

Environmental and Social Impact Assessment

237 MWp photovoltaic power plant in Khobna – Sidi Bouzid



Provisional Version B
September 13, 2025



ASF Consulting
Your Sustainability Partner

8 Essafa Ennasr Residence 2 2001
Ariana Tunisia
Awatef.siala.fourati@asfconsulting.org
www.asfconsulting.org
(+216) 770 299 554





Project	
Project to relocate a 237 MWp photovoltaic power plant in El Khobna – Sidi Bouzid	
Document title	ESIA
Prepared by	
Client	
VERSION No.	B
Document version	
Rev. No.	Modification details
Version A-22-07-25	Submitted for comments from Qair and donors
Version B-13-09-25	Revised following comments from the EBRD

Table of Contents

Contents

0	Introduction	10
0.1	General context	10
1	Political, legal and administrative framework.....	11
1.1	Political framework	11
1.1.1	National Energy Transition Strategy by 2030	11
1.1.2	Tunisian Solar Plan (PST)	11
1.1.3	Renewable Energy Code – Law No. 2015-12 of May 11, 2015	11
1.1.4	Tunisia’s Nationally Determined Contributions (NDC) – Paris Agreement	12
1.1.5	Regional development plan and territorial inclusion	12
1.2	National legislative and regulatory framework for environmental and social management 12	
1.3	Institutional framework.....	20
1.3.1	Ministry of Industry, Energy and Mines.....	20
1.3.2	National Agency for Energy Management (ANME)	20
1.3.3	The Tunisian Electricity and Gas Company (STEG).....	20
1.3.4	Ministry of the Environment (ME)	21
1.3.5	Ministry of Agriculture	21
1.3.6	Ministry of Culture, in particular the National Heritage Institute (INP)	21
1.3.7	Ministry of Social Affairs	21
1.3.8	Ministry of State Property and Land Affairs (MDEAF)	21
1.3.9	NGOs and Civil Society	21
1.4	International conventions.....	22
1.4.1	Environmental and social framework (EBRD EIB SFI)	23
1.4.2	Analysis of gaps between national law and international standards	26
2	Project Description	33
2.1	Context and objectives of the project	33
2.2	Project site location	33
2.3	Project components.....	35
2.4	Qair Group	37
2.5	Technical details of the project components.....	37
2.6	Project activities	40
2.6.1	Phase :	40
2.6.2	Pre-construction phase:	40
2.6.3	Construction phase: (18 months)	40
2.6.4	Operational phase.....	41
2.6.5	Dismantling phase.....	41
2.7	Materials used.....	42
2.8	Labour (Estimate)	44
2.9	Site condition and land use	44
3	Description of the initial state of the site	47
3.1	Project area of influence	47

3.2	Direct influence zone	47
3.3	Indirect influence zone	47
3.4	Physical environment of the project site.....	48
3.4.1	Geographical framework	48
3.4.2	Climate framework.....	48
3.4.3	Air Quality.....	52
3.4.4	Noise and vibrations	54
3.4.5	Geological Framework	55
3.4.6	Relief and geomorphology	57
3.4.7	Hydrological and hydrogeological framework.....	59
3.4.8	Pedology.....	64
3.5	Biological Environment	65
3.5.1	Flora.....	66
3.5.2	Fauna	83
3.5.3	Critical habitats and Priority Biodiversity Features (PBF)	93
3.5.4	Landscape.....	97
3.5.5	Ecosystem services.....	98
3.5.6	Protected areas	98
3.6	Socio-economic environment.....	101
3.6.1	Sociological Framework	101
3.6.2	Economic framework	103
4	<i>Analysis of alternatives</i>	<i>110</i>
4.1	<i>“No Project” Variant</i>	<i>110</i>
4.2	<i>Alternative solar energy production technologies</i>	<i>110</i>
4.3	<i>Alternative project location and configuration</i>	<i>111</i>
4.4	<i>Justification of the chosen variant.....</i>	<i>113</i>
4.4.1	Solar power plant site	113
4.4.2	Transmission line route.....	114
4.4.3	Connection station	115
4.4.4	Water resource management.....	115
5	<i>Environmental and Social Impacts</i>	<i>117</i>
5.1	<i>Methodology adopted</i>	<i>117</i>
5.2	<i>Impact assessment grid.....</i>	<i>118</i>
5.3	<i>Identification of negative environmental and social impacts</i>	<i>120</i>
5.3.1	Design phase	120
5.3.2	Pre-construction phase	120
5.3.3	Construction Phase	121
5.3.4	Operational phase.....	132
5.3.5	Dismantling phase.....	138
5.4	<i>Identification of positive environmental and social impacts</i>	<i>145</i>
5.4.1	Positive environmental impacts.....	146
5.4.2	Positive social and economic impacts.....	147
5.4.3	Physical environment.....	148
5.4.4	Biological Environment	155
5.4.5	Socio-economic background	156
5.5	<i>Characterization and evaluation matrix.....</i>	<i>159</i>
5.6	<i>Cumulative impacts and measures</i>	<i>164</i>

5.6.1	Cumulative air pollution (construction site + neighboring Scatec solar power plant)	164
5.6.2	Ecological disturbance and habitat fragmentation (cumulative with Scatec)	164
5.6.3	Social management and cumulative risks for local communities	164
5.6.4	Landscape and visual impact	165
5.7	Residual impacts.....	166
5.7.1	Soil and water resources	166
5.7.2	Birdlife and terrestrial fauna	166
5.7.3	Flora and natural habitats	166
5.7.4	Landscape and living environment	166
5.7.5	Social conditions	166
6	Study of HSE risks linked to the project	167
6.1	Methodology.....	167
6.2	Presentation of the evaluation grid	167
6.2.1	Pre-construction phase:	169
6.2.2	Construction phase:	171
6.2.3	Operational phase.....	177
6.2.4	Dismantling phase.....	179
6.3	Summary of the risk assessment	182
7	Stakeholder consultations and engagement plan.....	184
7.1	Consultation methodology adopted	185
7.2	Summary of consultations	185
7.3	Level of stakeholder participation	187
7.4	Main concerns expressed.....	187
7.5	Consideration of concerns in the ESIA	187
7.6	Conclusion.....	188
8	Conclusion	188

List of figures

Figure 1 : Project location map in the study area	34
Figure 2 : General diagram of the different components of the project	36
Figure 3 : Main components of a photovoltaic power plant.....	38
Figure 4:Etat du site de la centrale.....	45
Figure 5 : Presence of huts in the project site	46
Figure 6: Site location.....	48
Figure 7 : Climate map of the governorate of Sidi Bouzid (Source: Bioclimatic map of Tunisia)	49
Figure 8 : Monthly average temperatures in the Mezzouna region (1991-2020)	50
Figure 9 : Graphical distribution of average precipitation (1991-2020).....	51
Figure 10 : Wind rosette of Mezzouna	52
Figure 11 : Location of sampling stations	53
Figure 12 : Geological map of Sidi Bouzid (Source: GIFEX)	56
Figure 13 : Geomorphological map (Source: GIFEX)	57
Figure 14 : Profile of the terrain gradient.....	58
Figure 15 : Hydrographic map of Sidi Bouzid	59

Figure 16 : Profile of the slope proving the direction of inclination of the land from the site to Sebkhet el Noual.....	60
Figure 17 : Map of groundwater in the governorate of Sidi Bouzid.....	62
Figure 18 : Map of the deep water tables of Sidi Bouzid	63
Figure 19 : Distances between the power plant site, the HV transmission line and the Sebkha	64
Figure 20 : Soil map of Sidi Bouzid.....	65
Figure 21 : Landscapes and flora identified on site.....	67
Figure 22: Vantage points location	68
Figure 23 : Flora identified at the first observation point.....	70
Figure 24 : Flora identified at the VP2 level	72
Figure 25 : Halophytes of Sebkha (VP3)	74
Figure 26 : Flora identified towards VP4.....	75
Figure 27 : Plants identified at the VP5 level.....	77
Figure 28 : Plants identified at the VP6 level.....	79
Figure 29 : Species identified at the VP7 level	80
Figure 30 : Species identified in VP8	82
Figure 31 : Vertebrates and Invertebrates identified on site.....	85
Figure 32 : Position of the transects on the PV site. (Source: Biodiversity study carried out by EAM on the Khobna solar power plant).....	89
Figure 33 : Location of observation points (VP) along the OHTL.....	90
Figure 34 : Landscape of the project site	98
Figure 35 : Demographic map of Sidi Bouzid	102
Figure 36 : Percentages of age groups in the Mezzouna delegation.....	103
Figure 37 : Number of jobs per company in Sidi Bouzid	104
Figure 38 : Map of Sidi Bouzid's mineral resources	105
Figure 39 : Industrial map of Sidi Bouzid.....	106
Figure 40 : Technical characteristics of the project site	114
Figure 41 : Path alternatives.....	115
Figure 42 : Site protection solution using a trapezoidal ditch	124

List of tables

Table 5 : Environmental and social standards of the European Bank for Reconstruction and Development.....	23
Table 6 : Environmental and social standards of the European Investment Bank	24
Table 7 : Environmental and social standards of the International Finance Corporation)	25
Table 8 : Comparative analysis between Tunisian law and international standards.....	27
Table 9 : Main technical characteristics of the El Khobna solar power plant	39
Table 10 : General overview of the equipment planned for the project.....	42
Table 11 : Köppen-Geiger classification.....	50
Table 12 : Suspended particles	53
Table 13 : Sound level (ambient noise).....	54
Table 14 : Lithological characteristics of the superficial geological layers of the El Khobna site	55
Table 15 : Characteristics of the main water tables of Sidi Bouzid	60
Table 18 : Taxonomic list of plant species identified on the site	66
Table 19 : Observation points and geographic coordinates along the transmission line	67
Table 20 : Taxonomic list of flora identified towards VP1	69
Table 21 : Taxonomic list of flora identified towards VP2	71
Table 22 : Taxonomic list of species identified towards VP 3.....	73

Table 23 : Taxonomic list of flora identified at the VP4 level	75
Table 24 : Taxonomic list of plants at the VP5 level	76
Table 25 : Taxonomic list of plants identified towards VP6.....	78
Table 26 : Taxonomic list of plants identified in VP7.....	80
Table 27 : Taxonomic list of plants identified in VP8.....	81
Table 28 : List of species and conservation status (April-June 2025).....	91
Table 27 : PBF species and potentially present in the area of influence and neighboring areas	94
Table 29 : Table of protected areas.....	99
Table 30 : Social characteristics of Sidi Bouzid.....	103
Table 31 : Level 1 - Type of renewable energy suitable for Mezzouna	110
Table 32 : Level 2 - Type of solar technology	111
Table 33 : Level 3 - Type of photovoltaic panels.....	111
Table 34 Levels of factors (P, G) of the occupational risk assessment grid	168
Table 35 Risk Matrix	168
Table 36 Risk assessment grid	168
Table 37 : Meaning of colors	168
Table 38 : Consultation register.....	185

List of abbreviations

Abbreviation	Meaning
ESIA	Environmental and Social Impact Study
EIA	Environmental Impact Study
PGES	Environmental and Social Management Plan
PEPP	Stakeholder Engagement Plan
STEG	Tunisian Electricity and Gas Company
SONEDE	National Water Exploitation and Distribution Company
ONAS	National Sanitation Office
ANME	National Agency for Energy Management
ANPE	National Environmental Protection Agency

CRDA	Regional Agricultural Development Commissions (CRDA)
CPG	Gafsa Phosphates Company
GCT	Tunisian Chemical Group
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
SFI	International Finance Corporation (IFC)
IPP	Independent Power Producer
PV	Photovoltaic
PST	Tunisian Solar Plan
SCADA	Supervisory control/command system (SCADA)
STS	Transformer Station (TSS) – (used for transformers)
HSE	Health, Safety, and Environment (HSE)
ESHS	Environment, Health and Safety (ESHS)
HT	High Voltage
kV	kilovolts (unit of voltage)
CEM	Electromagnetic fields
PM2.5 / PM10	Suspended particles (PM2.5 / PM10)
IUCN	International Union for Conservation of Nature (IUCN)

INP	National Heritage Institute (INP) – mentioned
CEM	Exposure to electromagnetic fields

0 Introduction

0.1 General context

In a global context marked by the energy transition and the fight against climate change, Tunisia has embarked on a proactive policy of diversifying its energy mix through the massive development of renewable energies. This strategic orientation aims to reduce the country's dependence on fossil fuels, strengthen its energy security and promote sustainable development that respects the environment. It is in this context that the company Qair Tunisia, a subsidiary of the international group Qair, is proposing the development of a 237 MWp photovoltaic solar power plant in El Khobna, in the delegation of Mezzouna, governorate of Sidi Bouzid. Qair, a recognized international player in renewable energies present in more than twenty countries, designs, finances, builds and operates sustainable projects with a strong desire to contribute to the Tunisian energy transition while promoting local resources.

The project includes the installation of a photovoltaic power plant on an area of approximately 267 hectares, as well as the construction of a 45 km overhead power line (225 kV) connecting the site to the STEG substation in Meknassy, and the development of the necessary access tracks. From its design stage, particular attention was paid to reducing, or even avoiding, environmental and social impacts, through rigorous planning, controlled landscape integration and taking into account local sensitivities (Sebkhet Noual and Bouhedma National Park) from the initial phases. In accordance with international standards, including the IFC Performance Standards, as well as the environmental and social requirements of international donors such as the EBRD and the EIB, and in compliance with current Tunisian regulations, Qair is committed to developing this project in a sustainable manner. The Environmental and Social Impact Assessment (ESIA) conducted identified potential impacts and defined the necessary management and mitigation measures to ensure a responsible project that creates value for local communities and respects the environment. The El Khobna Project comprises three main components:

- An access track connecting the power plant to the MC205 regional road for the transport of equipment and operation of the site;
- The 237 MWp photovoltaic power plant, built and operated by Qair on a fenced site of approximately 267 ha;
- A 225 kV, 45 km overhead power line connecting the power station to the STEG substation in Meknassy.

The Tunisian Electricity and Gas Company (STEG), as the national operator, will ensure the reception and integration of the electricity produced into the network. Under the supervision of the Ministry of Industry, Energy and Mines, its mission is to guarantee the country's energy supply under the best economic, technical and environmental conditions.

This study, entrusted to ASF Consulting, therefore sets out all the elements linked to the project, analyses its potential impacts on the environment and local communities, and defines an appropriate Environmental and Social Management Plan (ESMP) in order to ensure implementation in accordance with international standards and the expectations of stakeholders.

1 Political, legal and administrative framework

1.1 Political framework

The photovoltaic power plant project is in line with Tunisia's major political guidelines regarding sustainable development, energy transition, the fight against climate change, and regional development. Several national policies support and justify this type of investment, particularly in inland regions such as Sidi Bouzid.

1.1.1 National Energy Transition Strategy by 2030

Faced with significant energy dependence and increasing demand, Tunisia has adopted an energy transition strategy ¹which aims to:

- Reduce primary energy consumption by 30% by 2030 compared to the current trend;
- Increase the share of renewable energy to 35% in electricity production;
- Reduce greenhouse gas emissions from the energy sector.

This strategy is based on the massive development of large-scale solar photovoltaic energy, particularly in the southern regions. The El Khobna photovoltaic power plant project is directly in line with this political vision.

1.1.2 Tunisian Solar Plan (PST)

The Tunisian Solar Plan (PST) ², developed in 2012 and updated in 2015, reflects Tunisia's new strategic directions in terms of energy transition. It aims to increase the share of renewable energy in the national electricity mix and to strengthen energy efficiency.

To support these objectives, Law No. 2015-12 of May 11, 2015 was adopted to structure the production of electricity from renewable sources and encourage private sector participation. It provides for three production regimes:

- The concession regime for large-capacity projects;
- The authorization system for intermediate-sized projects;
- The self-production regime, open to all types of consumers.

1.1.3 Renewable Energy Code – Law No. 2015-12 of May 11, 2015

This law aims to legally regulate the implementation of electricity production projects from renewable energy sources, whether for self-consumption, meeting local demand or export. It concerns all forms of production resulting from the conversion of renewable sources such as

¹ <https://www.giz.de/en/downloads/giz-2023-fr-factsheet-TETA.pdf>

² [Ministry of Energy, Mines and Renewable Energies: Strategy, objectives and orientations](#)

solar, wind, biomass, geothermal, organic gas or any other similar resource. It applies independently of the provisions of Decree-Law No. 62-8 of April 3, 1962, establishing and organizing the Tunisian Electricity and Gas Company, ratified by Law No. 62-16 of May 24, 1962.

1.1.4 Tunisia's Nationally Determined Contributions (NDC) – Paris Agreement

Since 2015, Tunisia has been committed to promoting low-carbon development that is resilient to the effects of climate change. This commitment ³is demonstrated through several major initiatives:

- The submission in September 2015 of its Nationally Determined Contribution (NDC) aiming for a 41% reduction in its carbon intensity by 2030 compared to 2010;
- Adherence to the 2030 Agenda for Sustainable Development, officially launched at the national level in December 2016;
- Participation in the Sendai Framework for Disaster Risk Reduction;
- The ratification of the Paris Climate Agreement; as well as the integration of these commitments into the National Development Plan 2016-2020 adopted in April 2017 by the Assembly of People's Representatives.

1.1.5 Regional development plan and territorial inclusion

In the Economic and Social Development Plans developed by the Tunisian government (2016–2020 and ongoing for 2023–2025), priority is given to reducing regional disparities. The development of infrastructure, particularly energy, in inland regions such as Sidi Bouzid, is presented as a strategic response to:

- Promote investment,
- Create local jobs,
- Reduce energy poverty.

1.2 National legislative and regulatory framework for environmental and social management

In Tunisia, the legal framework governing environmental management is structured to ensure effective protection against various forms of pollution and to promote improvements in the

³ [Support for the implementation of Tunisia's Nationally Determined Contribution | United Nations Development Programme](#)

living environment. This framework is based on an integrated approach combining prevention mechanisms, such as environmental impact assessments (EIAs), incentive measures through financial support and tax benefits, as well as sanctions applicable in the event of proven environmental damage.

All legislative and regulatory texts applicable at national level are presented in the table below.

- **Renewable energies**

Law/Decree/Order	Reference text
Decree No. 96-1125 of June 20, 1996	Defines the terms for granting electricity production concessions to private actors.
Law No. 2009-7 of February 9, 2009 (supplementing Law No. 2004-72)	Establishes the framework for the production of electricity from renewable sources, particularly for self-consumption in the industrial, agricultural or tertiary sectors.
Decree No. 2009-2773 of September 28, 2009	Regulates the conditions of access to the national electricity network and the sale of surpluses to STEG, within the limit of 30% of production.
Decree of May 12, 2011	Approves the technical specifications for the connection and evacuation of renewable and cogeneration energy to the national network.
Law No. 2015-12 of May 11, 2015	Defines the legal regime for the production and transmission of electricity from renewable sources, including for self-consumption, export or local consumption.
Government Decree No. 2016-1123 of August 24, 2016	Specifies the conditions for implementing projects for the production and sale of electricity from renewable sources.
Order of February 9, 2017	Approves the standard contract for the transport of electricity produced from renewable energy intended for

	self-consumption.
--	-------------------

- **Protection of natural resources**

Law/Decree/Order	Reference text
Law No. 88-91 (amended by Law No. 92-115) and Decree No. 2005-1991	Establishes the obligation to carry out an impact study for projects likely to affect the environment. Specifies the classification of projects and content requirements.
Water Code (Law No. 75-16), Decree No. 85-56, Order of March 26, 2018	Prohibits any polluting discharge into water resources; projects must obtain specific authorizations for any use or discharge into the public domain.
Law No. 2007-34, Decrees No. 2010-2519 and No. 2018-447	Defines air quality standards and atmospheric emission thresholds that projects must meet, with monitoring requirements.
Law No. 96-41, Decrees No. 2005-2317, 2005-3395, 2008-2565, Law No. 97-37	Regulates the management of solid and hazardous waste, imposes conditions for storage, transport and disposal, under the supervision of ANGED.
Law No. 97-37, Decrees No. 2000-2339 and No. 2005-3079	Framework for the transport and handling of hazardous substances and waste, including reporting and safety obligations.
Decree No. 84-1556, municipal decrees, Highway Code	Impose acceptable noise thresholds according to urban or industrial areas and vehicle types; necessary for the assessment of noise pollution.
Law No. 83-87 and Law No. 2019-47	Protect agricultural land from change of use. Exceptions are possible for renewable energy projects with approval from the authorities.
Law No. 95-70	Aims to prevent soil degradation, particularly erosion, through sustainable management measures in vulnerable areas.

Law No. 2001-119	The felling of olive trees is subject to authorization. This measure applies to projects requiring clearing or a change in land use.
-------------------------	--

- **Protection of biodiversity**

Law/Decree/Order	Reference text
Forestry Code (1966, revised in 1988, amended by Law No. 2005-13 of 26/01/2005)	Constitutes the legal basis for the protection of natural environments such as forests, rangelands, and protected areas. All development requires ministerial authorization. Prohibits activities that harm flora and fauna, particularly in national parks.
Law No. 92-72 of August 3, 1992	Determines the general rules for plant protection and regulates the use of pesticides for agricultural use.
Order of the Minister of Agriculture of June 29, 2006	Supervises temporary permits in forestry areas. Refuses any activity presenting risks to the environment or natural resources.
Order of the Minister of Agriculture and Water Resources of July 19, 2006	Establishes the official list of rare and endangered species of wild fauna and flora, a legal basis for their enhanced protection.

- **Land occupation and easements related to electrical projects**

Law/Decree/Order	Reference text
Decree of May 30, 1922 relating to electric transmission lines	Allows the passage of power lines over private property without transfer of ownership or expropriation, but requires compensation for operators in the event of damage to the land crossed. Prohibits passage over fenced properties or over buildings. STEG negotiates temporary agreements with owners and operators before work begins, paying compensation in the event of damage.

Law No. 76-85 of August 11, 1976 relating to expropriation for public utility (amended in 2003 and 2016)	Governs expropriation when amicable negotiations fail to acquire private land necessary for a public utility project. STEG prioritizes public land to avoid expropriation. Expropriation is accompanied by fair and prior compensation to the owner.
---	--

- **Protection of cultural resources**

Law/Decree/Order	Reference text
Heritage Code (Law 94-35 of February 24, 1994)	Regulates the protection of archaeological, historical, and traditional arts heritage. Work affecting the exterior appearance of cultural sites or protected areas requires prior authorization from the Minister responsible for heritage.
Article 68 of Law 94-35	In the event of the accidental discovery of remains (prehistoric , historical, artistic or traditional), the author must immediately inform the competent authorities within 5 days. These authorities will take the necessary measures for conservation and supervise the work if necessary.

- **Gender, vulnerability and social action**

Law/Decree/Order	Reference text
Personal Status Code - Decree of August 18, 1958	Establishes equal rights for men and women in marriage, divorce, property ownership, and access to employment; prohibits polygamy and sets the legal age of marriage at 18.
Law No. 85-68 of July 12, 1985	Ratifies the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), marking an international legal commitment to gender equality.
Successive reforms of the CSP (1992-2008)	Expand women's rights: abolition of the duty of obedience to the husband, transmission of nationality to children, right to alimony.

Tunisian Constitution - Articles 21, 46 (2014)	Guarantees gender equality, prohibits all discrimination and requires the State to promote women's rights and eliminate gender-based violence.
Lifting of reservations on CEDAW - April 17, 2014	Strengthens the full application of the international convention without legal restriction.
Nationality and Marriage Reforms - 2017	Repeal of restrictions on interfaith marriage and the transfer of nationality by women to their foreign spouses.
ILO Conventions No. 100 and No. 189	Respectively guarantee equal pay between the sexes and the protection of domestic workers within the Tunisian legal framework.
Government Decree No. 2016-626	Establishes a peer council responsible for ensuring equal opportunities between women and men in public institutions.
Organic Law No. 2017-58 of August 11, 2017	Establishes a comprehensive legal framework to prevent, punish and address violence against women.
Article 12 of the Constitution (2014)	Commits the State to ensuring social justice, equitable development of regions and the implementation of positive discrimination.

- **Health and safety**

Law/Decree/Order	Reference text
Labour Code - Law No. 66-27 of April 30, 1966 (and amendments)	Regulates labour relations, employment conditions, rights and obligations of workers and employers.
Decree No. 75-240 of April 24, 1975	Regulates the conditions of hygiene, safety and employment of women and children in the sectors of commerce, industry and the liberal professions.
Decree No. 68-328 of October 22,	Defines the general hygiene rules in businesses: drinking

1968	water, waste management, ventilation, sanitary facilities.
Decree No. 75-503 of July 28, 1975	Regulates the safety of workers in establishments using electrical currents.
Law No. 87-31 of July 6, 1987	Ratifies Arab Labour Convention No. 7 on occupational health and safety, including technical protection requirements.
Law No. 94-28 of February 21, 1994	Sets the rules regarding work accidents and occupational diseases, and imposes reporting obligations on the employer and the occupational physician.
Orders of 15/11/2005, 23/02/2010, 24/10/2012	Define the nomenclature of dangerous, unsanitary or inconvenient establishments according to their activity.
Decree No. 2006-2687 of October 9, 2006	Specifies the procedures for opening and operating establishments classified as at risk (dangerous, unsanitary, inconvenient).
Law No. 2009-11 of March 2, 2009	Implements the Code of Safety and Prevention against Fires, Explosions and Panic Movements in Buildings.

- **Classified establishments**

The system for dangerous, unsanitary or inconvenient establishments, known as "classified establishments", constitutes an essential part of the Tunisian regulatory framework for the protection of the environment and public health. It is defined by **Decree No. 2005-1991 of July 11, 2005**, supplemented by **the decrees of November 15, 2005, February 23, 2010 and October 24, 2012**, which establish the nomenclature of establishments subject to authorization or declaration according to their level of risk.

Electricity production projects, including photovoltaic solar power plants, are considered classified establishments. They must therefore obtain **prior authorization to operate** issued by the competent ministry. This authorization is based on a technical file which must include **the Environmental and Social Impact Assessment (ESIA)** validated by the National Agency for Environmental Protection (ANPE).

It is important to note that, unlike other projects classified as high risk, solar power plants **are not subject to a specific prior "no objection" procedure of the ESIA**. However, the preparation and validation of this study constitutes an essential condition for the granting of the operating permit, and guarantees that environmental and social risks are taken into account from the

design phases.

This system aims to regulate the location, construction and operation of electricity production projects in order to prevent nuisances for the population and the environment, while promoting the sustainable development of renewable energies.

- **Public consultation and access to information**

Law/Decree/Order	Reference text
Government Decree No. 2018-328 of March 29, 2018	Establishes the rules for organizing public consultation. Although the publication of EIA reports is not mandatory, some public companies voluntarily disseminate them in accordance with international standards.
Decree No. 2005-1991 of July 11, 2005	Constitutes the legal basis for EIAs in Tunisia. It remains general on social aspects and does not specifically address vulnerability or the gender dimension.
Draft Code of Territorial Planning and Urban Development	Its Article 22 provides for the involvement of local authorities, representatives of the population and associations in planning processes.
Decree-law No. 2011-41 of May 26, 2011	Guarantees access to administrative documents of public bodies, particularly on organization and programs.
Organic Law No. 2016-22 of March 24, 2016	Specifies the right of access to information held by administrations. Although the ESIA is not explicitly mentioned, a formal request is possible.
Decree No. 2017-18 of August 17, 2017	Establishes the National Authority for Access to Information, competent to receive appeals in the event of refusal of access.
Article 32 of the Constitution (2014)	Enshrines the right to information for all citizens.
Article 139 of the Constitution	Involves local authorities in participatory democracy mechanisms, particularly for development and planning

	projects.
--	-----------

- **Investment and renewable energy projects**

Law/Decree/Order	Reference text
Government Decree No. 2017-389 of March 9, 2017	Provides financial incentives for projects costing 50 million dinars or more. These projects may be classified as being of national interest in accordance with Article 20 of Law No. 2016-71 on investment.
Law No. 2019-47 of May 29, 2019	Establishes favorable provisions for investment, particularly for renewable energy projects. Allows the use of private or public land without requiring a change in the use of agricultural land, in accordance with the national renewable energy plan.

1.3 Institutional framework

1.3.1 Ministry of Industry, Energy and Mines

The Ministry is the primary authority responsible for defining and steering national policy in the industrial, energy, including renewable energy, and mining sectors. It coordinates actions aimed at developing these sectors, encouraging innovation, and ensuring the security of energy and mining supplies. In addition, it oversees industrial cooperation, as well as regulation and security in these areas.

1.3.2 National Agency for Energy Management (ANME)

Founded in 1985, ANME is Tunisia's key agency for promoting energy efficiency and renewable energy. Reporting to the Ministry of Industry, it plays a central role in implementing national energy policies. It manages support mechanisms for the photovoltaic sector, issues operator approvals, and monitors equipment compliance. ANME also administers the Energy Transition Fund, supporting projects that promote the energy transition.

1.3.3 The Tunisian Electricity and Gas Company (STEG)

The Tunisian Electricity and Gas Company (STEG), established by Decree-Law No. 62-8 of April 3, 1962, amended by Law No. 96-27 of April 1, 1996, is responsible for ensuring the electrification of the country, the development of the natural gas network and the establishment of energy infrastructure. It ensures the production of electricity and liquefied petroleum gas (LPG), as well as the transmission and distribution of electricity and natural gas on a national scale.

1.3.4 Ministry of the Environment (ME)

Responsible for the design and implementation of environmental policies, this ministry ensures the protection of natural resources and the promotion of sustainable development. It oversees several specialized agencies such as the National Agency for Environmental Protection (ANPE), the National Agency for Waste Management (ANGEd), and the National Office for Sanitation (ONAS), each of which contributes to specific aspects of environmental management.

1.3.5 Ministry of Agriculture

Through its departments, including the Directorate General of Forests and the Regional Agricultural Development Commissions (CRDA), the Ministry is involved in the sustainable management of natural resources. These structures play an important role in the preservation of forest areas, national parks, and nature reserves, ensuring compliance with applicable forestry and environmental regulations.

1.3.6 Ministry of Culture, in particular the National Heritage Institute (INP)

This organization is responsible for the conservation and promotion of cultural, archaeological, and historical heritage. In the context of projects likely to affect heritage sites or objects, the INP intervenes to carry out studies, inventories, as well as the monitoring and protection of heritage.

1.3.7 Ministry of Social Affairs

The Ministry of Social Affairs is responsible for implementing social policy. Responsible for social policy, this ministry aims to promote social cohesion and equity. It ensures the protection of vulnerable populations, workplace safety, social inclusion, and the development of education and social support programs. Its work includes coordination with civil society and the Tunisian diaspora, as well as the management of social housing.

1.3.8 Ministry of State Property and Land Affairs (MDEAF)

This ministry is responsible for the management and development of the state's public and private domain. It oversees land transactions, such as the allocation, transfer, or expropriation of real estate required for public or private projects, and ensures the regularization of land rights in compliance with current legislation.

1.3.9 NGOs and Civil Society

Tunisian NGOs play a vital role in environmental protection, sustainable development, and improving social conditions. They operate on the ground, raise awareness, and participate in

public consultation processes. Their involvement helps strengthen transparency, citizen participation, and project sustainability.

1.4 International conventions

- Stockholm Convention on Persistent Organic Pollutants (POPs): **Decree No. 2004-918 of April 13, 2004**
- Cartagena Protocol on Biosafety: **Law No. 2002-58 of June 25, 2002**
- Kyoto Protocol and Law 93-46 of May 3, 1993 ratifying the United Nations Framework Convention on Climate Change : **Law No. 2002-55 of June 19, 2002**
- Agreement relating to the creation and operation of the Sahara and Sahel Observatory: **Law No. 2000-12 of February 7, 2000**
- Bern Convention on the Conservation of European Wildlife and Natural Habitats: **Law No. 95-75 of August 7, 1995**
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal : **Law No. 95-63 of July 10, 1995**
- United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought : **Law No. 95-52 of June 19, 1995**
- United Nations Convention on Biological Diversity: **Law No. 93-45 of May 3, 1993**
- United Nations Framework Convention on Climate Change: **Law No. 93-46 of May 3, 1993**
- Convention on the Conservation of Migratory Species of Wild Animals: **Law No. 86-63 of July 16, 1986**
- Convention on Wetlands of International Importance RAMSAR: **Law No. 80-9 of March 3, 1980**
- Protocol on cooperation between North African States in the fight against desertification: **Law No. 71-1 of 25 January 1979**
- African Convention on the Conservation of Nature and Natural Resources: **Law No. 76-91 of November 4, 1976**
- Convention for the Protection of the World Cultural and Natural Heritage : **Law No. 74-89 of December 11, 1974**
- Convention on International Trade in Endangered Species of Wild Fauna and Flora: **Law No. 74-12 of March 11, 1974**

1.4.1 Environmental and social framework (EBRD EIB SFI)

In the context of the photovoltaic power plant project in El Khobna , Sidi Bouzid, it is essential to take into account the applicable international environmental and social standards, in particular those adopted by financial institutions such as the EBRD, the EIB and the IFC.

Table 1: Environmental and social standards of the European Bank for Reconstruction and Development

ESR No.	Title	Main objectives
ESR 1	Assessment and management of environmental and social risks and impacts	Identify, assess and manage risks/impacts throughout the project cycle through a proportionate management system (ESMS).
ESR 2	Conditions of employment and work	Protect workers' rights, promote safe, fair and non-discriminatory working conditions .
ESR 3	Efficient use of resources, pollution prevention and control	Promote resource efficiency (water, energy, raw materials) and reduce pollution and GHG emissions.
ESR 4	Health, Safety and Security	Protect the health and safety of workers, communities and consumers from risks associated with project activities.
ESR 5	Land acquisition, use restrictions and involuntary resettlement	Avoid or minimize involuntary resettlement; ensure fair compensation and restore livelihoods.
ESR 6	Preservation of biodiversity and sustainable management of living natural resources	Preserve biodiversity, avoid net losses and promote the sustainable management of ecosystems and natural resources.
ESR 7	Indigenous peoples	Respect the rights, dignity, aspirations and culture of indigenous peoples, and obtain their free, prior and informed consent where necessary.
ESR 8	Cultural heritage	Protect tangible and intangible cultural heritage, including archaeological, religious and natural sites.
ESR 9	Financial intermediaries	Ensure that financial intermediaries apply EBRD social and environmental standards in the projects

		they finance.
ESR 10	Stakeholder participation	Ensure transparent information, effective consultation and stakeholder participation throughout the project cycle.

Table 2: Environmental and social standards of the European Investment Bank

Standard	Titled	Main objectives
NES 1	Environmental and social impacts and risks	Identify, assess, prevent and manage environmental, social, climate and human rights risks and impacts.
NES 2	Dialogue with stakeholders	Ensure inclusive, transparent and continuous dialogue with stakeholders, guaranteeing their participation and access to information.
NES 3	Efficient use of resources and pollution prevention	Reduce pollution, ensure the rational use of natural resources and manage waste and emissions sustainably.
NES 4	Biodiversity and ecosystems	Preserve biodiversity, avoid net losses and protect ecosystem services, particularly in sensitive areas.
NES 5	Climate change	Integrate climate change mitigation and adaptation into projects, reduce GHG emissions, increase resilience.
NES 6	Involuntary resettlement	Avoid or minimize involuntary displacement, ensure fair compensation, restore livelihoods.
NES 7	Vulnerable groups, indigenous peoples and gender dimension	Protect the rights and cultures of indigenous peoples and vulnerable groups, promote gender equality and prevent discrimination.
NES 8	Employment and working conditions	Promote decent work, ensure health, safety, non-discrimination and respect for workers' rights.
NES 9	Health, Safety and Security	Protect the health and safety of communities and workers, including from the risks of accidents, violence and emergencies.

NES 10	Cultural heritage	Identify, assess, preserve and appropriately manage tangible and intangible cultural heritage.
NES 11	Intermediated financing	Ensure that financial intermediaries comply with EIB environmental and social standards in indirectly financed projects.

Table 3: Environmental and social standards of the International Finance Corporation)

Standard	Titled	Main objectives
NP 1	Assessment and management of environmental and social risks and impacts	Establish a management system to identify, assess, prevent and mitigate impacts throughout the project cycle.
NP 2	Working conditions and professional relations	Ensure fair treatment of workers, respect fundamental rights, promote safety and health and avoid forced or child labour.
NP 3	Resource efficiency and pollution prevention	Reduce pollution, improve resource efficiency (water, energy, raw materials), and limit greenhouse gas emissions.
NP 4	Community health, safety and security	Protect local communities from risks related to infrastructure, hazardous substances, diseases, disasters, etc.
NP 5	Land acquisition and involuntary resettlement	Minimize displacement, provide fair compensation, restore livelihoods and living conditions of affected populations.
NP 6	Conservation of biodiversity and sustainable management of natural resources	Preserve biodiversity, avoid net losses, sustainably manage natural resources.
NP 7	Indigenous peoples	Respect the rights, culture and aspirations of indigenous peoples, and obtain their free, prior and informed consent in certain cases.
NP 8	Cultural heritage	Protect and conserve tangible and intangible cultural heritage, including archaeological,

		religious or natural sites.
--	--	-----------------------------

1.4.2 Analysis of gaps between national law and international standards

As part of the project to build a solar power plant in Sidi Bouzid, this analysis aims to compare the environmental and social (E&S) regulations in force in Tunisia with the requirements of the main international financial institutions involved: the EBRD (Environmental and Social Requirements), the IFC (Performance Standards) and the EIB (Environmental and Social Standards). The table below presents, for each environmental and social theme, the applicable national requirements, the requirements of the donors and the identified gaps. It also proposes corrective measures and recommendations to ensure the project's compliance with international standards.

The themes follow the order of performance standards commonly used in ESIAs, thus facilitating comparative analysis and the integration of results into project documents.

Table 4: Comparative analysis between Tunisian law and international standards

Thematic	Tunisian E&S regulations	EBRD Requirement (ESR)	IFC Requirement (PS)	EIB Requirement (ESS)	Identified gap	Proposed corrective provisions
Environmental and social assessment	Tunisia has a structuring legal framework based on the Environmental Code (Law No. 2001-116), supplemented by Decree No. 2005-1991 relating to impact studies. EIAs are required for several categories of projects, including energy projects, and must be validated by the ANPE. However, social impact analysis is rarely in-depth, and the cumulative or climate approach is almost non-existent.	ESR1 requires a comprehensive assessment proportionate to the nature and scale of the impacts, including active risk management, mitigation measures, an E&S management plan (ESMP) and an assessment of indirect and cumulative impacts.	PS1 requires a rigorous assessment of E&S risks and impacts, the implementation of a management system (ESMS), and the early identification of indirect, cumulative and transboundary impacts.	ESS1 and ESS10 require a comprehensive ESIA, based on international best practices, integrating climate dimensions, social considerations and stakeholder participation.	Tunisian analysis focuses on the biophysical environment; social impacts, vulnerability, gender, and cumulative impacts are rarely addressed. The integration of climate change is also very limited.	Integrate social, climate and gender dimensions into the specifications of ESIA's. Provide a structured E&S Management Plan (ESMP) with indicators.
Consultation, stakeholder engagement and complaints	regulations do not provide for public consultation, but it remains ad hoc and limited to a specific phase of the project. No formal	ESR10 requires a structured consultation process from the design	PS1 and PS10 require stakeholder involvement, continuous	ESS10 provides for prior consultations, ongoing participation	The Tunisian framework does not guarantee structured engagement or a	Develop a project-specific PEPP, including mapping of vulnerable stakeholders and inclusive engagement. Implement a tailored,

management mechanism	framework requires ongoing stakeholder engagement throughout the project lifecycle. Furthermore, there is no structured mechanism for managing environmental or social complaints, let alone specific provisions for addressing sensitive complaints (e.g., gender-based violence - GBV, sexual exploitation and abuse - SEAH) or for protecting vulnerable people (e.g., women, youth, minorities, people with disabilities).	phase. The EBRD requires continuous, inclusive and accessible consultation with stakeholders, including vulnerable groups. It requires the establishment of a Stakeholder Engagement Plan (SEP) and a Complaints Management Mechanism (CM) proportionate to the project's risks. This mechanism must include specific measures for handling gender-sensitive complaints (GBV/SEAH), guarantee confidentiality, safety of survivors and non-retaliation, while ensuring accessibility for vulnerable people.	communication. The IFC requires proactive engagement with stakeholders, based on risk and vulnerability identification. The grievance mechanism must be tailored to specific risks, including sensitive complaints (GBV/SEAH), and allow equitable access to all groups, including marginalized populations. It must include confidential procedures, referral to specialized services, and case monitoring.	mechanisms, transparent access to information and a complaints mechanism in line with good practice. The EIB requires the preparation of a PEPP based on a stakeholder analysis and special attention to vulnerable groups. The MGP must cover all E&S complaints, including those related to gender-based violence and exploitation. It must be safe, accessible, confidential, include risk management measures for vulnerable complainants, and provide support for survivors.	functional complaints mechanism throughout the project. There is no specific mechanism for handling sensitive complaints (GBV/SEAH) or ensuring the process is accessible to vulnerable groups. There is also a lack of guidelines on confidentiality, non-retaliation, and support for survivors or people in vulnerable situations.	confidential, multi-channel (oral, written, online) MGP, including specific provisions for sensitive complaints (GBV/SEAH), with referral to specialized structures. Train staff, raise awareness among communities, and ensure the system is accessible to marginalized groups (language, disability, gender, etc.).
Working	The Tunisian Labour Code	ESR2 requires non-	PS2 incorporates	ESS2 applies the	Lack of a structured	Update the Labour Code to

conditions and employment	(Law No. 66-27) establishes basic rules regarding contracts, wages, working hours, and safety. It prohibits the employment of children under 16 years of age and provides for labour inspections. However, it does not explicitly cover freedom of association, internal workplace remedies, or harassment prevention.	discrimination, freedom of association, safe working conditions, and an internal grievance mechanism accessible to all employees.	ILO principles: freedom of association, equal pay, anti-harassment, decent working conditions, and the requirement for an internal grievance mechanism for employees.	fundamental ILO conventions, provides for the protection of workers' rights and the existence of internal mechanisms for recourse and expression of grievances.	framework for managing internal complaints, no clear provisions on freedom of association, harassment and non-discrimination in hiring or dismissal practices.	include provisions on freedom of association, the fight against harassment, salary transparency, and impose an internal complaints mechanism. Deploy a social audit guide on construction sites.
Pollution prevention and management	The Code of Environment (2001) National environmental regulations govern emissions into air, water, and soil. Technical standards exist for effluents and waste. However, there are no requirements for energy efficiency, climate change, or GHG inventories. Environmental monitoring obligations are sometimes unclear.	ESR3 requires compliance with international best practices, resource efficiency, GHG emission reduction, and hazardous waste management according to international standards.	PS3 imposes a pollution prevention strategy based on the mitigation hierarchy, GHG reduction, and natural resource optimization. It also requires the adoption of performance thresholds aligned with the World Bank's EHS guidelines.	ESS3 includes pollution prevention, waste management, and climate alignment. Projects must be consistent with EU climate commitments (including alignment with the Paris Agreement).	Tunisian regulations do not require assessments of greenhouse gas emissions or climate mitigation measures. The absence of reference to international standards on pollutants or environmental performance is also notable.	Align national standards with international performance thresholds (IFC/EHS). Require a waste management plan and GHG inventory in any ESIA. Integrate climate analysis into environmental authorization.
Health, safety	The Public Health Code	ESR4 requires the	PS4 requires the	ESS4 covers	Community	Introduce a community risk

and impacts on communities	and certain sector-specific regulations define general safety obligations, particularly for industrial equipment. However, community safety, the management of land use or nuisance conflicts, and the use of private security are not specifically regulated.	assessment and management of risks to the health and safety of affected communities, as well as the supervision of private security agents according to strict ethical principles.	identification of community risks, including risks related to insecurity, nuisances, or major accidents. It also regulates the practices of security providers and their relationships with communities.	community risks and impacts, including safety and health, industrial risks, and security aspects related to conflict or the use of private security.	impacts are not specifically assessed in Tunisian ESIA. There are no regulatory requirements relating to security guard standards of conduct or non-environmental social risks.	analysis requirement in the ESIA. Contractually regulate the practices of security providers. Impose a community HSS Prevention Plan in sensitive projects.
Physical and economic resettlement	Tunisian law does not provide a specific framework for involuntary resettlement. Expropriations are governed by Law No. 76-85, which is limited to monetary compensation for legally registered land. There are no resettlement requirements or compensation for loss of income or business for those without land titles.	ESR5 provides for structured resettlement plans, replacement value compensation, livelihood restoration, and special attention to vulnerable groups.	PS5 requires avoiding or minimizing involuntary displacement, ensuring fair compensation and resettlement that improves or at least restores living conditions, including for people without legal title.	ESS6 requires compensation at replacement value, restoration of livelihoods and inclusion of non-tenured PAPs, with a structured resettlement plan in line with good practices.	Tunisia lacks a national resettlement framework that meets international standards. Compensation is limited, with no plan, consultation, or measures for vulnerable or undocumented people. Informally affected people (squatters, occupants without legal rights) are not recognized as	Adopt specific legislation on involuntary resettlement. Define a national framework for compensating affected people without legal titles (squatters), as well as economic losses and access to livelihoods. Develop a national Resettlement Action Plan (RAP) guide aligned with IFC and EBRD standards, including consultations with PAPs, specific measures for vulnerable groups, and a functional complaints mechanism.

					eligible for compensation or resettlement support, contrary to the requirements of international donors.	
Biodiversity and ecosystem services	Tunisia has a Forest Code, a Protected Areas Act, and is a member of the Convention on Biological Diversity. However, the identification of critical habitats, biodiversity management plans, mitigation hierarchies, and ecosystem service assessments are not systematically integrated into ESIA processes.	ESR6 requires the protection of natural and critical habitats, mitigation hierarchy, and the implementation of biodiversity management plans with ongoing monitoring.	PS6 requires a specific assessment of impacts on biodiversity and ecosystem services, a mitigation hierarchy and compensation plans if necessary.	ESS5 provides for an approach based on avoidance, mitigation and compensation, with specific attention to sensitive areas, threatened species and critical ecosystem services.	Tunisian legislation is fragmented and insufficiently enforced. ESIAAs do not systematically address critical habitats or ecosystem services. There is a lack of a structured and integrated approach to project planning.	Strengthen E&S studies by requiring specific biodiversity studies for high-impact projects. Require a Biodiversity Management Plan (BMP) and map critical habitats.
Indigenous peoples	Tunisia does not recognize the existence of indigenous peoples within its territory. There is no legal framework or public policy addressing specific rights, cultural identity, or free, prior, and informed consent (FPIC).	ESR7 only applies in the presence of indigenous peoples or traditional communities, with the requirement of FPIC and measures adapted to their rights.	PS7 applies to indigenous peoples with the obligation of FPIC in certain cases (relocation, heritage, significant impact), and recognition of their collective	ESS7 requires respect for the rights of indigenous peoples, including FPIC, recognition of their cultural practices, and measures for social and economic	Not applicable: Tunisia does not recognize any indigenous peoples within its territory. International requirements are not transposable as they stand, except in the case of marginalized	Although Tunisia does not recognize indigenous peoples, marginalized communities (nomads, rural minorities) could benefit from cultural and social protection approaches recommended by international standards.

			rights.	inclusion.	communities that can be assimilated (e.g., nomads).	
Cultural heritage	Law No. 94-35 governs the protection of archaeological, historical, and artistic heritage. Any chance discovery must be reported. However, preventive excavation protocols or cultural heritage management plans are not systematically integrated into ESIA's.	ESR8 requires prior identification of cultural heritage, consultations with authorities and communities, and preventive or corrective measures to protect sensitive sites.	PS8 requires an assessment of cultural resources, the implementation of chance discovery procedures, and consultation with local populations.	ESS8 provides for the protection of tangible and intangible heritage, documentation, in situ or ex situ conservation, and follow-up procedures in the event of accidental discovery.	Tunisia formally protects its archaeological and historical heritage, but ESIA's do not always include a comprehensive cultural component. Intangible aspects – such as local traditions, know-how, social practices, or rituals – are not systematically identified or taken into account. Specific management plans are rarely prepared, and procedures for incidental discovery are often absent or poorly regulated.	Impose a systematic and integrated assessment of cultural heritage in ESIA's, including both tangible (sites, objects) and intangible (customs, local practices, traditional knowledge) elements. Formalize a national procedure for chance discoveries. Provide a Cultural Heritage Management Plan inspired by international best practices (IFC, UNESCO), with the participation of the communities concerned.

2 Project Description

2.1 Context and objectives of the project

Khobna solar photovoltaic power plant project, led by Qair International, is part of a national energy diversification program aimed at reducing Tunisia's dependence on imported fossil fuels. The project involves developing, constructing and operating a solar power plant with an installed capacity of 237 MWp in the El Khobna region, Mezzouna delegation (Sidi Bouzid Governorate). This is a project under a private concession regime, financed by international donors (EBRD, IFC and EIB). This project meets Tunisia's climate commitments, including the reduction of greenhouse gas emissions, sustainable development and the creation of green jobs locally. It also provides for the connection of the plant to the national electricity grid through the STEG station located in the Meknassy delegation, via a 225 kV high voltage (HV) line of approximately 45 km.

2.2 Project site location

The project site is located south of the delegation of Mezzouna, in the El Khobna sector, on land belonging to the private domain of the Tunisian state. It is bordered to the south by the delegation of Menzel Habib (Governorate of Gabes), to the west by El Guetar (Governorate of Gafsa) and to the east by Skhira (Governorate of Sfax). It covers a fenced area of 267.74 hectares, approximately 3 km from Mezzouna and 5.5 km from the Sebkhath Noual is a Ramsar-listed site. The solar power plant will be built on land belonging to the private domain of the Tunisian state. No agricultural activity has been observed on the solar power plant site, except for extensive pastoralism, which affects the entire region. The livestock observed is mainly composed of sheep and goats. Based on community consultations, no specific objections or concerns have been raised regarding land use and grazing activities specifically on the solar power plant site.

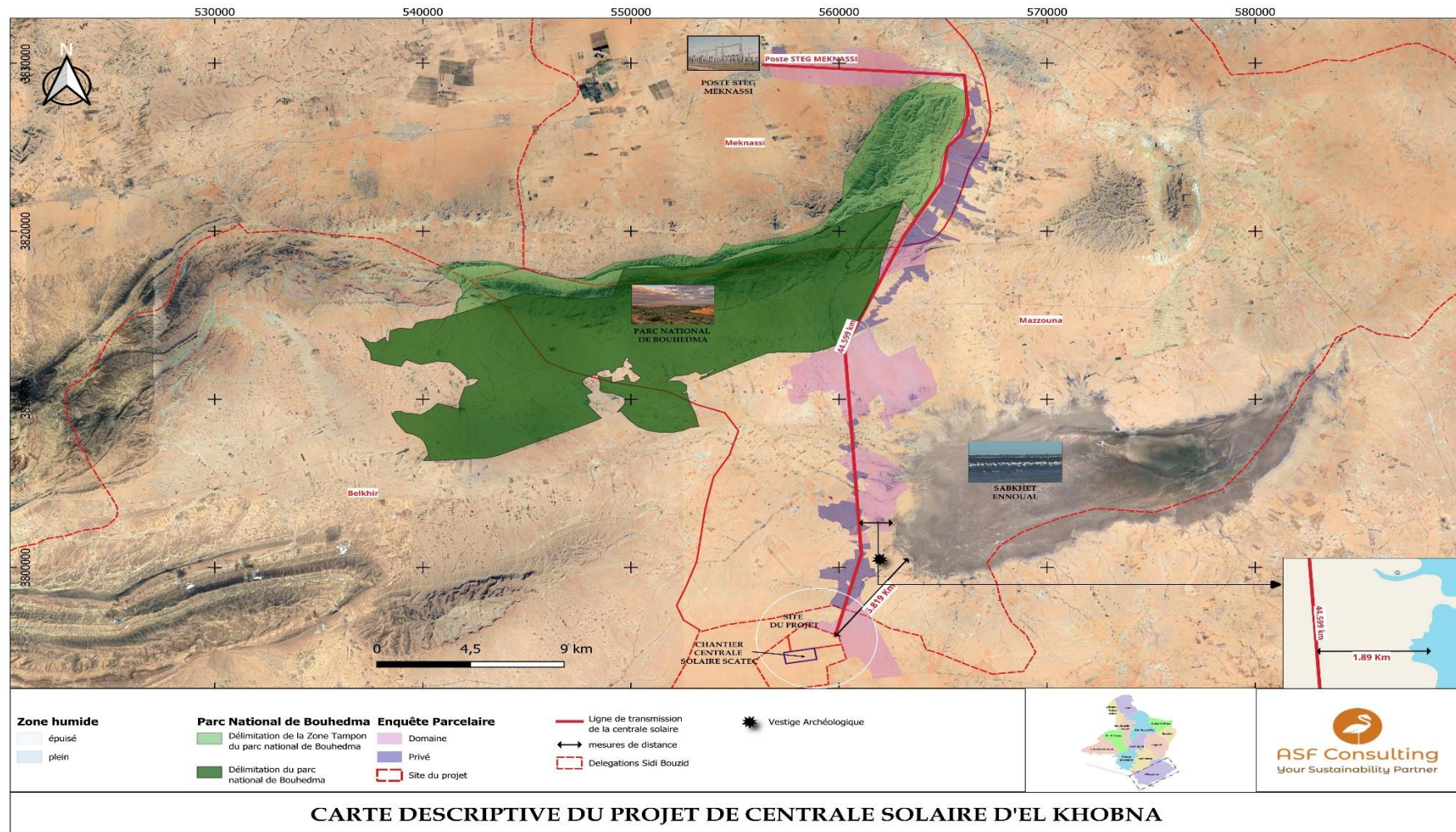


Figure 1: Project location map in the study area

2.3 Project components

The project has four main components

- MWp photovoltaic solar power plant installed on 267 ha.
- Meknassy transformer station .
- 5 km access track from the C205 road.

In addition, there are the following additional infrastructures:

- Internal road network and operating routes.
- 225/33 kV delivery station located on site.
- A photovoltaic power plant project is underway in the same project area

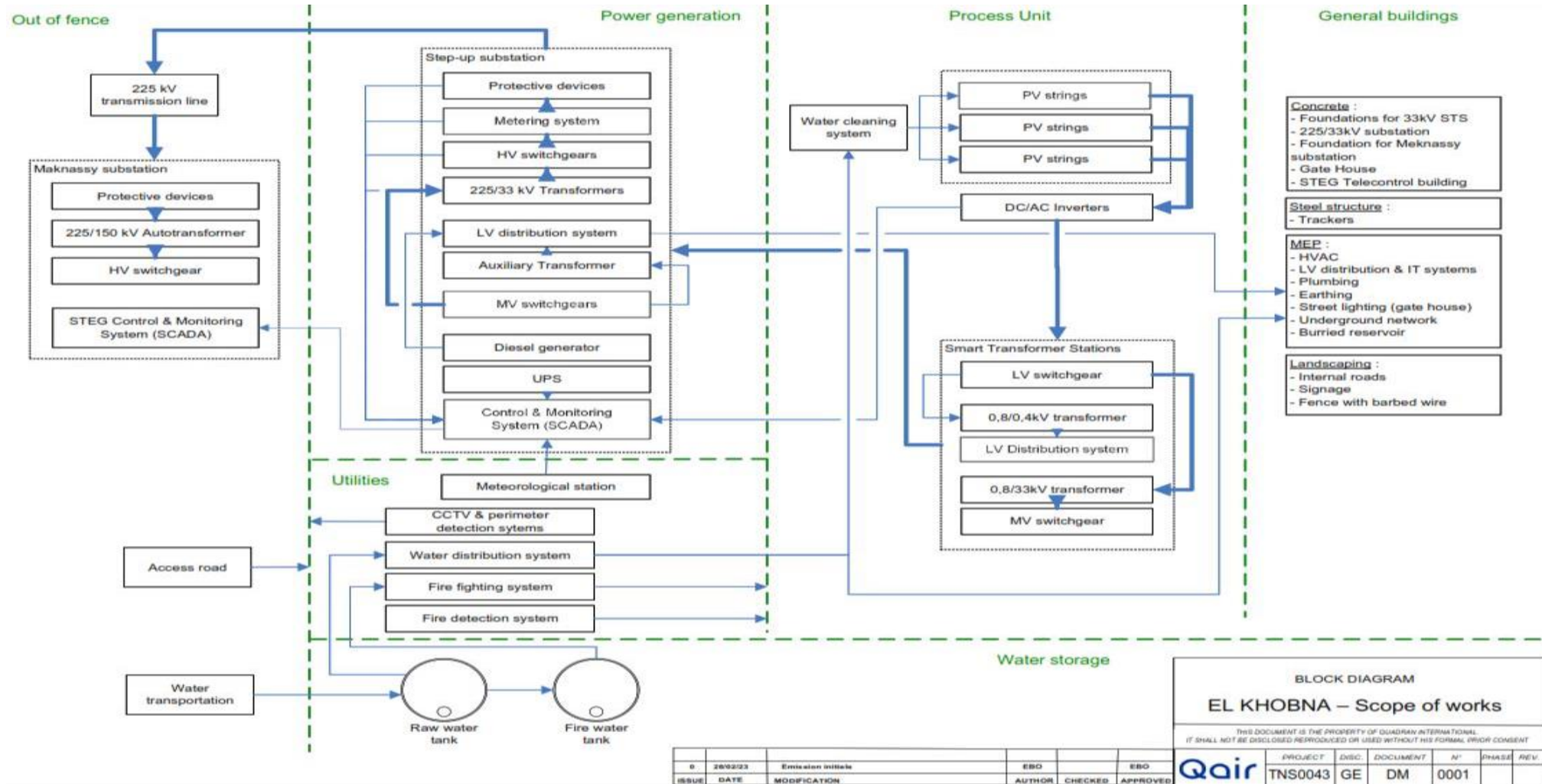


Figure 2: General diagram of the different components of the project

2.4 Qair Group

Qair is an independent power producer (IPP) exclusively dedicated to renewable energy. The group develops, finances, builds, and operates projects in the solar, wind (onshore and offshore), hydroelectric, waste-to-energy, storage, and renewable hydrogen sectors.

Present in 20 countries across Europe, Africa, and Latin America, Qair employs approximately 780 people and manages a project portfolio of more than 30 GW, 1.7 GW of which are already in operation or under construction. The group is distinguished by an integrated approach, combining technological innovation, local roots, and climate commitment. In Africa, Qair is active in several countries with a diversified energy mix. In Tunisia, Qair has been established since 2015 and is developing a pipeline of nearly 900 MW through several strategic projects, led by a team of 10 employees based in Tunis, including a stakeholder relations officer. Among its most notable projects:

Project	Ability	Status	Key details
Feriana (2×10 MW)	20 MW	Under construction	EBRD support – Production: 44 GWh/year
Lake Tunis	0.2 MW	Operational since 2022	Country's first floating solar power plant
Gafsa	100 MW	PPA and lease signed	Concessionary project – Injection planned for 2025
Mezzouna (El Khobna)	198 MW	PPA and lease signed	Project subject of this study

The El Khobna solar power plant project illustrates Qair 's ambition to significantly contribute to Tunisia's objective of increasing the share of renewable energy to 30% of the national electricity mix by 2030. This project, combining technical expertise, innovation and local socio-economic benefits, is part of a responsible vision of the energy transition.

2.5 Technical details of the project components

Photovoltaic (PV) technology generates electricity from solar energy. It relies on the use of solar panels made of photovoltaic cells. These cells, made from semiconductor materials (often silicon-

based), capture sunlight and convert it directly into electricity. Specifically, when the sun's rays strike the surface of a panel, the photons of light excite the electrons present in the semiconductor material. This phenomenon generates a direct electric current (DC).

However, since the electricity grid operates on alternating current (AC), this electricity must be converted. Inverters are therefore installed to transform the direct current produced by the panels into grid-compatible alternating current. Transformers then increase the voltage of this current so that it can be efficiently injected into the national electricity grid. This clean, silent, and reliable technology is now widely used around the world to produce renewable electricity, without direct greenhouse gas emissions. The figure below illustrates the process of converting solar energy into electricity using photovoltaic technology, up until its injection into the STEG national grid.

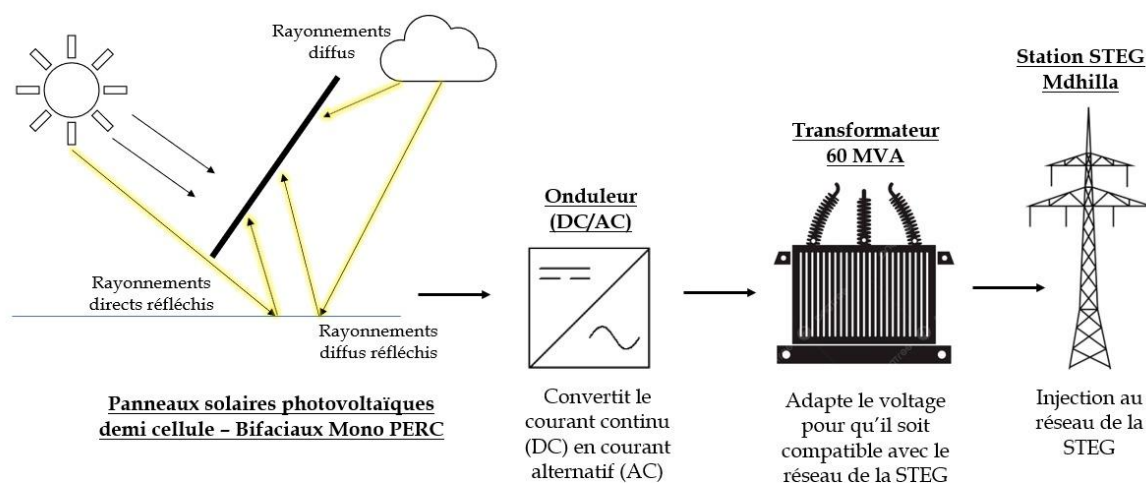


Figure 3: Main components of a photovoltaic power plant

Albedo refers to the ability of a surface to reflect solar radiation. This is an important concept to consider when using bifacial solar panels. This factor plays a significant role in solar power plants equipped with bifacial modules, which capture light on both the front and back sides. The back side exploits the radiation reflected by the ground, which increases energy production. In environments with a high reflection rate, such as arid areas with light, sandy, or slightly rocky soil, the albedo can reach values of 0.25 to 0.35, which promotes significant light reflection. In the case of the El Khobna site, this configuration allows the full use of bifacial modules, without additional work on the ground.

Technical studies and feedback from similar projects show that this technology allows for an overall energy gain of 8 to 12%, with possible peaks of up to 14%, compared to single-sided modules.

Table 5: Main technical characteristics of the El Khobna solar power plant

Setting	Unit	Value
Total nominal power @50°C	KWc	236,999
Fenced area	Ha	267.74
PV technology	-	Mono PERC bifacial half-cell
Unit power of the modules	Toilet	620
Number of modules	Units	382,256
Inverter technology	-	Branch inverter
Number of inverters	Units	720
Type of structures	-	NS horizontal tracker
Anchoring	-	Driven piles
Estimated annual production	GWh	522
Connection	-	Meknassy STEG substation (225 kV)

2.6 Project activities

2.6.1 Phase :

- **Preliminary studies:** Carrying out technical, economic and financial feasibility studies to confirm the viability of the project; conducting a preliminary Environmental and Social Impact Assessment (ESIA) and consulting the relevant stakeholders (local authorities, population, institutions).
- **Project definition:** Precise delimitation of the perimeter of the photovoltaic power plant and identification of its main technical components (modules, trackers, transformers, HV substation, road access).
- **Regulatory Authorization and Compliance:** Obtaining the necessary permits and authorizations (land, urban planning, environment, energy); stakeholder consultation; and alignment with national regulations and international standards (health, safety, environment, construction standards).
- **Technical and logistical planning:** Definition of the connection plan to the STEG network; preparation of logistics linked to the transport of heavy and special equipment; preparation of human resources and planning of life bases.

2.6.2 Pre-construction phase:

- **Development of the base camp and logistics:** Setting up the base camp for workers and technical staff; installation of storage areas and handling areas for equipment and provision of temporary sources of water (tanks) and electricity (generators).
- **Site security and organization :** Installation of temporary fences (barbed wire) to demarcate the perimeter, these fences will be 2.5m high above ground, equipped with a flap with 3 rows of barbed wire; double rolls of concertina-type barbed wire; installation of a security system (guarding, surveillance) as well as the development of temporary access tracks for the movement of machinery and personnel.
- **Site preparation:** Light clearing of vegetation and leveling of certain areas and marking out of the site and initial earthworks to stabilize the soil.

2.6.3 Construction phase: (18 months)

- **Civil engineering and VRD works:** Site layout, general leveling of the land, creation of internal tracks and platforms; construction of foundations: driven piles (~2.5 m for standard structures, up to 20 m for pylons in sensitive areas); construction of technical buildings (control room, guardhouse, maintenance premises, fire tanks) and installation of the drainage network and water/sanitation infrastructure.

- **Installation of photovoltaic equipment** : Assembly of supporting structures (horizontal trackers); fixing and wiring of photovoltaic modules; installation of inverters, transformers (STS) and electrical cabinets; creation of the earthing system, surge arresters and lightning protection.
- **Networks and connections** : Laying of power and communication cables in protected trenches; installation of the communication network (SCADA) and tracker control and construction of the 150/33 kV delivery station and connection to the Mdhila HV line .
- **Security and protection** : Installation of a video surveillance system and implementation of the perimeter detection system, lighting and anti-intrusion measures.

2.6.4 Operational phase

During the operational phase, the photovoltaic plant will operate continuously to produce electricity from solar energy. The panels generate direct current (DC) which is converted into alternating current (AC) by inverters and then fed into the national grid via the Mdhila transformer station . This phase also involves regular maintenance and technical management activities to ensure optimal performance and sustainability of the installation.

The main planned activities are:

- **Continuous monitoring** of plant performance using a SCADA (remote control and data acquisition) system;
- **Regular cleaning of photovoltaic modules** , requiring a water supply provided by SONEDE, in order to maintain optimal performance in a dusty environment;
- **Preventive and corrective maintenance** of equipment, including inverters, transformers and electrical cabinets;
- **Periodic inspection of the structural integrity** of supports and trackers;
- **Management** of spare parts and consumables stocks;
- **Monitoring of supplier guarantees** on critical equipment;
- **Site security** ensured by dedicated staff, fencing, a video surveillance system and security lighting;
- **Management of waste and end-of-life PV panels**
- **Implementation and monitoring of the environmental, social, health and safety (ESHS) management plan** .

2.6.5 Dismantling phase

At the end of the 20-year operating period stipulated in the Power Purchase Agreement (PPA), the El Khobna solar power plant project will be transferred to the Tunisian Electricity and Gas Company (STEG). In the event that complete dismantling is chosen, a structured

decommissioning program will be implemented to ensure the site's restoration, in compliance with environmental standards.

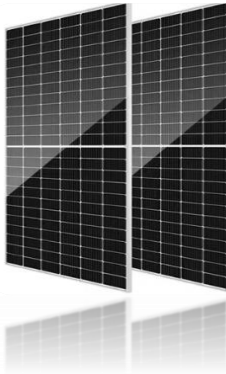
The main activities envisaged include:





- Disconnection and removal of all project components (photovoltaic modules, inverters, transformers, substation, etc.);
- Dismantling of infrastructure (technical buildings, internal networks, security equipment);
- The implementation of a waste management plan including collection, transport and treatment, particularly for sensitive materials such as PV panels;
- The restoration of the land, with leveling, removal of residual installations and possible ecological rehabilitation;
- Restoration of internal roads and removal of fences and protective equipment.

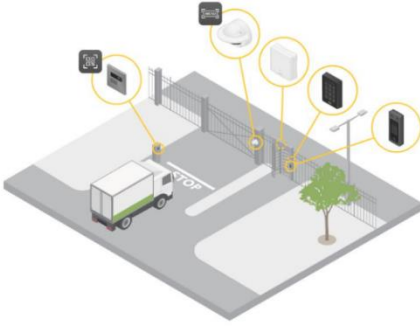
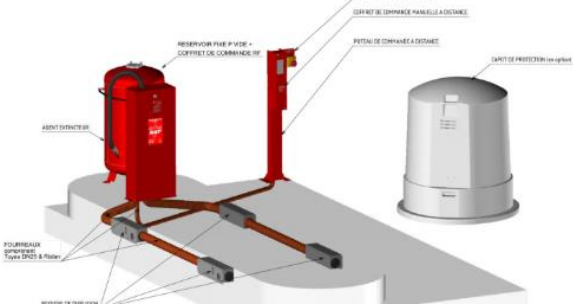
2.7 Materials used

A summary (for guidance only) of the material to be used is presented in the table below:

Table 6: General overview of the equipment planned for the project

Equipment	Description / Main Specification	Figure (source: Web)
Photovoltaic modules	Mono PERC bifacial half-cell - 620 Wp - 1500 V DC	

Support structures	North-South axis horizontal tracker	
Inverters	275 kW string inverter	
Foundation systems	Galvanized steel driven piles	
Transformers	6.6 MVA transformers	
Cables	Buried DC cables – Buried HV AC cables to the substation	
Security systems	Perimeter fencing, video surveillance, perimeter lighting	

		
Extinguishing systems	Tanks, fire extinguishers, fire detection system	
Additional infrastructure	Technical room, power station, caretaker's lodge, water tank	N / A

1.1.1 Logistics

Access to the site is via a 5 km track from the C205. The equipment arrives dismantled by truck. A temporary storage area will be set up. An internal road network will allow for the maintenance of the panels and the movement of personnel. The water supply is provided by a tank dedicated to sanitary uses and the fire system, supplied by SONEDE as illustrated in Figure 2.

2.8 Labour (Estimate)

The human resources mobilized for the construction and operation of the photovoltaic power plant are as follows:

- Construction phase (approximately 18 months): nearly 450 jobs will be created at peak activity, including approximately 100 skilled positions (engineers, technicians, consultants, surveyors, etc.) and 350 unskilled positions (workers, security guards, etc.).
- Operational phase (20 years): approximately 45 jobs will be required, including around ten skilled positions (engineers, technicians, administrative staff, etc.) and nearly 35 unskilled positions (security guards, drivers, etc.).

In this context, the Promoter undertakes to favor, as much as possible, the recruitment of labour from the local community, both for skilled and unskilled positions, throughout the construction and operating phases.

2.9 Site condition and land use

The field visit carried out in April 2025 made it possible to characterize the land use on the site

chosen for the El Khobna solar power plant . The site, generally flat and homogeneous, has a halomorphic gypsum-loam soil, not very fertile and typical of saline arid zones. No significant relief was observed, thus facilitating future developments.

Ecologically, the vegetation is steppe, dominated by halophytic and xerophytic species well adapted to local climatic conditions. The presence of holes for small mammals and reptiles, as well as the birdsong heard on several occasions, indicate moderate wildlife activity. From a land perspective, approximately six cabins have been identified within the project perimeter, apparently occupied by herders. According to consultations carried out, including that with the Omda of Khobna , these installations are informally occupied. Furthermore, the project shares an existing access road with the neighboring photovoltaic project developed by SCATEC, which constitutes a logistical and environmental asset.



Figure 4:Etat du site de la centrale



Figure 5: Presence of huts in the project site

3 Description of the initial state of the site

3.1 Project area of influence

The area of influence refers to all geographical areas likely to be affected, directly or indirectly, by the project's activities. This area is defined according to the nature and extent of the environmental, social and economic impacts that may result from the different phases of the project (preparation, construction, operation and decommissioning). Two areas are generally distinguished: the area of direct influence, corresponding to the area immediately affected by the project's components and activities, and the area of indirect influence, which includes neighboring territories that may be subject to induced or secondary effects.

3.2 Direct influence zone

It corresponds to a radius of approximately 500 m around the solar power plant, the base camp, the access tracks and the transmission line. The impacts in this perimeter are mainly linked to construction site nuisances (dust, noise, vibrations, traffic of machinery, risks of accidental pollution) and concern:

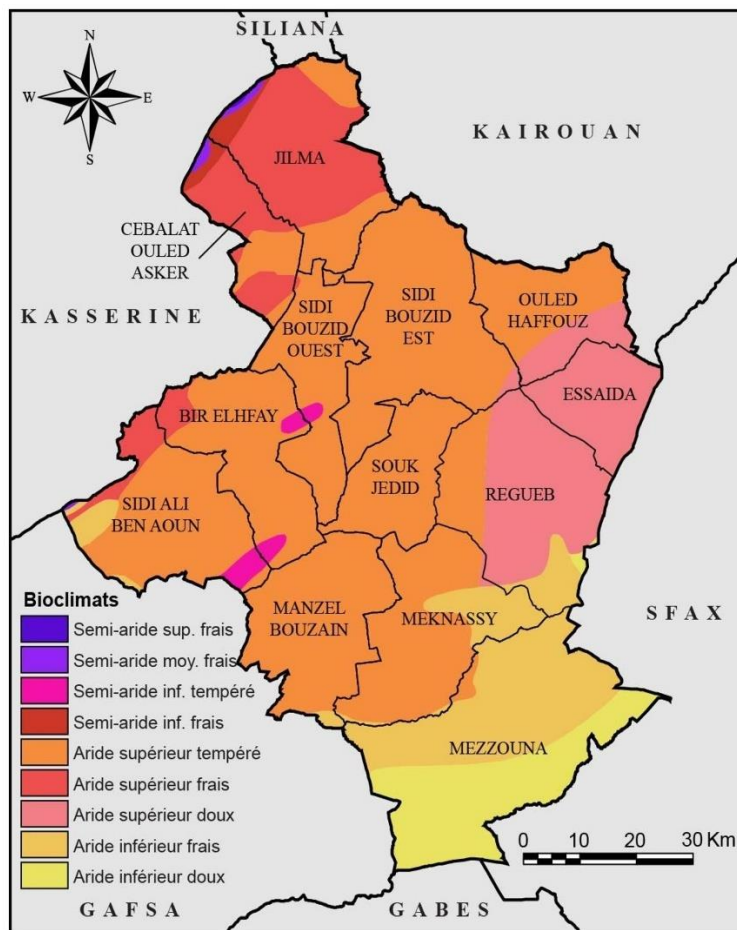
- agricultural and pastoral lands of the Mezouna delegation exploited by local communities (livestock, extensive crops);
- areas crossed by the power line route, where local disruptions may occur (limited access, temporary crop losses);

3.3 Indirect influence zone

It encompasses larger areas that may be subject to diffuse, cumulative or longer-term impacts:

- Sebkhet Noual, a wetland of international importance (RAMSAR), located approximately 7 km from the power plant site and approximately 1 km from the central section of the HV line. It constitutes a major ecological sensitivity, particularly for migratory birds;
- Bouhedma National Park, whose buffer zone is bordered by the northern section of the transmission line. This park is home to steppe habitats and protected species, sensitive to disturbance and habitat fragmentation;
- the archaeological site identified near the southern section of the line, the route of which was moved to avoid any direct impact.
- the neighboring rural communities of Mezouna and Menzel Habib, which may be indirectly affected by increased traffic, occasional pressure on water resources and social perception of the project;
- local economic players (small suppliers, transporters, subcontractors), likely to benefit from indirect positive spin-offs (jobs, services, local subcontracting).

Beyond these sensitivities, the indirect influence zone also covers the positive repercussions expected on a regional scale; we will consider the governorate of Sidi Bouzid as an indirect influence zone.



Source : Carte bioclimatique de la Tunisie, Ministère de l'agriculture, 1976

Figure 7: Climate map of the governorate of Sidi Bouzid (Source: Bioclimatic map of Tunisia)

According to the Köppen-Geiger system classification ⁴, the climate of El Khobna is considered to be of type BWh, namely:

- B: Arid climate
- W: Desert climate
- h: Hot climate
- k: Arid cold

As presented in the table below ()

⁴ <https://fr.climate-data.org/afrique/tunisie/gafsa-378/>

Table 7: Köppen-Geiger classification

Classification	Köppen-Geiger	Examples
Hot desert climate	BWh	Meknassy, Regueb, El Mezzouna, Omrane, El Boua
Cold desert climates	BWk	Sidi Bouzid, Cebbala, Lessouda, Faïd
Cold semi-arid climates	BSk	El Makarem, Jelma

In this case the project site is classified as a BWh climate, it is a hot desert climate

3.4.2.1 Temperature and climate

The average annual temperature in the region is around 20 ° C. Average maximum temperatures range from 16 ° C in January at 34 ° C in July/ August . Average minimum temperatures range between 6 ° C in January and 23 ° C in July/ August .

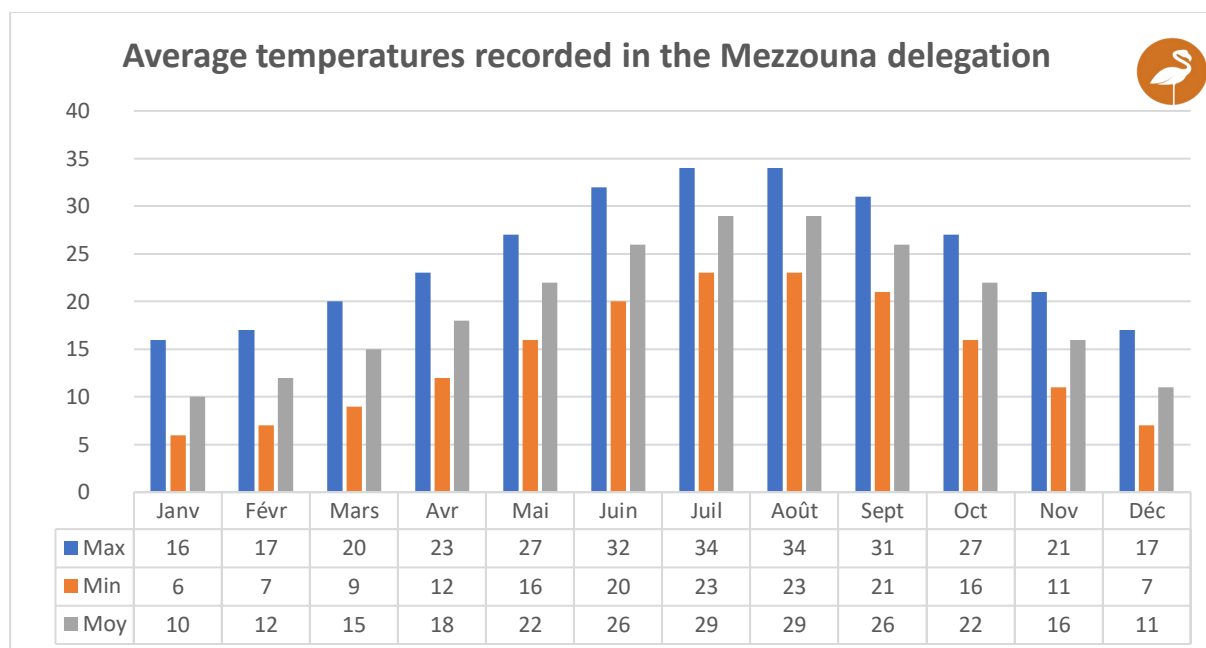


Figure 8: Monthly average temperatures in the Mezzouna region (1991-2020)

According to the World Bank's Global Solar Atlas, the Mezzouna region benefits from an average annual global horizontal solar irradiation (GHI) of approximately 1900 kWh/m² / year, recording approximately 9 to 12 hours of sunshine per day for an average of 3700 hours per year. These data confirm that the region offers particularly favorable climatic conditions for the development of solar energy projects, with high irradiation potential and abundant sunshine throughout the year.

The Sidi Bouzid region, particularly the Mezzouna area, is characterized by moderate seismic activity. Since the February 3, 2025, earthquake, which measured 4.9 on the Richter scale, approximately 17 tremors have been recorded in the region, reflecting a temporary reactivation of ancient faults. According to geologist Riadh Ahmadi, these movements are linked to the dynamics of the African and Eurasian tectonic plates, whose convergence is leading to a reactivation of Miocene-aged faults, particularly those located between Mezzouna, Meknassy, and Jbel Bouhedma. These faults can generate low- to medium-intensity earthquakes, such as those observed recently. The recorded tremors caused only minor damage, mainly cracks in ancient structures. Seismicity remains normal for the Tunisian context, where the occurrence of moderate earthquakes is generally spaced over several centuries (500 to 1,000 years). In conclusion, the seismic risk in the region is considered low to moderate, with no immediate danger to the population. However, targeted vigilance remains necessary, particularly in areas crossed by active faults.

The lightning strike density in the Sidi Bouzid region, and more specifically in the Mezzouna area, is between 2 and 4 atmospheric discharges per km² per year. This value comes from a specific study on lightning strike density in Tunisia, which provides detailed data by governorate. This lightning strike density is considered moderate according to international standards.

3.4.2.2 Precipitation

Average annual rainfall is low, averaging about 166mm per year. The rainy season runs mainly from September to April, with a peak in March (about 20.2mm), while the summer months, especially July, see minimal rainfall (about 2.4mm).

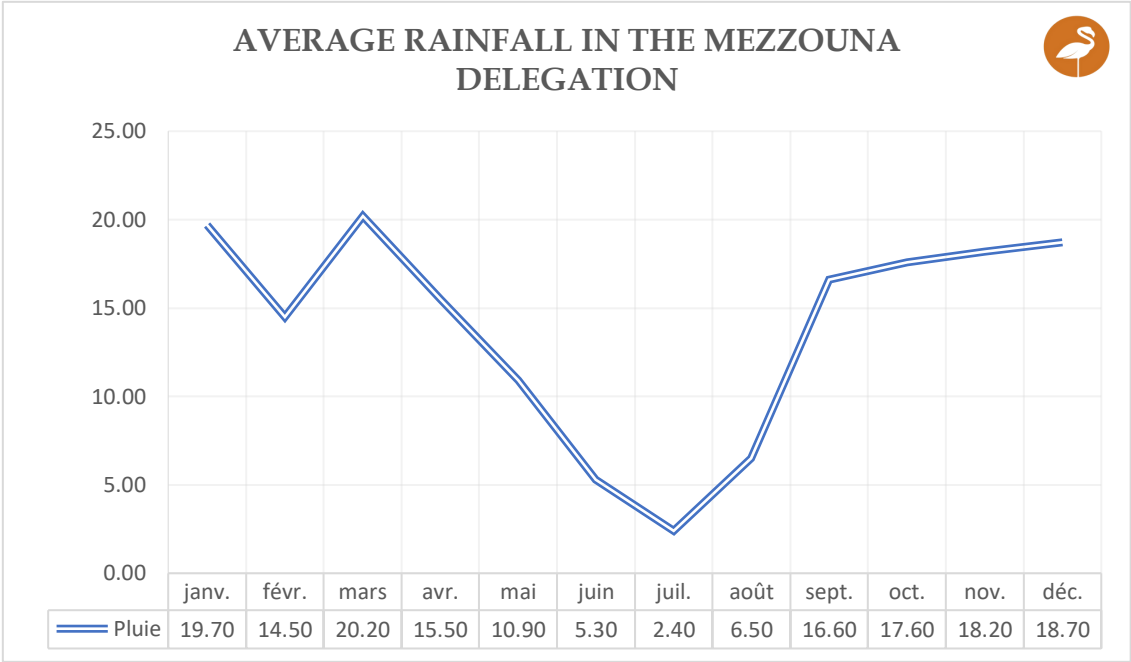


Figure 9: Graphical distribution of average precipitation (1991-2020)

wettest months , July and March respectively, of approximately 15.8mm.

3.4.2.3 Wind

Winds are moderate, reaching a maximum speed of 24 m/s. The most frequent winds come from the east-northeast (ENE), north-northeast (NNE) and northeast (NE), contributing to the rapid evaporation of moisture and the accentuation of drought.

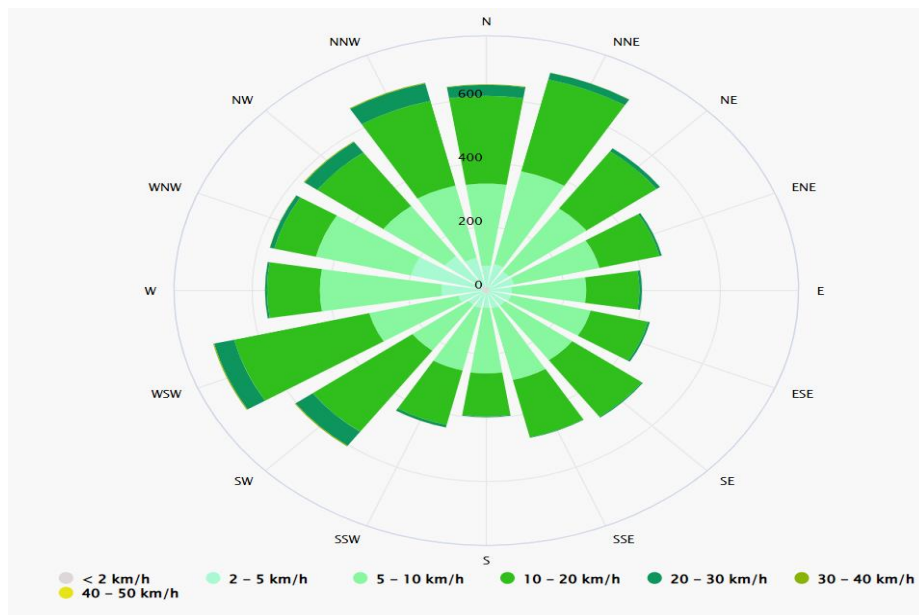


Figure 10: Wind rosette of Mezzouna

3.4.3 Air Quality

An air quality and noise level measurement campaign was conducted on May 13, 2025 in the project area. Five stations were installed for the measurement of fine particles (PM10 and PM2.5) according to the XP CEN/TS 16976 standard, and for the assessment of ambient noise according to the NF S 31-010 standard. The average concentrations recorded in PM2.5 and PM10 particles comply with the limit values of government decree No. 2018-447 of May 18, 2018. Regarding the noise level, the values obtained are below the thresholds authorized by the municipal decree of August 22, 2000.

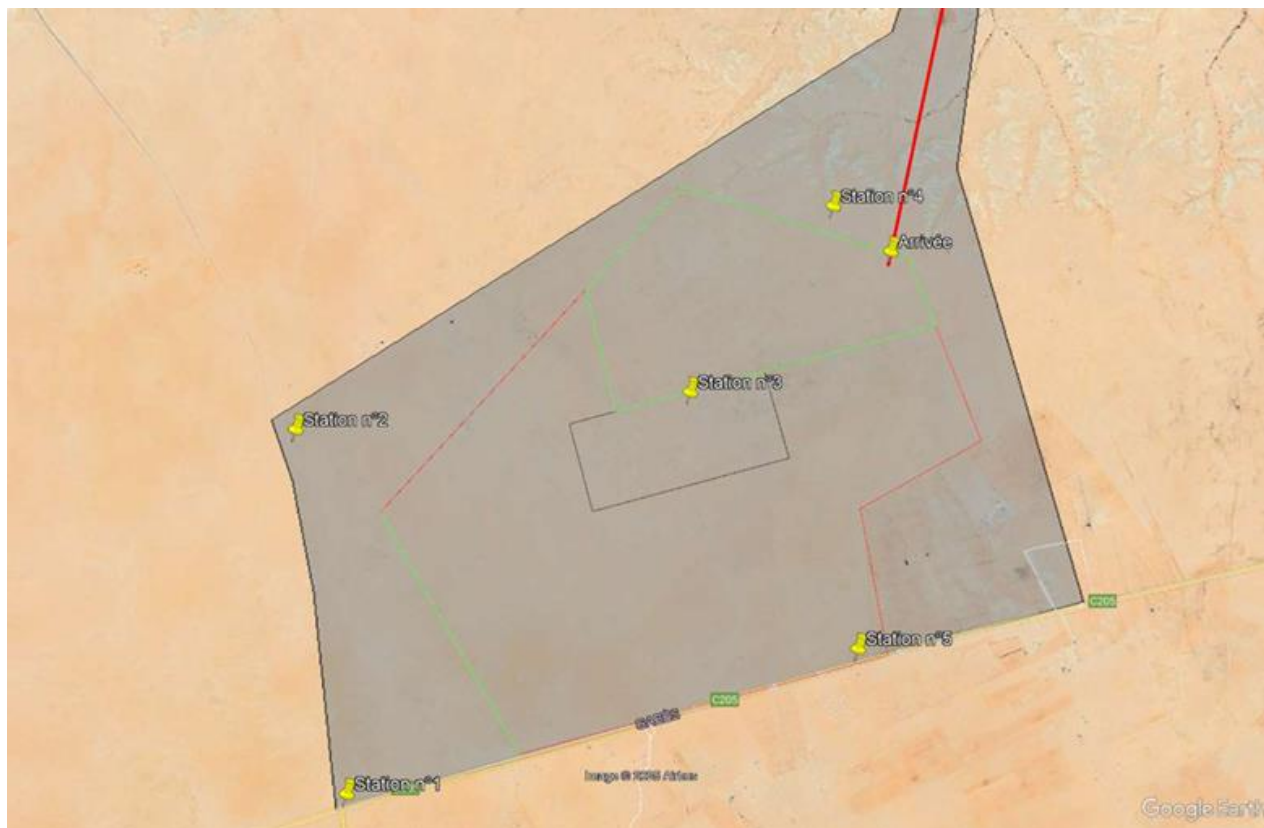


Figure 11: Location of sampling stations

The table below shows the PM2.5 and PM10 particles at each station studied, as well as the regulatory limit value (The threshold); in accordance with Government Decree No. 2018-447 of May 18, 2018 (JORT No. 42), the regulatory limit values are: for PM10, 50 $\mu\text{g}/\text{m}^3$ as a daily average (applicable from January 1, 2021) and 40 $\mu\text{g}/\text{m}^3$ as an annual average, with an alert threshold of 150 $\mu\text{g}/\text{m}^3$ if the daily average is exceeded for three consecutive days; for PM2.5, 35 $\mu\text{g}/\text{m}^3$ as a daily average (from January 1, 2021) and 20 $\mu\text{g}/\text{m}^3$ as an annual average.

Table 8: Suspended particles

Station	PM2.5 Avg. ($\mu\text{g}/\text{m}^3$)	PM10 Avg. ($\mu\text{g}/\text{m}^3$)	Compliance
Station No. 1	2.00	4.00	Conforme
Station n°2	2.20	4.80	Conforme
Station n°3	2.20	4.20	Conforme
Station n°4	3.00	5.60	Conforme
Station n°5	2.00	3.80	Conforme
Valeurs limites	35	50	-

The average concentrations of PM2.5 and PM10 fine particles measured in the five stations are significantly lower than the limit values set by Decree No. 2018-447 of May 18, 2018, i.e., 35 $\mu\text{g}/\text{m}^3$ for PM2.5 and 50 $\mu\text{g}/\text{m}^3$ for PM10 respectively. These results confirm good ambient air quality on the project site, with no significant exceedances, reflecting a relatively preserved environment with little exposure to major sources of air pollution. This observation is a favorable factor for the establishment of a photovoltaic project in this area.

3.4.4 Noise and vibrations

On the same day, May 13, 2025, the L2A labouratory carried out average measurements of the ambient noise level at the same five stations on the site.

Five stations were installed for the measurement of fine particles (PM10 and PM2.5) according to the XP CEN/TS 16976 standard. Regarding vibrations, although no specific instrumental measurements were carried out, no signs or indications of vibration nuisance were noted during the mission.

Table 9: Sound level (ambient noise)

Station	Average LEQ (dB(A))	Lmin	Lmax	Tunisian law limit value (dB(A))	Compliance with Tunisian law	World Bank limit value (dB(A))	World Bank Compliance
Station 1	38.52	39.90	48.70	50	Compliant	55	Conforme
Station 2	40,55	32,70	52,80	50	Conforme	55	Conforme
Station 3	42,95	33,90	55,70	50	Conforme	55	Conforme
Station 4	46,54	39,70	58,10	50	Conforme	55	Conforme
Station 5	46,28	38,70	56,50	50	Compliant		

The noise levels recorded at all stations are below the limit value of 50 dB(A), indicating a quiet acoustic environment that complies with regulatory requirements. This reinforces the site's suitability for hosting a photovoltaic project without major noise constraints. In conclusion, the site presents a quiet and stable acoustic environment, without significant vibration or noise nuisance. No corrective measures are required at the initial state.

3.4.5 Geological Framework

The project site is located on a gently sloping foothills bordering a northeast-southwest oriented mountain range, characteristic of the Atlas structure of the region. This area rests on a strong and stable bedrock, with a gentle topography favorable to the installation of a solar power plant.

The geological formations observed on the site are mainly of Quaternary age, composed of fine silts locally covered by aeolian sands and sometimes enriched with carbonate crusts or gypsum-limestone elements. On the surface, there are recent alluvium as well as scattered pebbles resulting from the erosion of the surrounding reliefs. The hydrological study on the El Khobna site presented a geophysical study, by radar which presented among others the following results:

Table 10: Lithological characteristics of the superficial geological layers of the El Khobna site

Layers	Facies	Thickness
Layer 1: Yellow	Sand	Average of 1.5 m
Layer 2: Purple	Gypsum limestone	1.5 to 2.5 m
Layer 3: White	Slightly gypsum sand	2.5 to 3.3 m
Layer 4: Blue	Gypsum clay	3 to 4.5 m

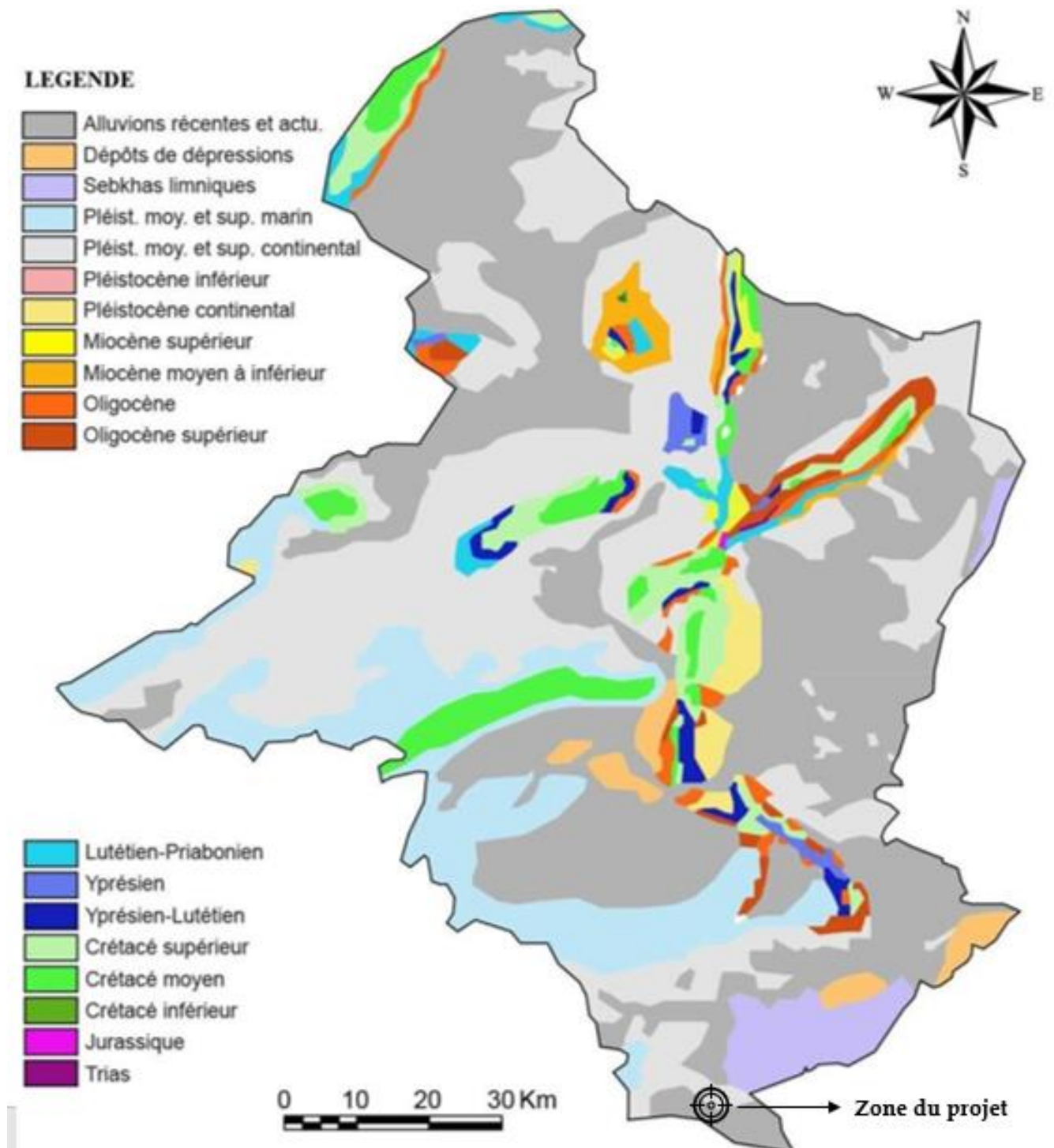


Figure 12: Geological map of Sidi Bouzid (Source: GIFEX)

3.4.6 Relief and geomorphology

The governorate of Sidi Bouzid presents a complex geomorphological configuration that reflects its intermediate position between several large structural ensembles. Located at the junction between the folded Atlas domain and the more tabular regions of southern Tunisia, the territory combines moderate mountainous relief, plateaus and vast plains.

The central area of the governorate is marked by the presence of mountain ranges with modest altitudes and varying structural directions. These include southwest/northeast alignments, characteristic of the Atlas system, including formations such as Jebel Majoura (874 m), Jebel Meloussi (622 m), Jebel Boudinar (716 m) and Jebel Khechem Lakhsouma (655 m). These heights frame a series of plains and depressions that form alluvial basins of varying sizes and altitudes.

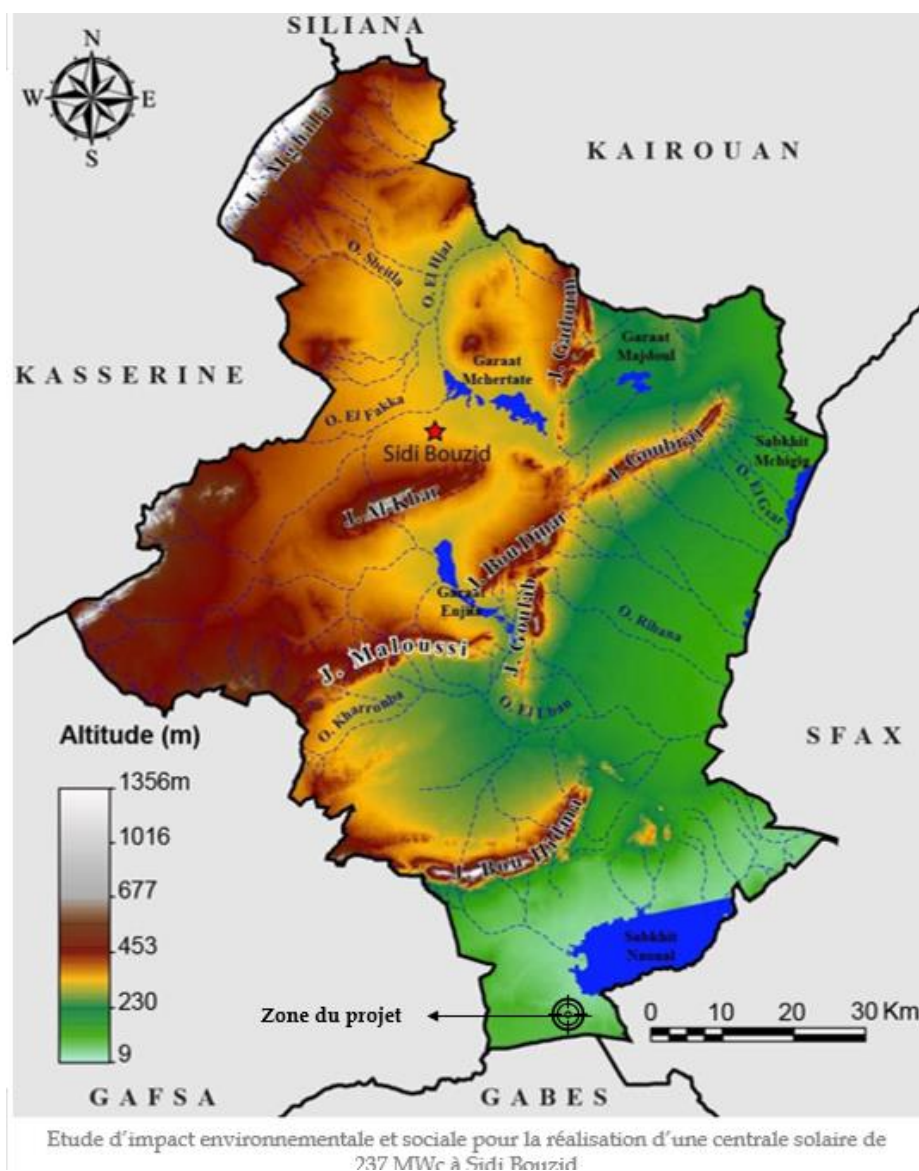


Figure 13: Geomorphological map (Source: GIFEX)

In the southern part of the governorate, where the study area is located, the landscape gradually becomes less rugged. The regions of Mezzouna, Meknassy, Ben Aoun and Regueb open onto more recent and less structured geological formations, testifying to a transition towards the Saharan domain. The project site in El Khobna fits into this configuration: it is characterized by a

low relief, with altitudes not exceeding 100 meters and very gentle slopes of less than 3%. This topographical context offers favorable conditions for the installation of linear infrastructures such as photovoltaic power plants, with a moderate need for leveling work.

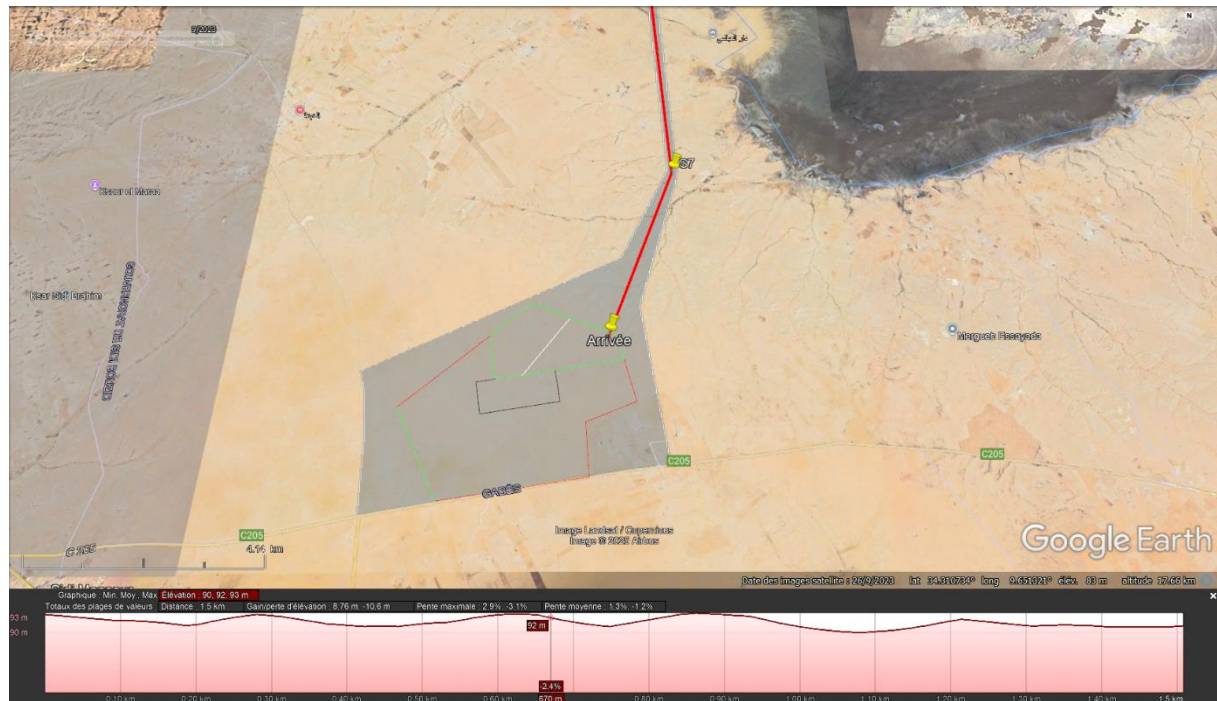


Figure 14: Profile of the terrain gradient

3.4.7 Hydrological and hydrogeological framework

The project site is located in an area slightly shaped by weak surface flows. These small thalwegs converge towards the Ghaddada wadi, located about ten kilometers away, which acts as a natural collector by directing water towards the Sebkhia El Naouel. Positioned upstream of this wetland, the study area is naturally part of the Sebkhia watershed. Thus, runoff water from precipitation or exceptional rainfall events on the site tends to flow downstream towards this closed depression. This dynamic is confirmed by the analysis of local watersheds and the flow directions identified on available hydrological maps.

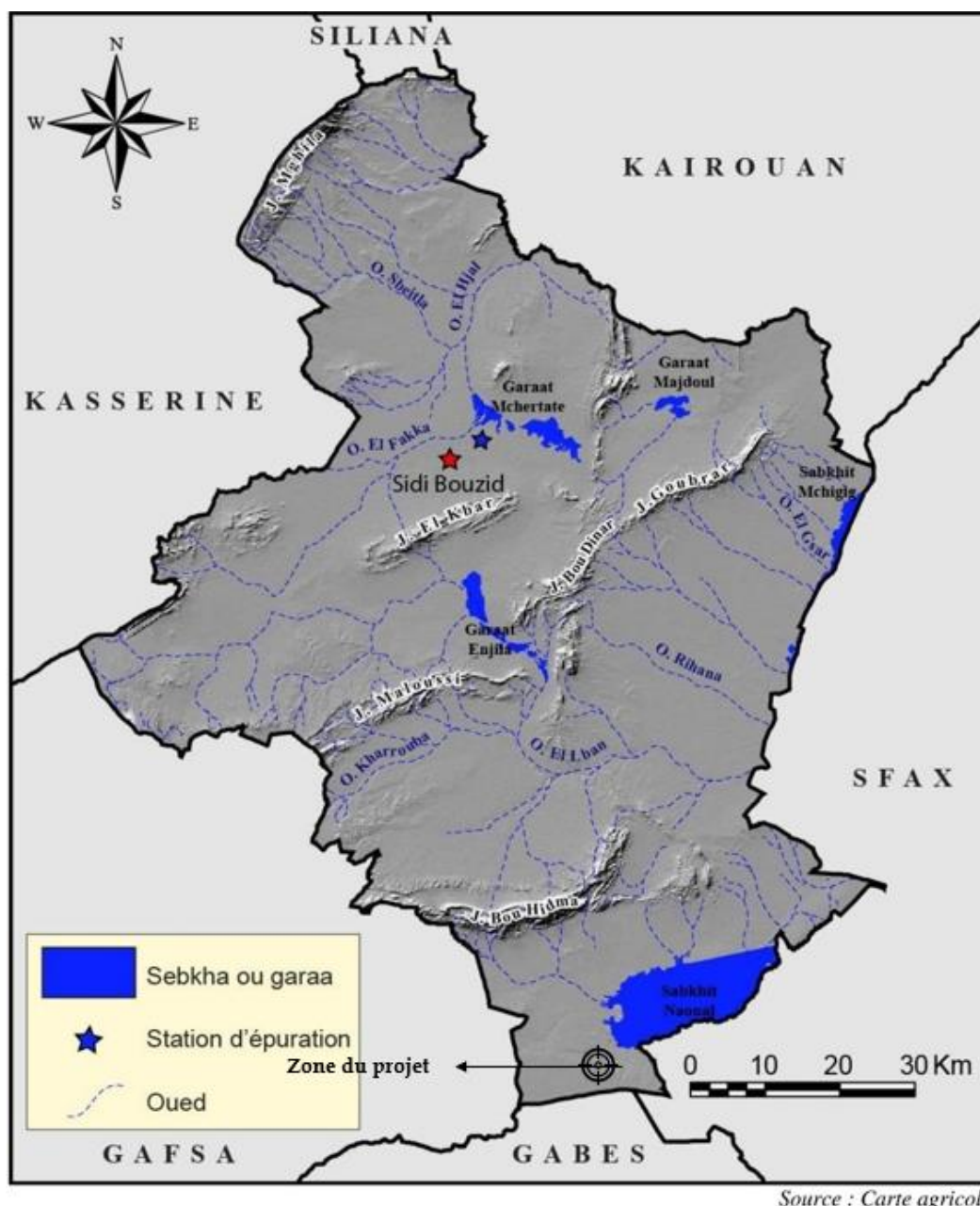


Figure 15: Hydrographic map of Sidi Bouzid

This flow dynamic is further confirmed by the elevation plan presented below, which highlights a gradual decrease in altitude towards the Sebkhia El Noual. This topographic gradient creates a natural slope oriented from the project site towards the sebkha, thus reinforcing the hypothesis of gravity drainage of surface water towards this wetland.

According to the results of the hydrological study carried out for the project site, it does not present a direct risk of flooding. However, occasional surface water inflows could occur from surrounding areas, particularly from the northwest, in the event of heavy rainfall. The relatively flat topography (false flat) of the site is an asset for the installation of a photovoltaic power plant, but the presence of clayey soils with high plasticity as well as gypsum formations at depth requires special attention. Indeed, uncontrolled infiltration of water could eventually cause deformation of the ground, compromising the stability of the foundations.

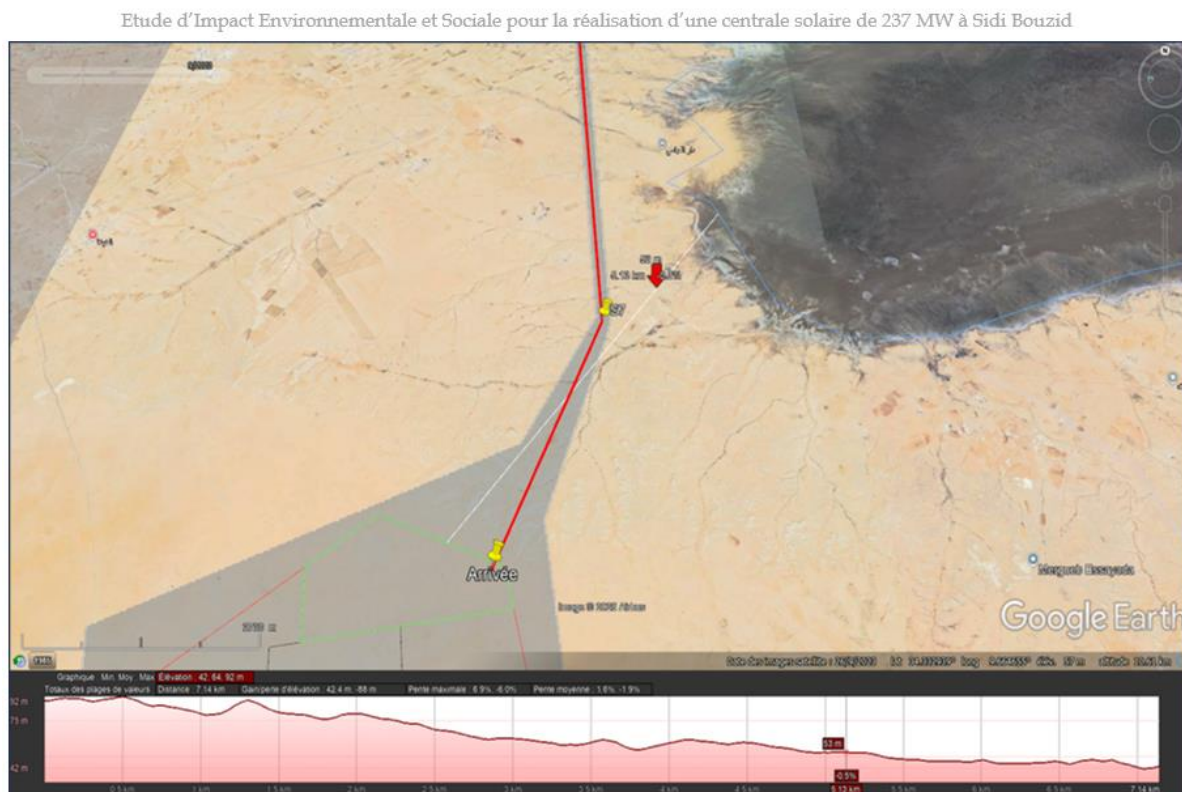


Figure 16: Profile of the slope proving the direction of inclination of the land from the site to Sebket el Noul

The study therefore recommends the installation of effective drainage systems, such as peripheral ditches, to prevent any accumulation or excessive infiltration. A complementary geotechnical study is also recommended at the execution stage, in particular to clarify the behavior of the gypsum and validate the optimal depth of the foundations, estimated at less than one meter under normal conditions. These measures will ensure the sustainability of the infrastructure and reduce risks linked to the hydrogeological characteristics of the site.

The Sidi Bouzid governorate is based on a complex hydrogeological system composed of eight main water tables. These groundwater resources play a crucial role in agricultural development, although they are under increasing pressure from overexploitation. Approximately 61.7 million m³ of water is available, with particularly intense exploitation in the Regueb and Braga water tables, whose exploitation/resource ratios exceed critical thresholds (2.45 and 1.94 respectively).

Table 11: Characteristics of the main water tables of Sidi Bouzid

Tablecloth	Water quality (Salinity)	Nitrates (mg/l)	Main Notes
------------	--------------------------	-----------------	------------

Jelma	≤ 2 g/l	≤ 2	Good quality, little used
Sidi Bouzid	1.5 – 3 g/l	≤ 35	Intensively exploited, moderate salinity
Braga	≈ 2.7 g/l	≤ 25	Upstream-downstream salinity gradient
Maknassy	≈ 3 g/l	≤ 25	Operated in the wet season, greenhouse agriculture
Regueb	1 – 7 g/l	Up to 45	Heavily exploited, impact of chemical fertilizers
Sabkhet Naouel	Very salty water (intermittent lake)	—	Seasonal drainage area, high ecological interest

As the table above shows, water quality varies from one aquifer to another, with salinity levels ranging from moderate to high and nitrate levels sometimes of concern. The two largest aquifers (Sidi Bouzid and Hajeb-Jilma) account for more than half of the available resources and alone host nearly 46% of the recorded boreholes.

The Sidi Bouzid governorate is based on a complex hydrogeological system composed of eight main water tables. These groundwater resources play a crucial role in agricultural development, although they are under increasing pressure from overexploitation. Approximately 61.7 million m³ of water is available, with particularly intense exploitation in the Regueb and Braga water tables, whose exploitation/resource ratios exceed critical thresholds (2.45 and 1.94 respectively).

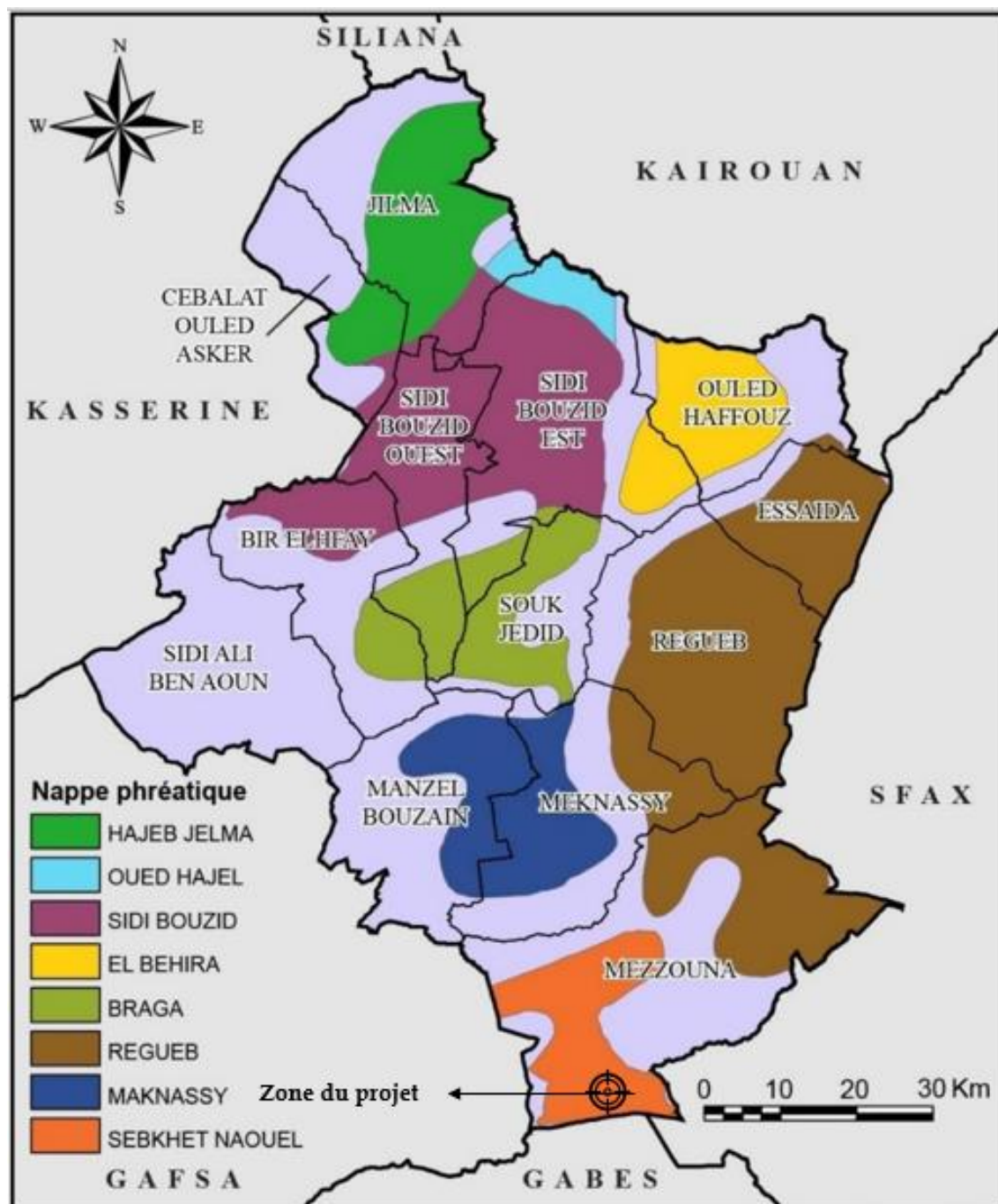
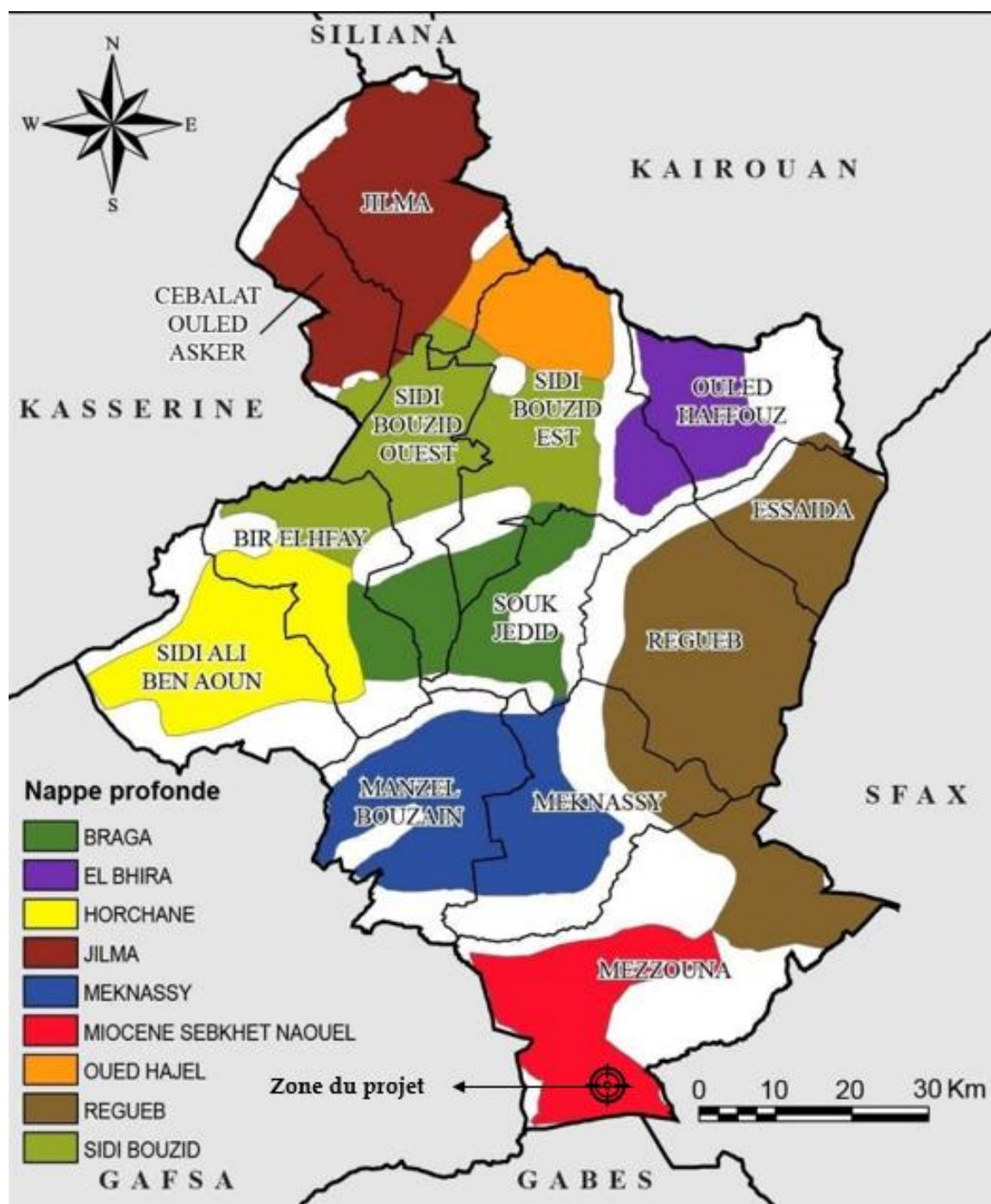


Figure 17: Map of groundwater in the governorate of Sidi Bouzid

As shown in the map below, the different deep water tables in the Sidi Bouzid governorate. The project site is located at the intersection of two distinct aquifer formations: a groundwater table and a deep water table. The first corresponds to the Sebkhet Naouel water table, characterized by endorheic behavior, with a supply mainly from runoff and seasonal flows from the surrounding reliefs.



Source : Carte agricole

Figure 18: Map of the deep water tables of Sidi Bouzid

This aquifer is particularly vulnerable to climatic variations and the quality of surface water. The second, deeper aquifer is identified as the Miocene – Sebkhet Naouel aquifer. It develops in older sedimentary formations, at significant depths, and represents a strategic groundwater resource for the region. This aquifer is less exposed to surface pollution sources, but remains subject to exploitation pressures, particularly in the context of local agricultural development.

Figure 17 illustrates the distance between the project components, namely its HV transmission line and the solar power plant site and Sebkhet Noual, classified as RAMSAR.

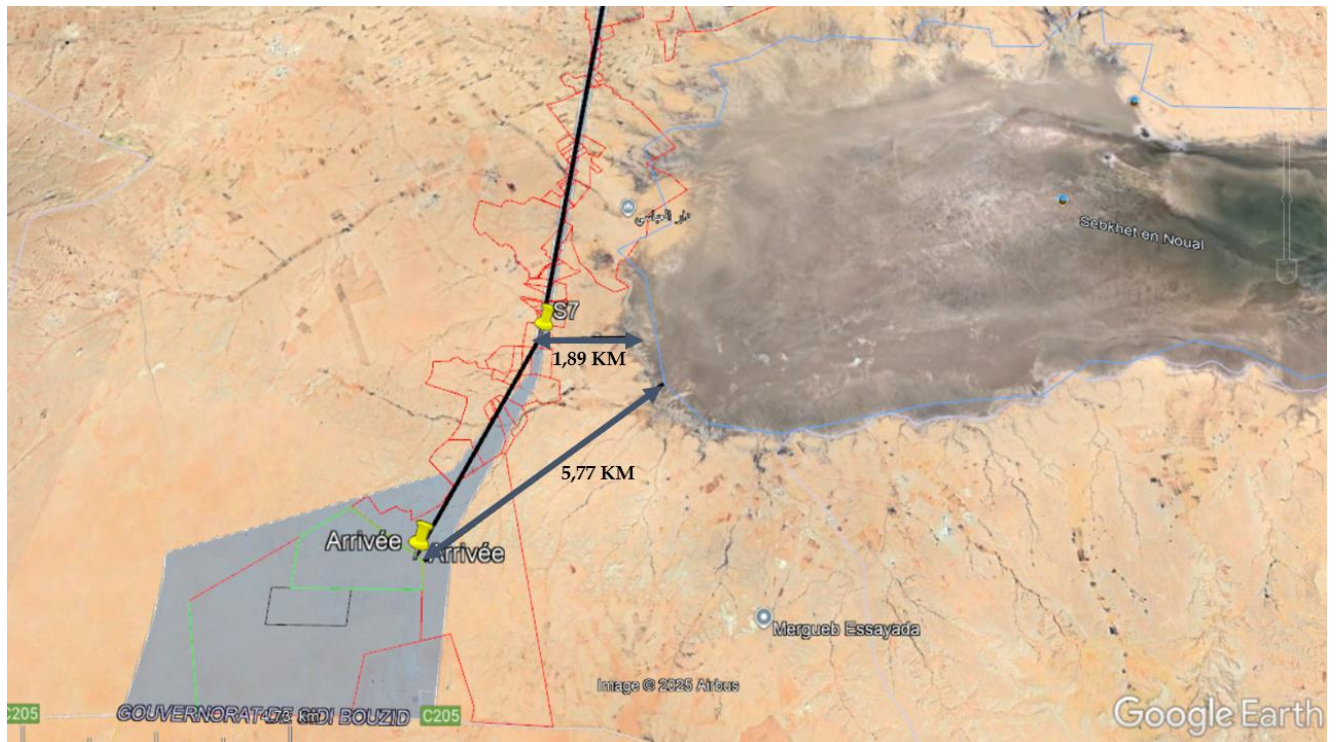


Figure 19: Distances between the power plant site, the HV transmission line and the Sebkha

3.4.8 Pedology

The soils present in the governorate of Sidi Bouzid present a remarkable diversity, closely linked to the geomorphological conditions of the region, as indicated in the soil map below. Little evolved soils and iso-humic soils dominate the inter-mountain valleys and depressions, rich in recent alluvium of Quaternary origin. These soil formations, well developed on the plains and plateaus, offer good fertility which has favored the development of agricultural activities in the region. The mountainous reliefs, notably the anticlines, are occupied by raw mineral soils, not very suitable for agriculture. In terms of extent, complex soils and brown calcareous soils constitute the third dominant soil type.

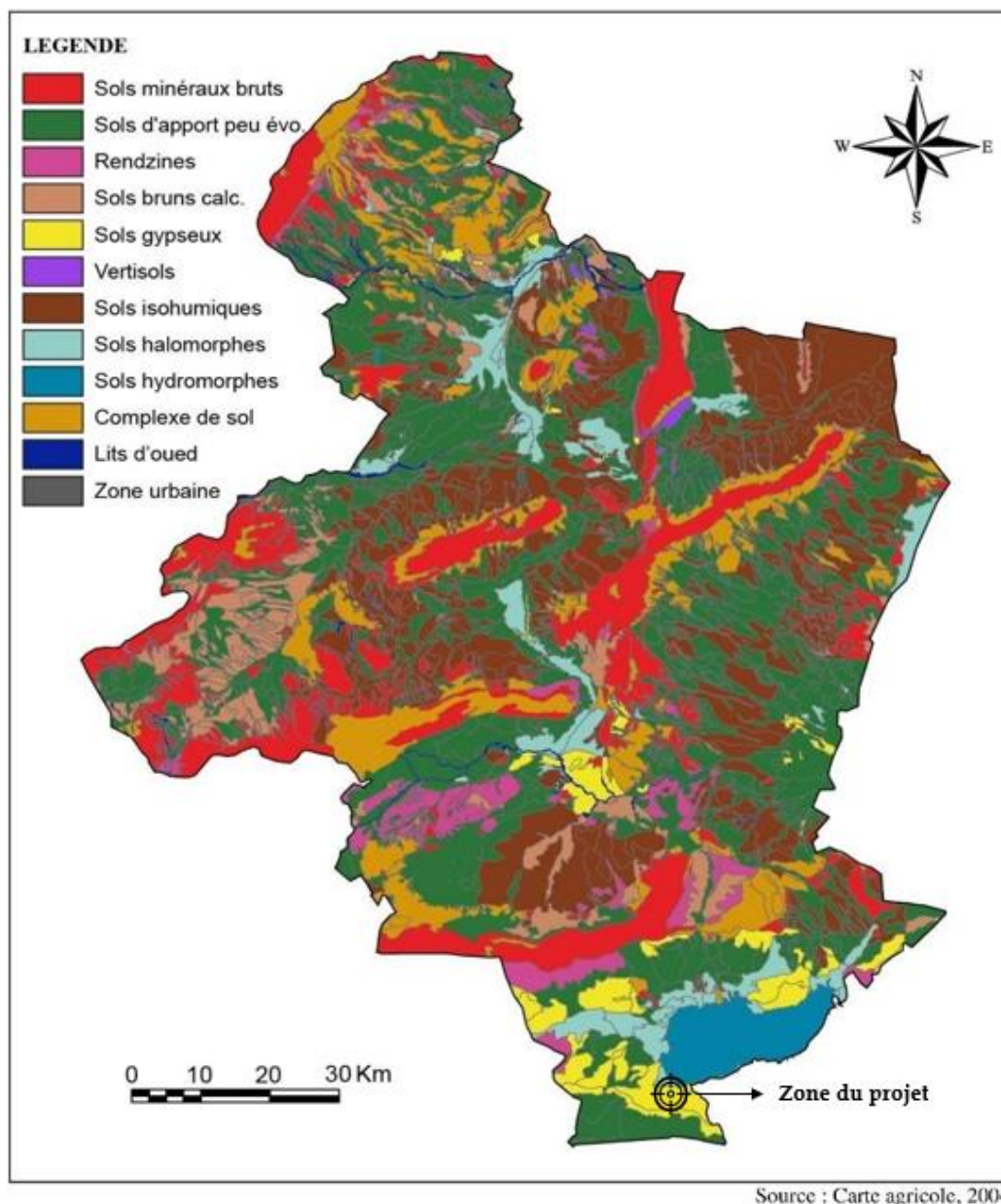


Figure 20: Soil map of Sidi Bouzid

At the regional level, marginal areas are occupied by low-fertility soils, located in endorheic basins and sebkhas. These poorly drained environments contain halomorphic and hydromorphic soils, whose characteristics (salinity, shallow depth, water stagnation) severely limit agricultural uses. Gypsum soils, wadi beds, and vertisols are also found in smaller proportions, often unsuitable for sustainable cultivation, as shown in the land use map below.

3.5 Biological Environment

3.5.1 Flora

3.5.1.1 Solar power plant

From an ecosystem point of view, the site is located in an arid steppe characterized by flat pastures on skeletal sandy-loamy soils, sometimes stony or sandy, with small dunes fixed by the jujube tree (*Ziziphus lotus*). The landscape is homogeneous, with sparse vegetation of low diversity, dominated by the Baguel (*Haloxylon salicornicum*), associated with the Vulnerable Milk Vetch (*Astragalus armatus*), the Wild Rue (*Peganum harmala*) and the Thistle-headed Atractyle (*Atractylis carduus*). In the stony-sandy areas, the Remth (*Haloxylon scoparium*) grows, while the nebkas and barkhanes fixed by the jujube tree provide shelter for small fauna, as indicated by numerous burrows observed.

The taxonomic list of plant species identified on the site is presented in Table 18, following the nomenclature of Le Floc'h et al., 2010. It should be noted that the conservation status of all these species is Not Evaluated (NE). However, they can be considered as Least Concern (LC) since none is listed in the national references (REGNES, Red List of Threatened Flora in Tunisia – ME, 2025), nor in the regional or international lists (IUCN, 2025). These taxa are also common and widely distributed, particularly in the arid zones of the country. (*NE=Not Evaluated)

Table 12: Taxonomic list of plant species identified on the site

Family	Species	French name	Status	
			IUCN (2025)	National
Amaranthaceae	<i>Haloxylon salicornia</i>	Baguette	NE	NE
	<i>Haloxylus broom</i>	Remth	NE	NE
Fabaceae	<i>Astragalus armatus</i>	Astragalus vulnerating	NE	NE
Zygophyllaceae	<i>Peganum harmala</i>	Wild street	NE	NE
Asteraceae	<i>Atractylodes thistle</i>	Atractyle à Thistle	NE	NE
Buckthorn	<i>Ziziphus lotus</i>	Jujube tree	BORN	BORN



Figure 21: Landscapes and flora identified on site

3.5.1.2 Along the HV transmission line

The transmission line associated with the planned photovoltaic power plant extends approximately 45 km from the eastern boundary of the site to Meknassy. Inventories of natural habitats along the corridor were carried out at eight stations, located near and around the eight vantage points. The geographical coordinates of points VP1 to VP8 are shown in Table 19.

Table 13: Observation points and geographic coordinates along the transmission line

Observation point	Geographic coordinates
-------------------	------------------------

	Latitude	Longitude
VP1	34°20'19.51 "N	9°39'52.84 "E
VP2	34°22'59.09 "N	9°39'41.01 "E
VP3	34°25'12.74 "N	9°39'32.02 "E
VP4	34°27'34.67 "N	9°39'28.99 "E
VP5	34°30'16.83 "N	9°41'41.40 "E
VP6	34°33'18.54 "N	9°42'48.80 "E
VP7	34°36'13.29 "N	9°43'11.72 "E
VP8	34°36'33.89 "N	9°39'38.97 "E

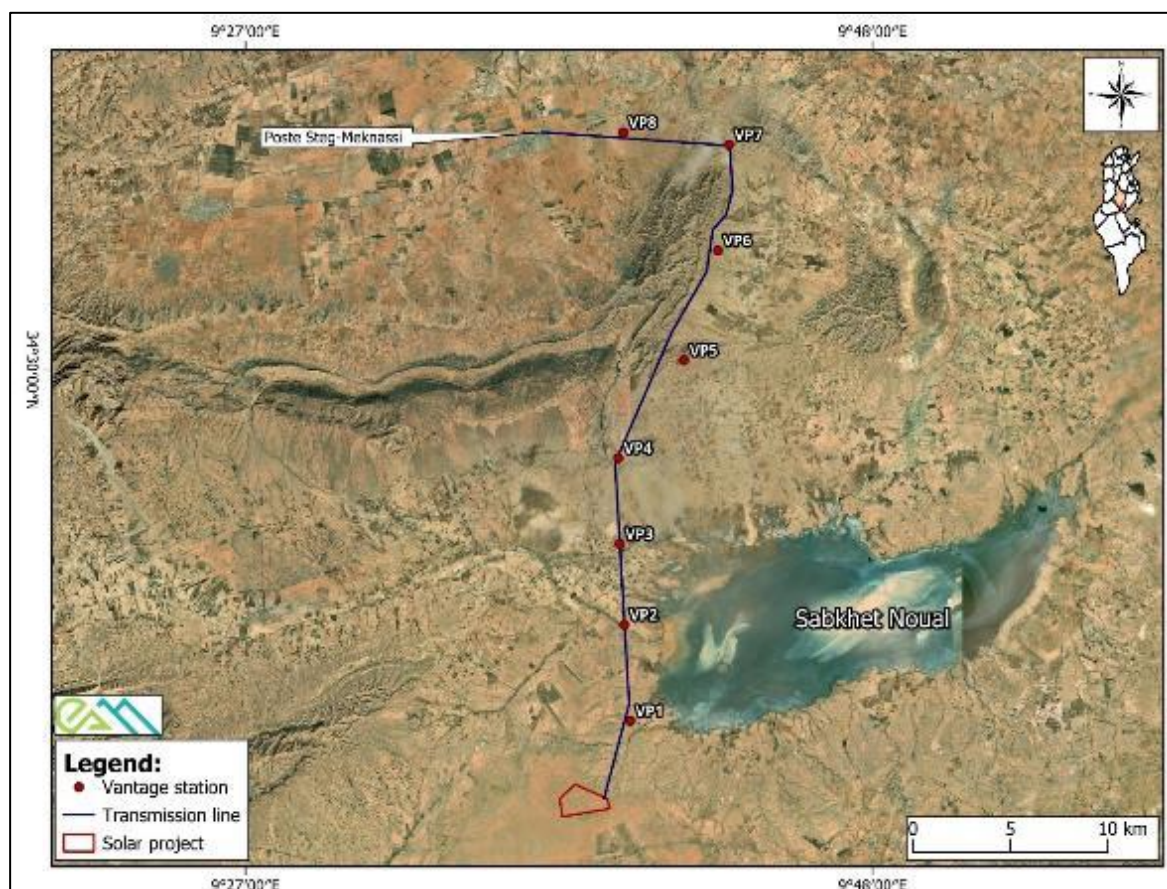


Figure 22: Vantage points location

Since these points are spaced approximately 5 km apart and located at different altitudes, in various bioclimatic stages, biotopes and ecosystems, the landscapes and floristic composition vary according to the environment. The following sections present the main characteristics of the habitats surveyed and the typical plant species recorded at each study station.

Station 1

Xerophilous hilly steppe, characterized by low and sparse steppe vegetation, composed mainly of Baguel (*Anabasis articulata*), White Saltwort (*Haloxylon salicornicum*), Black Saltwort / Remth (*Haloxylon scoparium*), Milkvetch (*Astragalus armatus*), Gymnocarpus (*Gymnocarpus decander*) and Sweet Rhanterium (*Rhanterium suaveolens*) (

Table 14: Taxonomic list of flora identified towards VP1

Family	Species	French name	It is established.	
			IUCN (2025)	National
Amaranthaceae	<i>Articulated Anabasis</i>	Baguette	NE	NE
	<i>Haloxylon salicornia</i>	White willow	NE	NE
	<i>Haloxylus broom</i>	Black saligne Remth	NE	NE
Caryophyllaceae	<i>Gymnocarpus decander</i>	Gymnocarpus	NE	NE
Fabaceae	<i>Astragalus armatus</i>	Astragale vulnérant	NE	NE
Asteraceae	<i>Rhanterium suaveolens</i>	Rhanterium odorant	NE	NE
Cistaceae	<i>Helianthemum lippii</i>	Fleur de Jade	NE	NE
Brassicaceae	<i>Diplotaxis harra</i>	Diplotaxe	NE	NE
Thymeleaceae	<i>Thymelaea hirsuta</i>	Passerine	NE	NE
Zygophyllaceae	<i>Peganum harmala</i>	Rue sauvage	NE	NE

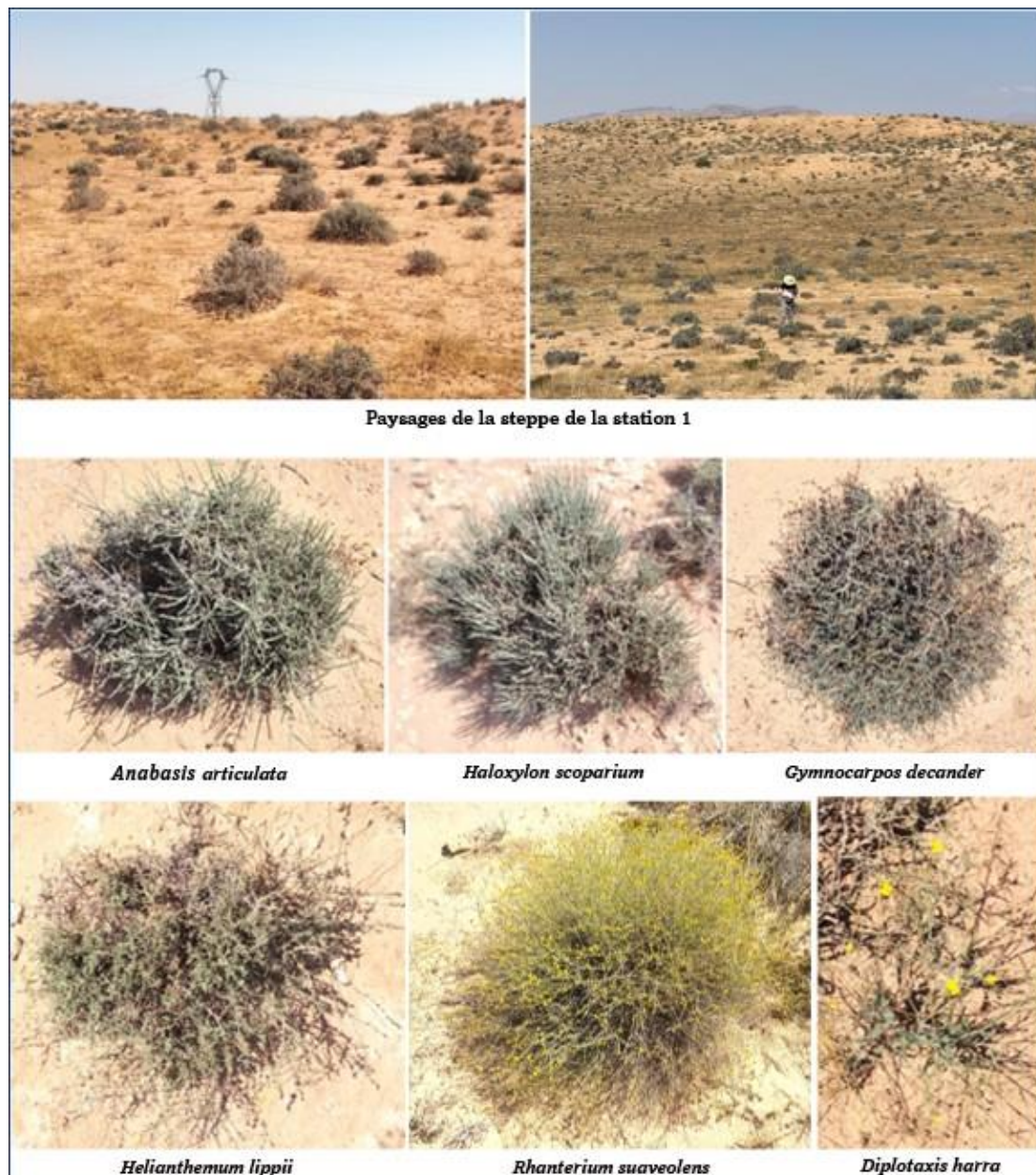


Figure 23: Flora identified at the first observation point

Station 2

Halophyte steppe on sandy soils on the edge of a wadi supplying the Sebkha Naoual. Vegetation dominated by the Vermiculated Soda (*Suaeda vermiculata*) and the Vermiculated Samphire (*Caroxylon vermiculatum*), accompanied by the Baguel (*Anabasis articulata*), the Passerina (*Thymelaea hirsuta*), the Frankenia (*Frankenia thymifolia*) and the Tuberous Statice (*Limonium tuberculatum*). A few isolated individuals of Gum Acacia (*Vachellia tortilis*) are observed, while

the wetter wadi bed is home to Arroche (*Atriplex halimus*), African Tamarisk (*Tamarix africana*), Nitraira (*Nitraria retusa*) and Large Static (*Limoniastrum monopetalum*).

Table 15: Taxonomic list of flora identified towards VP2

Family	Species	French name	State t	
			IUCN (2025)	National
Amaranthaceae	<i>Suaeda vermiculata</i>	Vermiculated soda	NE	NE
	<i>Caroxylon vermiculatum</i>	Vermiculated glasswort	NE	NE
	<i>Articulated Anabasis</i>	Bagel	NE	NE
	<i>Atriplex halimus</i>	Castling	LC	NE
Frankeniaceae	<i>Frankenia thymifolia</i>	Frankenia	NE	NE
Nitrariaceae	<i>Nitraria retusa</i>	Nitraire	NE	NE
Tamaricaceae	<i>Tamarix africana</i>	Tamaris africain	LC	NE
Plumbaginaceae	<i>Limoniastrum monopetalum</i>	Grande Statice	NE	NE
	<i>Limonium tuberculatum</i>	Statice à tubercules	NE	NE
Thymeleaceae	<i>Thymelaea hirsuta</i>	Passerine	NE	NE
Zygophyllaceae	<i>Peganum harmala</i>	Wild Street	BORN	BORN
Fabaceae	<i>Vachellia (Acacia) tortilis</i>	The Gum Acacia	LC	SEEN



Figure 24: Flora identified at the VP2 level

Station 3

Sebkha habitat dominated by halophytes, with dense stands of Striated Glasswort (*Halocnemum strobilaceum*) and Vermiculated Soda (*Suaeda vermiculata*). Nodal Ficoide (*Mesembryanthemum nodiflorum*) partially covers the ground, accompanied by *Nitraria retusa*

and Orache (*Atriplex halimus*). Scattered date palms and a few individuals of Gum Acacia appear sporadically.

Table 16: Taxonomic list of species identified towards VP 3

Family	Species	French name	Status	
			IUCN (2025)	National
Amaranthaceae	Halocnemum strobilaceum	Striated glasswort	BORN	BORN
	Suaeda vermiculata	Vermiculated soda	BORN	BORN
	Atriplex halimus	Orach	BORN	BORN
Aizoaceae	Mesembryanthemum nodiflorum	Nodal ficoid	BORN	BORN
Nitrariaceae	Nitraria retusa	Nitrater	BORN	BORN



Figure 25: Halophytes of Sebkha (VP3)

Station 4

Station located in a relict stand of Gum Acacia (*Vachellia tortilis*), in mosaic with irrigated farmland. The sandy soils outside the cultivated areas support Lobed Statice (*Limonium*

lobatum), with a few individuals of White Saltbush (Haloxylon salicornicum) and Wolfberry (Lycium shawii) at the edges of the fields.

Table 17: Taxonomic list of flora identified at the VP4 level

Family	Species	French name	Status	
			IUCN (2025)	National
Amaranthaceae	<i>Haloxylon salicornicum</i>	White saltwort	BORN	BORN
Plumbaginaceae	<i>Limonium lobatum</i>	Lobed statice	BORN	BORN
Solanaceae	<i>Lycium shawii</i>	Lyciet	LC	BORN
Fabaceae	<i>Vachellia (Acacia) tortilis</i>	The Gum Acacia	LC	SEEN



Figure 26: Flora identified towards VP4

Station 5

Piedmont of Bouhedma National Park (IBA/KBA), close to cultivated land and rural settlements. The dry, stony soils support xerophilous steppe vegetation dominated by White Saltwort (*Haloxylon salicornicum*), Bagel (*Anabasis articulata*), Milk Vetch (*Astragalus armatus*) and *Gymnocarpos decander*. Associated species: Mugwort (*Artemisia* spp.), *Pergularia* (*Pergularia tomentosa*), Lavender (*Lavandula multifidus*), Hairy Horehound (*Ballota hirsuta*) and *Asparagus horridus*. In the nearby ravines, stands of Sumac (*Searsia tripartita*) appear.

Table 18: Taxonomic list of plants at the VP5 level

Family	Species	French name	Status	
			IUCN (2025)	National
Amaranthaceae	<i>Haloxylon salicornicum</i>	White saltwort	BORN	BORN
	<i>Anabasis articulata</i>	Baguel	BORN	BORN
Caryophyllaceae	<i>Gymnocarpos decander</i>	Gymnocarpus	BORN	BORN
Fabaceae	<i>Astragalus armatus</i>	Vulnerable Astragalus	BORN	BORN
Asteraceae	<i>Artemisia herba-alba</i>	White mugwort	BORN	BORN
	<i>Artemisia campestris</i>	Field Mugwort	NE	NE
Apocynaceae	<i>Pergularia tomentosa</i>	Pergola	NE	NE
Lamiaceae	<i>Lavandula multifidus</i>	Lavender multifid	NE	NE
	<i>Ballota hirsuta</i>	Bristly horehound	NE	NE
Asparagaceae	<i>Asparagus horridus</i>	Horrible asparagus	NE	NE
Anacardiaceae	<i>Searsia tripartita</i>	Sumac tripartite	LC	VU

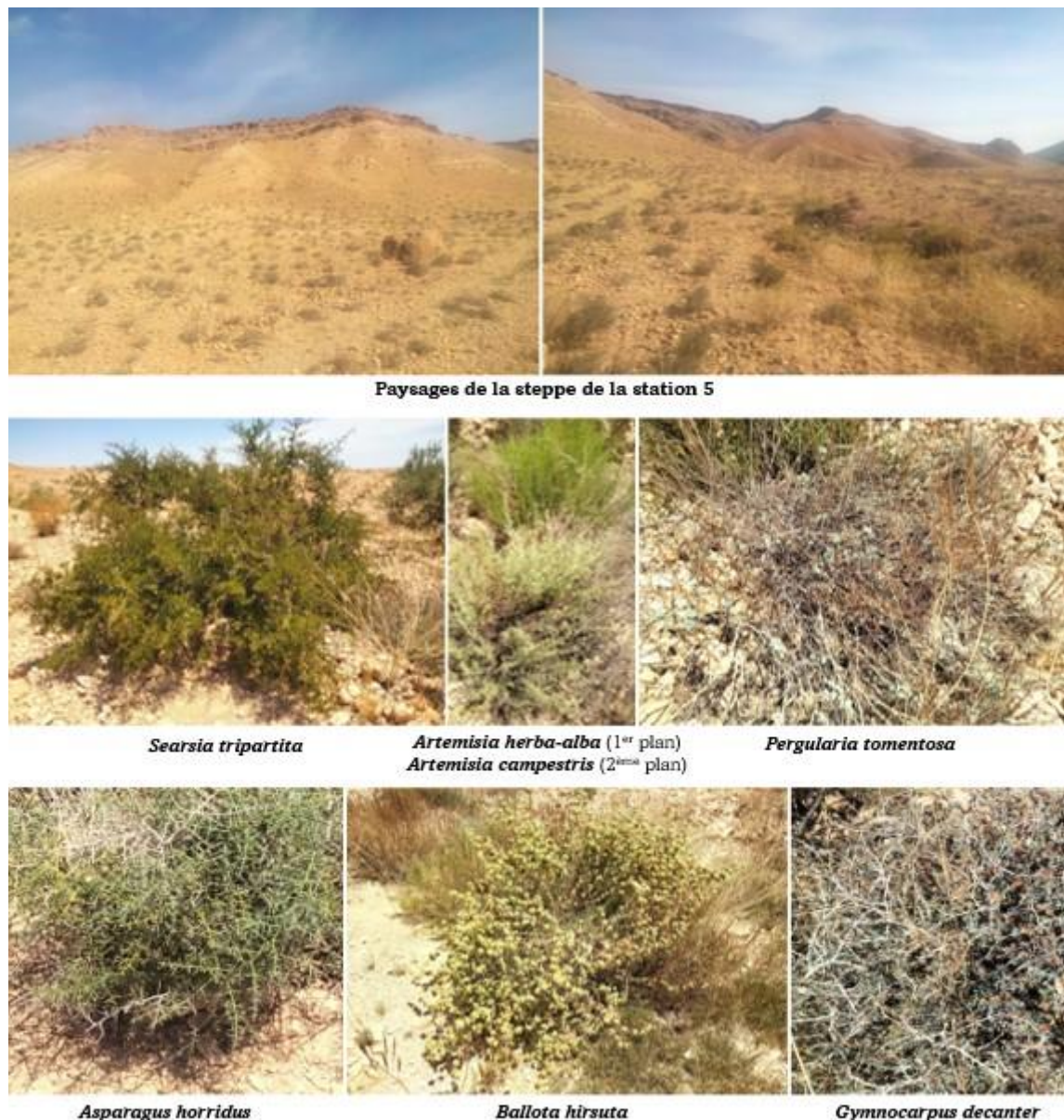


Figure 27: Plants identified at the VP5 level

Station 6

Area between the northeastern slope of Bouhedma National Park and an agricultural plain, separated by a wadi bed. The flora combines a xerophilous steppe (Remth - Haloxylon scoparium, Astragalus armatus, White Saltwort, Gymnocarpus, White Mugwort) and hydrophilic vegetation in the wadi (Cenchrus ciliaris - Cenchrus ciliaris, Retama - Retama

raetam, Blunt spurge – *Euphorbia retusa*, Multifidus lavender, Diplotaxis – *Diplotaxis harra*, Field cabbage – *Moricandia arvensis*, Wild cardoon – *Cynara cardunculus*).

Table 19: Taxonomic list of plants identified towards VP6

Family	Species	French name	Status	
			IUCN (2025)	National
Amaranthaceae	<i>Haloxylon scoparium</i>	Remth	NE	NE
	<i>Haloxylon salicornicum</i>	Saligne blanche	NE	NE
Caryophyllaceae	<i>Gymnocarpos decander</i>	Gymnocarpe	NE	NE
Brassicaceae	<i>Diplotaxis harra</i>	Diploptaxe	NE	NE
Fabaceae	<i>Astragalus armatus</i>	Astragale vulnérant	NE	NE
	<i>Retama raetam</i>	Rétame	NE	NE
Asteraceae	<i>Artemisia herba-alba</i>	Armoise blanche	NE	NE
	<i>Cynara cardunculus</i>	Cardon sauvage	NE	NE
Lamiaceae	<i>Lavandula multifide</i>	Lavande multifide	NE	NE
Euphorbiaceae	<i>Euphorbia retusa</i>	Euphorbe obtus	NE	NE
Poaceae	<i>Cenchrus ciliaris</i>	Cenchrus cilié	NE	NE
Brassicaceae	<i>Moricandia arvensis</i>	Field cabbage	BORN	BORN



Figure 28: Plants identified at the VP6 level

Station 7

Northern end of Bouhedma National Park, on rocky terrain. Xerophilous steppe vegetation dominated by White Saltwort, Milkvetch, Gymnocarpus, Pituranthos chloranthus, Horrid Asparagus, White Mugwort, Multifidus Lavender and Wild Cardoon. Notable : presence of Alfa

(*Stipa tenacissima*) and Esparto (*Lygeum spartum*), recorded for the first time along the HV line. In the ravines: Retame and Sumac tripartite.

Table 20: Taxonomic list of plants identified in VP7

Family	Genus and species	French Name	Status	
			IUCN (2025)	National
Amaranthaceae	<i>Haloxylon salicornicum</i>	Saligne blanche	NE	NE
Caryophyllaceae	<i>Gymnocarpos decander</i>	Gymnocarpe	NE	NE
Fabaceae	<i>Astragalus armatus</i>	Astragale vulnérant	NE	NE
	<i>Retama raetam</i>	Rétame	NE	NE
Nitrariaceae	<i>Nitraria retusa</i>	Nitraire	NE	NE
Brassicaceae	<i>Diploaxis harra</i>	Diploptaxe	NE	NE
Asteraceae	<i>Artemisia herba-alba</i>	Armoise blanche	NE	NE
	<i>Cynara cardunculus</i>	Cardon sauvage	NE	NE
Lamiaceae	<i>Lavandula multifida</i>	Lavande multifide	NE	NE
Poaceae	<i>Stipa tenacissima</i>	Alfa	VU	LC
	<i>Lygeum spartum</i>	Sparte	NE	NE
Asparagaceae	<i>Asparagus horridus</i>	Horrible asparagus	NE	NE
Apiaceae	<i>Pituranthos chloranthus</i>	Goddess of childbirth	NE	NE
Anacardiaceae	<i>Searsia tripartita</i>	Sumac tripartite	LC	VU

Figure 29: Species identified at the VP7 level

Station 8

Between olive groves and wadi bed, on moist sandy soils. The banks bear Rétame, Jujube, Fragrant Rhanterium and Broom Knotweed (*Polygonum equisetiforme*), with in adjacent areas Mugwort (*Artemisia campestris* and *A. herba-alba*), Purple Scabious (*Scabiosa atropurpurea*), Desert Wormwood (*Echiochilon fruticosum*) and Passerine (*Thymelaea hirsuta*). Between stations 7 and 8, bird's-foot trefoil (*Reaumuria vermiculata*) was observed on gypso-halophilic soils.

Table 21: Taxonomic list of plants identified in VP8

Family	Species	French name	Status	
			IUCN (2025)	National
Fabaceae	<i>Retama raetam</i>	Retame	BORN	BORN
Rhamnaceae	<i>Ziziphus lotus</i>	Jujube tree	BORN	BORN
Asteraceae	<i>Rhanterium suaveolens</i>	Rhanterium odorant	BORN	BORN
	<i>Artemisia campestris</i>	Field Mugwort	BORN	BORN
	<i>Artemisia herba-alba</i>	White mugwort	BORN	BORN
Thymeleaceae	<i>Thymelaea hirsuta</i>	Passerine	BORN	BORN
Apocynaceae	<i>Pergularia tomentosa</i>	Pergular	BORN	BORN
Poaceae	<i>Cenchrus ciliaris</i>	Cenchrus ciliate	BORN	BORN
Polygonaceae	<i>Polygonum equisetiforme</i>	Broom knotweed	BORN	BORN
Caprifoliaceae	<i>Scabiosa atropurpurea</i>	Purple scabious	BORN	BORN
Boraginaceae	<i>Echiochilon fruticosum</i>	Desert Wormwood	BORN	BORN
Tamaricaceae	<i>Reaumuria vermiculata</i>	Bird's foot trefoil	BORN	BORN



Figure 30: Species identified in VP8

Conclusion

The project site and the HV line corridor are dominated by arid steppe and halophyte ecosystems, with sparse and low-diversity vegetation typical of pre-desert environments. The most widespread species are: White Saltwort (*Haloxylon salicornicum*), Remth (*Haloxylon scoparium*), Baguel (*Anabasis articulata*) and Milkvetch (*Astragalus armatus*).

The majority of the species recorded are classified as NE (Not Evaluated) because they are not included in the national (REGNES, ME 2025) or international (IUCN 2025) references. They are common and widely distributed in arid regions, and can be considered LC (Least Concern). Three species of conservation interest have been identified:

- *Vachellia tortilis* (Gum wattle): LC worldwide; VU nationally, observed at stations 2 and 4.
- *Stipa tenacissima* (Alfa): VU worldwide; LC nationally, observed at station 7.
- *Searsia tripartita* (Tripartite sumac): LC globally; VU nationally, observed at stations 5 and 7.

In accordance with the definition of the EBRD PR6 standard, these species constitute Priority Biodiversity Features (PBFs) due to their vulnerable status at the national and/or global scale. However, they have been observed only as scattered individuals at low densities and do not form dominant or structuring habitat groups.

3.5.2 Fauna

3.5.2.1 Photovoltaic power plant (PV site)

a) Invertebrates

Small invertebrates observed on the site are:

- A gastropod mollusk: *Sphincterochila candidissima*.
- Two tenebrionid beetles: *Prionotheca coronata* and *Pimelia interstitialis*.
- Two scorpions of the Buthidae family: *Androctonus australis* and *Buthacus arenicola*.

b) Vertebrates

i) Reptiles

Two species of lizards were recorded at the site: *Stenodactylus mauritanicus* and *Chalcides boulengeri*. Staff at the adjacent PV plant also reported the presence of *Cerastes cerastes* (horned viper) and *Naja haje* (Egyptian cobra). An expanded list of potentially present reptiles was compiled from the literature (nomenclature by Nourira et al., 2002). All species listed are classified as Least Concern (LC) by the IUCN Red List of Mediterranean Reptiles (2006).

Order	Family	French & Latin names	Status
Saurians	Varanidae	Desert monitor lizard – <i>Varanus griseus</i>	LC
	Gekkonidae	Gecko – <i>Stenodactylus mauritanicus</i> (Obs.)	LC
	Agamidae	Agame – <i>Trapelus mutabilis</i>	LC
	Lacertidae	Acanthodactyle – <i>Acanthodactylus boskianus</i>	LC
		Mésaline – <i>Mesalina olivieri</i>	LC
	Scincidae	Seps – <i>Chalcides boulengeri</i> (Obs.)	LC
Ophidiens	Lamprophiidae	Psammophile – <i>Psammophis schokari</i>	LC
		Couleuvre – <i>Malpolon moileensis</i>	LC
	Viperidae	Horned viper – <i>Cerastes cerastes</i>	LC
	Elapidae	Egyptian Cobra – <i>Naja haje</i>	LC

LC: Least Concern; Obs.: observed on site. Status source: IUCN, 2006.

Mammals

Traces of jerboas moving on the live sands of the nebkas and several rodent and red fox burrows

were observed at the foot of the thickets, particularly under jujube trees in sandy areas. The list of mammals likely to occur comes from the literature (CHETOU, in press; EL-FARHATI et al., 2019). All these species are LC according to the IUCN Red List of Mediterranean Mammals (2008).

Order	Family	French name – Genus & species	Status
Lagomorphs	Leporidae	Cape Hare – <i>Lepus capensis</i>	LC
Rodents	Muridae	Field gerbil – <i>Gerbillus campestris</i>	LC
		Simon's gerbil – <i>Gerbillus simoni</i>	LC
		Shaw's fairywren – <i>Meriones shawi</i>	LC
		Sand Rat – <i>Psammomys obesus</i>	LC
	Dipodidae	Greater jerboa – <i>Jaculus orientalis</i>	LC
Insectivores	Erinaceidae	Algerian hedgehog – <i>Atelerix algirus</i>	LC
Carnivores	Canidae	Red fox – <i>Vulpes vulpes</i>	LC
		Golden Wolf – <i>Canis anthus</i>	LC

LC: Least Concern.

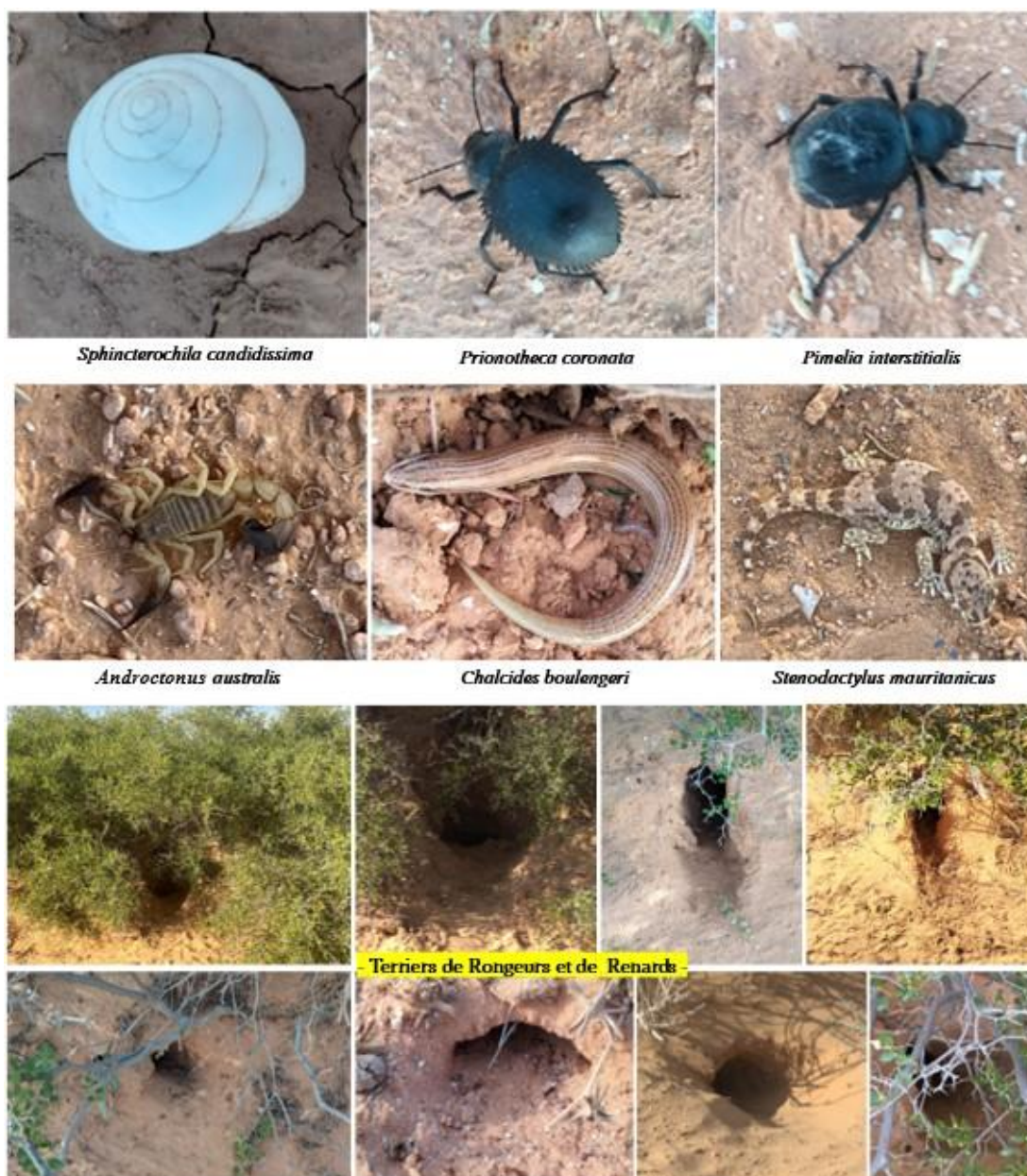


Figure 31: Vertebrates and Invertebrates identified on site

3.5.2.2 Along the route of the HT line

a) Invertebrates

Invertebrates recorded or potentially recorded along the HV line include three gastropods: *Sphincterochila candidissima*, *Eobania vermiculata*, *Xeroplana doumeti* (the latter confined to the rocky habitats of Station 7), several insects (*Eugaster guyony* , *Julodis* sp., *Geomantis larvoides* , hawkmoth caterpillars) and five scorpions. Among the latter, the venomous species *Androctonus australis* is confirmed, alongside *Buthus tunetanus*, *Androctonus bicolor*, *Buthacus arenicola* and *Scorpio punicus*.

b) Vertebrates

i) Amphibians

No amphibians were observed along the route, but four species are reported in the studied area (Ben Hassine & Nouira, 2012), all LC (IUCN 2025): *Rana saharica* , *Discoglossus pictus* , *Sclerophrys mauritanica* , *Bufo boulengeri* .

ii) Reptiles

The Bouhedma region (including the National Park) is particularly rich in reptiles due to the

overlap of Palearctic, Saharan, Saharan-Sindian, African, and North African Mediterranean elements—a true biogeographic transition zone. Field surveys noted a few lizards, including **Varanus griseus** (Station 1). The expanded list below compiles probable species based on the literature and faunal studies of Bouhedma.

Order	Family	Species	Status
Chelonians	Testudinidae	<i>Testudo graeca</i>	LC
Saurians	Chamaeleonidae	<i>Chamaeleo chamaeleon</i>	LC
	Varanidae	<i>Grey monitor lizard</i> (Obs.)	LC
	Agamidae	<i>Changeable trapelus</i> (Obs.)	LC
		<i>Uromastyx acanthinura</i>	LC
	Lizards	<i>Acanthodactylus boskianus</i> (Obs.)	LC
		<i>Spotted Acanthodactylus</i>	LC
		<i>Olive tree mesalina</i>	LC
		<i>Mesalina guttulata</i>	LC
		<i>Western sedge</i>	LC
	Gekkonidae	<i>Stenodactylus mauritanicus</i> (Obs.)	LC
		<i>Tropicolotes tripolitanus</i>	LC
	Phyllodactylidae	<i>Tarentola fascicularis</i>	LC
	Scincidae	<i>Chalcides ocellatus</i>	LC
		<i>Chalcides boulengeri</i> (Obs.)	LC
		<i>Eumeces schneideri</i>	LC
Ophidiens	Colubridae	<i>Hemorrhois hippocrepis</i>	LC
		<i>Hemorrhois algirus</i>	LC
	Lamprophiidae	<i>Psammophis schokari</i>	LC
		<i>Malpolon insignitus</i>	LC
		<i>Malpolon moilensis</i>	LC
	Viperidae	<i>Cerastes cerastes</i> (Obs.)	LC
		<i>Echis leucogaster</i>	LC
		<i>Daboia mauritanica</i>	NT
	Elapidae	<i>Naja haje</i>	LC

LC: Least Concern; NT: Near Threatened.

iii) Mammals

The best represented group is that of **rodents**, as indicated by the abundance of burrows at the foot of plant formations (jujube, retame, bagel, remth), particularly in sandy steppes. The list below is taken from the literature (notably **Moldrzyk, 2003**). All species are LC (IUCN, 2008).

- Lagomorphs: Cape Hare (*Lepus capensis*).
- Rongeurs (Muridae): Gerbille champêtre (*Gerbillus campestris*), Gerbille de Lataste (*G. latastei*), Gerbille de Simon (*G. simoni*), Mériion de Shaw (*Meriones shawi*), Rat des sables (*Psammomys obesus*), Rat noir (*Rattus rattus*), Souris domestique (*Mus musculus*).

- Ctenodactylidae: Goundi (*Ctenodactylus gundi*).
- Dipodidae: Great gerbil (*Jaculus orientalis*).
- Hystricidae: Porc-épic (*Hystrix cristata*).
- Insectivores (Erinaceidae): Algerian hedgehog (*Atelerix algirus*).
- Macroscelidea (Macroscelididae): Proboscis rat (*Petrosaltator rozeti*).
- Carnivores: European genet (*Genetta genetta*), red fox (*Vulpes vulpes*), golden wolf (*Canis anthus*).
- Chiroptera (bats). Thirteen species are reported in Bouhedma National Park (six habitat types; Dalhoumi et al., 2016; Temple & Cuttelod, 2009). Some may frequent the study area, particularly the rocky slopes of the park; targeted inventories are still necessary to confirm their presence on the PV site and along the HV line.

Family	Common name	Species	IUCN (2025)
Rhinolophidae	Great rhinoceros	<i>Rhinolophus ferrumequinum</i>	LC
	Small rhinoceros beetle	<i>R. hipposideros</i>	LC
	Rhinolophe euryale	<i>R. euryale</i>	NT
	Rhinolophe de Mehely	<i>R. mehelyi</i>	VU
Rhinopomatidae	Small rhinoceros beetle	<i>Rhinopoma cystops</i>	LC
Molossidae	Molossus of Cestoni	<i>Tadarida teniotis</i>	LC
Miniopteridae	Schreiber's miniopter	<i>Miniopterus schreibersii</i>	SEEN
Vespertilionidae	Sérotine Isabelle	<i>Eptesicus isabellinus</i>	LC
	Kuhl's pipistrelle	<i>Pipistrellus kuhlii</i>	LC
	Common pipistrelle	<i>P. pipistrellus</i>	LC
	Hemprich's Long-eared Bat	<i>Otonycteris hemprichii</i>	LC
	Maghreb Long-eared Bat	<i>Plecotus gaisleri</i>	BORN
	Maghreb bat	<i>Myotis punicus</i>	DD

LC: Least Concern; NT: Near Threatened; VU: Vulnerable; NE: Not Evaluated; DD: Data Deficient .

Conclusion

- The fauna of the PV site and the HV line is rich and diverse despite the arid context (confirmed by direct observations, traces and bibliographic review).
- Reptiles are the most diverse group, reflecting adaptation to the mosaic of habitats along the line.
- Mammals are dominated by rodents, as evidenced by the numerous burrows and sightings.
- The majority of vertebrates recorded or expected are common in central and southern Tunisia and without conservation issues (LC).
- *Daboia mauritanica* (NT, IUCN) has not been observed but is potentially present in rocky mountain habitats (Stations 5 and 7).
- Dangerous species confirmed locally include the scorpion *Androctonus australis*, the horned viper *Cerastes cerastes* and the cobra *Naja haje*.
- Bat inventories have not yet been carried out on the site and along the OHTL; however,

13 species are known at Bouhedma, including several of conservation interest (VU/NT) – targeted surveys are required.

- Priority Biodiversity Elements (PBF) – EBRD PR6: based on the species potentially present, *Daboia mauritanica* (NT) and several bats (VU/NT) could fall under PBF.

3.5.2.3 *Birdlife*

As part of the ornithological survey methodology for the Khobna– Sidi Bouzid PV power plant and the associated HV power line, three campaigns were conducted on 8–11 April 2025, 17–18 May 2025 and 14–15 June 2025. Surveys continue monthly, with campaigns planned for the coming months, including during the autumn migration. In southern Tunisia, the April and May campaigns coincide with the breeding season of many species, while the June campaign corresponds to the end of the spring passage of passerines.

The results presented are based on two complementary techniques, commonly used in ornithology:

1. Stop-point transects (~10 minutes) on the PV plant site (species seen/heard, behaviors, nests);
2. Fixed observation points (vantage points, VP) along the HV line.

The objective of the initial avifauna status is to inventory the species present, to estimate their relative abundance and conservation status, with particular attention to ESR6 issues:

- regular presence of species of conservation interest (IUCN threatened – global/national – or protected by Tunisian regulations);
- migratory populations likely to reach/exceed 20,000 individuals or 1% of the biogeographic population in the Western Palearctic;
- potential use of the sector as a major migratory corridor;
- endemic species of the Maghreb;
- raptors (diurnal/nocturnal; residents, nesting or migratory) with a key ecological role;
- species of historical/cultural value to local communities.

On the site of the PV plant

The ornithologists walked the site along seven transects (T1–T7), noting all birds seen or heard, their behaviors, and any nests encountered. This method makes it possible to identify the species frequenting the site, estimate their abundance/density (ind/km), and compile a nearly exhaustive list of sedentary, migratory, and transient breeding species. Particular attention was paid to emblematic or sensitive species (great gliders, species listed by international conventions or the IUCN).

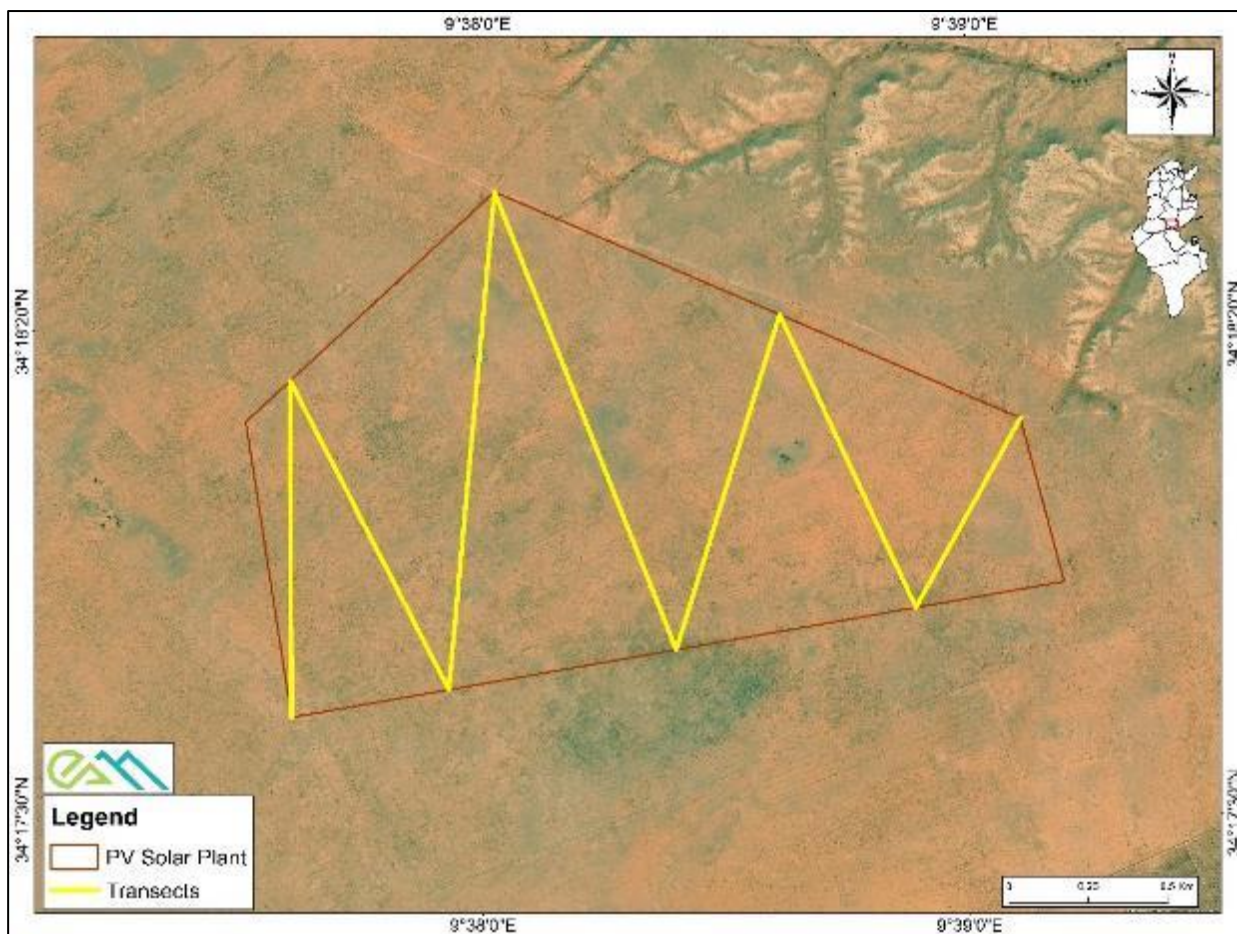


Figure 32: Position of the transects on the PV site. (Source: Biodiversity study carried out by EAM on the Khobna solar power plant)

Along the route of the HT line

Monitoring along the HV line corridor relies on strategically positioned fixed points (FPs) providing a wide field of view of the line and its surroundings. Eight FPs have been established, spaced approximately 2-2.5 km apart. At each FP, observers remain stationary for a defined period of time, scanning the sky and landscape with binoculars and spotting scopes to detect and record all birds in flight or using the area.

- April 2025 campaign: 6 hours per VP, or 48 hours of observation in total.
- May and June 2025 campaigns: 3 hours per VP, or 24 hours in total per campaign. Note: VP5 was placed ~1 km from the line due to mountainous/high terrain making direct access impossible.

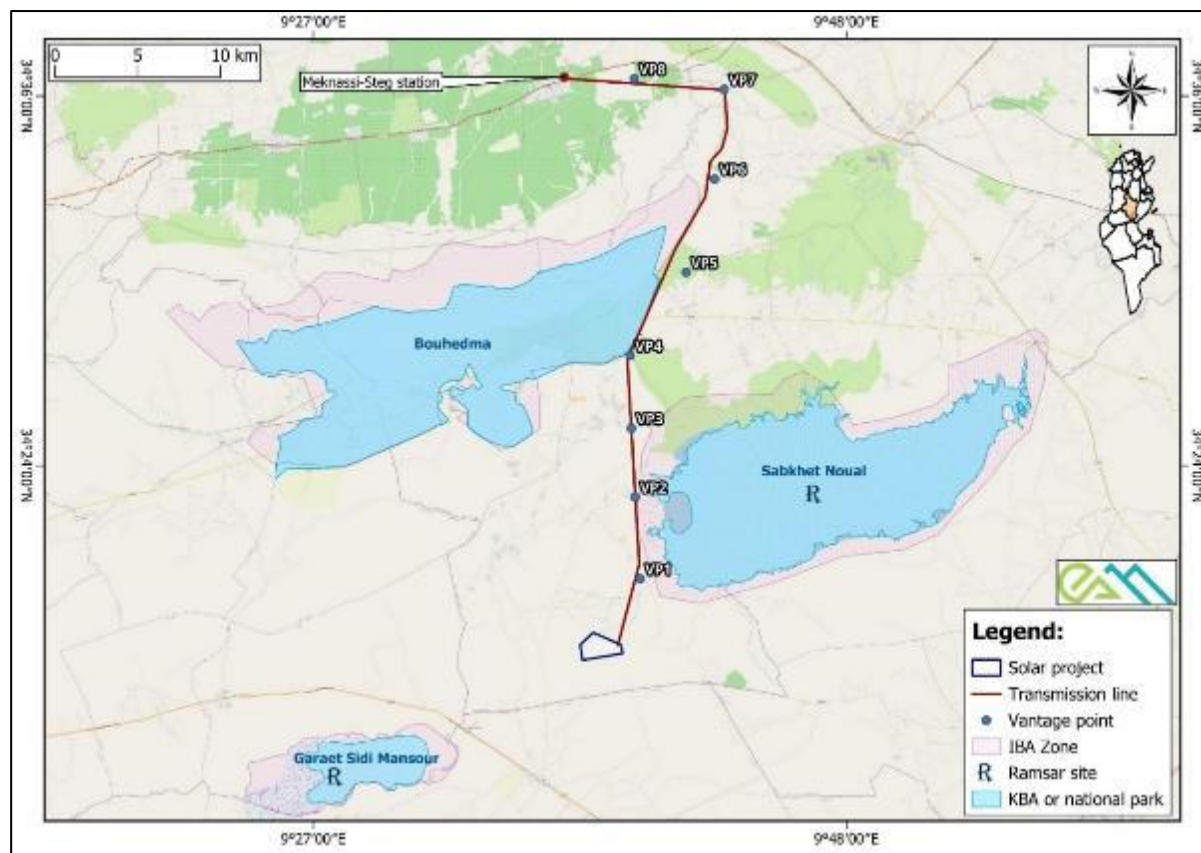


Figure 33: Location of observation points (VP) along the OHTL.

Results of the ornithological campaigns:

A total of 71 bird species were identified during the April, May and June 2025 campaigns. Among them:

- 5 species at least partially dependent on water (*Actitis hypoleucos*, *Anarhynchus alexandrinus*, *Burhinus oedicephalus*, *Cursorius cursor*, *Gallinula chloropus*);
- 10 raptors (*Aquila chrysaetos*, *Athene noctua*, *Buteo rufinus*, *Circus gallicus*, *Circus macrourus*, *Circus pygargus*, *Falco biarmicus*, *Falco tinnunculus*, *Milvus migrans*, *Pernis apivorus*);
- a majority of species from steppe/pre-desert environments (wheats, sirli/hoopoe-lulu, larks, courseivus, certain warblers).

In May 2025, Montagu's Harrier (*Circus pygargus*) and Pallid Harrier (*Circus macrourus*) were observed passing, along with a group of about 30 Honey Buzzards (*Pernis apivorus*) above/near the first VPs along the HV line. Several raptor nests – Long-legged Buzzard (*Buteo rufinus*) and Lanner Falcon (*Falco biarmicus*) – as well as corvid nests (Common Raven *Corvus corax*) were located on pre-existing HV pylons during the breeding season. In June 2025, erratic groups of Skylark (*Alauda arvensis*), Calandra Lark (*Melanocorypha calandra*) and Isabelline Lark (*Alauda rufescens*) were noted in the meadows where the new pylons are planned.

Species list (April–June 2025) and conservation status

(IUCN Global Status 2025; National Status according to Hamdi et al., 2021)

Table 22: List of species and conservation status (April-June 2025)

Latin names	English names	French name	IUCN National (*)	IUCN Global
<i>Actitis hypoleucos</i>	Common Sandpiper	Common Knight	IND	LC
<i>Alaemon alaudipes</i>	Greater Hoopoe-Lark	Desert Sirli	LC	LC
<i>Alaudala rufescens</i>	Mediterranean Short-toed Lark	Pispolette Lark	LC	LC
<i>Ammomanes cinctura</i>	Bar-tailed Lark	Elegant Ammomaniac	LC	LC
<i>Ammomanes deserti</i>	Desert Lark	Isabelline Ammomaniac	LC	LC
<i>Anarhynchus alexandrinus</i>	Kentish Plover	Kentish Plover	LC	LC
<i>Anthus trivialis</i>	Tree Pipit	Tree pipit	IND	LC
<i>Apus apus</i>	Common Swift	Black Swift	LC	LC
<i>Golden eagle</i>	Golden Eagle	Golden eagle	VU	LC
<i>Yellow-bellied woodpecker</i>	Fulvous Babbler	Fawn Craterope	NT	LC
<i>Athene noctua</i>	Little Owl	Athena's Owl	LC	LC
<i>Bucanetes githagineus</i>	Trumpeter Finch	Roselin githagine	IND	LC
<i>Burhinus oedicephalus</i>	Eurasian Stone-curlew	Oedicneme crier	LC	LC
<i>Buteo rufinus</i>	Long-legged Buzzard	Buse féroce	LC	NT
<i>Calandrella brachydactyla</i>	Greater Short-toed Lark	Alouette calandrelle	LC	LC
<i>Cercotrichas galactotes</i>	Rufous-tailed Scrub Robin	Agrobate roux	LC	LC
<i>Chloris chloris</i>	European Greenfinch	Verdier d'Europe	IND	LC
<i>Circus gallicus</i>	Short-toed Snake Eagle	Circaète Jean-le-Blanc	CR	LC
<i>Circus macrourus</i>	Pallid Harrier	Busard pâle	IND	NT
<i>Circus pygargus</i>	Montagu's Harrier	Busard cendré	IND	LC
<i>Cisticola juncidis</i>	Zitting Cisticola	Cisticole des joncs	LC	LC
<i>Columba livia</i>	Rock Dove	Pigeon biset	LC	LC
<i>Corvus corax</i>	Northern Raven	Grand corbeau	LC	LC
<i>Coturnix coturnix</i>	Common Quail	Caille des blés	LC	LC
<i>Curruca communis</i>	Common Whitethroat	Fauvette grisette	LC	LC
<i>Curruca conspicillata</i>	Spectacled Warbler	Fauvette à lunettes	LC	LC
<i>Curruca hortensis</i>	Western Orphean Warbler	Fauvette orphée	LC	LC
<i>Curruca</i>	Sardinian Warbler	Fauvette	LC	LC

<i>melanocephala</i>		mélanocéphale		
<i>Cursorius cursor</i>	Cream-colored Courser	Courvite isabelle	VU	LC
<i>Delichon urbicum</i>	Western House Martin	Window swallow	DD	LC
<i>Bunting Bunting</i>	Corn Bunting	Proyer sparrow	LC	LC
<i>Emberiza sahari</i>	House Bunting	Sahara Sparrow	LC	LC
<i>Eremophila bilopha</i>	Temminck's Lark	Two-toed Lark	LC	LC
<i>Falco biarmicus</i>	Lanner Falcon	Lanner falcon	EN	LC
<i>Falco tinnunculus</i>	Common Kestrel	Faucon crécerelle	VU	LC
<i>Ficedula albicollis</i>	Collared Flycatcher	Gobemouche à collier	IND	LC
<i>Fringilla spodiogenys</i>	African Chaffinch	Pinson des arbres africain	LC	LC
<i>Galerida cristata</i>	Crested Lark	Cochevis huppé	LC	LC
<i>Galerida theklæ</i>	Thekla's Lark	Cochevis de Thékla	LC	LC
<i>Gallinula chloropus</i>	Common Moorhen	Gallinule poule-d'eau	NT	LC
<i>Hippolais icterina</i>	Icterine Warbler	Hypolaïs ictérine	IND	LC
<i>Hirundo rustica</i>	Barn Swallow	Hirondelle rustique	LC	LC
<i>Iduna opaca</i>	Western Olivaceous Warbler	Hypolaïs obscure	LC	LC
<i>Jynx torquilla</i>	Eurasian Wryneck	Torcol fourmilier	LC	LC
<i>Lanius excubitor</i>	Great Grey Shrike	Pie-grièche grise	LC	LC
<i>Lanius senator</i>	Woodchat Shrike	Pie-grièche à tête rousse	LC	NT
<i>Linaria cannabina</i>	Common Linnet	Linotte mélodieuse	LC	LC
<i>Melanocorypha calandra</i>	Calandra Lark	Alouette calander	VU	LC
<i>Merops apiaster</i>	European Bee-eater	Guêpier d'Europe	LC	LC
<i>Milvus migrans</i>	Black Kite	Milan noir	LC	LC
<i>Wagtail flava</i>	Western Yellow Wagtail	Bergeronnette printanière	LC	LC
<i>Muscicapa striata</i>	Spotted Flycatcher	Gobemouche gris	LC	LC
<i>Oenanthe deserti</i>	Desert Wheatear	Traquet du désert	LC	LC
<i>Oenanthe halophila</i>	Maghreb Wheatear	Traquet halophile	LC	IND
<i>Oenanthe hispanica</i>	Western Black-eared Wheatear	Traquet oreillard	LC	LC
<i>Oenanthe leucura</i>	Black Wheatear	Traquet rieur	LC	LC
<i>Oenanthe moesta</i>	Red-rumped Wheatear	Traquet à tête grise	LC	LC
<i>Oenanthe oenanthe</i>	Northern Wheatear	Traquet motteux	IND	LC
<i>Passer hispaniolensis</i>	Spanish Sparrow	Moineau espagnol	LC	LC

<i>Pernis apivorus</i>	European Honey Buzzard	Bondrée apivore	IND	LC
<i>Phylloscopus bonelli</i>	Western Bonelli's Warbler	Pouillot de Bonelli	LC	LC
<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	Ganga unibande	VU	LC
<i>Ptyonoprogne rupestris</i>	Eurasian Crag Martin	Hirondelle de rochers	IND	LC
<i>Scotocerca inquieta</i>	Streaked Scrub Warbler	Dromoïque vif-argent	LC	LC
<i>Serinus serinus</i>	European Serin	Serin cini	LC	LC
<i>Spilopelia senegalensis</i>	Laughing Dove	Tourterelle maillée	LC	LC
<i>Streptopelia decaocto</i>	Eurasian Collared Dove	Tourterelle turque	LC	LC
<i>Streptopelia turtur</i>	European Turtle Dove	Tourterelle des bois	VU	VU
<i>Sturnus unicolor</i>	Spotless Starling	Étourneau unicolore	LC	LC
<i>Turdus merula</i>	Common Blackbird	Merle noir	LC	LC
<i>Upupa epops</i>	Eurasian Hoopoe	Huppe fasciée	LC	LC

LC = Least Concern; NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered; NE = Not Evaluated; DD = Data Deficient; IND = Nationally Data Deficient.

Conclusion :

- 71 species recorded (April–June 2025); high diversity for a pre-desert context.
- Raptors well represented (10 spp.), presence and nesting on existing HT pylons (Long-legged Buzzard, Lanner Falcon; Common Raven).
- Notable passages: Montagu's Harrier, Pallid Harrier, Honey Buzzards (~30 ind.).
- Groups of larks observed in June on the meadows where new pylons are planned.
- Most species are common in central/southern Tunisia and without major conservation issues (LC).
- *Daboia mauritanica* (NT, IUCN) not detected but potentially present in rocky habitats (Stations 5 & 7).
- Bats: 13 spp. known in Bouhedma (several VU/NT); specific inventories to be carried out on the PV site and along the OHTL.
- Potential PBF (EBRD PR6): *Daboia mauritanica* (NT) and several bats (VU/NT).

3.5.3 Critical habitats and Priority Biodiversity Features (PBF)

The critical habitat assessment was carried out in accordance with the criteria of **IFC Performance Standard 6 (PS6)** and **EBRD ESR6**, drawing on field inventories conducted between April and June 2025 as well as available secondary data (TRDB, IUCN 2025, neighboring protected areas).

The results of the study conducted by **EAM** demonstrate that **no Critical Habitat (CH)** is triggered in the project's area of influence (PV site and HV line route). No threshold defined by the IFC or the EBRD has been reached for critically endangered (CR), endangered (EN), restricted-range endemic or migratory/congregative species.

On the other hand, the analysis confirms the presence of several **Priority Biodiversity Elements (PBF)** , mainly plant species, raptors, passerines and bats with a vulnerable conservation status at the national or global level. These species, although present at low densities and in an ad hoc manner, require particular attention in the design and implementation of the project, particularly along the route of the HV line.

The table below presents the list of species identified or potentially present, their conservation status and their mode of presence in the study area.

Table 23: PBF species and potentially present in the area of influence and neighboring areas

Band	Species (Scientific Name)	English name	IUCN Global Status	National Status	Presence Observations /
Flora	<i>Vachellia (Acacia) tortilis</i>	Gum acacia	LC	SEEN	Observed along the OHTL route (May 2025)
	<i>Stipa tenacissima</i>	Alfa	SEEN	LC	Observed along the OHTL route (May 2025)
	<i>Searsia tripartita</i>	Sumac tripartite	LC	SEEN	Observed along the OHTL route (May 2025)
Raptors	<i>Aquila chrysaetos</i>	Golden Eagle	LC	IN	Observed April–June 2025 (site & OHTL)
	<i>Buteo rufinus</i>	Fierce Buzzard	SEEN	SEEN	Observed on OHTL pylons (April–May 2025)
	<i>Circaetus gallicus</i>	Short-toed Eagle	LC	SEEN	Observed April 2025 (OHTL)
	<i>Falco biarmicus</i>	Lanner Falcon	LC	CR	Nest on existing HT pylons (April 2025)
	<i>Falco tinnunculus</i>	Kestrel	NT	IND	Observed April 2025
	<i>Neophron percnopterus</i>	Egyptian vulture	IN	CR	Not observed; possible migrant
	<i>Falco cherrug</i>	Saker Falcon	IN	-	Not observed; unlikely migrant
	<i>Falco vespertinus</i>	Red-footed Falcon	SEEN	-	Not observed; possible migrant
Passerines & other birds	<i>Argya fulva</i>	Tawny Babbler	LC	CR	Observed April–May 2025
	<i>Circus macrourus</i>	Pallid harrier	LC	NT	Regular passages (April–June 2025)
	<i>Cursorius cursor</i>	Isabelline Courser	NT	LC	Observed April–June 2025
	<i>Gallinula chloropus</i>	Moorhen	LC	SEEN	Observed June 2025
	<i>Lanius senator</i>	Woodchat Shrike	LC	IN	Observed April–June 2025 (site & OHTL)
	<i>Melanocorypha calandra</i>	Grille Lark	LC	SEEN	Observed April 2025 (OHTL)
	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	LC	NT	Observed April 2025 (OHTL)

	<i>Streptopelia turtur</i>	Wood Turtle Dove	NT	LC	Observed April 2025 (OHTL)
Other vertebrates	<i>Daboia mauritanica</i>	Mauritania viper	NT	-	Not observed; possible in rocky habitats (Bouhedma NP)
	<i>Chlamydotis undulata</i>	Houbara Bustard	SEEN	IN	Not observed; probably extinct in the north, very unlikely in the AoI
Bats	<i>Rhinolophus euryale</i>	Greater horseshoe bat	NT	-	Not observed; possible in neighboring areas (NP/IBA)
	<i>Rhinolophus mehelyi</i>	Mehely's horseshoe bat	SEEN	-	Not observed; possible in neighboring areas
	<i>Miniopterus schreibersii</i>	Schreibers's Minioptera	SEEN	-	Not observed; possible in neighboring areas

3.5.4 Nationally protected species potentially present on the project site

The fauna inventory established in the biodiversity study was compared to the list of rare and endangered wildlife in the MARH decree of 19/07/2006.

For each taxon observed, the national status retained is either:

- “Rare and threatened with extinction (protected)” when explicitly cited (species or “all species” of a group) in Table No. 1;
- “Not included in the list of the decree” otherwise.

This legal status is independent of IUCN categories.

National status of identified species

Order/Group	Family	Species (scientific name)	National status (decree 19/07/2006)
Saurians	Varanidae	Varanus griseus	Not registered
Saurians	Gekkonidae	Stenodactylus mauritanicus	Not registered
Saurians	Agamidae	Trapelus mutabilis	Not registered
Saurians	Lacertidae	Acanthodactylus boskianus	Not registered
Saurians	Lacertidae	Mesalina olivieri	Not registered
Saurians	Scincidae	Chalcides boulengeri	Not registered
Ophidians	Lamprophiidae	Psammophis schokari	Not registered
Ophidians	Lamprophiidae	Malpolon moilensis	Not registered
Ophidians	Viperidae	Cerastes cerastes	Not registered
Ophidians	Elapidae	Naja haje	Not registered
Lagomorphs	Leporidae	Lepus capensis	Not registered
Rodents	Muridae	Field gerbil	Not registered
Rongeurs	Muridae	Simon's gerbil	Not registered
Rongeurs	Muridae	Meriones shawi	Not registered
Rongeurs	Muridae	Psammomys obesus	Not registered

Rongeurs	Dipodidae	Eastern arrow	Not registered
Insectivores	Hedgehogs	Atelerix algirus	Not registered
Carnivores	Canidae	Fox fox	Not registered
Carnivores	Canidae	Dog duck	Not registered
Mollusc	Sphincterochilidae	Sphincterochila candidissima	Not registered
Molluscs	Helicidae	Eobania vermiculata	Not registered
Molluscs	Hygromiidae	Xeroplane doumeti	Not registered
Insects	Tettigoniidae	Eugaster guyony	Not registered
Insects	Buprestidae	Julodis sp.	Not registered
Insects	Rivetinidae	Geomantis larvatus	Not registered
Insects	Sphingidae	Sphinx (larvae)	Not registered
Scorpions	Buthidae	Androctonus australis	Not registered
Scorpions	Buthidae	Buthus tunetanus	Not registered
Scorpions	Buthidae	Androctonus bicolor	Not registered
Scorpions	Buthidae	Buthacus arenicola	Not registered
Scorpions	Scorpionidae	Scorpio punicus	Not registered
Amphibians	Ranidae	Sahara frog	Not registered
Amphibians	Alytidae	Painted Discoglossus	Not registered
Amphibians	Toadstools	Sclerophrys mauritiana	Not registered
Amphibians	Toadstools	Boulenger's toads	Not registered
Chelonians	Tortoiseshell	Greek tortoise	Not registered
Saurian	Chameleonidae	Chameleon chameleon	Not registered
Saurian	Agamidae	Uromastyx acanthinura	Not registered
Saurian	Lizards	Spotted Acanthodactylus	Not registered
Saurian	Lizards	Mesalina guttulata	Not registered
Saurian	Lizards	Western sedge	Not registered
Saurian	Gekkonidae	Tropiocolotes tripolitanus	Not registered
Saurian	Phyllodactylidae	Tarantula fascicularis	Not registered
Saurian	Skinkidae	Chalcides eyed	Not registered
Saurian	Skinkidae	Eumeces schneideri	Not registered
Ophidian	Snakes	Hemorrhoids of the hippocampus	Not registered
Ophidian	Snakes	Hemorrhoids Algirus	Not registered
Ophidian	Lamprophiidae	Malpolon is distinguished	Not registered
Ophidian	Viperidae	Echis leucogaster	Not registered
Ophidian	Viperidae	Daboia mauritiana	Not registered
Rongeurs	Muridae	Gerbilus latastei	Not registered
Rongeurs	Muridae	Rattus rattus	Not registered
Rodents	Muridae	Mus musculus	Not registered
Rodents	Ctenodactylidae	Ctenodactylus gundi	Rare and endangered (protected)
Rodents	Hystriidae	Hystrix cristata	Rare and endangered (protected)
Macroscelidea	Macroscelididae	Petrosaltator rozeti	Not registered

Carnivores	Viverridae	Genetta genetta	Not registered
Bats	Rhinolophidae	Rhinolophus ferrumequinum	Rare and endangered (protected)
Bats	Rhinolophidae	Rhinolophus hipposideros	Rare and endangered (protected)
Bats	Rhinolophidae	Rhinolophus euryale	Rare and endangered (protected)
Bats	Rhinolophidae	Rhinolophus mehelyi	Rare and endangered (protected)
Bats	Rhinopomatidae	Rhinopoma cystops	Rare and endangered (protected)
Bats	Molossidae	Tadarida teniotis	Rare and endangered (protected)
Bats	Miniopteridae	Miniopterus schreibersii	Rare and endangered (protected)
Bats	Vespertilionidae	Eptesicus isabellinus	Rare and endangered (protected)
Bats	Vespertilionidae	Pipistrellus kuhlii	Rare and endangered (protected)
Bats	Vespertilionidae	Pipistrellus pipistrellus	Rare and endangered (protected)
Bats	Vespertilionidae	Otonycteris hemprichii	Rare and endangered (protected)
Bats	Vespertilionidae	Plecotus gaisleri	Rare and endangered (protected)
Bats	Vespertilionidae	Myotis punicus	Rare and endangered (protected)

Among the species identified on site, those which are “rare and threatened with extinction” within the meaning of the decree of 19/07/2006 are:

Mammals

Hystrix cristata (Porcupine)

Ctenodactylus gundi (Goundi)

Bats (all protected by the order): Rhinolophus ferrumequinum, R. hipposideros, R. euryale, R. mehelyi, Rhinopoma cystops, Tadarida teniotis, Miniopterus schreibersii, Eptesicus isabellinus, Pipistrellus kuhlii, P. pipistrellus, Otonycteris hemprichii, Plecotus gaisleri, Myotis punicus.

3.5.5 Landscape

The landscape of the El Khobna area is distinguished by a generally flat morphology, marked by a uniform topography without apparent drainage channels or depressions likely to retain rainwater. Despite this apparent horizontality, topographic analysis reveals the presence of a false flat oriented towards the northeast, in the direction of Sebkha Noual. This slight slope, difficult to perceive with the naked eye, promotes natural drainage of surface water towards the lower areas. The project site is located in a vast open plain, characterized by the absence of significant reliefs and sparse vegetation, testifying to a semi-arid context. The soil, composed mainly of silt covered with windblown sand, contributes to this impression of a homogeneous and unstructured landscape.

To the immediate south of the site is a landscaped olive grove, protected by an earth dike that serves both as a land boundary and as a barrier against seasonal runoff. This contrast between the bare land on the site and the surrounding agricultural plots highlights the heterogeneity of land use. It is also worth noting the presence of a construction site in progress on the neighboring plot, intended to house a solar power plant from the "SCATEC" group. This infrastructure, currently under construction, is part of the region's energy recovery dynamic and constitutes a structuring element of the changing local landscape.



Figure 34: Landscape of the project site

3.5.6 Ecosystem services

The project site, located in a vast semi-arid plain close to the Naouel sebkha, currently provides a limited but notable set of ecosystem services. Although its bare soil, sparse vegetation and low floristic cover limit its direct uses, several provisioning, regulating, supporting and even cultural functions can be identified. In terms of **provisioning services**, the site is used seasonally, from March to September, as a grazing area for goat herds. This activity, although not intensive, demonstrates a certain local dependence on natural fodder resources. No significant extraction of plant, woody or mineral resources was observed on the plot. Regarding **regulating services**, the terrain plays a role in **natural drainage**, since it slopes towards the Naouel sebkha, which captures the flows. On the other hand, the vegetation present does not appear to contribute significantly to erosion control, microclimatic regulation or protection against pests. The existence of runoff directed towards the sebkha suggests a punctual participation in the hydrological dynamics of the wetland, but the effects of flood buffering cannot be confirmed at this stage. From the point of view of **support services**, the site allows the movement and installation of various animal species, including birds, reptiles, rodents and insects, including pollinators. This fauna confirms an ecological support role, especially since the site is located in the immediate vicinity of the sebkha, and approximately 18 km from the Jbel Bouhedma National Park, both of which constitute environments of high ecological interest. Potential ecological connectivity therefore exists, even if it remains to be better characterized. Finally, in terms of **cultural services**, the landscape offers an **unobstructed view**, particularly of the sebkha to the southeast, which gives it moderate aesthetic value. Although no scientific, educational or tourist activities have been identified there, the presence of the small local mammal "Desert Kangaroo", traditionally eaten during rainy years, testifies to diffuse cultural links between the local population and the natural resources of the area.

3.5.7 Protected areas

The project site is not located within an officially designated protected area, but it is located in an area

relatively close to two areas of ecological and biological interest recognized nationally and internationally:

1. **The Sebkha Noual** , which constitutes a salty wetland classified as a **Ramsar site** , sheltering biodiversity specific to these environments, in particular wintering and resident water birds, as well as heritage species. A consultation was carried out with the head of the CRDA Water District. He confirmed that the project site is not located in a water resources conservation zone and that no specific constraints linked to the sebkhas exist in the area concerned.
2. **Jebel Bouhedma National Park** , located approximately 18 km to the north, is a major protected area home to rare Saharan wildlife, including several emblematic species (dorcass gazelle, ostrich, etc.). It is confirmed that the revised route does not cross Bouhedma National Park but runs along its periphery, parallel to an existing old line. A consultation was conducted with the park authorities, including a visit to the facilities and the ecomuseum, as well as a presentation by the Director of Forest Conservation. The discussions focused on park management, forestry regulations and the review of the exact route of the new line. The main recommendations concerned the need to avoid agricultural and inhabited land by favoring the installation of pylons in the private domain of the State subject to the forestry regime

These two areas constitute important elements to consider in terms of ecological connectivity and avifaunal sensitivity, even if the project site is located outside their formal perimeters.

Table 24: Table of protected areas

Name of the protected area	Status	Kind	Distance to site	Ecological value
Sebkha Naouel	Ramsar site	Saline wetland	Immediately northeast of the project site, near the southern section of the HV transmission line.	Sebkhet Ennaoual (IBA, KBA, Ramsar) – Site meeting Ramsar criteria 2, 3, 4 and 6. High ornithological value: presence of species from the Sindo-Saharan biome (e.g., Desert Owl <i>Bubo ascalaphus</i> – breeding; Leaf-billed <i>Ammomanes cinctura</i> – breeding; as well as <i>Alaemon alaudipes</i> , <i>Turdoides fulvus</i> , <i>Scotocerca inquieta</i> , <i>Rhodopechys githaginea</i>). 11 species from the Mediterranean-North Africa biome are also reported (all LC globally except <i>Sylvia deserti</i> LC global / NT national). In wet years, wintering abundance can reach $\geq 1\%$ of the biogeographic population (e.g., Greater Flamingo <i>Phoenicopterus roseus</i> , Common Shelduck <i>Tadorna tadorna</i>).



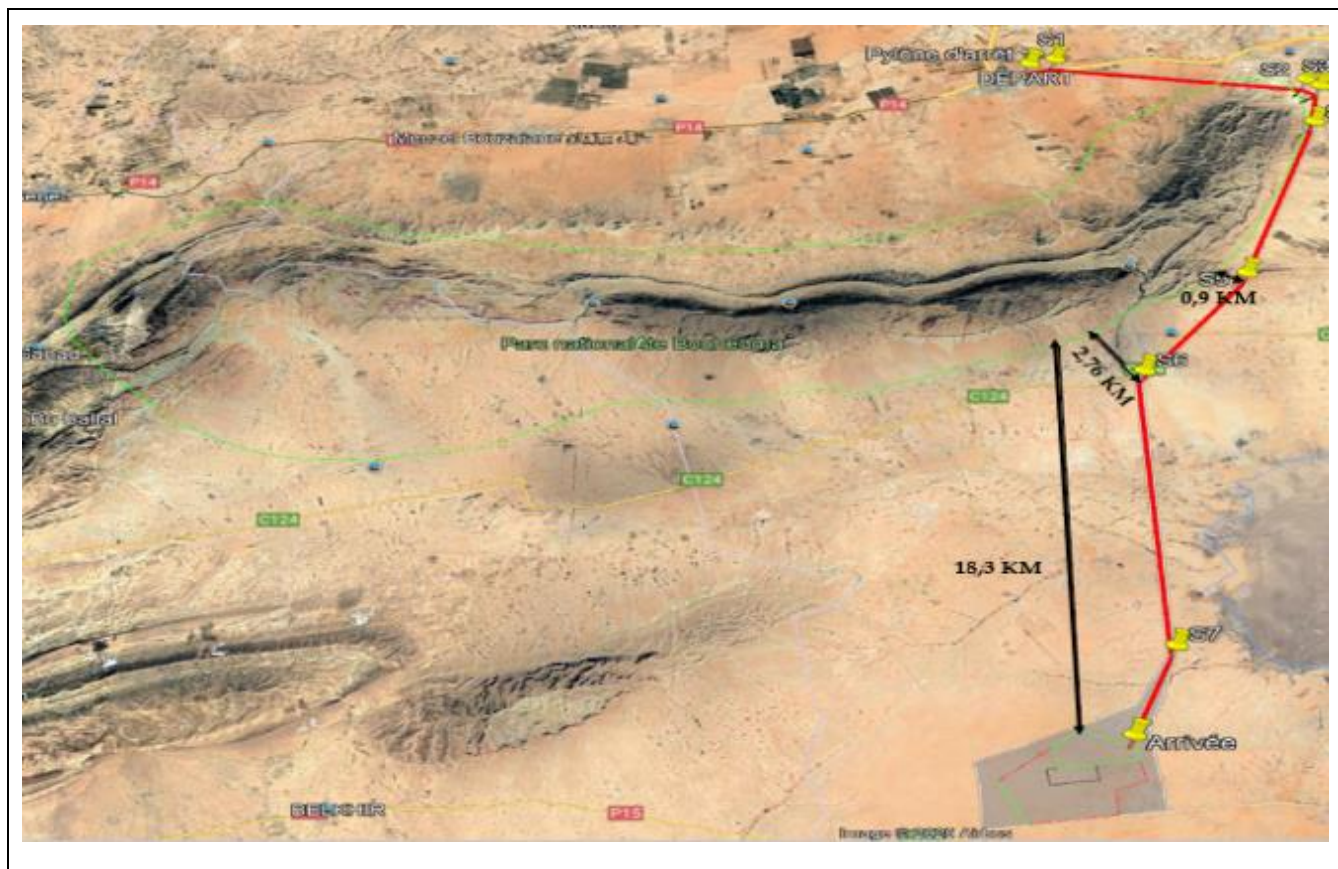
Jebel Bouhedma National Park

National Park (Tunisia)

Terrestrial protected area

~18 km north of the project site

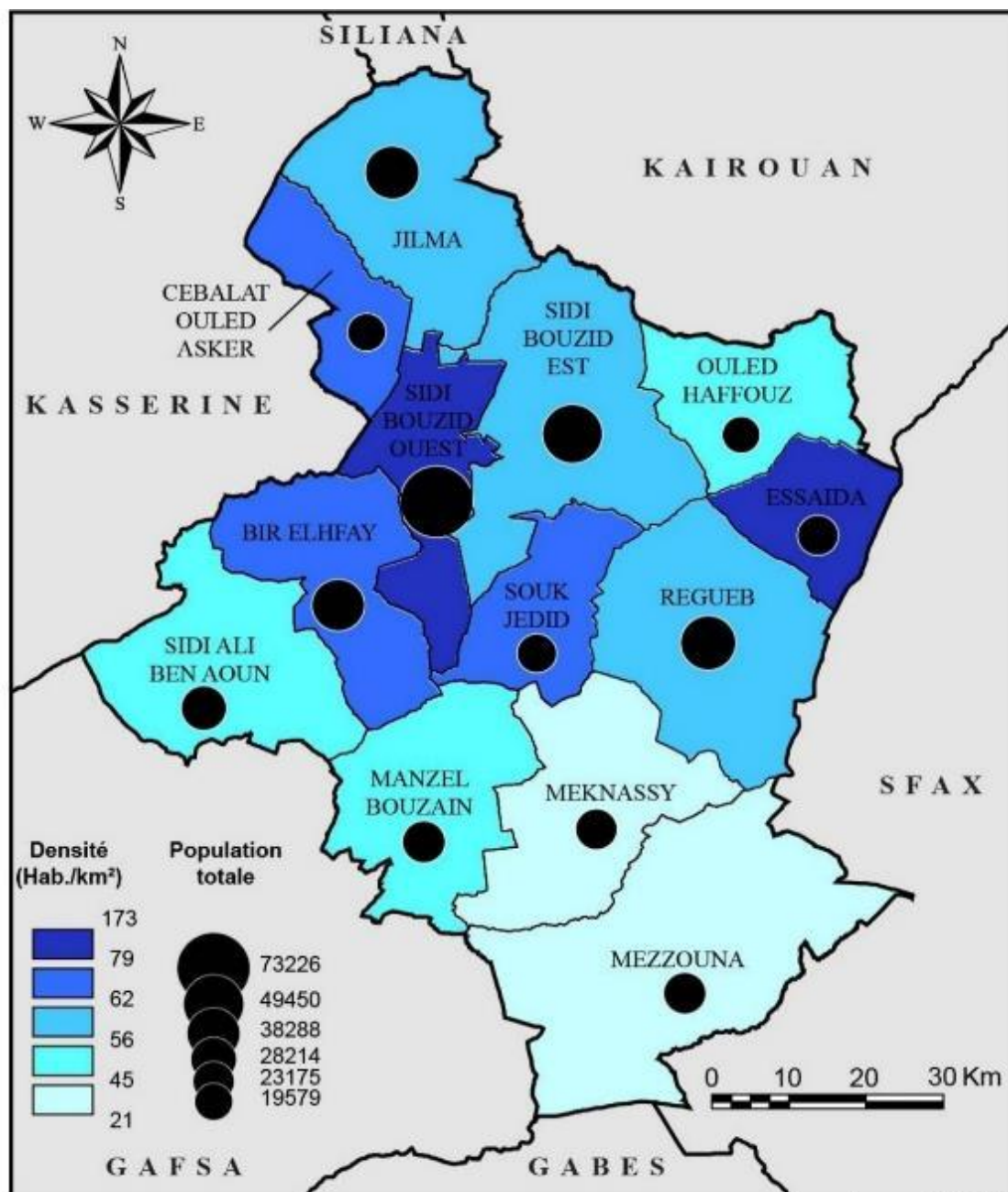
Bouhedma National Park (IBA/KBA, National Park) – 16,488 ha (8,804 ha in full protection; 2,400 ha in temporary occupation zone; remainder in buffer zone). More than 500 steppe plant species, with pseudo-savannah-type tree strata adapted to arid conditions, providing quality refuges for avifauna. Species reported (IUCN global 2025.1): Bonelli's Eagle *Aquila fasciata* LC, Desert Owl *Bubo ascalaphus* LC, Gambia Partridge *Alectoris barbara* LC, Black-bellied Sandgrouse *Pterocles orientalis* LC, Common Quail *Coturnix coturnix* LC, Skylark *Alauda arvensis* LC, North African Ostrich *Struthio camelus camelus* NE, Crested Lark *Galerida cristata* LC, etc.



3.6 Socio-economic environment

3.6.1 Sociological Framework

The governorate of Sidi Bouzid, located in the center-west of Tunisia, is surrounded by the governorates of Kairouan and Siliana to the north, Gafsa and Kasserine to the west, Sfax to the east, and Gabès to the south. Thanks to its specific natural and climatic conditions, this region is distinguished by its strong agricultural potential, occupying a prominent place in the local economy. Administratively, the governorate is subdivided into 12 delegations and covers a total area of 7,405 km², with an estimated population of approximately 430,000 inhabitants.



Source : INS, 2014

Figure 35: Demographic map of Sidi Bouzid

The regional economy is mainly based on agriculture (41.5% of the workforce), followed by services (15.1%) and manufacturing (10.5%), reflecting a socio-economic structure dominated by rural and semi-urban activities.

The project site is located in the delegation of Mezzouna, which covers 1,136 km² and had, according to the 2024 census, a population of 27,748 inhabitants. The density is relatively low (24.4 inhabitants/km²), reflecting a predominantly rural and sparsely urbanized territory. Located approximately 7 km north of the town of Menzel Habib and 8 km east of the village of Sidi Mansour, the site is far from urban centers and is bordered only by a few scattered, sometimes abandoned, dwellings. This spatial configuration reinforces the rural character of the study area, in which traditional activities such as extensive grazing remain present. In terms of

demographics, the delegation shows moderate growth (1.1% per year between 2014 and 2024) and a young population, more than a quarter of whom are under 15 years old.

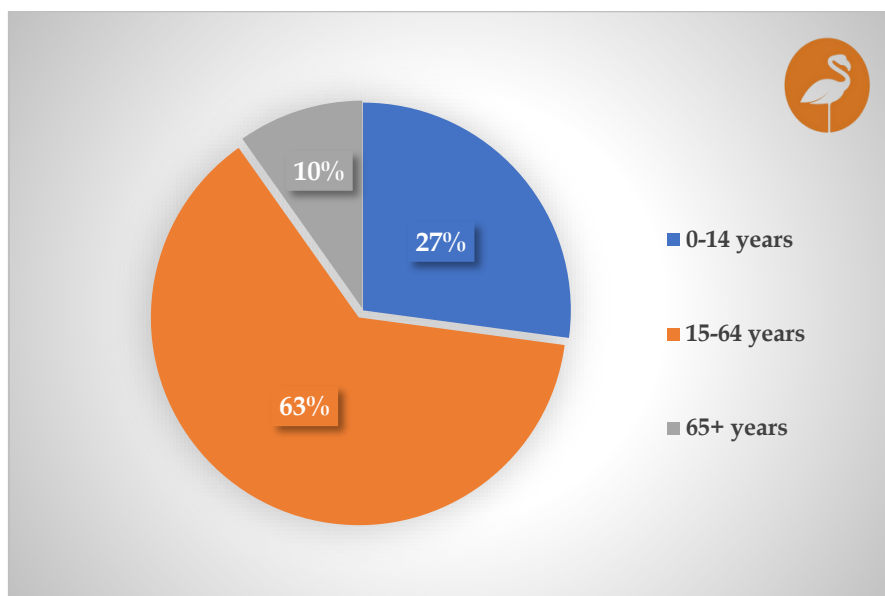


Figure 36: Percentages of age groups in the Mezzouna delegation

The main social data of Mezzouna are summarized as follows: (Source INS)

Table 25: Social characteristics of Sidi Bouzid

Indicators	Value (2024)
Total population	27,748 inhabitants
Area	1,136 km ²
Population density	24.4 inhabitants/km ²
Average annual growth	1.1%
Distribution of men and women	49.3% / 50.7%
Proportion of under 15s	27.1%
Proportion of the active population (15-64 years)	63.1%
Population aged 65 and over	9.8%

3.6.2 Economic framework

The economic fabric of the Sidi Bouzid governorate is based primarily on agriculture, although industry and commerce also play a significant role. The project site is located in the Mezzouna delegation, an agricultural area where industrial activity remains limited.

Agricultural sector: Agriculture is the mainstay of the Sidi Bouzid governorate's economy, employing more than 28% of the working population in 2016. This sector benefits from relatively favorable natural conditions, including the availability of fertile land and the exploitation of groundwater, which allow the development of market gardening and dry-farming, mainly olive, almond, and pistachio trees. Although the project site is not subject to intensive agriculture, it is regularly used by local herders as part of extensive grazing practices.

Industrial sector: The manufacturing industry remains underdeveloped in the governorate, with only 32 companies registered in 2016. These companies are mainly concentrated in the delegations of Sidi Bouzid East and Sidi Bouzid West. In contrast, the delegation of Mezzouna has no registered industrial companies. Furthermore, two industrial zones located in Sidi Bouzid East and West cover a total area of 40 hectares, with an overall operating rate of 54.5%.

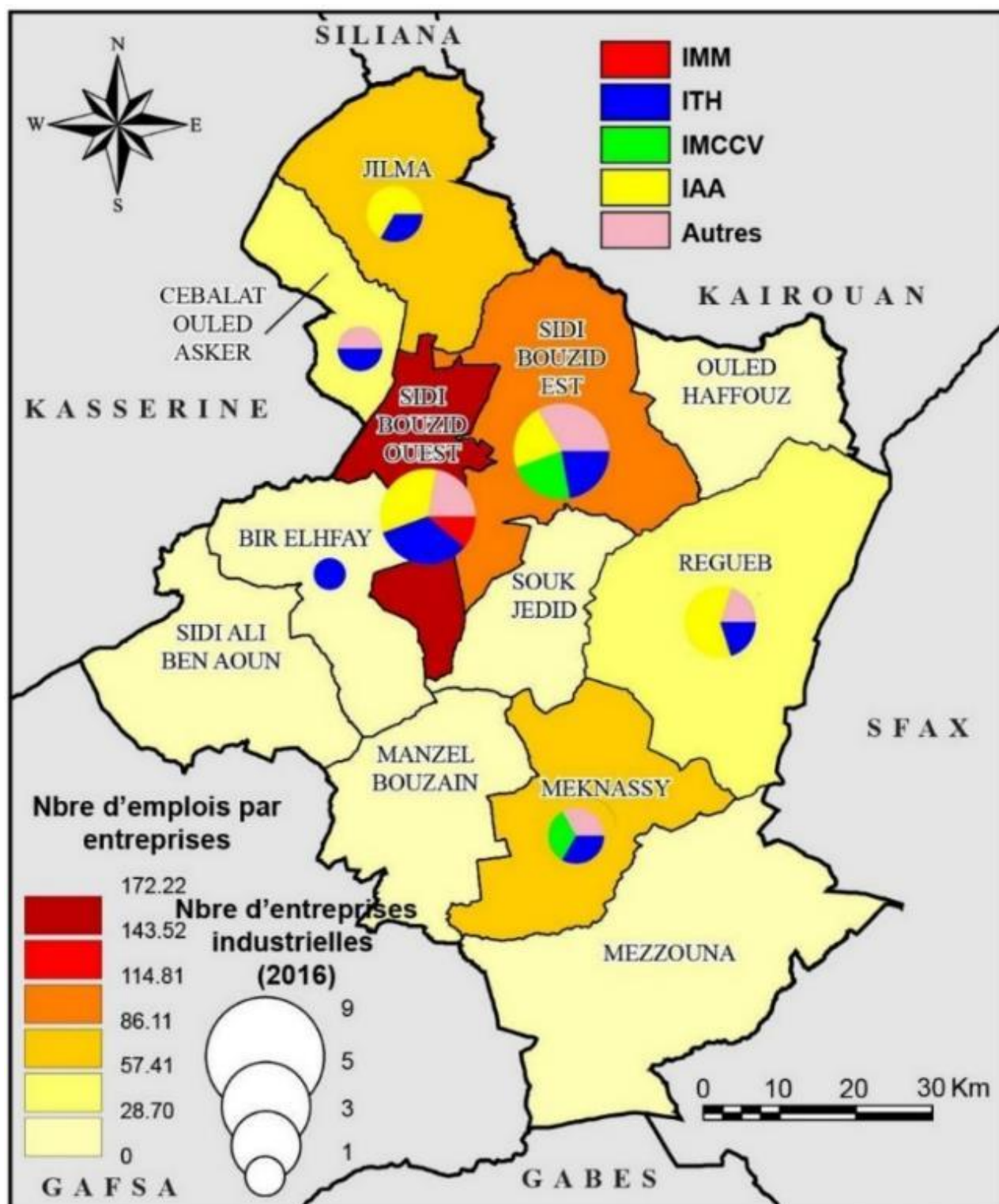
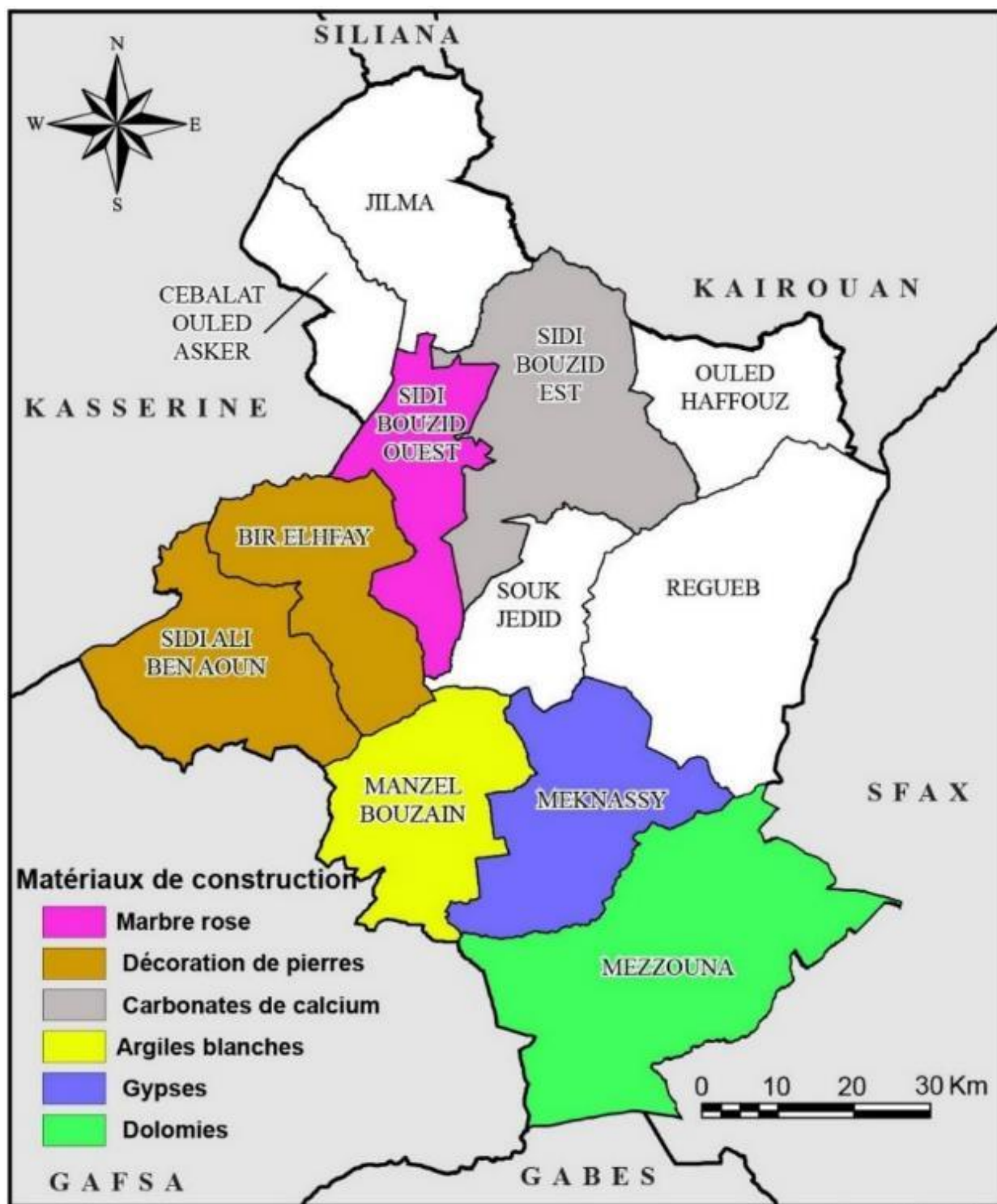


Figure 37: Number of jobs per company in Sidi Bouzid

- **Mining resources sector :** The Mezzouna delegation has potential in dolomite, exploited as construction materials.

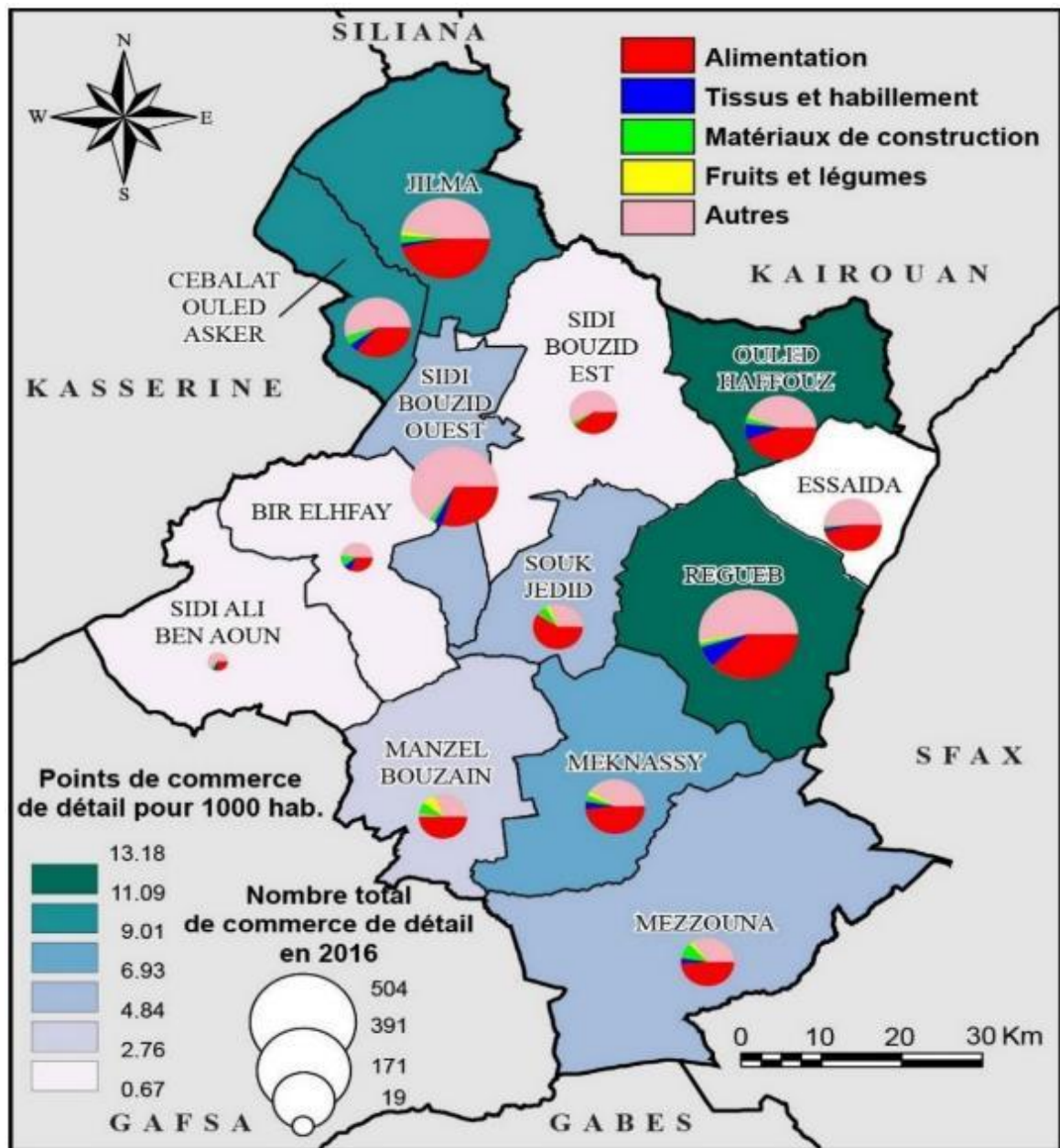


Source : ODCO, 2016

Figure 38: Map of Sidi Bouzid's mineral resources

- **Trade sector :** The trade sector in the governorate of Sidi Bouzid occupies a notable place in the local economy, representing approximately 11.25% of the active population in 2014. In 2016, there were 162 wholesale trade outlets and 2 697 retail outlets, distributed

relatively evenly across the delegations. However, the Mezzouna delegation, where the project is located, does not constitute a significant commercial hub. Conversely, the Rgueb and Jilma delegations concentrate a significant share of commercial activities, particularly in the food, building materials, and clothing sectors.



Source : Direction régionale du commerce, 2016

Figure 39: Industrial map of Sidi Bouzid

- **Public commercial infrastructure:** The Sidi Bouzid governorate has a structured distribution infrastructure for agricultural and food products. There are seven municipal slaughterhouses located between Sidi Bouzid, Jelma, Bir El Hfay, Sidi Ali Ben Aoun, Regueb, Meknassy, and Ouled Haffouz. Seventeen weekly markets are held by the delegations, each operating once a week, with the exception of Sidi Bouzid, which hosts two. Three wholesale markets are operational: the main one in Sidi Bouzid, and two secondary ones in Rgueb and Jelma. In addition, the governorate is home to the Grand Marché de Production du Centre, located in Oum Ladham (Sidi Bouzid West), covering 20 hectares and playing a key role in the promotion and distribution of agricultural

- products on a regional scale.
- The Mezzouna delegation has 27,748 inhabitants (RGPH 2024), including 17,502 of working age (15–64 years), indicating a pool of available labour for unskilled to semi-skilled positions in the construction phase (earthworks, assembly, logistics, security, catering) and for targeted skilled positions in the operational phase (electrical engineering, HSE, maintenance). The regional skills supply is supported by the governorate's public vocational training centers, notably Sidi Bouzid (capacity ~940, 15 specialties) and Meknassy (capacity ~476, 12 specialties), in addition to the rural girls' training center in Meknassy, making it possible to source local technical profiles. The context remains predominantly rural and agricultural (irrigated arboriculture, livestock), which favors the availability of a seasonal and versatile workforce for construction sites. As a result, the project has the potential to create significant local temporary jobs in construction and a small core of permanent jobs in operation, with indirect effects on local VSEs (transport, hardware, catering).
- The immediate area of concern is El Khobna, where the site is located, as well as the surrounding hamlets. These nearby localities will be able to provide labour and some basic services, but the provision of accommodation, catering, and leisure activities is very limited. To meet these needs, more distant urban centers, such as Mezzouna-centre and Meknassy, will serve as complementary hubs for access to more developed services (rental accommodation, specialized supplies, certain technical profiles).

3.6.2.1 *Project Affected Persons (PAPs) and Affected Assets*

The El Khobna photovoltaic power plant project and its 225 kV evacuation line affect several categories of Project Affected Persons (PAPs). The identification of PAPs is based on field missions, land surveys, and socio-economic studies and community consultations carried out by ASF Consulting and EAM.

Number and location of PAPs :

PV plant site (267.7 ha – private state property) : no permanent housing. The site includes five mobile huts used by seasonal livestock farmers. During the latest consultations, the livestock farmers confirmed that they can move or remove these huts and clear the area to allow for the plant, as it is a dry area not used for grazing during the project.

Route of the power line (45.5 km) : crossing 132 identified plots (79 private titled, 19 requisitioned, 32 state-owned). Some are cultivated (olive groves, citrus fruits) or occupied by families, including a large tribal family living near the route which was consulted.

Access track (1 km) : right of way on a 0.6 ha state-owned plot.

Vulnerability profiles:

Community consultations and socio-economic analysis have identified several vulnerability profiles requiring particular attention in the future Resettlement Action Plan (RAP):

Women heads of households alone,
Elderly people living alone,
People with disabilities,

Families living below the poverty line or dependent on seasonal income (olive picking, livestock farming),
 Agricultural or pastoral day laborers,
 Families affected by the lack of basic infrastructure (limited access to drinking water, unstable electricity network).
 Specific support measures are planned, including financial support, priority access to training programs, support for mobility, and access to microcredit.

Summary list of affected assets (LARF):

The preliminary inventory of assets likely to be affected includes:

Land : 267.7 ha for the power station; 0.7 ha for the installation of pylons (109 pylons); 0.6 ha for the access track; partially affected private cultivated plots.

Structures : 4 mobile livestock huts, livestock enclosures, and light dwellings related to pastoral activities. The livestock farmers have confirmed their availability to move or remove these huts.

Crops and trees : olive and citrus trees along the route; losses estimated at around 6 fruit trees per pylon.

Economic activities : seasonal livestock farming, agricultural exploitation (olive trees and annual crops) along the route.

Socio-economic context and other social issues

Khobna area has a relatively small population but faces several social problems:

Economic vulnerability : Many families depend on seasonal agricultural income and have social support needs.

Limited infrastructure : limited access to drinking water, unstable electricity, low tourist and industrial development.

State of the labor market : high unemployment rate (18.62% in 2014, with 39.17% among young female graduates); predominance of agriculture, construction, and public services.

Agricultural resources : mainly sheep farming (~30,000 animals) and limited olive oil production; lack of irrigation infrastructure and insufficient water management.

This information will help guide the PAR and compensation measures in a targeted manner adapted to the real needs of the PAPs .

Summary of assets affected by the project

Location	Asset Type	Description / Observations	Status / Remarks
PV power plant site (267.7 ha)	Structures	4 mobile breeders' huts, cattle pens	Breeders willing to move or remove cabins for the project
	Lands	State domain, 267.7 ha	Dry area, not used for

Route of the power line (45.5 km)			grazing
	Lands	132 plots (79 private titled, 19 requisitioned, 32 state-owned)	Some cultivated (olive trees, citrus fruits)
	Crops / trees	Olive and citrus trees	Estimated loss: ~6 fruit trees per pylon
	Economic structures / activities	Light dwellings, seasonal pastoralism, seasonal farming	Families and breeders affected along the route
Access track (1 km)	Lands	0.6 ha of state-owned land	Required space for site access

4 Analysis of alternatives

4.1 “No Project” Variant

The "no project" option is an essential reference alternative in any environmental and social impact assessment. It corresponds to a scenario in which the 237 MW solar photovoltaic power plant project, currently being carried out by the Qair company with the support of donors such as the EBRD, the IFC, and the EIB, would not be implemented. In this scenario, the site chosen in the locality of El Khobna would retain its current state: an undeveloped area, characterized by bare soil, sparse vegetation cover, and extensive seasonal agro-pastoral use. The territory would thus remain unchanged in physical, ecological, and landscape terms, and potential disruptions related to construction and operating activities would be de facto avoided. Similarly, the planned transmission line—which currently bypasses the Bouhedma National Park and borders the RAMSAR-listed Sebkhet Noual a few kilometers away—would not be implemented, thus eliminating any potential interaction with the nearby sensitive ecosystems. However, failure to develop the project would also result in the failure to achieve the expected socio-economic and energy benefits. At the national level, this would represent a missed opportunity to diversify the energy mix, in a context where Tunisia still relies primarily on fossil fuels (94.7% of installed capacity is thermal). Furthermore, it would not address the challenges of the energy deficit or contribute to the national low-carbon transition strategy aimed at reducing GHG emissions. The no-project scenario would also prevent the creation of local opportunities in terms of employment, economic development, and subcontracting during the construction and operational phases. Finally, it would limit the dynamics of private investment in the renewable energy sector, which is still largely dominated by the public operator. In summary, the "no-project" alternative would avoid certain one-off pressures on the local environment, but at the cost of foregoing potential benefits in terms of sustainable development, energy independence, and territorial economic spinoffs. This scenario is therefore analyzed as a useful point of comparison, but does not constitute a preferred option at this stage.

4.2 Alternative solar energy production technologies

The chosen technology is based on bifacial photovoltaic panels mounted on single-axis horizontal trackers. This choice was motivated by the specific characteristics of the site, notably the strong solar irradiation and the high albedo of the desert soil, which favors the reflection of radiation on the back of the panels. This solution optimizes energy production throughout the day by tracking the sun's trajectory. Trackers significantly improve yields compared to fixed systems, although their investment cost is slightly higher. The tables below present a three-level comparative analysis including solar energy compared to other renewable energies for the El Khobna area, located in the delegation of Mezzouna, solar photovoltaic compared to other technologies allowing the exploitation of solar energy and finally the panel technology used, in our case PERC bifacial solar panels compared to other panel alternatives.

Table 26: Level 1 - Type of renewable energy suitable for Mezzouna

Energy type	Benefits specific to Mezzouna	Disadvantages in the local context
Photovoltaic solar	High sunshine, flat terrain, low water footprint	Production variability (day/night)

Wind power	Can work at night	Uncertain local wind resources
Biomass	Recovery of agricultural waste	Limited resources, expensive logistics
Geothermal energy	Continuous energy	No potential identified in the area
Hydroelectricity	Stable, controllable source	Non-existent in the region, arid climate

Table 27: Level 2 - Type of solar technology

Solar technology	Benefits	Disadvantages
Fixed ground PV	Low cost, easy installation	Average yield, no solar tracking
PV on tracker	Optimized performance, better daily production	More expensive, engine maintenance
PV on the roof	No additional land use	Limited surface area, depends on existing roofs
Floating PV	Reduced evaporation, increased productivity	Unsuitable for arid region, high costs
CSP (solar thermal)	Controllable electricity with thermal storage	Very high water consumption, unsuitable for the local climate

Table 28: Level 3 - Type of photovoltaic panels

Panel technology	Specific advantages of El Khobna	Relative disadvantages
Bifacial panels	Enhances the high albedo of the desert soil, increased production	Requires clear and clean surface
Mono-facials	Cheaper	Lower performance, especially in reflective environments
Cadmium telluride (CdTe)	Good heat efficiency	Rarer, complex recycling
Amorphous panels	Less affected by shading	Lower overall yield

In the specific context of Mezzouna, characterized by strong solar irradiation, favorable albedo, open terrain and low water availability, the choice of bifacial panels on single-axis trackers constitutes an interesting technical option.

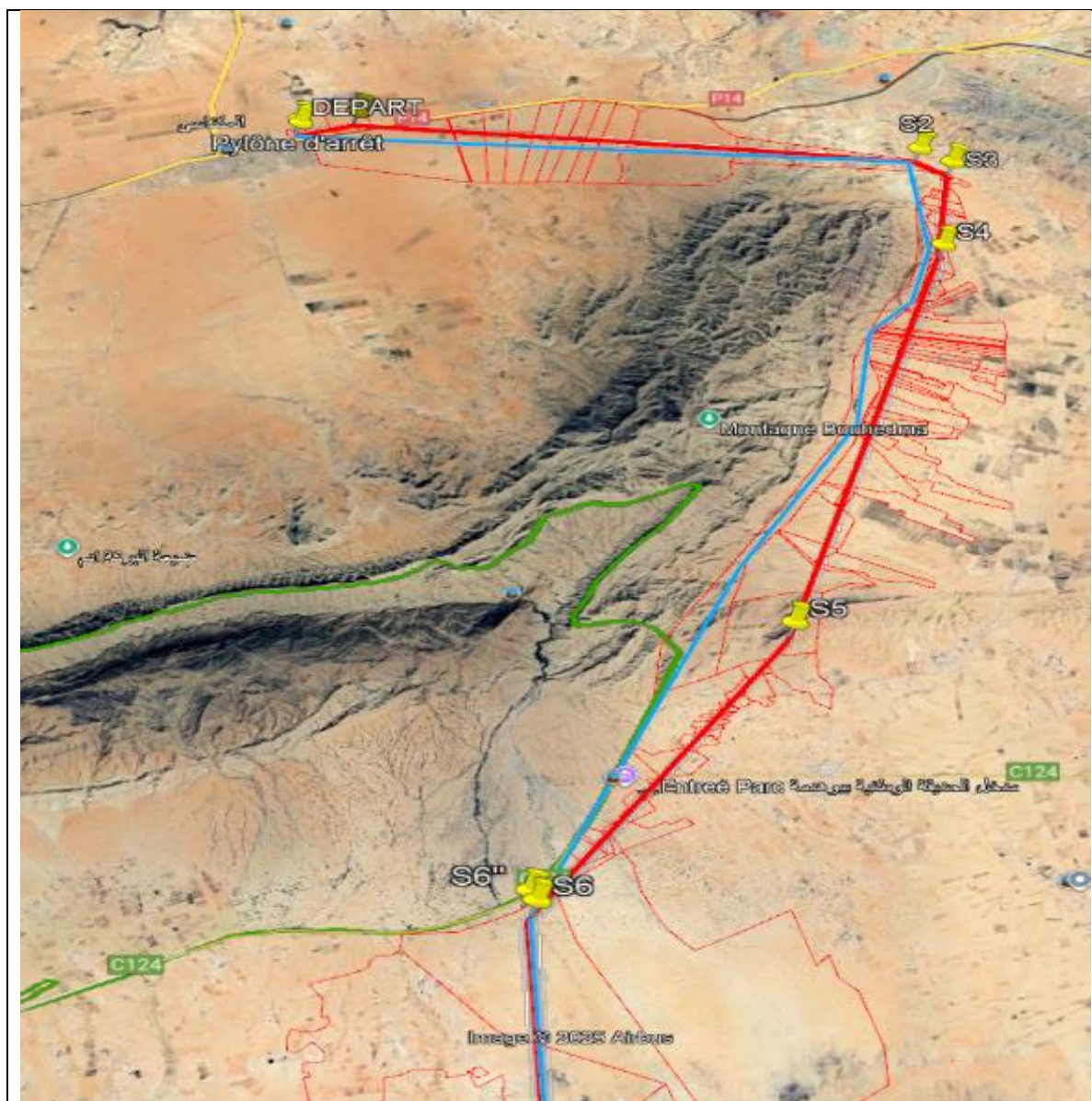
It optimizes energy production while remaining compatible with the site's constraints. Other options, while attractive in other contexts, have limitations in this area. This technological choice is therefore aligned with the performance, sustainability, and environmental compatibility objectives expected by the project owner.

4.3 Alternative project location and configuration

The project design incorporates a spatial and functional optimization approach based on the recommendations of the 2023 ESIA. The modular block layout facilitates facility management and allows for easier maintenance. Each block is composed of PV panels aligned on adjustable structures, and the distances between rows ensure the absence of shading. The infrastructure includes a control building, operations offices, an equipment warehouse, and an internal road network for access to the PV blocks. A surveillance and security system is planned, including a

perimeter fence, cameras, and motion-detecting lighting. The modules will be cleaned dry, reducing water consumption. Finally, a dismantling plan is envisaged, including land reclamation. No location or implementation site for the power plant or the access road has been proposed based on the information available, the term of reference refers to a route that would bypass the national park on its right, thus avoiding any intersection with the Bouhedma National Park and its mountain, an element of ecological interest. Recent discussions with Qair based on the land aspects of the project have given rise to a second route alternative suggesting shifting the upper sections of the line along the Bouhedma park further towards the latter in order to minimize the crossing of private land and favoring passages through state-owned land. The table below presents the two alternatives for the HV transmission line.





Note: In blue the proposed alternative which minimizes or avoids crossing private land at the level of the upper section of the transmission line. In red the initial route represented here by its upper section (S6 up to the station)

4.4 Justification of the chosen variant

4.4.1 Solar power plant site

The choice of the site was motivated by several technical, environmental, economic, and social criteria, as presented in the 2023 ESIA. The selected terrain is flat, regular, and composed of desert soils poor in organic matter, which limits the impacts of earthworks and guarantees good structural stability. Its location near the MC205 road facilitates logistical access and reduces infrastructure costs. In addition, the presence of strong sunshine (between 5 and 6 kWh/m²/day) in this arid area ensures optimal efficiency for solar energy production. The site is largely made up of state-owned land, which limits land conflicts and simplifies administrative procedures. It

is far from inhabited areas and does not have dense vegetation, trees, or buildings to be demolished. Finally, its proximity to the national electricity grid, particularly the Maknassy substation, allows for direct connection with minimal additional investment.

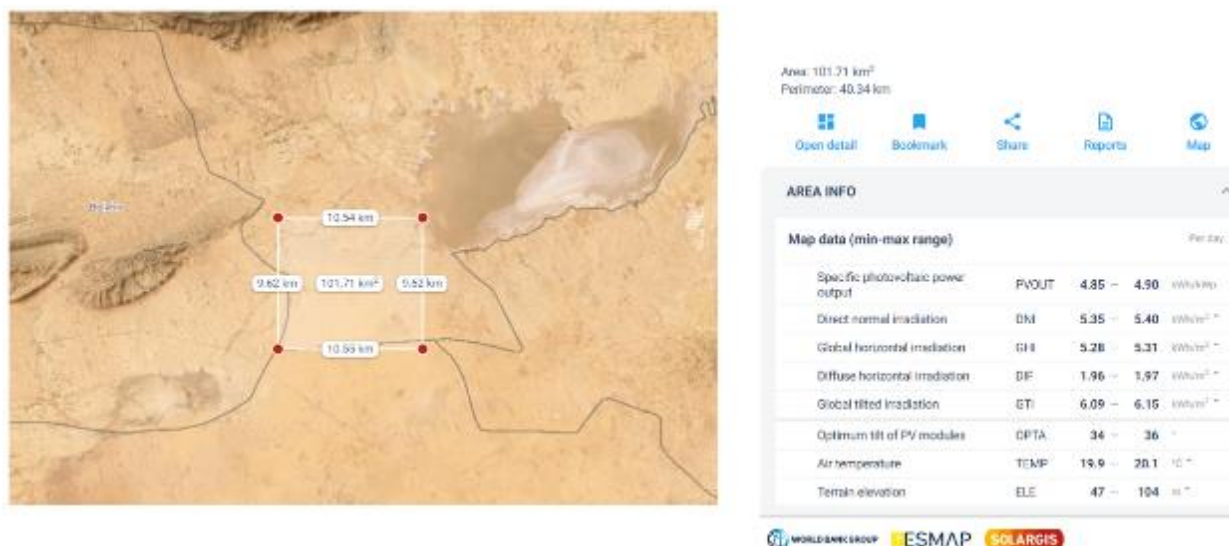


Figure 40: Technical characteristics of the project site

4.4.2 Transmission line route

The 225 kV overhead transmission line connecting the power plant to the Meknassy substation was initially defined on the basis of a comparative study presented in the preliminary ESIA of 2023. However, following further discussions and consultations with the various stakeholders, the route was revised. The new route was chosen to minimize crossings of private properties, while respecting the boundaries of the Bouhedma National Park buffer zone.

Furthermore, the route optimization also took into account biodiversity issues, in particular the avifauna identified in the area through the biodiversity study. Thus, the route was adapted to avoid the main travel corridors and sensitive habitats, and the southern section was moved further away from the sebkha in order to respect the distance from the discovered cultural remains as well as to limit the risks of interactions with birds. This approach not only reduces the potential impact on biodiversity, but also strengthens the compatibility of the project with conservation objectives.

It has been confirmed that the revised route does not cross Bouhedma National Park but runs along its periphery, parallel to an existing line. A consultation was held with the park authorities, including a tour of the facilities and the ecomuseum, as well as a presentation by the Director of Forest Conservation. The discussions focused on park management, forestry regulations, and a review of the exact route of the new line. The main recommendations concerned the need to avoid agricultural and inhabited land by favoring the installation of pylons in the private domain of the State subject to the forestry regime, which requires ministerial authorization in accordance with Article 222 of the Forestry Code. STEG also specified that the land would not be acquired but that compensation would be provided for temporary occupation or work carried out.

This route is currently the best option available, as it minimizes the number of private lands affected, preserves local biodiversity and ensures better consideration of the archaeological heritage and the requirements of the park management authorities.

4.4.3 Connection station

Regarding the connection to the national electricity grid, the Meknassy source station was chosen as the connection point for the project. This choice is mainly due to its geographical proximity to the implementation site, thus reducing the length of the high-voltage line required for the connection (approximately 46 km). This configuration limits land use, infrastructure costs, as well as the environmental and social impacts associated with crossing sensitive or inhabited areas. The Meknassy station thus represents the most optimal option from a technical, economic and environmental point of view.

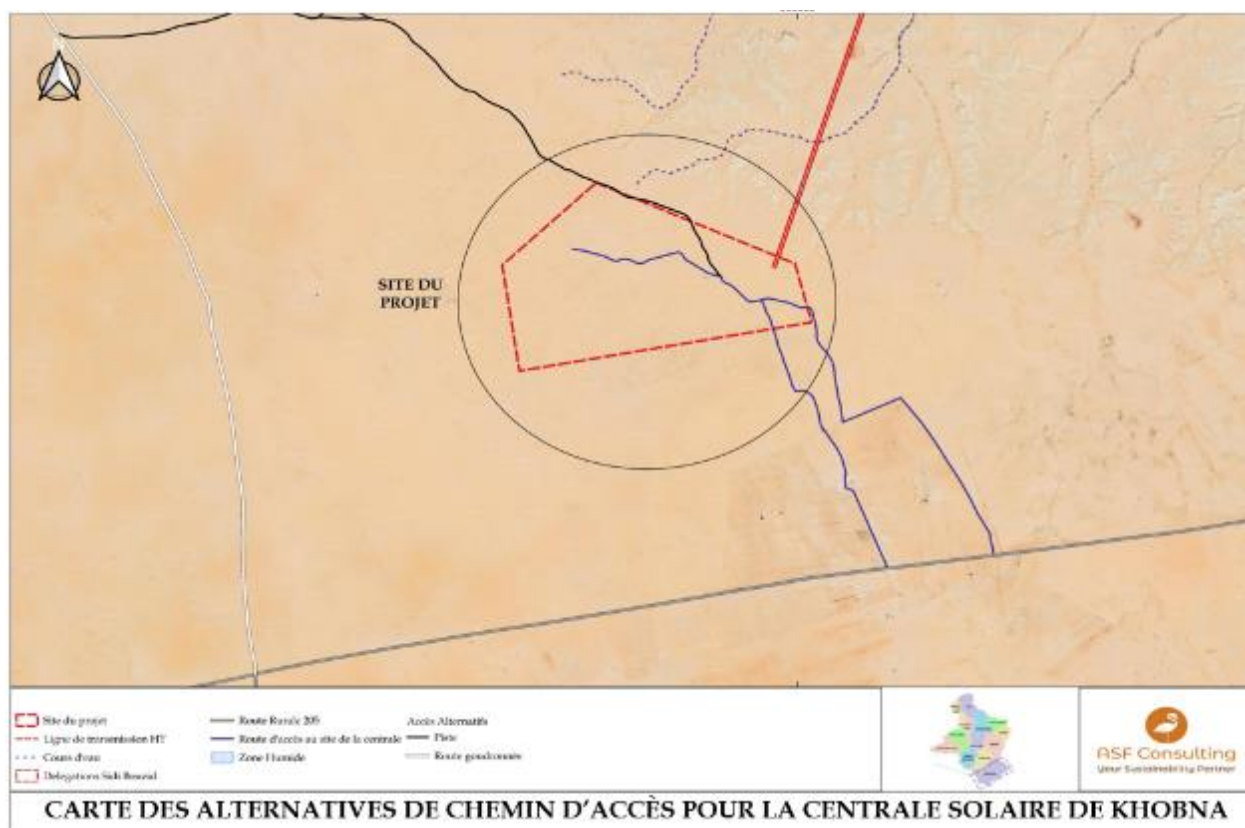


Figure 41: Path alternatives

4.4.4 Water resource management

In arid areas such as El Khobna, rational water resource management is a key criterion in the design of a sustainable photovoltaic project. Three main alternatives can be considered: (i) the use of a wet panel cleaning system, (ii) the installation of a dedicated borehole, or (iii) the use of a public supply combined with a dry cleaning method.

Regular wet cleaning is often used in dusty environments to ensure optimal panel performance. However, this solution involves significant water consumption, which is difficult to reconcile with local water conditions and the principles of sobriety. In addition, the regular use of large volumes of water increases operational costs. The private drilling alternative could have guaranteed self-sufficiency in supply, but it has several major drawbacks: (i) risk of overexploitation of the water table, (ii) need for lengthy administrative procedures, and (iii) uncertainties regarding the quality and quantity of available water.

During the preparation of the 2023 ESIA, a dry cleaning solution was considered to limit water consumption and address the water constraints of the Sidi Bouzid governorate. This choice was

part of a logic of sobriety in natural resources. However, within the framework of the current project planning, the solution chosen is based on regular wet cleaning of the panels, relying on a water supply provided by SONEDE. This decision is based on the fact that the Mezzouna site is exposed to a high accumulation of dust and sand, making dry cleaning insufficient to guarantee optimal long-term performance.

The water supplied by SONEDE will also be used for the sanitary needs of on-site personnel as well as for the fire safety system. In order to limit the project's water footprint, measures will be put in place to optimize the volumes of water consumed during operation (targeted cleaning, adapted frequency, low-consumption equipment). Thus, although the chosen solution relies on regular water use, it is considered technically justified and compatible with available public supply capacities, while remaining compliant with the standards of international donors.

5 Environmental and Social Impacts

5.1 Methodology adopted

This section brings together all the environmental and social impacts identified for the project (positive, negative, cumulative, and residual impacts), as well as their corresponding mitigation measures. To ensure clarity and traceability between each impact and its response, some measures may appear multiple times in the different sections. This redundancy is intentional: it allows for explicit demonstration, for each impact category, of the corrective or preventive actions associated with it. Thus, the same measure (for example, regular maintenance of machinery or waste management) may contribute to limiting several distinct impacts, but it is repeated each time to emphasize its importance.

However, in the Environmental and Social Management Plan (ESMP), these measures will be consolidated and presented only once, in a streamlined and thematically structured form. The ESMP therefore constitutes the single, operational reference tool for implementation, avoiding duplication while ensuring comprehensive coverage of all identified risks and issues.

The environmental and social impact assessment is based on methodologies recommended by major international donors. It distinguishes between the effects related to the preparation phase, those generated by construction work, and those associated with the operation of the photovoltaic plant, its access roads, and the connection line.

For impacts related to project implementation, the analysis relates the components of the receiving environment to the technical and spatial characteristics of the project. This approach makes it possible to identify the main changes in land use, interactions with ecosystems (fauna, flora, wadis), as well as potential modifications to the landscape.

The assessment takes into account the technical specificities of the project, the local context, experience gained in similar projects and data from specialist literature. It also relies on international reference standards and guidelines to ensure a rigorous analysis that complies with current standards.

The impact assessment criteria take into account several essential parameters:

<i>Impact intensity</i>	<p>Intensity reflects the extent of disturbances caused to a component, integrating its vulnerability and adaptive capacity. It is divided into three levels:</p> <ul style="list-style-type: none"> • Low : slight effects, with no noticeable impact on the quality or integrity of the component. • Medium : Measured alterations, with a partial reduction in the quality or use of the component. • Severe : significant disruptions leading to major changes or even loss of integrity of the component concerned.
<i>Extent of impact</i>	<p>The extent refers to the geographical space affected by the effects of an activity. It can be:</p> <ul style="list-style-type: none"> • One-off : limited to the direct scope of the activity. • Local : extending to the entire study area.

	<ul style="list-style-type: none"> • Regional : going beyond the boundaries of the study area and impacting a larger region or territory.
<i>Duration of impact</i>	<p>Duration represents the period during which the effects are manifested, including the time required for recovery or adaptation of the affected components. The duration categories are:</p> <ul style="list-style-type: none"> • Short-term : Temporary effects limited to a few weeks or months. • Medium duration : impacts noticeable over an intermediate period requiring moderate recovery. • Long-term : persistent consequences that can last for several years and lead to lasting transformations.

5.2 Impact assessment grid

The different elements cited above are combined according to the grid presented in the table below in order to determine the importance of the impact.

Table 1: Impact assessment grid

Intensity	Extent	Duration	Absolute importance of impact
Forte	Regional	Long	Major
		Average	Major
		Short	Major
	Local	Long	Major
		Average	Average
		Short	Average
	Punctual	Long	Average
		Average	Average
		Short	Minor
Average	Regional	Long	Major

		Average	Average
		Short	Minor
	Local	Long	Major
		Average	Average
		Short	Minor
	Punctual	Long	Average
		Average	Minor
		Short	Minor
Weak	Regional	Long	Average
		Average	Minor
		Short	Minor
	Local	Long	Average
		Average	Minor
		Short	Minor
	Punctual	Long	Average
		Average	Minor
		Short	Minor

5.3 Identification of negative environmental and social impacts

5.3.1 Design phase

5.3.1.1 *Social framework*

The announcement of the project may cause concern or misunderstanding among residents of Khobna and surrounding areas, especially if consultation mechanisms are insufficient. Clear, transparent, and regular communication from the outset is essential to avoid the rise of social tensions or unfounded rumors, and to establish a climate of trust.

5.3.1.2 *Economic framework:*

The project is seen as an opportunity for local socioeconomic development and job creation, both directly and indirectly. However, excessive expectations could arise within communities if they are not managed. Implementing a workforce recruitment and management strategy is important.

5.3.1.3 *Transport and logistics:*

Access to the site is provided by the MC205 regional road which connects the coastal town of Skhira (Governorate of Sfax) to the town of Guetar (Governorate of Gafsa) and forms the boundary between the two delegations of Mezouna (Governorate of Sidi Bouzid) and Menzel Habib (Governorate of Gabes). From the planning stage, it is necessary to anticipate the future impacts linked to the transport of heavy equipment (increased traffic, risk of accidents, degradation of the tracks), in coordination with the local authorities, in order to identify the needs for development or signage.

5.3.1.4 *Protected areas and areas of biological interest:*

The project site is located in a context marked by the presence of sensitive areas. Approximately 5.5 km away is the Sebkhath Noual, a RAMSAR-listed wetland of ecological importance, which is also 800 m from the lower section of the transmission line. In addition, the northern section of the transmission line runs along the buffer zone of the Bouhedma National Park, a designated ZICO and recognized for its steppe biodiversity and protected species. These sensitivities must be considered at this stage in order to integrate precautionary measures into the design of the route and future construction activities.

5.3.1.5 *Archaeological heritage*

During the site visit, an archaeological remains were identified in the potential installation area of the line. In order to protect this cultural heritage, the route of the transmission line was modified and shifted to the left, thus avoiding any damage to this sensitive site and complying with the requirements of the National Heritage Institute (INP).

5.3.2 Pre-construction phase

During this phase, the main work involves the installation of the base camp, the development of the access track, clearing of brush and initial earthworks. These activities, although upstream of the main construction site, can potentially have an impact on the physical, biological and socio-economic environment.

5.3.2.1 *Impact of the Soil*

Earthworks and heavy machinery traffic, combined with the installation of the base camp, expose the soil to risks of pollution from hydrocarbons, oils, and cleaning products. In the absence of retention basins, these pollutants can seep into the permeable soils and, eventually, reach the local water table.

5.3.2.2 *Air quality*

The transportation of materials, the leveling of runways, and the use of motorized equipment generate dust and exhaust fumes. These emissions particularly affect residents near the access runway.

5.3.2.3 Noise and Vibrations

Machinery (trucks, bulldozers, generators) produces continuous noise and vibrations that are locally perceptible. Although no immediate sensitive infrastructure is located on the site, residential areas near the access track are directly affected.

5.3.2.4 Water and wastewater management

The base camp produces domestic wastewater, which can seep into the environment if it is not treated in watertight pits. The risk of sediment or hydrocarbon runoff into natural drainage is increased. The proximity of Sebkhath Noual (5.5 km from the site and 800 m from the line) increases the sensitivity of this impact, particularly during rainy periods.

5.3.2.5 Fauna and flora

Noise, human presence and machinery traffic disturb local terrestrial fauna (small mammals, reptiles, nesting birds). The **Bouhedma area**, along the northern section of the transmission line, is home to sensitive steppe biodiversity (gazelles, birds of prey). These habitats, although partially remote from the site, can be affected by fragmentation and disturbance; clearing and leveling destroy steppe vegetation, reducing soil stability and the habitat of many species. Natural regeneration is slow in this arid environment.

5.3.2.6 Protected areas

The proximity of Sebkhath Noual and Bouhedma National Park requires special vigilance. Even if the site does not directly encroach on these protected areas, indirect impacts (dust, runoff, wildlife disturbance) are possible.

5.3.3 Construction Phase

5.3.3.1 Soil contamination

Earthworks for internal roads, anchoring of panels, installation of technical buildings and trenches for underground cables will result in localized settlement and waterproofing of the soil. The movement of construction machinery increases the risk of compaction, while accidental pollution (oils, fuels, solvents) can contaminate the soil. The installation of the LEHT pylons also carries a risk of occasional alteration of the soil and earth displacement, especially since the central section crosses agricultural land and the upper section runs along the buffer zone of the Bouhedma National Park, home to various species that could potentially interact with this surface.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Forte	Local	Average	Average	Minor

Mitigation measures:

Proposed measures
Limit traffic to essential needs, favor stabilized routes, water the track regularly
Equip equipment with leak-proof kits and carry out regular inspections.
Quickly rehabilitate ruts by filling
Store and handle polluting substances on sealed surfaces with retention tanks.
Carry out emergency maintenance on equipment in impermeable areas.
Optimize the controlled leveling operation to minimize earth movements and keep the soil in place.

Store and preserve topsoil for reuse at the end of the work
Restore, as far as possible, surfaces disturbed by construction work to their original condition or even to an improved condition.
Avoid carrying out excavation work in adverse weather conditions (heavy rain, strong winds, floods, etc.).
Avoid any release of concrete onto the ground through strict procedures
Ensure regular monitoring of sensitive areas to correct any deterioration.

5.3.3.2 Air quality

The construction phase of the power plant and the transmission line will generate dust emissions (grading work, excavation, traffic on unpaved runways) and exhaust gases (SO₂, NO_x, CO₂) linked to transport, machinery and generators. These emissions, although temporary and localized, may affect different receptors. Construction site workers are the most exposed due to their direct proximity to emission sources, which justifies the implementation of preventive measures (PPE, watering of runways, maintenance of machinery). Local communities could be slightly affected by dust and atmospheric pollution during phases of intensive traffic, but the impact remains limited due to the distance from inhabited areas. Local wildlife may be disturbed occasionally by the presence of dust and emissions, particularly in areas close to the sebkha or the park's buffer zone, but the expected effect is low given the temporary nature of the work. Finally, the surrounding flora may suffer from dust deposits on the leaves, which may slightly alter photosynthesis, but without any lasting effect.

Impact assessment:

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Workers	Average	Local	Average	Average	Minor
Residents	Weak	Local	Average	Minor	Minor
Wildlife	Weak	Local	Average	Minor	Minor
Flora	Weak	Local	Average	Minor	Minor

Mitigation measures:

Proposed measures
Ban prolonged idling of vehicles to limit fuel consumption and atmospheric emissions.
Raising awareness among drivers about good driving practices
Water work areas, avoid unnecessary travel and engine idling.
Limit engine idle times and systematically turn them off when stopped
Prohibit the burning of solid waste on site.
Implement a regular maintenance program for vehicles and equipment to prevent breakdowns and limit polluting emissions.
Also ensure regular cleaning of the wheels of machinery leaving agricultural areas

5.3.3.3 Noise and vibrations

The frequent passage of trucks on the access road generates noise pollution (engines, braking, horns). At the site, construction work produces constant noise from heavy machinery (bulldozers,

compactors, diesel trucks), pile driving, as well as the use of cranes and mechanical tools. The generators powering the base camp add background noise, which is especially noticeable near the rest areas. On the transmission line, the work of erecting the pylons (crane trucks, lifting) and the unrolling of cables also cause occasional noise pollution in the rural areas crossed and nearby protected areas. These disturbances, although limited in time, constitute a nuisance factor requiring rigorous management.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Short	Minor	Weak

Mitigation measures:

Proposed measures
Ban prolonged idling of vehicles to limit fuel consumption and atmospheric emissions.
Raising awareness among drivers about good driving practices
Water work areas, avoid unnecessary travel and engine idling.
Limit engine idle times
Prohibit the burning of solid waste on site.
Implement a regular maintenance program for vehicles and equipment to prevent breakdowns and limit polluting emissions.
Also ensure regular cleaning of the wheels of machinery leaving agricultural areas

5.3.3.4 Flooding and runoff

Construction work may temporarily alter surface flows, particularly during rainy periods, by intercepting water in excavated or grading areas. The absence of suitable drainage systems could increase runoff, carrying sediment or pollutants to neighboring areas. Although the site itself is not considered flood-prone, occasional water inputs from adjoining areas, mainly from the northwest, may generate a risk of localized flooding. To limit these effects, hydraulic management devices are necessary, such as drainage ditches and temporary dikes, to channel runoff water and prevent its infiltration into the deformable clay layers and gypsum soils. Figure 33 below illustrates the location of the drainage ditch proposed by the hydrological study, designed to protect the site and reinforce the stability of the infrastructure.

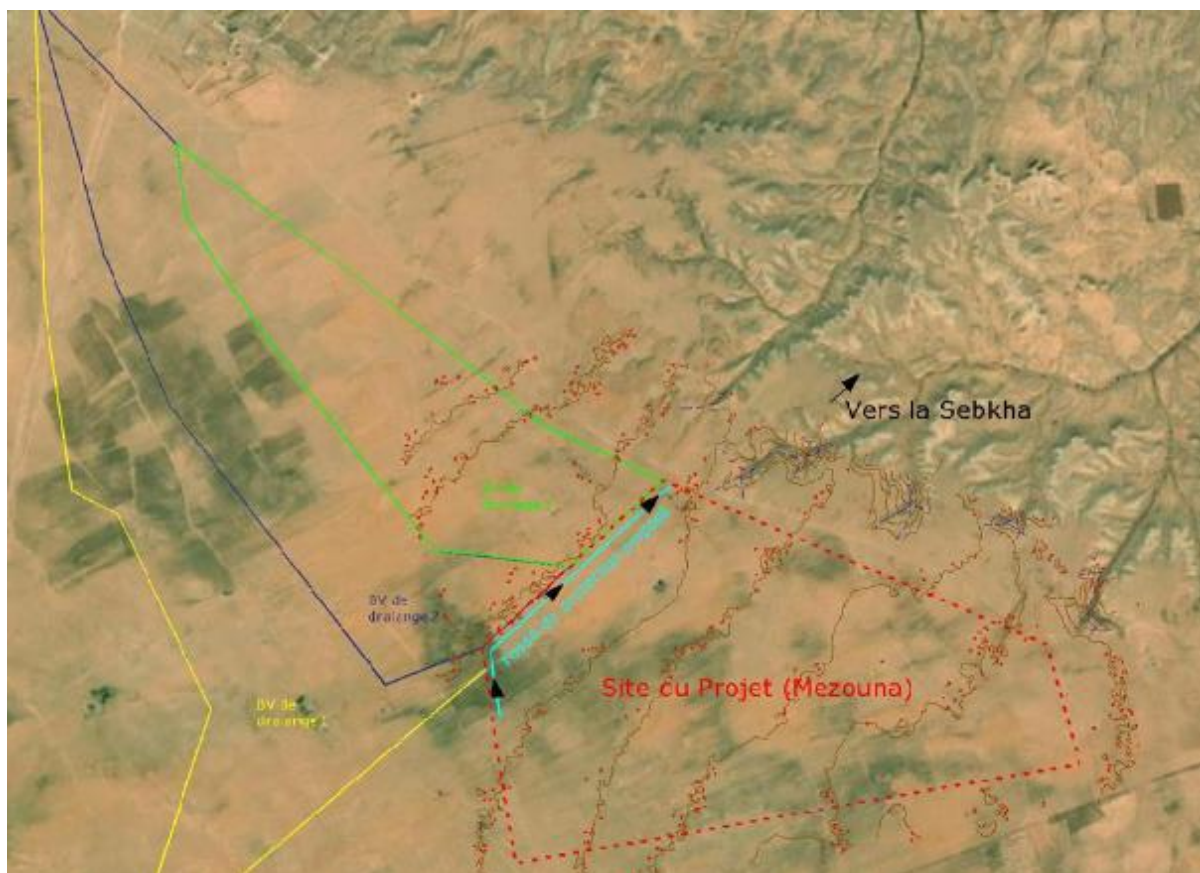


Figure 42: Site protection solution using a trapezoidal ditch

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Average	Average	Weak

Mitigation measures:

Proposed measures
Install a trapezoidal pit that is emptied regularly.
Ensure that the natural flow direction of rainwater is maintained without causing changes in the general hydrology of the site.

5.3.3.5 Water resources

Regarding groundwater, excavations, anchoring structures, and foundations reduce the natural protection between the surface and the water table. In the event of a leak of hydrocarbons, oils, or poorly managed sanitary discharges, the risk of contamination is increased. This risk remains localized but must be anticipated, given the pressure already exerted on the water tables in the Sidi Bouzid region.

For the power line, water consumption is moderate (mainly for pouring concrete for the pylons). However, runoff of water loaded with concrete residue or sediment can temporarily affect the agricultural soils crossed, particularly in the absence of water collection and channeling devices. These disruptions remain limited in time but require careful monitoring to reduce nuisances for

cultivated land and seasonal water points.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Forte	Local	Average	Average	Weak

Mitigation measures:

Proposed measures
Set up washing and concreting areas with retention tanks.
Prohibit washing trucks outside stabilized areas or on permeable ground
Promptly clean up any leaks or spills.
Store non-hazardous, hazardous and chemical waste in closed and reinforced premises on the ground

Local wildlife includes rodents, reptiles and birds, which may be disturbed by the construction site (noise, light, habitat fragmentation). Particular species require increased vigilance, notably the Lebetine viper (*Daboia mauritanica* , NT, IUCN) identified in rocky areas (stations 5 and 7), as well as other dangerous reptiles (horned viper, cobra, scorpions *Androctonus australis*). The work risks disrupting biological cycles, fragmenting habitats, and generating safety risks for workers.

5.3.3.6 Fauna

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Regional	Long	Major	Medium/Low

Mitigation measures:

Proposed measures
Limit noise and night-time light emissions during construction to reduce disturbances to local wildlife.

Schedule noisiest activities outside of sensitive bird breeding periods, based on the local ecological calendar.
Avoid heavy work in ecologically sensitive stations (stations 5 and 7).
Train workers in safe behavior around wildlife (reptiles, scorpions).
Set up an ecological team to monitor the fauna/flora during the work.

5.3.3.7 PBF and protected species

The construction phase generates local disturbances that can affect small wildlife populations (SWP) and protected species. Noise, dust, moving machinery, and partial destruction of vegetation cover can cause temporary disturbance and fragmentation of habitats. However, these impacts remain limited in time and space. Particular attention must be paid to **sensitive species** to reduce any risk of mortality or significant disturbance.

Priority species on the power line (TL) :

Migratory birds and raptors using the corridor to move or hunt.

These species are particularly sensitive to noise and disturbance, especially during the migration or breeding period.

Priority species on the photovoltaic (PV) plant site :

Protected reptiles and amphibians living in vegetation cover or wetlands.

Small mammals using peripheral areas as refuges or nesting sites.

Nesting birds present in remaining trees or bushes.

Impact assessment:

Location	Intensity	Extent	Duration	Importance	Importance after mitigation measures
Power line	Weak	Local	Short	Minor	Weak
Project site	Weak	Local	Short	Minor	Weak

Mitigation measures
For the power line
Avoid noisy work during the early hours of the day, when migratory birds and birds of prey

are most active.
Restrict access of machinery to only those areas necessary to limit disturbance to peripheral habitats.
Remove materials and structures without leaving obstacles that could trap or injure wildlife, paying particular attention to birds and small mammals.
Raise awareness among workers about the behavior to adopt in the event of an encounter with priority species.
Leave a period of ecological rest between stages of the work to allow the natural dispersal of disturbed species.
For the project site:
Strictly demarcate work areas to avoid damage to the habitats of priority species.
Avoid prolonged parking of machinery in vegetated areas, especially near nests and natural refuges.
Carry out work outside sensitive breeding or nesting periods for reptiles, amphibians and birds.
Plan for gradual restoration of the land (gentle leveling, limiting erosion) to encourage natural regrowth and the return of species.
Maintain undisturbed peripheral areas as refuges for priority species.
Avoid the use of chemicals or weedkillers during work.

5.3.3.8 Flora

The area where the power plant is located is generally steppe, homogeneous and not very diverse, but the route of the LEHT crosses several sensitive habitats (arid steppes, wadis, sebkhas, agricultural areas). Two species require special attention: *Vachellia tortilis* (protected in Tunisia, vulnerable REGNES) and *Searsia tripartita* (VU), recorded in certain stations. The work may result in the destruction of the plant cover and the loss of protected individuals.

Impact assessment:

Intensity	Extent	Durati on	Importanc e	Importance after mitigation
Average	Regional	Long	Major	Medium/Low

Mitigation measures;

Proposed measures

Demarcate construction areas to avoid encroachment on sensitive habitats.
Mark and protect any <i>Vachellia</i> plants <i>tortilis</i> and <i>Searsia tripartita</i> before the works.
Install passages for small wildlife under the LEHT service tracks.

5.3.3.9 Landscape and visual impact

The construction site will cause a temporary alteration of the landscape linked to the presence of machinery, modular buildings and material depots. This impact will also affect the owners and users of the land crossed by the line route, who will see the landscape of their plots permanently modified by the presence of pylons and cables.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Average	Average	Weak

Mitigation measures:

Proposed measures
Demarcate construction and storage areas to limit the visual dispersion of materials.
Plant hedges or install green fences around the perimeter to reduce the disruption to the landscape.
Reduce non-essential nighttime lighting to avoid light pollution.
Limit the visual impact of the access path by following the existing route and avoid excessive widening.
Quickly stabilize track edges to avoid visible ruts and deposits.
Water the track regularly to reduce dust visible from a distance.
Inform local residents about the work to better manage the perception of landscape change.

5.3.3.10 Socioeconomic

Construction will employ nearly 450 workers (100 skilled and 350 unskilled), creating employment opportunities for the local community. However, increased traffic on the MC 205 and local tracks will increase nuisances (dust, noise, road safety). Agricultural land crossed by the LEAHT may be subject to temporary usage restrictions.

- Adjacent communities: nuisances linked to increased traffic (dust, noise, road safety) and risks of conflicts linked to cohabitation with workers.
- People affected by the project (PAPs): owners and operators of private agricultural land partially affected by the installation of pylons and the crossing of the HV line; holders of light structures and enclosures present on the site of the power plant; users of state or collective land crossed by the route; as well as breeders occasionally using the areas for grazing, including camel breeding. The losses mainly concern limited land rights, crops or fruit trees, and traditional pastoral activities. In accordance with the CATR, all these categories will be subject to appropriate, transparent compensation validated in consultation with local authorities.

- Vulnerable people (rural women, unemployed youth, precarious households): risk of exclusion from employment opportunities, and increased sensitivity to nuisances and socio-economic disruptions.

GBV & HS (Gender-Based Violence & Sexual Harassment): At the main site, the presence of a temporary, predominantly male workforce can disrupt social habits in this conservative rural environment. Although a few women may be employed in cooking, cleaning, or administrative tasks, their integration into this very masculine environment exposes them to risks of gender-based violence (GBV) and can limit their mobility. Women living nearby may restrict their movements out of caution, which worsens their social and economic marginalization. The route of the transmission line, crossing lands used by rural families, can also directly affect vulnerable populations – including rural women, widows, the elderly, or households without land titles – by accentuating inequalities in access to resources and creating a feeling of exclusion if consultation is not inclusive.

Impact assessment:

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Workers	Forte	Local	Average	Average	Weak
PAPs	Average	Local	Long	Average	Weak
Vulnerable people	Weak	Local	Average	Minor	Weak
Adjacent community	Weak	Local	Average	Minor	Weak
VBG & HS	Average	Local	Average	Average	Weak

Mitigation measures:

Proposed measures
Prioritize the employment of local labour.
Inform communities about the work schedule.
Implement a safe traffic plan for trucks.
Provide fair compensation for land affected by the LEHT.
Promote the hiring and participation of local women in the project (administration, logistics).
Raise awareness among workers about respecting local social and cultural norms, including GBV.
Establish a confidential complaints management mechanism, accessible to women and vulnerable groups.
Install clear and safe road signs near the school and organize truck traffic outside of school entry and exit times.
Provide accompaniment or supervision for children crossing the road.
Identify, consult and support vulnerable people (widows, the elderly, isolated breeders, families without titles).

Establish appropriate compensation for people directly affected by the work.
--

Communicate regularly and transparently with local communities, adapting materials to vulnerable audiences.

5.3.3.11 Health and safety of workers

The construction phase of the project primarily exposes workers to exhaust emissions from construction machinery, as well as dust generated by earthworks, material handling, and vehicle traffic on unpaved roads. These emissions can cause respiratory problems and be accompanied by noise pollution due to the use of heavy equipment.

Occupational hazards are varied and include: the use of mechanical excavation machinery and rotating tools, heavy lifting, exposure to live electrical components, and the risk of slips and trips in work areas. In addition, accidental intrusion by unauthorized persons into the work area, particularly during excavations, represents a potential hazard that can lead to serious injuries or even fatalities.

Particular emphasis should also be placed on preventing risks related to cohabitation between the workforce and neighboring communities, including road traffic risks and social risks, such as gender-based violence and sexual harassment (GBVH/SEA-SH). These risks should be mitigated through the implementation of a strict code of conduct, awareness-raising sessions, and a confidential and accessible complaint mechanism for workers and local residents.

Finally, given the region's climatic conditions, extreme heat poses a major risk to workers' health (heat stress, dehydration, heat stroke). Preventive measures will include the organization of appropriate working hours (heavy work scheduled during the coolest hours), the provision of shaded areas for rest, a constant supply of drinking water, as well as awareness campaigns and training on the recognition and management of heat-related symptoms.

These impacts are short-term and generally confined to the construction site. Although they do not have long-term consequences, they require rigorous safety management and increased awareness among all personnel.

Impact assessment

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Forte	Local	Average	Major	Average

Proposed mitigation measures

Proposed measures
Implement a strict HSE management plan including clear signage of work areas and limitation of unauthorized access.
Provide and enforce the use of personal protective equipment (dust masks, helmets, gloves, safety shoes, harnesses for working at height).

Regularly train workers in specific risks: handling, electrical work, movement of machinery, first aid.
Install ventilation or occasional watering systems to limit dust during intensive work.
Establish a system of regular inspection and maintenance of machinery to limit gas emissions and reduce noise pollution.
Provide a clear intervention protocol in the event of an accident (on-site first aid station, HSE team, coordination with local medical services).

5.3.3.12 Waste management

Earthworks, concreting, and installation activities produce a variety of solid waste: inert waste (rubble), similar household waste (SIW), and hazardous industrial waste (HW) such as used oils, solvents, batteries, and chemicals from the maintenance of electrical machinery and equipment. Without proper management, this waste can generate various impacts depending on the recipients:

- Groundwater and surface water: potential infiltration of hydrocarbons in the event of inappropriate storage or discharge
- Soils: accumulation of inert or plastic waste which can degrade the quality of the agricultural soils crossed.
- Fauna and flora: deposits of plastic, wood or used oils risk disrupting habitats and poisoning wildlife.
- Workers: health risks linked to exposure to dangerous substances (oils, solvents) or to nuisances generated by the accumulation of waste (injuries, infections). →
- Adjacent communities: negative perception in the event of waste being scattered on the land, nuisances linked to household waste from the base camp (odors, pests).

Regarding the transmission line, occasional work (installation of pylons, unrolling of cables) also generates waste (cables, sheaths, plastic bags, wood), which can temporarily soil the agricultural land crossed. These impacts will be minimized by immediate cleaning of the rights-of-way after work and by providing specific containers for the collection and disposal of this waste.

Impact assessment

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Water resources	Forte	Local	Average	Average	Weak
Soils	Forte	Local	Average	Average	Weak
Fauna and Flora	Weak	Local	Average	Minor	Weak
Workers	Average	Local	Average	Average	Weak
Adjacent	Weak	Local	Average	Average	Weak

communities					
-------------	--	--	--	--	--

Mitigation measures

Proposed measures
Implement systematic cleaning of runways and access areas.
Set up selective sorting with covered bins and ensure their removal through approved channels.
Store hazardous waste in sealed containers before disposal.
Organize regular collection of household waste to avoid nuisances.
Clean storage and traffic areas frequently.
Prohibit any prolonged storage of waste on agricultural land.
Educate workers and subcontractors to keep areas clean.

5.3.4 Operational phase

5.3.4.1 Climate and air quality

The operation of the photovoltaic plant does not result in any direct emissions of greenhouse gases or air pollutants, with the exception of limited emissions from vehicles and maintenance equipment. This production method therefore contributes positively to reducing overall emissions and combating climate change. Air quality will remain generally unchanged, with the following effects depending on the receptors:

- Workers: occasional exposure to exhaust gases from maintenance vehicles.
- Adjacent communities: no significant impact expected, apart from rare local emissions linked to the passage of maintenance vehicles.
- Fauna: negligible disturbances, limited to temporary emissions from machinery during maintenance.
- Flora: no significant impact on vegetation, apart from possible dust generated by traffic on the runways.

Impact assessment:

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Workers	Average	Local	Long	Weak	Weak

Adjacent communities	Weak	Local	Long	Weak	Weak
Fauna and Flora	Weak	Local	Long	Weak	Weak

Mitigation measures:

Proposed measures
Limit vehicle speeds and water runways occasionally during dry periods to reduce dust emissions.
Regularly maintain generators to ensure clean combustion and limit polluting emissions.
Favor wet or semi-wet cleaning of the panels when climatic conditions permit, in order to limit the resuspension of particles.

5.3.4.2 Soil contamination

During operation, the soils will not undergo any major new physical disturbances. The negative impacts come mainly from: (i) water discharges related to cleaning the panels (water use); (ii) occasional storage of chemicals (oils, greases); and (iii) solid waste generated by personnel. The presence of tracks and technical areas results in permanent but limited compaction.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Weak	Local	Long	Average	Weak

Mitigation measures:

Proposed measures
Limit traffic to prepared and stabilized tracks to avoid excessive compaction of soils outside the planned lanes.
Store oils and cleaning products on waterproof platforms with retention trays to prevent accidental leaks into the ground.
Install a controlled drainage system to channel cleaning water and prevent erosion or soil saturation

5.3.4.3 Noise and vibrations

During the operational phase, noise pollution remains generally low and localized. It mainly comes from occasional traffic of maintenance vehicles, cleaning operations of the photovoltaic panels and the operation of technical equipment such as transformers, inverters and, more occasionally, generators. These noises are discreet and are only perceptible in the immediate vicinity of the installations. No significant vibrations are expected within the project perimeter.

Impact assessment

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Weak	Local	Long	Minor	Weak

Mitigation measures

Proposed measures
Schedule the noisiest operations (maintenance, cleaning) outside of sensitive hours to limit disruption.
Ensure regular maintenance of technical equipment to prevent abnormal noises linked to wear or mechanical defects.
Install soundproofing hoods or sound insulation devices on generators and transformers if noise levels exceed locally acceptable thresholds.

5.3.4.4 Water resources

The operation will require water to clean the solar panels and for sanitation purposes. This volume remains limited but significant in an arid environment. The main negative impact is related to accidental contamination (oil leaks, uncontrolled wastewater discharges).

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Long	Average	Weak

Mitigation measures:

Proposed measures
Install a controlled drainage system to collect cleaning water and prevent uncontrolled runoff.
Use non-toxic and biodegradable cleaning products to reduce the risk of chemical contamination.
Train staff in good water management practices.
Regularly monitor the quality of discharged water.
Limit the use and quantity of harmful cleaning products.

5.3.4.5 Fauna

The site's fencing limits the mobility of medium and large mammals. In addition, the high-voltage

line generates additional impacts: habitat fragmentation, disruption of ecological corridors, and especially the risk of collision for birds. Nesting and migratory birds frequenting Sebkhet Noual and Bouhedma Park (birds of prey, wading birds) are particularly vulnerable to conductor cables and pylons. Small terrestrial fauna may also be affected by loss of connectivity and the risk of accidental mortality.

Impact assessment :

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Weak	Local	Long	Minor	Weak

Mitigation measures:

Proposed measures
Provide artificial perches away from active areas to reduce disturbance to raptors.
Limit vegetation maintenance outside of nesting periods to encourage the reestablishment of species on the ground.
anti-collision devices on transmission lines (visual spirals, beacons) to reduce risks to migratory birds.
Promote the controlled development of local vegetation adapted to arid conditions under the panels to limit erosion.
Avoid excessive use of herbicides or aggressive mechanical methods when weeding.

5.3.4.6 Flora

During the operational phase, the impacts on flora mainly concern the degradation of vegetated habitats (trampling, weeding, vegetation maintenance). Two species require particular attention: *Vachellia tortilis* (protected in Tunisia, vulnerable REGNES) and *Searsia tripartita* (VU). Inadequate maintenance practices (herbicides, mechanical cutting) can lead to the loss of these species and impoverish the vegetation cover

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Weak	Local	Long	Minor	Weak

Proposed measures
Promote the controlled development of local vegetation adapted to arid conditions under the panels in order to limit erosion.
Avoid excessive use of herbicides or aggressive mechanical methods when weeding.
Define strict traffic zones to limit trampling and damage to vegetated areas.
Implement regular monitoring of vegetation to adapt maintenance practices based on the natural evolution of the plant cover.
Raise awareness among operating personnel of the importance of preserving spontaneous vegetation as a factor in protecting biodiversity and stabilizing soils.

5.3.4.7 PBF and protected species

During operation, disturbances are generally less than during construction, but certain activities

(maintenance, movement of machinery, occasional noise) can affect PBFs and protected species.

Priority species on the power line (PL): migratory birds and raptors using the corridor for travel or hunting. They are sensitive to noise and human presence.

Priority species on the power plant site (PV): protected reptiles and amphibians living in wetlands or vegetation cover, small mammals using peripheral areas as refuges.

Impact assessment:

Location	Intensity	Extent	Duration	Importance	Importance after mitigation measures
Power line	Weak	Local	Short	Minor	Weak
Project site	Weak	Local	Short	Minor	Weak

Mitigation measures:

For the power line:
Schedule maintenance work outside of bird migration and raptor breeding periods.
Raise staff awareness of the detection of priority species and the measures to adopt in the event of an encounter.
Avoid parking or storing equipment in bird hunting or resting areas.
For the project site:
Identify areas where reptiles and amphibians are concentrated and limit access of equipment to these areas.
Provide safe passages for small mammals (e.g., tunnels or vehicle bypass areas) in high-traffic areas.
Maintain undisturbed peripheral areas as refuges for priority species.
Avoid the use of chemicals that may affect amphibians.

5.3.4.8 Landscape and visual impact

The solar panels and pylons of the high-voltage line are having a lasting impact on the local landscape. However, as the site is far from built-up areas and main roads, the visual impact remains limited.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Long	Average	Weak

Mitigation measures:

Proposed measures
Provide light landscaping (local steppe plantations) around technical buildings.
Reduce nighttime lighting visible from a distance to a minimum.

5.3.4.9 Health and safety of workers

During the operational phase, the main health and safety risks are related to electrical infrastructure and maintenance operations. The occasional increase in noise levels, mainly generated by transformers, inverters, and power lines, remains limited and considered minor due to the distance from residential areas.

A second factor concerns exposure to electromagnetic fields (EMF) generated by cables, transformers and high-voltage lines. Their intensity is more pronounced in the immediate vicinity of the equipment, but it decreases rapidly with distance. This impact is considered to be of medium intensity, of punctual extent and of medium duration, which gives it medium significance. The permanent exposure of workers to heat must also be taken into consideration.

Finally, risks of accidents or fires remain possible due to the presence of electrical systems (air conditioning, lighting, surveillance). These risks, although occasional and short-lived, require constant vigilance. The significance of this impact is considered minor.

5.3.4.10 Impact assessment

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Long	Average	Weak

Proposed mitigation measures

Proposed measures
Implement regular training in electrical safety and working at height for staff.
Provide and enforce the wearing of suitable personal protective equipment (PPE) (helmets, insulating gloves, harnesses, dust masks).
Organize regular breaks, shaded areas and a supply of drinking water to prevent heat-related risks.
Ensure good management and maintenance of sanitary facilities and waste to avoid health risks.
Establish an emergency plan with rapid emergency resources in the event of an accident or illness.
Carry out regular medical monitoring of exposed workers

5.3.4.11 Socioeconomic

The operational phase will generate a limited number of permanent jobs, mainly skilled (operations, maintenance, HSE), constituting a positive contribution to the local community. The nuisance for the neighboring population will remain limited given the distance from the dwellings. The effects can be detailed according to the different receptors:

- Project workers: access to permanent jobs and working conditions governed by Qair's OHS and work management procedures.
- Project-affected people (PAPs): No additional loss of land or livelihoods is expected

during the operational phase.

- Vulnerable people (rural women, unemployed youth, precarious households): limited integration opportunities because the majority of operating positions require technical skills.
- Adjacent communities: almost no negative impacts in operation, apart from the occasional passage of maintenance vehicles.

Impact assessment:

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Workers	Weak	Local	Long	Minor	Weak
Adjacent communities	Weak	Local	Long	Minor	Weak
PAPs	Weak	Local	Long	Minor	Weak
Vulnerable	Weak	Local	Long	Minor	Weak

Mitigation measures:

Proposed measures
Maintain dialogue with local stakeholders through the communication mechanism.
Promote local hiring for maintenance, surveillance and security positions.
Encourage sourcing from regional suppliers to maximize economic benefits.
Establish partnerships with local economic players (businesses, cooperatives).
Ensure regular monitoring of economic impacts and adjust local development strategies accordingly.

5.3.5 Dismantling phase

5.3.5.1 Air quality

The dismantling phase of the power plant and the transmission line will generate dust emissions (dismantling of structures, handling of materials, circulation on unpaved tracks) and exhaust gases (SO₂, NO_x, CO₂) linked to machinery, trucks and generators. These emissions, although temporary and limited in time, can affect different receptors:

- **Construction site workers** : direct exposure to dust and exhaust gases due to their proximity to dismantling operations
- **Riverside communities** : occasional impacts due to dust and nuisances linked to increased traffic from transport trucks.
- **Wildlife** : temporary disturbance due to noise and gas emissions, particularly in sensitive

areas close to the sebkha or the park buffer zone .

- **Flora** : dust deposits on surrounding vegetation which can slightly alter photosynthesis.

Impact assessment:

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Workers	Average	Local	Short	Average	Weak
Residents	Weak	Local	Short	Minor	Weak
Wildlife	Weak	Local	Short	Minor	Weak
Flora	Weak	Local	Short	Minor	Weak

Mitigation measures:

Proposed measures
Regularly moisten work areas and internal tracks to limit dust drift.
Reduce the speed of vehicles and limit unnecessary journeys.
Use well-maintained machinery to reduce exhaust emissions.
Avoid dust-generating work during periods of strong wind.
Install a filtration system (if applicable) or orient storage areas away from the wind.
Provide protective masks for workers directly exposed to dust.
Limit the operating periods of generators or thermal engines to what is strictly necessary.

5.3.5.2 Soil contamination

Dismantling exposes soils to several risks: pollution by hydrocarbons and hazardous products (used oils, fuels), compaction due to heavy machinery, as well as an increased risk of erosion on bare soils. These impacts are temporary and localized but require rigorous management of waste and fluids.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Average	Average	Weak

Mitigation measures:

Proposed measures
Avoid earthmoving operations during periods of heavy rainfall to limit soil leaching.
Clearly delineate intervention areas to limit soil disturbance to specific areas.
Temporarily store materials (waste, rubble) on waterproof tarpaulins and in secure areas.
Provide retention tanks for potentially polluting liquids (oils, solvents) to avoid any spills.

Regularly water dusty areas to limit the dispersion of particles.
Properly backfill and reprofile trench or structure removal areas to stabilize the soil.
Check for the absence of pollution at the end of the work, and if necessary, treat the contaminated areas.

5.3.5.3 Waste management

The dismantling of the power plant and transmission line will generate a significant amount of waste related to the dismantling of structures, the removal of photovoltaic modules, cables, ducts, transformers, as well as rehabilitation earthworks. This waste will include inert waste (concrete, rubble, scrap metal), hazardous industrial waste (HW) (oils, batteries, residual chemicals), as well as recyclable waste (PV modules, metals, wood, plastics). Without proper management, this waste can generate various impacts depending on the receptors:

- Water resources: risk of contamination by infiltration of hydrocarbons, leachates or chemicals in the event of uncontrolled storage or spillage.
- Soils: possible pollution by accumulation of inert waste or dispersion of residual plastics and metals on the vacated areas.
- Fauna and flora: disturbance of habitats due to the presence of debris and risks of poisoning linked to hazardous waste.
- Workers: exposure to hazardous substances (oils, solvents, demolition dust) and physical risks (cuts, falls, injuries).
- Adjacent communities: visual nuisances, odors and negative perception in the event of waste dispersion, particularly during transport and temporary storage.

Appropriate management must include: sorting at source, selective collection, recovery of recyclable materials (PV modules, metals), disposal of DMA to approved channels, and systematic cleaning of rights-of-way after work.

Impact assessment

Receiver	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Water resources	Average	Local	Short	Weak	Weak
Soils	Forte	Local	Short	Average	Weak
Fauna and Flora	Weak	Local	Short	Minor	Weak
Workers	Average	Local	Short	Average	Weak
Adjacent communities	Weak	Local	Short	Average	Weak

Mitigation measures

Proposed measures
Implement rigorous selective sorting of waste from the source, with identified and secure storage areas.
Store hazardous waste (oils, batteries, solvents) in sealed containers that comply with standards.
Organize regular evacuation to approved treatment, recovery or recycling channels.
Raise awareness among construction site teams about correct waste management and compliance with established procedures.

5.3.5.4 Water resources

Dismantling operations (excavation of foundations, removal of structures, handling of cables and transformers) may temporarily reduce the natural protection between the surface and the water table. In the event of poor management of residual oils, hydrocarbons or sanitary effluents linked to the base camp, a localized risk of groundwater contamination remains and must be anticipated, given the pressure already exerted on the water tables in the Sidi Bouzid region.

For the power line, the work to remove the pylons and restore the rights-of-way requires occasional excavations, which can generate runoff loaded with sediment or demolition residue. This runoff may temporarily affect the agricultural land crossed or seasonal water points, particularly if no collection and channeling measures are put in place. These impacts will remain limited in time, but require careful monitoring and the application of mitigation measures, including: the installation of temporary drainage ditches, the containment of hazardous products, the selective collection of effluents, and the immediate cleaning of work areas after dismantling operations. **Impact assessment:**

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Short	Weak	Weak

Mitigation measures:

Proposed measures
Specific training of workers in emergency procedures in the event of a leak.
Provide collection or drainage devices to channel runoff water.
Stabilize slopes or reworked areas to limit erosion.
Avoid storing polluting materials or products near sensitive areas
Use retention tanks for any temporary storage of oils or hazardous substances.
Equip the site with spill kits to react quickly in the event of an accidental leak.
Ensure the regulated evacuation of wastewater produced by staff (mobile toilets, watertight tanks).
Prohibit any direct discharge into the environment without prior treatment

5.3.5.5 Noise and vibrations

During dismantling, equipment dismantling operations, occasional digging to remove foundations, and site restoration work generate intermittent noise pollution. This noise comes mainly from the use of heavy machinery (mechanical shovels, trucks, compactors) and can cause local vibrations. Although temporary and concentrated in specific areas, this noise can disturb nearby residents and cause occasional stress to local wildlife. Vibrations remain limited but may, in some places, slightly affect soil stability.

Impact assessment

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Weak	Local	Average	Minor	Weak

Mitigation measures

Proposed measures
Limit noisy work to regulatory working hours (avoid work at night or early in the morning).
Maintain construction machinery in good condition to reduce noise pollution.
Use machines equipped with high-performance silencers.
Inform local populations in advance of the schedule for dismantling work.
Temporarily suspend certain activities if excessive nuisances are reported by local residents.
Reduce the speed of construction machinery to limit vibrations transmitted to the ground.

5.3.5.6 Landscape and visual impact

The dismantling project will involve the use of heavy machinery and the temporary storage of dismantled materials. The visual impact, while real, will be limited to the duration of the project and will disappear once the equipment is removed and the site reclaimed.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Short	Minor	Weak

Mitigation measures:

Proposed measures
Limit the storage time of materials and avoid their dispersion over large areas

Carry out a progressive program of restoration and re-vegetation with adapted local species.

Install temporary visual screens (e.g. hedges or netting) to mitigate the impact on sensitive areas during work .

5.3.5.7 Fauna

Dismantling causes local disturbances: noise, dust, movement of machinery, partial destruction of the remaining vegetation cover. Temporary fragmentation of habitats and disturbance of small fauna are possible, but limited in time. Lifting the fence may nevertheless encourage the gradual return of fauna .

Impact assessment :

Intensi ty	Exten t	Durati on	Importan ce	Importance after application of mitigation measures
Weak	Local	Short	Minor	Weak

Mitigation measures:

Proposed measures
Avoid noisy work during the early hours of the day, when some species are active.
Restrict access of machinery to only those areas necessary to limit disturbance to peripheral environments.
Remove materials and structures without leaving obstacles that could trap or injure wildlife.
Raise awareness among workers about the behavior to adopt in the event of an encounter with animal species.
Leave a period of ecological rest between stages of the work to allow the natural dispersal of disturbed species.

5.3.5.8 Flora

Dismantling may cause partial destruction of the remaining vegetation cover and disturbance of the soil and surrounding areas.

Impact assessment:

Intensi ty	Exten t	Durati on	Importan ce	Importance after application of mitigation measures
Weak	Local	Short	Minor	Weak

Strictly demarcate work areas to avoid unnecessary damage to surrounding vegetation.
Avoid prolonged parking of machinery in vegetated areas.
Carry out dismantling work outside of peak plant growth periods (spring).
Plan for gradual restoration of the land (gentle leveling, limiting erosion) to encourage natural regrowth.
Leave some peripheral areas undisturbed to preserve natural seed reservoirs.
Avoid the use of chemicals or weedkillers during work.

5.3.5.9 PBF and protected species

Dismantling can generate occasional disturbances similar to construction (noise, dust, movement of machinery, partial destruction of plant cover). The impacts are limited in time, but certain

priority species require special attention.

Priority species on the power line (TL) : migratory birds, raptors and protected bats that may use the corridor as a temporary refuge.

Priority species on the power plant site (PV) : protected reptiles and amphibians, small mammals and certain species of nesting birds using the remaining trees and bushes.

Impact assessment:

Location	Intensity	Extent	Duration	Importance	Importance after mitigation measures
Power line	Weak	Local	Short	Minor	Weak
Project site	Weak	Local	Short	Minor	Weak

Mitigation measures:

For the power line:
Avoid noisy work and the movement of machinery during the resting periods of birds and bats.
Gradually remove structures to allow species to disperse naturally.
Raise awareness among workers about priority species and the behavior to adopt in the event of an encounter.
For the project site:
Strictly demarcate work areas to protect remaining refuges for reptiles, amphibians and small mammals.
Plan a prior inspection to identify nests or shelters of priority species before any dismantling.
Maintain undisturbed peripheral areas as temporary refuges.
Carry out gradual restoration of the land (gentle leveling, limiting erosion) to encourage the return of species.
Avoid the use of chemicals or weedkillers during work.

5.3.5.10 Health and safety

Dismantling work presents significant risks for workers: accidents related to machinery and lifting operations, falls from height and collisions, electrical risks (handling cables, transformers), exposure to dangerous products, extreme climatic conditions (high heat). These risks, although temporary, require strict preparation and appropriate training.

Impact assessment:

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Short	Average	Weak

Mitigation measures:

Proposed measures
Train all workers in the specific risks of dismantling (lifting, electricity, heat).
Implement an appropriate safety and first aid plan.

Equip workers with personal protection (helmets, harnesses, gloves, goggles).
Mark out construction areas with clear signage to prevent unauthorized access.

5.3.5.11 Socio-economic impact:

During dismantling, the increased presence of machinery, trucks, and workers can cause temporary nuisances for neighboring communities, particularly through noise, dust, and additional traffic on local roads. This situation can disturb the peace and quiet of local residents, particularly families living near the access road. On a social level, the end of operations results in a loss of permanent jobs and can increase the vulnerability of certain social categories (low-skilled workers, low-income families). However, dismantling work also provides temporary employment and service opportunities, generating a certain local economic dynamism. The restoration of the site, on the other hand, constitutes a potential positive impact if it is well coordinated with stakeholders and allows for future reuse of the land. Overall, this phase presents impacts of a contrasting nature, with positive temporary effects (jobs, services) but also lasting losses (end of the economic benefits of operations).

Impact assessment

Intensity	Extent	Duration	Importance	Importance after application of mitigation measures
Average	Local	Average	Average	Weak

Mitigation measures

Proposed measures
Implement a regular communication plan with local residents to provide information on the duration and schedule of the work.
Promote temporary local hiring to maximize socio-economic benefits during the dismantling phase.
Organize the restoration of the site in consultation with the local community, considering future uses that will enhance its value.
Provide social and economic support for workers affected by the end of the project (training, retraining).
Encourage the purchase of local goods and services during dismantling in order to support the local economy.

5.4 Identification of positive environmental and social impacts

The project represents a significant socioeconomic development opportunity for the Sidi Bouzid governorate and, more broadly, for Tunisia. It will generate significant economic momentum through the mobilization of local and regional companies. These companies will be involved in the supply of materials (earthworks, civil engineering, logistics), the installation of technical infrastructure, as well as ancillary services related to the base camp and the transportation of equipment. Some specialized components, such as photovoltaic panels, metal structures, and electrical cables, will be imported, but the majority of service and labour requirements will be provided by national providers.

In terms of employment, the project will employ both skilled and unskilled workers, with priority given to local labour from neighboring communities. This employment policy will not only reduce unemployment in the region, but also strengthen household incomes and their access to

essential services such as health and education. Indirect economic benefits will also affect the workers' families, improving their standard of living and reducing their socio-economic vulnerability.

According to the preliminary impact study conducted in 2023, the project incorporates an inclusive dimension: the participation of women is encouraged, whether in skilled or unskilled positions, or through administrative and support tasks. This female involvement represents an opportunity to promote gender equality, strengthen women's economic autonomy, and increase their role in decision-making within the household.

Thus, beyond the direct benefits in terms of renewable energy, the El Khobna solar power plant will contribute to a positive socio-economic dynamic, promoting job creation, training, inclusion and local development.

5.4.1 Positive environmental impacts

Positive impact	Intensity	Extent	Duration	Importance	Explanation
Contribution to the energy transition	High	National	Long term (20+ years)	High	The project supplies the network with clean energy, reducing the share of natural gas and fuel oil in national production.
Reduction of GHG emissions (CO ₂)	High	National / Global	Long term	High	By replacing fossil fuels, the project avoids the emission of thousands of tons of CO ₂ each year.
Reduction of air pollution	Forte	Local	Long term	Major	Combustion-free operation avoids the release of harmful air pollutants, improving air quality.
Rehabilitation and ecological restoration	Average	Local	Medium to long term	Average	Once the project is completed, unused areas can be restored, encouraging the return of local species.
Reducing dependence on fossil fuels	Forte	National / Regional	Long term	Major	Increasing solar capacity allows the country to reduce its

					imports of fossil fuels.
--	--	--	--	--	--------------------------

5.4.2 Positive social and economic impacts

Positive impact	Intensity	Extent	Duration	Importance	Explanation
Creation of direct and indirect jobs	Average	Local (El Aguela, Mdhila)	Average	Medium to high	The work mobilizes the local workforce (workers, drivers, guards, etc.), strengthening employment in areas of high unemployment.
Local economic development	Average	Local	Short to medium	Average	The presence of the construction site stimulates demand for accommodation, catering, transportation and supplies, benefiting local small businesses.
Improving access infrastructure	Average	Local to regional	Medium to long	Average	The rehabilitation of the undeveloped access track facilitates movement for residents and improves accessibility to agricultural areas.
Strengthening local capacities	Average	Local	Average	Average	Safety, health and environmental training enables workers to improve their future employability.
Technical skills development	Low to medium	Local	Medium to long term	Average	Some employees gain experience in solar energy, maintenance or electricity, which can be used in other projects.

Indirect economic benefits	Low to medium	Local	Medium term	Average	Purchases made from local suppliers, artisans or cooperatives strengthen the local economy.
----------------------------	---------------	-------	-------------	---------	---

1.2 Impact assessment

5.4.3 Physical environment

5.4.3.1 Impact on the ground

5.4.3.1.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Impact on the ground	Intensity	Forte	The intensity focuses on changes in soil structure caused by construction activities, which remain low. The possible presence of oil, chemical, wastewater, or fuel leaks increases the risk of pollutants entering the soil.
	Extent	Punctual	The impacts mainly concern the construction site area, along the track and the transmission line
	Duration	Average	The work will last approximately 18 months, which is a significant but limited period.
	Significance of impact	Average	

5.4.3.1.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Impact on the ground	Intensity	Weak	The risks of soil contamination are limited but real, linked to the regular circulation of maintenance vehicles, the storage of products (oils, solvents), or even the runoff of cleaning water. They can cause compaction, altered drainage or localized pollution.
	Extent	Local	The impact is concentrated on the technical areas of the site (maintenance areas, runways, storage areas), without extending beyond the project perimeter.

	Duration	Long	These disruptions can persist throughout the operating phase, or even worsen over time in the absence of prevention and monitoring measures.
	Significance of impact	Average	

5.4.3.1.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Impact on the ground	Intensity	Average	The operations of removing structures and cables mechanically disturb the ground and present a temporary risk of pollution.
	Extent	Punctual	The impact is limited to specific areas of removal and passage of machinery.
	Duration	Average	The disruptions are temporary and linked to the dismantling work.
	Significance of impact	Average	

5.4.3.2 Air Quality

5.4.3.2.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Impact on air quality	Intensity	Average	Due to significant dust emissions from earthworks, embankments, movement of machinery on bare ground and polluting gases (NO _x , SO ₂ , CO), aggravated by arid and windy conditions. Significant impact on the health of workers and visibility .
	Extent	Local	The impact remains concentrated on the site, the access track and surrounding areas, particularly nearby homes, without extending to a regional scale.
	Duration	Long	Limited to the duration of construction work (18 months), emissions ceasing at the end of the work.
	Significance of impact	Average	

5.4.3.2.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Impact on air quality	Intensity	Weak	Emissions from the circulation of maintenance vehicles, any emergency generators and dry cleaning of panels are limited and low polluting.
	Extent	Local	The effects are restricted to the technical areas of the site (traffic lanes, maintenance area).
	Duration	Short	The broadcasts are punctual and associated with brief and infrequent interventions.
	Significance of impact	Weak	

5.4.3.2.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Air quality	Intensity	Average	Mechanical work and the movement of machinery generate dust and exhaust gases that can temporarily affect air quality.
	Extent	Local	The impact is limited to areas close to the construction site.
	Duration	Average	The broadcasts last for several months, the time needed for the dismantling operations.
	Significance of impact	Average	

5.4.3.3 Noise and Vibration

5.4.3.3.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Noise and vibration	Intensity	Average	The continuous operation of heavy machinery, pile driving generating noise and vibrations, and the use of generators create a significant noise level during working hours.
	Extent	Local	The noise pollution is concentrated on the site, the access road (particularly the part crossing a residential area and close

			to the school), and occasionally around the pylons, without any impact on a regional scale.
	Duration	Average	The nuisances persist only during the work period, i.e. a few months to a year depending on the phase, then cease at the end of the work.
	Significance of impact	Average	

5.4.3.3.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Noise and vibration	Intensity	Weak	Noise and vibration pollution comes from fixed equipment (transformers, inverters, generators) and occasional traffic of maintenance vehicles, with a moderate noise level.
	Extent	Punctual	The effects are limited to the immediate vicinity of the technical installations, with no significant spread beyond the site.
	Duration	Average	Noise sources are present throughout the operating phase, even if they are low and infrequent.
	Significance of impact	Minor	

5.4.3.3.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Noise and vibration	Intensity	Weak	The noise pollution generated by mechanical equipment is moderate, occasional and intermittent.
	Extent	Local	The impact only affects areas close to the construction site.
	Duration	Average	The nuisances persist for several

			months, the time needed for dismantling.
	Significance of impact	Minor	

5.4.3.4 Water and wastewater resources management

5.4.3.4.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Water and wastewater resource management	Intensity	Forte	Due to the risk of contamination of the water table by infiltration via earthworks and foundations. Also due to the proximity of the Sebkha, which can be reached by this pollution via runoff given that the variation in altitude favors runoff towards the Sebkha.
	Extent	Local	This impact affects the project components (access road, site and line)
	Duration	Average	The work will last approximately 18 months, which is a significant but limited period.
	Significance of impact	Average	

5.4.3.4.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Water and wastewater resource management	Intensity	Average	Wastewater volumes are limited, but occasional chemical or organic pollution can occur if poorly managed
	Extent	Local	The impact mainly concerns the site and its immediate surroundings.
	Duration	Average	Wastewater generating activities are repeated throughout the life of the plant.
	Significance of impact	Average	

5.4.3.4.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Water and wastewater resource	Intensity	Average	The risks concern erosion, disruption of flows and point pollution from dismantled equipment.

management	Extent	Local	The effects are limited to the site and nearby natural outlets.
	Duration	Average	Disruptions may extend for months during dismantling work.
	Significance of impact	Average	

5.4.3.5 Solid and hazardous waste management

5.4.3.5.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Waste management	Intensity	Forte	The significant production of solid waste (rubble, plastics, wood) and hazardous waste (oils, solvents, batteries) exposes the soil to pollution risks in the absence of sorting, collection or secure storage.
	Extent	Local	The waste mainly affects the site, the access road and the immediate surroundings of the line pylons, with the possibility of dispersion towards the nearby wadis.
	Duration	Average	The impact is limited to the construction phase; waste is generated continuously during the work and stops when the site is cleaned up.
	Significance of impact	Average	

5.4.3.5.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Waste management	Intensity	Weak	The waste, although small in volume, includes hazardous waste (used oils, solvents) increasing the risk of pollution.
	Extent	Punctual	The effects are limited to the immediate surroundings of the technical installations,
	Duration	Long	Waste production is continuous throughout operation.
	Significance of impact	Average	

5.4.3.5.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Waste management	Intensity	Average	The production of waste, including hazardous waste, presents a significant environmental risk.
	Extent	Local	The effects are concentrated on the site and its immediate surroundings.
	Duration	Average	The activities take place over several months, with a risk of persistence if the waste is not properly managed.
	Significance of impact	Average	

5.4.3.6 Landscape and visual impact

5.4.3.6.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Landscape	Intensity	Average	The transformation of the natural site into a temporary industrial space is very marked, with the installation of technical buildings, tracks, storage areas and metal structures, creating a strong visual contrast with the light ground and lack of vegetation.
	Extent	Local	The impact mainly concerns the site and its surroundings, the access track (in particular the undeveloped portion), as well as the length of the transmission line in agricultural or steppe areas, without affecting the regional scale.
	Duration	Average	The landscape remains artificial during the construction phase, but the visual impact diminishes after the end of the work and the removal of the equipment, although some infrastructure remains visible. But remains artificial, especially for the site and the line throughout the project.
	Significance of impact	Average	

5.4.3.6.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
--------	---------	------------	----------------------------------

Landscape	Intensity	Average	The permanent presence of metal structures and solar panels significantly changes the rural landscape.
	Extent	Local	The visual effect is noticeable mainly from nearby areas and access routes around the site.
	Duration	Long	The transformation of the landscape is permanent throughout the operating life of the power plant.
	Significance of impact	Average	

5.4.3.6.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Landscape	Intensity	Average	The temporary visibility of machinery, materials and works changes the appearance of the landscape.
	Extent	Local	The visual impact is perceived from the immediate surroundings of the site.
	Duration	Short	The disruption is limited to the period of the works, followed by a gradual improvement
	Significance of impact	Weak	

5.4.4 Biological Environment

5.4.4.1 Fauna and flora

5.4.4.1.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
Wildlife	Intensity	Forte	The works (earthworks, piling, movement of machinery) disturb the habitats of terrestrial fauna (reptiles, rodents) and avifauna (sedentary and migratory species), some of which are sensitive, especially when they take place near the Sebkheth Noual or on the boundaries of the Bouhedma National Park.
	Extent	Regional	The effects are concentrated on the site, the transmission line and the areas crossed (crops, phragmites).
	Duration	Average	Disturbances cease at the end of the work, but

		some residual effects (species flight, changes in behavior) may persist temporarily.
	Significance of impact	Major

5.4.4.1.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Wildlife	Intensity	Average	The intensity of the work becomes low, which reduces the impact on wildlife, whether terrestrial or avifauna, however the risk of collision persists.
	Extent	Local	The impact is limited to the immediate perimeter of the site and the transmission line.
	Duration	Average	The conditions persist throughout the operating phase.
	Significance of impact	Average	

5.4.4.1.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Wildlife	Intensity	Weak	The species are accustomed to modified environments and the site has already been affected by human activity. Disturbances remain occasional.
	Extent	Punctual	The impact is limited to the immediate area of the dismantling works.
	Duration	Short	The effects are temporary, limited to the duration of the withdrawal operations.
	Significance of impact	Weak	

5.4.5 Socio-economic background

5.4.5.1 Social Framework

5.4.5.1.1 Construction phase

Impact	Setting	Assessment	Justification for the assessment
--------	---------	------------	----------------------------------

Socio-economic impact	Intensity	Average	The disruption of an existing agricultural activity (olive trees), the arrival of external labour and the lack of consultation with local residents can generate social tensions, misunderstandings or demands for compensation, without however reaching a high level of conflict.
	Extent	Local	The effects only concern the site of the power station, the residential area crossed by the access track (noise, dust, risks for children), and the agricultural land bordered by the transmission line, with no impact beyond these areas.
	Duration	Average	The impact is limited to the duration of the work; most of the nuisances disappear at the end of the work, although some resentments or land conflicts may persist in the short term.
	Significance of impact	Average	

5.4.5.1.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Social impact	Intensity	Average	Activities are limited and minimally disruptive compared to the construction phase.
	Extent	Regional	The impact mainly concerns the site and the homes close to the access road.
	Duration	Average	Social interactions, although continuous, remain low intensity and may diminish over time.
	Significance of impact	Average	

5.4.5.2 Gender and vulnerability

Impact	Setting	Assessment	Justification for the assessment
Gender and vulnerability	Intensity	Average	The arrival of a large male workforce in a conservative rural area disrupts social habits and limits women's mobility, especially in accessing nearby wells and trails. The lack of employment for women reinforces their marginalization. The interruption of activities for vulnerable people (single women, widows, the elderly) exacerbates their precariousness. Increased traffic on the path increases the risk of accidents, especially for

			children. On the transmission line, low-income and vulnerable families can be affected without consultation or compensation.
	Extent	Local	The impacts mainly affect communities near the site, the access road and the transmission line, with no regional effects.
	Duration	Short	The effects last during the works, with some persistent short-term social impacts.
	Significance of impact	Average	

5.4.5.3 Health and safety of workers and the population

5.4.5.3.1 Construction Phase

Impact	Setting	Assessment	Justification for the assessment
Health and safety of workers and the population	Intensity	Forte	They mainly concern workers exposed to physical risks and difficult conditions, as well as local residents affected by dust and noise.
	Extent	Local	The risks mainly concern the site, the access track and the work areas of the transmission line
	Duration	Average	Risks persist during construction, with possible long-term consequences.
	Significance of impact	Major	

5.4.5.3.2 Operational phase

Impact	Setting	Assessment	Justification for the assessment
Health and safety of workers and the population	Intensity	Average	The risks associated with technical interventions in electrical environments and climatic conditions are present but controllable.
	Extent	Local	These risks mainly concern permanent staff on site and the nearest population
	Duration	Average	The risks persist throughout the plant's operating life.
	Significance of impact	Average	

5.4.5.3.3 Dismantling phase

Impact	Setting	Assessment	Justification for the assessment
Health and safety of workers and the population	Intensity	Average	The risks associated with manual and mechanical operations (accidents, exposure to dust) are significant.
	Extent	Local	The impact is limited to the construction site area and its immediate surroundings.
	Duration	Short	Corresponds only to the dismantling period.
	Significance of impact	Weak	

5.5 Characterization and evaluation matrix

Phase	Impact	Intensity	Extent	Duration	Importance	Importance after application of mitigation measures	Explanation
Construction	Soil contamination	Forte	Local	Average	Average	Minor	Pollution by hydrocarbons, oils, concreting and excavation.
	Air quality	Average	Local	Short	Minor	Minor	Temporary dust and exhaust fumes, impact on workers and local residents.
	Noise & vibrations	Average	Local	Average	Average	Minor	Constant noise of heavy machinery, lifting and unrolling cables.
	Water resources	Forte	Local	Average	Average	Minor	Risk of runoff and contamination of groundwater and

							agricultural soils.
	Fauna & flora	Average	Regional	Long	Major	Average	Habitat fragmentation, vegetation destruction, reptile/raptor disturbance.
	Landscape & Visual	Average	Local	Average	Average	Minor	Temporary landscape alteration by construction site, pylons and depots.
	Socioeconomic	Average	Local	Average	Average	Minor	Job creation, but nuisances and temporary agricultural restrictions.
	Health & Safety	Forte	Local	Long	Major	Average	Exposure to dust, mechanical and electrical risks and accidental intrusions.
	Waste management	Forte	Local	Average	Average	Minor	Inert, household, hazardous waste generated on site and LEHT.
	Gender & Vulnerability	Average	Local	Average	Average	Minor	Risks of GBV, marginalization of local women, vulnerability of children/families.
Exploitation	Climate & Air Quality	Weak	Regional	Short	Minor	Minor	Climate benefit, only limited emissions

							maintenance vehicles.
	Soil contamination	Weak	Local	Long	Average	Minor	Possible pollution by oils, waste and cleaning water.
	Noise & vibrations	Weak	Local	Average	Minor	Minor	Discreet sounds of technical equipment and maintenance vehicles.
	Water resources	Average	Local	Average	Average	Minor	Risk of contamination by panel cleaning water.
	Fauna & flora	Forte	Local	Average	Average	Minor	Bird collisions, habitat fragmentation, protected species impacted.
	Landscape & Visual	Average	Local	Long	Average	Minor	Sustainable landscape modification using panels and pylons.
	Health & Safety	Average	Local	Average	Average	Minor	EMC exposure, fire risks and electrical accidents.
	Socioeconomic	Average	Regional	Average	Average	Minor	Creation of permanent jobs, local economic benefits.
Dismantling	Air quality	Average	Local	Average	Average	Minor	Temporary dust and gases generated by machinery.

	Soil contamination	Average	Local	Average	Average	Minor	Pollution from oils, fuels and heavy machinery compaction.
	Waste management	Average	Local	Average	Average	Minor	High volume of solid and hazardous waste to manage.
	Water & wastewater	Average	Local	Average	Average	Minor	Risk of contamination by runoff and hazardous products.
	Noise & vibrations	Weak	Local	Average	Minor	Minor	Intermittent noise from heavy machinery and local vibrations.
	Landscape & Visual	Average	Local	Short	Minor	Minor	Temporary visual impact linked to machinery and material storage.
	Fauna & flora	Weak	Local	Short	Minor	Minor	Local disturbances but gradual return after lifting of fences.
	Health & Safety	Average	Local	Average	Average	Minor	Risks related to machinery, electricity, lifting and heat.
	Socioeconomic	Average	Local	Average	Average	Minor	Permanent job loss but temporary opportunities, positive

							recovery possible.
--	--	--	--	--	--	--	--------------------

5.6 Cumulative impacts and measures

Neighbouring projects:

PV Plant of Sidi Bouzid 1 – 60 MW (Scatec, under construction)

The 60 MW Sidi Bouzid 1 photovoltaic plant, developed by Scatec, is currently under construction and is scheduled to start operations in the fourth quarter of 2025. The site is located in the Mezzouna delegation of Sidi Bouzid governorate, about 8 km from the local community of Khobna and 6 km from Menzel Habib in the Gabès governorate. In terms of proximity, the plant lies approximately 10 km in a straight line from the Sidi Bouzid 2 PV plant and around 12 km away along the proposed OHTL route linking the two sites. Electricity generated from Sidi Bouzid 1 is already being connected to STEG's transmission network through a 5.2 km, 225 kV line that has been constructed.

PV Plant of Menzel Habib – 100 MW (Votalia)

The 100 MW Menzel Habib photovoltaic plant, developed by Votalia, is located about 25 km in a straight line from the Sidi Bouzid 2 PV plant. Power generated by the facility will be evacuated through a dedicated connection line to an existing 150 kV OHTL situated on the southern boundary of the site. This transmission line, connecting Bouchema to Mdhila, is planned to be reinforced and upgraded to 225 kV to accommodate the additional capacity.

PV Plant of Sidi Bouzid 2 – 120 MW (Scatec)

In December 2024, Scatec (hereafter “the Developer”) was awarded an agreement for the development of a 100 MW / 120 MWp photovoltaic (PV) solar power plant in the governorate of Sidi Bouzid, hereafter referred to as “the Project” or “PV Plant Sidi Bouzid 2”. To evacuate the electricity generated, the Developer will construct a 12 km overhead transmission line (OHTL) linking the solar arrays to the National Grid through the Mezzouna PV site, also under construction by Scatec.

5.6.1 Cumulative air pollution (construction site + neighbouring Scatec solar power plant)

During the construction phase, dust and exhaust emissions from construction machinery and trucks will be added to those generated by the work at the SCATEC plant, located in the same area. Although these emissions remain temporary and localized, their combination can temporarily increase the concentration of fine particles, especially in dry and windy weather, affecting air quality for workers and nearby communities.

5.6.2 Ecological disturbance and habitat fragmentation (cumulative with Scatec)

The installation of two adjacent photovoltaic power plants (Qair and SCATEC) leads to a wider artificialization of steppe habitats. Ecological fragmentation is reinforced, limiting the movement of terrestrial fauna. The risk of bird collision is accentuated by the presence of two HV lines and a greater density of reflective structures (panels, pylons). These effects are compounded by the proximity of sensitive areas such as Sebkheth Noual (5.5 km) and the buffer zone of the Bouhedma National Park along the northern section of the line.

5.6.3 Social management and cumulative risks for local communities

The simultaneous presence of two major projects increases the pressure on local infrastructure

(access roads, truck traffic). The risk of road accidents is multiplied, particularly for children attending the school crossed by the access road. Socially, the influx of a large, mainly male workforce associated with the two projects can increase the vulnerability of women and accentuate the risks of GBV (Gender-Based Violence) or marginalization.

5.6.4 Landscape and visual impact

The juxtaposition of two large photovoltaic power plants and their high-voltage lines has permanently altered the landscape of the Mezzouna region. Although the areas are far from the main towns, the cumulative visual effect is noticeable on the homogeneous steppe plains, reinforcing the perception of artificialization of the environment.

Mitigation measures:

Cumulative impact	Prevention and mitigation measures
Cumulative air pollution (construction site + neighboring power plant)	<ul style="list-style-type: none"> • Water unstabilized tracks regularly • Limit the speed of machinery on site • Maintaining machinery to reduce emissions • Install dust shields in sensitive areas • Plan work during hours less exposed to wind
Ecological disturbance and habitat fragmentation (cumulative with SCATEC)	<ul style="list-style-type: none"> • Install anti-collision devices (spirals, reflectors) on HV lines. • Reduce nighttime lighting and direct spotlights towards the ground. • Plan joint Qair-Scatec ecological monitoring of protected birds and flora (<i>Vachellia tortilis</i>, <i>Searsia tripartita</i>). • Create wildlife corridors and avoid continuous hermetic fences.
Social management and cumulative risks for local communities	<ul style="list-style-type: none"> • Coordinate truck traffic between the two projects to avoid traffic congestion. • Install reinforced signage and organize traffic to protect sensitive areas (schools, hamlets). • Deploy joint complaints management mechanisms, accessible to women and vulnerable people. • Raise awareness among workers about respecting local social standards and preventing GBV.
Landscape and visual impact	<ul style="list-style-type: none"> • Provide light landscaping (local steppe plantings) around technical buildings. • Limit the height of non-essential ancillary structures. • Reduce nighttime lighting visible from a distance.

5.7 Residual impacts

Despite the implementation of the mitigation measures provided for in the **ESMP** , certain residual impacts remain.

5.7.1 Soil and water resources

Even with strict preventive measures (retention tanks, watertight platforms, reinforced HSE management), a moderate risk of accidental soil pollution remains in the event of failure (oil leak, poor management of construction site wastewater). In an arid context, this localized pollution could infiltrate and contaminate the water table. Furthermore, during exceptional rainy episodes, runoff phenomena can increase the dispersion of pollutants. These risks, although low, remain **residual and localized** .

5.7.2 Birdlife and terrestrial fauna

Despite the installation of bird markers and the establishment of ecological corridors, the risk of **collision with the HV line cables** remains present, particularly for migratory birds using Sebkhet Noual as a stopover, and for certain species linked to the wooded areas of Bouhedma. Certain sensitive species (raptors, waders, owls) could also avoid the area in the event of repeated disturbance. In the long term, these residual impacts may weaken regional ecological connectivity. For terrestrial fauna, the risk of road mortality or habitat disturbance, although reduced, remains possible around pylons and tracks.

5.7.3 Flora and natural habitats

Protected and vulnerable species identified during the surveys (notably **Vachellia tortilis** and **Searsia tripartita**) are protected by strict avoidance measures. However, in the event of occasional non-compliance with the instructions or acts of illegal logging, a residual risk remains for these relict species. In addition, habitat fragmentation linked to the HV line could limit the regeneration of natural flora in certain sensitive areas.

5.7.4 Landscape and living environment

The permanent installation of metal structures (signs, pylons, fences) permanently modifies the homogeneous steppe landscape of the area. Even after dismantling, an altered visual perception will persist, especially in the absence of complete plant reconstitution. This residual impact is **small but permanent**.

5.7.5 Social conditions

After the construction and operational phases, the end of temporary jobs and the reduction in local economic benefits can generate frustration, particularly if community expectations have not been well managed. Vulnerable populations (rural women, livestock farmers dependent on the land crossed by the HV line) could retain a **feeling of exclusion** if benefit-sharing mechanisms are not strengthened.

6 Study of HSE risks linked to the project

Risk assessment is an important step in occupational health and safety management. It involves identifying potential hazards for workers and assessing the risks associated with these hazards. This assessment allows for the planning of preventive actions to reduce or eliminate the identified risks by implementing effective preventive measures to protect the health and safety of workers and surrounding communities.

6.1 Methodology

The methodology followed is divided into three stages for risk analysis:

- **The first step** is to identify hazards and dangerous situations. This involves conducting a comprehensive assessment of the construction site to identify potential risks to the health and safety of workers, as well as to the environment and nearby communities. This step may include analyzing construction plans, equipment used, construction materials, work processes, and environmental conditions.
- **The second step** is to estimate the severity of potential harm and the frequency of exposure for each identified hazardous situation. This involves determining the potential consequences of each identified hazard, as well as the likelihood of those consequences occurring. This step may include using historical data, statistics, and expertise to assess risks.
- **The third step** is to prioritize risks to determine the action plan. This involves ranking the identified hazards and dangerous situations according to their severity and frequency of exposure to determine the highest and most urgent risks. This step may include implementing prevention and control measures to reduce the identified risks, as well as establishing a monitoring plan to monitor the effectiveness of the measures taken.

6.2 Presentation of the evaluation grid

When estimating potential project risks, it is important to follow a series of rigorous steps. One of these steps is risk estimation, which involves assessing the potential hazards associated with a given situation by considering two key factors: the frequency of exposure to the hazard and the severity of potential damage.

To assess the frequency of exposure to a hazard, it is important to consider the likelihood of the hazardous situation occurring. Frequency levels can range from low to very frequent, depending on the likelihood of the hazard occurring. For example, a hazardous situation that occurs rarely would be considered low frequency, while a hazardous situation that occurs regularly would be considered high frequency.

Z

When considering the severity of potential harm, it is important to consider the potential consequences of the hazardous situation. Severity levels can range from low to very severe, depending on the severity of the potential harm. For example, a hazardous situation that could cause minor harm would be considered low severity, while a hazardous situation that could cause major harm or fatality would be considered high severity.

Once the frequency of exposure to the hazard and the severity of potential harm have been assessed, it is possible to determine the level of risk associated with the hazardous situation. This level of risk can then be used to make informed decisions on how to manage the hazardous situation and minimize risks to the environment and society.

Table 29 Levels of factors (P, G) of the occupational risk assessment grid

Ladder of probability (P)		Ladder of gravity (G)	
Score	Meaning	Score	Meaning
P1	Very unlikely	G1 = weak	Accident Or disease without stop of work
P2	Unlikely	G2 = average	Accident Or disease with stop of work
P3	Likely	G3 = serious	Accident or illness with permanent or partial disability
P4	Very likely	G4 = very serious	Accident or fatal disease

Table 30 Risk Matrix

Severity \ Probability	P1 Very unlikely	P2 Unlikely	P3 Probable	P4 Very likely
G4 Very serious	● Low-Medium	● Medium	● High	● Very high
G3 Grave	● Medium	● Medium	● High	● High
G2 Average	● Low	● Medium	● Medium	● Medium
G1 Low	● Low	● Low	● Medium	● Medium

Table 31 Risk assessment grid

	P1	P2	P3	P4
G 4				
G 3				
G 2				
G 1				

Table 32: Meaning of colors

Level of risk 1 : Pupil	
Level of risk 2: AVERAGE	
Level of risk 3 : Weak	

1.3 Risk analysis:

The risk analysis is presented by project phase (pre-construction, construction, operation and decommissioning), since each activity in each phase involves risks, both for workers and local communities. For this photovoltaic power plant project, including a site, an access road and a transmission line, the activities can have impacts on health, hygiene and the environment.

This analysis is based on both:

- Observations and information collected regarding the specific activities of each phase of the project.

Each identified risk was assessed with reference to the risk matrix, according to the defined

methodology, in order to determine the appropriate prevention and mitigation measures.

6.2.1 Pre-construction phase:

6.2.1.1 Risk: Fire (base camp, storage, vegetation)

Dangers and/or dangerous situations Risk of fire in the preparatory phase linked to: <ul style="list-style-type: none"> • Presence of temporary accommodation (base life) • Storage of flammable materials (wood, pallets, fuels) • Presence of dry vegetation on the site before earthworks 	Qualitative risk assessment: This situation is common on construction sites during the preparation phase, especially in hot and dry conditions. Incidents can occur due to short circuits, human negligence (cigarettes, poorly extinguished fires), or improper storage of flammable materials. This risk is increased by the dry, steppe vegetation of the Sidi Bouzid region, particularly in summer.	
	Probability: Likely	P3
	Severity: Very Serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • No smoking in risk areas and clearly displayed. • Separate and secure storage of combustible materials (ventilated, marked area). • Clearing dry vegetation around the base camp. • Regular checks of temporary electrical installations. • Equipping the base camp with standardized fire extinguishers. • Training of staff in the use of first response resources. • Permanent surveillance or security rounds. • Implementation of fire emergency procedures (with instructions posted). 		

6.2.1.2 Mechanical injuries (fences, metal materials/barbed wire)

Dangers and/or dangerous situations Risks of cuts, scratches, punctures or crushing linked to: <ul style="list-style-type: none"> • Handling barbed wire or metal fences • Transport and assembly of stakes, fences, metal structures • Lack of suitable protective equipment (gloves, goggles, long sleeves, toe-cap shoes) 	Qualitative risk assessment: These situations are common during the installation of temporary fences or storage areas, during the preparatory phase. The risk is increased in cases of haste, poor coordination, or lack of personal protection.	
	Probability: Very Likely	P4
	Severity: medium	G2
	Risk level: AVERAGE	2
	Risk level after applying preventive measures: Weak	3
Preventive measures: <ul style="list-style-type: none"> • Mandatory provision of PPE: cut-resistant gloves, safety glasses, long clothing, safety shoes. • Training/awareness on the safe handling of metal materials and barbed wire. • Clear organization of assembly areas to avoid haphazard movements. • Use of suitable tools for tensioning and fixing fences (avoid direct handling). • Presence of an easily accessible first aid kit. 		

- Supervision by a safety manager during installation work.

6.2.1.3 Collision/rollover for workers (machinery – temporary tracks, narrow maneuvers)

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	These dangerous situations are common on construction sites during the preparatory phase and the initial earthworks. They can lead to collisions between machines, collisions with ground personnel, or even the overturning of machines on unstable ground.	
• The circulation of machinery on unstabilized or poorly sized tracks	Probability: Likely	P3
• Maneuvers in areas with reduced visibility or clutter	Severity: Severe	G3
• The lack of separation between vehicles and pedestrians or adequate signage	Risk level: Pupil	1
• Lack of driver training or machine failure	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • Clear traffic plan established from the preparation phase (crossing zones, priority lanes). • Physical separation between vehicle traffic and pedestrian paths (barriers, ribbons). • Visible signage (signs, road markings, flashing lights). • Prior stabilization of temporary tracks (leveling, compaction if necessary). • Qualified drivers trained in on-site driving. • Presence of a ground guide (" traffic man ») during maneuvers in sensitive areas. • Limited speed and no reversing without a guide. • Regular technical inspection of vehicles (braking, steering, tires, lights). • Mandatory wearing of PPE for ground staff. 		

6.2.1.4 Health risk (hygiene, wastewater, waste – base camp)

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	These situations are common in poorly maintained construction site living quarters. They can lead to waterborne diseases, infections, allergies, or infestations. The risk is heightened by the region's hot climate.	
• Insufficient sanitary facilities (toilets, showers)	Probability: Likely	P3
• Poor wastewater disposal (overflowing pit, stagnation)	Severity: medium	G2
• The accumulation or improper sorting of household and organic waste	Risk level: AVERAGE	2
• Lack of disinfection or regular cleaning of living spaces	Risk level after applying preventive measures: Weak	3

<ul style="list-style-type: none"> The presence of vectors (rodents, insects) favored by unsanitary conditions 		
Preventive measures: <ul style="list-style-type: none"> Installation of sufficient, separate, maintained sanitary facilities connected to a compliant drainage system. Daily cleaning of common areas. Regular collection and controlled disposal of household waste. Provision of closed bins and suitable bags. Installation of a drainage system to prevent stagnation of wastewater. Contracts with approved service providers for emptying pits or tanks. Staff training/awareness raising on individual and collective hygiene. Preventive pest control (traps, regular disinfection). Display of hygiene rules in living spaces. 		

6.2.2 Construction phase:

6.2.2.1 Fall from height / falling objects (assembly of structures, trackers, modules)

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	This type of accident is common on high-rise construction sites, especially when safety devices are missing or misused. It can result in serious or even fatal injuries to fitters or ground workers.	
<ul style="list-style-type: none"> Working at height for fixing structures or PV modules 	Probability: Very Likely	P4
<ul style="list-style-type: none"> Falling metal parts or tools during lifting or installation 	Severity: Very serious	G4
<ul style="list-style-type: none"> Lack of guardrails, harnesses, or lifelines 	Risk level: Pupil	1
<ul style="list-style-type: none"> Slipping on metal or unstable surfaces 	Risk level after applying preventive measures:	2
<ul style="list-style-type: none"> Improper or rushed handling of heavy loads 	AVERAGE	
Preventive measures: <ul style="list-style-type: none"> Installation of a fall protection system: harnesses, lifelines, anchor points. Installation of fall protection nets or temporary guardrails. Mandatory wearing of helmets with chin straps for all personnel in the assembly area. It is prohibited to stand or move under lifting areas. Training of fitters in working at height techniques and safe actions. Daily verification of the stability of the scaffolding or platforms used. Organization of high-level storage areas to prevent tipping. Use of suitable lifting devices (cranes, winches) with certified operators. Presence of an HSE supervisor during assembly operations. 		

6.2.2.2 Electrocuting (cable installation, inverters, STS)

Dangers and/or dangerous situations	Qualitative risk assessment:
Risks related to:	This risk is critical during electrical installation or connection, especially in the absence of strict security measures. Electrocuting can cause severe burns, cardiac arrest, or

<ul style="list-style-type: none"> • Direct contact with bare or poorly insulated conductors • Intervention on inverters or transformers without prior consignment • Connection of live or unidentified cables • Lack of adequate collective or individual protection • Failure to comply with lockout, tagging or power-down procedures 	immediate death.	
	Probability: Likely	P3
	Severity: Very serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • Mandatory wearing of suitable PPE: insulating gloves, visor, dielectric mat, flame-retardant clothing. • Clear identification and traceability of all electrical circuits. • Marking and prohibition of access to live areas. • Specific training for electricians in HV risks and mandatory authorization. • Presence of an electrical manager to supervise critical interventions. • Systematic check for the absence of tension before any intervention. • Use of insulated and standard-compliant tools. • Visible display of wiring plans and single-line diagrams on site. 		

6.2.2.3 Accidents and disruptions to communities related to the movement of machinery)

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> • Frequent traffic of tanker trucks, cement trucks, construction material trucks and excavation equipment on the access road to the construction site. • High risk of road accidents, injuries or deaths for pedestrians and local residents. • Disruption of agricultural activities and inconvenience to residents. 	Qualitative risk assessment:	
	The increase in vehicle and heavy machinery traffic during the construction phase significantly increases the risk to communities. The immediate proximity of sensitive areas (agricultural land) increases the severity of the impacts.	
	Probability: Likely	P3
	Severity: Very Serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • Speed limit for vehicles on the track and clear signage along sensitive areas (school, farmland, railway). • Organization of safe traffic circuits and adapted timetables to reduce the exposure of children and local residents. • Driver awareness of community risks and road safety training. • Continuous monitoring at critical points, especially near the school, the railway and agricultural areas. 		

- Regular communication with local residents and farmers on the schedule and work areas.

6.2.2.4 Noise and air pollution for communities

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	Local residents and school children are exposed to noise pollution and localized air quality degradation. Even moderate exposure can cause discomfort, fatigue, respiratory irritation, and stress.	
• Noise generated by machinery circulating on the access road and by construction activities (pile driving, generators, earthworks).	Probability: probable	P3
• Exhaust emissions from vehicles operating on the track used by local residents and the school.	Severity: serious	G3
• Prolonged exposure may affect respiratory health or cause stress.	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures:		
<ul style="list-style-type: none"> • Limit the hours of noisy work and the passage of machinery near the school and homes. • Maintain machinery regularly to reduce noise and emissions. • Install information signs and communicate with local residents about work periods and areas. • Watering of runways as needed to reduce dust and improve air quality. • Raise staff awareness of the impacts on communities and practices to limit nuisances. 		

6.2.2.5 Disruption of groundwater resources for communities

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	Any disruption or pollution of the water table can compromise access to drinking water or water for agriculture. Even a minor incident can have significant health and economic impacts for local communities.	
• The site is located in a water table area.	Probability: probable	P3
• Construction site activities (earthworks, movement of machinery, storage of fuels and chemicals) can cause infiltration or contamination of the water table.	Severity: serious	G3
• Local populations use this water table for their domestic, agricultural and livestock needs.	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures:		
<ul style="list-style-type: none"> • Limit the storage of fuels, lubricants and chemicals to sealed and secure areas. • Install retention tanks under equipment and refueling points. • Implement strict accidental spill management procedures and on-site containment kits. 		

- Train staff in water resource protection and leak response.
- Regularly check the tightness of installations and equipment.
- Periodic monitoring of groundwater quality before, during and after work.
- Communication with communities on measures taken and safety instructions.

6.2.2.6 Chemical risk (oils, lubricants, construction site residues)

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	This risk is present during the installation, filling or maintenance phases of equipment containing technical fluids. It can cause burns, poisoning, allergies or pollution of the soil and water table.	
<ul style="list-style-type: none"> • Leaks or spills of transformer insulating oils (e.g. mineral oil) • Accidental use or release of lubricants or solvents • Inhalation of vapors or prolonged skin contact with chemical substances • Lack of protective equipment during handling • Improper storage of chemicals (open, unlabeled cans) 	Probability: probable	P3
	Severity: serious	G3
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures:		
<ul style="list-style-type: none"> • Use of retention tanks under transformers, drums or filling areas. • Storage of oils and lubricants in a ventilated, closed, identified room equipped with fire extinguishers. • Mandatory wearing of PPE: chemical gloves, goggles, waterproof suit in case of handling. • Training of staff in reading Safety Data Sheets (SDS). • No emptying or discharge onto the ground. • Provision of containment and absorption kits (granules, absorbent cloths). • Disposal of chemical waste via an approved service provider. • Mandatory labeling of all chemical containers. 		

6.2.2.7 Risk of bites or stings (dangerous wildlife)

Dangers and/or dangerous situations	Qualitative risk assessment: This is dangerous wildlife that represents a cross-cutting risk for workers	
<ul style="list-style-type: none"> • The confirmed presence of scorpions (<i>Androctonus australis</i>), horned vipers (<i>Cerastes cerastes</i>) and cobras (<i>Naja haje</i>) poses a real danger to workers. • These venomous species frequent stony soils, embankment areas or rocky edges. • Risks include bites or stings from accidental contact during earthworks, storage of materials or nighttime travel. 	Probability: Likely	P3
	Severity: Very Serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2

Preventive measures:

- Specific training for workers in the identification and behavior to adopt when faced with these species.
- Sufficient lighting of work areas and traffic routes at night.
- High-top shoes and thick gloves must be worn when handling on the ground.
- Regular inspection of storage areas and barracks.
- Provision of antivenom kits and emergency protocol in coordination with local health services.

6.2.2.8 *Burn/electric shock (exposed modules, premature power-up)*

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to:	This type of risk is real from the very beginning of panel installation. Voltage can appear as soon as the panels are exposed to sunlight, even without a complete connection. This can cause electrical burns or shocks if the panels come into direct contact.	
<ul style="list-style-type: none"> • Contact with modules exposed to the sun generating spontaneous voltage (active photovoltaic effect) • Connection of non-isolated module strings • Uncontrolled power-up of inverters or transformers • Temporary lack of grounding • Lack of PPE during electrical handling 	Probability: Likely	P3
	Severity: serious	G3
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • Handling of modules only outside periods of sunshine or with active faces temporarily covered. • Use of insulated connectors and terminal blocks upon installation. • Prohibition of partial connection or commissioning without prior validation. • Presence of a chief electrician during the gradual commissioning. • Mandatory wearing of insulated gloves, visor, long-sleeved clothing. • Systematic temporary grounding during electrical work. • Training in the prevention of risks linked to direct current (DC) generated by panels. 		

6.2.2.9 *Risk of contamination of surface and groundwater during foundation work on the pylons of the HT line near the Sebkha*

Dangers and/or dangerous situations	Qualitative risk assessment:	
Contamination of surface and groundwater during foundation work on pylon foundations:	Foundation work for high-voltage line pylons, particularly in the agricultural and steppe areas crossed, can create a risk of groundwater contamination in the event of an oil leak or uncontrolled concreting. This risk is increased in areas where the water table is shallow.	
<ul style="list-style-type: none"> • Accidental leaks or spills of hydraulic oils, fuels and lubricants from piling equipment. • Temporary rise of sediment and turbidity in the water during threshing. 	Probability: Likely	P3
	Severity: Severe	G3
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2

<ul style="list-style-type: none"> Accidental releases of concrete laitance. . 		
Preventive measures: <ul style="list-style-type: none"> Systematically install retention tanks under all equipment and pumping stations. Set up a network of collection gutters and a settling basin for runoff water before discharge. Check the tightness of the machines (pipes, fittings, cylinders) daily and replace any defective parts immediately. Provide rapid response kits (sorbents, floating barriers) and train personnel in spill response. Permanent surveillance or security rounds. Implementation of emergency response procedures (with instructions posted). 		

6.2.2.10 Risk of soil degradation and erosion

Dangers and/or dangerous situations Risk due to: <ul style="list-style-type: none"> Earthworks Repeated passage of heavy machinery Cut/fill without stabilization Lack of protective vegetation 	Qualitative risk assessment: In certain areas of the HT line crossing unstable or agricultural land, the repeated passage of machinery can aggravate erosion phenomena.	
	Probability: Unlikely (in case of heavy rain or wind)	P2
	Severity: Severe	G3
	Risk level: AVERAGE	2
	Risk level after applying preventive measures: Weak	3
Preventive measures: <ul style="list-style-type: none"> Limiting open and unprotected areas Reduction of machine movements in unstable areas Earthworks in limited stages Installation of anti-erosion devices in the event of steep slopes Rapid restoration of impacted areas 		

6.2.2.11 Hazardous waste risk

Dangers and/or dangerous situations Risk due to: <ul style="list-style-type: none"> Improper storage of used oils, paints, solvents or batteries Lack of containment areas or sealed containers Accidental leaks during handling or transport Accidental spills on bare ground 	Qualitative risk assessment: This situation is common on construction sites when hazardous waste is not properly identified, separated, or managed according to standards. This can lead to soil and water contamination, and even pose a health hazard to workers and local residents.	
	Probability: Likely	P3
	Severity: Very Serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2

Preventive measures:

- Clear identification of the types of hazardous waste present on site
- Establishment of dedicated, waterproof, covered and marked storage areas
- Use of containment trays for all hazardous liquid containers
- Staff training on the safe handling of hazardous waste
- Regular inspection of containers and storage facilities
- Mandatory labeling of waste according to its nature
- Periodic evacuation by approved service providers
- Maintaining a hazardous waste tracking register
- Strict ban on discharge into the environment (soil, water)

6.2.3 Operational phase

6.2.3.1 Electrocution (maintenance of live equipment)

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to: <ul style="list-style-type: none"> • Maintenance or repair of inverters, transformers and panels without prior lockout • Failure or failure to turn off power • Presence of residual voltage not detected • Use of non-insulated tools or inadequate PPE • Lack of marking or access control to electrical work areas 	Electrocution is a major risk during maintenance operations. Negligence in applying lockout procedures can cause a serious, potentially fatal accident. This risk is increased by the DC continuity effect of the PV modules.	
	Probability: Likely	P3
	Severity: Very serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2

Preventive measures:

- Strict application of consignment and deconsignment procedures (LOTO).
- Systematic verification of the absence of tension before any intervention (VAT).
- Mandatory training and authorization of personnel working on electrical equipment.
- Wear specific PPE: insulating gloves, visor, dielectric mat, arc-proof clothing.
- Use of insulated tools that comply with current standards.
- Marking and prohibition of access to areas under intervention.
- Presence of a second qualified operator to monitor critical operations.
- Preventive maintenance of electrical equipment to limit the risk of short circuits.
- Regular updating of electrical plans and diagrams.

1- Drop (cleaning of photovoltaic panels)

Dangers and/or dangerous situations	Qualitative risk assessment:	
Risks related to: <ul style="list-style-type: none"> • Working at height on inclined or raised structures 	Cleaning modules can expose workers to falls, particularly if they lose their balance on inclined or slippery surfaces. Falls can result in serious injuries, particularly in the absence of PPE or a fall arrest system.	
	Probability: Likely	P3

<ul style="list-style-type: none"> Slipping on wet surface (cleaning water) Use of long poles or unstable ladders Lack of lifeline, harness or guardrail Lack of visibility or adverse weather conditions (wind, heat, rain) 	Severity: serious	G3
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> Implementation of a secure cleaning plan: cool time slots, mandatory supervision. Mandatory wearing of PPE: harness, non-slip shoes, helmet with chin strap. Specific training in the prevention of working at height. Stabilization of work areas: platforms, secure access, certified ladders. It is forbidden to work alone when working on the modules. HSE monitoring during cleaning work. Pre-check weather conditions before each intervention. 		

6.2.3.1.1 Intrusion / malicious acts (site security failure)

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> Failure or absence of human supervision (guarding) Damaged or non-continuous fences Failures or blind spots in the video surveillance system Uncontrolled access to the site (gates left open or poorly locked) Presence of valuable materials or sensitive areas (inverters, cables, transformers) exposed 	Qualitative risk assessment: The site is exposed to malicious acts (theft, sabotage, intrusion) in the event of poor security. These intrusions can result in material damage, production interruptions, or even accidents for intruders or personnel. In an isolated site, the ability to respond quickly in the event of an intrusion is often limited.	
	Probability: Unlikely	P2
	Severity: serious	G3
	Risk level: AVERAGE	2
	Risk level after applying preventive measures: Weak	3
Preventive measures: <ul style="list-style-type: none"> Establishment of permanent and trained security (day/night). Regular inspection of the integrity of perimeter fences and access points. Preventive maintenance of video surveillance equipment, with alert system. Strict access control with entry/exit recording. Formalized and regularly updated site security plan. Cooperation with local authorities to increase vigilance in the event of a suspicious event. Raising staff awareness of security instructions and procedures in the event of an intrusion. 		

6.2.3.2 Exposure to electromagnetic fields (EMF)

Dangers and/or dangerous situations Risks related to:	Qualitative risk assessment: Electromagnetic fields generated during operation are generally weak, but can become significant in the direct
---	---

<ul style="list-style-type: none"> Prolonged presence in the immediate vicinity of transformers, inverters, or high-current AC cables Technical interventions around the delivery station (150/33 kV) Lack of signage in high radiation areas Repeated exposure without monitoring or measurement of thresholds 	vicinity of certain equipment. Prolonged or repeated work in these areas without precautions can expose workers to non-serious but disturbing physiological effects (fatigue, headaches, sleep disturbances).	
	Probability: Very Unlikely	P1
	Severity: Medium	G2
	Risk level: Weak	3
Risk level after applying preventive measures: Weak		3
Preventive measures: <ul style="list-style-type: none"> Limiting access to the immediate vicinity of transformers, inverters and power cables. Installation of visible signage around areas generating a high field. Carrying out periodic measurements of electromagnetic fields around the substation and transformers. Prolonged parking ban in high-emission zones. 		

6.2.3.3 Risk of bird collision with pylons and high-voltage lines

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> Presence of overhead power lines crossing or running along bird migration areas (semi-desert areas with sparse vegetation) Lack of visual signaling (beacon balls, spirals, etc.) on cables Migratory or local activity of certain avian species (gliders, birds of prey, etc.) 	Qualitative risk assessment: The region is located near the Sebkhet Noual, a wetland of avifaunal importance, and borders the Bouhedma National Park, which is home to several protected species. The HV line cables therefore represent an increased collision risk for migratory birds, raptors and wading birds.	
	Probability: very likely	P3
	Severity: Severe	G3
	Risk level: Pupil	1
Risk level after applying preventive measures: AVERAGE		2
Preventive measures: <ul style="list-style-type: none"> Installation of anti-collision devices on power lines (spirals, colored balls, UV reflectors visible to birds) Periodic monitoring of bird mortality (counting, inspection) Knowledge of migratory and nesting periods Integration of a biodiversity monitoring plan Maintenance of marking devices (replacement in case of wear or fall) 		

6.2.4 Dismantling phase

6.2.4.1 Electrical risk (disconnection and handling of residual live equipment)

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> Incomplete or uncontrolled disconnection of the delivery station or transformers 	Qualitative risk assessment: When dismantling, the most critical error is assuming that all equipment is de-energized. Failure to lock out or check insulation can cause electrocution. The direct current generated by the modules remains active even after disconnection if the procedure is not rigorous. This poses a life-threatening risk to untrained electricians or technicians.	

<ul style="list-style-type: none"> • Cables or modules still containing a residual charge (direct current) • Failure to check for absence of voltage (VAT) • Direct or indirect contact with live or poorly insulated conductors • Poor coordination between electrical dismantling teams 	Probability: probable	P3
	Severity: Very serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • Implementation of a rigorous consignment plan (AC and DC equipment). • Mandatory VAT (Voltage Absence Verification) before any handling. • Use of insulated tools and certified electrical PPE (gloves, mats, visors, arc-fighting clothing). • Clear separation of work areas: marking, physical locking of electrical cabinets. • Presence of an HSE manager or authorized electrician to supervise each step. • Training and qualification of personnel involved in electrical dismantling. • Visual recording (posters, tags, padlocks) on each piece of equipment dismantled. • Maintaining a consignment/deconsignment register with validation at each stage. • Preparation of immediate emergency resources: first aid kit, defibrillator, emergency call line. 		

6.2.4.2 Fall / collapse (dismantling of structures, buildings, fences)

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> • Dismantling of high-rise metal structures (trackers, modules, fences) • Subsidence or imbalance of poorly supported load-bearing elements • Work on roofs or unstable platforms (control room, guard post) • Fall from height or object when dropping without a basket or harness • Partial collapse of weakened structures (foundations, walls) without a secure deconstruction plan 	Qualitative risk assessment:	
	The dismantling of structures and buildings presents a high risk of falls, either by personnel (from heights) or by loose elements (heavy objects or materials falling onto others). The lack of a phased dismantling plan or physical securing (shoring, nets, harnesses) increases this danger.	
	Probability: probable	P3
	Severity: Severe	G3
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> • Development of a sequenced deconstruction plan, validated by a safety engineer. • Implementation of collective protections: guardrails, safety nets, rigid barriers. 		

- Mandatory use of fall protection PPE: harnesses, lanyards, non-slip shoes.
- Intervention via secure lifting platforms for dismantling at height.
- Preliminary stabilization of structures before removal (shoring if necessary).
- Specific training in fall prevention and working at height.
- Marking out areas where objects could potentially fall, with the exclusion of all unauthorized personnel.
- Continuous monitoring and control by the HSE coordinator during critical operations.
- Provision of an emergency plan and an on-site first aid team.

6.2.4.3 Injury during sorting and disposal of waste (sharp, heavy or bulky items)

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> • Manual handling of metal structures, cables, broken modules or sharp edges • Poor packaging of bulky or sharp waste • Lack of suitable PPE (cut-resistant gloves, safety shoes, glasses) • Bulky waste placed unstably → risk of crushing or falling • Use of lifting equipment without proper training or marking 	Qualitative risk assessment:	
	Sorting and disposing of waste during dismantling exposes workers to the risk of cuts, crush injuries, sprains, and back pain. This risk is even higher if staff are not trained in safe handling or if waste is poorly sorted or scattered throughout work areas.	
	Probability: probable	P3
	Severity: Medium	G2
	Risk level: AVERAGE	2
	Risk level after applying preventive measures: Weak	3
Preventive measures: <ul style="list-style-type: none"> • Mandatory wearing of suitable PPE: cut-resistant gloves, goggles, helmet, reinforced shoes. • Implementation of initial sorting in the area with signage of hazardous waste (glass, sharp edges, oxidized metals). • Use of trolleys, handcarts or mechanized equipment to avoid manual carrying of heavy loads. • Staff training in safe handling and correct lifting. • Development of temporary waste disposal areas, marked and stabilized. • Use of suitable and resistant containers for sharp or metal waste. • Continuous supervision of sorting areas by an HSE representative. • Planning evacuation rotations to avoid congestion. • Checking the condition of lifting and transport equipment before each use. 		

6.2.4.4 Fire (short circuit or spark when disconnecting/cutting cables)

Dangers and/or dangerous situations Risks related to: <ul style="list-style-type: none"> • Improper handling of live cables • Defect or wear of protective equipment 	Qualitative risk assessment:	
	Risk of fire due to the production of sparks or short circuits during disconnection, cutting or handling of residual electrical cables. This risk can cause a fire on site, damage remaining installations, and threaten the safety of personnel.	
	Probability: probable	P3

<ul style="list-style-type: none"> Lack of rigorous security procedures Presence of combustible materials nearby 	Severity: Very serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	2
Preventive measures: <ul style="list-style-type: none"> Check and carefully insulate all cables before intervention Use appropriate personal protective equipment (PPE) Train staff in specific disconnection and cutting procedures Prohibit the presence of flammable materials in the work area Have suitable and easily accessible fire extinguishers available Carry out continuous monitoring during risky operations Implement a fire emergency protocol with clear instructions 		

1- Risk of bites or stings (dangerous wildlife)

Dangers and/or dangerous situations <ul style="list-style-type: none"> The confirmed presence of scorpions (<i>Androctonus australis</i>), horned vipers (<i>Cerastes cerastes</i>) and cobras (<i>Naja haje</i>) poses a real danger to workers. These venomous species frequent stony soils, embankment areas or rocky edges. Risks include bites or stings from accidental contact during earthworks, storage of materials or nighttime travel. 	Qualitative risk assessment: "As during the construction phase, dismantling work exposes workers to risks linked to the venomous fauna present in the area (scorpions, horned vipers, cobras). These risks must be anticipated by similar preventive measures (training, PPE, antivenom kits)." 	
	Probability: Likely	P3
	Severity: Very Serious	G4
	Risk level: Pupil	1
	Risk level after applying preventive measures: AVERAGE	
Preventive measures: <ul style="list-style-type: none"> Specific training for workers in the identification and behavior to adopt when dealing with these species. Sufficient lighting of work areas and traffic routes at night. High-top shoes and thick gloves must be worn when handling on the ground. Regular inspection of storage areas and barracks. Provision of antivenom kits and emergency protocol in coordination with local health services. 		

6.3 Summary of the risk assessment

Risk	Phase	Probability	Gravity	Risk level	Risk level after applying preventive measures
Fall from height / falling objects (assembly of	Construction	Very likely	Very low pitch	High (1)	Medium (2)

structures, trackers, modules)		(P4)	(G4)		
Risk: Fire (base camp, storage, vegetation)	Pre-construction	Probable (P3)	Very low pitch (G4)	High (1)	Medium (2)
Electrocution (maintenance of live equipment)	Exploitation	Probable (P3)	Very low pitch (G4)	High (1)	Medium (2)
Hazardous waste risk	Construction	Probable (P3)	Very low pitch (G4)	High (1)	Medium (2)
Fire (short circuit or spark when disconnecting/cutting cables)	Dismantling	Probable (P3)	Very low (G4)	High (1)	Medium (2)
Electrocution (cable installation, inverters, STS)	Construction	Probable (P3)	Very low pitch (G4)	High (1)	Medium (2)
Bird collision with pylons	Exploitation	Very likely (P4)	Grave (G3)	High (1)	Medium (2)
Risk of contamination of surface and groundwater	Construction	Probable (P3)	Grave (G3)	High (1)	Medium (2)
Burn/electric shock (exposed modules, premature power-up)	Construction	Probable (P3)	Grave (G3)	High (1)	Medium (2)
Drop (cleaning of photovoltaic panels)	Exploitation	Probable (P3)	Grave (G3)	High (1)	Medium (2)
Fall / collapse (dismantling of structures, buildings, fences)	Dismantling	Probable (P3)	Grave (G3)	High (1)	Medium (2)
Collision / rollover (machines - temporary runways, narrow maneuvers)	Pre-construction	Probable (P3)	Grave (G3)	High (1)	Medium (2)
Chemical risk (oils, lubricants, construction site residues)	Construction	Unlikely (P1)	Grave (G3)	Medium (2)	Low (3)

Health risk (hygiene, wastewater, waste – base camp)	Pre-construction	Probable (P3)	Average (G2)	Medium (2)	Low (3)
Noise and dust (earthworks, machinery)	Pre-construction	Probable (P3)	Average (G2)	Medium (2)	Low (3)
Mechanical injuries (fences, metal materials/barbed wire)	Pre-construction	Very likely (P4)	Average (G2)	Medium (2)	Low (3)
Intrusion / malicious acts (site security failure)	Exploitation	Unlikely (P1)	Grave (G3)	Medium (2)	Low (3)
Soil degradation and erosion	Construction	Unlikely (P1)	Grave (G3)	Medium (2)	Low (3)
Injury during sorting and disposal of waste (sharp, heavy or bulky items)	Dismantling	Probable (P3)	Average (G2)	Medium (2)	Low (3)
Exposure to electromagnetic fields (EMF)	Exploitation	Very unlikely (P0)	Average (G2)	Low (3)	Low (3)
Risk of bites or stings (dangerous wildlife)	Construction and Dismantling	Likely	Very serious	High (1)	Medium (2)

7 Stakeholder consultations and engagement plan

In accordance with national regulatory requirements and international standards (including the IFC Performance Standards and the EBRD and EIB Policies), stakeholder consultation and engagement were integrated from the preparatory phase of the Environmental and Social Impact Assessment (ESIA). A Stakeholder Engagement Plan (SEP) was developed as a separate document, constituting the main reference for organizing, planning and monitoring consultations throughout the project lifecycle. This document defines in detail the objectives, the adopted methodology, the consultation mechanisms and the grievance management system.

In this ESIA, only the results of upstream consultations are included in order to ensure the traceability of exchanges with local communities, authorities and stakeholders. The entire operational process of stakeholder engagement is described in the PEPP, while the ESIA focuses on elements directly useful for impact assessment and the development of the Environmental and Social Management Plan (ESMP).

7.1 Consultation methodology adopted

The methodology used to develop the PEPP was based on a participatory, progressive and contextual approach aimed at ensuring inclusion and transparency. It began with a documentary analysis of existing data (cadastral plans, soil maps, preliminary layouts and institutional documents) which made it possible to identify an initial hypothesis of the stakeholders concerned. Field missions were then carried out on the power plant site and along the planned route of the HV line, in order to observe land use, identify sensitive areas (Sebkha Ennaouel, Bouhedma Park, agricultural and pastoral lands) and meet directly with some local families, such as the Arch Jenf family.

At the same time, institutional consultations were conducted with the Governorate of Sidi Bouzid, the various CRDA districts (soils, CES, forests, water resources), the State Property Directorate, the Office of Topography and Cadastre, as well as the Forestry Directorate and the curator of the Bouhedma Park. These discussions made it possible to collect technical and regulatory data, clarify land and ecological constraints, and specify conservation issues.

At the local level, community meetings were held with local councils and the Omda of Khobna, Gharbiya and Charkiya, to identify agricultural and pastoral uses, access constraints and social concerns. Finally, a cross-analysis of the information collected made it possible to map stakeholders according to their level of interest and influence, highlighting vulnerable groups (rural women, pastoralists, households without land titles, unemployed youth, isolated elderly people, isolated families, people with disabilities). All these steps resulted in the development of the PEPP as a stand-alone document, in compliance with EBRD PR10, IFC PS1 and EIB ESS10.

7.2 Summary of consultations

Table 33: Consultation register

Date	Meeting	Stakeholders consulted	Main points covered	Actions to follow
08/05/2025	Meeting in the governorate of Sidi Bouzid	Governorate, CRDA, State Domain, ANME, STEG, Regional Council, Energy Transition Directorate, Mezzouna Local Council, Omda Khobna,	Presentation of the project and the EIES process, confirmation of the state status of the land (plot no. 52 732), support from the institutions, no objection from community representatives	Finalize the field mission, collect missing institutional data, plan restitution

		Mazzouna Delegation, Qair Group		
05/09/2025	Meeting with the district of hydraulic resources	Head of the Water Resources District - CRDA Sidi Bouزيد	Presentation of the project, absence of a conservation zone, access to topographic maps and water table, data on salinity and drop in the water table level	Carry out the flood study, plan a temporary acquisition, obtain the available hydrological maps
05/09/2025	Meeting with the CES district	Head of district CES - CRDA Sidi Bouزيد	EIES methodology, need not to impact CES structures, rehabilitation possible in the event of allocation of benches, no CES structure active on the power plant site	Identify any CES structure on the route, plan rehabilitation measures if necessary
05/09/2025	Meeting with the Sol district	Head of district Sols - CRDA Sidi Bouزيد	Agricultural vocation of land, importance of preservation even in the event of easement, risks of erosion, sharing of soil maps, suitability and vocation	Integrate maps and recommendations into the E&S assessment
05/09/2025	Meeting with the Forests district	Head of Forestry District - CRDA Sidi Bouزيد	Reference to Article 222 of the Forestry Code, absence of digital data from Bouhedma Park, coordination necessary with the DGF	Contact the DGF to obtain official delimitation data
10/05/2025	Meeting with the Meknassi Forestry Department	Director of Forest Conservation	Visit to the park and protected areas (Addax, Oryx), confirmation of the forest's influence on the mountains, route outside the park, option of setting up in the forest	Study other route options and their technical and institutional feasibility

09/07/2025	Meeting with the National Heritage Institute (INP)	Conservatives of the INP (Bir El Hafey), ASF Consulting (Aroua Mestiri, Mehdi Benchelbi)	Presentation of the QAIR project and mission of the design office, discussion on the archaeological heritage discovered in Khobna, location of the Roman site (basins), assessment of potential impacts	Carry out a joint field visit to view the archaeological site and discuss implementation issues
------------	--	--	---	---

7.3 Level of stakeholder participation

The consultation process involved institutional stakeholders (governorate, CRDA, STEG, Directorate of Estates, INP), local structures (municipalities, local councils, Omda), local communities, and families directly affected by the transmission line. The meetings took the form of formal meetings at the governorate, field visits, targeted consultations, and community meetings. This early level of participation helped establish a climate of transparency and initiate an ongoing dialogue between the developer, the authorities, and local populations.

7.4 Main concerns expressed

The concerns raised mainly relate to the preservation of agricultural and pastoral land, the risks of restricted access to livestock grazing areas, the possible overlap of the route with the Bouhedma National Park, and the proximity of the Sebkha Ennaouel. The Arch Jenf family expressed particular concern regarding access to their land and the risk of isolation in the event of flooding. The technical services emphasized the need to respect the CES structures, limit the impact on the water table, and ensure compatibility with the Forestry Code and heritage regulations.

7.5 Consideration of concerns in the ESIA

The concerns collected were incorporated into the impact assessment and the definition of mitigation measures. The route of the high-voltage line was adjusted to avoid the most sensitive areas, notably by moving away from the perimeter of the Bouhedma park and reducing the exposure of the Sebkha Ennaouel. Land issues identified among local families are taken into account within the framework of the CPR (Political and Resettlement Framework), and a complaints management mechanism has been established to ensure the fair and transparent handling of grievances. In addition, the gender dimension and the inclusion of vulnerable groups are integrated into the participation strategy, in accordance with donor standards.

7.6 Conclusion

Ultimately, the consultation process carried out during the preparatory phase has helped to strengthen transparency, identify critical issues and lay the foundations for inclusive and ongoing engagement. The results demonstrate that local authorities and communities welcome the project, provided that their concerns are addressed. This ESIA is limited to presenting the consultations carried out and their results, while the PEPP, developed as a separate document, constitutes the operational framework for continued stakeholder engagement and grievance management throughout the project lifecycle.

8 Conclusion

The Environmental and Social Impact Assessment (ESIA) for the El Khobna solar photovoltaic power plant project in Sidi Bouzid Governorate provided a comprehensive assessment of the project's potential impacts on the biophysical environment, the social and economic framework, as well as on natural and cultural resources. This analysis highlighted, on the one hand, the significant positive impacts expected, and on the other hand, the risks and constraints requiring appropriate management.

Environmentally, the project is fully in line with the national strategy to reduce greenhouse gas emissions and actively contributes to Tunisia's energy transition. The identified impacts on soil, water, air, fauna and flora have been assessed and are generally limited, temporary and manageable thanks to the prevention, mitigation and monitoring measures provided for in the Environmental and Social Management Plan (ESMP). Major sensitivities, namely the proximity of Sebkhet Noual and Bouhedma National Park, have been integrated from the design stage and will be the subject of particular vigilance during construction and operation.

On the social and economic front, the project will make a significant contribution to local development. It will generate several hundred temporary jobs during construction and around forty permanent jobs during operation. Local communities will benefit not only from direct employment and income, but also from indirect opportunities through services, subcontracting, and the resulting economic dynamism. The emphasis on local hiring, community consultation, and grievance management demonstrates a clear commitment to social inclusion and equitable benefit sharing.

Beyond its immediate impacts, the project is part of a sustainable and responsible approach. The planned enhancement measures—ecological rehabilitation, community training, gender promotion, and local capacity building—provide significant added value to the project and promote its social acceptability. Furthermore, environmental and social monitoring and surveillance systems will ensure ongoing performance control and allow practices to be adjusted as the context evolves.

Ultimately, the El Khobna project illustrates a successful convergence between national energy transition objectives, environmental protection imperatives, and the expectations of local communities. Its implementation, in accordance with international standards (IFC, EBRD, EIB) and Tunisian regulations, represents a major opportunity for the Sidi Bouzid region and for Tunisia. Thanks to rigorous planning, open dialogue with stakeholders, and a firm commitment to sustainability, this project constitutes a model of responsible energy development, associated with long-term environmental and social benefits.

