the operation of the OHL line (annual crops, some species whose height doesn't reach the conductor.
- Periodic maintenance of the equipment and ensure proper spill control and management at site and along the OHL line
- Monitor and detect any contamination on soil
- All generated waste during operation phase should be treated in compliance with national standard and requirements set by the ANGED and ANPE agencies
- Maintain recorded of the E-waste generated and managed (panels, used batteries, etc.)

In case of unplanned events, such as equipment failure or CS shut down, the safety systems and emergency procedure will guarantee the water tightness of the rain water and oily water tanks, therefore any oils and contaminated water will be handled as waste.

Considering the outcome of the impact assessment, **no need for additional specific mitigation measures** is anticipated at this stage

3.2.3.3 Residual Impacts

The performed assessment took into account above presented design measures. Residual impacts are therefore equal to the above presented impacts in absence of mitigations (see Section 3.2.2.1.4).

3.3 Freshwater Resources (Surface and Groundwater)

The following Table provides a brief overview of the potential impacts induced by the Project on freshwaters.

Table 3-19: Freshwater Resources – Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
• Potential Contamination of water resources • Alteration of ground water level	• Potential contamination of water resources. • Alteration of ground water level	• As Construction Phase

3.3.1 Definition of Sensitivity

According to the IA Methodology presented above, the sensitivity of surface and ground waters in the Project AoI has been assessed on the base of the following criteria.

- *Existing regulation and guidance*

Humans can be adversely affected by diffusion of pollutants in the subsoil to groundwater contamination. Groundwater accounts for a considerable share of the overall drinking water demand, for agricultural purposes, and the importance of its protection as established by the Tunisian Water Code. The Law N°75-16 of March 31, 1975 related to the above Code contains various provisions governing the protection of the public hydraulic domain in Tunisia.

According to the Article 109 of the Law N°75-16, it is forbidden to let flow, discharge or throw in the waters of the public hydraulic domain, conceded or not, residual waters as well as waste or substances likely to harm public health or the good use of these waters for any possible use.

In addition to the previous law, other laws and decrees have been issued for the preservation of water resources (fresh and ground resources): the Decree N°85-56 of January 2, 1985 relating to the regulation of discharges into the receiving environment and the Ministerial Order of March 26, 2018 which setting the limit values for effluent discharges into the receiving environment, including rivers, wetlands and other surface water.

At the international level, Tunisia has ratified several conventions such as the RAMSAR convention related to the conservation of wetlands areas (Law N°80-9 of march 3, 1980).

Given the above, “existing regulation and guidelines” has been classified as *“**Moderate**”.*

- *Societal Value*

In general, groundwater has a quite significant societal value as it can have direct effects on people's health and on activities such as agriculture.

The project (in particular the OHL lien) crosses 4 governorates (Nabeul, Zaghouan, Ben Arous and Manouba) belonging to a wider region the North East (which also includes the governorates of Tunis and Bizerte). The Northeast area is the country's leading economic region with more than 40% of the national population (source: the National Institute of Statistics INS, 2019). Agriculture is a vital sector in this region, especially in

Nabeul, Zaghouan and Ben Arous and the use of water is very important for agricultural and other needs (drinking water, industry, etc.).
The project, including the OHL corridor, does not cross any wetlands or important lakes or reservoirs, with the exception of the small reservoir of Ain Faouara (36.569543°,10.159681°) where the OHL will pass towards its northern limit (the pylons will be located outside the lake).

All wetlands (RAMSAR, IBA and other reservoir) are located away from the proposed line route of the OHL and from the Mlaâbi CS. Only the last section of the underground cable will pass near the right bank of the oeud tafekhsite (over a distance of 500 m).

Direct impacts on groundwater are not likely to occur, or to be minimal, due to the shallow depth of the excavations nor to surface water courses and given the small–scale nature of the project at individual locations (towers foundations and its access roads).

Giving the above, "*societal value*" has been classified as *"**Moderate**".*

- *Vulnerability for change*

Legislative Decree 152/06 requires the regions to implement a monitoring and control programme of nitrate and plant protection product pollution in surface water bodies, and to this end gives indications on control activities and the identification of vulnerable zones in relation to this issue.
Considering the shallow depth of the excavation, the small-scale nature of project activities, depth of the water table in the crossed region and the distance between the project corridor and all existing wetlands areas, the vulnerability for change has been classified as *"**Low**".*

Overall, the Sensitivity of the receptor "hydrogeology and hydrology" is classified as ***Moderate.***

Freshwater Resources (Surface and Groundwater)			
Characteristics of sensitivity			**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
Moderate	Moderate	Low	Moderate

3.3.2 Construction phase

3.3.2.1 Potential impacts

With regard to water resources (surface and ground), the following potential negative impacts might arise during the project construction activities:

- Potential ground water contamination cause by: accidental spills of wastes and fuel, leakage of drilling fluids into underground geological formations and excavation works potentially interfering with the water table
- Alteration of ground water level caused by the reduction of groundwater supply due to the realisation of paved surfaces (i.e. underground cable section crossing the easement of Tafekhsite river, Mlaâbi CS) and to consumption of water resources that may contribute to increased pressure on water abstraction and a decrease in groundwater levels. The groundwater in Cap Region is in critical situation due to an over-exploitation by agriculture, so the water extraction for construction purpose can cause considerable impact on the already stressed resources, especially without any supporting/mitigation measures to protect this resource.

3.3.2.1.1 Potential water contamination

During the Project construction phase, excavation depths are quite limited and not likely to cause any interferences with the water table with consequent pollution of water resources.

Accidental release of fuel oil & chemical stored (transformer oil, paints and solvents) used at site can contaminate the surface water body. This impact would be important in case of Tafekhsite River where the underground cable will be placed.

The Mlaâbi CS is located near the Tafekhsite river and the Mlaabi dam (from only 600 m), the latter is an important site for biodiversity issues (RAMSAR and IBA) and for water supply to the irrigated areas located in the zone.

Construction activities, that include land clearing and vegetation removal at towers locations and around the Mlaâbi CS and its roads access, as well as vehicle movement (fuelling and maintenance) which will take place near water bodies and dams could disturb ground surface and could increase total solids and turbidity in these wetlands. These disturbances may affect their use by human activities and by the wildlife present in the area.

Construction activities and vehicules movement can cause spills of fuel, lubricants, paints and other chemical/electrical equipement that could contaminate surface water and/or ground water directly by precipitating into these aquatic ecosystem or indirectly through contaminated soils which are then eroded into water bodies. Concrete to be used for towers foundations and the construction of the Mlaâbi CS can also contaminate water by changing the pH (increase towards a more alkaline environment).

Phenomena of groundwater contamination due to accidental fuel spills and/or waste spills are considered highly unlikely, given that all suitable precautions to avoid such situations will be put in place (primarily regular maintenance of equipment and machinery and waste management procedures in accordance with national legislation in force and applicable international standards see section 3.3.2.2 for further details).

Moreover, first rain water from the construction yards will be collected with at least one tank for the sedimentation of suspended materials and a de-oiling tank, while the civil discharges will have to be connected to the public sewerage, preventing groundwater pollution.

With regard to the potential leakage of drilling fluids during HDD operations, adequate mud management procedures will be put in place during and drilling operation (see section 3.3.2.2 on mitigations for further details).

Considering the accidental nature of potential water contamination and the nature of potential spills, and taking into account standard design measures to prevent accidental water pollution implemented by the Project, the intensity of the impact is considered ***negligible***.

The extent of the potential water contamination is expected to be **low**, as well as the duration, limited to the construction phase and more specifically to the potentially contaminating activities.

Overall, the impact magnitude is ***negligible***.

Groundwater – Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Potential groundwater contamination	Negligible	Low	Low	Negligible

3.3.2.1.2 Alteration of water level

Water withdrawal for construction purposes (preparation of concrete, washing vehicle and equipment, watering of unpaved access roads to reduce the emission of dust) could reduce the availability of water for other purposes. At this regard, it is important to note that water consumption is not a critical issue and project activities will not disrupt the water supplies availability in the affected area. The latter has adequate water supplies system and construction activities will require only small amounts of water that will be used for concrete preparation and washing purpose.

For the OHL line, towers will not affect water bodies and reservoirs and will not be located in drainage ways, se there is no risk for water resources during the erection of towers.

Alteration of ground water level might be caused by realisation of paved surfaces (i.e. Mlaâbi CS and related access roads) and to consumption of water resources.

The Maâbi CS and related access road occupy a surface of roughly 100000 m^2. The water consumption during construction will be limited to the preparation of drilling fluids, dust suppression needs and washing vehicles.

Overall, the Project is not expected to lead to noticeable changes of the water level and impacts are classified as negligible.

Groundwater – Construction Phase					
Characteristics of magnitude					Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**		
Alteration of groundwater	Negligible	Low	Low	→	Negligible

3.3.2.1.3 Impact Significance

Groundwater – Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Potential groundwater contamination	Moderate	Negligible	Low
Alteration of groundwater	Moderate	Negligible	Low

3.3.2.2 Mitigation Measures

Sources of pollution considered for soil and subsoil, such as accidental spills of fuel, accidental spill of liquid wastes and leakage of drilling fluids into underground geological formations, can contribute to the release of pollutants into water bodies and groundwater. As a result, the measures taken to prevent soil and subsoil pollution will also prevent groundwater pollution.

With regard to the management of first rain waters, potentially contaminated, according to the project construction standards the yard will be equipped with at least one tank for the sedimentation of suspended materials and with a de-oiling tank, while the civil discharges will have to be connected to the public sewerage, preventing groundwater pollution.

The following measures must be implemented to mitigate potential impact due to accidental spillage of fuel and other chemical products:

- Maintenance operations for vehicles used during construction activities. These operations must be carried out in appropriate place within the construction area (inside the Mlaâbi CS) with concrete floor in order to prevent any contamination of soil.
- Oil and chemical storage area should be covered and have impervious floor and bund.
- Use of spill control kits to contain and clean small spills and leaks.
- Use oil will be collected and stored for recycling (by specialized companies and authorized by the national authorities).
- The contractor company in charge of construction activities, and its subcontractors, have to prepare guidelines and procedures for appropriate clean-up actions to be taken in case of any oil/fuel or chemical spills.
- The contractor company have also to prepare a site-specific emergency response plan for soil clean-up and decontamination actions.
- A training program must be implemented by the company to its personnel about emergency procedures and good practices to prevent accidental pollution.
- Then base camp and construction site must be located at more 100 meters from the closet stream or water reservoirs, in particular for the Mlaâbi CS where the base camp must be installed away from the Mlaâbi Dam and Tafekhsite river. The same must be applied for the OHL line.

In order to prevent/reduce potential impact due to discharge of wastewater from construction activities, the following measures must be implemented and respected:

- The effluent generated from washing of vehicle and equipment and from the HDD activity need to be stored and treated in a sedimentation tank.
- A stormwater drainage system must be installed in the construction site, especially in the HDD area and in the Mlaâbi CS, to ensure the channel all runoff. This measure could avoid any pollution of water bodies and reservoirs near the project area (especially the Tafekhsite river near the CS and the Mlaâbi Dam).
- Adequate sanitary facilities (toilets, showers) must be available for the involved personnel during the construction phase. Workers will be strictly required to use these facilities.

As the exact location of towers will be known at an early stage of the construction phase, the contractor company will have to guarantee a god distance between the final locations of towers and its construction areas from water bodies and all reservoirs of water in order to avoid/reduce any disturbance of their quality.

3.3.2.3 Residual Impacts

The performed assessment took into account above presented design measures. Residual impacts are therefore equal to the above presented impacts in absence of mitigations (see Section 3.3.2.1.3).

3.3.3 Operation phase

3.3.3.1 Potential impacts

Similarly, to what reported for the construction phase, the surface water bodies in the project area are at a sufficiently high distance so as not to be affected by project operation.

With regard to waters, the following potential negative impacts might arise during the project operation phase:

- Potential ground water contamination cause by: accidental spills of wastes primarily including contaminated oily waters and first rain water (i.e. potential leaks from first rain water tanks and de-oiling tanks);
- Alteration of ground water level caused by the reduction of groundwater supply due to the realisation of paved surfaces (i.e. Mlaâbi CS) and to consumption of water resources that may contribute to increased pressure on water abstraction and a decrease in groundwater levels.

During the operational phase, the OHL transmission line is not expected to induce any discharge pollutants to the water bodies. Some minor potential impacts on water quality due to maintenance activities (control of electrical equipment and access roads) and to the vehicle movement.

The potential impacts on waters during operational phase of the OHL transmission line include the following:

- Change in hydrological regime and sub-surface water as a result of the drainage of access roads.
- Local impacts on hydrological patterns and groundwater level due to the tower foundation. Tower foundation could represent a barrier effect for water penetration with presence of concrete. This impact is not significant due to the small area occupied by towers foundations.
- Soil compaction and local effects on hydrology due to vehicle movement during maintenance actions.
- Risk of pollution from fuel/oil and other chemical pollutants due to the maintenance traffic operations.

3.3.3.1.1 Potential water contamination – Mlaâbi CS

Potential water's contamination during the Mlaâbi CS operation, might occur in case of failure of the rain waters and oily waters drainage and management systems in place, previously described within the assessment of impacts on soil and subsoil. These systems are aimed at preventing the release of contaminated waters to the soil and subsoil and consequently accidental pollution of groundwater.

Contaminated waters will be managed as waste and disposed in accordance with national regulations in force and international standards, whereas clear waters will be dispersed on soil. It is noted that civil discharges will be routed to a dedicated sewage system.

Regular maintenance of CS equipment will follow detailed protocols in order to prevent accidental spill of oil and/or other potential contaminated materials. In the event of equipment failure/CS shutdown, emergency procedure will be put in place such as to ensure no accidental groundwater pollution occurs.

Considering the above, water pollution is considered unlikely by performing the correct routine and extraordinary maintenance operations. Therefore, the intensity of the impact is deemed **negligible**. Moreover, in the event of accidental spills, the extent and duration of impacts is expected to be **low**.

Overall, the impact magnitude is ***negligible***.

water – Operation Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Potential water contamination (Mlaâbi CS)	Negligible	Low	Low	Negligible

3.3.3.1.2 Accidental leakage and spillage of fuel and chemical – OHL line

Accidental release of fuel oil and chemical stored used by vehicle or other electrical component of the transmission line can contaminate the surface water body and soil, which may increase the contamination risk of groundwater resources.

The main sources/causes of this potential impact on water resources are related to the following:

- Vehicle movement during maintenance operations,
- Tower inspection and checks
- Line element replacements
- Maintenance of the Right of Way (in case of using of chemicals products for vegetation removal).

As stated in section 3.3.2, towers will be at sufficient distance form rivers and other water reserves (RAMSAR, IBA, etc.) to avoid any negative impacts on water resources.

Overall, the Project is not expected to lead to noticeable changes of the groundwater level and impacts are classified as negligible.

water – Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Accidental leakage and spillage of fuel and chemical (OHL line)	Negligible	Low	Low	Negligible

3.3.3.1.3 Impact Significance

water – Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Potential water contamination (Mlaâbi CS)	Low	Negligible	Negligible
Accidental leakage and spillage of fuel and chemical (OHL line)	Low	Negligible	Negligible

3.3.3.2 Mitigation Measures

Sources of pollution considered for soil and subsoil, such as accidental spill of wastes (primarily first rain waters and oily waters), can contribute to the release of pollutants into groundwater. As a result, the design measures taken to prevent soil and subsoil pollution will also prevent groundwater pollution.
These design measures primarily include rain waters and oily waters drainage and management systems.

Considering the outcome of the impact assessment, **no need for additional specific mitigation measures** is anticipated at this stage.

3.3.3.3 Residual Impacts

The performed assessment took into account above presented design measures. Residual impacts are therefore equal to the above presented impacts in absence of mitigations (see Section 3.3.3.1.3).

3.4 Noise

The following Table provides a brief overview of the potential noise impacts induced by the project.

Potential impacts for each project Phase are described in detail in the following sections, prior to presenting the mitigation measures that will be adopted by the Project. Lastly, residual impacts are presented at the end of the assessment, by taking into account the application of mitigation measures.

Table 3-20: Noise– Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase

• Temporary noise emissions from equipment and machinery used in different construction stages, potentially resulting in an increase of ambient noise level at sensitive receptors, in particular:
  • Increase in noise levels due to the construction of the Mlaâbi CS;
  • Increase in noise levels due to construction of underground cable ducts;
  • Increase in noise levels due HDD at the marine cables' landfall.
  • Increase in noise levels due to the construction of the OHL line
  → Transportation of equipment and construction materials
  → Tower foundations works
  → Operation of materials handling equipment and stationary equipement
  → Operation of the winching machine
  → Traffic congestion due to stringing of conductor
	• Constant noise emission associated to the operation of the Mlaâbi CS (operation of transformers);
	• Noise generated from the operation of the transmission line due to the ''corona effect''
	• Negligible impacts due to do the general project maintenance (i.e. traffic noise).
		• As Operation Phase

3.4.1 Definition of Sensitivity

According to the IA Methodology presented above, the sensitivity of the receptor "Noise" in the Project AoI has been assessed on the base of the following criteria.

➢ *Existing regulation and guidance*

Humans and animals can be adversely affected by exposure to high noise emission. In response, regulations in force at both national and international level set noise limits depending on the existing environment.

Noise legislation in Tunisia is established by the following:

- The Decree N°84-1556 of December 29, 1984 related to noise generated by industrial activities, it regulate noise level for industrial areas and units. Its article 26 sets the level of 50 dB as a limit value to not exceed during daytime by an industrial activity. This decree is applicable for the present project, in particular for the HDD landfall activities in Kélibia and for the construction and operation of the Mlaâbi CS. The first one will be located in the existing industrial zone of Menzel Yahia and the second component will be developped within the proposed industrial zone of Mlaâbi.
- The Highway Code in relation with noise emission from vehicles, which prohibiting the use of multiple or high-pitched sound generators and the free exhaust of gas and pollutants and it sets limit values of noise for each type of vehicle. This Code is applicable for the present project as the construction and operation activities will use several types of vehicle.
- The Order of the Ministry of Public Health and Social Affairs of January 10, 1995 related to noise in workplace. The Order sets the daily noise exposure level at 85 dB.
- The Order of the Municipality of Tunis of August 22, 2000 which sets the limit values of noise within the area covered by the communal space. It is important to note that Tunis is the only council in Tunisia that has a specific regulation on noise.

No municipalities crossed by the proposed project dispose a specific noise regulation, as the case of the Municipality of Tunis. Consequently, at National level the noise limits applicable to the Project are those set by the Order of the Municipality of Tunis.
The following table shows the noise limit values as per the municipal decree of the Municipality of Tunis setting the regulation of noise pollution control.

Table 3-21: Noise level set by the Municipality of Tunis

Zone	***Limit values (dB)***		
	Night	***Period between day-night (6-7 am and 8-10 pm)***	***Day***
Medical centre, recreation area and natural protected areas	35	40	45
Residential areas (sub-urban) with low traffic flow	40	45	50
Urban residential areas urban	45	50	55
Residential areas (urban or sub-urban) with commercial, business centre and workshops and with high traffic flow	50	55	60
Zone dominated by commercial, industrial or agricultural areas	55	60	65
Zone dominated by heavy industry	60	65	70

Considering that, the area potentially affected by the project is mostly rural and agricultural, except some section of the underground cable crossing the city of Sidi Jamel Eddine and some sections of the OHL line, it reliably falls under the fifth category ‘’Zone dominated by commercial, industrial and agricultural activities’’ as described in the following table:

- 65 dB(A) for day time;
- 55 dB(A) for night time.

With regard to the World Bank Group (WBG) Noise Level Guidelines, the following noise limits set for “residential, institutional and educational” receptors are conservatively deemed applicable to the Project given that the project area in not classifiable as “industrial”, except the chosen area for landfall and junction box and the construction site of the Mlaâbi CS classified as industrial land:

- 55 dB(A) for day time;
- 45 dB(A) for night time.

The HDD work site is located inside an existing industrial zone (IZ of Menzel Yahia where only two sardine industrial units are in operation) and its surrounding is rural.

The area potentially affected by the underground cable is mostly rural, except the section crossing the city of Sidi Jamel Eddine (over a distance of about 1 km), and occupied by agricultural lands (annual crops with some olive trees).

The Mlaâbi CS is located inside another industrial zone (planned one) and the surrounding is mostly rural with some isolated houses which may be affected by the project activities.

The area affected by the OHL line is mostly rural with some isolated habitations, in particular between beni Khalled-Grombalia in Nabeul Gouvernorate.

Some Key Biodiversity Areas are located near the OHL line, among these natural areas some water reservoirs classified as RAMSAR or IBA sites, thus sites of interest for various fauna species (migratory and nesting avifauna).

Given the above, existing regulation and guidelines has been classified as *"**high**"*.

- *Societal Value*

In general, noise can produce a relevant impact over broad areas. On the other hand, in this case it's important to notice that the Project AoI is mostly rural and sparsely populated, with the majority of settlements being located in the section crossed by the underground cable (near Sidi Jamel Eddine) and around some section of the OHL line.

A moderate number of people is therefore expected to be impacted by the Project and in light of the above societal value has been classified as *"**Moderate**"*.

- *Vulnerability for change*

The background noise level in the Project AoI is expected to fluctuate seasonally, depending especially on two factors: agriculture for the whole area crossed by the OHL line and the Mlaâbi CS ; and tourism for the the two municipalities (Kélibia, Menzel Temime) crossed by the underground cable and concerned by the HDD activities.

The project is not expected to cause a substantial change in existing noise levels, especially during the touristic season. There is no major settlement or sensitive receptor in the immediate proximity of the project areas (in particular for the HDD and the OHL construction sites), considering that the vulnerability for change has been classified as "***Moderate***".

Overall, the Sensitivity of the receptor "Noise" is classified as *''**Moderate**''.*

Noise			
Characteristics of sensitivity			**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
High	Moderate	Moderate	Moderate

3.4.2 Construction phase

3.4.2.1 Potential impacts

The Project construction can lead to a potential increase in ambient noise level at sensitive receptors, associated to the following activities and related noise emissions:

- Earth movement, aggregate material handling, excavation, mechanical works and vehicle movements.
- Use of engine driven vehicles and machinery (*i.e*. excavators, bulldozers, side booms, trucks, cars), whose engine will produce noise.
- Transport of raw material, personnel and wastes to and from the construction areas resulting in an increase of traffic and related noise.
- Towers construction: tower foundations, tower assembly and erection, attachment of the conductors and improvement of access roads.

The assessment of potential noise impacts (namely increase in noise level) has been performed only for the HDD worksite. For the Mlaâbi CS and the OHL line, the assessment of potential impact will be based on a available data from bibliography.

3.4.2.1.1 Increase in noise levels due to the Mlaâbi CS construction

The construction of the Mlaâbi CS will require using various constuction equipment and vehicle and these activities signify potential major sources of noise that may affect sensible receptors present in the construction site.

Mechanical equipement which is planned to be involved in the construction of the present CS includes the following: track loader, excavator, hydraulic hammer and breaker, dump trucks, air compressor, generators, concrete pump, etc.
In the absence of data on the noise levels of the equipment to be used during the construction phase for the proposed project, the evaluation of the potential impact of noise for the Mlaâbi CS was based on the data provided by the Federal Highway Administration (US Department of Transportation).

Table 3-22: Expected construction equipment and noise level

Equipment	***Sound level dB (at 15 m from the equipment)***
Track loader	88
Excavator	80
Compressor	81
Compactor	82
Concrete pump	82
Concrete mixing	85
Mobile crane	83
Billdozer	85
Generator	81
Woodcutter	84
Track loader	85
Source: US Department of Transportation	

The potential vulnerable groups/sensible receptors who are susceptible to be affected by the noise disturbance during construction phase of the Mlaâbi CS are the following (as shown also in the following figure):

- Settlments located near the site proposed for the industrial zone of Mlaâbi, located at 600 m from the northern boundary of the proposed site (3 families of agricultural workers working in farms located in the area).
- Onsite workers for construction purposes.
- Potential fauna present in the RAMSAR/IBA site of Mlaâbi (located at 800 m from the northern boundary of the proposed site).

Figure 3-1: area concerned by the Mlaâbi CS

The duration of the construction activities of the Mlaâbi CS is expected to be 40 months and noise will be genrated during day only. During these activities, noise levels may exceed the limits fixed by the Order of the Municipality of Tunis (as described in 3.4.1 section) and by the WBG Standard, but the noise generated is

likely to be attenuated within 500 m from the construction site and we excpect that the noise intensity should not exceed the fixed levels for the above sensible receptors (settlement and fauna).

The noise generated by the construction activities will mainly have an impact on the involved workers. Construction activities will be concentrated and done sequentially in order to garantee the monitoring of noise during this phase of the Project. Considering the construction activities schedule, the nature of works and the mitigation measure to be taken, the intensity of the impact is considered ‘’Moderate’’ and its extent is expected to be ‘’Low’’.

Overall, the impact magnitude is ***Moderate***.

Noise–Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in noise levels due to the construction of the Mlaâbi CS	Moderate	Low	Moderate	Moderate

3.4.2.1.2 Increase in noise level due to the underground cables construction

The construction of underground HVDC cable primarily includes the following construction activities:

- Excavation of the trench and removal/transfer of excavated materials;
- Cable laying;
- Trench backfilling;
- Asphalt restoration.

The most invasive activity in terms of noise emissions is the trench excavation, for which the use of a wheeled excavator, a wheeled shovel and a truck is expected. The trenches will mainly be dug on road surfaces: the cable ducts will follow the existing roads. The installation trench will have the following approximate dimensions:

- for the DC cable, 0.70 m wide and 1.6 m deep;

Table 3-23: Cables ducts construction – Equipment list

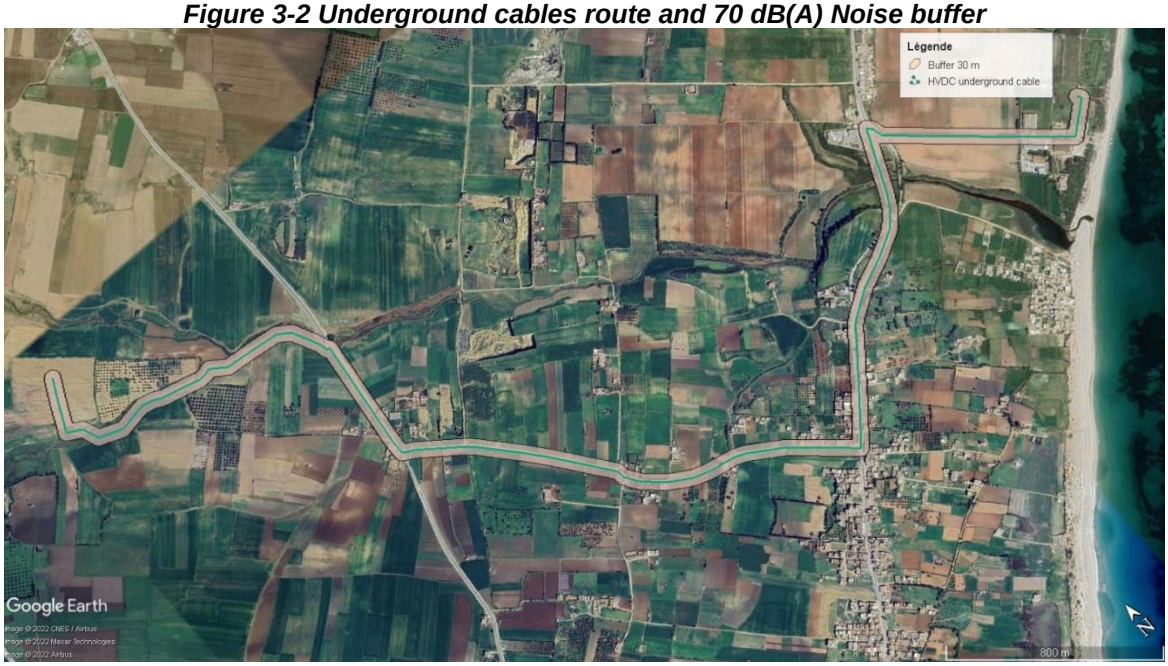
Machine	**LW**	**% Rate of use**	**% actual activity**	**LW weighted**
Wheeled excavator	107.5	40	85	102.8
Wheeled mechanical shovel	107.4	40	85	102.7
Medium truck	106.1	50	85	102.4
LW Max = 111.8 e LW media 8h = 107.4				

Construction activities and related noise emissions will take place only during day time, between 8am to 6pm.

Considering an open field propagation, it is possible to estimate that the area within which the noise contribution exceeds the 70 dB(A) threshold[3] extends up to 30m from the trench on each side (i.e.60 m buffer centred on the cable route).

The following Figure shows the underground cable and the above mentioned 60 m buffer, within which noise levels are expected to exceed 70 dB(A).

Figure 3-2 Underground cables route and 70 dB(A) Noise buffer



As showed in the map, noise emissions from cable duct construction will affect residential areas only in a small portion in the Sidi Jamel Eddine city (Municipality of Menzel Temime) and some settlements in the Municipality of Kelibia (around the industrial zone of Menzel Yahia), whereas the majority of the cable crosses agricultural areas with limited presence of people and therefore sensitive receptors.

Even if within the 60 m buffer the Tunisian and the WBG Standard daytime noise limits are exceeded, it should be noted that the construction activity will move along the cable route, at a rate of 500÷800 m per month, affecting potential receptors for a very limited amount of time. Given the above the duration of noise impacts is classified as **low duration**.

Noise propagation will also have a very small extent; in particular temporary exceedances of daytime national and the WBG Standard limit of 70 dB(A), is confined within a 60 m buffer centred on the cable route, whereas exceedances of the stricter daytime WB Group limit set for residential, institutional or educational receptors of 55 dB(A). Therefore, noise impacts are expected to be extremely localized (**low Spatial extent)**.

Given the above noise emissions related to the underground cable construction, are expected to result in in negative impacts of **moderate intensity**.

The overall impact magnitude is defined as **Low.**

[3] This threshold is equal to the one set by WBG for industrial and commercial areas (e.g. non-residential, institutional or educational receptors)

Noise–Construction Phase					
Characteristics of magnitude					Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**		
Increase in noise levels due to construction of underground cable	Moderate	Low	Low	→	Low

3.4.2.1.3 Increase in noise level due to Horizontal Directional Drilling (HDD)

In Kélibia an HDD (Horizontal Directional Drilling) will be carried out for the construction of the cable landing site.

The HDD technique involves drilling straight holes of an appropriate length and depth so that they are not subject to problems of “uncovering” of the system due to coastal erosion.

In order to estimate the noise level generated during HDD activities at the marine cables’ landfall, a quantitative analysis of the potential Project impact was performed using Acous-Prop noise propagation software, as described hereinafter.

R1	Closest one, locate at the industrial area of Menzel Yahia
R2	An isolated settlement, usually used during summer time
R3	A dense residential area

3.4.2.1.3.1 Acous_Propa

Acous_Propa is software for modeling acoustic propagation indoors and outdoors. Our program is a modular tool that meets the needs of each user. Whether it is an industrial project, a environment project, a wind farm and room acoustics. The tool calculates noise maps and allows the calculation of spatial decay and sound decay time.

This software allows to access to many types of forecast calculations:

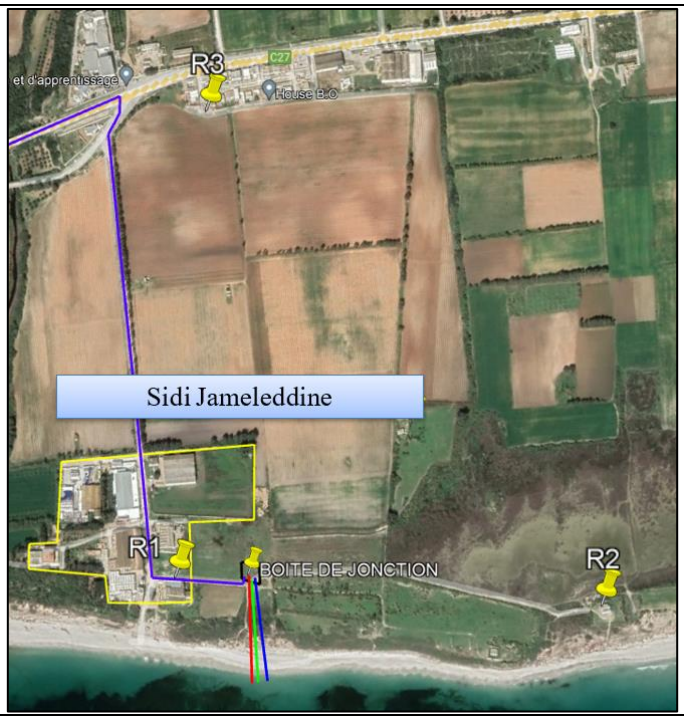
- Sound propagation calculations taking into account the transmission through the walls
- Calculations of spatial decay
- Sound decay time calculations

3.4.2.1.3.2 Model Calibration and set-up

- Digital Elevation Model
- Sensitive receptors identified during the noise monitoring campaign

Table 3-24: Noise Sensitive receptors in the HDD worksite area

Receptor ID	Coordinates		Description
	Latitude	Longitude	
R1	36° 47' 59.75" N	11° 2' 10.78" E	Closest one, locate at the industrial area of Menzel Yahia
R2	*	An isolated settlement, usually used during summer time	An isolated settlement, usually used during summer time
R3	*	*	A dense residential area



3.4.2.1.3.3 Noise Emission inventory

The noise emission inventory defined for the HDD activities at the marine cables' landfall is based on project data available to date and conservatively represents the worst-case scenario (the Lw Max scenario).

For HDD operation, a Vermeer horizontal driller will be used, possibly assisted by a lifter.

Figure 3-3: Vermeer Horizontal Driller

The following table reports the equipment list for the HDD works at the marine cables' landfall and related sound power levels based on technical datasheet.

Table 3-25: HDD worksite – Equipment list

Machine	LW	% Rate of use	% actual activity	LW weighted
Horizontal driller	111.0	80 %	85 %	109.3

Forklift	107.4	20 %	85 %	99.7
LW Max = 112.6 and LW 8h = 109.8				

The above pieces of machinery were included in the model as noise emission sources (point sources) (1 Horizontal driller and 1 forklift) and located within the worksite area available at the current stage of project design.
The simulation considered conservatively that both machines will operate continuously and simultaneously at the maximum power level

3.4.2.1.3.4 Noise simulation results

The following table reports the noise levels predicted at sensitive receptors identified in the HDD area.

The Table provides the comparison between predicted noise levels and national and international noise limits applicable to the project. Predicted noise levels include both, the sole contribution of the HDD and the cumulative noise level given by the HDD contribution in conjunction with existing noise levels; the latter have been recorded during the noise monitoring survey performed at the marine cables' landfall in October 2022.

It is noted that the comparison with inforce noise limits has been made only for the daytime standards because drilling activities will be primarily take place between 8am and 6pm.

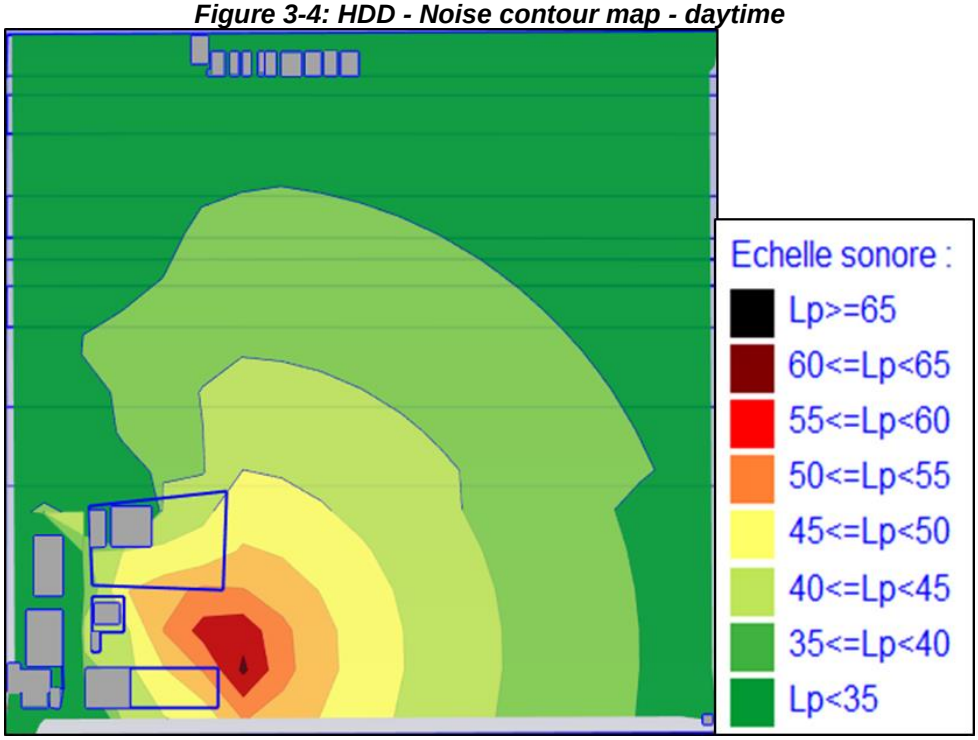
Table 3-26: Noise Pressure Levels at Receptors generated by HDD during Daytime

Measurement/ receptor ID	Background noise level	HDD Construction Contribution	Cumulative Noise level (Baseline+ HDD contribution)	Increase on background	Tunisian Limit (daytime)	WBG Limit (daytime)
	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
R1	*	62.4	62.5	15.9	65	55
R2	*	66.8	66.8	25.3	65	55
R3	*	64.6	64.6	21.9	65	55

It is possible to notice that the total noise levels are compliant with the Tunisian absolute noise limit set by the Order of the Municipality of Tunis, whereas they exceed the international WBG limit; with regard to the increase in background levels, both national and WBG differential limits of 5 dB(A) and 3 dB(A) respectively, are exceeded.

The following map reports the noise contour map, showing the HDD contribution in the area surrounding the worksite.

Figure 3-4: HDD - Noise contour map - daytime



3.4.2.1.3.5 Assessment of impacts magnitude

Based on the outcome of the noise modelling study, the negative impact associated to the HDD noise emissions have been classified as of **moderate intensity.**

Overall the magnitude of noise impacts induced by the HDD at the marine cables' landfall is classified as **Low** despite the WBG limit exceedance, because of the limited spatial extension and duration.

Noise–Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in noise levels due HDD at the landfall	Moderate	Low	Low	Low

3.4.2.1.4 Increase in noise levels due to the OHL 400 kV line

- Increase in noise levels due to the realization of tower foundations

The construction activities of the proposed power transmission line are likely to cause increase in the ambient noise levels. These activities includes the following: transportation of raw materials for tower installation, operation of machine, traffic, construction of tower foundations, tower assembly and erection, attachment of conductors, etc.

As for the other components of the Project, the construction of the OHL line will involve different mechanical, such as: track loader, excavator, hydraulic hammer and breaker, mobile crane, generator, air compressor, concrete engins, dump trucks, etc.

Baseline noise conditions at sensitive receptors within the Study Area tend to be dominated by noise generated by residents of local villages and/ or fauna (avifauna). Noise receptors in the area are mostly of moderate and/or low sensitivity (e.g. industrial units, commercial properties, Industrial zone of El Fejja in Manouba, and waste management unit near Menzel Bouzelfa Delegation). In addition to human receptors,

ecological receptors are located within and around the Project Area, in particular these located within RAMSAR and IBA sites.

The construction of the OHL line will require using various constuction equipment and vehicle and these activities signify potential major sources of noise that may affect sensible receptors present in the construction site.
Mechanical equipement which is planned to be involved in the construction of the present component includes the following: track loader, excavator, hydraulic hammer and breaker, dump trucks, air compressor, generators, concrete pump, tower crane, truck crane, etc.

The potential vulnerable groups/sensible receptors who are susceptible to be affected by the noise disturbance during construction phase of the Mlaâbi CS are the following (as shown also in the following figure):

- Settlments located near the proposed corridor of the OHL line.
- Onsite workers for construction purposes.
- Ecological receptors located within natural areas (wetlands, forests, RAMSAR AND IBA sites that shelter some wildlife species) located near the AOI of the OHL line.

The duration of the construction activities of the OHL is expected to be 24 months and noise will be genrated during day only.

The main source of noise during construction phase would be from activities of winching machine during stringing of the transmission line.

The evaluation of the potential impact of noise for the OHL line was based on the data provided by TERNA using data from similar power transmission projects. The two following tables show the sound levels for machinery to be used for the construction of the OHL line and their percentage of use.

Table 3-27: Sound power levels of construction equipment of the OHL line (source: TERNA)

Hz	***Power levels (dB)***										***LwTOT***	
	31.5	63	125	250	500	1K	2K	4K	8K	16K	dB	dB(A)
Motor generator	108.1	105.7	101.1	102.7	95.2	90.0	90.1	84.4	86.2	78.4	**111.4**	**98.8**
Truck	101.8	99.8	93.7	91.0	97.0	99.3	97.7	95.0	94.7	89.2	**107.3**	**103.9**
Concrete mixer truck	97.3	97.6	95.3	88.4	98.2	95.8	90.6	88.6	91.1	76.9	**104.6**	**100.3**
Track excavator	108.5	104.8	118.1	111.8	111.0	108.0	105.7	99.5	94.4	88.0	**120.6**	**113.5**
Tower crane	75.2	87.5	98.3	102.3	98.8	94.5	89.4	87.1	86.0	77.6	**105.6**	**100.4**
Truck crane	110.5	111.3	109.9	106.8	104.5	105.9	107.1	100.0	89.2	79.9	**117.2**	**111.5**

It should be noted that machinery power levels should be interpreted according to percentages of actual use, which are given in the following table.

Table 3-28: Percentage of actual use of construction equipement of the OHL line

Macchinario	**% of using**	**% di att. eff.**
Motor generator	10	100
Truck	50	85
Concrete mixer truck	50	85
Track excavator	80	85
Tower crane	80	50
Truck crane	80	50

Phonometric measurements taken at a similar construction site about 50 meters from a support in March 2013 were used to assess the impact due to this construction phase. The following figure show the time history and frequency spectrum of the construction site activity period (7 a.m. to 7 p.m.) using the machines listed above.

Figure 3-5:Time history construction site 7 - 19 for OHL construction activities (source: TERNA)

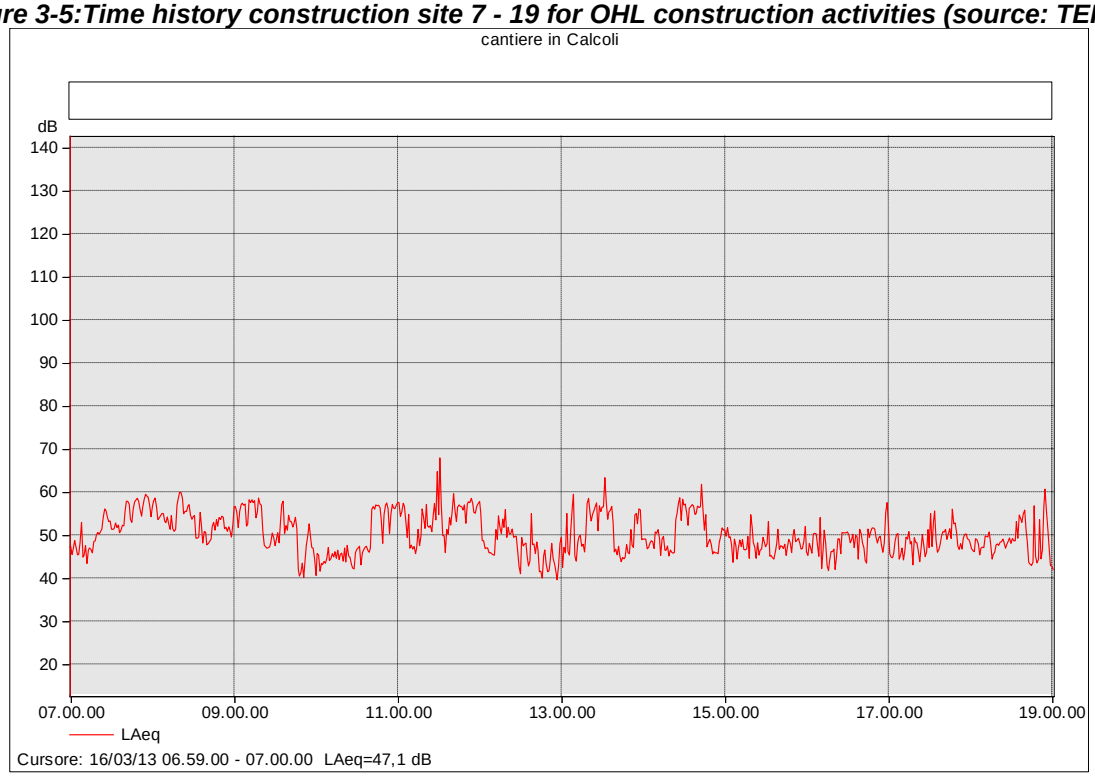
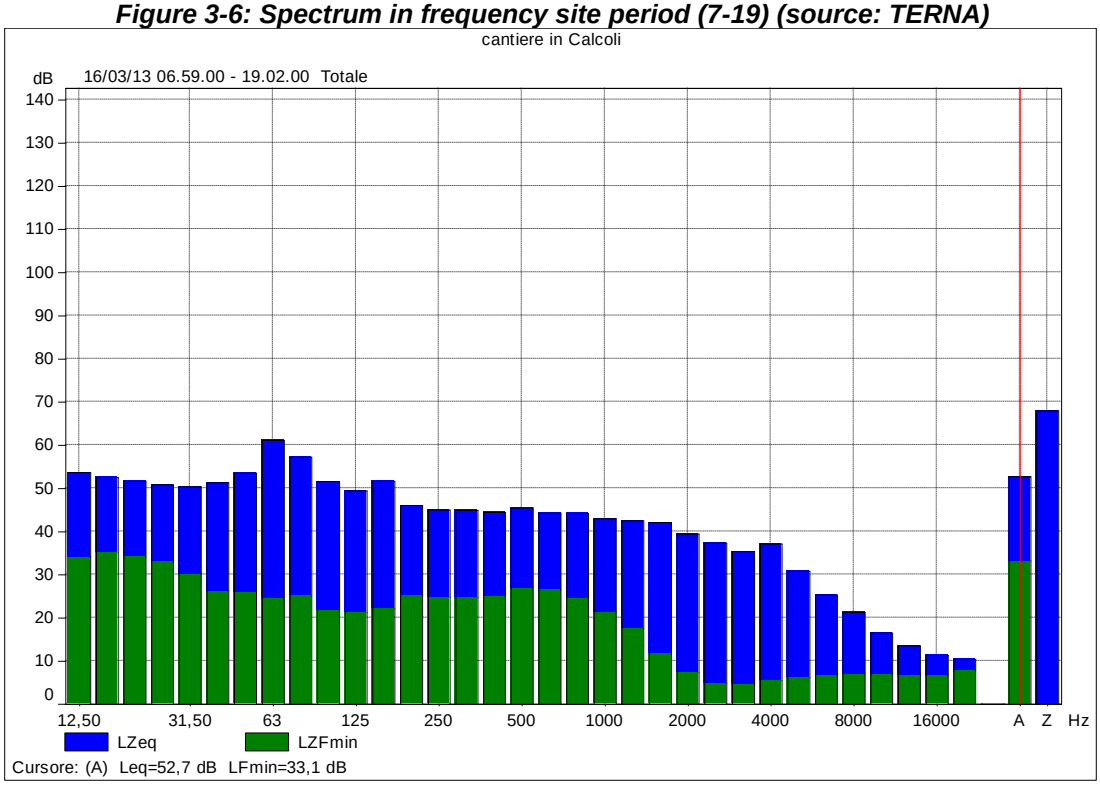


Figure 3-6: Spectrum in frequency site period (7-19) (source: TERNA)



During the tower foundation construction activities, noise levels may exceed the limits fixed by the Order of the Municipality of Tunis (as described in 3.4.1 section) and by the WBG, but the noise generated is likely to be attenuated with the distance from the construction site and we excpect that the noise intensity should not

exceed the fixed levels for the above sensible receptors (settlement and fauna), as indicated by the tow above graphs showing that the operation of construction equipement would generate a noise of about 53 dB at 50 m from the center of gravity of the construction site.

It is important to note that the OHL line does'nt cross any residential areas, thus there is no major settlement or high sensitive receptors near the AOI of the OHL. Only some isolated houses may be affected by the increase in noise due of tower construction and the vehicle movement.

- Stretching of conductors

Stringing of the conductors is generally done with the help of a helicopter to speed up operations.

During the stringing phase, the helicopter is stationed for the time required to lay the stringing cord in the pulley (approximately 2-3 minutes). This operation is performed for each phase and for the guard rope. The helicopter flies at a height close to the brackets of the supports, both while resting on the support and while in transit, and every 1 to 1.5 hours of flight, a refueling stop is performed (approximately 15 minutes).Helicopter use is generally limited to the middle hours of the day, avoiding the hours dedicated to rest (early afternoon).

Given the minimal duration of the concentrated disturbance at one point relative to the reference time, generally the noise impact related to helicopter use can be considered negligible.

The noise generated by the construction activities will mainly have an impact on the involved workers.

Construction activities will be concentrated and done sequentially in order to garantee the monitoring of noise during this phase of the Project. This noise generated will not have a consistent level throughout the entire construction duration (48 months) due to the discontinues nature of construction operations in terms of location, by tower foundation.

Considering the construction activities schedule, the nature of works and the mitigation measure to be taken, the intensity of the impact is considered ''Moderate'' and its extent is expected to be ''**Low**''.

Overall, the impact magnitude is ***Low***.

Noise–Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in noise levels due to the construction of the OHL line	Moderate	Low	Low	Low

3.4.2.1.5 Impact Significance

In the following table reports the impact significance for all potential impacts previously analysed, based on the receptors sensitivity and impact magnitude

Noise– Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Increase in noise levels due to the construction of the Mlaâbi CS	Moderate	Low	Moderate
Increase in noise levels due to construction of underground cable	Moderate	Low	Low
Increase in noise levels due HDD at the landfall	Moderate	Low	Low
Increase in noise levels due to the construction of the OHL line	Moderate	Low	Low

3.4.2.2 Mitigation Measures

The reduce potential impacts from noise generated by the construction activities, the following measures will be required:

- All major construction plant and equipment will comply with international noise emission limits;
- Switch off equipment when not in use (Machines in intermittent use will be shut down in the intervening periods between work, or throttled down to a minimum);
- Minimising noise emissions, with implementation of a regular inspection and maintenance regime;
- All vehicles and mechanical plant used for the purpose of the works will be maintained in good working order.
- Transportation activities and the delivery of construction materials will be planned during normal working hours;
- Limit noise activities to the least noise –sensitive time of the day: the contractor company must notify local community when they are located within 500 m from the OHL corridor. The noise generating equipment (with high level of noise emission) should be located as far as possible from nearby sensitive receptors;
- During land clearance land activities for the OHL, , noisy plant or equipment will be situated as far as possible from nearby noise sensitive receptors that may be adversely affected by noise;
- Vehicle movements shall be limited to a speed limit of 20 km/h, especially when sensitive receptors are located near the construction sites;
- Noise monitoring will be undertaken during periods when activities are taking place in close proximity to noise sensitive receptors to demonstrate compliance with WBG noise criteria and according to the Environmental Management Plan.

3.4.2.3 Residual Impacts

With the implementation of the above mitigation measures for reducing noise generation at source, noise impacts would further reduce.

3.4.3 Operation phase

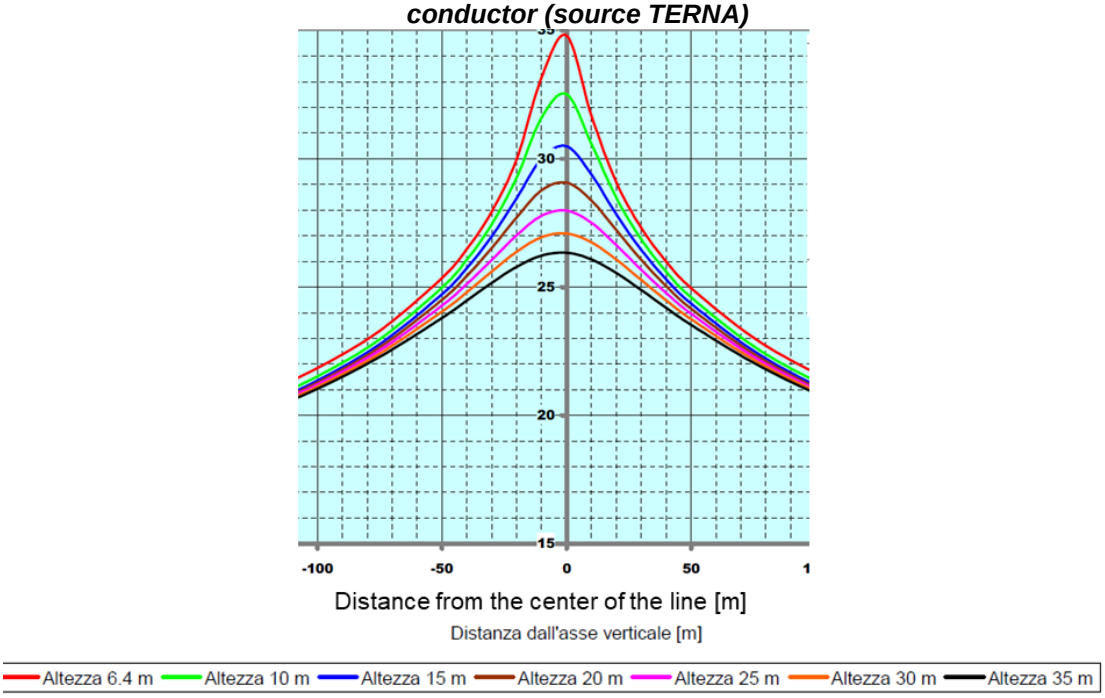
During the project operation phase, the only noise emissions are related to the operation of the Mlaâbi CS and the operation of the OHL line.

Sources of noise during the operation and maintenance phase would include the following:

- Operation of the transformer units and the cooler systems, which are the key noise emission;
- Vehicle movement during maintenance activities;
- Wind effect: the effect occurs only under conditions of strong winds (10-15 m/s), thus with high background noise. Although experimental and literature data are not available, it is believed that, in the presence of such winds, the background noise nevertheless assumes values such that the effect of wind on the structures of the work is practically negligible.

- Corona effect: This effect is manifested around high-voltage lines by the production of electrical discharges in the air, which are generally visible in very wet weather conditions such as fog or rain or on humid nights through a faint luminescence around conductors. . The noise associated with it is thus due to the ionization of air surrounding an electrically charged conductor in a thin tubular layer, which, once ionized, becomes plasma and conducts electricity.
  The cause of the phenomenon is the high potential difference that in some cases is established in this region. Ionization is determined when the value of the electric field exceeds a threshold called the dielectric strength of air, and is manifested by a series of electric discharges, which affect only the ionized zone and are thus confined to the cylindrical corona in which the field value exceeds the dielectric strength. The dielectric strength of dry air is about 3 MV/m, but this value decreases significantly in the mountains (due to the greater rarefaction of air) and especially in the presence of moisture or dirt.
  For the evaluation of noise from the corona effect, reference is made to a study produced by CESI that evaluated the noise levels due to various types of supports and at various distances from the same under weather conditions of zero rain and light rain.
  The following figure shows the L50 noise level under light rain conditions.

Figure 3-7: Noise level L50 (light rain) for corona effect at 1.5 m above the ground for different high of the conductor (source TERNA)



The supports under construction have a usable height between 18 and 39 meters; from the graph, it can be inferred that the expected level below the line is between 29 dBA and 26 dBA respectively and then decreases by 5 dBA at a distance of 50 meters from the support.

For the OHL line, the generated noise (corona effect) from the operation of this component is not expected to cause any impact to the potential sensitive receptors (local community and ecological receptor) because the noise would be mostly be head with the RoW of the transmission line and its noise levels will be very low as described above.

Noise generated by the operational of the Mlaâbi CS increases noise levels in the surrounding environment and it could cause nuisance for the nearby sensitive receptors. As indicated in the description of the surrounding environment of the Mlaâbi CS, no settlements are located under a radius of 500 m, the closest one are located at more than 600 m. Thus, the generated noise will be almost imperceptible at closest proprieties and other sensitive receptors (fauna living in the Mlaâbi dam).

Given the above, the intensity of the impact is considered ‘’Low’’ and its extent is expected to be ‘’Low’’. Overall, the impact magnitude is ***Negligible***.

noise – Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Increase in noise levels due to the operation of the Mlaâbi CS and the OHL line	Low	Negligible	Negligible

3.4.3.1 Mitigation Measures

At the current stage of project design no noise mitigation measures are anticipated. The implementation of specific noise mitigation measures at the Mlaâbi CS will be carefully evaluated after the performance of monitoring activities currently envisaged within the ESMP. The latter includes noise monitoring activities at the closet residential receptors:

- prior to the start of the Mlaâbi CS operation, with the aim of gathering up to date information on existing background noise level at the Mlaâbi CS compared to those currently available;
- during the Mlaâbi operation in order to ensure the compliance of induced noise levels with in force regulations.
- se of conductors conforming international standard on noise to minimize corona effect during rainy weather conditions
- Planting trees at surrounding the CS of Mlaâbi to reduce noise for human and ecological receptors (isolated settlements and fauna in Mlaâbi dam)
- uConduct noise monitoring/inspection in case of complaints from communities.

3.4.3.2 Residual Impacts

Residual impacts are equal to the above presented impacts in absence of mitigations (see Section 3.4.3.1.2).

3.5 Electromagnetic fields

The Electromagnetic field (EMF) is emitted by any electrical device, including CS and power transmission lines. The EMF is composed of two parameters, the electric field and the magnetic field. The electric field is produced by the difference of potential between two points and measured in kV/m. The magnetic field (MF) is produced by electric current and measured in microteslas (µT). The difference between the two fields is that magnetic field penetrate most materials and are difficult to shield. Electric and magnetic fields decrease inversely with the square of the distance, which is why voltage reduction occurs rapidly over very short distances.

The amplitude of the electric field modulation depends on the voltage of the OHL compoenent, which remains more or less constant as long as the OHL equipment is under operation. The strength of the magnetic field modulation depends on the electrical current (the load) carried by the OHL equipment, which varies according to the demand for power at any given time.

The Project has the potential to cause an increase in general public exposure to time-varying and static EMF only during its operation phase. In particular the Mlaâbi CS operation will generate both time varying and static EMF whereas the HVDC cable will generate only static EMF.

The following table shows the potential impacts due to the emission of EMF fields by the project components.

Table 3-29: Electromagnetic fields– Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
No impacts	• Increase in general public exposure to time-varying and static EMF due to the operation of the Mlaâbi CS • Increase in general public exposure to static EMF due to the operation of the HVDC cable • Increase in general public exposure to static EMF due to the operation of the OHL line	• As Operation Phase

3.5.1 Definition of Sensitivity

The sensitivity of the component "EMF" has been assessed on the base of the following criteria.

- *Existing regulation and guidance*

A number of guidelines/standards have been set both at national and international level to limit public exposure to EMF; international reference standards are those published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The latter is a non-governmental organization formally recognized by the World Health Organization (WHO).

Each country sets its own national standards for exposure to electromagnetic fields. In most cases, the guidelines are based on the recommendations of the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This nongovernmental organization, which is officially recognized by the WHO, examines scientific data from all countries of the world. Based on a thorough review of the scientific literature, the Commission establishes recommended exposure limits. These recommendations are reviewed periodically and updated as necessary.

The WBG EHS Guidelines also requires that exposure level limits to the public should remain below the International Commission on Non-Ionizing Radiation Protection (ICNIRP) limits provided in the table below. The WBG EHS guidelines also state that transmission lines require Right-of-ways to protect the system from windfall, contact with trees and branches, and other potential hazards that may result in damage to the system, power failures, or forest fires. Rights-of-Way (RoW) are also utilized to access, service, and inspect transmission and distribution systems, and in which RoW for transmission lines are generally from 15m to 100m.

The European standards for exposure to magnetic fields are given in recommendation 1999/519/EC of the Council of the European Union of 12 July 1999 on the public exposure to electromagnetic fields (0 Hz to 300 GHz). These standards follow the recommendations of the CPIRNI.The following table summarize the maximum exposure limits to EMF radiation as set by the ICNIRP. As indicated, the exposure limit for public is about 100 µT for magnetic fields and 5000V/m for electric fields.

Figure 3-8: Maximum EMF exposure limits as fixed by ICNIRP

Frequency	Electrical Field (V/m)	Magnetic Field (µT)
50 Hz	5000	100

At the national level, STEG has requirements for the distance of power transmission projects (OHL and cables) to potential sensitive receptors present in the neighbourhood of the OHL line, as indicated in the following table.

Figure 3-9: STEG's requirements for distance from power lines and cables

Description	Required distance			
Immediate vicinity of conductors	90 KV	150 KV	225 KV	400 KV
	12 m	13 m	14m	16 m
Immediate vicinity of conductors	La hauteur du pylône			

Given the above, existing regulation and guidelines has been classified as *"**High**".*

- *Societal Value*

Over the last years, several scientific studies was conducted to examine the short-term and long term effects from acute exposure at high level of EMF field. These studies have established a direct correlation between exposure to this field and biological effects, such as nerve and muscle stimulation and changes in nerve cell excitability in the central nervous system. These effects are directly related to external EMF fields that induce fields and currents in the human body (WHO).

While scientific studies have been conducted and there is growing interest among researchers in the potential health effects of EMF exposure to the general public, there is still no empirical evidence of adverse health effects from exposure to typical EMF levels from electrical transmission lines and equipment (extremely low frequency - ELF).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines notes that there are a number of well-established acute effects of exposure to low frequency EMFs on the nervous systems; the direct stimulation of nerve and muscle tissue and the induction of retinal phosphenes. These health effects are not believed to result in long term or pathological health effects. Regarding chronic effects, specifically, epidemiological studies indicated that long term exposure to 50 – 60 Hz magnetic fields might be associated with an increased risk of childhood leukaemia, and possible increased risk of cancer.

The Project AoI is mostly rural and sparsely populated, with the majority of settlements being located in the marine cables' landfall area (Kélibia) and near the section of the HVDC cable that cross the city of Sidi Jamel Eddine, where the project will induce only static magnetic fields as a result of the presence of this cable.

Similarly, the HV line crosses only rural areas (farmland, forest areas, etc.) with only a few isolated settlements located at certain sections along the OHL corridor.

A small number of people is therefore expected to be impacted by the Project and in light of the above societal value has been classified as *"**Low**".*

- *Vulnerability for change*

To date, no site-specific EMF data is available for the Project AoI. However, the Mlaâbi CS is relatively far from sensitive human receptors as well as from other possible sources of electric, magnetic and electromagnetic fields.

The HVDC cable crosses mostly agricultural areas, with the exception of the portion near the city of Sidi Jamel Eddine and near the industrial zone of Menzel Yahia, which are urban areas. However, direct current generates static magnetic fields and negligible adverse impacts are anticipated at this stage.

The proposed OHL transmission line would pass away form settlement except for a few isolated cases, located over 100 m from the line route. Most of the people living in the large AoI of the project are involved in agricultre (cereal, olive tree, citrus orchads, etc.) and the generated EMF would not cause inconvenience to them because of the limited time of exposure to this field. The project contains several existing HV lines, in particular the part located in Mlaabi and Grombalia where the proposed OHL line follows an existing 90 KV line. The risk of interference contains several existing HV lines, in particular the part located in Mlaabi and Grombalia where the proposed OHL line follows an existing 90 KV line. The risk of interference between the two lines and cumulative between the two lines remain possible.

Overall, even relevant changes in the local EMF are unlikely to lead to exceedances of in force limits in the Project AoI; moreover considering the absence of highly sensitive subjects such as homes, playgrounds, schools and places with stay > 4 hours per day in the close proximity of the Project, the vulnerability for change has been classified as *"**Low**".*

Compliance with safety distances from the line and the prohibition of any permanent activity in this right-of-way (16 m on either side of the axis of the line) guarantee that no one is dangerously exposed. to the electromagnetic field.

Overall the Sensitivity of the component EMF is conservatively classified as ***Moderate.***

Electromagnetic fields			
Characteristics of sensitivity			Sensitivity
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
High	Low	Low	Moderate

3.5.2 Construction phase

3.5.2.1 Potential impacts

The project construction phase does not generate electromagnetic fields, therefore **no impacts** are expected to occur in this phase.

3.5.3 Operation phase

3.5.3.1 Potential impacts

3.5.3.1.1 Increase in general public exposure to EMF associated to the Mlaâbi CS operation

As performed in Italian side, the assessment of EMF associated to the operation of the Mlaâbi CS is based on field measurements performed by CESI for TERNA on existing facilities of the same kind.

In particular, field measurements considered in the assessment have been performed for the converter station “HVDC-Galatina”, located in Italy (Apulia), in 2004. This station is part of the “Greece-Italy undersea electricity connection Project” and currently represents the standard scheme for this type of facilities. Its characterization with respect to electric and magnetic fields can be therefore considered representative for similar HVDC undersea connection, such as the one object of the present IA.

The above-presented EMF monitoring campaign was performed in accordance with the following standards:

- International Standard IEC 61786 (1998): "Measurements of low frequency magnetic and electric fields with regard to exposure of human beings - Special requirements for instruments and guidance for measurements" and the recommendations of the CPIRNI.

Measurements have been recorded along the station fence line at a height of 1 m above ground, during the station operation under normal operative conditions.

- Time-varying electric and magnetic fields

Monitored values of time-varying electric and magnetic fields are well below international and national exposure limits in force for general public. The table below shows monitored concentration maxima against international and national exposure limits in force.

The highest values of EMF associated to the CS operation were recorded near the cables entry and exit points.

Table 3-30: Time –varying EMF monitoring at the operative CS fenceline (Source: HVDC-Galatina –EMF Monitoring study 2004)

Monitored variable	Maximum monitored value	ICNIRP and WBG limits
Electric Field (V/m)	≈ 3800	5000 V/m
Magnetic Field (μT)	1.39	100 μT

→ Limit set for the protection of human health not to be exceeded under any exposure conditions. This limit refers to the RMS (root mean square) value

→ Limit set for protection from long-term effects near homes, playgrounds, schools and places with stay > 4 hours per day. This limit refers to the daily median of short term values under normal operative conditions

→ Limit set for protection from long-term effects applicable to:

- The design of new power lines in proximity of sensitive areas such as homes, playgrounds, schools and places with stay > 4 hours per day;
- The design/planning of new settlements and sensitive areas listed above in the proximity of existing power lines.

This limit refers to the daily median of short term values under normal operative conditions

- Static magnetic field

Static magnetic field measurements were performed in the proximity of direct current cables. Recorded values are slightly above the background value due to the earth's magnetic field (≈ 50 μT) and below ICNIRP and EU exposure limits (400·000 μT and 40·000 μT respectively).

In light of the above, the EMF associated to the Mlaâbi CS operation is expected to result in **negative impacts** of **low Intensity** and **low spatial extent**.

The operation of the CS is going to be continuous through the Project lifetime, with consequent continuous generation of EMF. The changes in local EMF induced by the project in the near proximity of the CS (fence line) will therefore be of **high duration**; however those changes are not expected to be noticeable.
Given the above the magnitude of impacts, intended as potential increase in general public exposure to time-varying and static EMF due to the operation of the Mlaâbi CS, has been classified as **low**.

Electromagnetic fields –Operation Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in general public exposure to time-varying and static EMF due to the operation of the Mlaâbi CS	Low	Low	High	Low

3.5.3.1.2 Increase in general public exposure to EMF associated to the HVDC cable operation

- Static electric field

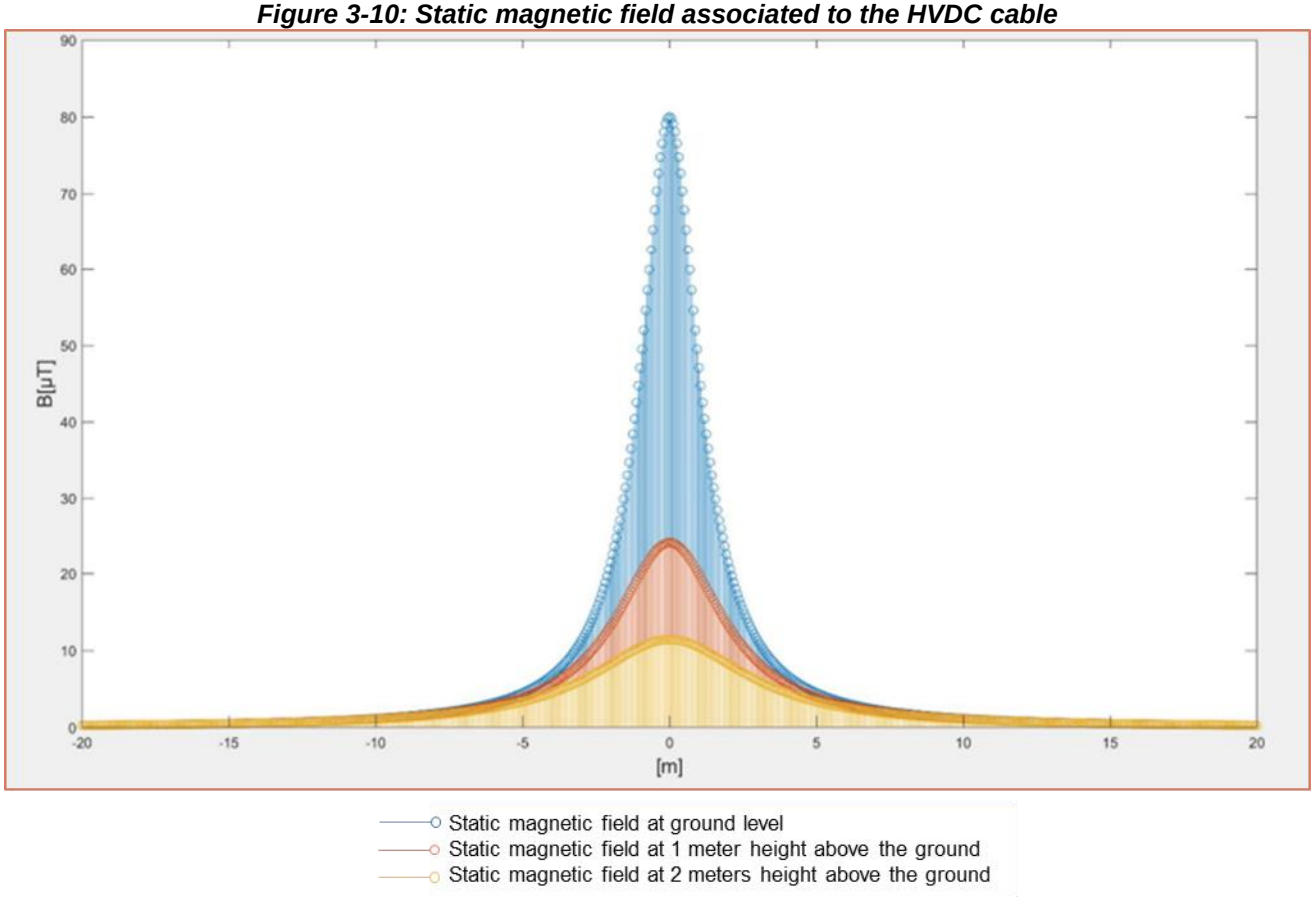
The electric field generated by the HVDC cable during the Project operation phase will be completely shielded by the cable metal shield; therefore, **no impacts** associated to the **HVDC cable electric field** are expected to occur.

- Static magnetic field

As for the Italian side, the assessment of static magnetic field induced by HVDC cable is based on the outcome of a detailed study performed by TERNA in support of the Project design.

According to this study, the maximum static magnetic field value calculated at ground level is of ≈ 80 µT, at 1 meter height above the ground is ≈25 µT and at 2 meters height above the ground is ≈12 µT. These values are all well below ICNIRP and EU exposure limits (400·000 µT and 40·000 µT respectively). Ground level values in correspondence of the cable are slightly above the background value due to the earth's magnetic field (≈ 50 µT).

Figure 3-10: Static magnetic field associated to the HVDC cable



In light of the above, the static magnetic field associated to operation is expected to result in **negative impacts** of **low Intensity** and **low spatial extent**.

The operation of the HVDC cable is going to be continuous through the Project lifetime, with consequent continuous generation of static magnetic field. The change in the local magnetic field induced by the project in the near proximity of the HVDC cable (5-10 m buffer) will therefore be of **high duration**, however those changes are not expected to be noticeable.

Given the above the magnitude of impacts, intended as potential increase in general public exposure to static MF due to the operation of the HVDC cable, has been classified as **low**.

Electromagnetic fields –Operation Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in general public exposure to static EF due to the operation of the HVDC cable	-	-	-	No Impact
Increase in general public exposure to static MF due to the operation of the HVDC cable	Low	Low	High	Low

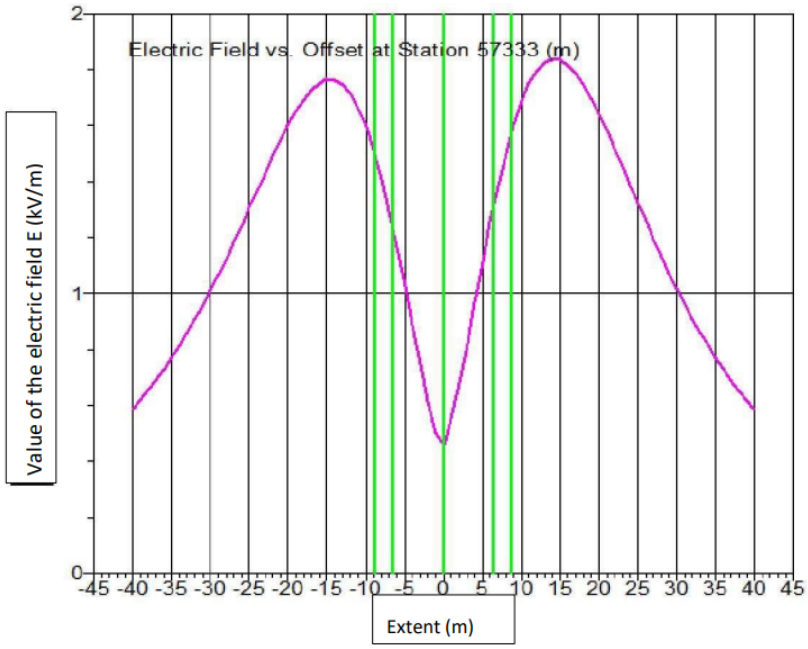
3.5.3.1.3 Increase in general public exposure to EMF associated to the OHL line

For the OHL 400 kV Mlaâbi-Mornaguia, the evaluation of the generated EMF were made based on data collected from similar projects.

- Static electric field

The electric field generated by the OHL line during the Project operation phase will will reach a maximum value of 1837 V/m at 14 m from the axis of the transmission line and at 27 m the value will be only 139 V/m, as presented in the following figure. At 16 m, which is the neighbourhood distance set by STEG for 400 kV power transmission lines, the electric field reaches the 1800 V/m.

Figure 3-11: Electric field for a 400 kV power line (source EMS)

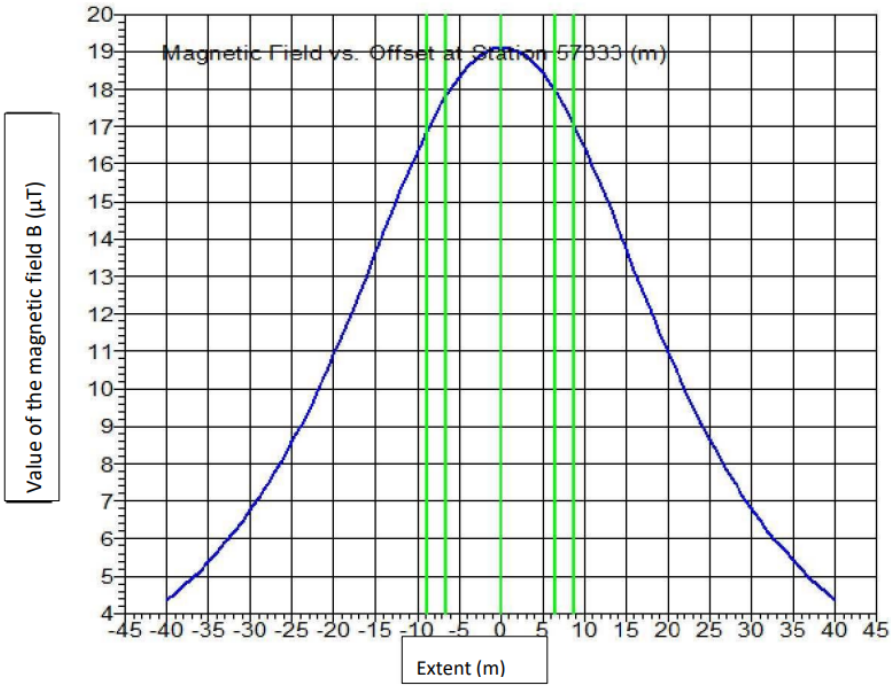


In light of the above, the static magnetic field associated to operation is expected to result in **negative impacts** of **low Intensity** and **low spatial extent**.

- Static magnetic field

The magnetic field generated by the OHL line during the Project operation phase will reach a maximum value of 19.10 µT in the axis of the transmission line and the value at 16 m (as fixed by STEG for the distance required for 400 kV lines) the value will be 12.8 µT which is below the limit value fixed by ICNIRP (100 µT), as shown by the following figure.

Figure 3-12: Magnetic field for a 400 kV power line (source EMS)



According to this study, the maximum static magnetic field value calculated at ground level is of ≈ 80 µT, at 1 meter height above the ground is ≈25 µT and at 2 meters height above the ground is ≈12 µT. These values are all well below ICNIRP and EU exposure limits.

In light of the above, the static magnetic field associated to operation is expected to result in **negative impacts** of **low Intensity** and **low spatial extent**.

Given the above the magnitude of impacts, intended as potential increase in general public exposure to static MF due to the operation of the OHL cable, has been classified as **low**.

Electromagnetic fields –Operation Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increase in general public exposure to static EF due to the operation of the OHL line	Low	Low	High	Low
Increase in general public exposure to static MF due to the operation of the OHL line	Low	Low	High	Low

3.5.3.1.4 Impact Significance

Electromagnetic fields – Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Increase in general public exposure to time-varying and static EMF due to the operation of the Mlaâbi CS	Moderate	Low	Low
Increase in general public exposure to static EF due to the operation of the HVDC cable	Moderate	No Impact	No Impact
Increase in general public exposure to static MF due to the operation of the HVDC cable	Moderate	Low	Low
Increase in general public exposure to static EF due to the operation of the OHL line	Moderate	Low	Low
Increase in general public exposure to static MF due to the operation of the OHL line	Moderate	Low	Low

3.5.3.2 Mitigation Measures

At the current stage of project design, the following **design measures** resulting in prevention of EMF impacts, are anticipated:

- HVDC cable metal shield, shielding completely EF;
- Project layout definition and siting of new facilities aimed at ensuring that no direct impact on sensitive receptors occur (e.g. CS siting, cable route definition);
- Towers will be designed according to best practices and standards;
- Use of appropriate personnel protective equipment (PPE), such as: rubber hand gloves, hard hats, safety boots, etc.
- Information and Education of local communities regarding the effects of EMF.

Considering the outcome of the impact assessment, based on EMF monitoring and modelling studies, **no need for additional specific mitigation measures** is anticipated at this stage. It is noted that the changes in local EMF induced by the Project are not expected to be noticeable at the closest sensitive receptors.

Moreover, during the Mlaâbi CS and OHL operation, EMF will be periodically monitored and evaluates such as to ensure no disturbance occurs.

3.5.3.3 Residual Impacts

Residual impacts are equal to the above presented impacts in absence of mitigations (see Section 3.5.3.1.4).

3.6 Landscape and Visual Amenities

The following Table provides a brief overview of the potential impacts on landscape and visual amenities induced by the Project.

Table 3-31: Landscape and Visual Amenities– Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
• Visual impacts and physical changes of the landscape features due to the construction of the Mlaâbi CS and related worksite, earthworks and machinery • Temporary visual impacts due to the construction of underground cable • Visual impacts and physical changes of the landscape features due to the construction of the OHL line	• Visual impacts and physical changes of the landscape features due to the presence of the Mlaâbi CS • Visual impacts and physical changes of the landscape features due to the presence of the OHL line	• As Operation Phase

3.6.1 Definition of Sensitivity

As outlined above the only permanent landscape transformations are attributable to the new CS and the OHL line, whereas interferences induced by underground cable connections will be temporary and limited to the construction phase only.

With regard to the latter, it is noted that the "underground cable'' category includes a HVDC cable which will be developed on existing asphalted roads and by being buried they will not cause visual interferences during the project operation phase, and are therefore comparable for the purposes of assessing the impacts on landscape.

The sensitivity of the landscape has been assessed based on the criteria set by the IA methodology (namely: existing regulation and guidance, societal value and vulnerability for change).

- *Existing regulation and guidance*

The reference landscape context is characterized by the presence of some historical-archaeological-cultural constraints, even if they are not on the corridor However, there is no direct interference with future construction site areas and neighbouring areas, neither under the constraint aspect, nor in relation to interferences with historical-testimonial values and valuable elements of the historical settlement system.

Given the above, the level of existing regulation and guidelines in the study area has been classified as ***"Low"***.

- *Societal Value*

The landscape societal value has been was determined by evaluating the following landscape aspects:

  - Morphology and soil use

The area is characterized by a predominantly flat morphology for the whole area concerned by the HVDC cable and the Mlaâbi CS. In the other hand for the OHL component, the latter crosses flat land between Menzel Temime and El Mida, between Beni Khalled and Grombalia and towards Mornaguia, It also passes by relatively uneven grounds (towards Beni Ayech, Khanguel El Hojjej and over a large part located in Ben Arous).

There is an agricultural use of the soil, with the presence of tree crops, mainly olive groves and, to a lesser extent, vineyards and orchards (citrus groves especially in Menzel Bouzelfa and Beni Khalled delegations) and annual crops (cereal) very present in the delegations of Menzel Bouzelfa and El Mida (Nabeul) and in the sections located in Zaghouan, Ben Arous and Manouba.

  - Naturalness

Although most of the study area is heavily influenced by agricultural activities, the OHL line will also cross natural areas occupied by forest species, especially for the part located on the administrative boundary between Nabeul and Ben Arous (Khanguel El Hojjej and Kabouti).

- Visual relevance

The geomorphological and landscape characteristics of the site in relation to the main visual receptors that can be found within 4 km (Partanna CS and OHL line AoI) result in a moderate visual relevance of the project area.

- Landscape singularity

The characteristics of the landscape surveyed appear generally common in the territory of the area in question; however, the presence of vegetation emergencies represents a landscape value element that further qualifies the project area.

The area crossed by the OHL line, has already many existing transmission power lines, as shown as shown in Figure 3-7, and other facilities (roads, telecommunication towers, etc.).

Given the above, the level of societal value in the study area has been classified as *"Moderate".*

- *Vulnerability for change*

The vulnerability for change has been was determined by evaluating the following landscape aspects:

- Presence of landscape degradation elements (e.g. anthropic elements);
- Vegetation emergencies intended as sensitive targets.

The area of interest shows landscape degradation elements of medium importance. Among the most important elements are:

- Existing power lines.
- Ongoing infrastructure/road projects

In terms of sensitive targets in the area, the following vegetation emergencies are noted: forest areas in particular near the administrative limit between Nabeul and Ben Arous, these areas includes several species (tetraclinis cuticulata ''Thuya de Berberie", cypress, carob tree, pine, etc) of high visual value and presence of citrus and olive plantations, as elements of landscape singularity.

Given the above, the vulnerability for change in the study area has been classified as *"Moderate".*

Overall the Sensitivity of the landscape is classified as ***Moderate.***

Landscape and visual amenities			
Characteristics of sensitivity			
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	**Sensitivity**
Low	Moderate	Moderate	Moderate

3.6.2 Construction phase

3.6.2.1 Potential impacts

3.6.2.1.1 Visual impacts due to the construction of Mlaâbi CS

Visual impacts and physical changes to the landscape features due the construction of the Mlaâbi CS have been assessed by evaluating the landscape components reported below:

- The CS area has a sub-flat morphology: the CS construction will require the removal existing vegetation (annual crops), earthmoving, levelling operations and excavation and back-filling with re-profiling of the ground around the CS.
  Actually, the construction site is used for agricultural purposes for the fodder production. Before the start of the construction phase, these crops will be eliminated as a preparatory activity, which will change the landscape in this rural area.
  Minor landscape disturbance is associated with the CS construction yard, as well as with the presence of machinery, materials and stockpiles which will be a temporary and reversible as the site will be restored after construction.
  The construction of the new CS constitutes a moderate in the impact on the landscape due to the nature of the land that will be completely transformed into a new industrial zone where other industrial units will be developed.

Given the above, the construction of the Mlaâbi CS will overall result in **negative impacts** of **high intensity** and **moderate spatial extent and duration**, overall classified as **high.**

Landscape and visual amenities – Construction phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Visual impacts and physical changes of the landscape features associated to construction of the Mlaâbi CS	High	Moderate	Moderate	High

3.6.2.1.2 Visual impacts due to the construction of underground cable

The construction of underground cables and related construction yards and machinery will constitute a temporary and reversible interference with the landscape for all the evaluation components examined (morphological, visual and symbolic).

Furthermore, no direct physical changes of the landscape features are expected to occur, given that the underground cables will be primarily built on existing roads and related temporary work sites/storage areas will be located on the carriageway.

Given the above, the construction of cable connections will result in **negative impacts** of **low intensity**, **spatial extent** and **duration**, overall classified as **low**.

Landscape and visual amenities – Construction phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Visual impacts due to the construction of underground cable	Low	Low	Low	Low

3.6.2.1.3 Visual impacts due to the construction of OHL line

For the OHL line, the main project activities likely to affect landscape character and visual amenity in the Study Area are:

- Vegetation clearance and removal: areas of tree cover (forest), agricultural/plantations (olive, citrus, annual crops) will be cleared by heavy machinery within the project are.

- Landform modification: localised variations in the natural landform will be removed, in particular for the tower foundations.
- Temporary camp for workers that will be located within the construction sites.

Construction activities may create a temporary disturbance due to degradation of views in the surrounding landscape, especially for sensitive receptors located near the tower locations. These activities would be more visible when carried out within an open landscape: flat ground with no dense vegetation cover, which is the case for several areas affected by the OHL line (areas located between the Mlaâbi CS and El Mida delegation and around Grombalia where the main land use is annual crops with some vineyards). In forest areas (around Beni Ayech, Khanguet El Hojjej and Djebel Ressas and Kabouti), construction activities will be less visible for local communities

The landscape and visual human receptors includes the following:

- Resident persons located near the corridor of the transmission line: local residents will be affected by the presence of construction vehicle and equipment. It concerns communities living around the area potentially affected by the construction activities, including peoples near the access roads used by construction vehicles and machines. The impact will be moderate to low due to the nature of construction operations, limited in time and space and will be done in a discontinuous way tower by tower.
- Travellers and tourists: visitors of the Cap Region especially during summer season and hikers who choose the natural protected areas, forest zones and cultural attraction sites (Nabeul and Ben Arous). The construction activities could negatively affect this category. Travellers and tourists would be exposed for a short period and we expect that the visual impact of the construction phase will be moderate to low on them.

Given the above, the construction of cable connections will result in **negative impacts** of **low intensity**, **spatial extent** and **duration**, overall classified as **low**.

Landscape and visual amenities – Construction phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Visual impacts due to the construction of OHL line	Moderate	Low	Low	Low

3.6.2.1.4 Impact Significance

Landscape and visual amenities – Construction phase			
Impact Significance			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Visual impacts and physical changes of the landscape features associated to construction of the Mlaâbi CS	Moderate	High	High
Visual impacts associated to the construction of underground cable	Moderate	Low	Low
Visual impacts due to the construction of OHL line	Moderate	Low	Low

3.6.2.2 Mitigation Measures

The project will not implement specific mitigation measures to mitigate impacts on landscape during the construction phase. This is due to the following aspects:

- The start of the CS construction involves the replacement of the vegetation with the anthropic element and this marks the beginning of interferences on the landscape: these will reach the highest peak when the construction works of the CS are completed (operation phase). Several design and mitigation measures will be implemented to mitigate impacts during the project operation phase, some of which will be developed alongside construction works;

- Impacts on landscape associated to the construction of underground cable have been classified as low. The nature of these impacts is temporary (i.e. limited to the length the construction activities) and transient (i.e. works will move along the cable route as they progress at a rate of 500÷800 m per month, and do not constitute a fixed source of disturbance); given the above no need for additional specific mitigation measures associated to the construction of underground cables is anticipated at this stage.

- Rehabilitate disturbed areas around construction sites of the OHL line (tower foundations) in order to restrict extended periods of exposed soil.

- Maintain construction site in orderly condition and do not distribute material over many sites before usage.

- Restore temporal work sites after construction, once construction operations of a tower are completed and before moving on to the next tower the previous tower construction site should be restored and all generated waste removed.

3.6.2.3 Residual Impacts

Residual impacts are equal to the above presented impacts in absence of mitigations.

3.6.3 Operation phase

3.6.3.1 Potential impacts

The only landscape transformations attributable to the Project operation phase are visual and physical changes to the landscape features due the presence of the Mlaâbi CS and the OHL line, described and assessed hereinafter.
No impacts on landscape are associated to the presence of underground cable, developed on existing roads.
The insertion of new towers and its conductors will have an intrusive effect on sensitive receptors present in the area. These towers could be visible over a long distance from the corridor (around 4 km) while the conductor is less visible.

3.6.3.1.1 Visual impacts and physical changes to the landscape features due the presence of the Mlaâbi CS

The overall visual impact due to the presence of the Mlaâbi CS is likely to be negative for some human receptors living near the project area, the isolated settlements near the industrial zone where three families living there and for residents of the village located close to the Mlaâbi dam (at 1 km from the CS site).

In addition, the aesthetic effect of the CS could be expected to be on the users of the existing regional road C45 where many persons frequent this infrastructure through the new industrial zone of Mlaâbi and they would perceive the new CS.

The main landscape and visual impacts due to the presence of the CS are related to the following aspects:

- Morphological impact on landscape components: the technical characteristics of the CS and its location lead to a significant alteration of the morphological and vegetation characteristics of the project area with the replacement of the vegetation with anthropic elements.
- Visual impact: the CS is expected to cause relevant visual interferences due to its technical characteristics (volumes and relative heights (about 20 m)) and to the presence of sensitive landscape receptors within the range of visual influence of the work (4 km).
  The new CS is expected to become the dominant element of the landscape, in sharp contrast with the agricultural environment, which is impoverished by the direct interference of the project infrastructures with elements of landscape singularity and visual characterizing relevance (agricultural lands including both annual crops and olive tree, some eucalyptus tree near the Mlaâbi wetland).
- Symbology impact: as already noted, the study area is already affected by numerous landscape interferences, among all the presence of a wastewater treatment plant located towards the northern part of the project area and some MV powers lines. Therefore, in a context that has already absorbed landscape transformation elements, the new CS constitutes a moderate increase in the landscape impact.

Given the above, the operation of the Mlaâbi CS will result in **negative impacts** of **high intensity** and **moderate spatial extent** and **high duration**, overall classified as **high.**

Landscape and Visual Amenities – Operation Phase					
Characteristics of magnitude					**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**		
Visual impacts and changes of landscape features associated to operation of the Mlaâbi CS	High	Moderate	High	→	High

3.6.3.1.2 Visual impacts and physical changes to the landscape features due the presence of the OHL line

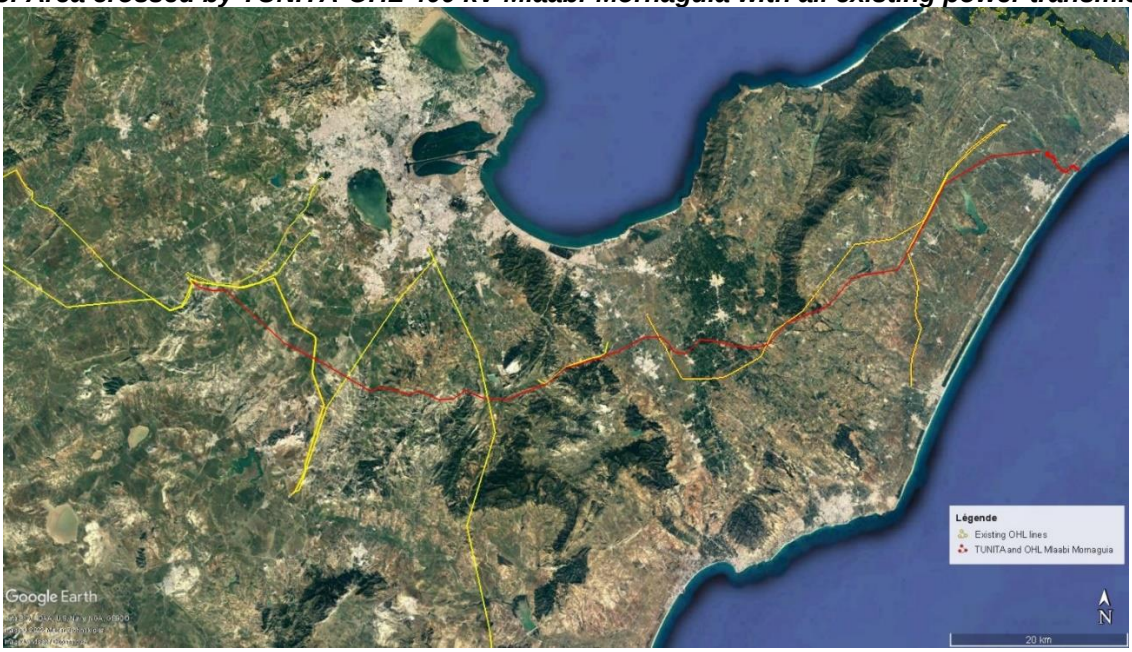
Visual impacts from the transmission line are highly variable and depends on several factors and criteria, such as: the perception of human receptors, location and type of visual receptor, topography, lines of sight, scenic vistas, the features of the environment crossed by the OHL component.

Potential visual receptors in the region crossed by the line may include, as the final design of the latter is to be fixed later by the contractor company, the following: communities located near the line corridor (most common are isolated and scattered settlements), travellers using road network, visitors and tourists.

The overall visual impact of the transmission line is likely to be negative for rural communities, in particular for these living between EL Kabbouti and Jbel Ressas (Mornag Delegation, Ben Arous Governorate) where the area is mainly characterized by a landscape dominated by agricultural activities (cereal and olive plantations) and forest land (shrub).

The other areas crossed by the OHL transmission line, have many existing transmission lines and other telecommunication facilities. From Mlaâbi to Grombalia, the OHL 400 kV line will be located near two 90 kV power lines that connect Sidi Abdelmonam CS to Korba and Grombalia. The same goes for parts located between Grombalia (Nabeul) and Jbel Ressas (Ben Arous) and sections between Bir Mchergua (Zaghouan) and Mornaguia (Manouba), where several power transmission lines exist as shown in the following figure.

Figure 3-13: Area crossed by TUNITA-OHL 400 kV Mlaâbi-Mornaguia with all existing power transmission lines



Given the above, the operation of the OHL line will result in **negative impacts** of **moderate intensity** and **moderate spatial extent** and **high duration**, overall classified as **moderate.**

Landscape and Visual Amenities – Operation Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Visual impacts and changes of landscape features associated to operation of the OHL line	Moderate	Moderate	High	Moderate

3.6.3.1.3 Impact Significance

Landscape and visual amenities –Operation phase			
Impact Significance			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Visual impacts and changes of landscape features associated to the operation of the Mlaâbi CS	Moderate	High	High
Visual impacts and changes of landscape features associated to operation of the OHL line	Moderate	Moderate	Moderate

3.6.3.2 Mitigation Measures

Within the framework of the present IA, a series of potential landscape mitigation measures in the new CS and the OHL line area have been identified.

These measures are aimed at reducing the interference on the landscape components and the visual disturbance induced by the two new components, improving the inclusion of the project into the current landscape.

- *Design measures*

At the current stage of project design, the following design measures resulting in prevention of impacts on landscape, are anticipated:

- Project layout definition and siting of new facilities aimed at ensuring the least possible negative impacts (e.g. CS siting, cable route definition);
- Restore pre-construction conditions as much as possible (e.g. re-vegetation) in temporary construction yards and construction areas;
- With reference to the external finishes of the CS, materials in harmony with the dominant colours of the landscape context will be preferred, favouring soft and pastel colours (light sand-earth colour palette);
- The design of the CS includes a surrounding area to be used for soil re-profiling suitable to host shielding wooded areas.
- Positioning towers carefully within the landscape by including tower visibility as a factor in final tower placement, taking advantage of existing structures and determining an appropriate balance between tower heights and number of towers.

- *Addittional specific mitigation measures*

In addittion to the design measures listed above, the project will implament the following landscape mitigations:

- Within the RoW of the OHL, smaller trees and vegetation (not exceeding 4 m) shall be preserved in order to reduce the visual impact due to the presence of towers;
- Replacement planting of native trees, in particular for areas strongly affected by vegetation removal operations (forest and shrub areas between Grombalia and Zaghouan and near Beni Ayech);
- Shielding wooded area (pluri-specific natural system of autochthonous tree-tall-shrubby and shrubby species). This measure will allow a reduction of visibility from sensitive receptors by creating a stratified vegetation visual screen. The reintegration of autochthonous species of high ecological and landscape value will be preferred as well as composite vegetation systems which, in addition to the creation of an effective visual screen, are functional to the trophic support for the avifauna and useful entomofauna;
- Consolidation of the perimeter slopes with naturalistic engineering works and planting of native shrubs. This measure has a stabilizing effect and allows to reduce erosion on the slopes affected by soil excavation re-profiling;
- Where possible, protection measures will be implemented for valuable olive trees interfering with the station area;
- The reintegration of autochthonous species along the access road to the CS and, occasionally, within the perimeter shielding wooded area.

Given the above, the mitigation and prevention possibilities related to impacts on landscape during the project operation phase are classified as *high*. It is however noted that the feasibility and detailed design of the above measures will be assessed and finalised in details in the following stages of the Project design.

Landscape and Visual Amenities – Operation Phase	
Impact	**Mitigation and prevention possibilities**
Visual impacts and changes of landscape features associated to the operation of the Mlaâbi CS and the OHL line	High mitigation possibilities

3.6.3.3 Residual Impacts

Landscape and Visual Amenities – Operation Phase					
Residual impacts significance					
Impact	**Sensitivity**	**Magnitude**	**Significance (prior to mitigations)**	**Mitigation and prevention possibilities**	**Impact significance after mitigation**
Visual impacts and changes of landscape features associated to the operation of the Mlaâbi CS	Moderate	High	High	High mitigation possibilities	Moderate
Visual impacts and changes of landscape features associated to the operation of the OHL line	Moderate	Moderate	Moderate	High mitigation possibilities	Low

4. ENVIRONMENTAL RISKS AND IMPACTS – BIOLOGICAL ENVIRONMENT

Baseline information for terrestrial biodiversity in relation to the study area has been collected, as based upon a desk study review, data collected from detailed field visits and the findings of the IBAT assessment.

Potential ecological receptors include the following:

- Protected areas: sites with legal status and protected by law in Tunisia and these covered by international conventions such RAMSAR or biological receptor that have been identified as important for biodiversity, such as Important Bird Areas (IBA) and Key Biodiversity Areas (KBA).
- Natural habitats: although habitats within the project area are degraded (expansion of agriculture, urbanization, etc.), they are still some areas considered as important for many species (flora and fauna).
- Plant species: species within the RoW of the project
- Fauna species: within and outside the project area, which are likely to be disturbed due to the construction and operation activities (namely avifauna).
- Other species: including freshwater fish, mammals and reptiles.

4.1 Definition of Sensitivity

The following Table provides a brief overview of the potential impacts induced by the Project on flora and habitats.

Table 4-1: Flora and vegetation– Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
• Loss and disturbance of natural habitats and species (flora and fauna) • Increase of invasive alien species • Impact on ecosystem service due to the disturbance of species with ecological high value and providing services for local community or regarding their role for carbon sequestration and other services	• Loss and disturbance of natural vegetation due to operation activities • Increase of mortality for birds • Increase of mortality for bats	As Construction Phase.

The sensitivity of the component “Flora and habitat” has been assessed on the base of the following criteria.

- *Existing regulation and guidance*

The main projects activities that have the potential to disturb biodiversity components, in particular disturbing natural habitats, flora and fauna species include the establishment of construction areas at towers and CS, construction of the CS, construction of towers, vegetation clearing and removal during construction and operation phases.

The vegetation in the project area varies: the area concerned by HDD and the HVDC underground activities is totally anthropized with the presence of several human activities (industry, housing, agricultural land). For this two components, the agricultural crops present are vineyards (near the industrial zone of Menzel Yahia) and cereal crops within the area located between Sidi Jamel Eddine and the CS of Mlaâbi.

The Mlaâbi CS will be built on a future industrial zone, which will be developed by the Industrial Agency (AFI) before the construction of the CS. The construction area is currently occupied by annual crops (maize) to produce fodder for livestock sector. The removal of vegetation to clear the CS construction site will cause loss of mostly modified agricultural land.

The HVDC cable will pass through existing roads: the unpaved road connecting the industrial zone of Menzel Yahia, where the construction of underground cable may affect a line of cypress windbreak installed along a vineyard. After, the cable will then follow the existing roads to reach the river of Tafekhsite, where the cable will reach the CS by passing through the easement of Tafekhsite. For this section of HVDC, directed drilling will be used to avoid/reduce any damage or disturbance on water resources or riparian species.

The OHL, considered as the main component of the terrestrial part of the project, will cross different types of habitats and land use. This includes agricultural land (olive, citrus, cereal, vineyard, etc.), grassland and some fragmented forest areas. Areas with potential high biodiversity value are mainly mountainous lands, around Beni Ayech, the area between Grombalia and Jebel Ressas and some areas located in Zaghouan. These areas are occupied by forest and scrubland with some olive trees. The OHL corridor is located near many sites of ecological interest for flora and fauna (wetlands, RAMSAR/IBA sites, etc.).

It is important to note that most of forest areas in Cap-Bon and in other regions crossed by the OHL, is affected by human activities (agriculture and urbanization).

Currently, Tunisia has comprehensive legislation regarding exploitation of natural resources and biodiversity conservation, such as Forestry Code, Water Code and other specific regulations on protection of wetlands (RAMSAR sites).

National laws and/or international agreements with protect several flora and fauna species in Tunisia, in particular those placed in the Red List of IUCN.

The inventory of the ecosystem services output from the area affected by the OHL project reveal the relatively low importance of forest, wetlands and natural zone that represent successively 13%; 0.7% and 0.4 %. The major OHL buffer still over modified areas (agricultural or urban which represent 82.3% and 4.1%).
According to this, the ecosystems services still not vulnerable.

Concerning flora, the only specified vulnerable flora taxa revealed by IBAT Tool assessment is *Leopoldia maritima* (VU). It is largely extent in Tunisia (Ben Haj Jilani et al. 2020). The IBAT Tool allows identifying eight point of this red list specie in the extended AoI.

Given the above, "*existing regulation and guidelines*" has been classified as *"**High**", in particular for protected areas (RAMSAR Convention) or for species with a conservation species.*

- *Societal Value*

The disturbance expected on flora and fauna component due to the development of all terrestrial parts of the Project are minimal, limited in space and time. Therefore, the "*societal value*" has been classified as *"**Moderate**".*

- *Vulnerability for change*

The HDD and the underground cable will not have a significant long-term impact on natural habitats and species.

The habitat, environment dominated by an agricultural activity, loss at the CS site will directly altered agricultural land causing the loss of ecosystem services offered by the area chosen for the construction of CS (decline in fodder production, erosion, landslide, etc.). Without adequate mitigation measures, the construction of CS may affect natural habitats.

The tower footing and erection of OHL line will involve removal of trees/shrubs located only on tower foundations and all vegetation present along the RoW of the power transmission line will be preserved, since species present never reach the conductor.

Therefore, considering that the majority of Project will be developed on existing roadways, the "vulnerability for change" has been classified as "***Moderate***".

Overall the Sensitivity of the receptor "Biological Environment" is classified as ***Moderate.***

Biodiversity			
Characteristics of sensitivity			**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
High	Moderate	Moderate	Moderate

4.2 Construction phase

4.2.1.1 Potential impacts

4.2.1.1.1 Loss of vegetation and habitat disturbance due to the construction of HDD, HVDC underground cable and Mlaâbi CS

Most of land to be crossed by the HVDC cable consists of paved and unpaved roads located on urban areas and agricultural land (cereal and olive trees). The line route of HVD cable follows existing roads, located between the industrial zone of Menzel Yahia and the CS of Mlaâbi, in order to avoid/reduce potential impact on natural habitats and flora. No new access roads should be required for construction activities. Construction activities of HDVC may have a low impact on a cypress windbreak, located along the access road to the industrial zone, and on vegetation species present on the bank of the Tafekhsite watercourse (last section of the underground cable to reach the Mlaâbi CS.

The HDD activities, at the marine cable's landfill in Kélibia, should not have any potential impacts on natural habitats or species as the junction box and all works will be on an industrial area, where the baseline is already disturbed by human activities (industrial units for sardine and anchovy industrial units).

As indicated above (section 4.1), the CS will be built on a future industrial area and construction activities will require the removal of exiting maize crop causing the loss of this agricultural land. The construction yard will also be located within the industrial zone in order to avoid any additional loss or disturbance of natural or sub natural vegetation in adjacent areas to the Project site. No additional access roads will be developed during construction phase of CS.
Construction activities of the CS, such as filling, levelling or grading operations could alter the topography and therefore the existing natural drainage system, change the soil profile and soil proprieties and could disturb top-soil habitats and other micro-habitats, which may be present in the area. They also can obstruct drainage channels and affect the natural groundwater recharge process as a result.

The main component of the terrestrial part of the OHL project, will cross different types of modified habitats. This includes agricultural land (irrigated perimeters, farmland, Pastureland, olive, citrus, cereal, vineyard), grassland and some fragmented forest areas are common. The OHL corridor is located near many wetlands sites of ecological interest for flora and fauna (RAMSAR/IBA/KBA sites, etc.).
Variable damage on crops and vegetation can be expected during this activity. Outside forest areas with very dense cover, it is possible to pass the cable between trees and avoid/reduce any possible damage to them. This is the case for the project's area, where the OHL will pass through relatively open and rural landscape, except areas occupied by citrus orchards between Menzel Bouzelfa and Grombalia and forest areas and scrubland near Jebel Ressas (between Ben Arous-Nabeul and Zaghouan).

Corridors of 12km wide along the routes of the OHL line over 113 km between Mlaabi and Mornaguia, will be affected both in the terrestrial part and in the aerial part in relation to the heights and types of pylons. Added to this are the 5.7 km of HVDC underground cables and the junction box.

In the underground part, the burying of the cables displaces the sediments, however its effect is localized because the majority of the displaced sediments will be deposited less than tens of meters from the route of the cable. In addition, the small-scale impacts will concern agricultural soils and road structures or infrastructure (roads, tracks, roads).

Otherwise for the high voltage lines, more specifically, the areas where the pylons are installed are subject to temporary damage and disturbances linked to excavations and the displacement of sediments over approximately 20,608 m² (322 pylons x 64 m²). Flora and endogenous fauna species will have occasional impacts and their recovery will be relatively quick due to their adaptation to the environment. As for the vagile fauna, the species are capable of fleeing outside the work area. The overall environmental footprint on the terrestrial environment is generally low and most habitats will only be partially disturbed. The avifauna may suffers the highest impact and disturbance.

Indirect impact zone may extends through varied agricultural and urban lands, likely to affect wadis (rivers) as well as natural wetlands and at reservoirs or dams (artificial wetlands) around. These sites make a network suitable for different birds' activities, breeding, nesting, feeding, and resting.

Given the above, the magnitude of impacts associated to the loss of natural vegetation during construction activities for the above three components of the Project (HDD, HVD and CS) is classified as ***Low*** with low intensity and direction and low spatial extent but with moderate duration.

Biodiversity – Construction phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Loss of vegetation and habitat due to the construction activities of HVDC, HDD and CS	Low	Low	Moderate	Low

4.2.1.1.2 Loss of vegetation due to the construction of OHL line

The proposed line route for the OHL 400 kV between Mlaâbi and Mornaguia traverses through a mix of modified habitats, mostly farmland (cereal crops, citrus orchards, olive tree plantations, vineyard, etc.), with some natural habitats, mostly located in mountainous areas: areas close to Jebel Sidi Abderrahmen (towards Errahma and Beni Ayech delegations) and on the section located between Khanguet El Hojjej –Jebel Ressas and El Gonna.

During construction phase, tower footing and erection will require removal of trees, shrubs present at tower location only, and all vegetation present under the conductor and between towers will be preserved. These activities and the construction of access roads, if any, are likely to cause change in the exiting natural habitat within the OHL corridor leading to a loss of species (flora and fauna). Excavation and vegetation removal will increase soil exposure to erosion and run-off.

The magnitude of OHL construction activities on farming land, present in the region, is therefore moderate, impact will be small and will concern only footprint area for towers, and it can be reduced to low with the implementation of additional mitigation measures.

Given the above, the construction of the Mlaâbi CS will overall result in **negative impacts** of **low intensity** and **low spatial extent and moderate duration**, overall classified as **low.**

Biodiversity – Construction phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Loss of vegetation due to the construction of OHL line	Low	Low	Moderate	Low

4.2.1.1.3 Impacts on protected and sensitive areas

There are a variety of habitats in the AoI considered as a protected areas and key biodiversity areas, as reported by the IBAT assessment. These sensitive areas are protected by national law and covered by international conventions ratified by Tunisia (Ramsar Convention). The impact of construction activities will be significant on these areas, where some sensitive receptors (animals and birds) may be affected by the project.

A total of 14 KBA (Key Biodiversity Area) are located in the large AoI of the Project.

Table 4-2: List of the Key Biodiversity Areas (KBA) identified by the IBAT tool in the extended AoI

N°	Key Biodiversity Area (KBA)	Distance from AoI (km)	Typology	International Status
1	Barrage Oued El Hjar	0 km (inside AoI)	Artificial Wetland	Ramsar Area
2	Barrage Mlâabi	0 km (inside AoI)	Artificial Wetland	Ramsar Area
3	Barrage Sidi Abdelmoneem	0 km (inside AoI)	Artificial Wetland	Ramsar Area
4	Barrage Lebna	0 km (inside AoI)	Artificial Wetland	Ramsar Area
5	Barrage Chiba	0 km (inside AoI)	Artificial Wetland	
6	Barrage Bezikh	3 km	Artificial Wetland	
7	Barrage Masri	3 km	Artificial Wetland	
8	Barrage Mornaguia	7 km	Artificial Wetland	Ramsar Area
9	Lagune de Korba	6 km	Natural Wetland	Ramsar Area
10	Lagune de Soliman	5 km	Artificial Wetland	Ramsar Area
11	Jbel Boukornine	0.5 km	Moutain	
12	Jbel Zaghouan	14 km	Moutain	
13	Dunes de Ras El Melan	2 km	Coastal dunes	
14	Aqueduc de Zaghouan	0 km (inside AoI)	Archeological site	

These areas are described in the table below.

Table 4-3: Protected and Key Biodiversity areas (source: IBAT)

Name	Summary
Barrage Mlâabi Ramsar Site and Important Bird Area (IBA)	98 ha freshwater storage area on the Cap Bon peninsula constructed mainly for ground water recharge, serving today for irrigation. It supports several populations of waterbirds migrating between Africa and Eurasia, as well as Endangered (EN) White-headed Duck (*Oxyura leucocephala*, up to 32 individuals) and Vulnerable (VU) Marbled Teal (*Marmaronetta angustirostris*).

Name	Summary
Barrage Oued el Hjar Ramsar Site and Key Biodiversity Area	One of the most recent and biggest freshwater dams (254 ha) in a series recently constructed in Tunisia for agricultural purposes. It is an important migratory bottleneck for migrating birds which pass across the Mediterranean and is a nesting and wintering ground for several waterbirds (e.g. *Oxyura leucocephala, Marmaronetta angustirostris*. In spring, it provides a resting place for several species (not only waterbirds) which migrate to Africa in winter. It harbours more than 1% of the population of several important waterbird species including *Arythya nyroca, Oxyura leucocephala and Phoenicopterus roseus*.
Barrage Lebna Ramsar Site and Important Bird Area (IBA)	1,147 ha of water reservoir isolated from the rest of the national dam system, effectively preventing any water exchange between this site and other nearby barrages. It has become a destination for tens of thousands of waterfowl migrating between Africa and Europe (*Marmaronetta angustirostris, Oxyura leucocephala, Aythya nyroca* etc.). The site is classified as an IBA due to its importance for migratory and nesting waterbirds (number exceed 20.000 birds), such as the Glossy Ibis (*Plegadis falcinellus*), the Eurasian Spoonbill (*Platalea leucorodia*), the Little Bittern (*Ixobrychus minutus*), the Western Swamphen (*Porphyrio porphyrio*), etc.
Barrage Sidi Abdelmoneem Ramsar Site and Key Biodiversity Area (KBA)	31 ha artificial reservoir which provides nesting opportunities for many threatened waterfowl species (*Oxyura leucocephala, Marmaronetta angustirostris*).
Barrage El Masri Important Bird Area (IBA)	Unlike the Cap Bon reservoirs, it has been constructed for water-supply to the national grid rather than local irrigation. It is situated quite high up in the Dorsale and flanked by mountains which reach 660 m, to the west of the town of Grombalia, south-east of Tunis. Though the reservoir is small, it holds *Oxyura leucocephala* (10–50 pairs), while breeding species include *Podiceps cristatus* and *Tachybaptus ruficollis*. Wintering waterbirds include *Aythya ferina* and *Fulica atra*.
Aqueduc de Zaghouan IBA	The site is a Roman aqueduct, situated 17 km south of Tunis, which used to form part of the Zaghouan to Carthage water-supply system. It consists of a series of 20-m-high pillars and arches in which many cavities and holes have developed. The cavities and holes in the aqueduct are used as nesting and roosting sites by *Falco naumanni* (30 pairs), *F. biarmicus, F. tinnunculus, Coracias garrulus, Petronia petronia, Sturnus unicolor* and *Corvus corax.*
Lagunes du Cap Bon oriental / Korba Ramsar Site and IBAT	504 ha coastal wetlands isolated from the sea by a thin sand strip and beaches. The variety of habitats and vegetation make the site ideal for several species of fauna, especially reptiles and waterfowl, several of which are threatened.
Lagunes de Soliman (Sebkhet Soliman) Ramsar Site and IBA	The coastal plains of Soliman are located at the southern end of the Gulf of Tunis, between two mountains, Djebel Bou Kournine and Djebel Korbeus. The site is representative of the large coastal plain in a quasi-natural state and includes a lagoon, sandy areas and dunes. It serves as a refuge for species whose original habitats have disappeared, particularly given the proximity to Tunis, It is an important refuge for waterbirds, supporting nesting populations of many species, such as Marbled teal (*Marmaronetta angustirostris*), White stork (*Ciconia ciconia*), Mediterranean gull (*Ichthyaetus melanocephalus*), Sandwich tern (*Sterna sandvicensis*) and Collared Pratincole (*Glareola pratincola*).

Name	Summary
Complexe des zones humides de barrage Ghédir El Golla et barrage El Mornaguia Ramsar Site and Important Bird Area (IBA)	273 ha freshwater storage areas nearby the city of Tunis constructed for potable water supply and irrigation, providing nesting grounds for several waterbirds and a wintering ground for migrating species, including the Eurasian Wigeon (*Anas Penelope*), the Marbled Teal (*Marmaronetta angustirostris*) and White-Headed Duck (*Oxyura leucocephala* - up to 73 individuals, representing 14 % of the species population in the West Palearctic region).
Parc National Boukornine National Park and KBA	19 km2 of national park located east of Tunis, which supports important flora and fauna species in an increasingly urbanised landscape.
Forêt de Dar Chichou Faunal Reserve	Forest located close to the northern extreme of Cap Bon Peninsula.
Barrage Bezirk Key Biodiversity Area (KBA)	Very little information on the biodiversity value of this KBA.
Barrage Chiba Key Biodiversity Area (KBA)	Very little information on the biodiversity value of this KBA.
Dunes de Ras El Melan Key Biodiversity Area (KBA)	Little information on the biodiversity value of this KBA.

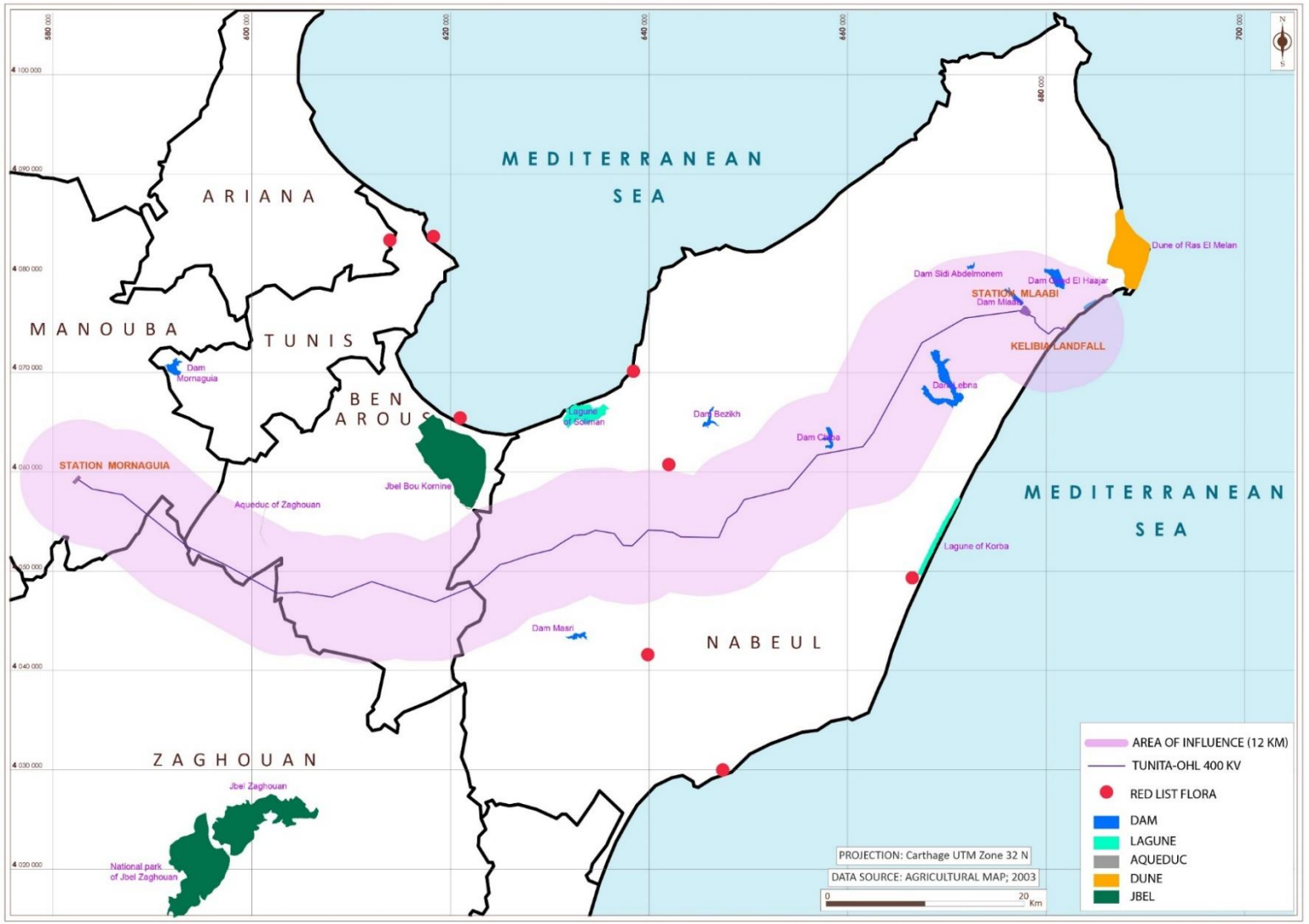


Figure 4-1: Key Biodiversity Areas (KBA) and Red List Flora identified by the IBAT tool in the extended AoI

Clearing and construction of the land to be used for the construction (CS, towers installation and erection, access roads, etc.) will involve the removal of existing vegetation at tower locations and substation and will change topographic features and habitat alteration. Several species, typical of these protected and key biodiversity areas, may have their habitats disturbed and changed due to destruction and fragmentation of forest and shrub areas and due to loss of feeding, hunting and nesting areas within the RoW of the project.

These protected and KBA areas, including forest and scrubland land, may host a good number of sensitive floral species and wildlife (mammals, reptiles, birds and bats). Such areas are often used as breeding, feeding and nesting habitats for many bird and bat species, some of which are placed on the IUCN red list as vulnerable or endangered species.
The following table presents potential impacts on sensitive species, identified within the project's area, that may potentially affected during construction activities:

Table 4-4: Potential impacts on sensitive fauna due to construction activities

Potential impact	Source of impact	Potential species
Alteration and disturbance of bird habitats, used generally for breeding and nesting	Removal of vegetation and clearing of RoW for the CS and OHL line (at tower locations), such activities will lead to the alteration of natural habitat for birds (migrating and nesting) used for feeding and roosting. Dust and waste, including chemical pollutants, generated by vehicle and construction equipment and that may be a source of pollution for wetlands used by birds Noise generated by the operation of vehicle and machinery may also dirupt bird habitats during breeding and nesting seasons.	White-headed Duck (*Oxyura leucocephala,* considered as endangered (EN) by IUCN red list) Marbled Teal (*Marmaronetta angustirostris*, considered as vulnerable (VU) by IUCN red list) Glossy Ibis (*Plegadis falcinellus*) Eurasian Spoonbill (*Platalea leucorodia*)
Alteration and disturbance of bat habitats, used generally for breeding and nesting	Removal of vegetation, trampling and clearing of RoW of the OHL line. These activities will lead to the alteration of natural habitat used by bats for feeding and roosting. Removal of trees and shrubs used by foliage roosting bats, in particular in areas occupied by forest tree (Beni Ayech, Jebel Ressas). Accidental pollution due to movement of vehicle and construction equipment.	Potential bat species may be present within the RoW of the OHL line. Mountains areas located near Chiba Dam (Beni Ayech and Errahma) and Jebel Ressas (between Nabeul and Ben Arous) where some bats species are often found (a feu individuals), such as: *Myotis capaccinii* (VU) *Miniopterus schreibersii* (VU) *Rhinolophus blasii* (LC)

The movement of vehicles and construction machinery is expected to increase the exposure of natural habitats, located near the CS and tower foundations, to dust emission, noise and will lead to pollution of natural resources and possible contamination of wetlands by fuel and other chemical pollutants.

Given the above, the construction of cable connections will result in **negative impacts** of **High intensity** and **Moderate spatial extent** and **duration**, overall classified as **Moderate**.

Biodiversity – Construction phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Impacts protected and sensitive areas	High	Moderate	Moderate	Moderate

4.2.1.1.4 Impact Significance

Biodiversity – Construction phase			
Impact Significance			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Loss of vegetation and habitat due to the construction activities of HVDC, HDD and CS	Low	Low	Moderate
Loss of vegetation due to the construction of OHL line	Low	Low	Moderate
Impacts protected and sensitive areas	High	Moderate	Moderate

4.2.1.2 Mitigation Measures

Mitigation measures must focus on the minimization of the duration of field works and the work seasons which should less interfere with these services such as: birds migration, pollination or recreational and tourism services. Secondly, the mitigation may be reinforced by the reforestation of all modified zones taking into account the original vegetation cover.

Even though the construction activities of the whole project (HDD, HVDC, CS and OHL) will not have significant impacts on natural habitats and flora and fauna species. Therefore, the following mitigation measures are required to avoid and/or reduce impact on biodiversity:

- Prior to the construction phase, a Biodiversity Action Plan (BAP) will be prepared to identify the distribution of species (fauna and flora) with conservation concern within the OHL corridor and CS of Mlaâbi
- The Contractor must integrate the results/recommendations of the BAP to ensure the protection of natural habitats and species
- Consult with the competent authorities (Ministry of Agriculture and Forest Department DGF, APAL) and stakeholders (association and NGO such as AAO and ATVS) prior to any vegetation removal and clearing)
- Undertake an additional flora/fauna inventory during wet season to verify if there are any protected species within the project's area, in particular for ‘’*Leopoldia maritima*’’ (considered as vulnerable VU by IUCN) and the ‘’ *Thorectes puncticollis*’’ (considered as EN by IUCN) around the HDD construction sites
- Provide training for workers on biodiversity value and need to avoid any disturbing or destroying flora and fauna
- Conserve the connectivity and integrity of existing natural water channels to reduce impact of vegetation removal on herpetofauna, invertebrates and other species
- Avoid construction activities during breeding/nesting season in forested areas and near IBA/RAMSAR sites
- Avoid complete clearing of the RoW and protect trees located adjacent to the construction sites
- Demarcate the boundaries of construction areas (CS, towers, HDD, HVDC, access roads) and vegetation disturbance will be limited to within the boundaries and train workers to remain within demarcated construction sites
- Integrate natural topographical features into the project construction plans to conserve the natural topography of the construction areas
- Use existing roads as far of possible to reach the construction sites and restrict movement of construction vehicles (heavy machines) strictly to pre-designated routes
- Ensure an adequate management of spoil and soil to prevent any damage outside the construction areas
- Offset the loss of any natural vegetation removed along RoW of the OHL and near the CS and along the access roads used during construction phase
- At the end of construction, all disturbed areas and used roads must be restored
- Reduce external soil supply (from other regions) to avoid any introduction of invasive species
- Noise mitigation/management measures (see above)

- Limiting of vehicles speed, preventing possible wildlife-vehicles collisions
- Undertake an additional flora/fauna inventory during wet season to verify if there are any protected species within the project's area, in particular for ''Leopoldia maritima'' (considered as vulnerable VU by IUCN) and the '' Thorectes puncticollis'' (considered as EN by IUCN) around the HDD construction sites.

Specific measures must be taken for avifauna and other animal groups (bats), when the final design of the OHL line is fixed by the Contractor, such as:

- Monitoring of bird mortality (collision and electrocution): conduct a field survey of bird mortality on the existing power transmission lines in Cap Bon region to identify areas with high risk for birds. This survey will help the Contractor to optimize the design of OHL line and avoid passing through these high risk areas. A qualified ornithologist will be involved with the design team. The monitoring should cover all the area to be crossed by the OHL line and around the existing power transmission lines, it will also allow to:
    - Identification of proiroty sites (IBA and RAMSAR sites near the OHL corridor and used by birds) and avifauna species, such as ***Neophron percnopterus*** (Egyptian vulture, **EN**), ***Falco cherrug*** (Saker Falcon, **EN**), ***Falco vespertinus*** (Red-footed Falcon, **VU**) and other considered highly vulnerable due to the risks of collision and electrocution due to the presence of power transmission lines. Other bird species are likely to have their feeding and/or nesting sites disturbed due to construction activities, such as ***Oxyura leucocephala*** (White-headed Duck, **EN**), ***Marmaronetta angustirostris*** (Marbled Teal, **VU**) and other water birds.
    - Awareness and training plans for workers with the participation of DGF department and AAO (NGO)
    - Implementation of monitoring activities during construction works
- Consult stakeholders and local community to collect information on bird incidents or hits and areas with high risk of mortality should be identified
- Before establishing the final design of the OHL, bird-use areas (breeding, nesting, etc.) should be reported to guide appropriate routing of the OHL and its roads access
- Clearance of vegatation should be minimized, in particular for OHL sections crossing areas occupied by forest and shrub (nera Beni Ayech, between Grombalia and Jebel Ressas)
- Keep existing vegetation in the RoW as floral species present in the region will never reach the conductor
- The Contractor should integrate bat protection during the design of the OHL ligne and towers should be placed away from wetlands and any water points
- Waste management procedure to avoid/reduce any waste accumulation on construction site
- Switching off engines not in use to reduce noise duration and intensity.

The project will not implement specific mitigation measures to mitigate impacts on terrestrial biodiversity during construction phase.

4.2.1.3 Residual Impacts

Residual impacts are equal to the above presented impacts in absence of mitigations.

4.3 Operation phase

4.3.1.1 Potential impacts

4.3.1.1.1 Impacts due to operation of CS of Mlaâbi, HVDC and HDD

The HVDC underground cable and SLJ junction box (HDD area) will be completely buried and will not have significant impacts on the biological environment and habitats, which are already affected by human activities (urbanization and agriculture). Therefore, impact of operation of the two components of the Project is considered negligible.

During the operation phase, potential impacts of the presence of the OHL will be as follows:

- Physical barrier due to presence of electrical equipment might affect the movement of wildlife within the project areas, which may affect the access of some waterbirds to Mlaâbi dam, considered as key

biodiversity area for many migratory and nesting birds. The presence of CS could also affect other fauna groups potentially present near Tafekhsite watercourse and Mlaâbi dam.

- Pollution and accidental contamination of watercourses and wetlands due to presence of oil and other chemical pollutants used by electrical equipment present in the CS. Although low, the risk of a leak or accidental spill remains possible and can negatively affect the soil and water resources present in the area of CS.
- Use of artificial lighting for the illumination of CS during the operation phase, during night-time, is likely to disrupt natural biological cycle of many species.
- Movement of vehicle and operation equipment will be associated with an increase of dust and exhaust emissions and an increase of noise level within the project area and around it. These factors could increase the risk of pollution of natural habitats used by several fauna species for breeding, feeding and nesting.

With adequate mitigation measures, to avoid and reduce any potential risk for RAMSAR/IBA site of Mlaâbi near the CS, the impact of operation phase is considered low.

Biodiversity – Operation phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Impact due to construction of CS of Mlaâbi, HVDC and HDD	Low	Low	Low	Low

4.3.1.1.2 Impact due to operation of OHL

During operational phase, the main environmental risks are the collision and the electrocution of avifauna species, in particular for migratory birds. Other animal species may also be negatively affected, such as bats (in particular species with critical conservation status).

There is no risk of electrocution because it can only take place when two conductors are touched at the same time and the minimum distance between two cables is 5 m.

The RoW and the presence of OHL line, including its electrical equipment, do not present any impact on terrestrial flora and fauna during operation phase. As mentioned for construction phase, no vegetation will be removed during operational phase of the Project since the type of vegetation (forest, agricultural land, etc) present in the area allows keeping an optimal distance with the conductor and will not present any technical risk for the operation of OHL.

- ***Avifauna***

The project area is well concerned by avifauna: around 71 bird species were inventoried in the area (AAO, 2013). The Cap Bon has always represented a privileged way of passage for the migratory flow of water birds on a global scale due to its geographical location (Sicily-Tunisian channel). The migratory flows of these birds are spectacular during the spring prenuptial passages.

Indirect impact zone may extends through varied agricultural and urban lands, likely to affect wadis (rivers) as well as natural wetlands and at reservoirs or dams (artificial wetlands) around. These sites make a network suitable for different birds' activities, breeding, nesting, feeding, and resting.

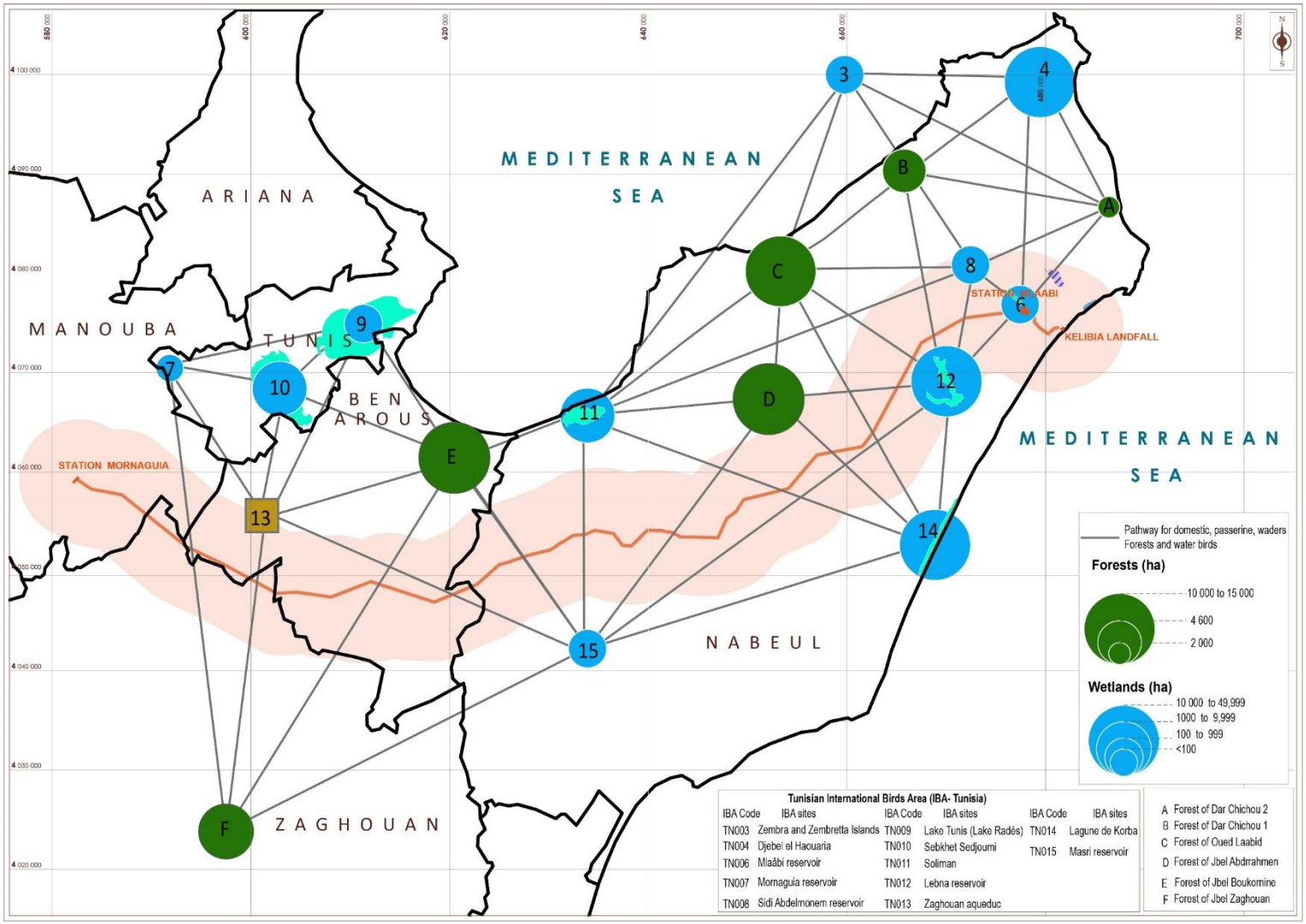
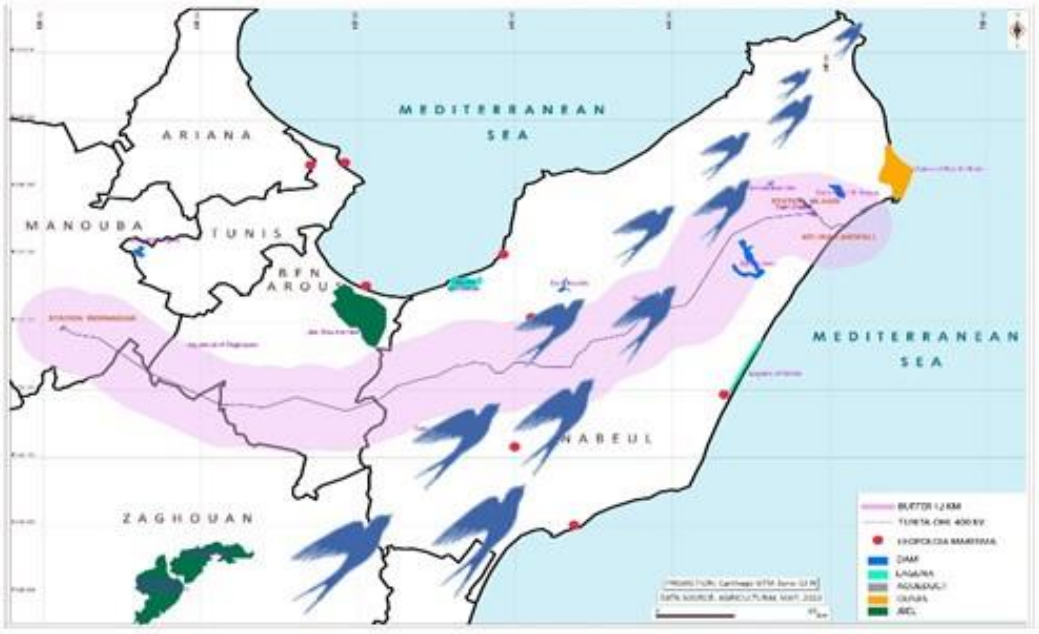


Figure 4-2: Pathways for domestic, passerine, waders, forests and water birds

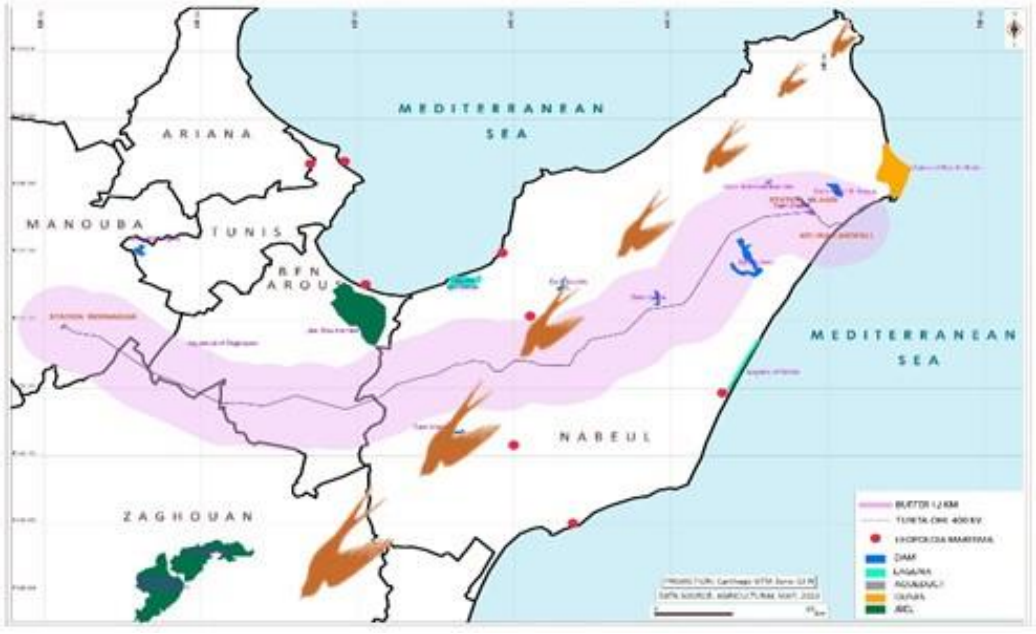
Usually, three (3) migratory flows can be identified:

- **The spring migration** which extends from March to June, with Africa-Europe direction. This migration is characterized by flights in flocks comprising a large number of individuals. Spring migration is rapid, and birds returning to their nesting grounds are therefore in a hurry to reproduce.



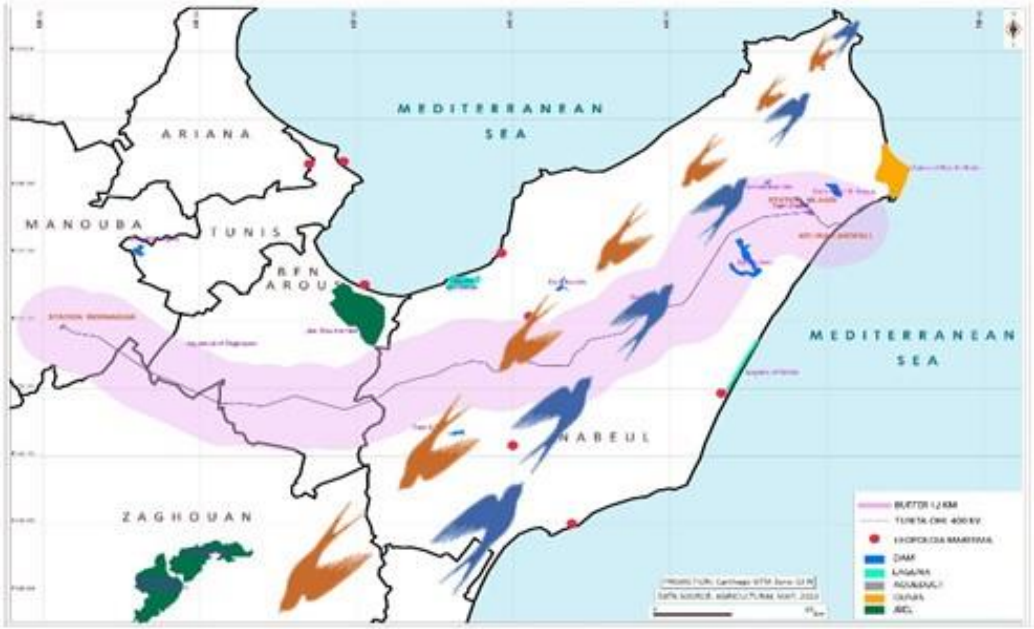
Spring migration

- **The autumn migration** which extends from September to November in the Europe-Africa direction. The birds that migrate during this period are much more dispersed with several stopovers along the way.



Autumn migration

- **The winter migration** of water birds (ducks, geese) starting by the end of November from Europe to Africa, and by the end of February for the comeback.



Winter migration
Figure 4-3: Major migratory corridors across the project area

Many raptors have been observed at this site: the booted eagle (Hieraeetus pennatus), the short-toed eagle (Circaetus gallicus), the honey buzzard (Pernis apivorus), the common kestrel (Falco tinnunculus), the black kite (Milvus migrans), marsh harrier (Circus aeruginosus), sparrowhawk (Accipiter nisus). Other sedentary nesting species such as white kite (Elanus caeruleus), ferocious buzzard (Buteo rufinus), are encountered.

Among the birds that frequent the wetlands four species requiring special attention:

- The slender-billed curlew (Numenius tenuirostris);
- The Audouin's gull (Larus audouini);
- The white-headed duck (Oxyra leucocephala);
- The marbled teal (Marmaronetta anguistorostris).

Further to the eleven (11) wetlands designed Ramsar sites adjoin the project area, the closest IBAs are eight (8) sites, between 0.5 and 33 km from the project route: Zembra and Zembretta (TN003) Mlaabi dam (TN006), Sidi Abdelmoneem dam (TN008), Lobna dam (TN012) , El Masri dam (TN015), Korba lagoon (TN 014) Sebkha Soliman (TN011), Sebkha Sijoumi (TN010).

The flight altitude is highly variable depending on the species, ranging from tens to hundreds of meters above the ground. Some species fly very high, including geese and cranes which have been seen between 3000 and 5000 meters above sea level.

The raptors evolve at a few hundred meters in height when the wind is moderate, but they approach the ground in strong winds.

Migrations are diurnal in raptors, storks, cranes, swallows, swifts and grain-eating birds, nocturnal for several waterbirds.

The birds likely to be observed along the OHL reach thirty (30) species, with a flight height ranging from 10m to 300m. According to sizes and taxonomic status, two major groups can be considered: Raptor and Passerine, waders, water and domestic birds. The first group evolves more or less beyond the height of the OHL, while the second evolves rather below the lines with multiple movements between the different habitats of the area.

Considering the flight height, the collision risks for the first group are mainly moderate for the first group at mainly low or neglected for the second groups (See tables below)

Considering the flight height, the collision risks for the first group are mainly moderate for the first group at mainly low or neglected for the second groups (See tables below).

Table 4-5: Ecological status, risks and flight height ranges common birds on the area

Species	Ecological status: M: Migratory, N: Nesting, S: Sedentary	Flight height (m)	Collision risk for flights in flocks
Raptors			
Sparrowhawk Accipiter nisus	M : Raptor	20- 30	moderate
Short-toed Eagle Circaetus gallicus	N : Raptor, rare and protected species	20- 50	moderate
Milan black *Milvus migran*	M : Raptor, protected species	20-40	moderate
Long-legged buzzard *Buteo rufinus*	S : Raptor, vulnerable and protected species	20- 40	moderate
Common Buzzard *Buteo buteo*	M : Raptor		
Western marsh harrier *Circus aeruginosus*	SN : Raptor	40	Neglected
Montagu's Harrier *Circus pygargus*	M : Raptor	50	neglected
Honey buzzard *Pernis apivorus*	M : Raptor, protected species	30-100	moderate
Black-winged kite *Elanus caeruleus*	N : Small raptor	15- 40	moderate
Booted eagle *Hieraaetus pennatus*	M : Raptor	200	neglected
Egyptian vulture *Neophron percnopterus*	M : Raptor	100	neglected
Peregrine Falcon *Falco peregrinus*	S: diurnal raptor threatened, rare and protected	30- 50	moderate
Common kestrel *Falco tinnunculus*	S: diurnal Raptor, expanding and protected	30 - 40	moderate
Raven *Corvus corax*	N : Raptor	20- 40	moderate
Passerine, waders, water and domestic birds			
Cattle Egret *Bulbucus ibis*	S : Wader, endemic species	15- 20	neglected
Little Egret *Egretta garzetta*	S ; Wader, vulnerable and protected species	15- 30	moderate
Gray Heron *Ardea cinerea*	NM : Wader	20- 25	low
Turtle Dove *Streptopelia turtur*	N : passerine	15- 30	moderate
Mesh Dove *Spilopelia senegalensis*	NS : passerine	50- 300	neglected
European bee-eater *Merops apiaster*	M : Passerine	30-150	low
Hoopoe *Upupa epops*	NS : Passerine	30	moderate
Starling *Sturnus sp*	NS : Passerine	30	moderate

Species	Ecological status: M: Migratory, N: Nesting, S: Sedentary	Flight height (m)	Collision risk for flights in flocks
BlueBird *Monticola solitarius*	NS : Passerine	10	neglected
Window swallow *Delichon urbicum*	M : passerine	20	neglected
Crested Lark Galerida cristata	NS : passerine	15- 20	neglected
Rock Pigeon Columba livia	NS : Domestic	20- 30	moderate
White Stork Ciconia ciconia	M : Grand voilier	30	
Black Stork *Ciconia nigra*	M : Grand voilier	100-150	Neglected
Blossy ibis *Plegadis falcinellus*	M : Water bird	30-150	low

For large migration, we can consider a major collision risk zone that extends over 23 km through the OHL where the migratory flow is channeled between the Tunisian dorsal and the Gulf of Hammamet.

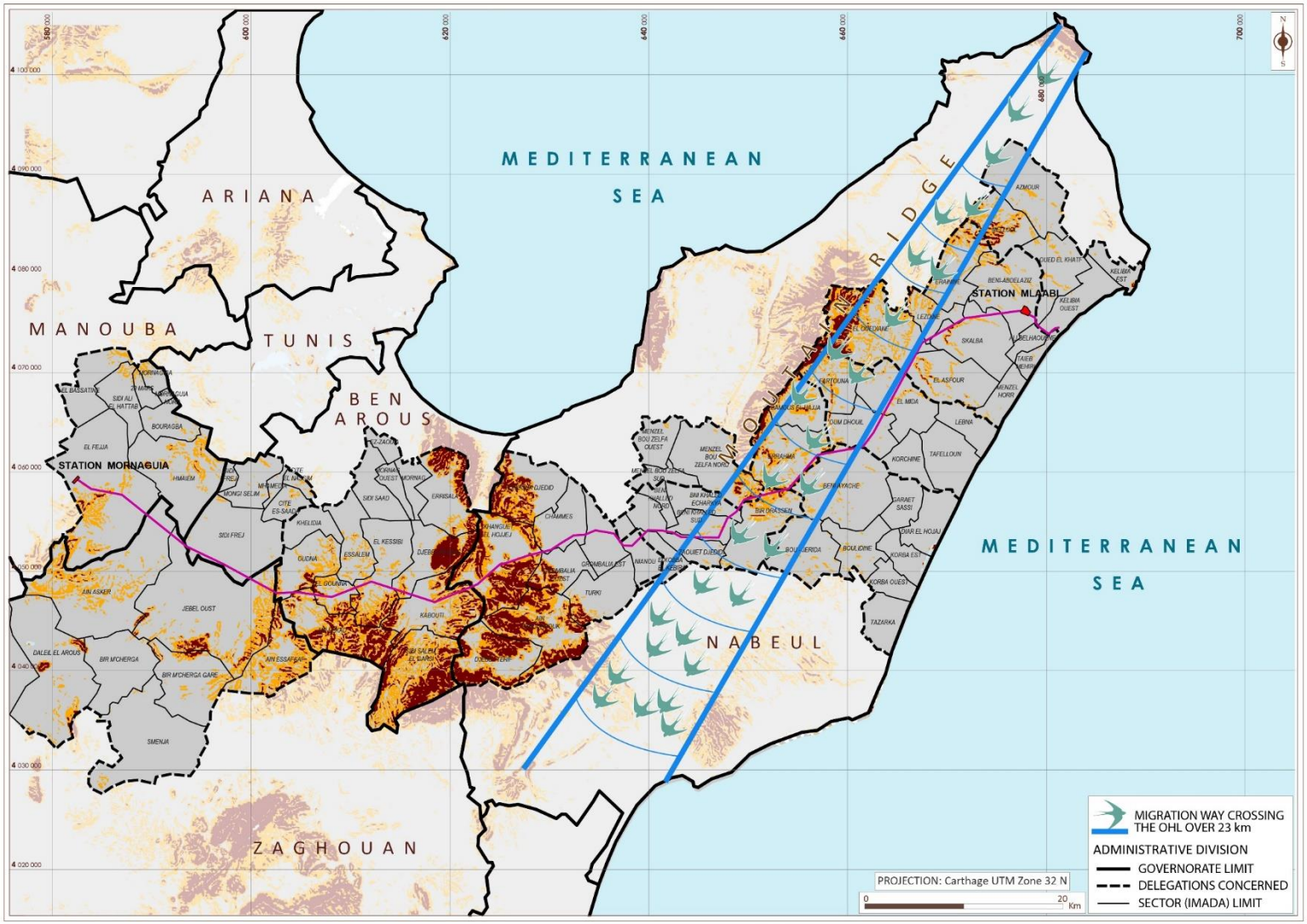


Figure 4-4: Migration corridor and Major collision risk zone

Problems that power lines can cause to birds include:

- → Loss and disturbance/fragmentation of bird habitats due to vegetation removal along the RoW of OHL line. However, this is not the case for the Mlaâbi-Mornaguia power transmission line where all vegetation under the OHL conductor will be preserved.
- → Disturbance due to increased human activities during operation and maintenance activities (noise, pollution, etc.). Maintenance activities will be of low frequency and will have a very low impact on avifauna species present along the RoW of the OHL.
- → Barrier effect: OHL power transmission projects are considered as a physical barrier to the daily and seasonal movement of birds. Based on Raab and al (2011), these lines may alter the migratory behaviour and flight patterns of some bird species and that several species are very sensitive to the introduction of vertical artificial elements in the landscape, as reported by Silva et al (2010).
- → Direct Mortality by:
  - ➢ **Collision:** risk associated with high voltage transmission lines, it occur when a bird in flight strikes an OHL conductor and they occur on all type of lines (high transmission and medium voltage distribution power lines)

Figure 4-5: Accipiter gentilis killed during a collision after interaction with an OHL line (source Justo Martin)

  - ➢ **Electrocution:** risk more associated with medium voltage transmission lines but is also reported for high voltage transmission lines and usually happens to the larger bird species. There are several reasons for electrocution, mainly:

    - Inadequate location of conductors and isolators
    - Interaction between bird and the phase conductor (cause of electrocution and death of birds)
    - Interaction with two phases of two conductors with different voltage, in particular for larger birds

    In the case of the Mlaabi-Mornaguia OHL, there is no risk of electrocution because it can only take place when two conductors are touched at the same time and the minimum distance between two cables is 5m (No birds reaching this wingspan).

For migratory birds, we can consider a major collision risk zone that extends over 23 km through the OHL where the migratory flow is channeled between the Tunisian dorsal and the Gulf of Hammamet.

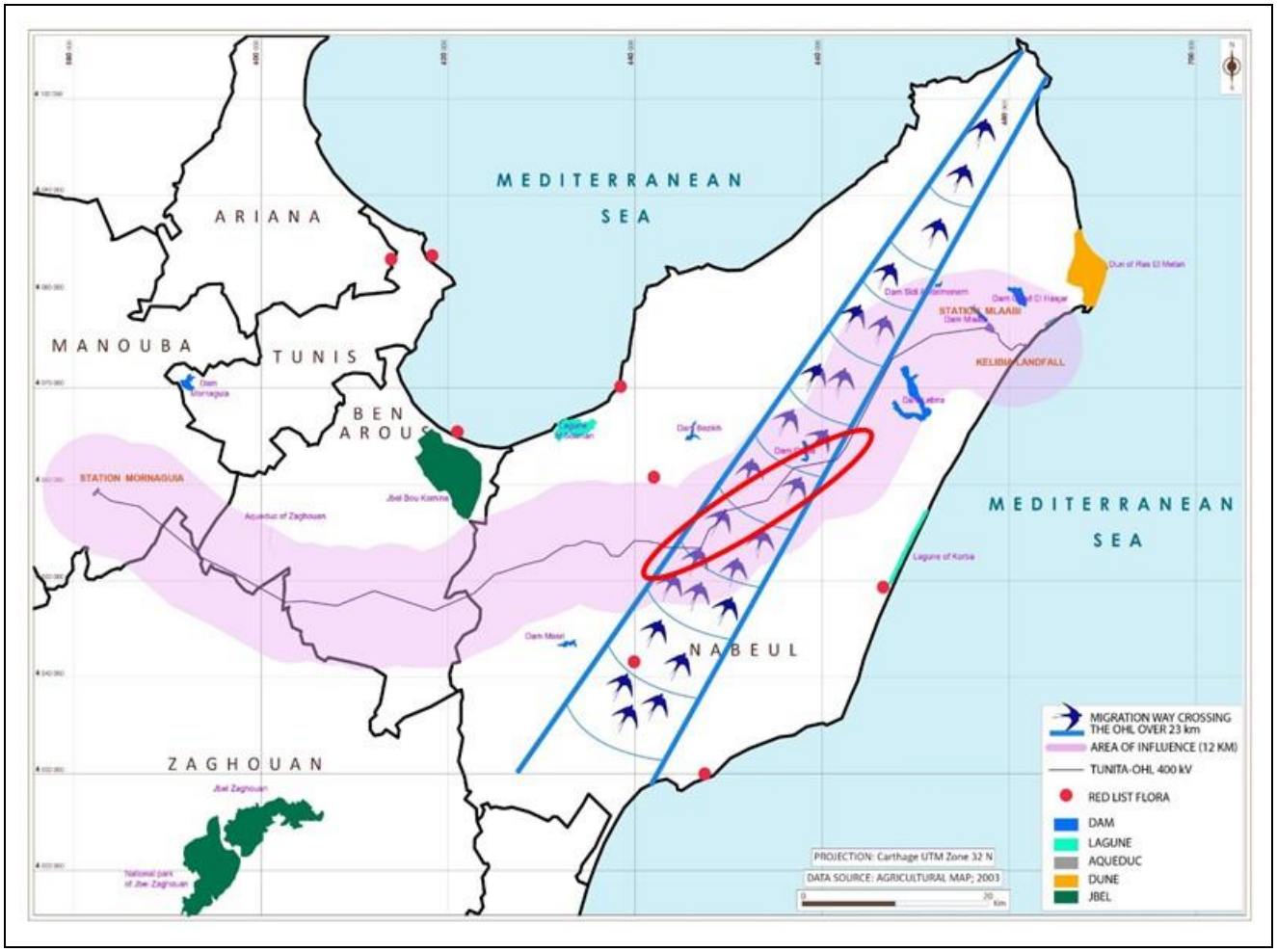


Figure 4-6: Migration corridor and Major collision risk zone

Based on the result of IBAT assessment, high priority species for OHL project's area are presented in the following table

Table 4-6: Bird species of conservation importance present in the project area

Species	IUCN status	Distribution	Presence in Project area	Potential CH trigger	Risk of significant impacts from the Project
White-headed Duck (*Oxyura leucocephala*)	EN	This bird is known to be resident in Northern Africa, where 400-600 individuals are estimated in Algeria and Tunisia. It breeds on small-enclosed semi-permanent brackish or eutrophic lakes surrounded by emergent vegetation (BirdLife International, 2022). It is known from the Mlâabi dam and other areas nearby the overhead line route (Ideaconsult et al, 2022)	Confirmed	Likely	Medium

Species	IUCN status	Distribution	Presence in Project area	Potential CH trigger	Risk of significant impacts from the Project
Egyptian Vulture (*Neophron percnopterus*)	EN	This bird is Vulnerable (VU) in the Mediterranean according to a recent assessment (Westrip et al, 2022). It occurs in a variety of habitats and typically nests on ledges or in caves on cliffs. It is known to breed in Tunisia. An important part of the breeding population of Eurasia passes through the Strait of Gibraltar and the Red Sea Flyway, but individuals also pass through Cap Bon in Tunisia. In Tunisia illegal trade and poisoning have been reported. Collision with and electrocution by power lines are a potential threat to the species.	Reported but not confirmed	Likely if presence confirmed	High
Saker Falcon (*Falco cherrug*)	EN	This bird is Critically Endangered (CR) in the Mediterranean according to a recent assessment (Westrip & BirdLife International, 2022a). Within the Mediterranean region it is only thought to breed in North Macedonia, where there is a tiny population of 0-3 pairs. It has traditionally been used for falconry purposes.	Reported but confirmed	Likely if presence confirmed	High
Red-footed Falcon (*Falco vespertinus*)	VU	This bird is Critically Endangered in the Mediterranean (CR) according to a recent assessment (Westrip & BirdLife International, 2022b). In the Mediterranean the species only breeds in Northern Italy and Turkey. Main threats include illegal killing and poisoning, as well as electrocution on power lines.	Reported but not confirmed	Likely if presence confirmed	High

The overhead line is located nearby several man-made water reservoirs, considered as a high importance for several waterbirds species, including threatened species (White-headed Duck) and the corridor overlap with an important migratory bird corridor in Cap-Bon peninsula. Risks of collision with the new OHL is considered high.

Given the above, the operation of the OHL will result in **high risk of collision for birds.**

- ***Bats***

Tunisian's bat fauna is considered as poorly known among North African faunas with only 19 species recorded to date, as reported by Dalhoumi and al (2011). Some of these species are identified, only a few

individuals, in the study area in particular in mountain forest areas between Jebel Ressas (Ben Arous), Jebel Sidi Abderrahman (Nabeul) and Zaghouane (near the aqueduct and the national park).

Power transmission line impacts on bat species during the operational phase of the project include the following:

- Habitat alteration and disturbance, with a relatively low impact compared to construction phase due to the absence of large-scale disturbance factors during operation and maintenance activities.
- Direct mortality by collision as for birds
- Interaction between bat and EMF generated by OHL operation: Bats use echolocation or biosonar to navigate and find prey at night by emitting short ultrasonic calls and analyse the reflected echoes. Several scientific studies have been conducted to study the possible interaction between EMF produced by bats and EMF generated by power transmission lines, to date, none of these studies have confirmed the presence of a significant impact (increase of mortality and movement disturbance) (EIRGRID, 2015)[4].

Some bat species can be observed in the AoI of the OHL, especially in mountain and forest areas between Nabeul-Ben Arous and Zaghouan: Myotis capaccinii (VU), Miniopterus schreibersii (VU), Rhinolophus blasii (LC), etc. (in particular near mountain areas Beni Ayech, Djebel Ressas and Zaghouane).

Given the above, the operation of the Mlaâbi CS will result in **negative impacts** of **Moderate intensity** and **Moderate spatial extent** and **Moderate duration**, overall classified as **Moderate.**

Biodiversity – Operation phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Impact on birds	High	High	High	High
Impact on bats	Moderate	Moderate	Moderate	Moderate

4.3.1.1.3 Impact Significance

Biodiversity –Operation phase			
Impact Significance			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Impact due to construction of CS of Mlaâbi, HVDC and HDD	Low	Low	Low
Impact due to construction of OHL line on birds	High	High	High
Impact due to construction of OHL line on bats	Moderate	Moderate	Moderate

4 https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/part2/DWR-1108%20EirGrid%202015.pdf

4.3.1.2 Mitigation Measures

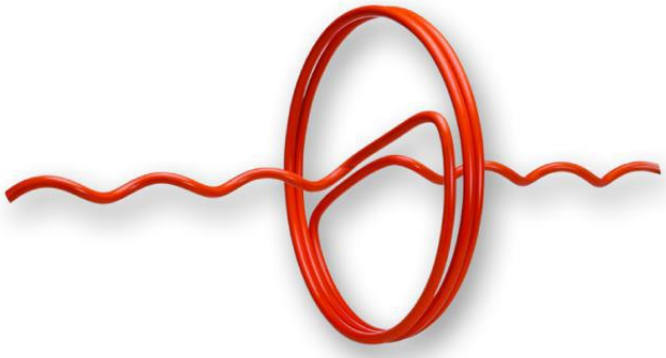
Within the framework of the present IA, a series of mitigation measures in the new CS and the OHL area have been identified:

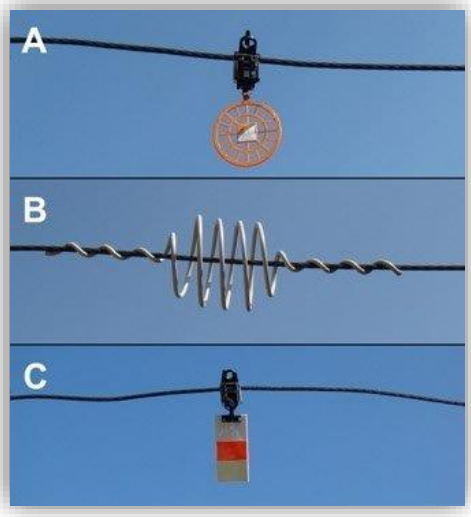
Flora and vegetation

- No chemical products to be used during vegetation maintenance under the RoW
- Vehicle movements shall be limited in forest areas and near wetlands sites

Avifauna

- Conduct an annual monitoring of avifauna
- Assessment of mitigation measure effectiveness
- Conducting regular revisions of measures taken to protect birds
- Restrict maintenance activities to the daily time
- Increase the visibility of the OHL by installing line markers: spirals or other forms of suspended devices, to prevent collision of birds





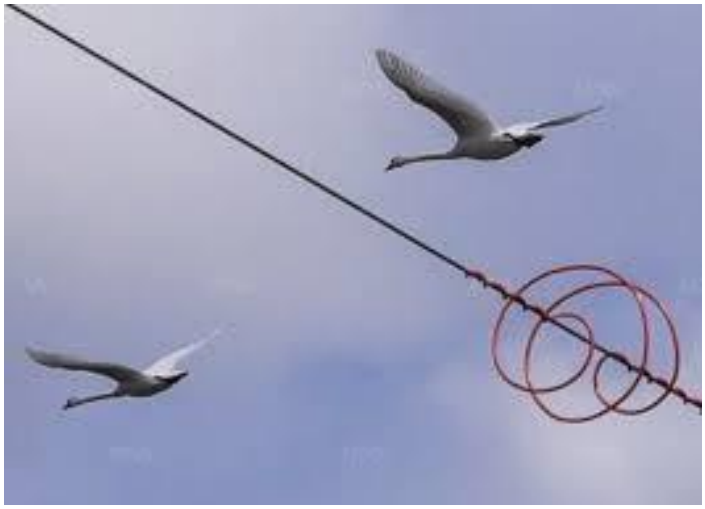


Figure 4-7: Signaling devices having a temporary mitigation effect with medium to high efficiency.

Bats

- Maintenance activities should be planned outside breeding season for most resident species including bats

5. SOCIO-ECONOMIC RISKS AND IMPACTS

5.1 Cultural heritage

The following Table provides a brief overview of the potential impacts on cultural heritage induced by the Project.

Construction Phase	Operation Phase	Decommissioning Phase
Risk of damage to archaeological heritage during excavations, vegetation clearance and vehicle movement	No impacts on cultural heritage	No impacts on cultural heritage

The assessment of potential impacts of the Project's activities on archaeological and cultural heritage is based mainly on available bibliographical information (INP website and other sources). In 2022, the Technical Consultant conducted a Georadar field survey with the presence of two archaeological experts from INP only for the Kelibia landing point and the land that will house the junction box. The survey convered and area of 4 100 m2 as shown in the following figure.

Figure 5-1: Georadar survey conducted for Kelibia landing and SLJ site

The CS construction site will be subject of a Georadar survey, as for the HDD and landfall site in Kelibia, in order to verify the absence of archaeological vestiges on the chosen area, details and results of this survey are not yet available. No additional survey to be conducted for the OHL line, archaeological aspects will be studied once the final design and final line route is fixed by the Contractor and STEG and archaeological issues should be discussed with competent authorities, in particular INP department.

The archaeological risk evaluation derived from the study is based on:

- Bibliographic and data available in INP website for major archaeological sites in the study area
- Results of Georadar survey conducted for Kelibia option and HDD site
- Distance of existing archaeological sites from the project area.

The following table shows the main archaeological sites located near the project, in particular those along the OHL corridor.

Site	Distance from the Project area
Fort de Kelibia	8 km
Kerkouane	17 km
Uthina	4 km
Aqueduc Zaghouan	6 km

5.1.1 Definition of Sensitivity

- *Existing regulation and guidance*

The Heritage code (- Law n° 94-35 of 24 February 1994) related to the protection of historical monuments give a significant value for the protection of archaeological historical and cultural heritage.
Specific regulations apply to archaeological risk evaluation for public works. During construction phase, any remains discoveries must be reported and the Contractor should inform the competent authority ''INP'' and and must take necessary actions and measures to conserve these remains. In case of discovery, construction activities must ne stopped while waiting for INP's decisions.
The project area is in a territory with important archaeological sites and new findings during construction works cannot be excluded.
Given the above, the level of existing regulation and guidelines in the study area has been classified as *"High".*

- *Societal Value*

Cultural Heritage is highly unique, very valuable for the society, and irreplaceable.
Given the above, the level of societal value in the study area has been classified as *"High".*

- *Vulnerability for change*

Archaeological Heritage is extremely vulnerable in case of construction works and requires specific procedures to be applied for its safeguard.
Given the above, the vulnerability for change has been classified as *"High".*
The overall Sensitivity of Cultural Heritage can thus be classified as ***High.***

Cultural Heritage			
Characteristics of sensitivity			**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
High	High	High	High

5.1.2 Construction phase

5.1.2.1 Potential impacts

Construction activities could affect cultural and archaeological heritage, unknown vestiges/sites can be discovered, and disturbed/destroyed by the construction of HVDC cable, CS of Mlaâbi and OHL line between Mlaâbi and Mornaguia, which cross a region hosting several historical monuments.

Potential activities that can cause degradation of archaeological heritage include the following:

- Clearance and vegetation removal and excavation at CS of Mlaâbi, at tower locations and HVDC cable. Such activities could destroy potential archaeological vestiges, in particular those buried.
- Construction sites and access roads along the OHL line could also affect any potential cultural sites/objects.
- Construction activities could disturb visitors to cultural heritage sites, especially when construction vehicles uses the same roads and usually frequented by visitors of cultural heritage in Cap Bon region (Fort Kelibia, Kerkouane site), Ben Arous (Uthina) and Zaghouane (Aqueduc).

Construction works will be carried out after a Preliminary Archaeological Assessment Procedure, to be carried out under the supervision of the INP department, in particular for the OHL line due to lack of information available at this stage on potential impacts of this component on cultural heritage.
The Contractor and STEG shall consult with INP department prior to setting the final design of the OHL line in order to avoid crossing through any potential archaeological sites located within RoW of the line. In addition,

INP experts must be involved during all excavation, drilling and clearing activities. This will allow to prevent damage to underground objects; at the same time the works will determine an archaeological investigation of the project area, thus potentially adding data and information. A low positive impact may thus be determined by the works.

Overall, the Sensitivity of the receptor "Cultural heritage" is classified as ***Low.***

Cultural heritage – Construction phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Damage to underground archaeological objects	Low	Low	Low	Low

5.1.2.1.1 Impact Significance

Landscape and visual amenities – Construction phase			
Impact Significance			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Damage to underground archaeological objects	High	Low	Low

5.1.2.2 Mitigation Measures

Mitigation measures for cultural heritage during the construction phase will consist in excavations and drilling activities being carried out with the continuous coordination and consultation with INP department.

- Conduct a Preliminary Archaeological Assessment Procedure before the construction phase.
- Develop and implement a chance find procedure.
- Require the Contractor/STEG to consult with INP department to identify, as a first step, the presence of any cultural heritage value and to guide the Contractor in the choice of tower locations.
- In case of discovery of archaeological remains, construction activities should be stopped and INP must be informed in order to ensure necessary measures for the protection of the discovered vestiges.
- Prohibit disturbance/destruction of any material or feature that have cultural heritage value.
- Training of workers about the value of historical and cultural heritage

5.1.2.3 Residual Impacts

No residual impacts are expected.

5.1.3 Operation phase

Potential impacts during operation phase include the following:

- Disturbance of cultural sites existing along access roads: maintenance operations will generate additional traffic and will be accompanied by an increase of noise level and dust/exhaust emissions due to vehicle movement, which may affect exiting cultural sites and peoples visiting the study area. Nevertheless, maintenance operations will be very limited and without any impact on cultural heritage.
- Visual deterioration of cultural heritage due to potential alteration of the landscape in areas concerned by the CS and OHL line as the long-term presence of electrical equipment (CS and towers) would have an effect on landscape and views, in particular for heritage sites very close to the OHL and CS. The OHL corridor and CS of Mlaâbi are located away from all major archaeological sites in the region and will not affect the existing heritage).

Considering the above, no noticeable impacts (**no impact**) on cultural heritage during operation phase related to the project.

5.2 Impact on land use and economic activities

Construction Phase	Operation Phase	Decommissioning Phase
• Impact on Land Use • Impact on livelihoods and economic activities	• Impact on livelihoods and economic activities due to operation and maintenance activities	• As construction phase

5.2.1 Definition of Sensitivity

➢ *Existing regulations and guidance*

In Tunisia, the legislation relating to land acquisition and temporary occupation and easement includes the following:

- Decree of May 30, 1922: Relating to the establishment, maintenance and operation of electric transmission lines. Allowing power line projects to cross private property (including agricultural land or land used for other productive purposes) without the need for land acquisition. There is therefore no transfer of ownership or expropriation to be carried out in relation with the power transmission lines.
  Easements are compensable: when they cause damage to the land crossed, compensation must be paid for affected persons.
  Compensation is paid to the operators of the land crossed, whether they own it. When a piece of land is owned by an owner but operated by another person, it is the latter who is entitled to receive compensation.
  The passage of a power line is prohibited through any fenced property overhanging existing buildings. Tunisian law thus de facto minimizes the impacts that a proposed line could have on physical movement by prohibiting it.
  Before construction activities for power transmission lines, STEG concludes temporary occupation agreements with owners and/or farmers before the start of work. The same agreements are entered into with the owners and farmers using the land where the towers will be installed, even if the occupation will be for a much longer period. These agreements give rise to the payment of compensation when crop damage occurs.
- Law N°2016-53 of July 11, 2011 (modified Law N°76-85 of August 11, 1976 and Law N°2003-26 of April 14, 2003) regarding land acquisition and setting procedure of expropriation for public utility, which is an operation conducted by authorities to oblige private individual owner to transfer their ownership for public utility purpose and in return affected person will get a compensation.

Given the above, existing regulations and guidelines have been conservatively classified as "***High***".

➢ *Societal Value*

Types of land use identified included agricultural, residential, industrial, etc. In the study area, agriculture was identified as the primary activity and the primary source of livelihood for local communities that produce cereal, fodder, citrus and olive from their land.

The project activities could affect a wide number of human receptor due to potential land acquisition and land clearance that will trigger economic displacement due to loss of the access to assets and resources during construction activities.

Given the above, societal value has been classified as "***High***".

➢ *Vulnerability for change*

The local community groups most vulnerable to the current economic situation are young people, either unemployed or not in education or formation, women (due to the gender gap in employment) and elders with low state pensions.

Moreover, low-income households generally have fewer resources to fight economic crises and are less likely to have savings or access to credit, making them more vulnerable to stock changes.

The livelihood of local community, in the four governorates concerned by the Project, has been negatively impacted by the difficult economic situation that has affected the country for years and that has intensified with the price increase of raw materials (energy, fertilizers, etc.). The limited water supply due to the decrease of annual rainfall (climate change) has also affected the livelihoods of the local populations who are highly dependent on the agricultural sector.

Given the above, vulnerability for change has been classified as "***High***".

Overall, the sensitivity of the receptor "Economy, Employment and Working Conditions, and Income" is classified as **High**.

Land use and economic activities			
Characteristics of sensitivity			**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
High	High	High	High

5.2.2 Construction Phase

5.2.2.1 Potential Impacts

Impact on Land Use

Land requirements for power transmission projects are limited areas to be reserved for tower construction and substation. For the present project, these requirements vary between the tree components as follow:

- **HDD and Underground cable**

The junction box will be located on a 50*50 m underground box, STEG has started an acquisition procedure with AFI agency for this area located on a plot within the industrial zone of Menzel Yahia (a public land).

HVDC underground cable will pass only through existing roads between the industrial zone of Menzel Yahia and the industrial zone of Mlaâbi where the CS will be built. For the construction of underground cable, STEG's technique required opening a small sections of only 4 to 20 m in length, in which PVC sheaths coated with concrete are laid and then closed. After, the cable is pulled through the sheaths. This technique allows to reduce potential impacts of the construction phase on goods and services, in particular in urban areas. For this part of the project, no new access roads are planned for the construction phase and the project will not require any land acquisition as the line route is entirely located on existing roads. Nevertheless, construction activities may cause some disturbances for the populations using the roads between Menzel Temime and Kélibia (MC27), especially during the summer season when there is a greater flow of tourists.

- **CS of Mlaâbi**

The station will be built on state-owned land, reserved by the AFI to develop an industrial zone on a 60-hectare site. STEG has concluded an agreement with AFI to build the said station on a 10 ha lot. The CS area is currently used for agricultural purposes under a lease between an industrial company (agroindustry) and the State to produce fodder for livestock sector. Some local residents (three families located near the construction area) work in this farm and the project could affect their incomes with the change in land vocation (agriculture to industrial).

- **OHL line Mlaâbi to Mornaguia**

During the construction phase, activities expected to impact the social environment (land acquisition, economic displacement, loss of income and access to resources) include:

- ✓ Land occupation by towers and tower construction sites: tower erection require building foundations and for that four square excavations (few meters deep) are made. The total footprint of towers vary according to the line type and the tower type. According to STEG, tower footprint for 400 kV lines can vary from 14*14 m to 20*20 m. During the construction phase, the RoW of the tower construction site could exceed this footprint in order to have enough space for soil excavation and storage and to allow access for machinery.
- ✓ Conductor installation/enrolment: variable damage on crops and vegetation can be expected during this activity. Outside forest areas with very dense cover, it is possible to pass the cable between trees and avoid/reduce any possible damage to them. This is the case for the project's area, where the OHL will pass through relatively open and rural landscape, except areas occupied by citrus orchards between Menzel Bouzelfa and Grombalia and forest areas and scrubland near Jebel Ressas (between Ben Arous-Nabeul and Zaghouane).
- ✓ Access roads: construction activities of the OHL line should not require the construction of access roads. Most sections of the line are located in an agricultural area where accesses exist (regional and local roads, agriculture unpaved roads, etc.). Consequently, vehicle movements and access to tower construction sites are not likely to cause damage to property (agricultural crops, damage to crops, disruption of access to resources, etc.).

STEG have standard for the distance required between power transmission lines (conductor and tower) and different land uses. For 400 kV line, the conductor must be located more than 10 m from the ground above fruit tree plantations (citrus, olive, etc.) and more than 9 m from the ground in general. Land owners and users can continue to carry out their agricultural activities under the conductor and can cultivate annual crops below towers but with the prohibition to build houses or any construction along RoW of the line as required by STEG (16 m on both sides of conductor and height of tower in each tower position). Based on that, some areas potentially suitable for settlements will be lost (only under the OHL corridor), in particular these located near Beni Khalled, Menzel Bouzelfa and Grombalia.

Areas required for the temporary and permanent occupation of the OHL line are presented in the following table:

Table 5-1: Areas required for construction and operation activities

Component	**A 50 m corridor for construction phase (temporary occupation)**	**A 16 m corridor with use restrictions (building) or potential damage on crops and plantations during operation phase**	**RoW of tower during operation phase**	**Description of crossed area**
400 kV OHL line Mlaâbi Mornaguia (113 km)	565 ha (113 km x 50 m)	180 ha (113 km x 16 m)	4.9 ha (251 towers* x (14x14m))	Agricultural land (perimeters around water reservoirs and ceral crops around Menzel Temime and El Mida near Grombalia and Bir Mchergua ; citrus orchards and vineyard around Menzel Bouzelfa, Beni Khalled and Grombalia, olive tree plantations) Forest and scrubland areas around Beni Ayech, Khanguet El Hojjej and Jebel Ressas)
Underground HVDC cable	2.84 ha (5.67 km x 5 m*)			Urban area by crossing existing road

	A temporary occupation for construction activities	
SLJ box	50 m x 50 m needed will be buried after construction phase	Industrial zone (Menzel Yahia)
Mlaâbi CS	10 000 m^2 A permanent occupation	Currently occupied by annual crop but will be transformed for the development of the industrial zone of Mlaâbi

*251 towers: considering the hypothesis of 1 pylon every 450 m along 113 km of OHL line
*5 m: temporary corridor needed for the construction of the HVDC cable

Construction activities could affect different categories of peoples living along the project area by economic displacement, two category can be identified:

- Landowners, whose land are along RoW the project, in particular near the OHL line.
- Farmers who lease (land or yield/usufruct) land present along RoW

Persons potentially affected by the project will be identified once the final line route is fixed by the Contractor and STEG before the construction phase beginning. The total number of affected owners/farmers is equal to the total number of towers to be built.

Given the above, the intensity of the impact is considered "**high**", the spatial extent "**high**" and the duration "**high**".
The magnitude of the impact on local economic activities is classified as "**high**".

Land use and economic activities Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Impact on land use	High	High	High	High

Impact on livelihoods and economic activities

Some people living along RoW the project area might see their livelihoods affected during construction activities, in particular if towers, access roads or other activities encroaches on land that constitutes a significant part of their land. This impact will be felt more if affected person is highly dependent on the part damaged by construction works to ensure their livelihood.

Local context is dominated by agriculture activities for commercial purposes and subsistence farming is not very present compared to the first category. Areas dominated by field crops (irrigated and rainfed) are located in flat land in Menzel Temime, El Moida and some areas in Grombalia, Zaghouane and Ben Arous. Land parcels used for commercial purposes are medium to large sizes (more than 5 ha).

Areas occupied by arboriculture, in particular citrus, olive and vineyard plantations, which are more present around Menzel Bouzelfa, Beni Khalled, Grombalia and in some areas of Ben Arous are dominated by small to medium sized farms. Therefore, potential impacts on livelihoods can be more important in areas dominated by citrus orchards (small size plot).

Other minor impacts of the project construction phase on the local economic activities may include tourism Indeed, tourism activities may be affected by the disturbance caused by the placement of the underground cables along the road (MC27) between Menzel Temime and Kélibia, usually used by visitors/tourists during summer seasons.

Given the above, the intensity of the impact is considered "**moderate**", the spatial extent "**moderate**" and the duration "**high**".
The magnitude of the impact on local economic activities is classified as "**moderate**".

Land use and economic activities Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Impact on livelihoods and economic activities	Moderate	Moderate	High	Moderate

5.2.2.2 Impact Significance

Land use and economic activities – Construction phase			
Impact Significance			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Impact on land use	High	High	High
Impact on livelihoods and economic activities	High	Moderate	Moderate

5.2.2.3 Mitigation Measures

The following measures should be implemented in order to avoid/reduce potential impacts on land use and livelihoods and economic activities:

- Clearance and vegetation removal activities to be restricted to the minimum area;
- Strictly follow procedures of the Resettlement Framework Policy (RFP) and the Resettlement Action Plan (RAP, to be conducted later before the construction phase);
- The Promoter would ensure full compensation is paid to affected persons in compliance with the procedures of the RFP and RAP studies;
- Conduct consultations with stakeholders (landowners and land users) prior to the construction phase to inform them about the construction activities and expected impacts and the grievance mechanism, fixed by the RAP/RFP, to raise their complaints;
- The grievance mechanism will manage issues concerning the local economic activities.

5.2.2.4 Residual Impacts

Residual impacts are equal to the above presented impacts in absence of mitigations.

5.2.3 Operation Phase

5.2.3.1 Potential Impacts

Potential impacts during operation phase include damage to crops and plantations due to maintenance activities and movement of vehicles. Nevertheless, maintenance operations will be very limited and without any significant impact on land use and livelihoods.

Considering the above, no noticeable impacts (**no impact**) during operation.

5.3 Economy, Employment and Working Conditions, Income

The following section describes potential impacts on the local economy, employment and income for each project phase before presenting the mitigation measures. Residual impacts are then assessed based on the mitigation measures' potential effects.

Local communities can be impacted, both positively and negatively, by the Project. Positive impacts are primarily related to the economic and income outcomes of increased employment opportunities, which have the potential to generate increased income and expenditure for local households which will stimulate local and national economy, as well as positive impacts created from the Project's local procurement of goods and services. Capacity development (skills enhancement) and training of the local workforce can also result in increased employability, better job opportunities, and overall sustainability effects in the long term for the local communities.

In turn, the local communities may be negatively impacted by economic displacement, disturbance and damage of assets, changes to community dynamic due to the presence of external workforce, illegal employment practices such as informal or irregular work, forced child or juvenile labour, low wages and the gender pay gap.

Construction Phase	Operation Phase	Decommissioning Phase
• Increased employment opportunities and related economic and income effects (construction phase) • Working conditions and rights • Local procurement • Capacity development and training of construction workers • Impact of construction works on the local economic activities	• Increased employment opportunities and related economic and income effects (operation phase) • Working conditions and management of worker relationships at operation sites • Local procurement	• As construction phase

5.3.1 Definition of Sensitivity

➢ *Existing regulations and guidance*

In Tunisia, the legislation relating to health and safety and working conditions of workers is set by several laws and decrees including:

- Labour code: set by Law N°66-27 of April 30, 1966
- Decree N°75-503 of July 28, 1975 setting several measures to protect workers in establishments using electrical currents.
- Decree N°68+328 of October 22, 1968 establishing general hygiene rules applicable for companies subject to the Labour Code
- Decree N°75-240 of April 24, 1975 amending decree N°67-391 of November 6, 1967 relating to health safety and employment of women and children in industrial and professional trade units
- Law N°87-31 of July 6, 1987 ratifying the Labour Arab Convention N°7 and regulating occupational health and safety and that provisions in relation with OSH must include all necessary technical rules to ensure safety and protection.
- Government decree N°2016-626 of May 25, 2016 establishing the peer council equality abd equivalence of opportunities between women and men.

Furthermore, Tunisia has ratified the following International Labour Organisation (ILO) Core Conventions:

- ILO C100 - Equal Remuneration Convention, 1951. It establishes the right to equal remuneration for equal work.

- ILO C189 on domestic work (decent work for domestic workers)

Assessing human rights impacts related to working conditions and workers' management is also linked to a central tenant of the UN Guiding Principles (UNGPs) on Business and Human Rights, which provides that companies should carry out due diligence to ensure that they respect the international human rights of people affected by their business activities.

These rights include some of those contained in the key international conventions protecting human rights that have been ratified by Italy and contain all the rights relevant to the Project:

- Universal Declaration of Human Rights: The cornerstone of modern human rights instruments, concluded in 1948. It is not a treaty and is not legally binding, however, it is considered party of customary international law and the 30 core rights included in the Declaration provides the basis for the rights contained in the two international Covenants.
- International Covenant on Civil and Political Rights: International human rights instrument containing the right to life, freedom of religion, freedom of speech, freedom of assembly, non-discrimination and others. Civil and political rights are most often implicated in a business context by security services and are most relevant to the scope of this assessment; and
- International Covenant for Economic Social and Cultural Rights: International human rights instrument setting out rights to health, education, social welfare and an adequate standard of living (which includes livelihoods and environmental health and safety). Governments that ratify this instrument commit to 'progressively realizing' these rights subject to the country's resource availability.
- World Bank's Environmental and Social Standard 1 (ESS1) - Assessment and Management of Environmental and Social Risks and Impacts: the Project must comply specifically with ESS1 which underlines the importance of managing social and environmental performance throughout the life of a project, specifically concerning labour, health, safety and security.
- World Bank's Environmental and Social Standard 2 – Labour and Working Conditions (ESS2): in addition, the impact assessment of the Project must identify actions or policies that need to be put into place to contribute to Project alignment with World Bank's ESS2;

Given the above, existing regulations and guidelines have been conservatively classified as "***High***".

- *Societal Value*

Types of land use identified included agricultural, residential, industrial, etc. In the study area, agriculture was identified as the primary activity and the primary source of livelihood for local communities that produce cereal, fodder, citrus and olive from their land.

The project activities could affect a wide number of human receptor due to potential land acquisition and land clearance that will trigger economic displacement due to loss of the access to assets and resources during construction activities.

The present project is considered as a large scale infrastructure project by all stakeholders met in the study area (councils, municipalities and regional services). Usually, this type of projects is often associated with high expectations for employment from local communities' resident near the RoW. Unmet expectations around project employment opportunities are likely to cause disappointment and frustration against the project by local population. Without a good strategy regarding employment and working conditions, social conflicts and tensions could appear.

The anticipated contracting structure for the project and the likely number of project workers to be employed or engaged by each contractor/subcontractor are not known at this time. For the construction phase, the construction workforce to be employed is estimated at approx. 300 workers. During the operation phase, which will primarily entail the O&M and security services of the converter station, 25-30 workers should be employed.

Given the above, societal value has been classified as "***High***".

- *Vulnerability for change*

The local community groups most vulnerable to the current economic situation are young people, either unemployed or not in education or formation, women (due to the gender gap in employment) and elders with low state pensions.

Moreover, low-income households generally have fewer resources to fight economic crises and are less likely to have savings or access to credit, making them more vulnerable to stock changes.

The livelihood of local community, in the four governorates concerned by the Project, has been negatively impacted by the difficult economic situation that has affected the country for years and that has intensified with the price increase of raw materials (energy, fertilizers, etc.). The limited water supply due to the decrease of annual rainfall (climate change) has also affected the livelihoods of the local populations who are highly dependent on the agricultural sector.

Given the above, vulnerability for change has been classified as "***High***".

Overall, the sensitivity of the receptor "Economy, Employment and Working Conditions, and Income" is classified as **High**.

Economy, Employment and Income			
Characteristics of sensitivity			**Sensitivity**
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
High	High	High	High

5.3.2 Construction Phase

5.3.2.1 Potential Impacts

Increased employment opportunities and related economic and income effects (construction phase)

During construction phase, A number of skilled, semi-skilled and unskilled workers will be required through all phases to fulfil the project workforce requirements.

Indirect employment opportunities are also likely to be created through the Project's supply chain including the procurement of goods and services from local companies, which will further increase jobs in the domestic market. The employment of local workers and their consequent wages and increased income could positively impact local communities' employment and generate income, taxes and expenditure effects. Project workers will be hired locally where possible and will not need accommodation, while those residing in nearby municipalities will have to commute to and from work.

Given the above, the impact is considered to have a "**moderate**" intensity, a "**moderate**" spatial extent and a "**moderate**" duration.
The overall magnitude of the positive economic impact of temporary employment is classified as "**moderate (positive)**".

Increased employment opportunities and related economic effects Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increased employment opportunities and related economic effects (construction phase)	Moderate (positive)	Moderate (positive)	Moderate (positive)	Moderate (positive)

Working conditions and rights

A possible negative impact may arise with the working conditions at contractors' construction sites, Illegal employment is common in Tunisia, resulting in wages below the national minimum, unlawful agreements and inadequate working conditions. . Benefits from employment may also be reduced due to poor enforcement of labour rights in the Project supply chain.

Given the above, the impact is considered to have a "**low**" intensity, a "**moderate**" spatial extent and a "**low**" duration, as it is limited to the selection of procurement companies.

Working conditions and rights Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Working conditions and rights	Low	Moderate	Moderate	Moderate

Local procurement

During the construction phase, local procurement of goods and services, could positively impact the local economy, considering the amount of materials and services necessary for the duration of the construction phase.

The intensity of the impact is considered "**low**", the spatial extent "**moderate**" and the duration is "**moderate**". The overall magnitude of the project's economic impacts is classified as "**moderate**".

Local procurement Construction Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Local expenditures	Moderate (positive)	Moderate (positive)	Moderate (positive)	Moderate (positive)

Capacity Development and Training

During the construction phase, unskilled workers will have the opportunity to receive on-the-job trainings and develop professional skills. Upskilling of local workers' construction skills may also increase their employability, thus lowering the local unemployment rates.

Given the workforce size, the intensity of the impact is considered "**moderate"**, the spatial extent "**moderate**" and the duration "**moderate**".

The overall magnitude of the impact of upskilling and training on the local community is considered "**moderate**".

Capacity Development and Training Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Capacity Development and Training	Moderate (positive)	Moderate (positive)	Moderate (positive)	Moderate (positive)

5.3.2.2 Impact Significance

Economy, Employment and Income– Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Increased employment opportunities and related economic and income effects (construction phase)	Moderate	Moderate (positive)	Moderate (positive)
Working conditions and rights		Moderate	Moderate
Capacity Development and Training		Moderate (positive)	Moderate (positive)
Local procurement		Moderate (positive)	Moderate (positive)

5.3.2.3 Mitigation Measures

<u>Working conditions and rights</u>

To avoid the incidence of undeclared work and guarantee regular terms of employment, ELMED and its sub-contractors will meet all national laws related to labour rights. This commitment will be expressed in the following actions, policies and procedures:

- Develop a Human Resources Policy and Procedures detailing the principles guiding ELMED's approach to the management of workers, including equal opportunities, non-discrimination, non-employment of children or forced workers and ELMED's approach to trade unions, collective bargaining and employment of migrant workers;
- Issue all Project staff, including subcontracted staff, with an individual contract of employment detailing their rights and conditions in accordance with the Italian law and WB's ESF requirements related to hours of work, wages, overtime, compensation and benefits such as maternity or annual leave, and update the contract when material changes occur;
- Develop, formalise and disclose staff grievance policies and mechanisms for complaints about unfair treatment or unsafe living or working conditions without reprisal and make these available to all Project workers, including sub-contracted staff;

- Hold toolbox talks on labour law issues and the labour grievance mechanism twice a year during construction.
- Develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps and in the local communities. This should cover inter alia: cultural awareness for workers coming from outside of the area, a drugs and alcohol policy with information about testing and penalties for contravention. The Worker Code of Conduct should use an inclusive approach and address behaviour related to equal opportunity and non-discrimination based on personal characteristics (such as gender, race, nationality, ethnicity, origin, religion, disability, age or sexual orientation). The Worker Code of Conduct should have a zero tolerance for harassment and bullying;
- In regard to contracted workers, ESS2 requires the borrower to make reasonable efforts to ascertain that third parties who engage contracted workers are legitimate and reliable entities and have in place labor management procedures applicable to the project that will allow them to operate in accordance with the requirements of ESS2. Borrowers must also require such third parties to include equivalent requirements and non-compliance remedies in their contractual agreements with subcontractors. Further, contracted workers must be given access to a grievance mechanism.
- In regard to primary supply workers, ESS2 (Sec 39) provides that as part of the ESIA the risks of child and forced labor and serious OHS issues that may arise will be assessed in relation to primary supply workers. Where a significant risk of child or forced labor related to primary supply workers is identified, the Project will require the primary supplier to identify those risks consistent with sections 17-20 of ESS2. The Project will also set out roles and responsibilities for monitoring primary supplier and where child or forced labor cases are identified, the Project will require the primary supplier to take appropriate steps to remedy them (ESS2, Section 40).

Capacity Development and Training

- Maintain individual training registers for each construction worker which they can have at the end of contract for procuring future work.

5.3.2.4 Residual Impacts

Potential Impact	Mitigation Measures	Residual Impact
Working conditions and rights	- Develop a Human Resources Policy and Procedures - Issue all Project staff, including subcontracted staff, with an individual contract of employment detailing their rights and conditions in accordance with the Italian law and WB's ESF requirements - Develop, formalise and disclose staff grievance policies and mechanisms for complaints about unfair treatment or unsafe working conditions; - Develop and implement Health, safety and correct working practices and human rights procedures, including remediation steps, at contractors' construction sites and for primary supply workers, and develop and implement regular random inspections to monitor fair working conditions. - Pre-engagement, background screening and ongoing due diligence of construction contractors and primary suppliers.	Low
Local Expenditures	-	Low (Positive)
Capacity Development and Training	- Individual training registers	Moderate (Positive)

5.3.3 Operation Phase

5.3.3.1 Potential Impacts

Impacts on the local community from the Project operation phase include long-term employment in monitoring, maintenance and security activities.

Increased employment opportunities and related economic and income effects (operation phase)

During this phase, workers will be primarily employed in O&M and security occupations.
Due to the nature of the roles, the workers will be medium or highly skilled and likely be hired at a regional or national level more than local. Moreover, the number of workers employed in this phase will be low.
For the OHL component, operation and maintenance activities will be directly carried by the regional services of STEG and will not require any additional external workforce recruitment.
The impact of workers' expenditures, taxes and income economic effects would be limited in this phase, as the number of workers would be significantly lower compared to the construction phase.

Given the above, the intensity is considered "**low**", the spatial extent "low" and the duration "**moderate**". The magnitude of the impact is classified as "**low**".

Increased employment opportunities and related economic and income effects Operation phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Long-term employment	Low (positive)	Low (positive)	Moderate (positive)	Low (positive)

Working conditions and rights

During this phase, this risk is significantly lower compared to the construction phase due to the limited number of workers that will be employed for the operational phase of the converter station.

Working conditions and rights Operation phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Working conditions and rights	Low	Low	High	Low

Local procurement

During the project operation phase, the positive impact that will be generated by local procurement is expected to be significantly lower compared to the construction phase, although the longer duration of the operation phase.
Given the above, the intensity is considered "**low**", the spatial perimeter "**low**" and the duration "**high**".
The overall magnitude is classified as "**low**".

Local procurement Operation phase					
Characteristics of magnitude					Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**		
Local procurement, expenditures and taxes	Low (positive)	Low (positive)	Low (positive)	→	Low (positive)

5.3.3.2 Impact Significance

Economy, Employment and Working Conditions, Income Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Increased employment opportunities and related economic and income effects (operation phase)	Moderate	Low (positive)	Low (positive)
Working conditions and rights		Low	Low
Local procurement		Low (positive)	Low (positive)

5.3.3.3 Mitigation Measures

The same mitigation measures of the construction phase will be applicable to the operation phase.

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5.3.3.4 Residual Impacts

Potential Impact	Mitigation Measures	Residual Impact
Increased employment opportunities and related economic and income effects (operation phase)	-	Low (positive)
Working conditions and rights	As construction phase	Moderate
Local procurement	-	Low (positive)

5.4 Infrastructures and Public Services

The following table briefly overviews the potential impacts on the local infrastructures and public services. The most important sources of impact are represented by:

- Construction of Mlaâbi CS
- Installation OF HVDC cable
- Installation of 400 kV OHL line

Most direct impacts on local infrastructure and services are likely to occur during the construction and de-commissioning period given the nature of activities, hence no impacts are envisaged during the operation phase in terms of potential localised temporary disruption of utilities. At the same time, given the workforce size during the operation phase, which will be mainly employed for O&M activities of the converter station, no impacts are envisaged in terms of potential increased demand for accommodation facilities for non-local and foreign workers.

Potential impacts for each project Phase are described together with a description of mitigation measures intended and an indication of the residual significance of each impact.

Construction Phase	Operation Phase	Decommissioning Phase
• Possible damages to infrastructures during construction activities; • Temporary access limitations to health facilities; • Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste).	• None	• As construction phase

5.4.1 Definition of Sensitivity

The evaluation of the sensitivity of infrastructure and public transportation has been carried out according to the Impact Assessment methodology presented above.

➢ *Existing regulations and guidance*

Several laws and guidelines regulate infrastructures and public services, such as:

- Law N°2004-33 of April 19, 2004 regulating terrestrial transport sector by managing transportation of persons and goods and setting rules and conditions on this purpose;
- Water code set by Law N°75-16 of March 31, 1975 regulating water sector in Tunisia and setting provisions governing, safeguarding and enhancing the public hydraulic domain.
- Other laws related waste management also exist.

Given that the above, existing regulations and guidelines have been classified as "Low".

➢ *Societal Value*

In general, infrastructures and public services has a quite significant societal value as it can have direct effects on living conditions of people and on the economic attractiveness of the region. Any disruption of existing utilities could have a significant impact on local communities.

Given the above, societal value has been classified as "***moderate***".

➢ *Vulnerability for change*

Infrastructures and public services are delicate topics for local communities. The disruption of road infrastructures may affect local communities and those using road transportation to commute to work, such as healthcare personnel, and emergency services such as ambulances.

Increased water consumption may have a great impact on local communities and cause interruptions in the delivery of freshwater to local households. This could affect elders and disabled people who struggle to cope with water shortages.
The management of construction waste may increase the pressure on the local waste management system and thus create disruptions in the collection or correct disposal of local waste.

Given the above, vulnerability for change has been classified as "***moderate***".

Overall, the receptor's sensitivity to "Infrastructures and Public Services" is classified as **Moderate**.

Infrastructures and Public Services			
Characteristics of sensitivity			Sensitivity
Existing Regulation and guidance	Societal Value	Vulnerability for change	
Low	Moderate	Moderate	Moderate

5.4.2 Construction Phase

5.4.2.1 Potential Impacts

During project construction, potential impacts on infrastructures and public services and utilities are related to possible damages to infrastructures during construction works, disruptions to the access of local health facilities (see also Community Health and Safety) and increased pressure on local utilities and public services.

Possible damages to infrastructures during construction activities;

Construction activities may therefore damage the road pavement, also due to the passage of heavy machines. Further, the roadworks will interest areas crossed by underground services such as gas pipes, which may be damaged during the construction activities.

Moreover, due to the partial obstruction of road mobility caused by the Project, there may be an increase in traffic loads on alternative roads and consequent infrastructural damages.

Given the above, the impact is considered to have a "**low**" intensity, a "**moderate** "spatial extent and a "**moderate** "duration.

The overall magnitude of impacts induced by construction activities is considered "**moderate**".

Possible damages to infrastructures during construction activities Construction Phase				Magnitude
Characteristics of magnitude				
Impact	Intensity and direction	Spatial extent	Duration	
Possible damages to infrastructures during construction activities;	Low	Moderate	Moderate	Moderate

Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste).

During project construction activities, services such as water supply, electricity supply, solid waste management and wastewater and sanitation services will be locally procured.

The project is expected to generate to generate solid waste due to construction activities (clearing and removal of vegetation, land excavation and levelling, debris and soil, electrical material, etc.), general waste management due to presence of workforce (paper, plastic, glass, bottles, etc.), wastewater (mainly from sanitation facilities) and hazardous waste (oil, lubricants, solvents, etc.).

Given the above, the intensity is considered "**moderate** ", the spatial perimeter is considered "**moderate** "and the duration "**moderate** ".

The magnitude of the impact of the increase pressure on local utilities and public services is therefore classified as "**moderate**".

Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste). Construction Phase				
Characteristics of magnitude				Magnitude
Impact	Intensity and direction	Spatial extent	Duration	
Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste).	Moderate	Moderate	Moderate	Moderate

5.4.2.2 Impact Significance

Infrastructures and Public Services – Construction Phase			
Impact Significance matrix			
Impact	Sensitivity	Magnitude	Significance
Possible damages to infrastructures during construction activities;	Moderate	Moderate	Moderate
Temporary limitations to healthcare facilities access		Moderate	Low
Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste).		Moderate	Moderate

5.4.2.3 Mitigation Measures

Possible damages to infrastructures during construction activities;

In order to limit damages to road infrastructures, the Project will identify and reinstate any road damage resulting from the movement of project vehicles or construction activities.

Temporary Limitations to access to health facilities

In order to limit the load of traffic and the risks of road accidents, the Project will notify the local authorities before starting any construction activity. Moreover, the roadworks will take place in low tourism season and obstruct only one carriageway whenever possible.

Regarding the added pressure to the healthcare facilities in the study area, project workers will be provided with primary healthcare and basic first aid at worksites. Furthermore, an Emergency Response Plan (ERP) covering also contractors and subcontractors will be developed and implemented in collaboration with local emergency providers and healthcare facilities.

Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste).

The Project will assess the capacity of local utilities and public services such as electricity, water and waste management before starting construction activities. Further, the Project will engage with local utilities

providers so as to be informed of any unplanned event or disruption to the service (e.g., power outage) that may be linked to the project, in order to solve it quickly, and inform the local communities accordingly.

The Project will also develop a waste management procedure in collaboration with the local providers and will develop and implement a water management procedure to limit the Project's water consumption; moreover, an adequate source of water will be identified with relevant local authorities.

Further, to limit any eventual disruption to utility services linked to maintenance activities, the Project will undertake a geophysical survey to ascertain the presence of utilities services along terrestrial cable, and cross-check the information with local utilities companies.

5.4.2.4 Residual Impacts

Potential Impact	Mitigation Measures	Residual Impact
Possible damages to infrastructures during construction	- Employ a community liaison officer (CLO) to be a resource for local stakeholders along the pipeline route - Geophysical assessment - Before any significant road activity, conduct focused consultation with specific stakeholders whose livelihood activities are close to construction activities - Reinstatement of any road damaged as a result of the movement of project vehicles or construction activities	Low
Temporary limitations to the access to health facilities	- Notification of construction activities to local authorities; - Conduct activities during low tourism seasons; - Provide project workers with primary healthcare and first aid at worksites; - Develop an Emergency Response Plan.	Low
Increased pressure and potential disruption to local utilities for households reliant on local services (e.g., electricity, water, waste).	- Capacity assessment of local utilities companies before construction phase - Geophysical survey to ascertain the presence of utilities services along terrestrial cable, and cross-check the information with local utilities companies. - Engage/Cooperate with utilities companies to resolve any disruption to local utilities casued by the Project, or arrange any necessary services' suspension, as well as fully inform local communities; - Implementation of waste management plan in collaboration with local providers;	Low

5.5 Community Health & Safety

This section evaluates potential project-related impacts on health, social well-being and safety of workers and populations located within the study area. Potential impacts for each project Phase are described in detail

in the following sections, prior to presenting the mitigation measures that will be adopted by the Project. Lastly, residual impacts are presented at the end of the assessment, considering the application of mitigation measures.

Construction Phase	Operation Phase	Decommissioning Phase
• Potential safety risks from increased road traffic. • Potential health risks due to limitations to access local healthcare facilities. • Site trespass and injury.	• Perceived safety risks (local communities)	• As construction phase

5.5.1 Definition of Sensitivity

The evaluation of the sensitivity of community health and safety has been carried out according to the Impact Assessment methodology presented in section 9.

- *Existing regulations and guidance*

The local Health and Safety service can be adversely affected by an increased pressure on local health infrastructures, increased road accidents, injuries due to trespassing of construction areas or unexpected events, and by a disruption of the mobility to and from the infrastructures.

At a national level, the Article 38 of the Tunisian Constitution (2014) states '' Every human being has the right to health. The State guarantees prevention and health care care to every citizen and ensures the necessary means for the safety and quality of health services. health services. The state guarantees free health care for people without support or without resources. It guarantees the right to social coverage in accordance with provided for by law".

At an international level, Tunisia has ratified several international instruments, such as the International Covenant on Economic Social and Cultural Rights in 1969, of which article 12 forms the basis of international recommendations of the right to health. Tunisia has also adopted the Sustainable Development Goals adopted by UN General Assembly in September 2015, including Goal 3 regarding health issues.

Given the above, existing regulations and guidelines has been classified as "***moderate****".*

- *Societal Value*

In Tunisia, public hospital infrastructure includes 33 regional hospitals across the country. Outside the major cities, in each governorate a category A regional hospital is implemented with one or more category B regional hospital. Health infrastructure have an insufficient number of beds per capita and lack of staff and specialists.

The statistics carried out by the INS (2011-2012, health map), on the infrastructure and human resources allocated to the health sector at the national level show a strong regional disparity and that the North-East region, which includes the 4 governorates concerned by the Project, remains the best equipped in terms of health.

Surveys conducted on the right to health in Tunisia (2016) [5], have shown various shortcomings in terms of access to health services and use of public services.
Given the above, societal value has been classified as "***Moderate***".

- *Vulnerability for change*

[5] Droit à la santé en Tunisie (2016) : https://ftdes.net/rapports/ATDDS.pdf

The presence of primarily local workforce for the construction works will not likely to increase the pressure on the existing health care facilities in the municipalities crossed by the project, or potentially decrease the quality of healthcare services available to local communities, which may result in worse health outcomes.

The members of the local community that are more vulnerable to a decrease of wellbeing and quality of life, and thus also to a decrease in the quality of healthcare service, are elders, children, and groups at heightened discrimination risks.

Given the above, the vulnerability for change has been classified as "***Moderate***".

Overall, the sensitivity of the receptor "Community Health and Safety" is classified as **Moderate**.

Community Health and Safety			
Characteristics of sensitivity			
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	**Sensitivity**
Moderate	Moderate	Moderate	Moderate

5.5.2 Construction Phase

5.5.2.1 Potential Impacts

Potential safety risks from increased road traffic

During construction activities, accidents due to increased project-related road transportation can result in unintentional injuries. Increases in road transportation accidents and injuries (mortality) could occur during the construction phase, and will likely affect residents located near the construction sites; in particular, these living near the site to be used for the construction of HVD cable and near access roads to be used for tower construction of the OHL component.

The existing regional roads (RR45 and RR27) in Menzel Temime, will be strongly used during construction phase of the HDD, HVDC and CS of Mlaâbi. Similarly, several roads linking Menzel Temime to Menezel Bouzelfa, Menzel Bouzelafa to Grombalia and several others located in Ben Arous, Zaghouane and Manouba will be heavily used by construction and transport equipment. These transportation activities will cause an increase in road traffic and will increase the risk of accident and other potential injuries with other road users. that utilise the N1 and the existing access road.

For HVDC component, It is highly expected that road traffic on the road connecting Menzel Temime to Kélibia through the city of Sidi Jameleddine, will be disrupted during the installation of the underground cable over a distance of about 1.5 km (to the training center located at the entrance of the industrial area of Menzel Yahia).

For the OHL, the proposed corridor is located mostly in rural areas and far from urban centres and major roads. Nevertheless, construction and transportation equipmenet may disrupt traffic on some roads, in particular when passing through RR43 (linked Menzel Temime to Beni Khalled and Menzel Bouzelfa) and RR42 (between Beni Khalled and Grombalia).

The increase in movement of vehicle and heavy machinery may result in greater disturbance and may decrease wellbeing for local residents and road users (visitors).

Given the above, the intensity is considered "**moderate**". The spatial extent is considered "**moderate**" and the duration "**moderate**", as it is limited to the construction phase.

The overall magnitude of impacts induced by the external workforce is considered "**moderate**".

Potential safety risks from increased road traffic Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Increased traffic and risks of road accidents	Moderate	Moderate	Moderate	Moderate

Potential health risks due to limitations to access local healthcare facilities.

The roadside construction activities and consequent road closures, along increased road traffic and construction traffic, could affect community's access to healthcare facilities. In addition, the provision of health care for the workforce (both primary and secondary, i.e. hospital care) has the potential to affect access to health care for communities (due to competition for resources) with the potential for worsening health outcomes, e.g. resulting in longer waiting times.

Decreased access to routine healthcare services at the local healthcare facilities could occur during the Project, because the current local healthcare services will be inadequate to support potential inward migration, in particular in rural areas crossed by the OHL line.

Delays to road users are expected where construction and operational activities is undertaken adjacent to and/ or requiring carriageway space leading to disruptions. However, it is difficult to predict the time and locations of such congestion. It is also assumed that workers and construction traffic will operate on a six-day working week, with typical working hours of 07:00 - 18:00 hours.

Given the above, the intensity is considered "**low**", the spatial extent "**moderate**", and the duration "**moderate**".

The overall magnitude of impacts induced by the external workforce is considered "**moderate**".

Potential health risks due to limitations to access local healthcare facilities Construction Phase				
Characteristics of magnitude				**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Potential health risks due to limitations to access local healthcare facilities.	Low	Moderate	Moderate	Moderate

Site Trespass and Injury

There is a potential risk of site trespassing at work fronts for the duration of the construction activities. The excavation sites will be constantly looked after by project workers, but the risk of trespassing could be higher at nighttime in isolated areas. Site trespassing into areas where construction activities are being undertaken could result in accidents leading to injuries and even fatalities.

Given the above, the intensity is considered "**low**", the spatial extent "**low**" and the duration "**moderate**". The overall magnitude of impacts induced by the external workforce is considered "**low**".

Site Trespass and Injury Construction Phase					
Characteristics of magnitude					Magnitude
Impact	Intensity and direction	Spatial extent	Duration		
Accidents or fatalities	Low	Low	Moderate	→	Low

Exposure to potentially hazardous materials and pollutants

Emissions due to construction activities (land clearing and vegetation removal, excavation operation, etc.) and vehicle movement may affect local air quality with primary air pollutants (generation of dust and exhaust emissions).

In rural areas, the air baseline is good and it is disturbed in urban areas (near Menzel Temime in particular), with the presence of human activities (road traffic, industry, agriculture, etc.). With the presence of vehicle and heavy machinery and all construction activities, human receptors present along the access roads to the Project area will be potentially affected by vehicle exhaust emissions and dust generated by excavation and clearing activities.

With all mitigation measures specific for the management of diffuse dust and exhaust emissions and water and soil contamination, the impact of construction phase on community health due to exposure to potentially hazardous materials is considered low.

Exposure to potentially hazardous materials Construction Phase					
Characteristics of magnitude					Magnitude
Impact	Intensity and direction	Spatial extent	Duration		
Exposure to pollutants (dust, exhaust emissions, etc.)	Low	Low	Low	→	Low

5.5.2.2 Impact Significance

Community Health and Safety – Construction Phase			
Impact Significance matrix			
Impact	Sensitivity	Magnitude	Significance
Potential safety risks from increased road traffic	Moderate	Moderate	Moderate
Potential health risks due to limitations to access local healthcare facilities.		Moderate	Moderate
Site trespass and injury		Low	Low
Exposure to potentially hazardous materials and pollutants		Low	Low

5.5.2.3 Mitigation Measures

The following mitigation measures are required to avoid/reduce impacts on community, health and safety:

- Develop and implement a Transport Management Plan and all safety measures and driving rules must be included on it. This plan must adhere to existing relevant local legislations related to traffic and transportation.
- Identify the traffic requirements of construction activities needed to material, equipment and project workers transportation.
- Identify adequate traffic management procedures onsite and offsite before starting works.
- Construction activities will be conducted in low tourism season to reduce traffic risks for tourists and for the community.
- When possible, only one carriageway will be closed so as to allow partial mobility through the road. Moreover, roadworks will be carried out in sections of about 400m (likely) and it will be possible to access private properties located in the work areas, thus limiting the disturbance to local mobility and increased traffic in secondary roads.
- To minimise the risk of incidents, all activities will be notified to local authority in advance of the activity-taking place.
- To minimise the risk of incidents, all activities will be notified to local authority in advance of the activity-taking place.
- Provision of workforce healthcare services
- To minimise the risk of incidents, all activities will be notified to local authority in advance of the activity-taking place, undertake consultation with stakeholders and local communities before the beginning of construction activities.
- The Project will undertake a programme of stakeholder engagement and consultation to inform local communities of the risks of trespassing into areas where construction activities are being undertaken.
- Regular security inspections to prevent trespassing on construction sites.
- The Project will develop and implement an **Emergency Response Plan** specific to construction to prepare personnel and local emergency response crews to emergency situations.
- The Project will ensure that work areas are visible and delimited, placing signs around the construction area to inform of the risks associated with trespassing signs. All signs shall be in Italian and in diagram form to ensure a universal understanding of the risks.
- Construction machineries will be switched off and secured when not in use.

5.5.2.4 Residual Impacts

Potential Impact	Mitigation Measures	Residual Impact
Potential safety risks from increased road traffic	- Activities will be planned in low tourist season; - Only one carriageway will be closed when possible; - Access to private properties nearby roadworks will be guaranteed; - All activities will be notified to local authorities and local health services in due time	Low
Potential health risks due to limitations to access local healthcare facilities.	- When possible, one carriageway will be kept viable; - All activities will be notified to local authorities in due time	Low
Site Trespass and Injury	- Stakeholder engagement plan and consultation to inform of risks of trespassing;	Low

	- Implementation of emergency response plan; - Signalling of the construction area; - Securing machineries when not in use.	
All Community Health and Safety impacts	- Capacity / needs assessment of equipment and personnel of hospitals to determine if facilities have sufficient resources and equipment to deal with emergencies, particularly emergencies that have the greatest probability of occurring during construction, such as fractures and burnings. Agreements will be entered into with suitable healthcare to provide health care in emergency situations, including the provision of additional equipment or training for staff if required by Elmed.	Low

5.5.3 Operation Phase

5.5.3.1 Potential Impacts

Safety Risks

During the operation phase of CS of Mlaâbi and OHL line between Mlaâbia and Mornaguia, the EMF generated by these two components can affect negatively local residents on the surrounding areas. As described in section 5.4.3.1.1 (EMF impact assessment), the impact of the Project (including CS, HVDC and OHL line) on EMF exposure is considered low.

Given the above, the intensity is considered "**low**", the spatial perimeter "**moderate**" and the duration "**moderate**".

Safety Risks (EMF exposure) Operation Phase				
Characteristics of magnitude				Magnitude
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Safety risks due to increase of EMF level	Low	Moderate	Moderate	Moderate

5.5.3.2 Impact Significance

Community Health and Safety – Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Safety risks	High	Moderate	High

5.5.3.3 Mitigation Measures

The following measures must be implemented during operation phase in order to avoid/reduce any potential impacts on public health and safety:

- The project will implement activities of stakeholder engagement and awareness campaigns on the risks/absence of safety risks caused by the Project.

- Require all Contractors and Subcontractors to comply with relevant ELMED's health and safety requirements.
- Prepare and implement a Community Health and Safety Plan
- Fencing and guarding of areas intended for company use (base camp, extraction areas, worksites, etc.)
- Fluorescent strips to delimit other areas of the construction site prohibited to the public
- Installation of panels indicating and informing local population about the progress of the work
- Prepare and implement a Community Health and Safety Plan
- Notify landowners along the line route about the construction schedule and activities.

5.5.3.4 Residual Impacts

Potential Impact	**Mitigation Measures**	**Significance of Residual Impact**
Temporary Safety Risks	- Stakeholder engagement activities - Education and Awareness (safety risks)	Low