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ESIA REPORT

SUSTAINABLE AKKAR WIND FARM, LEBANON

CONTENTS

NON-TECHNICAL SUMMARY

FIGURES

TABLES

NON-TECHNICAL SUMMARY

1. INTRODUCTION

1.1. Project Background

Sustainable Akkar SAL (the Developer) is proposing to develop a 90.75 megawatt (MW) onshore wind farm in the Akkar region of Lebanon (the Project). The location of the Project site is shown in **Figure NTS-1**.

In accordance with legislation and standards of Lebanon governed by the Ministry of Environment (MOE), the Project has been subject to a full Environmental Impact Assessment (EIA). In addition, The Developer is seeking financing for the Project from International Finance Institutions (IFIs); therefore, an Environmental and Social Impact Assessment (ESIA) Report has been prepared in accordance with good international industry practice and international standards.

1.2. Structure of the ESIA Report

The ESIA document package consists of three documents:

- ESIA Report:
  - Volume I: the main ESIA Report which provides a detailed description of the Project, presents assessment methodologies, findings and conclusions of the ESIA process.
  - Volume II: the Technical Appendices which provides supporting information for the assessment undertaken and reported in Volume I.
- Stakeholder Engagement Plan (SEP).
- Environmental and Social Management Plan (ESMP).

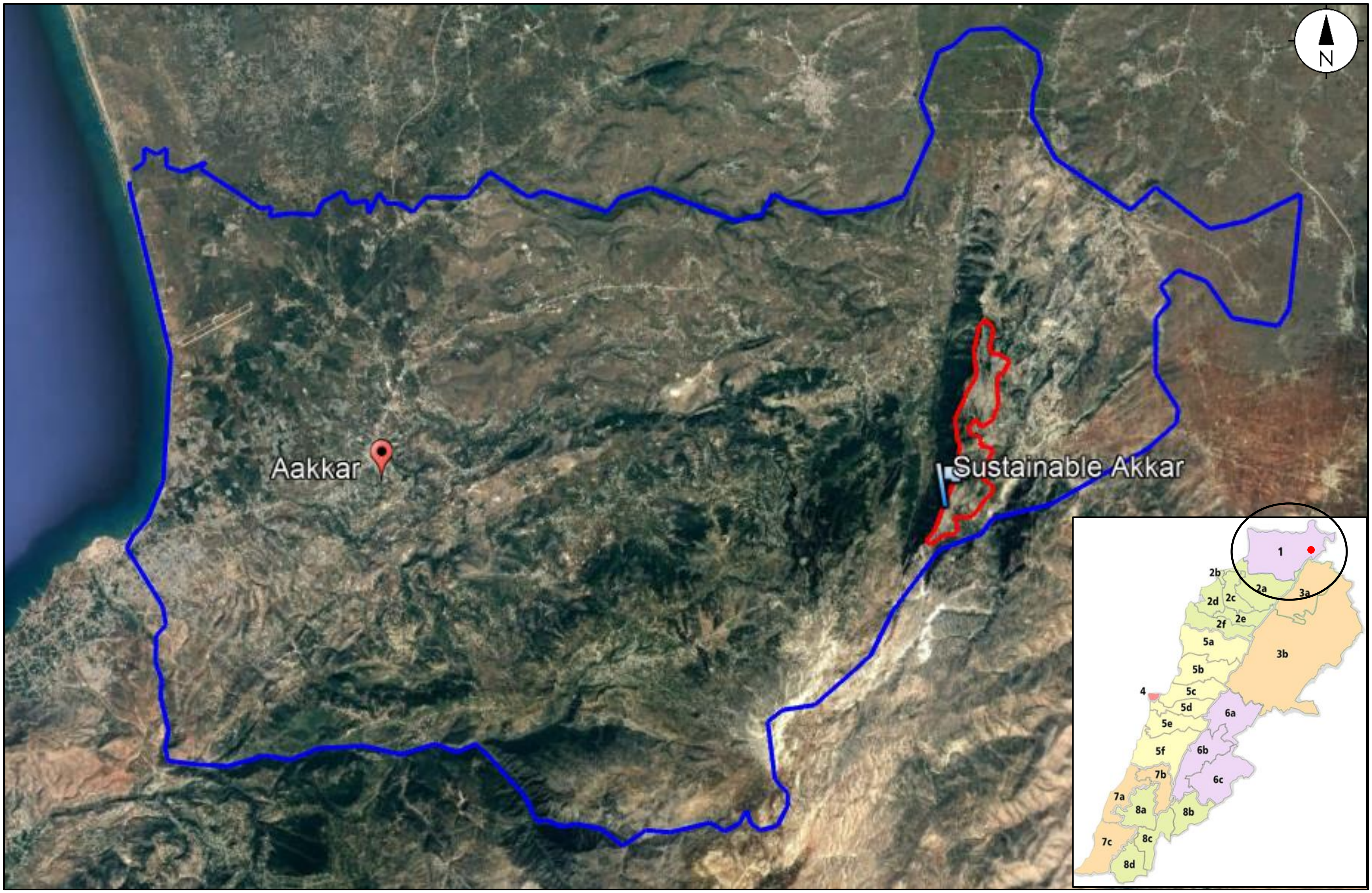
1.3. The ESIA Process

The ESIA has been completed in accordance with Lebanon's legislation, International Finance Corporation (IFC) Performance Standards (2012) and European Investment Bank (EIB) Environmental and Social Standards. The key objectives of the ESIA process are to assess the potential environmental and social impacts associated with the construction and operation of the Project, and to identify measures that can be adopted to avoid, minimize or offset adverse impacts. The process also identifies ways to enhance any beneficial impacts of the Project. The ESIA process included the following activities:

Scoping

A scoping exercise was undertaken to identify and focus the impact assessment on potentially significant environmental and social issues associated with the development of the Project (through the construction and operation phases). Scoping has an important role to play in achieving proportionate and effective assessment. Key stakeholders, including interested and affected parties, were identified during this exercise and provided with an opportunity to raise any comments, concerns and/or queries that they may have on the proposed Project. A Scoping Report was submitted solely to the MOE in December 2017 and reviewed by an internal committee.

Figure NTS-1 Project Location



The aim of the scoping process is to identify Project effects that have the potential to be significant and to exclude (scope out) from the assessment those effects that are unlikely to be significant. During the scoping phase a summary of available high-level baseline information was collected, key potential environmental and social impacts and sensitive receptors and resources were identified, and the impact assessment methodology was defined.

Collection of Baseline Data

The "baseline" describes the existing environmental and social conditions of the Project. It is this baseline against which the potential effects of the Project can be assessed. Primary and secondary environmental and social data were collected in order to enhance understanding of the receiving environments. The full baselines for each assessment topic are presented in Volume I, Sections 8 through 19, and supporting specialist annexes in Volume II.

Stakeholder Consultation and Engagement

Stakeholders have been engaged throughout the ESIA process. Activities included high level consultation with municipalities, detailed engagement with family leadership of affected communities, meetings with key informants, household survey, public disclosure meetings, meetings with landowners, focus group meetings, meetings with the Lebanese Army and meeting with mayors and officials representing towns along the transport route. The key findings of the consultation and engagement are reflected in the ESIA Report and have been incorporated into the project design and planning, where relevant.

Assessment of Alternatives

The key environmental and social constraints identified during scoping influenced the Project design early in the ESIA process. This allowed the majority of significant impacts to be avoided. Additionally, alternative turbine makes, models, numbers, layouts and construction logistics were considered to further reduce potential impacts.

Impact Assessment

The impact assessment provides a detailed analysis of the potential environmental and social issues that may result from the Project. The assessment is supported by specialist scientific studies. It also provides details of the measures and management actions that will be implemented to avoid, reduce, remedy or compensate for any significant adverse impacts predicted. Where practicable, details of how the Developer will maximize potential positive benefits and opportunities from the Project are also given. The assessment was completed in May 2019.

Spatial Scope: The spatial scope or study area for the ESIA takes into account the physical extent of the Project components/activities and the nature of the affected resource, the source of impact and the manner in which the resultant impact is likely to spread beyond the physical extent of the Project activities. This is also known as the Area of Influence or AOI. For the Project, the Direct Area of Influence (DAOI) is defined by the spatial extent of the footprint created by the core Project components and associated facilities, and their associated effects on the physical, biological and socioeconomic environments, including:

- A 3km radius around the Project footprint of land to be leased or purchased from landowners for the installation of the turbine platforms, internal roads, which encompasses the noise, shadow flicker and visual receptors.

- The footprint of land needed to construct the internal roads for Lebanon Wind Power and Hawa Akkar (as new segments of track to access the Project).
- The office space to be leased for the Community Relations Office in Kfartoun.
- The new segments of road.
- Settlements within the sightline of the wind farm were also assessed, including Rweimeh, Sahle, Qenia, Quobaiyat, Aandqet and Kfartoun.
- Extends up to 15km from the Project footprint (limited to sites and monuments of national importance located within the 15km and potentially affected by the Project's visual impact).

The Indirect Area of Influence (IAOI) for the ESIA comprises the existing transport corridor between the Tripoli Seaport and the Project and includes informal settlements within 1km of the existing road. It further includes visual impacts to key landscape units.

Temporal Scope: The Project will be developed in a three-phase sequence, as follows: 1) Construction Phase; 2) Operations and Maintenance Phase; and 3) Decommissioning Phase:

Subject	Treaty, Convention or Protocol
Construction Phase	This includes construction activities which will be undertaken by the OEM/EPC Contractor. This mainly includes preparing the detailed design and layout of the Project, transportation of Project components to the Project site, as well as site preparation and construction activities for installation of wind turbines, foundations, internal access roads, buildings, etc.
Operations and Maintenance Phase	This includes activities to be undertaken by the Project Operator. Activities expected to take place mainly include the normal daily operation of the wind turbines and the routine maintenance activities.
Decommissioning Phase	At the conclusion of the PPA term, the Project will be completely decommissioned by the Developer. The anticipated impacts throughout the decommissioning phase are similar in nature to impacts assessed during the construction phase – and specifically in impacts related to soil, air quality, and occupational health and safety. Therefore, the assessment of impacts for those receptors and mitigation identified during the construction phase is assumed to apply to this phase in particular without the need to reiterate or emphasize this throughout this section.

Assessment of Cumulative Impacts

Cumulative effects result from incremental changes caused by other past, present or reasonably foreseeable development (i.e. the planned Lebanon Wind Power and Hawa Akkar wind farms) together with the cumulative effect and those from the Project. In most instances past and present development will have been captured in the baseline for the Project (e.g. through noise measurements) and the normal practice of 'adding' impacts from the Project to the baseline will assess the cumulative impacts.

Management Plans

Following the assessment of impacts, an Environmental and Social Management Plan (ESMP) framework is developed. This sets out how the impact mitigation and management measures will be put into practice through a suite of specific plans. Refer to Section 6.

Disclosure

The ESIA report will be disclosed to interested stakeholders.

2. PROJECT DESCRIPTION

2.1. Overview

The Project will involve the construction and operation of up to 21 wind turbines within the site boundary. Depending on the Engineering, Procurement and Construction (EPC) Contractor selected, the wind farm will comprise wind turbine generators (WTGs) with different power ratings:

Potential Contractors, Turbine Power Ratings and Turbine Numbers

OEM/EPC Contractor	Turbine Power Rating	No. of Turbines	Power Generated by Turbines	Total Power Generated
Vestas Wind Systems	4.2MW	21	88.6MW	88.2MW
General Electric	4.8MW	3	30.0MW	88.6MW
	5.3MW	14	74.2MW	

The entire investment will include the following components:

- A maximum of 21 WTGs.
- Underground cable networks (electric and fiber-optic control and communication cables).
- External and internal access roads.
- Power substation and temporary and permanent maintenance buildings.
- Parking/laydown/assembly areas.
- Concrete batching plant in Rweimeh Village.
- A CRO building to be located in Kfartoun.

Generally, a wind turbine consists of a foundation, tower, nacelle, rotor blades, a rotor hub, and a transformer. The foundation is used to bolt the tower in place. The tower contains the electrical conduits, supports the nacelle, and provides access to the nacelle for maintenance. Typically, three (3) blades are connected to the hub which then connects with the nacelle; the box-like component that sits atop the tower and which most importantly contains the gear box (which steps up the revolutions per minute to a speed suitable for the electrical generator) and the generator (which converts the kinetic energy into electricity). Each turbine and associated platform will occupy a maximum surface area of +3,500m^2. Foundation platforms will be constructed to bolt the tower of the turbine in place.

Construction is expected to commence in Q4 of 2019, employing up to 125 staff on site for a duration of approximately 18 months. This will mainly include skilled opportunities (to include engineers, technicians, consultants, surveyors.) and unskilled job opportunities (mainly labor force but will also include a number of security personnel). Approximately 3 job opportunities will be available during the operations phase for a duration of 20 years. This will include skilled job opportunities (such as technicians) and unskilled job opportunities (such as drivers). This number does not consider the security personnel that will be required onsite.

2.2. Need for the Project

The country has yearlong power deficit that can reach up to 1,400MW during the summer. As of 2016, the peak power demand reached 3,594MW while the effective power production by EDL only reached 2,108MW, generating to 21 hours of electricity supply in Beirut and 14 hours outside of the capital.[1] In response to the frequent power rationing by the government, local residents rely on private back-up generators.

As of 2010, private generators are satisfying 77% of the blackouts. Private generators operate using gas oil at notoriously low efficiencies rates, by comparison, the average generation efficiency of EDL from cradle to consumer gate is about 30% higher; thus, any given private generator is a wasteful and a major contributor to air pollution and costing the consumer 4.74 times more per kilowatt hour (KWH) than government generated electricity.[2]

In a bid to decrease the environmental footprint of its energy sector and align itself with the international efforts to reduce global Green House Gas (GHG) emissions, the Government of Lebanon (GOL) officially pledged to meet 12% of its energy consumption from RE sources by 2020 at the 2009 Copenhagen Climate Change Conference. The Ministry of Energy and Water (MOEW) published the 2010 Policy Paper for the Electricity Sector that was approved by the Council of Ministers (COM) on 21 June 2010. In addition to proposing a strategic solution to the electricity sector in Lebanon, the Policy Paper built on the 12% commitment of RE by 2020 to propose some future milestones.

The MOEW published the Wind Atlas of Lebanon and a 2013 Request for Proposal (RFP) for developing the first utility-scale wind farm in Lebanon sparked private sector interest. At the U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in December 2015, the GOL also pledged to reach a 15% reduction in GHG and 3% reduction in power demand by 2030 relative to a business-as-usual scenario.

The current electrical energy demand is estimated at 16,400 gigawatt hours (GWH), and is projected to reach around 20,000GWH in 2020 assuming a 3% yearly increase. Thus, renewable energy (RE) must provide 2,400GWH of electrical energy in order to meet the RE target set by the GOL. In February 2018, the Minister of Energy and Power Cezar Abi Khalil signed the first Power Purchase Agreement[3] (PPA) with companies of the private sector to build three wind farms of an individual capacity 200MW. The energy ministry's signing of the agreements represents Lebanon's first PPA with the private sector in electricity generation as part of efforts to close an estimated 1GW gap between current electrical supply and demand in the country.

[1] Ashari, T (2018) Lights Out as Demand Surges for Electricity. The Daily Star Published on 10 July 2018. Retrieved from www.dailystar.com.lb.

[2] Bouri, E., El Assad, J. 2016. The Lebanese Electricity Woes: An Estimation of the Economical Costs of Power Interruptions. Energies, 9, 583; doi:10.3390/en9080583.

[3] LBCI. (2018). Lebanon signs wind Power Purchase Agreement. News Bulletin Reports. Retrieved from www.lbcgroup.tv.

2.3. Project Location and Site

The area to be developed is located in Jabal Akroum, Akkar on Lebanon’s northeastern border with Syria, approximately 182 kilometers (km) northeast of the capital city of Beirut. The Project location is as shown in **Figure NTS-1** and photographs presented in **Figure NTS-2**.

Figure NTS-2 Photographs of the Project Site

Météo Liban (ML) provided wind data from 17 meteorological stations located throughout the country for the MOEW to develop the Wind Atlas for Lebanon, which was supplemented by hourly wind data from 5 meteorological stations situated within Syria near to the Lebanese border. These data were used to derive information about long term annual and seasonal mean wind speeds and to establish a basic understanding of the dominant wind regimes in the country. The site was favored as the wind speeds present in the mountain ridge in Akkar represent the best wind conditions for siting a wind farm.

2.4. Land Ownership

Land parcels needed for the Project for wind turbines, platforms, parking areas, permanent buildings, internal tracks, access roads and buried transmission lines, as well as the installation of the substation, are owned by the Municipality of Aandqet to the west and multiple families across the Project site. Following the cadastral survey undertaken in 2018, land lease and purchase were obtained as follows:

- For the construction of Project wind turbines and platforms for WTGs 2, 5, 8, 10, 14, 19, 20, 21, 22, 23, 24, 25 and 27, parking area, access road/transmission line and construction of the substation, land lease and purchase was finalized in accordance with '*Ilm w Khabar*' (Acknowledgement Certificates) as follows:
  - WTGs 2 and 5 - Kanaan Family.
  - WTGs 8 and 10 – Salah Family.
  - WTG 14 – Houda Family.
  - WTGs 19, 20, 21, 22 and 24 – Adraa Family
  - WTG 23 – Aamche, Hassan and Khoder Families.
  - WTGs 25 and 27 – Melhem Family.
  - Substation – Jaafar Family.

  Ilm w Khabar attests to the ownership of a real estate property which is un-surveyed and un-registered in the official real estate records.
- For the construction of Project wind turbines and platforms 3, 4, 6, 7, 9, 11, 13, 15, 16, 17, 18, 26 and 28, parking area and access road, land lease paperwork was issued by the Ministry of Finance General Directorate of Land Registry and Cadastre and signed by a judge in Tripoli.

The plots subject of the abovementioned lease agreements are free from any occupant, liabilities, rights, liens, or encumbrances. The Project land take will not result in resettlement/economic displacement (loss of livelihoods). The agreed financial compensation for land plots has been agreed between the Developer and private land plot owners and the Municipality of Aandqet. The lease term is for a period of 28 years, with leasing value determined equally across land plots for 3 phases: Phase I Technical Studies and Installation (Design and Construction); Phase II Implementation (Operation & Maintenance); and Phase III Decommissioning (Project Closure and Site Rehabilitation).

The total land to be leased is 1,481,868m^2.The size of the land plots leased range in size between 5,507m^2 and 45,115m^2, with a total land lease of 111,624m^2. Land purchased from the Jaafar Family for the installation of the Project substation is 13,255m^2. The size of land plots leased from the Municipality of Aandqet range from 45,260m^2 to 367,500m^2, with a total land lease of 1,370,244m^2. The Developer is in the process of finalizing the Project land tenure. The transfer of ownership and use the Developer will be a transparent process that will be fully documented, as required by IFC standards.

2.5. Project Alternatives

The 'No Project' alternative considered that the 90.75MW Project will not be developed, and that the Project site area would remain unchanged. While the No Project Alternative offers the advantage of absence of disturbance to the natural environment at the Project site, the Project remains more attractive as it gives several advantages over the No Project Alternative including:

- Decreased power outage.
- Contribute to increasing energy security through development of local energy resources and reducing dependency on external energy sources.
- Increased use of renewable green energy and less reliance on conventional polluting energy production.

- Increased security (access road, lighting, cameras) in the region and thus improved protection of the nearby reserve from fires and illegal logging.
- Demonstrating the commitment by Lebanon in realizing clean energy production and reducing greenhouse gas emissions.
- Positive socio-economic impact due to benefit from land rental and creation of job opportunities.

Options were evaluated to identify the preferred approach in consideration of the following:

- Site selection alternatives:
  - Overall Project site.
  - Turbine locations.
  - Substation location.
- Design alternatives:
  - Turbine types/specifications.
  - Alternative substation designs.
  - Alternative transmission designs.
- Transportation alternatives:
  - WTG component vehicle types/modalities.
  - Alternative road transport vehicle types/modalities.
  - Alternative road alignments.
- Technology alternatives.
  - Solar power.
  - Power plants.

2.6. Project Sensitivities and Constraints

Throughout the undertaking of the ESIA, key sensitivities and constraints of the Project site were identified for consideration during the wind farm design process, as follows:

Climate and Climate Change

Climate change is expected to have the following effects in Lebanon:[4]

- Increased mean temperatures of 1-2°C by 2050 and 3.5-5°C by the end of the 21st century.
- Decrease in annual average precipitation of 10-20% by 2040 and 45% by 2090.
- Reduced snow cover of 40–70% and decreased snow residence time from 110 days to 45 days by the end of the 21st century.
- Increased incidence of drought conditions by 9-18 days relative to present day by 2090.
- Increased wildfire risk.
- Continued sea level rise, rising by a total of 30-60 cm in the next 30 years.

[4] MOE website http://climatechange.moe.gov.lb/vulnerability-and-adaptation.

- Increased frequency of heat waves and decreased number of frost days.
- Less precipitation falling as snow, with snow line shifting from 1,500m to 1,700m by 2050, and to 1,900m by 2090.

Geology and Hydrology

The Project area is characterized by thinly bedded to widely exposed and highly karstified limestone overlying pale gray fractured fine and thick bedded limestone shaped by major tectonic events in Lebanon. The Project is situated east of the Yammouneh Fault which controls the direction of groundwater flow. The Al Kabir is the main river in the area. There are no major springs in the study area, with the closest being the Ras El Ain Spring in Hermel. Two public wells were identified near the Project.

Geophysical and Ground Seismicity

A geophysical ground investigation was implemented in April-June 2018 to determine the engineering parameters for the wind turbine and plant foundations, platforms and roads to be constructed. The Project will be located at the highest altitude points of the Akkar region and is not be expected to be exposed to flood or flooding due to its geological structure and elevation, and the Akkar region is not within a landslide area and/or considered to slope stability issues.

Air Quality

The Project is located in a rural area of Jabal Akroum. No industrial point sources of air pollution have been identified within the Project boundary, and review of baseline information indicates that concentrations of criteria pollutants are low in the Project area. There are no sensitive receptors (i.e., residents, hospitals, schools) near the Project area.

Transport and Traffic

The Project site can be accessed by a number of existing asphalt roads. Internal tracks currently traverse the site. Two route surveys and a Traffic Impact Study were undertaken between April and October 2018 to assess existing road conditions, identify road obstacles and assess potential impacts to road access to support selection of the preferred route for WTG transport.

Biodiversity

<u>Habitat</u>

The landscape is dominated by dense mixed forest, shrub and sparse herbaceous vegetation, grassland and barren land. The Project site lies entirely within the Qammouaa-Dinnyeh-Jurd Hermel Important Plant Area (IPA) and the Western Akroum Key Biodiversity Area (KBA). An overview of habitat types present in the Project area was provided through literature review. A more detailed habitat mapping and species records will be provided following further flora surveys.

<u>Mammals</u>

Mammals observed at the Project site and/or the planned Hawa Akkar wind farm (to the north) include the Golden (common) jackal, Red fox, Beech (stone) marten, Striped (Barbary) hyaena, Wild boar, Caucasian (common, Perisan or red) squirrel, Indian crested porcupine and Eastern broad toothed field mouse. A mammal survey will be completed on the Project site in early Summer 2019 and involve a walkover to search for signs and installation of camera traps.

Bats

The distribution of bat species in Lebanon is strongly associated with varied altitudinal gradient.

Species most frequently recorded at lower altitudes include: Egyptian fruit bat, Mediterranean horseshoe bat, Blasius's horseshoe bat, Botta's serotine and greater mouse-tailed bats.

At medium altitudes, records of greater mouse-eared, long-fingered and bent-winged bats are most frequent, while records of serotine and Savi's pipistrelle were recorded at higher altitudes. Common pipistrelle, Kuhl's pipistrelle, noctule, free-tailed bat, lesser mouse-eared bat, Natterer's bat, Geoffroy's bat, greater horseshoe bat and lesser horseshoe bat appear across the majority of the gradient, suggesting a wider altitudinal range.

Birds

The Upper Mountains of Akkar-Donnieh Important Bird Area (IBA) is located approximately 5km to the southwest of the Project site. Up to 50,000 soaring birds pass through the area each year, with the IBA being more important in the autumn when large flocks of levant sparrowhawk, great white pelican, common crane and white stork pass over it. 102 species were observed on the Project site during surveys.

The rare species recorded include:

- Alpine accentor *Prunella collaris*.
- Blue rock thrush *Monticola solitarius*.
- Common reed bunting *Emberiza schoeniclus*.
- Greater spotted eagle *Clanga clanga*.
- Stock dove *Columba oenas*.
- Winter wren Troglodytes troglodytes.

The very rare species recorded include:

- Cinereous vulture Gyps monachus.
- Egyptian vulture Neophron percnopterus.
- Eurasian Griffon Vulture Gyps fulvus.
- Imperial eagle Aquila heliaca.

Reptiles

Lebanese viper, Fraas' lizard, and an unnamed lizard are three species of reptile considered likely to be present within the Project site, as their known ranges occur close by to the south.

Community

There are no communities located within the Project site. Rweimeh Village is on the southern end of the Project, where the Project substation will be installed. The village has no electricity supply, as it is short-stay destination for visitors rather than a residential village. It is mostly inhabited by the Jaafar Family Clan. A total of 200 families, part of Jaafar Clan, are registered in Fnaidek, half of which visit Rweimeh Village in the summer. Numerous residences are located outside the Project area. There are no informal settlements or Syrian or Palestinian refugee camps within or near the Project site. Shepherds from nearby Kfartoun and Aandqet use the area for grazing animals. Recreational bird hunters use a network of existing tracks inside and outside the Project site, although they advised they do not use hunting as subsistence of a source of income.

Noise

The loudest sources of noise in the area are the movement of vehicles using unsealed and sealed roads. The movement of trucks are largely between existing quarry operations east of the Project area, through Rweimeh Village along Quobaiyat-Qasr Road and customers in the northern Akkar region.

Landscape and Visual Setting

The study area (i.e. project plots and surrounding area) encompasses the following habitats: Calabrian pine forests, evergreen oak woods, juniper woodland, mixed forests, grassland, cliffs and rocky habitats. The Aandqet Forest is dominated by Calabrian pine *Pinus brutia* and is the largest Pinus brutia forest in Lebanon. The western edge of parts of the Project site contains similar forest.

Houses near the Project area were assessed for potential noise, shadow flicker and visual impacts. In addition, viewpoints from settlements in the vicinity of the wind farm were also assessed, including Jour el Hachich, Rweimeh Village, Quobaiyat, Akkar El-Atiqa'a, Es Sayeh and Fnaidek, as shown in **Figure NTS-3**.

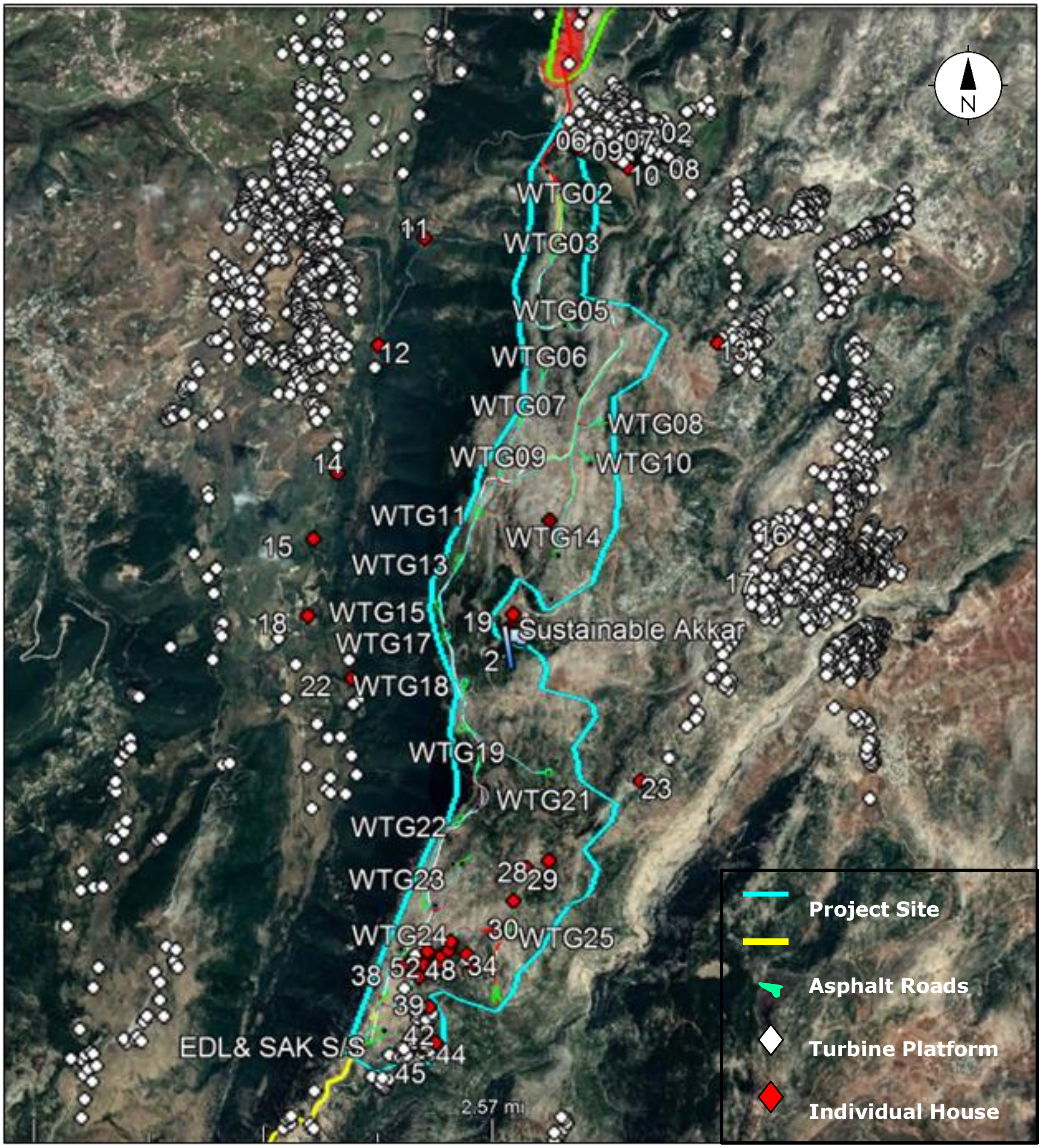
Landscape and Visual Setting

The landscape units near the Project site is characterized by agricultural areas mainly comprised of terraces planted with apple and cherry trees, native dense pinus and quercus forests, dense cedrus forests, abies forests, mixed forests, rocky land, shrublands, sparse coniferous and sparse leafy forests, swamps and urban areas. The primary landscape unit of the Karm Chbat Nature Reserve is sparse coniferous forest. Although the proposed wind turbines will introduce new technical elements in the landscape and affect the perception of the landscape, the typological appearance of the ridge will remain largely recognizable.

Archaeology and Cultural Heritage

No archaeological or cultural heritage sites are located within the Project area. The closest site is the Qalaat Akkar (Citadel of Hosn Akkar), a 13th century fortified building/earthwork site located nearly 3km southwest of the Project site.

Figure NTS-3 Project Landscape and Visual Setting



2.7. Project Design and Layout

In response to the findings of the technical studies, the ESIA process and stakeholder engagement completed to date, the following revisions have been made to the Project design in consideration of environmental, social, health and safety sensitivities:

- Eliminating wind turbines to minimize potential noise, shadow flicker and visual impacts.
- Locating turbines outside vegetated areas and/or would require the removal of trees.
- Siting the Project substation at a location that satisfies the minimum distance away from turbine, while requiring the least amount of vegetative clearance and low leveling requirements.
- Selection of the gas insulation substation design as it provides the most efficient insulation for altitudes >1,100m and requires less land occupancy.
- Designing the transmission line as a buried utility rather than an overhead power line.
- Using existing 2-, 4- and 6-land asphalt roads for the transport of the WTG components from the Tripoli Seaport to outside Chadra.
- New segments of road to be constructed as follows:
  - A new 0.65km section of asphalt road to avoid impacts to Chadra, Machta Hassan and Machta Hammoud to be constructed through currently vacant land.
  - A new 0.15km section of asphalt road to be constructed between two existing sections of asphalt road in order to avoid hairpin turns near homes.
  - A new 3.0km section of gravel road to be constructed within the existing railroad ROW managed by Machta Hammoud Village.
- Transport of the WTG components will be scheduled to take place between 12am and 4am inclusive in order to minimize impacts to road users.
- Limiting the transport of WTG components to a police-escorted convoy of 11 trucks per convoy, two times per week for a period of 13 weeks.
- Maintaining access to grazing areas and hunting tracks to ensure shepherds and livestock can pass through the Project during operation and hunters can access land.
- Construction of asphalt roads scheduled for time periods when traffic levels are lowest.
- Limiting the movement of construction materials to the existing quarry tracks and Quobaiyat-Qasr Road during the construction phase.

Figure NTS-4 shows two different turbine design layouts; Design 1 shows one of the initial layouts, while Design 2 shows the currently proposed turbine layout. It is noted that the Project design assessed through the ESIA process is subject to change according to the EPC Contractor selection.

Figure NTS-4 Project Turbine Layout

Scoping Report Design - December 2018

Current Design - June 2019

3. ADMINISTRATIVE FRAMEWORK

A summary of each of the legislative requirements governing the ESIA process is provided in Volume I, Section 4 *Regulatory and Policy Framework*.

The ESIA has been undertaken to meet local requirements to gain permission for the construction and operation of the Project. In addition, to ensure the Project lender's financing policies, standards and requirements are adhered to and met, the ESIA has been completed to meet the following:

- Existing national legislations and policies related to environmental protection, land classification, and environmental control requirements.
- Relevant international treaties, conventions and protocols.
- Relevant International Finance Corporation (IFC) Performance Standards (PSs).
- European Investment Bank (EIB) Environmental and Social Standards (ESSs).
- IFC Environmental, Health and Safety (EHS) General Guidelines.
- IFC EHS Guidelines for Wind Energy.
- Application Decree 2366/2009 related to the National Physical Master Plan for the Lebanese Territory (NPMPLT) covering land use and zoning of lands.
- MOE Decision No. 52/12 of 29 July 1996 setting air quality standards, including thresholds for air pollutants and safe noise exposure limits.
- Law No. 78 dated 19/4/2018, and Decree 3320 dated 29/6/2018 which is related to the adherence to the Convention on the Conservation of Migratory Species of Wild Animals signed in Bonn in 1979.
- Law for the Protection of Forests of 1949 and Law No. 85/1991 for the protection of shrublands and associated floral biodiversity.

Law No. 444 emphasizes the principle of EIA as a tool for planning and management, and stipulates that proponents undertake assessment for all projects likely to affect the environment due to their sizes, nature, impacts or activities for review and approval by the MOE. In addition, this legislation is implemented by Decree No. 8633/2012: Fundamentals of Environmental Impact Assessment and the MOE's Decision 261/1 of 2015: Review Process for EIA Scoping and EIA Reports.

The law and the decree assign full authority to the MOE to arrange the screening, review, control, and follow-up of the EIA process and its implementation. The approval of an EIA is a pre-requisite for any subsequent license or permit by any or all other relevant authorities that may be required prior to construction. The efforts of the MOE aim at improving the Lebanese environmental performance on the international level, alike all developed countries, and the coordination, cooperation and follow up between the MOE and concerned parties, as the private and public sectors or the civil society organizations that may have a real positive impact on achieving a global unified vision related to all what concerns the protection of the environment.

3.1. Relevant International Treaties, Conventions and Protocols

International conventions, treaties and protocols which are triggered by the Project are as shown in the following table**.**

3.2. Lender Requirements

As previously mentioned, this ESIA has been developed in accordance with international finance institution (IFI) requirements, namely the IFC Performance Standards, the EIB Environmental and Social Standards, the IFC EHS General Guidelines, including IFC EHS Guidelines for Wind Energy.

A listing of the IFC PSs and EIB ESSs, and their relevance to the Project, are provided in **Table 4-6** and **Table 4-9** in **Section 4 Regulatory and Policy Framework**.

Subject	Treaty, Convention or Protocol
Environment	• Convention on Migratory Species of Wild Animals (CMS); Bonn Convention. • Convention on Biological Diversity; Rio De Janeiro. • Convention on Wetlands of International Importance especially as Waterfowl Habitat – Ramsar. • Cartagena Protocol on Biosafety to the CBD. • Agreement on the Conservation of African-Eurasian Migratory Water Birds.
Cultural and Natural Heritage	• UNESCO Convention on the protection of Cultural and Natural Heritage.
Air and Climate Change	• Vienna Convention for the Protection of the ozone layer. • Montreal Protocol on Substances that deplete the ozone layer. • Amendment to the Montreal Protocol on Substances that deplete the ozone layer; London. • Amendment to the Montreal Protocol on Substances that deplete the ozone layer; Copenhagen. • UN Framework Convention on Climate Change aiming to fight global warming. • United Nations Convention to Combat Desertification; Paris. • Beijing Amendment of the Montreal Protocol. • Kyoto Protocol. • Euro-Mediterranean Energy Partnership HY-PA. • International Renewable Agency (IRENA).

4. STAKEHOLDER CONSULTATION AND ENGAGEMENT

Stakeholder consultation and engagement is an integral part of ESIA good practice and is a statutory requirement of the national EIA legal framework in Lebanon, within the IFC Performance Standards and EIB Environmental and Social Standards. The principles of the engagement process are illustrated below:

Integrated

The process should be able to integrate the contributions of very different groups of stakeholders from government, to international organizations, to local communities. This principle reflects inclusivity (all stakeholders considered equally) and representability (all elements, perspectives and interests are represented).

Adaptive

The process should be flexible in engaging a range of stakeholders through different methods.

Transparent

The process should have clear requirements. It should ensure public access to information, identify factors taken into account in decision making, and acknowledge limitations and difficulties.

Credible

The stakeholder engagement process is the only way in which affected stakeholders may influence the decision-making process. It is important that the process be conducted by professionals to ensure faith in the process.

Rigorous

The process should apply "best practice", using methodologies appropriate to the scale and phase of the project for stakeholder engagement, stakeholder consultation and record-keeping.

Practical

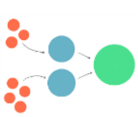
The process should result in outputs which assist with problem solving and are practical for implementation by proponents.

Purposive

The process should help decision-making by considering all stakeholder concerns.

Efficient

The process should be efficient, making use of well-developed methodologies.



Systematic

The process should result in full consideration of all relevant information.

4.1. Stakeholder Identification

The Project has a wide range of stakeholders ranging from national and regional government institutions, in addition to communities within the area of influence of the Project. As such stakeholders have been identified at all geographic levels, including national, regional and local levels. The three principal categories of stakeholders are as follows:

- National governmental institutions, including the MOE, MOEW, Ministry of Public Works and Transport (MOPWT), Ministry of Interior and Municipalities (MOIM) and other bodies involved in the permitting and ESIA process, and governmental authorities at the regional level, including the Governorate level (Governors) and District level (Kaemmakam).
- Affected Communities, defined as the local community as well as other people directly affected by the Project, land owners and/or those who have been identified as most vulnerable to change and who need to be engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measure. Affected communities are considered to include:
  - 3 villages where land was or will be leased/acquired for the Project:
    - Aandqet.
    - Jabal Akroum area, including Kfartoun and Sahle Municipality (where the CRO Office is to be leased).
    - Rweimeh Village (where the Project substation will be constructed).
  - 4 villages where land was or will be leased/acquired for new segments of track through Hawa Akkar:
    - Chadra.
    - Machta Hammoud.
    - Machta Hassan.
    - Mqaible.
  - 4 Villages where land was or will be leased/acquired for new segments of track through Lebanon Wind Power:
    - Fnaidek.
    - Karm Chbat.
    - Rweimeh Village (same village as listed for the Project; so not counted twice).
    - Kfartoun (same village as listed for the Project; so not counted twice).
  - Settlements where potential visual impacts were assessed (may be otherwise indicated above):
    - Sahle.
    - Qenia.
    - Quobaiyat.
    - Aandqet.
    - Kfartoun.
    - Rweimeh Village.
- Other Interested Parties, defined as people and organizations that are interested in the Project and/or could affect the Project in some way. Those generally include universities and non-governmental organizations.

4.2. Stakeholder Engagement Activities

Full details of consultation with regulatory authorities, local communities and other key stakeholders are presented in **Section 6 Stakeholder Consultation and Engagement**. Photographs of the consultation and engagement are presented in **Figure NTS-5**.

Figure NTS-5 Consultation and Engagement

a – Initial Disclosure Meeting; 15 May 2018

b – Iftar; 7 June 2018

c – Meeting with Daher Family; 3 October 2018

d – Final Disclosure Meeting; 6 December 2018

e – Meeting with the Al Fayhaa Union of Municipalities (Mayors of Tripoli, Al Beddaoui, Al Minie and Qalamoun)

f - Meeting with the Kobet Al Choumra Municipality; 19 February 2019

g - Meeting with Zoug Bhannine Municipality; 19 February 2019

h - Meeting with the Talmaaiyan Union of Municipalities; 20 February 2019

i – Meeting with the Governor of the Akkar Region; 20 February 2019

j – Meeting with Al Mahmra Municipality; 20 February 2019

k - Meeting with North Akkar Union of Municipalities; 26 February 2019

l – Meeting with North Lebanon Governor; 26 February 2019

Engagement with family leadership of the affected communities began in 2017, in advance of the ESIA activities. In early 2018, meetings were organized with key informants to discuss their opinions regarding the Project. The Initial Public Disclosure Meeting took place on 15 May 2018. The seminar was followed by a discussion whereby SES responded to the concerns raised by meeting attendants and committed to addressing them in the ESIA study.

A public participation dinner was prepared on Ramadan (7 June 2018) for several communities, including Akroum, Kfartoun and Rweimeh Village. The dinner was held to provide a better understanding of the Project design execution and the implications on the surrounding environment.

In July 2018, discussions were undertaken with officials regarding land rentals and potential ownership impacts from turbines such as noise, shadow flicker and visual amenity in Fnaidek and Quobaiyat.

Two focus group meetings were organized on 2 and 4 November 2018, with a group of hunters who usually hunt in or in close proximity to the area where the Project turbines will be installed and a locally active non-governmental organization (NGO), the Environment Council in Quobaiyat (مجلس البيئة - القبيات). After introducing the Project to both groups, feedback was collected regarding their knowledge of the wind energy technology and the proposed Project. Their perceptions regarding the Project and its effects, along with the management mitigation measures that the Developer will be adopting to eliminate or reduce impacts were discussed, especially potential impacts to the Karm Chbat Nature Reserve.

A site visit to a wind farm in Turkey was undertaken on 21 November 2018, so that land owner representatives, the Mayor of Kfartoun, Ahmad el Zein, Kanaan Family representatives, Adraa Family representatives, and Daher Family representatives, could observe the operation of the wind farm and its potential negative and positive environmental effects.

A final public disclosure meeting took place on 1 December 2018 at the Qammouaah Plain in Fnaidek Village. Similar to the Initial Public Disclosure Meeting, a seminar presentation was given and included a description of the Project and a summary of the findings of the ESIA studies, including analysis of impacts and the proposed Environmental and Social Management Plan (ESMP), the general findings of the ESIA study being conducted, and actions that were taken by the developer in order to mitigate any potential negative impact of the wind farm on the environment. The seminar was followed by a discussion where the Developer replied to the concerns of the meeting attendants and committed to addressing them during project implementation and operation.

Consultation activities were undertaken on 19-20 February 2019 with officials representing the villages along the WTG component transportation route, from Tripoli to Sahle, including:

- Tripoli
- Beddaoui
- Al Minie
- Deir Amar
- Borj El-Yahoudiyé
- Nabi Youcheaa
- Zoug Bhannine
- Al Mahmra
- Mqaiteaa
- Kfar Moki Akkar
- Rmoul
- Qaabrine
- Sammouniyé
- Hissa
- Tall Aabas El-Gharbi
- Tall Aabbas El-Charqi
- Tall Hmaire
- Chir Hmairine
- Hokr Jouret Srar
- Qoubber Chamra
- Mahmra
- Janine
- Qachlaq
- Aamaret El-Baykat
- Noura El Tahta
- Kouachra
- Dibbabiyé
- Amayaret Akkar
- Fraidis
- Qsair Akkar
- Menjez
- Aaoaainat Akkar
- Rmah
- Iltigo
- Barcha
- Khamoubet Akkar
- Chikhlar
- Mqaible
- Quobaiyat
- Chadra
- Machta Hassan
- Machta Hammoud

4.3. Outcomes of Engagement

The response to the Project has, on the whole, been positive with support expressed in all the meetings held. Key concerns raised by the residents of the local communities regarding the Project and how the Project has addressed these and other concerns are outlined below:

Subject	Issue	Response
Land use, land lease and land acquisition	Status of the ownership of the parcels located at the top of the mountain ridge, i.e. whether they are public/municipal or private properties and lack of official survey.	Access to certain grazing areas and hunter's tracks will be restricted during the construction phase. Following construction, access to these areas will be reinstated. Following cadastral survey, land leases and land purchase for the construction of the substation were finalized with the Kanaan, Salah, Houda, Adraa, Aamche, Hassan, Khoder, Melhem and Jaafar Families in accordance with 'Ilm w Khabar'. Paperwork was issued by the Ministry of Finance General Directorate of Land Registry and Cadastre to lease land parcels in Fnaidek Municipality and Karm Chbat and was signed by a judge in Tripoli.
Land value/depreciation.	Impact of the wind farm on the existing facilities without considering the depreciated value of surrounding land.	The potential locations for the turbines will be compared to select locations which will have the least adverse impact, all while considering electricity production potential in the assessment. Once selected, the lands to be leased or purchased increase the compensation potential for land owners. However, most of the lands are publicly owned which decreases the significance of the depreciation impact.
Impacts to migrating birds.	Potential for bird casualties in comparison to international guidelines.	Bird monitoring and collision modeling has been undertaken to identify the potential impacts to birds and requirements for turbine shutdown periods, if required.
De-icing mechanisms.	Accumulation of ice on turbines and ice throw.	Turbines will either be equipped with a de-icing mechanism which will ensure sound operation under snowy conditions, or the turbine operations will be stopped under specific snow conditions. The final security measures to be adopted will be specified in the final ESMP.

Subject	Issue	Response
Biodiversity.	Assessment of impacts to bats and flora with high ecological value.	Bat monitoring and collision modeling are being undertaken to identify the potential impacts to bats and requirements for turbine shutdown periods, if required. Habitat survey is being undertaken to map habitats and develop avoidance, mitigation or offset measures.
Cumulative impacts.	Assessment of potential cumulative impacts of the three proposed wind farms in the Akkar region, Lebanon Wind Power, Sustainable Akkar and Hawa Akkar.	The potential cumulative impacts of construction, operation and decommissioning of the three wind farms were assessed as part of the ESIA Report.
Job creation and employment.	Job opportunities that will be created by the Project.	Employment of up to 125 people will be required for the construction phase. Potential employees will be sourced with a preference for the local area, then regional, throughout Lebanon, then internationally, if suitable for the available position. There will be online and onsite training courses made available such that the chances of recruitment of locals can be increased.
Project schedule.	Since 2014, the GOL has discussed wind farms, promised RE in 2018, and now the deadline is 2020.	Work could not begin before November 2017, when the PPA was signed. They have a 36-month term for the final delivery of the project.
Electricity supply.	Infringements made on the public power grid and solution provided to be provided.	The PPA includes producing electrical power and supplying it to the public grid. The solution for the infringements is not within the scope of the Developer.
12% RE commitment by the GOL.	Can the Project provide enough electrical power to satisfy the commitment by the GOL to supply 12% energy demand through renewable energy sources and will the implementation of the wind farms would cover the electrical power shortage.	Operation of the 3 planned wind farms are able to satisfy a significant portion of the commitment, and they are anticipated to supply 25% of the shortage.
Noise.	Noise impacts to residences.	Noise generated by the turbines is below the IFC noise limit of 45 dB(A).
Habitat loss.	Number of trees to be cut.	The number of trees present in the immediate construction zone were quantified and will be avoided, mitigated or offset. Mature trees are

Subject	Issue	Response
		not present on the exposed ridges due to high winds.
Monitoring.	Who will monitoring Project implementation.	The Developer is responsible for recruiting an HSE specialist who would need to properly implement all ESMP requirements. The MOE will conduct inspections in the future to ascertain that the ESMP is implemented and that the latter inspections may involve actual measurements. The international lenders will also have third party auditing processes who will check for ESMP implementation and compliance with environmental standards before giving clearances to release payments to the Developer. The GOL will also participate in supervising Project implementation.
Project benefits.	Who will benefit from the Project.	There will be recruitment of up to 125 persons during construction. Local municipalities and communities will benefit from road widening activities and the development of new roads. Secondary benefits for local businesses, i.e. restaurants and hotels are anticipated.
Groundwater.	Impacts to groundwater quality.	Wind farms are typically not associated with negative impacts to groundwater. Groundwater is very deep in the Project area; measures will be put in place to prevent potential spills and the appropriate disposal of wastewater generated.
Transport of the WTG components, timing, schedule and traffic impacts.	Road routes to be taken during the construction phase.	Coordination has been undertaken with officials from all villages along the transport route. Obstacles have been identified and will be removed in advance of the transport, i.e., pedestrian bridges, concrete blocks, etc., and improvement of road conditions will be coordinated with the municipalities. Modification to the Al Abdeh Roundabout may be necessary, but any modification will be discussed with the municipality as it is under their authority. New road segment construction will be scheduled for low traffic periods.

Subject	Issue	Response
		A maximum of 2 roundtrip convoys of 12 trucks will be escorted by police twice per week between 11pm and 4am during weekdays to avoid potential impacts to travelers, for a total of 8 weeks. replacing the asphalted speed bumps with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. Multiple methods of communication will be used to provide advance notification of the scheduled transport, and in particular, informal settlements present along the transport route. A communications protocol is being developed between the Project companies and the MOIM for the transport of the turbines from Tripoli to the Project site. Once this protocol is ready, it will be distributed to the Mayors two to three months prior to the start of the transport. All community Mayors have emphasized their willingness to provide further coordination across the municipalities and Project companies and assisting in accomplishing the Project as quickly as possible.
Potential turbine malfunction.	What parts of the turbine are susceptible to malfunction.	Bad weather conditions, e.g. ice, very high wind speed may harm the turbine parts. Turbines will either be equipped with a de-icing mechanism which will ensure sound operation under snowy conditions, or the turbine operations will be stopped under specific snow conditions. The final security measures to be adopted will be specified in the final ESMP. The monitoring and control of the turbines will be implemented by the turbine manufacturer in collaboration with a local control and support office.

4.4. Stakeholder Engagement Plan

The Stakeholder Engagement Plan (SEP) outlines the approach and plans to be adopted and implemented for engagement across all Project stages. The overall objectives of the SEP are shown below:

Informs

Promotes the informed participation of all stakeholders (i.e., national and local government institutions, local communities and other interested parties).

Decision-Making

Incorporates dialogue and agreements on decision-making on issues related to Project implementation.

Development

Contribute to the social development of local communities, through actions and programs in the Project's area of influence.

Builds Relationships

Builds strong, constructive, and responsive relationships with all stakeholders.

Manages Impacts

Successfully manages the Project's environmental and social impacts.

Promotes Benefits

Promotes socioeconomic benefits, i.e. job creation and social development.

Builds Trust

Builds consensus, credibility, trust and support for Project activities and future endeavors.

Promotes Understanding

Discloses relevant, clear and accessible Project information to enable stakeholders to express their views on the Project and understand risks and opportunities.

Analyzes Information

Serves as a way to analyze information gathered throughout the Project phases.

4.5. Grievance Mechanism and Feedback

The following feedback channels have been available to stakeholders throughout the ESIA process:

- In writing (Project contact details provided in Scoping Report).
- Focus group discussions and key informant interviews during baseline data collection and ESIA engagement.
- Public meetings during ESIA engagement.

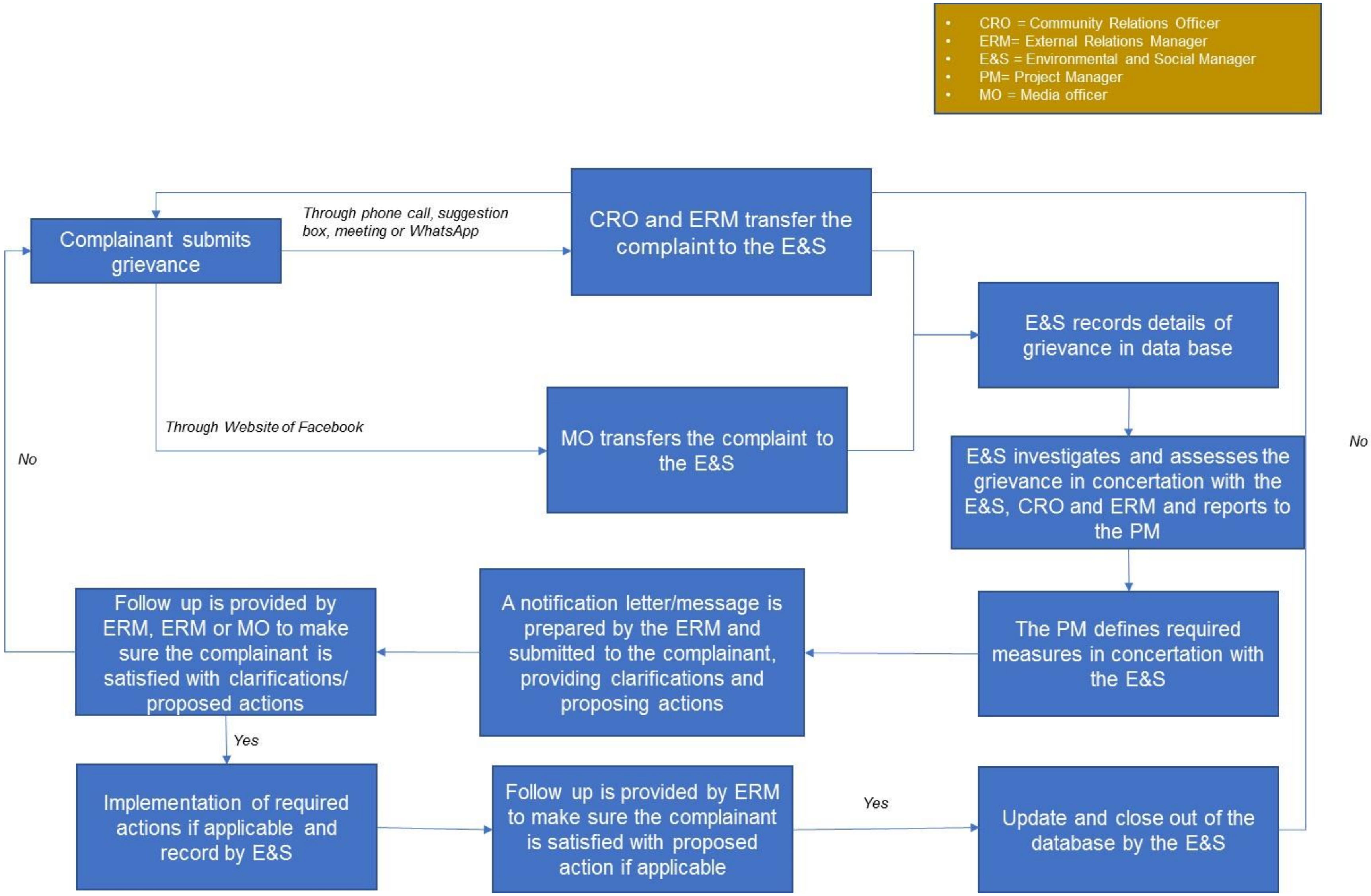
A grievance mechanism will be established to respond to and resolve stakeholder concerns during future Project activities. Grievances may take the form of specific complaints or concerns or perceived incidents and impacts. Grievances can be raised confidentially and without repercussion. The grievance mechanism seeks to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate and readily accessible, as shown in **Figure NTS-7**.

The key steps of the Community Grievance Mechanism Process are as follows:

1. Identification of grievances. This could be by:
    a. Meeting, Phone call, WhatsApp, or depositing a grievance in a suggestion box addressed to the CRO or the External Relations Manager (ERM). Women who feel uncomfortable talking to a man can also contact directly the Environmental and Social Manager (E&S), who is a woman.
    b. The company website or Facebook page managed by the Media Officer (MO).
2. Grievance is then transferred to the E&S and recorded in an electronic 'grievance log' within 2 days of receipt. The grievance log will be held at Sustainable Akkar sal & Lebanon Wind Power, 1st floor, An-Nahar, Martyr's Square, Beirut Central District – Lebanon.
3. The significance of the grievance will then be assessed by the E&S within five working days using the criteria outlined below:
    - Level 1 Complaint: An inquiry, suggestion or request.
    - Level 2 Complaint: A complaint of a minor nature.
    - Level 3 Complaint: A complaint of a significant nature, i.e. a risk to community health and safety.

    If the grievance is not well understood or if additional information is required, clarification should be sought from the complainant during this step.
4. E&S investigates and assesses the grievance in concertation with the E&S, CRO and ERM and will report the case to the Project Manager (PM).
5. The PM will decide how to deal with the grievance and determine adequate measures in concertation with the E&S.
6. A notification letter/message is prepared by the ERM and submitted to the complainant (directly, through the CRO or the MO), providing clarifications and proposing actions.
7. A follow up is provided by ERM, ERM or MO to make sure the complainant is satisfied with clarifications/ proposed actions.
8. If the complainant is satisfied and if applicable, actions are undertaken by the team as required; actions are then documented by the E&S.
9. Then3, follow up is provided by ERM to make sure the complainant is satisfied with proposed action if applicable.
10. If the complainant is satisfied, the E&S updates and closes out the database.
11. If the complainant is not satisfied, the E&S should return to Step 2 to re-assess the grievance.

Figure NTS-7 Grievance Mechanism Process



5. IMPACT ASSESSMENT

5.1. Summary of Impacts, Benefits and Key Mitigation

Impact	Mitigation
GHG Emissions	• The GHG emissions are considered offset by the beneficial impact of generating clean energy through the operation of the wind farm.
Flood Risk	• Avoid locating any of the Project components within the buffer distances developed under the flood risk assessment to eliminate any risks for flood. • Hydrological study to be undertaken to identify and determine the required engineering structures to be considered as part of the detailed design for new asphalt and gravel road segment and internal tracks (e.g. drainage structures, culverts).
Wildfire	• Avoid locating any of the Project components within the buffer distances (if any) developed for the Aandqet Forest. • Identify and determine the required fire detection and protection equipment to be considered as part of the detailed design.
Impacts from Improper Management of Waste Streams	• Coordinate with the appropriate Municipality or hire a competent private contractor for the collection of water, wastewater, solid waste and hazardous waste from the site to the municipal approved disposal area. • Prohibit disposal of waste to the land. • Implement proper housekeeping practices at all times. • Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. • Ensure appropriate management of septic tanks. • Regular maintenance of all equipment and machinery used onsite. • Implement spill management procedures. • Additional protection shall be afforded by scheduling major activities with high potential for the generation of water pollution away from the snow melt season when the large majority of recharge is believed to occur.
Impacts on Soil and Groundwater	• Implementation of general best practice housekeeping measures • Following the Construction Health and Safety Plan. • Staging of work areas. • Provision of washout/washdown facilities with filter/neutralization prior to discharge. • Installation of silt fencing. • Erosion and sediment control. • Excavation and grading containment. • Provision of spill response equipment.
Impacts on Disposal Utilities	• There are no mitigation measures to be applied. Coordinate with the appropriate Directorates to: - Obtain list of authorized contractors for disposal of wastewater. - Undertake discussions with the appropriate municipal landfills to determine where there is sufficient capacity to easily handle construction debris generated from the Project. - Coordinate with the appropriate municipality or hire a competent private contractor for the collection of construction waste from the site to the approved landfill. - Coordinate with the appropriate municipality or hire a competent private contractor for the collection of solid waste from the site to the approved landfill.
Landslide, Slope Stability, Earthquake	• Incorporate recommendations of the seismic study for excavation at the platform foundation locations to a depth where stable soils are encountered.
Air Quality	• Use of wind screens or enclosures around dusty activities or the site boundary.

Impact	Mitigation
	• Water spray to reduce fugitive dust. • For unpaved roads, water flushing is the essential with 0.48 gallons per square yard twice per day. • For paved roads, water flushing with 0.48 gallons per square yard followed by sweeping is very effective and can reach 96%. If conducted directly before the passage of the turbines convoy or the morning and evening passages of the project vehicles to and from the site, a consequent decrease will occur. • A combination of the different above-mentioned measures will give a higher control efficiency that when applied individually.
Traffic and Transport	• An additional transport route survey will be undertaken. • The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition will be coordinated with the Port Authority. • Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport. • Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. • Any modification required for the Al Abdeh Roundabout will be discussed with the municipality as it is under their authority. • Works will be coordinated and permitted by the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest. • The construction of asphalt roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. • Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army. • A communications protocol being developed for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport. A final transport route map will be provided to all municipalities. • Announcements will be made to all villages along the WTG transport route from the Tripoli Port to the entrance of the Project site. • WTG components will be transported 2 days per week, a total of 24 trucks roundtrip per week for a period of 13 weeks. • Municipal police will provide an escort for the WTG transport convoy. • Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market. • The road that passes through El Rweimeh Village is the main access of the trucks transporting rocks and gravel, and maintenance activities will be undertaken by the Project Proponent. • For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road. • For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic. • Once the EPC Contractor has been selected, and the number and location of construction numbers are known, measures will be put in place to maximize mitigation of traffic impacts through carpooling and group transport by van.
Total Habitat Loss: • Approximately 75.47 ha out of 948.72 ha (8%). Sensitive Features Loss: • *Juniperus excelsa* dominance: 2,69ha (19.55%) lost or modified (moderate adverse impact) • Mixed oak woodland: 49.89ha (6.59%) lost or modified (moderate adverse impact)	During Pre-Construction: • Completion of a pre-construction flora survey to identify habitats and key flora species as identified in the baseline section. • Micrositing of infrastructure to avoid or reduce oak woodland and mixed woodland removal. • Preparation of a final BAMP outlining the measures required to deliver no net loss for areas of natural habitat, such as oak woodland and mixed woodland. A framework BAMP has been provided with the ESIA, as an appendix of the stand-alone ESMP.

Impact	Mitigation
• Oak woodland: 165ha (12.39%) lost or modified (moderate adverse impact) • Oak/pine woodland: 13.97ha (12.05%) lost of modified (moderate adverse impact) Habitats Including Vulnerable Plant Species: • Pine forest dominance 2: 7.16ha (16.93%) lost or modified (moderate adverse impact) • Oak/pine habitat: 13.97ha (12.05%) lost or modified (moderate adverse impact) • Mixed oak woodland: 49.98ha (6.59%) lost or modified (moderate adverse impact) • Oak woodland: 1.65ha (12.39%) lost or modified (moderate adverse impact)	During Construction: • Offsetting for the loss of natural habitats will be required to deliver no net loss of biodiversity in these areas. Full details of the measures to achieve no net loss will be provided in the final BAMP. Measures would include additional tree planting to produce new areas or improve degraded areas of oak-dominated woodland and mixed woodland. The translocation of tree species would also be considered. • Preparation and provision of workforce toolbox talks and monitoring to ensure all staff understand the importance of the biodiversity controls in place, what they entail and how these controls should be followed. Particular key early tasks in workforce education will include implementation of a hunting ban on the Project site and prohibition of burning of vegetation for warmth or cooking. • Minimization of the project footprint within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure construction. • If any key flora species are identified during the pre-construction survey, areas of habitat inhabited by the plants would be avoided. If it is not possible to avoid examples or areas of the species detailed in the baseline, every effort would be made to reduce the impact and further offsetting would be required. • Implementation of rehabilitation measures to mitigate the loss of habitat, such as vegetation remediation, translocation or creation of new habitat areas. Full details of these measures will be provided in the final BAMP to be developed by others. • Proper management of excavation materials. Rubble from site excavations should not be allowed to spread down slopes. Clear working procedures should be defined, implemented and supervised. • Separation and storage of top soil for use in restoration of all temporary project infrastructure and areas of temporary disturbance, e.g. track margins. Segregation of the topsoil of different habitat types will be required. • Soil management would also include observance of appropriate biosecurity controls to prevent the spread of invasive plants or floral diseases. This would involve washing vehicles and equipment to remove particles of vegetation and loose soil, with this done in specific “wash down” areas. Any invasive plants that are removed during vegetation clearance would need to be disposed of appropriately, in a safe way that does not allow it to spread. • Good construction environmental management on site based on good practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents. During Operation and Maintenance: • Monitoring of all habitat reinstatement, translocation, recreation, offsetting or enhancement as identified and implemented as required following pre-construction surveys. • Remove invasive plant species during routine vegetation maintenance. • Monitor power-line right-of-way vegetation to avoid fire risk. Remove blowdown and other high-hazard fuel accumulations. During Decommissioning: Typically, the same controls set out for construction will apply. • Minimization of activities within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure decommissioning. • Good construction environmental management on site based on good practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents. • Preparation and provision of workforce toolbox talks to ensure all staff understand the importance of the biodiversity controls in place and exactly what they entail.
Terrestrial Fauna	During Pre-Construction: • Completion of pre-construction fauna walkover survey to identify potential habitat for key mammal and reptile species, followed by camera trapping to confirm species considered to be present/status of any dens found. • Preparation of a final BAMP setting out the measures required based upon the findings of the further surveys. A framework BAMP will be included with the ESIA.

Impact	Mitigation
	During Construction: • If any mammal or reptile species are encountered during works, they would be allowed to disperse or would be translocated outwith the construction area. During Operation and Maintenance • If found to be present during pre-construction surveys, monitoring of populations of endangered reptiles as appropriate, including monitoring of any offsets or enhancements for those species.
Bats: Loss or Disturbance of Roosts and Foraging Habitat Collision Risk	During Pre-Construction: • A full year of activity surveys will be competed pre-construction, adding to the information gathered from the spring activity surveys used to inform this assessment. As per best guidance, a full year of survey data will allow for a more accurate understanding of bat activity across the site, temporally and spatially, which will enable a more accurate and informed impact assessment which in turn will determine the most effective mitigation required. During Construction: • A presumption for avoidance of all artificial light as far as possible. All lights should be cowled and downward facing and avoid light spill onto surrounding non-construction areas. During Operation and Maintenance: • Once the pre-construction survey results have been analyzed, it will be possible to develop an appropriately focused scope of operational period bat surveys. Surveys would cover up to three years' activity periods. • Given the high levels of activity recorded at SA2, SA6, SA9 and SA20 and predominately from species identified as high or medium risk in terms of collision (common pipistrelle, Kuhl's pipistrelle and serotine) it is recommended that turbines situated at these locations are subject to operational adjustments. Raising the cut-in speed at which the turbine begins to generate electricity, thus preventing movement in low winds, notably decreases bat mortality rates[5] along with feathering of blades i.e. adjusting the angle f the blade parallel to the wind or turning the unit away from the wind[6]. In addition, operational times could be altered – stopping turbines at these locations between the most active periods i.e. 20:00-05:00. • Monitoring of bat collision fatalities under and around each turbine following a standardized methodology potentially using trained dogs. Monitoring to be completed monthly and concurrently with bird collision monitoring. • Preparation and subsequent implementation of plan to identify and protect key bat roost caves in the area on and around the Project site from human persecution, such as identified elsewhere in the area. • Additional Good Practice: To prevent further persecution and destruction of bat roost caves protective metal grates should be installed across the entrances of all bat roost caves identified during the December 2017-March 2018 surveys. These would prevent members of the public from accessing the caves and disturbing or damaging the roosts, as observed previously.
Ornithology: Designated Sites Habitat Loss Barrier Effects Collision Risk	Due to the large number of ecological and ornithological mitigation proposed for the Project, it is recommended that a suitable qualified Ecological Clerk of Works (ECOW) be employed for the Project to ensure the appropriate implementation of the Biodiversity Action and Management Plan (BAMP) to be developed by others. All of the mitigation listed below is detailed in the framework BAMP. During Construction and Decommissioning: *Nest Destruction* • Where required, vegetation would be removed outside of the bird breeding season (March-August). The following vegetation removal deterrence methods would also be used to ensure ground nesting birds do not nest on the site following vegetation clearance: - Iridescent tape across the construction areas prior to construction activities. - Bird deterring machines which produce intermittent loud noises.

[5] Horn J.W., Arnett E.B. & Kunz T.H. (2008) Behavioral responses of bats to operating wind turbines. *The Journal of Wildlife Management,* 72, 123–132.
[6] Hein, C, D and Schirnacher, M, R. (2016). Impact of Wind Energy on bats: A Summary of our Current Knowledge. Human-Wildlife Interactions 10 (1), Pp 19-27.

Impact	Mitigation
	- Walking of the cleared area by individuals on a regular basis to prevent birds settling and to monitor if any birds are settling to nests on areas close to the planned construction activity. • Where vegetation has not been removed outside of the breeding bird season and must be removed during the breeding bird season, then pre-clearance surveys must be undertaken by a suitably experienced ornithologist. These surveys would identify any potential nests in the vegetation to be removed and then establish suitable "no go" buffers around these nests, to prevent the nest being destroyed or disturbed. Buffers would be species specific and determined by the ECOW. • In addition to the above, prior to commencement of decommissioning activities, walkover surveys would be completed in habitats suitable for and known to be used by breeding bird species as to identify any previously unknown nest sites. *Monitoring/Additional Good Practice Measures* • It is recommended that the program of VP surveys is continued, but with a greater survey effort. Surveys should be undertaken between August 2019 and November 2020, with six hours of survey undertaken at each VP location during the months of January, February, June, July and December. During the other months, when birds are migrating, this survey effort should be doubled to 12 hours of survey effort per VP location. It is recommended that more VP locations are used, with at least five locations recommended to cover the site. These should be chosen with the help of a viewshed analysis to ensure that all turbine locations can be observed from a survey location. All surveys must be undertaken by surveyors who are experienced in the identification and recording of Lebanese birds. Where required, these surveyors should also be trained in how to survey as per the SNH guidance. Data should be recorded as per SNH Guidance (2017) , with flight paths mapped into GIS and these reproduced on figures. This data can then be analyzed in GIS. Instead of undertaking a full CRA on the results, the analysis should consider the total number of birds per hour that are passing within the footprint of the wind farm at collision risk height. This should be calculated for each species and, if it is significantly greater than the numbers previously recorded (see **Table 14-9**: Collision Risk Assessment by Species), further assessment of collision risk impacts may be required. • Hunting Ban: A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year[7] impacting populations in their breeding grounds in Europe and Asia. It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4**. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves. The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site. Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders. Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway. • Artificial Light: The use of artificial light should be avoided where possible as steady white lights on the nacelle can attract prey, such as moths, and the prey can attract predators, such as moth eating birds like hobbies and red-footed falcons. Instead, it is proposed that red lights or pulsing/blinking lights are used on the nacelle instead. • Waste Disposal: To prevent attracting scavenging bird species to the site, any waste produce by the workers on the site would need to be disposed of following a detailed plan. Waste should not be stored or deposited where it is open to the air, as this would attract birds to the site. This could, inadvertently, lead to the creation of a de-facto feeding station for scavenging birds such as corvids, kites and vultures. • Disturbance and Displacement: Identified nests of birds of prey, such as common kestrel and short-toed snake eagle, are considered far enough away from any construction area and disturbance impacts are unlikely. However, the ECoW would be responsible for monitoring both nest sites and ensuring that they remain productive through the construction/decommissioning works. During Operations and Maintenance: *Migration VP Surveys* • It is recommended to continue the migratory season VPs during the start of the operational phase of the proposed development. These would commence as soon as the Project is operational and would be undertaken following the methods described in this section, although with an increased survey effort to meet the 36 hours per migration season as suggested by SNH Guidance. During each VP watch, flight activity by target species[8] will be recorded using the same details collected before:

[7] Committee Against Bird Slaughter (CABS) (2013) Report on the hunting of migrant birds in the Lebanon - affected species and their conservation status in the EU.
[8] Target species include all species of raptor, cranes, storks and pelicans.

Impact	Mitigation
	- Flight Number. - Time. - Date. - Species. - Number of Birds. - Flight height. - Total time of flight including time spent at each height. • In addition to this information, surveyors will record if any birds display any flight behavior apparently associated with the presence of the turbines (avoidance) or if any were seen to collide with a turbine (collision). Observations would use the following terminology after Meredith (2002)[9]: - Weave - Weaving flight line up to maximum height of turbine. - Direct - A direct flight line, within the turbine envelope but clearly in a line up to maximum turbine blade height, avoiding turbines. - Horizontal - A bird flying towards a wind farm site, which takes avoiding action by a horizontal movement (i.e. no change in height) so as to take it around the edge of the turbines. - Vertical - As for horizontal, but this time, the bird gains altitude to take it over the top of the wind farm site. - Bullet - Flight behavior with no avoiding action with regards to turbines (or other infrastructure). - Hit - A recorded collision between a bird and a turbine (or other infrastructure). - Avoid - Avoidance behavior near a turbine, generally taken at short notice and likely to appear as a sudden change in direction and/or height. - Other – Any other behavior not easily classifiable into any of the above categories. *Carcass Searches* • As well as the VP surveys, searches for collision victims will be completed under the turbines. Visual searches within an area at least five meters greater than the length of each turbine blade will be undertaken. The surveys would be stratified, with a third of the turbines survey during each visit. It would also be randomized, with a different set of turbines chosen to be surveyed on each visit. These surveys would be undertaken ten times per month during the migration period (mid-February to mid-May and mid-August to mid-November) and three times per month during the rest of the year. The amount of time spent searching will be standardized to allow comparability between turbines and visits. • Prior to starting the surveys, both scavenger and surveyor bias will be calibrated. This will be completed by leaving proxy carcasses10 under turbines in locations where they can be seen by static trail cameras to record how much time passes before a carcass is removed by scavenging animals. • A similar process will be used to calibrate how successful surveyors are at locating carcasses. One surveyor will place a number of carcasses, ideally of differing sizes randomly under turbines and a different surveyor would search as described above. This process will be repeated across a number of turbine locations and for all surveyors involved in the searching. How many of the placed carcasses which are found can then be used to identify how effective the surveyors are at finding carcasses. • A project specific monitoring protocol would be developed. This will need to be adapted following the publication of the Bird Monitoring Protocol by the MOE. *Radar Bird Monitoring Equipment* • Radar equipment to monitor volumes of migrating birds approaching the proposed development would be considered. The requirement for this would be based on the expectations of the Bird Monitoring Protocol currently being prepared by the MOE. It is anticipated that this would involve guidance on the specifications of system appropriate and how it should be utilized.

[9] Meredith, C., Venosta, M., & Ressom, R. (2002) *Cordington Wind Farm Avian Avoidance Behaviour Report*, 2002. Biosis Research Report.
[10] Proxies required as its unlikely that access to any hooded vulture carcasses will be possible. A bird of similar size and colouration should be used. It will be acceptable to use man-made dummies in the surveyor bias trials as that is a test of the surveyors' visual abilities. However, for the scavenger bias trials, real carcasses should ideally be used.

Impact	Mitigation
	• The radar system would have a more direct feedback into the shutdown mitigation of the proposed development, as it would detect large volumes of birds approaching so large collision risk events can be avoided. The other monitoring methods would have an indirect feedback into the shutdown mitigation.
Positive Impacts: • The potential for the consistent provision of electricity to meet demand. • Economic benefits from the expected sourcing of construction materials from the Akkar region. • Economic benefits from the sourcing of Project personnel from the northeastern part of Akkar. • Economic benefit from income that may be generated by nearby businesses including hotels and restaurants. • Land lease / acquisition for 23 years with a possible extension to 28 years. Negative Impacts: • Land lease / acquisition for 23 years with a possible extension to 28 years. • Temporary loss of access by shepherds to 0.43km^2 of grazing areas. • Temporary loss of access to tracks by recreational bird hunters. • Potential impacts to vulnerable groups, including women, the elderly and informal settlements. • The potential to overwhelm businesses in the Project area by the influx of workers. • Reduced cost of provision of power to residents. • Boosting of the local economy. • Enhancing infrastructure such as roads and transportation. • Cleaner environment. • Improved quality of life. • Economic growth.	Construction, Operations and Maintenance and Decommissioning: • Landowners have agreed that the compensation provided is appropriate and fair, though the Project represents a loss of access to 747,589m^2 will be leased for the Project for 28 years, and +3,500m^2 will be acquired permanently. • A temporary loss of access of land for grazing of 45% of the total available in the Project area. Given the loss of access to nearly half of the total, the impact severity is anticipated to be high. Additional consultation will be undertaken with livestock owners and shepherds to explain the areas they cannot access for the duration of the construction. Shepherds will be consulted to find out whether goat grazing is a subsistence activity and whether there are adequate alternative grounds that can be used during the construction period. If there's impact or loss of livelihoods, a Livelihood Restoration and Compensation Plan will be developed. Shepherds grazing near the Project will be advised of exclusion zones in advance, noting that other grazing areas are available. Alternative areas for grazing will be researched and secured by the Developer for alternative use during construction. If the Developer cannot arrange an alternative area because of landowners' objection, financial compensation will take place. All grazing areas will again be accessible at the end of construction. • Access to tracks within the Project area would be temporarily prohibited during the construction phase for a period of 18 months. Recreational hunters near the Project will be advised of exclusion zones in advance, noting that other tracks are available, and hunting is for recreational purposes, i.e. not subsistence. There are other tracks available for hunters, who only hunt recreationally. A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year impacting populations in their breeding grounds in Europe and Asia. It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4** in **Section 14 Ornithology**. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves. The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site. Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders. Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway. • Impacts to vulnerable groups, including women, the elderly and Palestinian and Syrian refugees, are not expected to be disproportionately different than other community members. The impact severity is anticipated to be Low (to be confirmed). The Developer will collect additional data, identify all Project stakeholders and engage with them, as necessary, including directly-affected people and vulnerable groups. These exercises will help clarify and confirm the DAOI and focus the assessment of project impacts and inform mitigation, as well as inform management plans. The Developer will identify and map all of the Project stakeholders and engage with them as necessary. This will help ensure that all Project stakeholders are consulted and there are no hidden pockets of opposition. Other potential use of natural resources on the Project site will be investigated. Additional measures to communicate the Project information, including provision of schedules, health, safety and security measures are necessary (refer to Section 16 Community Health, Safety and Security and the stand-alone SEP). • Up to 125 workers will be employed by the Project. Workers will be sourced from the Project area first, regionally second, nationally third and internationally last. Employment will supply income for a period of up to 18 months. Pre-recruitment skills training will be provided. A job skills assessment will be undertaken to provide transparency in hiring practices. The impact to workers is expected to be positive. • General impacts to communities are expected to be Positive based on establishment of the CRO Office in Jabal-Akroum Kfartoun and community development projects as agreed between Municipalities and the Developer.
Noise	Construction: • Limit the working hours from Monday to Friday 7 a.m. to 7 p.m., if possible. Some flexibility in working hours may be required during the delivery and erection of turbines and depending on weather conditions. • The final time schedule of the transport movements should be clarified with the authorities and communities. Only well-maintained equipment should be operated on-site. Operations and Maintenance: • The distance of the WTGs to nearby receptors was increased by eliminating the originally planned WTGs 26, 27 and 28. In addition, WTG 25 was shifted to increase the distance to nearby receptors.

Impact	Mitigation
	• In order to comply with the IFC noise limit of 45 dB(A) some turbines need to be operated in noise reduced modes. Using the noise reduced modes which are available for all considered turbine types, the IFC noise limit of 45 dB(A) can be complied with. Due to the fact, that the calculation was based on a worst-case assumption of 23 turbine locations, the noise assessment should be redone when the final and reduced turbine layout is available. At the time the final number of turbines is available, the noise reduction modes for the corresponding turbine type can be stipulated. • The WTGs will be maintained regularly to ensure that the turbines do not become louder over time.
Shadow Flicker	• Shutdown modules will eliminate the possibility for exceedances of annual and day limits. An automatic shadow-flicker shutdown system shuts down the WTG when the sun is shining (direct sunshine on a horizontal area > 120 W/m²). These systems shut down a turbine when one of two conditions are reached: - More than 30 minutes of shadow-flicker occur on one day at a receptor. - The maximum annual quota of shadow-flicker at a receptor is exceeded. - When shutdown systems feature a radiation sensor, the turbines only shut down when the sun is shining. If the shadow-flicker shutdown system does not include a radiation detector, the WTG will shut down at all times when the shadow-flicker assessment indicates shadow-flicker at a receptor (i.e. also in cases of overcast sky or fog when there is actually no shadow flicker). • The use of shadow flicker shutdown modules will have a (small) negative effect on the energy yield of the wind farm.
Visual Amenity in Settlements or Key Viewpoints	• The distance to the planned Lebanon Wind Power wind farm was also increased so that cumulative impacts were reduced. • The wind fam design layout follows the existing morphology of the mountain. • Tracks will be designed to follow the existing tracks and fit with contours as far as possible. • The turbines and all the other aboveground structures will be removed at the end of the operational lifetime. • The internal cabling will be underground cabling.
Transport and Traffic	• The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition of the 45m of concrete wall be coordinated with the Port Authority. • Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport. • Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. • Any modification required for the Al Abdeh roundabout will be discussed with the municipality as it is under their authority. • Such works will be coordinated and permitted by the Developer and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest. • The construction of asphalt and gravel roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. The construction would be performed under the supervision and conditions of the relevant municipality. • The improved road network will have a positive impact on the health and safety in the area by providing safer roads, minimizing impacts to city centers, providing greater buffer distances between houses and the road and eliminating dangerous curves/turns. • Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army. • Occupational health and safety rules, codes and regulations will be followed during works. • The OEM/EPC Contractor will be supervised by and accountable to the Developer. • The transport of WTG components will occur between 11pm and 4am to avoid impacts to communities traveling to work and school. • Municipal police will provide end-to-end escort for the transport convoy. • Advance notification of the scheduled transport will be provided to all communities along the route.

Impact	Mitigation
	• The trucks will travel at a low speed to lessen the generation of noise, vibration and dust. • A communications protocol being developed for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport. A final transport route map will be provided to all municipalities. • Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market. • For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road. • For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic. • The Developer will meet with Rweimeh Village residents of the houses located along the quarry tracks and existing asphalt roads to discuss the Project and nature and timing of the transport of construction materials. • Advance notification of the start of construction will be provided. • The trucks will travel at a low speed to lessen the generation of noise, vibration and dust. • Occupational health and safety rules, codes and regulations will be followed during works. • Negotiation of entry to quarry roads by resident vehicles will follow standard traffic safety/traffic control protocols, i.e. Stop/Go signage, flagman, etc. • The OEM/EPC Contractor will be supervised by and accountable to the Developer.
Landscape Impacts	• Large, multi-MW turbines with large rotor diameters are considered. By using large, multi-MW turbines with large rotor diameters the number of turbines per generation capacity and the footprint of the Project will be reduced. In addition, large rotors have a reduced rotor speed compared to smaller turbines which will also reduce the visual impact of the Project. • The distance of the WTGs to nearby receptors was increased by eliminating the originally planned WTGs 26, 27 and 28. In addition, WTG 25 was shifted to increase the distance to nearby receptors.The wind farm layout was designed so that the array follows the existing landform of the mountain ridges. By considering the landform of the mountain ridges at the wind fam design, the wind farm layout follows the existing morphology of the mountain. Consequently, the typological appearance of the ridge remains largely recognizable. In addition, the overlapping of rotors of views from the east and the west are unlikely which can be perceived as visually restless. • Tracks will be designed to follow the existing tracks and fit with contours as far as possible. By following the existing tracks and fitting the location of the tracks with the contours lines the landscape impact of the tracks can be reduced. • The turbines and all the other aboveground structures will be removed at the end of the operational lifetime. By removing the turbines and all the other aboveground structures at the end of the operational lifetime, the landscape impact of the project will be entirely revisable and limited to the operation phase of the project. • The internal cabling should be underground cabling. By designing the internal cabling as underground cabling the landscape impact in the immediate surrounding was reduced.
Buried Artifacts	• Though the potential for impact is considered low, a Chance Finds Procedure has been developed (in accordance with guidance provided by the Ministry of Culture and the General Directorate of Antiquities) to appropriately respond to cultural resources encountered during construction.
Eco-Tourism at Karm Chbat Nature Reserve	• During the construction phase, access to certain portions of the 5.13M m^2 Karm Chbat Nature Reserve will be limited to ensure the health and safety of visitors.
Impacts to Workers	• Provide appropriate worker training. • Implement H&S measures (masks, work gloves, proper clothing, H&S rules) and safe work practices. • Control and supervise personnel. • Development and implementation of an Emergency Response Plan and training personnel on the actions to be taken in risk situations. • Appropriately maintain and operate equipment. • Collect and address worker complaints and suggestions through grievance mechanism.

5.2. Residual Impact Summary

The assessment of residual impacts following implementation of the planned mitigation was in accordance with the following:

		Sensitivity of Receptor				
		Low	Low-Medium	Medium	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Most residual impacts are minor for the construction and operations and maintenance phases, with only seven impacts being assessed as moderate or moderate to substantial.

The following summarizes residual impacts for the construction phase:

Residual Impacts - Construction Phase

		Sensitivity of Receptor				
		Low	Low-Medium	Medium	Medium-High	High
Impact Severity	No Change					
	Slight			3, 5, 7	15, 20	20
	Low			1, 4, 6, 8, 9, 10, 12,	16, 18	2, 22
	Medium			11, 17		
	High					
	Very High					

Key: Construction Phase

1 GHG Emissions
2 Management of Waste Streams
3 Landslide, Slope Stability, Earthquake
4 Air Quality
5 Obstacle Removal
6 New Road Development
7 Internal Track Development
8 Transport of WTG Components, Construction Materials and Workers
9 Habitat Loss
10 Terrestrial Fauna: Loss or Disturbance of Resting Places
11 Bats: Loss or Disturbance of Roosts and Foraging Habitat
12 Designated Sites
13 Birds: Habitat Loss, Nest Destruction, Disturbance and Displacement
14 Socioeconomic Impacts
15 Noise
16 Visual Amenity in Settlements
17 Visual Amenity from Key Viewpoints
18 Impacts to Communities Along the Transport Corridor
19 Impacts to Informal Settlements Along the Transport Corridor
20 Buried Artifacts
21 Eco-Tourism at Karm Chbat Nature Reserve
22 Impacts to Workers

Residual Impacts – Operations and Management Phase

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High**
Impact Severity	No Change					
	Slight			1, 4,		10
	Low			5, 6, 7	9, 11, 13	2, 3
	Medium			12		
	High					
	Very High					

Key: Operations and Maintenance Phase

1 Flood Risk
2 Wildfire
3 Management of Waste Streams
4 Landslide, Slope Stability, Earthquake
5 Habitat Loss
6 Bats: Collision Risk
7 Birds: Collision Risk, Disturbance and Displacement and Barrier Effects.
8 Socioeconomic Impacts - Positive
9 Noise
10 Shadow Flicker
11 Visual Amenity in Settlements
12 Visual Amenity from Key Viewpoints
13 Impacts to Workers

6. ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING

6.1. Introduction

To effectively manage social and environmental impact identified through the ESIA process, an Environmental and Social Management Plan (ESMP) framework has been developed. The framework identifies and outlines appropriate measures and mitigation that will be needed to achieve acceptable levels of environmental and social performance, through all phases of the Project. The Developer will use the ESMP framework as the basis for developing an Environmental and Social Management System (ESMS) and series of detailed management plans, initially for construction and then for the operations phase.

The management plans developed for the Project will be practical and fully integrated into the Developer's ESMS. This will ensure alignment with corporate policies and procedures. The system will need to be fully integrated to enable the plans to be effective (i.e. covering environment, health, safety and security in an integrated manner). These are expected to include the following, as a minimum (noting that some elements may be combined into a plan):

Detailed Management Plans:

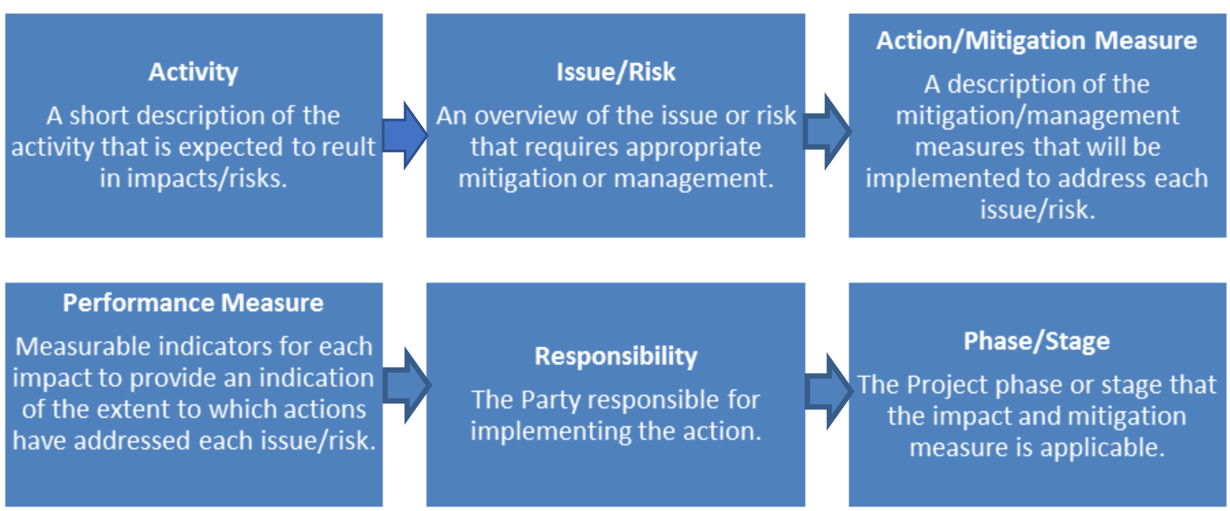
- **Stakeholder Engagement Plan**
- **Biodiversity Management Plan**
- **Resource Efficiency and Pollution Prevention Plan**
- **Water, Solid Waste, Wastewater and Hazardous Waste Management Plan(s)**
- **Air Quality Management Plan**
- **Noise Management Plan**
- **Shadow Flicker Management Plan**
- **Landscape and Visual Impact Management Plan**
- **Traffic Management Plan**
- **Chance Finds Procedure**
- **Safety Management Plan (natural disasters, accidents and emergencies)**
- **Security Management Plan**
- **Employee Training Plan**
- **Occupational Health and Safety Plan**
- **Community Health and Safety Plan**
- **Contractor Management Plan**
- **Community Benefit-Sharing Plan (Corporate Social Responsibility (CSR) Plan)**
- **Labor Accommodation Plan**
- **Local Hiring and Labor Conditions Plan**
- **Human Resources Policy**

The main objectives of the ESMS and ESMPs are to:

- Ensure conformance with IFC PSs, IFC Industry Sector EHS Guidelines, international lender's environmental and social (E&S) policies, local regulations and good international practice.
- Help the Developer to select and manage local consultants and engage with Project stakeholders.
- Have a concrete action plan to avoid and mitigate the negative impact of the project on the environment and local population and to compensate/remedy the negative impacts that cannot be avoided or reduced.
- Provide references for actions, plans and procedures.
- Have an efficient monitoring tool for the contractors of the project company.
- Improve the communication on the environmental and social topics within the project stakeholders.
- Improve the positive impacts of the Project.
- Advise the Developer and assist them in undertaking Informed Consultation and Participation with Affected Communities and other interested parties as per IFC PS1.
- Advise the Developer on E&S capacity requirements for each Project phase and to enhance existing capacity with training and on-the-job learnings.
- Provide advisory support to the Developer to mobilize, execute and staff/resource the ESMPs effectively.
- Engage with potential civil society partners and/or international agencies who could potentially assist in Project preparation and delivery.

6.2. Approach to Management and Monitoring Plans

The detailed management plans for the Project will be developed to align with national regulatory requirements and Good International Industry Practice (GIIP) including that set out by IFC, EIB and FMO. The plans will incorporate the following components:



6.3. Roles and Responsibilities

The Developer will have ultimate responsibility for implementing the provisions of the ESMP.

This role will include the on-going management of environmental and social impacts, control of health, safety and security (HSS) risks, monitoring of contractor performance as well as development of mechanisms for dealing with environmental and social problems, and HSS concerns.

The Developer will also ensure that the activities of its EPC Contractor and other contractors (and subcontractors) are conducted in accordance with good practice measures, implementation of which will be required through contractual documentation. The Developer will oversee the Project performance pertaining to environment, health, safety and social issues.

The selected EPC Contractor will provide a dedicated Health, Safety and Environment (HSE) Department to support the Project. The EPC Contractor's HSE Department will have overall responsibility for the coordination of the actions required for environment and social management and mitigation, control of HSS risks, and for monitoring the progress of the proposed ESMP for the Project. However, ultimate responsibility for implementing the provisions of the ESMP will lie with the Developer.

In general, the EPC Contractor's HSE Department shall perform the following activities:

- Ensuring availability of resources and appropriate institutional arrangements for implementation of the ESMP.
- Preparation of required documents on environmental, social and health and safety management.
- Effective implementation of the health, safety and security management system.
- Confirming the competence of contractors/sub-contractors engaged on the Project and monitoring their performance in complying with the HSS management system.
- Collection of the statistics of health of workers.
- Collection and monitoring of data on personnel. Contractor, health and safety.
- Providing support during routine medical check-ups of workers.
- Awareness-raising and implementing safety programs.
- Providing job specific induction training.
- Compliance with regulatory requirements.
- Carrying out environmental, health and safety and security audits.
- Identify unsafe acts & conditions and suggest remedies.
- Develop safety culture and comply with the company's HSE policy and standards requirements.
- Encourage and enforce the use of PPE.
- Educate all employees in the use of PPE and safe practices.
- Direct, coordinate and orient the HSS activities.
- Promulgate the spread of policy, objectives, rules and/or regulations.
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition.
- Monitoring the progress of implementation of the ESMP.
- Reviewing and updating the ESMP as and when required for its effective implementation.

1. INTRODUCTION

Sustainable Akkar SAL (hereafter referred to as 'the Developer'), a Lebanese investment company, together with Tefirom İnşaat Enerji Sanayive Ticaret A.Ş (Tefirom), a Turkish construction, engineering and contracting firm with experience in the field of wind energy, is seeking an environmental license for the construction and operation of the Sustainable Akkar Wind Farm (hereafter referred to as the Project). The area to be developed is located in Jabal Akroum, Akkar on Lebanon's northeastern border with Syria.

The Project comprises the construction and operation of wind turbines to provide a maximum licensed capacity of 90.75 megawatts (MW). A potential for a 10% expansion as stipulated in the Power Purchase Agreement (PPA) arranged between SA and the Government of Lebanon (GOL), which will be delivered to the public grid, i.e. 82.5MW + 10% = 90.75MW.

The purpose of this Environmental and Social Impact Assessment (ESIA) is to assess environmental and social impacts generated by the Project in line with the good international practice, as per International Finance Corporation (IFC) Performance Standards (PSs) (2012) and European Investment Bank (EIB) Environmental and Social Standards (ESSs) (2010).

This report is accompanied with two stand-alone documents: a Stakeholder Engagement Plan (SEP) and an Environmental and Social Management Plan (ESMP), which together constitute a full set of documents necessary for the international lenders to take a decision on Project financing.

1.1 Project Background

In Lebanon, the average available production capacity in 2009 was 1,500MW while the average demand was around 2,000MW-2,100MW. The total energy demand was 15,000 gigawatt hours (GWH) although the total produced energy was 11,522GWh; thus, the electric energy deficit in Lebanon in 2009 was estimated at 3,478GWh. At the 2009 Copenhagen Climate Conference, the GOL pledged to meet 12% of its energy consumption from renewable energy (RE) sources by 2020. Several strategies and Action Plans were put forth by different ministries to achieve this target, most importantly the Ministry of Energy and Water (MOEW) 2010 Policy Paper for the Electricity Sector (PPES),[11] committing to "*launching, supporting and reinforcing all public, private and individual initiatives to adopt the utilization of renewable energies to reach 12% of electric and thermal supply*".

Based on the contents of the PPES, the Lebanese Center for Energy Conservation (LCEC) developed the first National Energy Efficiency Action Plan (NEEAP) for Lebanon for the period 2011-2015. It included fourteen initiatives to address energy efficiency and renewable energy, including Initiative 6: Electricity Generation from Wind Power. The subsequent *Wind Atlas of Lebanon* (UNDP-CEDRO, 2011) provided a mesoscale and microscale modelling for the entire country to produce a wind map at heights of 50 meters (m) and 80m above ground level and at a resolution of 100m (GL Garrad Hassan, 2011). The Wind Atlas demonstrated a potential of 1,500MW of wind energy in the country, with the possibility to install 400MW to 500MW by 2020.

Developers responded to a 2013 Request for Proposal (RFP) for developing the first utility-scale wind farm in Lebanon. Shortly thereafter, a higher electricity deficit of 5,524GWH was indicated in 2014,

[11] http://www.databank.com.lb/docs/Policy%20paper%20for%20the%20electricity%20sector%202010.pdf

despite the start of power generation through rental floating power plants.[12] This situation resulted in end users being forced to rely on diesel generators to overcome the electricity shortages. As of 2016, the peak power demand reached 3,594MW while the effective power production by Electricité du Liban (EDL) only reached 2,108MW,[13] leading to 21 hours of electricity supply in Beirut, and 14 hours outside of the capital.

In response, Lebanon signed its first-ever Power Purchase Agreements (PPAs) to purchase wind energy from three separate consortiums that will build and operate wind farms in Akkar, in the north of the country. The MOEW's signing of the agreements represent Lebanon's first PPA with the private sector in electricity generation as part of efforts to close an estimated 1GW gap between current electrical supply and demand in the country.

To this extent, the Developer was qualified and signed a PPA in February 2018 to construct and operate the Sustainable Akkar Wind Farm (the Project) to provide a maximum licensed capacity of 90.75MW which will be delivered to the public grid.

1.2 Project Location and Setting

The Project is located on an uninhabited mountain ridge of Jroud Akkar in the Akkar District and Akkar Governates as outlined in blue in **Figure 1-1**, where the mean wind speed is 6-8 meters per second (m/s).

The Akkar Governate (shown as "1" in the inset of **Figure 1-1**) is the northernmost governate of Lebanon and covers an area of 788 square kilometers (km^2). It is bounded by the Mediterranean Sea to the west, North Governate to the south and Baalbek-Hermel Governate to the southeast (shown as "2a" and "3a", respectively, in **Figure 1-1)**, and the Syrian governates of Tartus and Homs to the north and northeast.

Akkar can be divided into 7 parts: Qaitea, Jouma, Dreib, Jabal Akroum, Wadi Khaled, Cheft and As-Sahel. The largest cities in Akkar are Halba, Bire Akkar and Quobaiyat. The Project site is located within Jabal Akroum. The Project area is approximately 8.7km^2 with an actual installation area of 112,005m^2. The Project site is located on lands that shall be leased and/or purchased from the Municipality of Aandqet, Rweimeh Village and Jabal-Akroum Kfartoun.

The layout of the Project is shown in **Figure 1-2**. The Project will comprise the construction of up to 21 wind turbines which range in power from 4.2MW to 5.3MW. Regardless of the Original Equipment Manufacturer (OEM)/Engineering, Procurement, and Construction (EPC) Contractor selected, the wind turbine generators (WTGs) will be installed among the 23 locations (WTG 02 through WTG 25) shown in **Figure 1-2**. Note: potential turbine locations WTG 01, WTG12, WTG21, WTG28, WTG29, WTG30 and WTG31 were removed as part of the ESIA process to mitigate Project impacts (refer to **Section 3 Analysis of Alternatives).**

[12] Bouri, E., El Assad, J. 2016. The Lebanese Electricity Woes: An Estimation of the Economical Costs of Power Interruptions. Energies, 9, 583; doi:10.3390/en9080583.
[13] Ashari, T (2018) *Lights Out as Demand Surges for Electricity*. The Daily Star Published on 10 July 2018. Retrieved from: http://www.dailystar.com.lb.

Figure 1-1 Project Location

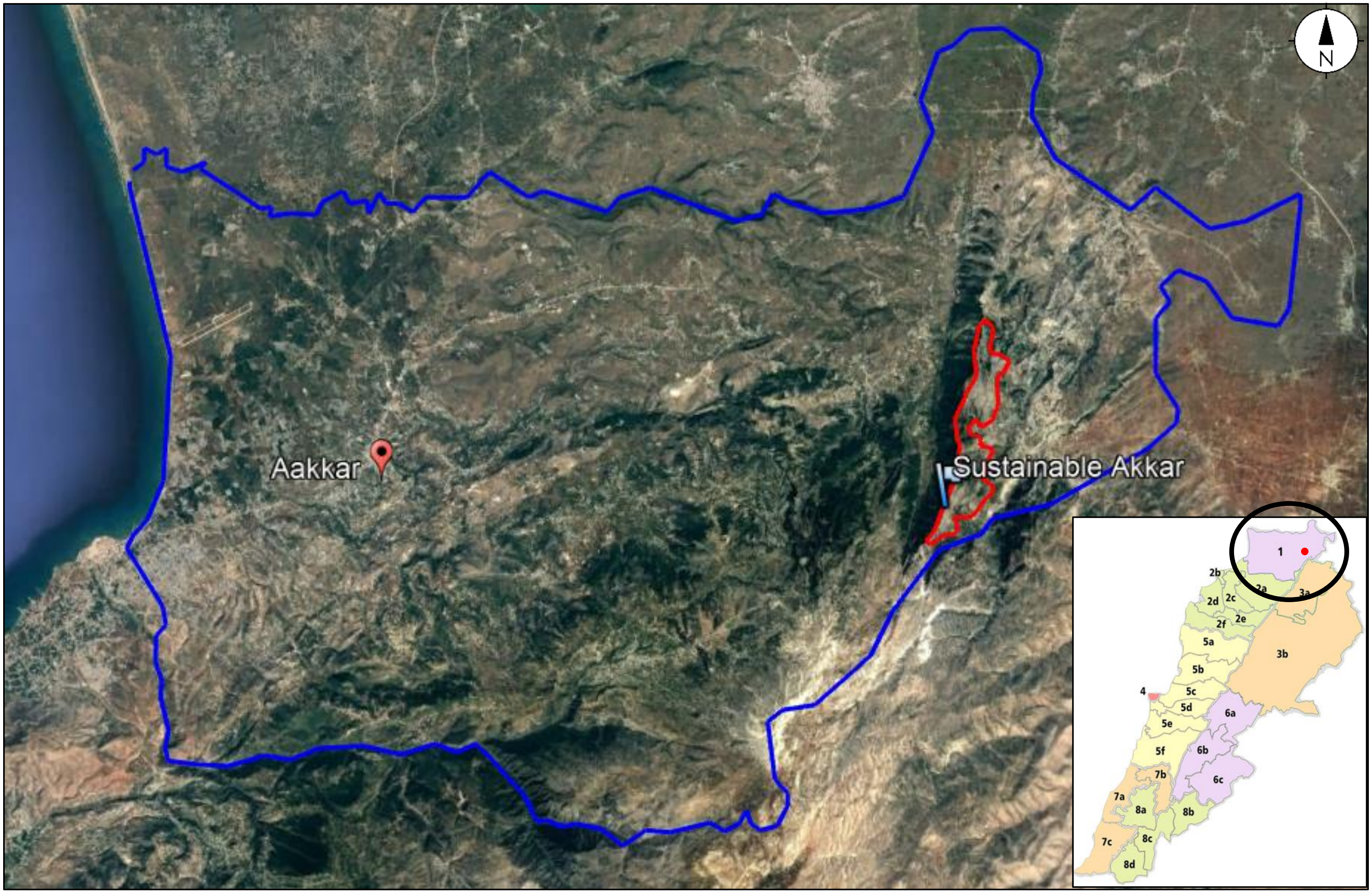
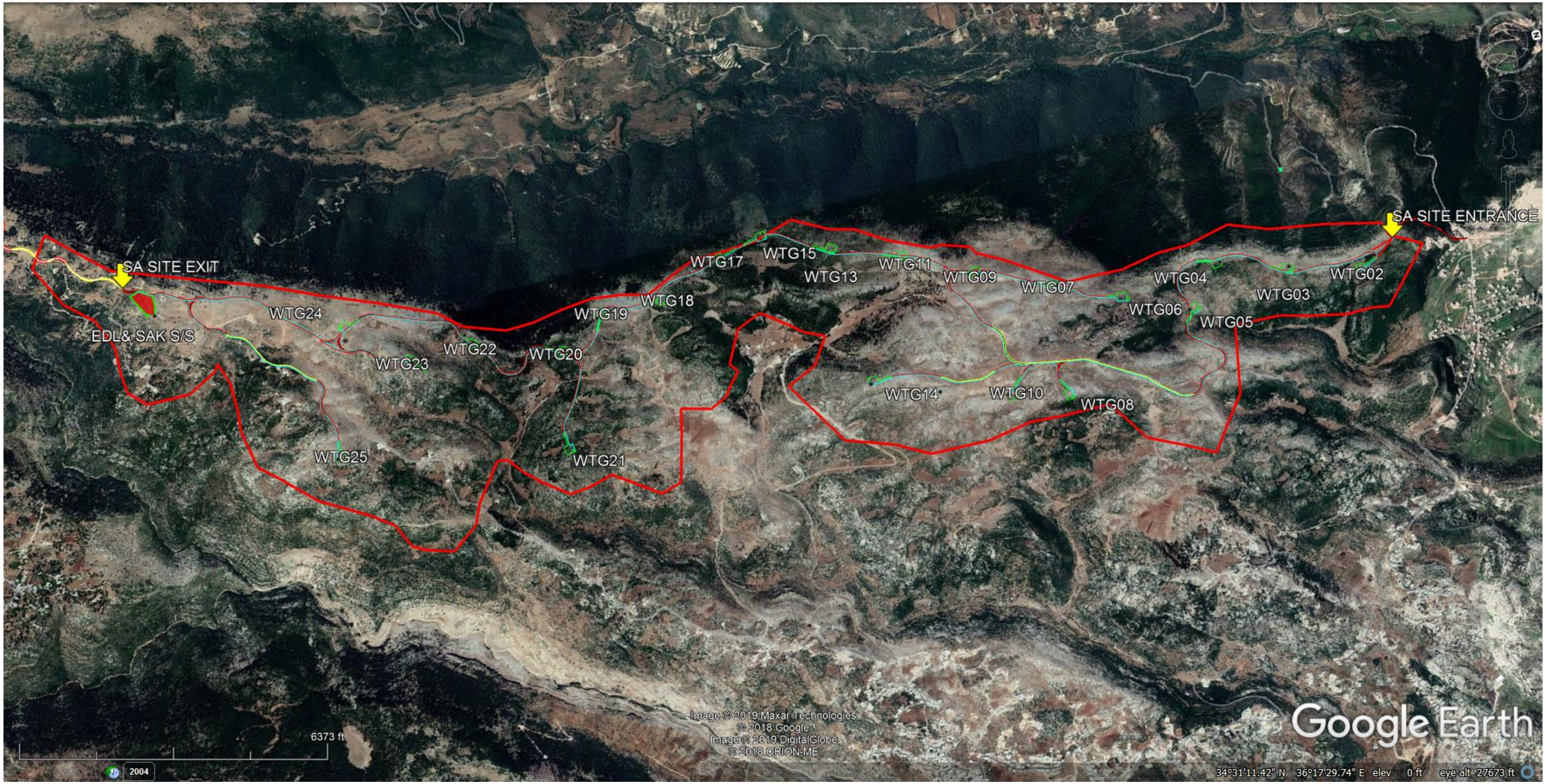


Figure 1-2 Project Layout



1.3 The Environmental and Social Impact Assessment Report

The environmental clearance for this Project is governed by the Ministry of Environment (MOE) as stipulated in Law 444 of 2002 for the Protection of the Environment[14] and the MOE Decree No. 8633 of 2012, Fundamentals for Environmental Impact Assessment[15]; the Project falls under Annex 1 requiring a full Environmental Impact Assessment (EIA).

The Developer will be seeking financing for the Project from prospective lenders, including International Finance Institutions (IFIs). Therefore, the Developer wishes to design and manage the Project in accordance with this ESIA Report which will be submitted to the MOE and the relevant IFIs and has therefore been prepared in accordance with good international industry practice and standards. For the purpose of the ESIA, this has therefore been developed in accordance with the following:

1. A Scoping Report prepared by ECODIT and submitted to the MOE on 12 January 2018 (**Appendix A**). The scoping phase included a public participation meeting with local stakeholders in the presence of MOE's representatives to inform the them about the Project and solicit their feedback as requested by the EIA decree. The MOE provided a Scoping Report response, also included in **Appendix A**.
2. IFC PSs.[16]
3. Relevant IFC Environmental Health and Safety (EHS) Guidelines.[17]
4. EIB ESSs.[18]

1.4 Document Structure

Table 1-1 provides an overview of the sections within this ESIA document.

Table 1-1 Summary of Volume I ESIA Report Contents

Section	Contents
Section 2 – Project Description	Provides a detailed description of the Project in relation to its location, the key project components and an overview of the proposed activities that are to take place during the various Project phases.
Section 3 – Analysis of Alternatives	Provides an analysis of certain alternatives to the Project development in relation to: (i) the Project site selection alternatives, (ii) the Project design, (iii) the chosen technology; and investigates (iv) the 'No Action' Alternative.

[14] Lebanese Official Gazette: Law 444, dated 08/08/2002.
[15] Environmental Impact Assessment Decree - MOE Decree 8633 of 2012.
[16] World Bank. 2017. IFC Performance Standards on Environmental and Social Sustainability. IFC E&S. Washington, D.C.: World Bank Group.
[17] IFC, 2007. Environmental, Health and Safety General Guidelines, World Bank Group; IFC, 2007. Environmental, Health and Safety Guidelines, for Toll Roads, World Bank Group; IFC, 2007. Environmental, Health and Safety Guidelines, for Electric Power Transmission and Distribution, World Bank Group; IFC, 2015. Environmental, Health and Safety Guidelines, Wind Energy, World Bank Group.
[18] Environment, Climate and Social Office Projects Directorate, Version 10.0 of 08/10/2018.

Section	Contents
Section 4 – Regulatory and Policy Framework	Provides an overview of the environmental clearance process for the Project as governed by the MOE.
Section 5 – ESIA Approach and Methodology	Presents the methodology and approach that was adopted for the ESIA study. This is followed by presentation of gaps in baseline data and/or nature and extent of current knowledge, and environmental commitments for future data collection.
Section 6 – Stakeholder Consultation and Engagement	Discusses the stakeholder consultation and engagement which were undertaken as part of the ESIA process and provides an overview of the findings. In addition, this section also discusses the future stakeholder engagement and consultation plans and references the stand-alone SEP.
Section 7 – Overview of Strategic Environmental and Economic Impacts	Provides an overview of the significant positive environmental and economic impacts that will result from the Project development on the strategic and national level. Also highlights the site specific negative environmental and social impacts anticipated from the Project throughout its various phases – each of which is discussed in detail in the subsequent sections.
Section 8 – Section 19	Presents the environmental and social attributes studied throughout the ESIA. This includes: Climate and Climate Change (Section 8), Geology and Hydrology (Section 9), Geophysical Ground and Seismicity (Section 10), Air Quality (Section 11), Transport and Traffic (Section 12), Biodiversity (Section 13), Ornithology (Section 14), Socioeconomic Conditions --- to include Land Use --- (Section 15), Community Health, Safety and Security --- to include Noise, Shadow Flicker, Visual Amenity and Traffic --- (Section 16), Landscape (Section 17) Archaeology and Cultural Heritage (Section 18) and Occupational Health and Safety (Section 19). For each attribute, the baseline conditions within the Project site and its surroundings is assessed. Each section then moves on to identify and assess the potential impacts from the Project on each attribute.
Section 20 – Cumulative Impact Assessment	Investigates the cumulative impacts which could result from other known existing and/or planned developments in the area and currently available information on such planned developments.
Section 21 – Summary of Anticipated Impacts and Mitigation	Summarizes all identified impacts discussed throughout the previous sections which are anticipated throughout the various phases of the Project to include planning and construction phase, operation phase, and decommissioning phase.
Section 22 – References	Summarizes the references within the Volume I ESIA Report.
Volume II - Appendices	Appended documents referenced in the Volume I ESIA Report.

1.5 Project Proponent and Key Contributors

Different entities are involved in the planning and implementation of the Project. The responsibilities of each key entity which is of relevance to the ESIA are listed in the text below along with a general description of their roles.

- Sustainable Akkar SAL (the Developer): serving as owner and lead developer of the Project.
- ECODIT SAL (ECODIT): was commissioned by the Developer to prepare the Environmental Impact Assessment (EIA) for the Project in order to apply for the necessary environmental permit in accordance with the requirements of the MOE and in Law 444 of 2002 for the Protection of the Environment and the MOE Decree No. 8633 of 2012, Fundamentals for Environmental Impact Assessment. This report is the EIA report submitted to the MOE.
- Ramboll US Corporation (Ramboll US): was commissioned by the Developer to prepare this Environmental and Social Impact Assessment (ESIA) for the Project in accordance with IFC Performance Standards, IFC's Environmental, Health and Safety (EHS) Guidelines and EIB Environmental and Social Standards.
- OEM/EPC Contractor: will be responsible for preparing the detailed design and layout of the Project; supply of the material, wind turbines, and equipment; and construction of the internal access roads, crane pads, foundations, operation building and the medium voltage and data interconnection between the individual wind turbines and the wind farm substation. The OEM/EPC Contractor has not yet been selected for this Project; however, Vestas Wind Systems A/S and GE have been shortlisted and are in negotiations with the Developer.
- Ministry of Environment: The MOE is the lead government agency responsible for environmental permitting based on the submission of the EIA report by LWP. The MOE was established by Law 216/1993, amended by Law 690/2005, and then restructured by Decree 2275/2009. This decree defined the functions and responsibilities of each administrative unit including staff size and qualifications. According to Article 20 of Decree 2275/2009, the Service of Natural Resources at MOE is responsible for the protection of natural resources in the country including fauna and flora species, habitats, mountains, etc.

  According to Article 25 of Decree 2275/2009, the Service of Environmental Technology - Department of Integrated Environmental Systems at MOE is responsible for adopting clean and renewable energy sources as well as reducing the use of polluting energy sources in the country. Moreover, the Service of Environmental Technology, in line with several other services and departments at the MOE, is in charge for reviewing EIA studies. MOE is also responsible for meeting Lebanon's reporting obligations under the United Nations Framework Convention on Climate Change, particularly the National Communication on Climate Change (which includes emission data for the energy sector) prepared under its aegis. The Third National Communication, inventorying emissions for base-year 2005 and time-series covering the period from 1994 to 2010 was published and presented to the Government and national stakeholders in 2014. The Third National Communication gives an updated analysis of potential Green House Gas (GHG) mitigation measures as well as an updated assessment of potential impacts of climate change in Lebanon and adaptation measures.
- Ministry of Energy & Water: The MOEW is the lead government agency responsible for producing energy and for licensing renewable energy projects and programs, including the Project. The

MOEW was first established by Law 20/66 (dated 29/03/1966) amended several times and lastly (13 years ago) by Law 247 (dated 07/08/2000). Decree 5469 (dated 07/09/1966), that defined the functions and responsibilities of every Directorate (2 Directorates) at the Ministry and each administrative unit including staff size and qualifications was not amended and remains valid since 1966. Under the Directorate of Water and Electrical Resources (1st Directorate at MOEW), the Directorate of Electrical Resources studies and implements Electricity Projects in the Country. Supervising all activities related to water and electricity at the MOEW are performed by the Directorate of Investment (2nd Directorate at MOEW). The MOEW is the most active public body attempting to promote Energy Efficiency and Renewable Energy programs in Lebanon. To date, the most noteworthy achievement is the sponsoring of the Lebanese Center for Energy Conservation Program further discussed below as well as the development of the Policy Paper for the Electricity Sector.

- Electricité du Liban: EDL was established in 1964 (Decree 16878 dated 10/07/1964). With the exception of four private concessions (Zahle, Jbeil, Alay and Bhamdoun representing about 82,000 subscribers) and private/semi-private hydroelectric power plants (Nahr Ibrahim and Kadisha) as well as a public hydropower plant owned by the Litani River Authority, EDL has quasi total monopoly over electricity production, transmission and distribution in the country; it controls around 90% of the Lebanese electricity sector.
- Ministry of Interior and Municipalities: The Ministry of Interior and Municipalities (MOIM) has jurisdiction over Lebanon's estimated 994 municipalities organized according to Decree-Law 118 (dated 30/06/1977). The Akkar Caza counts 175 municipalities. Municipalities are local administrations charged with the day-to-day management of all public works located inside their jurisdiction (municipal boundaries). Specific responsibilities are wide and diverse including landscaping and beautification works, water and wastewater networks, street lighting, waste disposal, internal roads, recreational facilities, as well as urban planning in coordination with the Directorate General of Urban Planning (Article 49). Municipal Councils have also to approve all projects related to re-designing major roads in their municipal boundaries as well as any activity regulating the traffic in the municipal area (Article 51 of Decree-Law 118-1977 and Article 389 of Law 243-2012).
- Ministry of Public Works and Transport: In 2000, the Ministry of Transport was cancelled, and the two Directorates were affiliated to the Ministry of Public Works by Law 247 (dated 07/08/2000). The Ministry of Public Works became, then, the MOPWT which studies (technically and financially), evaluates and monitors the implementation and maintenance of public construction projects (buildings, road networks, etc.) and regulates land, sea and air transport. The MOPWT comprises three directorates including the General Directorate of Urban Planning (DGUP), which is responsible for permitting all construction projects including the Project. The Ministry of Public Works was first established in 1959 by Decree 2872 (dated 16/12/1959) and included four Directorates; two of them were later affiliated to the Ministry of Energy and Water (Law 20/66 – 1966). The Ministry of Transport was first established by Law 214 in 1993 and included two Directorates: 1) the Directorate General of Civil Aviation; and 2) the Directorate General of Land and Maritime Transport.
- Directorate General of Urban Planning: The DGUP falls under the authority of the MOPWT. Its mandate is to develop urban regulations and coordinate urban planning activities. Lebanon is divided into governorate ("mohafazah"), district ("caza") and municipalities. The DGUP also plays

a key role in the construction permitting process through the regional Departments of Urban Planning in each caza.

- The Lebanese Center for Energy Conservation: Established in 2002, the Global Environment Facility funded the Lebanese Center for Energy Conservation Program (LCECP) which is currently hosted at the MOEW and managed by the UNDP. Registered under the name of the Lebanese Center for Energy Conservation (Attestation No. 172 dated 27/1/2011), the organization addresses end-use energy conservation and renewable energy at the national level by supporting the Government of Lebanon in developing and implementing national strategies that promote energy efficiency and renewable energy at the consumer level. The LCEC has implemented Renewable Energy (RE) and energy efficiency (EE) projects in Lebanon including the installation of domestic solar water heaters (DSWH) in south Lebanon, management of the DSWH project "One DSWH for every house" aiming at installing no less than 1M m^2 of collectors by 2020, management of the 3M compact fluorescent lamp (CFL) lamps project, etc. LCEC is financially and administratively independent and operates under the direct supervision of the MOEW.
- Community Energy Efficiency and Renewable Energy Demonstration Project: CEDRO is a partnership created in 2007 between the MOEW/Ministry of Finance (MOF)/Ministry of Economy & Trade (MOET)/Lebanon Recovery Fund (LRF)/Council for Development and Reconstruction (CDR)/UNDP, with a five-year mandate and a budget of $9.73 million funded by the LRF by means of a donation from Spain. Its aim is to promote energy efficiency and renewable energy in Lebanon through awareness, capacity building, market incentives for EE and RE installations, as well as country-wide research and development activities.

  CEDRO also initiated and financed several national milestone research documents related to RE including (1) the national bio-energy strategy that shed the light on available bioenergy resources in the country, and (2) the national Wind Atlas that establishes an understanding of the dominant wind regimes (onshore & offshore) in the country, essential to determine best areas to build wind farms in the country. CEDRO's January 2019 publication, Renewable Energy Sector in Lebanon, National Studies, concluded that:

  - Wind energy can potentially employ up to 2,753 people under the optimistic scenario in 2021, roughly half of them in direct jobs.
  - The largest number of jobs will be in the service sector and during the construction phase.
  - The transport of wind energy equipment will also create employment wherever infrastructure is needed, be it at the port or along the roads. Roads have to be widened and the area around the roads has to be cleared.

2. PROJECT DESCRIPTION

This section provides a detailed description of the Project in relation to its location, the key Project components and an overview of the proposed activities that are to take place during the planning and construction, operation, and decommissioning phase.

2.1 Overview

The considered development consists of construction of a wind farm along with the auxiliary technical infrastructure in the Akkar Governorate in the northeast of Lebanon, approximately 172km northeast of the capital city of Beirut. The Developer holds a signed PPA to construct and operate the Project to provide a maximum licensed capacity of 90.75MW to be delivered to the public grid.

One of two OEM/EPC Contractors are currently under consideration by the Developer for construction and operation of the wind farm, Vestas Wind Systems A/S and GE. Depending on the OEM/EPC Contractor selected, the wind farm will comprise up to 21 WTGs with rated outputs ranging between 4.2MW and 5.3MW, as presented in **Table 2-1**.

Table 2-1 Potential OEMs, Turbine Power Ratings and Turbine Locations

OEM/EPC Contractor	Turbine Power Rating	No. of Turbines	WTG Locations Selected	Power Generated by Turbines	Total Power Generated
Vestas	4.2MW	21	WTG 02-WTG 11, WTG 13–WTG 15 and WTG 17-WTG 24	88.2MW	88.2MW
GE	4.8MW	2	WTG 02-WTG 03	9.6MW	89.1MW
	5.3MW	15	WG 04-WTG 11, WTG 13-WTG 15 and WTG 17-WTG 20	79.5MW	

The entire investment will include the following components:

- A maximum of 21 WTGs.
- Underground cable networks (electric and fiber-optic control and communication cables) between the WTGs.
- External and internal access roads.
- Power substation and temporary and permanent maintenance buildings.
- Parking/laydown/assembly areas.
- Concrete batching plant in Rweimeh Village.
- Community Relations Office (CRO) building to be located in Jabal-Akroum Kfartoun (note: the budget for this office is included in the Project).
- Underground electric transmission line connecting the Project to the Electricité du Liban (EDL) substation, which transmits the energy to the EDL power grid, to the substation at the planned Lebanon Wind Power wind farm to the south.

2.2 Project Location

The area to be developed is located in Jabal Akroum, Akkar on Lebanon's northeastern border with Syria, approximately 182 kilometers (km) northeast of the capital city of Beirut. The Project is located on a mountain ridge of Jroud Akkar at an altitude ranging between 2,190m (7,008 feet) above sea level (asl) in the south and 791m (2,596 feet) asl in the north and, as shown in **Figure 2-1**. The Project site can currently be accessed by Quobaiyat-Qasr Road which connects to Rweimeh Village and Kfartoun to the northeast, and beyond to Mqaible. The largest cities in the Akkar Governate are Halba, Bire Akkar and Quobaiyat. The Project is located in Aandqet, Jabal-Akroum Kfartoun and Rweimeh Village. **Figure 2-2** presents the location of the Project in proximity to the nearest villages.

2.3 Project Components

The Project comprises the construction and operation of up to 21 horizontal axis wind turbines to provide a maximum licensed power capacity of 90.75MW to be delivered to the public grid. **Table 2-2** provides a summary of the Project components by OEM/EPC Contractor (it is noted that Nordex dropped out from consideration and Siemens-Gamesa was removed from consideration during the Developer's OEM/EPC tender process). The locations of all Project components are shown in **Figure 2-3**. Conceptual diagrams of the substation and operations buildings (with elevations) have not been prepared as they are an element of the detailed design.

2.3.1 Wind Turbines

Generally, a wind turbine consists of a foundation, tower, nacelle, rotor blades, a rotor hub, and a transformer. The foundation is used to bolt the tower in place. The tower contains the electrical conduits, supports the nacelle, and provides access to the nacelle for maintenance. Typically, three (3) blades are connected to the hub which then connects with the nacelle; the box-like component that sits atop the tower and which most importantly contains the gear box (which steps up the revolutions per minute to a speed suitable for the electrical generator) and the generator (which converts the kinetic energy into electricity).

Each turbine and associated platform will occupy a maximum surface area of +3,500m^2. The OEM/EPC Contractor will be constructing platforms (one for each turbine). Foundation platforms will be constructed to bolt the tower of the turbine in place. A crane pad next to each wind turbine to accommodate cranes for the installation of the wind turbines and for maintenance activities during operation. The crane pads will be suitable to support loads required for the erection, assembly an operation and maintenance of the turbines.

The layouts of the land plots occupied by the turbine platforms and substation are as provided in **Figure 2-1** and the diagrams presented in **Appendix B**. Each turbine will be equipped with a transformer that converts/steps up the output from the turbine to a higher voltage to meet a specific utility voltage distribution level that is appropriate for connection with a substation. Regardless of the OEM/EPC Contractor selected, the turbines will be installed among the locations shown. It is noted that potential turbine locations WTG 01, WTG 12, WTG 16 and WTG 26-WTG 28 were removed as part of the ESIA process to mitigate Project impacts (refer to **Section 3 Analysis of Alternatives**).

Figure 2-1 Elevation Profile of the Project

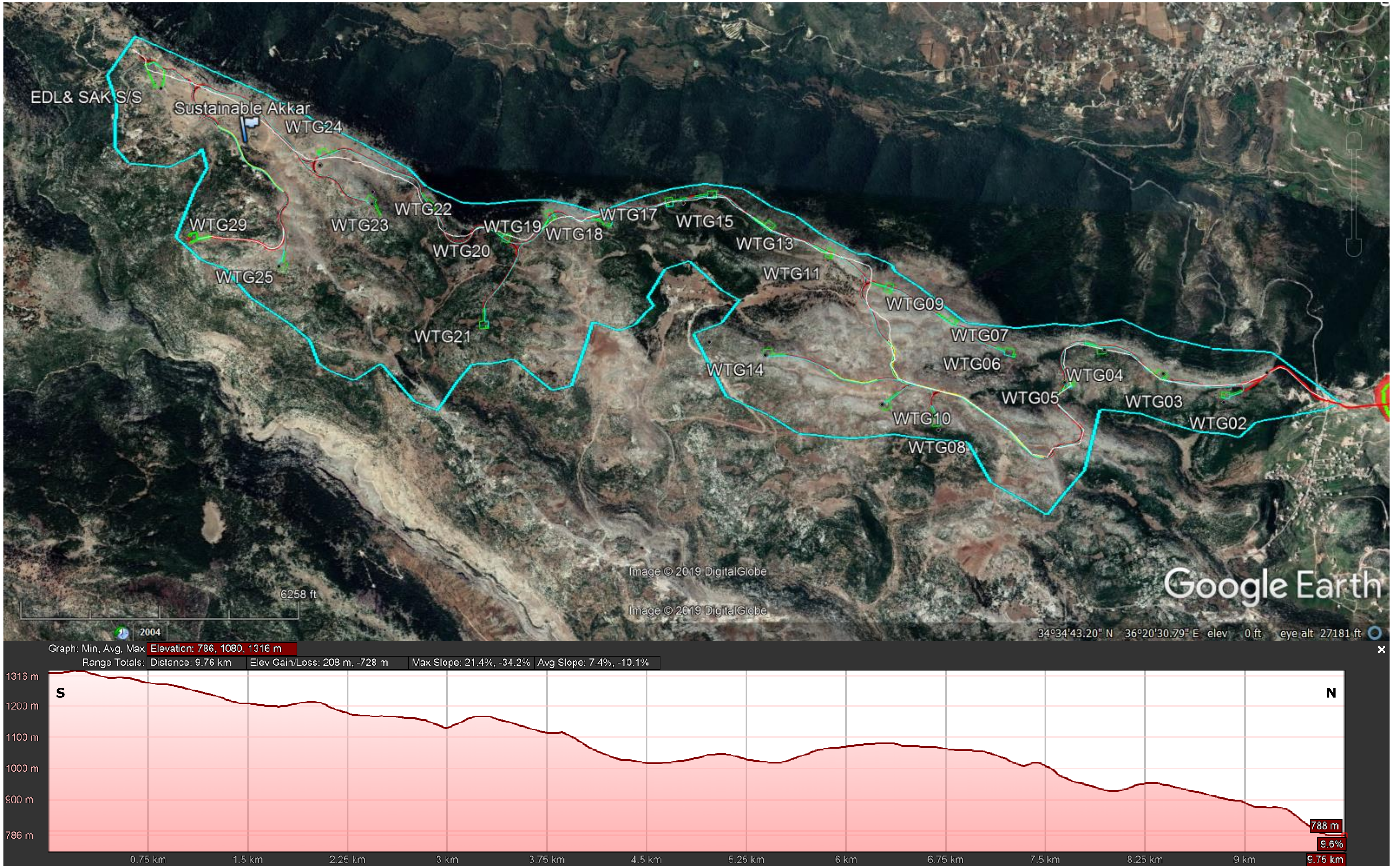


Figure 2-2 Project Site Location Relative to Nearest Villages

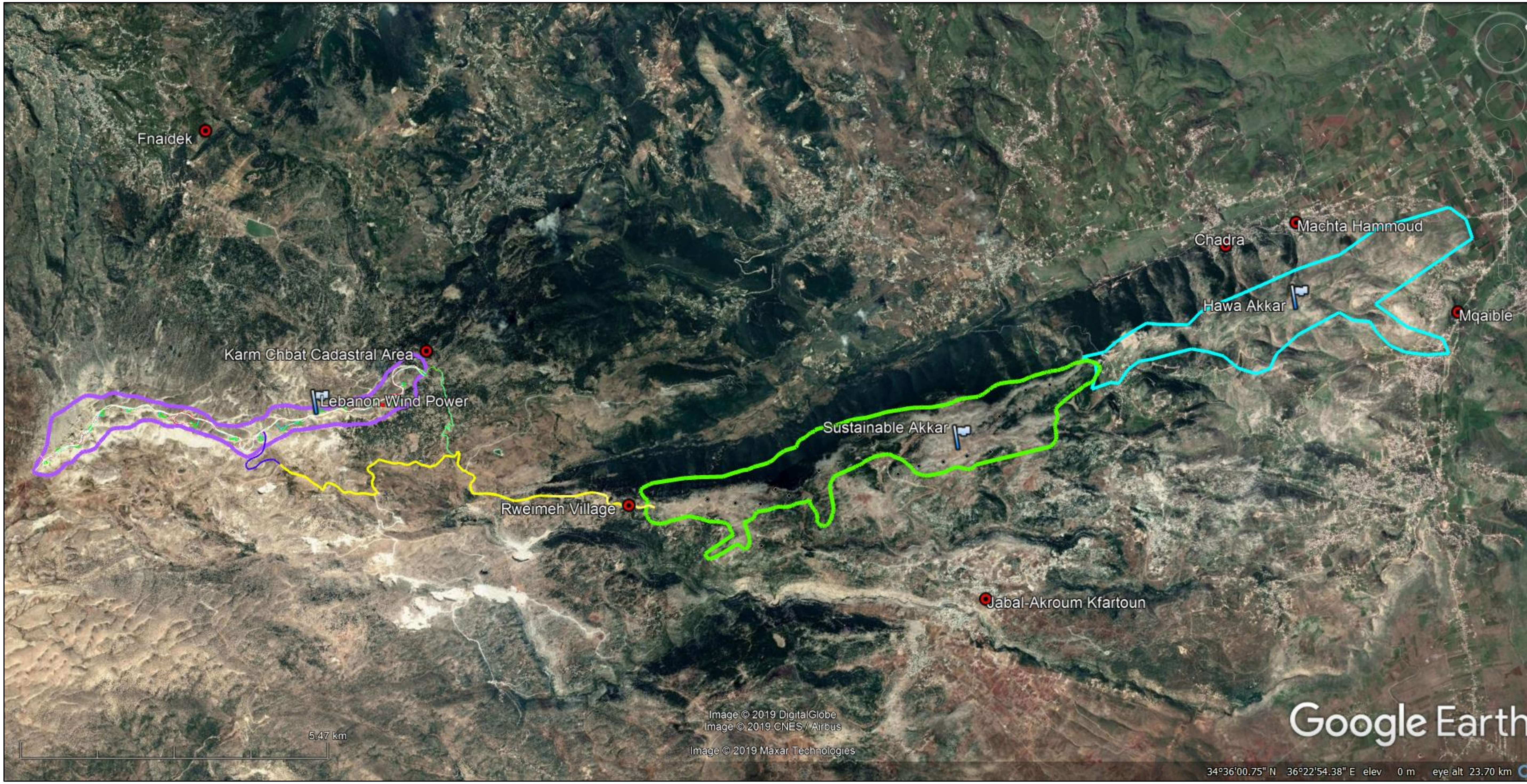
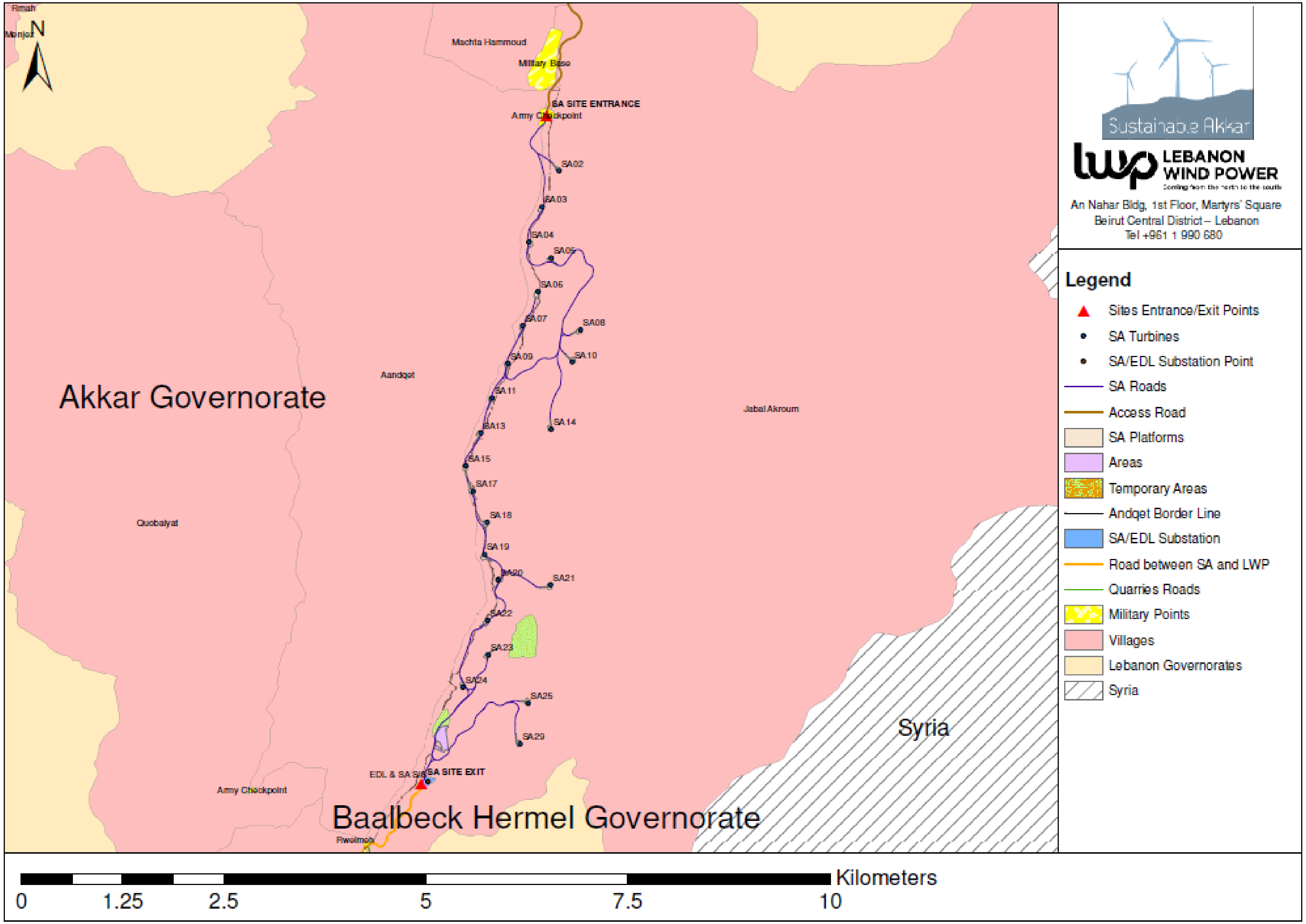


Table 2-2 Project Components

Design	Vestas Wind Systems A/S	GE
Project Generation Capacity (MW)	88.2MW	88.6MW
Technology Type	Wind Power	Wind Power
Number of Wind Turbines	21	2 and 15
Nominal power	4.2MW	4.8MW and 5.3MW, respectively
Type	3-blade rotor and a hub	3 blade rotor and hub
Hub height	105m	101m (steel) and 121m, respectively
Number of tower sections	4	4 or 5
Rotor diameter	150m	158.0m
Swept area	17,671m^2	19,607m^2
Rotor shaft inclination angle (Tilt angle)	6º	4º
Blade cone angle (Hub coning)	5.5º	5º
Rotor blade material	Fiberglass reinforced epoxy, carbon fibers and solid metal tip (SMT)	Glass fiber reinforced polyester + Carbon fiber spar
Total blade length	73.7m	77.4m
Tip height	180m	180m (200m)
Maximum height above MSL	2,000m; above 2,000msl is specifically available with some project-specific customized solutions	Maximum 1,000m with the maximum standard operational temperature of +40 °C. Above 1,000m, the maximum operational temperature is reduced per DIN IEC 60034 1
Certificate	In accordance with IEC 61400-22 and DIBt 2012	IEC 61400-22 in combination with IEC 61400-1.
Nominal power starting at wind speeds of (at air density of 1.225 kg/m^3)	12m/s (at air density of 1.225 kg/m^3)	12.5m/s
Nominal speed	4.9-12.0 min^{-1}	9.7rpm
Cut-in wind speed	3m/s	3m/s
Cut-out wind speed	24.5m/s	25m/s
Cut-back-in wind speed	22.5m/s	22m/s
Calculated service life (Design Life)	At least 20 years	20 years standard
Design temperature; (Extreme Design Parameters)	Standard -20ºC to +45ºC; (-40ºC to +50ºC)	-20°C - +50°C
Maximal noise power level	104,9 dB(A) (0067-7067 V08)	106,0 dB(A) (NO_5.3-158-50Hz_IEC_EN_r03)
Infrastructure and Utilities	This includes: (i) two new asphalt road segments; (ii) internal road network; (iii) substation; (iv) underground transmission line; (v) offices; and (vi) associated facilities.	

Figure 2-3 Project Components



The wind farm design considered wind resources in the specific Project site, spacing between the turbines to minimize wake effects which could lead to a decreased wind energy production, accessibility to the turbines, etc., as well as environmental considerations as presented throughout this ESIA. In line with the recommendations of the Convention on Civil Aviation (ICAO, 2016) and local Lebanese regulations, the wind turbines will be installed as follows:

Turbine Distances:

- Peripheral wind turbines: wind turbines on the periphery of the cluster or the line formation. In case of a cluster or a grid: on corners and additional turbines on the perimeter in order to keep a maximum distance of 900m.
- Other wind turbines: no separations or gap to an equipped turbine of more than 900m exist for the integrity of the group appearance to be maintained.

Paint Markings:

- The blades of the selected wind turbines will be equipped with a painted blade marking in form of two red/orange stripes and one white stripe starting from the blade tip: 6m red or orange, 6m white and 6m red or orange.
- If the height of the wind turbine exceeds 150m, a red/orange strip of 3m shall be placed on the tower at a height between 35m and 45m above ground in a way to avoid covering the stripe with the blades of the wind turbine. The wind turbines shall be painted white.
- If a turbine within the wind farm (non-peripheral) projects at a height of more than 30m from the next equipped turbine (due to topography), it must be equipped with aviation warnings.
- Measurement masts within the wind farm area should be considered as obstacles (like the wind turbines) and be equipped as required above.
- As a result, not all the wind turbines in the wind farm will be equipped with aviation warnings.

Obstruction Lights:

- All obstruction lights in the wind farm should be synchronized to flash simultaneously.
- Obstruction lights must be equipped with an uninterruptable power supply system with at least 12 hours of autonomy.
- Lights shall be placed on the nacelle and be visible from all directions in the horizontal plane.
- If the wind turbines height exceeds 150m, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, should be installed.
- If the wind turbines height exceeds 150m, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other.

Obstruction Light Types and Intensity:

- Daytime: Medium intensity, Type A aviation white flashing light, minimum intensity 20,000 candela.
- Nighttime: Medium intensity, Type B aviation red flashing lights, minimum intensity 2000 candela.

Once the OEM/EPC Contractor has been selected, and the final number, layout and height of the wind turbines is fixed, the Developer will submit the final plan to the Civil Aviation Authority for approval.

2.3.2 Transmission Lines and Power Substation

The wind turbines will be connected at the switchgear panels through a 36kV medium voltage (MV) cross linked polyethylene (XLPE) cabling system to a substation located within the Project site. The connection between the turbines and the substation will be made using underground transmission cables buried in ground by trenches. The Sustainable Akkar/EDL substation will be installed outside of the Project site, in Rweimeh Village. The Project substation will be connected by an underground 30cm diameter transmission line to the neighboring Lebanon Wind Power Wind Farm Project substation to be located within its boundary.

The transmission line will be buried within the existing, asphalt 2-lane Quobaiyat-Qasr Road right-of-way (ROW) for 7km until reaching an existing ~3.25m wide track through the Karm Chbat Cadastral Area, previously created by recreational hunters and navigating around vegetation and under tree canopies, until reaching the Lebanon Wind Power wind farm and connecting to its substation (as shown in **Figure 2-4**), before the generated electricity being injected into the EDL transmission line.

Two possible design options are possible, consisting of either a 33 to 66KV or a 33 to 220KV substation. The electrical diagrams of the wind farm are shown in **Appendix C**, and include the following components:

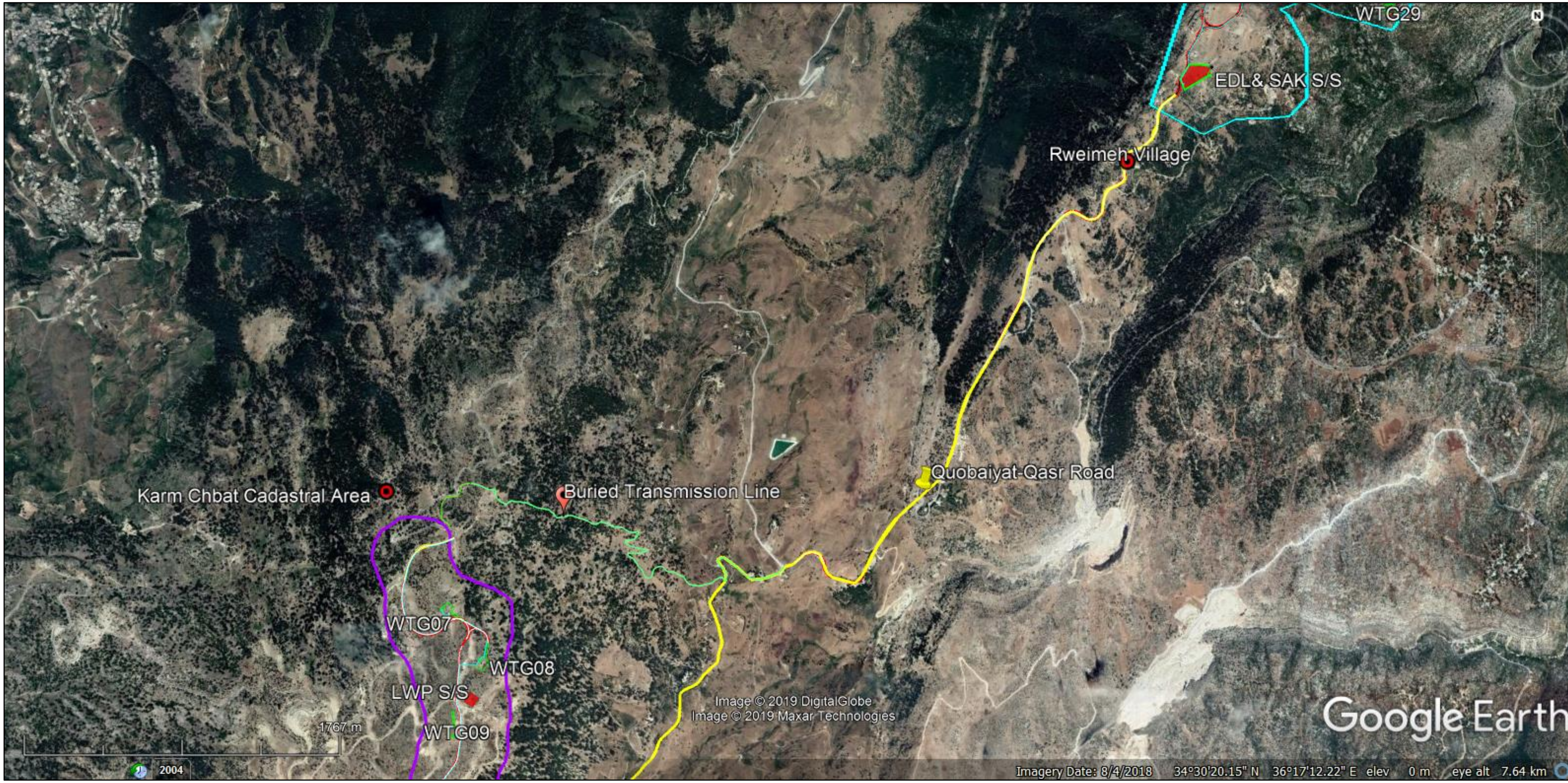
- A 36kV MV XLPE cabling system connecting the MV switchgear panels at the wind turbines with the 36kV switchgear in the Control Buildings.
- An MV 36kV indoor switchgear in Control Building of wind farm.
- MV/High Voltage (HV) transformer: A 36/220kV step-up power transformer.
- Earthing: One complete earthing system comprising all earthing conductors, earthing rods, equipment connectors, welding fittings, etc. for the complete Facility.
- Fiber optic cables: between the wind turbines and the wind farm SCADA system and the closed-circuit television (CCTV) system to be installed in the Operation Building.
- Operation buildings and auxiliary facilities including among others one 36/0.4kV auxiliary service transformer and one 0.4kV emergency diesel generator, a complete CCTV system, and complete fire detection and alarm systems

2.3.3 Operation Buildings

Two separate operation buildings shall be constructed, one building to be used by the OEM/EPC Contractor and their contractors, and the other to be used by the grid operator, EDL. The layout of the control buildings is included along with the layouts of the substation also provided in **Appendix C**. The operation buildings will include the following:

- A storage space for spare parts, lifting equipment, placement of batteries, tools and spare oil.
- A control room for communication equipment, medium voltage switchgear room, working station for the monitoring of the Project.
- A meeting room and facilities for maintenance personnel as deemed necessary, but as a minimum will include a kitchen, changing room, lounge or living room, toilets and showers.

Figure 2-4 Alignment of Buried Transmission Line



2.3.4 Community Relations Office

As part of the Project development, a member of the local community has been hired as the first of three Community Relations Officers (CRO)s. During the pre-construction phase, a Community Relations Office will be established in Jabal-Akroum Kfartoun using leased office space (to be shared with the Sustainable Akkar wind farm project; specific location to be determined).

The Community Relations Office will remain open through the construction, operation and decommissioning phases of the Project. The purpose of the Community Relations Office will be as follows:

- Establish a skills training program for members of the local communities.
- Maximize the hiring of local workers.
- Maximize the local procurement of construction materials and other goods and services.
- Establish a location for the receipt of community grievances and to provide Project information.

2.3.5 Meteorological Masts

Three meteorological masts, MM4, MM5 and MM6 (Enisolar 80m and 60m models), are currently installed at the locations shown in **Figure 2-5**. Each mast includes first class advanced top and low anemometers, wind vanes, a humidity and temperature sensor, an air pressure transducer, a data logger box, an aviation light and a top lighting rod. The data recorded by the mast is automatically sent twice daily to the Developer via internet. The currently installed meteorological masts will be removed at the start of wind turbine erection activities and will be replaced with new masts to be installed by the selected OEM/EPC Contractor.

2.3.6 Road Development

The overall route planned for the transport of the WTG components to the Project is shown in **Figure 2-6**. The wind turbine components will be transported from the Tripoli seaport to the Project site using a combination of existing asphalt roads (shown in blue), new asphalt road segments (shown in red), and existing and new tracks internal to the proposed Hawa Akkar, Sustainable Akkar and Lebanon Wind Power wind farm sites (also shown in red). The transport route can be described as follows:

1. Tripoli Seaport to outside Chadra: The existing 2-, 4- and 6-lane asphalt road between the Tripoli Seaport to outside Chadra will be used.

2. Outside Chadra to the entrance of the Hawa Akkar Wind Farm: New sections of road will be constructed as follows:

- In order to avoid impacts to Chadra, Machta Hassan and Machta Hammoud, a new 0.65km section of asphalt road will be constructed through currently vacant land purchased from private land owners (shown as #1 in **Figure 2-7**).
- A new 0.15km section of asphalt road will be constructed (shown as #2 in **Figure 2-7**) between two existing sections of asphalt road in order to avoid hairpin turns near homes.
- A new 3.0km section of gravel road will be constructed within the existing railroad right of way (ROW) managed by Machta Hammoud Village (shown as #3 in **Figure 2-7**), traveling east before connecting to an existing asphalt road to enter the Hawa Akkar Wind Farm.

Figure 2-5 Existing Meteorological Mast Locations

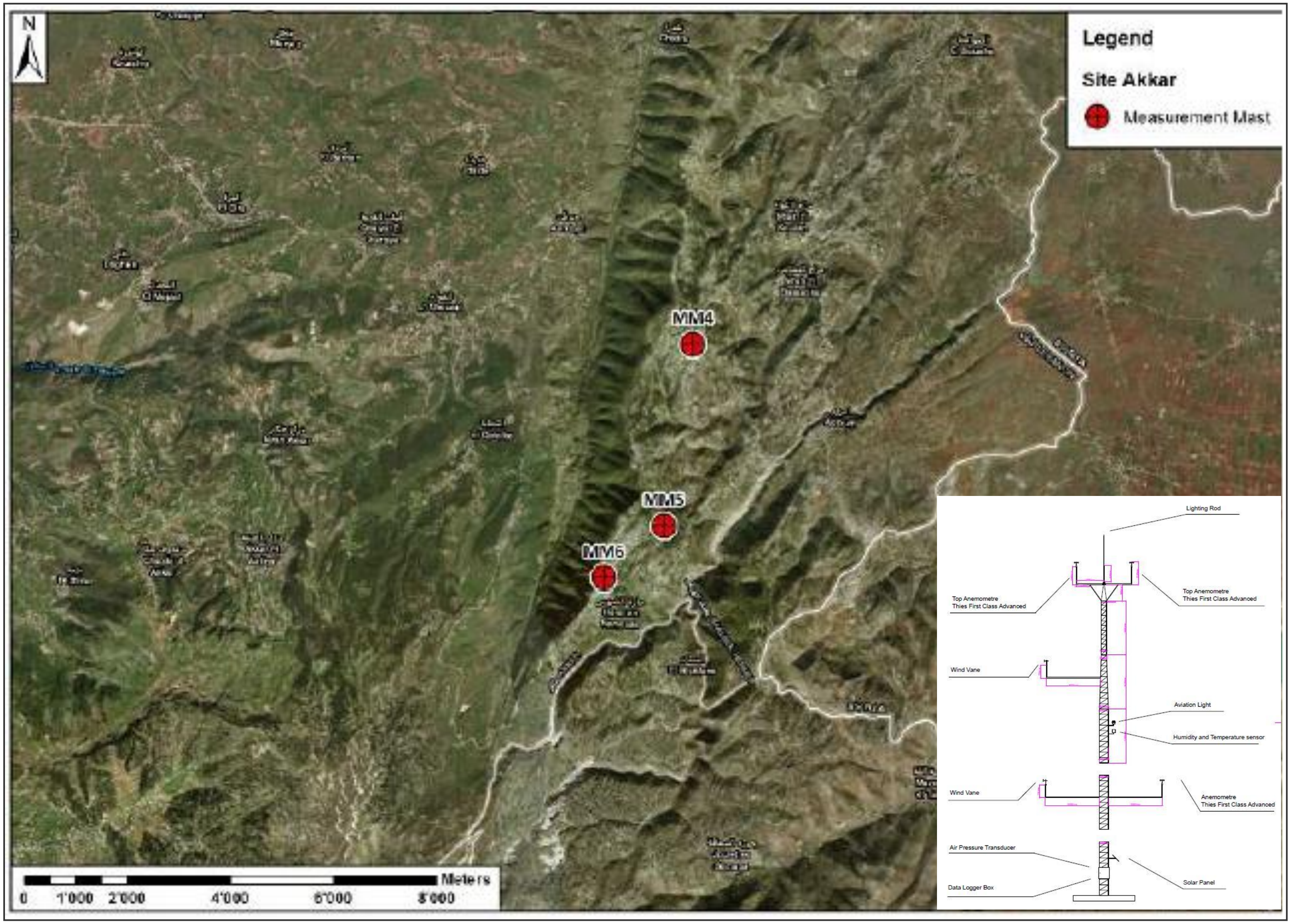


Figure 2-6 Transport Route from the Tripoli Seaport to the Project

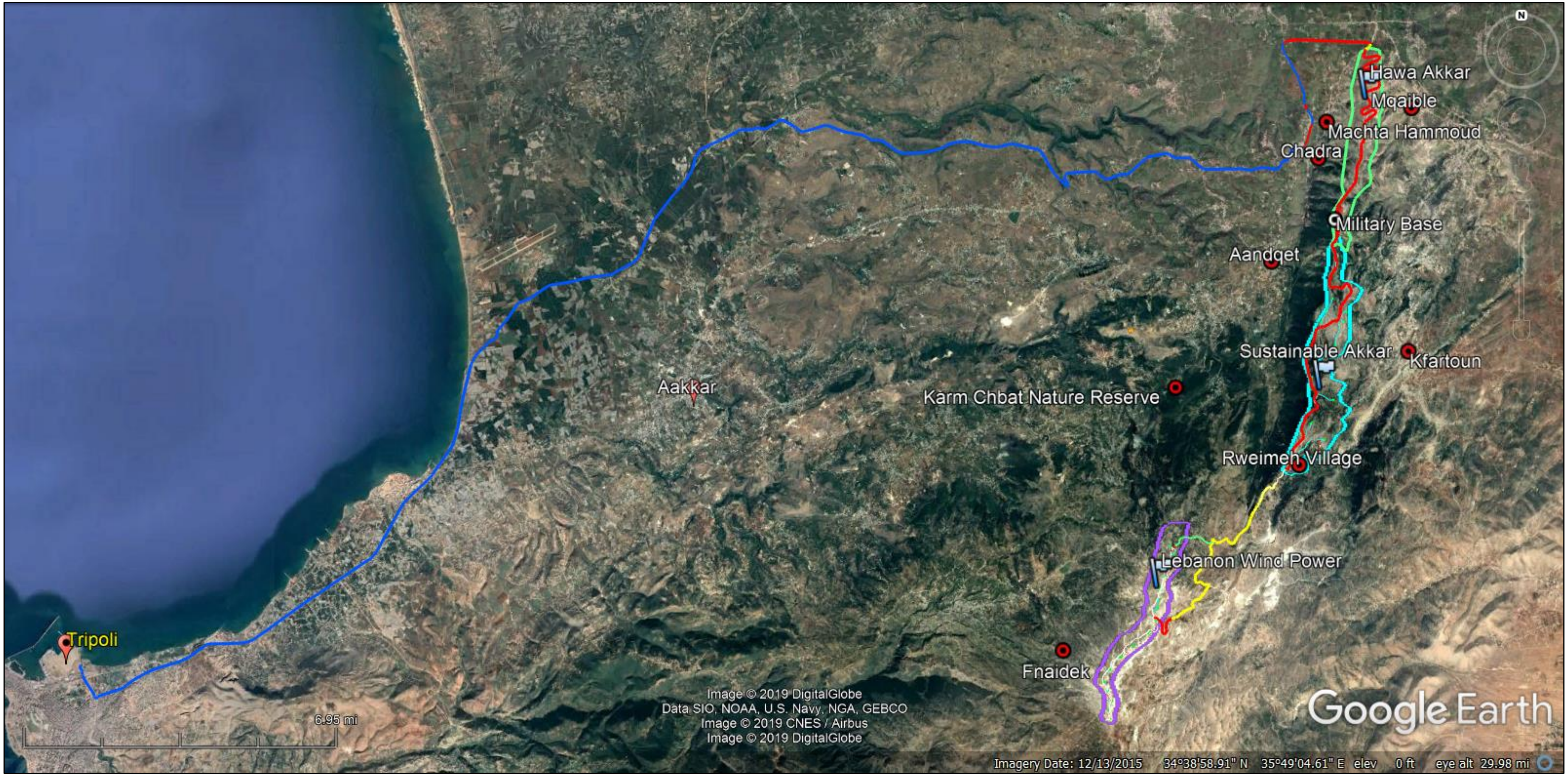
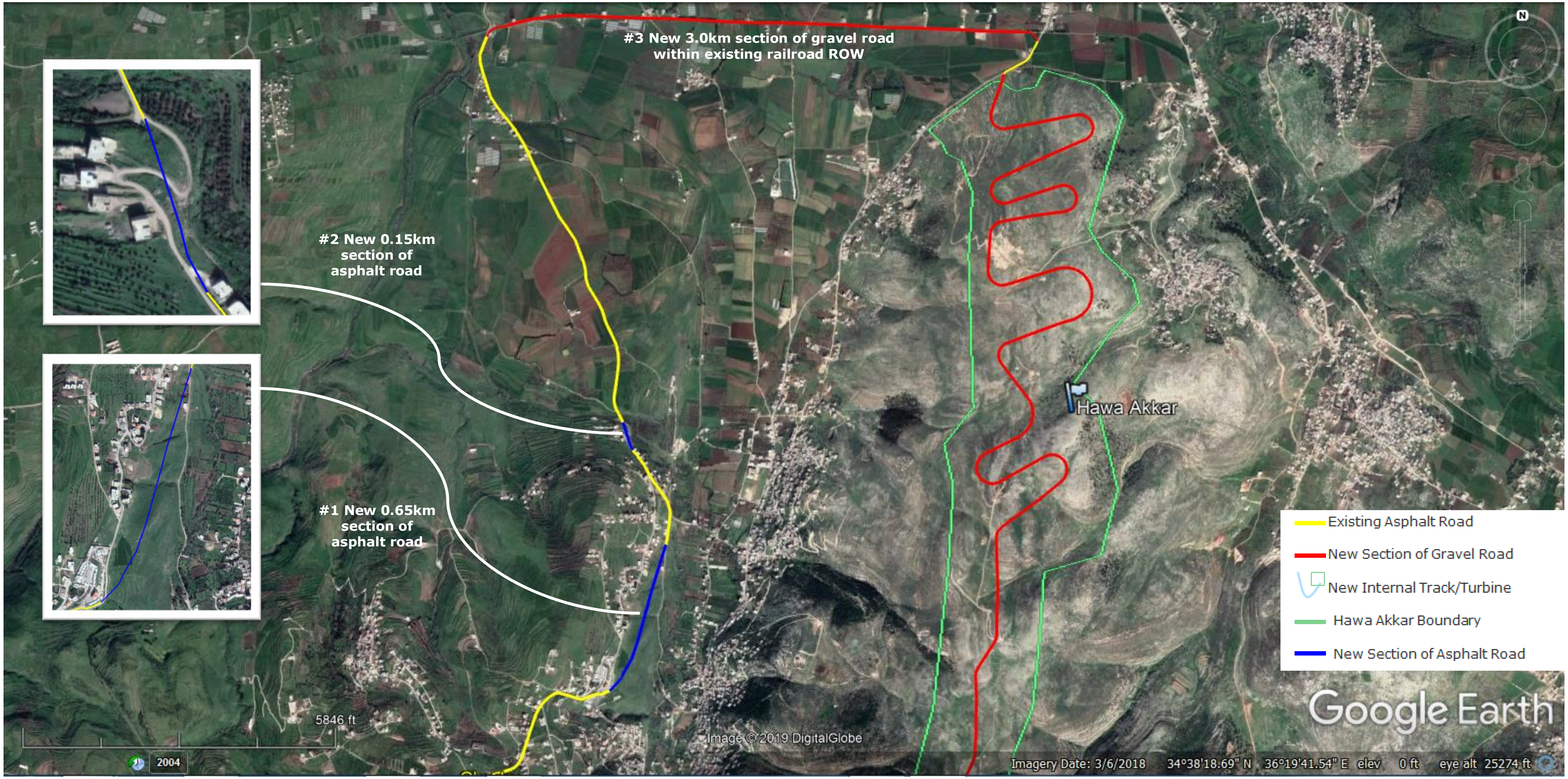


Figure 2-7 Outside Chadra to Hawa Akkar Wind Farm



3. The route traverses a network of internal tracks to be constructed within the Hawa Akkar Wind Farm, exiting at the Sahle Checkpoint before entering the Project, also shown in **Figure 2-7**. The road that will connect the turbines within the Hawa Akkar site has already been established by the Lebanese Army as a dirt road, as shown in **Figure 2-8**. Leveling and widening the road to 6m when straight, and 10m at curves, will be undertaken to accommodate large vehicles carrying the turbine parts, creating openings within the piled soil, rocks, stone and gravel along the road sides.
4. The route traverses a network of internal tracks to be constructed within the Project, exiting at Quobaiyat-Qasr Road, as shown in **Figure 2-9**.
5. After exiting the Project, the route travels south along Quobaiyat-Qasr Road for approximately 3.5km. Upon reaching an existing asphalt road, the route turns south for 4.8km, where a new 1.5km section of track will be constructed to enter the planned Lebanon Wind Power wind farm site near WTG 14, as shown in red in **Figure 2-10**.

The transport of WTG components to the Project will not begin until all civil works to construct road segments has been completed, including internal tracks through Hawa Akkar, Sustainable Akkar and Lebanon Wind Power. All communities along the transport route have been engaged with to address potential concerns related to the frequency, timing and duration of the transport activities and access to roads, school, employment and livelihoods as discussed in **Section 6 Stakeholder Engagement and Consultation**.

Ahead of transport of the WTG components, removal of identified obstacles (i.e. concrete debris, roundabout curbs, poles, etc.) and raising of pedestrian bridges and placards to accommodate the necessary vertical clearance will be undertaken as discussed in **Section 12 Transport and Traffic**.

In February 2019, the Developer applied to the Ministry of the Interior and Municipalities (MOIM) in Lebanon to facilitate the passage and use of public roads between the Tripoli Seaport and the Project via the described transport route (Registration No. 4147, 25 February 2019). The request was made to: 1) permit the use of public roads for the transport of the WTG components; and 2) for the municipalities to provide escort during the transport of the WTG components. This request was granted on 7 March 2019, as presented in **Appendix D**.

2.4 Land Ownership and Lease Information

Land issues are one of the most important considerations during Project development and implementation. Land parcels needed for the Project are owned by the Municipality of Aandqet to the west and the Jaafar Family to the south (Rweimeh Village) and multiple families to the east (Jabal-Akroum Kfartoun). Engagement with family leadership began in to support the planned development of the Project, as summarized in **Table 2-3**.

Following installation of the meteorological masts in December 2013, the Developer met with the Akkar Community to kick-off the environmental impact assessment campaign began. A lunch was held at RT General Daher's house where more than 90 community members were present to take part of the on-going discussions. The question raised included the following:

Figure 2-8 Photographs of Hawa Akkar Track

Unpaved road established by Lebanese Army

Army equipment at side of unpaved road

Unpaved road established by Lebanese Army

Soil and rock pile adjacent to unpaved road

Figure 2-9 Internal Tracks through the Project

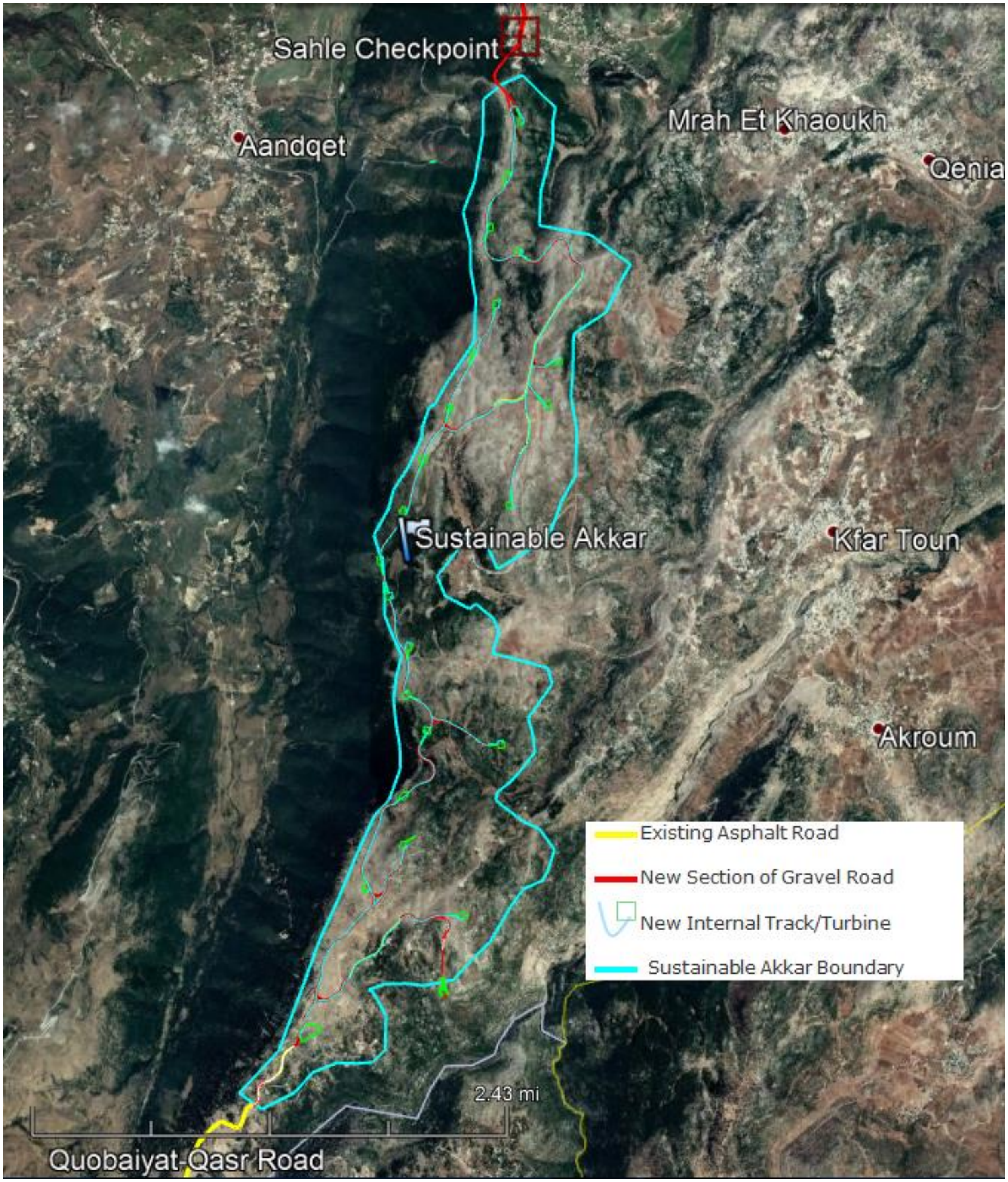


Figure 2-10 Quobaiyat-Qasr Road to the Lebanon Wind Power Wind Farm

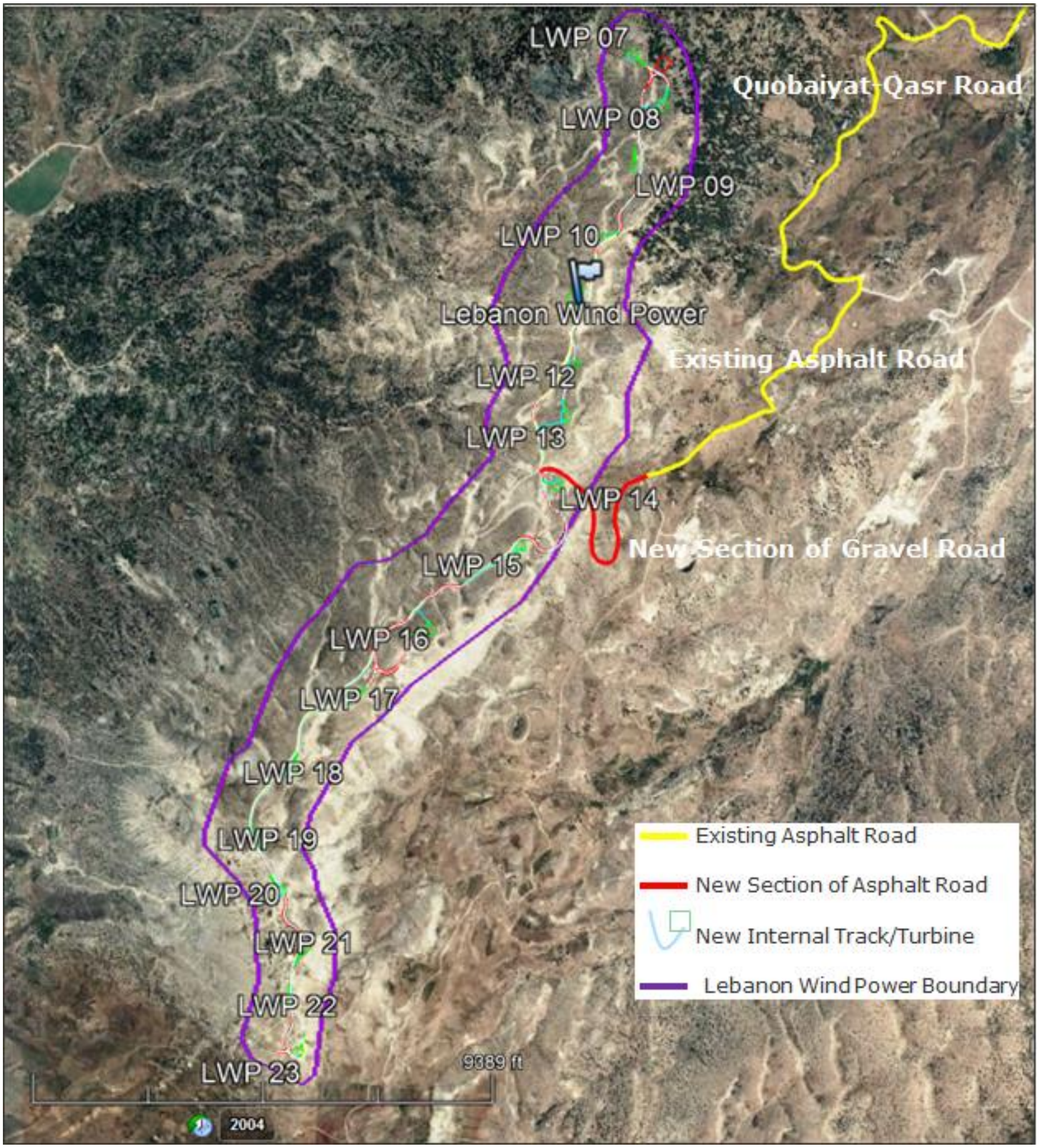


Table 2-3 Face-To-Face Meetings with Family Leadership in Affected Communities

Date	Family/Area Representative		Description
25-Feb-11	Obeid Family		Arha was the first area visited on (owned by the Obeid Family), but due to its proximity to the Syrian border, and the political situation they were facing, they indicated that other areas needed to be explored.
22-Mar-11	Mr. Ziad El Aryan		After referencing the Wind Atlas, Jabal Al Cheikh in the Beqaa region and Mazraat Deir Al Achayer in Rachya were visited on and were taken into consideration as potential areas for development.
12-Apr-11	Mr. Yaseen Jaafar		A meeting was held with Mr. Yaseen Jaafar (a prominent figure in the Akkar region) to introduce the wind farm concept in the neighboring countries and discussed the importance of the wind resource of the Akkar region. Mr. Jaafar expressed his full support for the project and gave insights regarding the political and social output in the area, stating "*The success of this project lays in the equal opportunities that will be provided to all political and religious parties in the area*." Following this meeting, Mr. Jaafar introduced SA to retired Army General Khaled Al Daher (another prominent figure in the Akkar region) along with Mr. Abdo Jaafar (the focal point who will be handling all communications with the Jaafar Family).
22-May-11	Retired Army General Khaled Al Daher		The purpose of the meeting was to elaborate about the strategies and steps that needs to be taken in order to move forward with the Project. The one-year wind measuring campaign, 2 meteorological masts should be installed in the area to have a clear vision of the wind regime.
22-May-11	Mr. Abdo Jaafar		The purpose of the meeting was to discuss the different aspects of the project and discuss the strategies behind securing the necessary lands.
20-Jun-12 2-Jul-12 10-Jul-12 20-Aug-12	Retired Army General Khaled Al Daher		These visits were conducted to communicate with the land owners about the rental agreements and contracts. Due to the importance of the lands and their current situation the rental agreement stated that 7,000 USD will be given per megawatt knowing the average rental cost internationally is 3,500 USD. SA has decided to pay double the average MW price because of the importance of lands in Lebanon along with the fact of being the first wind farm Project in Lebanon (need to attract the land owners with the price): - Mohamad Ahmad Salah - Al Khatib Family - Farhat Family - Kanaan Family
20-Aug-12 2-Sep-12 10-Sep-12	Mr. Abdo Jaafar		These visits were conducted to communicate with the land owners about the rental agreements and contracts and given the nature of the lands and the lack of affidavits promises of rental were given.
6-Feb-13	Kfartoun		A Public Participation Meeting was conducted on in Kfartoun, Akroum to inform community members about the Project, discuss the environmental aspects, and answer any raised question or concerns that the community had.
13-Feb-13	Retired Army General Khaled Al Daher		This meeting was held to finalize the rental agreement in Akroum where the first met mast will be installed. General Khaled was pleased with the results of the lands but explained that some families are not pleased for they are not benefiting from the land rentals and wanting a piece of the pie.
13-Feb-13	Mr. Abdo Jaafar		This meeting was held to finalize the rental agreement in Rweimeh where the second met mast will be installed. Mr. Abdo Jaafar showed his full support to Sustainable Akkar.
13-Feb-13	Ahmed Noman Ghazi Hassan Khaled Mohamed Hassan Salah Mohammed Khalil Mustafa Abbara Nasser Adra Khaled Al-Adara Mouti'e Alkhatib	Mayor of Mouanseh (Moukhtar) Mayor of Qenia (Moukhtar) Land Owner Land Owner Land Owner Mayor of Mrah El Khaoukh (Moukhtar)	To facilitate public acceptance of the Project, ECODIT conducted a Public Meeting during the Scoping stage with local stakeholders including residents and local authorities, in the presence of representatives from the MOE and MOEW. The purpose of the meeting was to inform communities about the Project and solicit feedback. The meeting was organized at Al-Intilaqua Private School in Kfartoun Village. The most significant concerns raised during the public meeting are summarized below: • Does the wind farm impact public health in anyway? • How will the wind turbines be transported to the site? The roads leading to the Project site are in poor condition and meander through difficult terrain. • How will the wind farm and individual wind turbines limit access and use of private lands? Can the land owner build a house nearby? Grow crops? • Lebanon is not the first country to implement a wind farm. Therefore, SA and this ESIA study should review past experiences and documentation from other countries and adapt those findings to Lebanon. • SA must provide local jobs and income to people living in the area, during both the construction and operation phases of the Project. Will the local population have preferential access to electricity generated by the wind farm?

Date	Family/Area Representative		Description
	Faris Maarouf Dahir Khader Dahir Hussein Al-Adara Hajj Hussein Ali Yusuf Ahmed Daher Amer al-Khatib Mohammed Al - Adara Ahmed Hassan Salah Bilal Salah Faisal Khader Dahir Halla Mounjid Khaled Daher	Land Owner Mayor of Sahleh (Moukhtar) Land Owner Land Owner Land Owner Land Owner Mayor of Kfartoun (Moukhtar) Land Owner Citizen of Sahleh Land Owner Land Owner Land Owner Land Owner Ministry of Environment Land Owner	The ESIA aimed to address the above concerns raised by the local community, in addition to any other concerns received during Project development including informal feedback received during the team's presence onsite. Additional public meetings will also be conducted as part of the ESIA process to present the ESIA findings and solicit further feedback during the final stages of the study.
16-Mar-13	Meeting with Retired General Khaled Al Daher		After the installation of the meteorological masts, a social presence was necessary to indulge any raised question or concerns the locals had. Several separate meetings were conducted with RT. General Khaled and Mr. Abdo Jaafar to further discuss the social aspect of the Project. Multiple visits were done to different families in the area. Introducing the Project and showing its benefits as well as raising their hopes of something better to come, knowing that the Akkar people have lost their trust in the government and are craving for change, nevertheless some of the locals became adapted to their surrounding and would be resilient to any change.
16-Mar-13	Meeting with Abdo Jaafar		
11-Apr-13	Meeting with Retired General Khaled Al Daher		
11-Apr-13	Meeting with Abdo Jaafar		
28-May-13	Meeting with Retired General Khaled Al Daher		
28-May-13	Meeting with Abdo Jaafar		
19-Jul-13	Meeting with Retired General Khaled Al Daher		
19-Jul-13	Meeting with Abdo Jaafar		
20-Aug-13	Meeting with Retired General Khaled Al Daher		
20-Aug-13	Meeting with Abdo Jaafar		
25-Sep-13	Meeting with Retired General Khaled Al Daher		
25-Sep-13	Meeting with Abdo Jaafar		
5-Feb-14	Meeting with Retired General Khaled Al Daher		
5-Feb-14	Meeting with Abdo Jaafar		
8-Mar-14	Meeting with Retired General Khaled Al Daher		
27-Mar-14	Meeting with Retired General Khaled Al Daher		
4-Apr-14	Meeting with Retired General Khaled Al Daher		

Date	Family/Area Representative	Description
9-May-14	Meeting with Abdo Jaafar	
24-May-14	Meeting with Retired General Khaled Al Daher	
6-Jun-14	Meeting with Abdo Jaafar	
11-Jul-14	Meeting with Abdo Jaafar	
12-Aug-14	Meeting with Retired General Khaled Al Daher	
1-Sep-14	Meeting with Retired General Khaled Al Daher	
22-Sep-14	Meeting with Retired General Khaled Al Daher	
6-Oct-14	Meeting with Abdo Jaafar	
20-Oct-14	Meeting with Abdo Jaafar	
16-Nov-14	Meeting with Abdo Jaafar	
12-Jan-15	Meeting with Retired General Khaled Al Daher	The meeting took place in RT. General Khaled's house where discussion were made regarding dismantling the met mast in Akroum for several reasons: • More than one year of data was collected. • The political status of the country was not clear. • The project was put on hold, but the social presence is necessary to sustain the work that was done in the area.
12-Jan-15	Meeting with Abdo Jaafar	The meeting regarded dismantling the met mast in Rweimeh took place.
11-Mar-15	Meeting with Retired General Khaled Al Daher	After the met masts were dismantled, multiple meetings were undertaken to sustain the social presence in the area, continuously targeting the land owners but in a subtle way. In addition, SA kept on paying land rental (700 USD/MW) for the land owners who showed interest in the project although no clear visibility on the future of the Project was foreseen.
4-Apr-15	Meeting with Abdo Jaafar	
9-May-15	Meeting with Retired General Khaled Al Daher	
6-Jun-15	Meeting with Abdo Jaafar	
11-Jul-15	Meeting with Abdo Jaafar	
12-Aug-15	Meeting with Retired General Khaled Al Daher	
1-Sep-15	Meeting with Retired General Khaled Al Daher	
6-Oct-15	Meeting with Abdo Jaafar	
16-Nov-15	Meeting with Abdo Jaafar	
12-Jan-16	Meeting with Retired General Khaled Al Daher	
12-Jan-16	Meeting with Retired General Khaled Al Daher	
11-Mar-16	Meeting with Abdo Jaafar	
4-Apr-16	Meeting with Abdo Jaafar	
16-May-16	Meeting with Abdo Jaafar	
8-Jun-16	Meeting with Retired General Khaled Al Daher	
16-Jul-16	Meeting with Retired General Khaled Al Daher	
14-Aug-16	Meeting with Abdo Jaafar	
1-Sep-16	Meeting with Abdo Jaafar	
6-Oct-16	Meeting with Retired General Khaled Al Daher	

Date	Family/Area Representative	Description
16-Nov-16	Meeting with Retired General Khaled Al Daher	Following the presidential election, Sustainable Akkar recommenced its social and environmental presence in the area.
2-Mar-17	Abbas Jaafar, Kamel Jaafar, Mohamad Jaafar and Abdo Jaafar	Several face-to-face meetings with the landowners of Karm Chbat, Kfartoun and Rweimeh were undertaken in order to relaunch the development steps of the Project. Meetings were held during the process of exploring the layout for the wind farms. During these meetings, SA/LWP were answering the questions that the land owners had, such as the negative impacts of wind turbines on their lands especially if they will be able to use them after the turbines will be installed. In addition, the general terms of the contract were discussed, and comments were taken into account and transferred to the lawyers of SA to integrate these changes to the contract if the Project was approved by the international lenders.
8-Mar-17	Hussein Jaafar, Youssef Jaafar	
13-Mar-17	Meeting with Maher Chawki Al Adraa, Ahmad Hasan Al Adraa and Ahmad Mustafa Al Adraa	
27-Mar-17	Meeting with Hussein Ahmad Salah, Mohamad Ali Salah and Hussein Ali Salah	
4-Apr-17	Meeting with Mohamad Khaled Abed Al Rahman and Ahmad Abed Al Rahman	
18-Apr-17	Meeting with Mohamad Hussein Hussein and Khaled Mohamad Hussein	
9-May-17	Meeting with Ahmad Ali Youssef Salah, Hasan Hasan Salah and Adnan Ali Salah	
9-May-17	Meeting with Mustafa Hada	
24-May-17	Meeting with Richdi Khaled Al Adraa, Hani Khaled Al Adraa and Mohamad Khaled Al Adraa	
6-Jun-17	Meeting with Ahamad Ahmad Al Adraa and Hani Al Adraa	
12-Jul-17	Meeting with Hani Al Adraa	
12-Jul-17	Meeting with Ahmad Ali Daher	
14-Aug-17	Meeting with Ahmad Abou Amcha, Hasan Khoder Abou Amcha and Mouhamad Hasan Abou Amcha	
11-Sep-17	Meeting with Khaled Hasan Khoder	
7-Oct-17	Meeting with Khoder Hussein Melhem, urki Hussein Melhem and Jamil Hussein Melhem	

1. *What will the effect of these turbines have on our personnel health?* There may be noise, shadow flicker and visual impacts.
2. *What will happen to the lands when rented?* Will we have access to them? A portion of the parcels leased will be used for the installation of the wind turbine platform, parking Area and access road. The community will only be prohibited from accessing the wind farm components.
3. *Will we be able to raise our herds?* or will these turbines blow them away? Some areas of grazing will be prohibited during the construction phase; however, there will be other areas available for grazing during construction and free grazing will be allowed during the operations phase.
4. *What are the job opportunities that this project will create?* There may be up to 150 jobs created for the construction phase.
5. *Will this project provide electricity 24/7 to the Akkar region taking its location of implementation?* The energy will be provided to the public grid. It is up to EDL to supply electricity.

Following the cadastral survey undertaken in 2018, land lease with the Kanaan, Daher, Salah, Houda, Adraa, Aamche, Khoder, Melhem, Hussein and Jaafar Families for the construction of the Project wind turbines and platforms for WTGs 2, 5, 8, 10, 14, 19, 20, 21, 22, 23, 24 and 25, parking areas and access road, and land purchase for the construction of the substation were finalized in accordance with and '*Ilm w Khabar*' (Acknowledgement Certificates) attesting the ownership of a real estate property which is un-surveyed and un-registered in the official real estate records.

Land lease paperwork was issued by the Ministry of Finance General Directorate of Land Registry and Cadastre and signed by a judge in Tripoli for lease of the three largest land parcels from Aandqet Municipality.

The plots subject of the abovementioned lease agreements are free from any occupant, liabilities, rights, liens, or encumbrances. The Project land take will not result in resettlement/economic displacement (loss of livelihoods).

Land tenure has been secured for a period of 28 years at an agreed value of US$34,000/year during Phase 1 Technical Studies and Installation, US$7,000/MW/year during Phase 2 Operations and Maintenance ("Implementation"), and US$583.33/MW/month during Phase 3 Decommissioning.

Executed Acknowledgement Certificates, along with Lease Agreements with the Municipality of Fnaidek for land for other wind turbines, platforms and internal access roads, are as summarized in **Table 2-4** and **Figure 2-11a** through **Figure 2-11c**. **Appendix E** presents the Executed Acknowledgement Certificates.

In addition to the land leases needed for installation of the wind turbine components, land is needed to construct the new 0.65km and 0.15km sections of asphalt road (shown as #1 and #2 on **Figure 2-7)**. Again, it is noted that these new road segments are being constructed to mitigate impacts during the transportation of wind turbine components.

Further, a new 3.0km section of gravel road will be constructed within the existing railroad right of way (ROW) managed by Machta Hammoud Village (shown as #3 in **Figure 2-7**), traveling east before connecting to an existing asphalt road to enter the Hawa Akkar Wind Farm.

Table 2-4 Land Lease/Purchase Agreements

# on Map Area (m^2)	Cadastral Zone	Intended Use	Owner	Lease Term	Leasing Value	Legal Rights (Ownership/Lease/ Sublease)	Underlying Documentation	Contractual Status
WTG 2* **6,329m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Kanaan family	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Sustainable Akkar	Acknowledgment Certificate to be issued	Final form of Lease Agreement under discussion - In process
WTG 5 **6,285m2**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Hassan Assaad Kanaan, Ali Mostafa Kanaan, Ahmad Khaled Kanaan, Mohamad Assaad Kanaan, Ahmad Mostafa Kanaan and Khaled Mostafa Kanaan	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 31/01/2019	Final form of Lease Agreement under discussion - In process
WTG 8 **5,508m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Mohammad Ali Salah and Hussein Ali Salah	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Daher RE - Land to be subleased by Daher RE to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 28/12/2018	Final form of Lease Agreement under discussion - In process
WTG 10 **5,575m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Ahmad Ali Youssef Salah, Hassan Hassan Salah and Adnan Ali Salah	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Daher RE - Land to be subleased by Daher RE to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 06/12/2018	Final form of Lease Agreement under discussion - In process
WTG 14 **6,368m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Mostafa Mohamad Houda	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Daher RE - Land to be subleased by Daher RE to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 07/12/2018	Final form of Lease Agreement under discussion - In process
WTG 19 **3,483m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Mohamad Shaouki Adraa	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 18/12/2018	Final form of Lease Agreement under discussion - In process
WTG 20 **8,291m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Ahmad Moustafa Adraa	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 06/12/2018	Final form of Lease Agreement under discussion - In process
WTG 21 **5,540m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Reshdi Khaled Adraa	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 06/12/2018	Final form of Lease Agreement under discussion - In process
WTG 22 **6,313m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Issa Malek Adraa	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 06/12/2018	Final form of Lease Agreement under discussion - In process

# on Map Area (m^2)	Cadastral Zone	Intended Use	Owner	Lease Term	Leasing Value	Legal Rights (Ownership/Lease/ Sublease)	Underlying Documentation	Contractual Status
WTG 23 **5,787m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Ahmad Abou Aamche, Mohammad Hassan Hussein Khoder Abou Aamche, Hassan Khoder Abou Aamche and Khaled Hassan Khoder	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Daher RE - Land to be subleased by Daher RE to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 15/11/2018	Final form of Lease Agreement under discussion - In process
WTG 24 **45,115m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Adraa Ahmad Adraa and Hussein Ahmad Adraa	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Daher RE - Land to be subleased by Daher RE to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 18/02/2013	Final form of Lease Agreement under discussion - In process
WTG 25 **6,915m²**	Jabal Akroum-Kfartoun	Turbine + Platform + Parking Area + Access Road	Jamil Hussein Melhem and Khoder Hussein Melhem	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Land to be leased by Owner to Daher RE - Land to be subleased by Daher RE to Sustainable Akkar	Land owned by Owner as per the Acknowledgment Certificate of 05/11/2018	Final form of Lease Agreement under discussion - In process
WTG03 and WTG04 **222,484m²**	Aandqet	Turbine + Platform + Parking Area + Access Road	Municipality of Aandqet	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Launch of surveying and delimitation works in 2007 (In process) - Land owned by Owner as per the Temporary Real Estate Certificate of 27/11/2018	Land owned by Owner as per the Acknowledgment Certificate of 06/12/2018	Forms of Lease and Sub-Lease Agreements being reviewed by Lenders' counsels - In process
WTG06 and WTG07 **367,500m²**	Aandqet	Turbine + Platform + Parking Area + Access Road	Municipality of Aandqet	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Launch of surveying and delimitation works in 2007 (In process) - Land owned by Owner as per the Temporary Real Estate Certificate of 27/11/2018	Land owned by Owner as per the Acknowledgment Certificate of 15/11/2018	Form of Lease Agreement being reviewed by Lenders' counsels - In process
WTG09 **367,500m²**	Aandqet	Turbine + Platform + Parking Area + Access Road	Municipality of Aandqet	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Launch of surveying and delimitation works in 2007 (In process) - Land owned by Owner as per the Temporary Real Estate Certificate of 27/11/2018	Land owned by Owner as per the Acknowledgment Certificate of 15/11/2018	Form of Lease Agreement being reviewed by Lenders' counsels - In process
WTG11 and WTG13 **367,500m²**	Aandqet	Turbine + Platform + Parking Area + Access Road	Municipality of Aandqet	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Launch of surveying and delimitation works in 2007 (In process) - Land owned by Owner as per the Temporary Real Estate Certificate of 27/11/2018	Land owned by Owner as per the Acknowledgment Certificate of 15/11/2018	Form of Lease Agreement being reviewed by Lenders' counsels - In process
WTG15, WTG17 and WTG18 **45,260m²**	Aandqet	Turbine + Platform + Parking Area + Access Road	Municipality of Aandqet	28 years	1. **Phase 1 'Technical Studies and Installation':** US$34,000/year; 2. **Phase 2 'Implementation':** US$7,000/MW/year; and 3. **Phase 3 'Decommissioning':** US$583.33/MW/month	Launch of surveying and delimitation works in 2007 (In process) - Land owned by Owner as per the Temporary Real Estate Certificate of 27/11/2018	Land owned by Owner as per the Acknowledgment Certificate of 18/02/2013	Form of Lease Agreement being reviewed by Lenders' counsels - In process
SA Substation **13,255m²**	Rweimeh-Kfartoun	Installation of Sustainable Akkar/EDL Substation	Abdo Mohammad Jaafar	Will be purchased by Sustainable Akkar	Not determined yet / down payment paid	Land owned by Owner as per the Acknowledgment Certificate of 30-07-2018	Land owned by Owner as per the Acknowledgment Certificate of 05/11/2018	Forms of Land Sale and Purchase Agreements being reviewed by Lenders' counsels - In process

Figure 2-11a Land Lease Parcels – Acquisition of LWP Substation

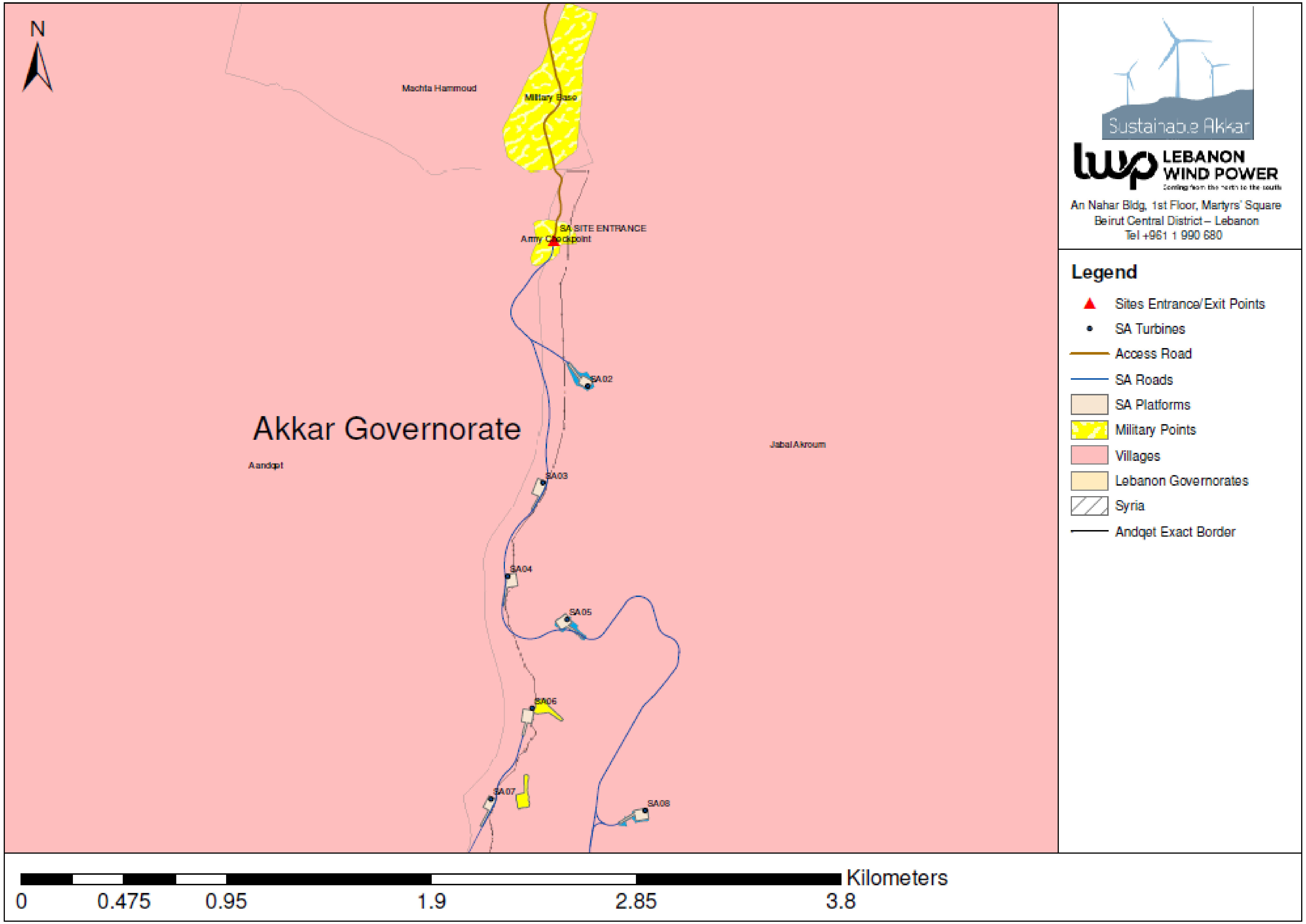


Figure 2-11b Leased Land Parcels

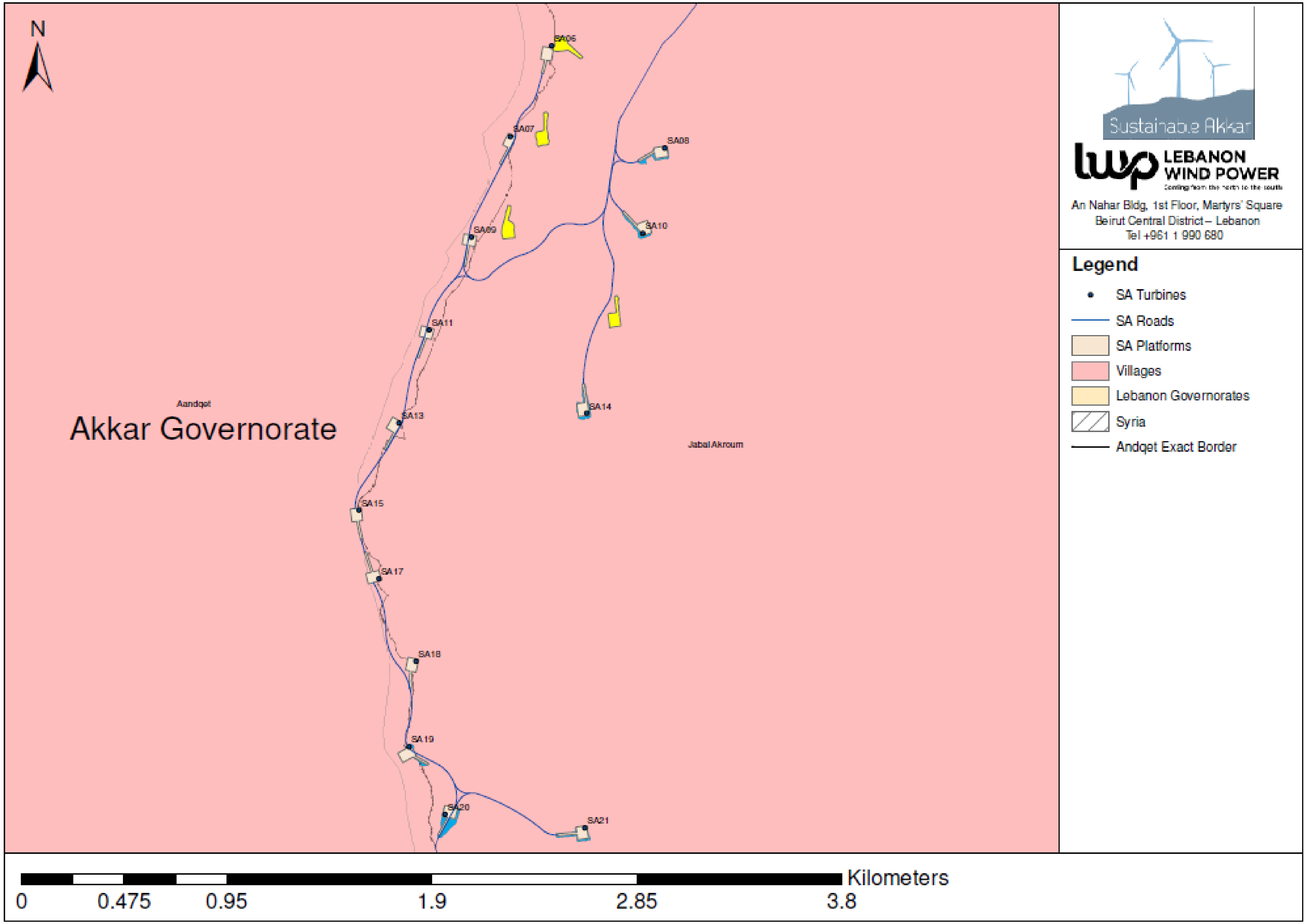
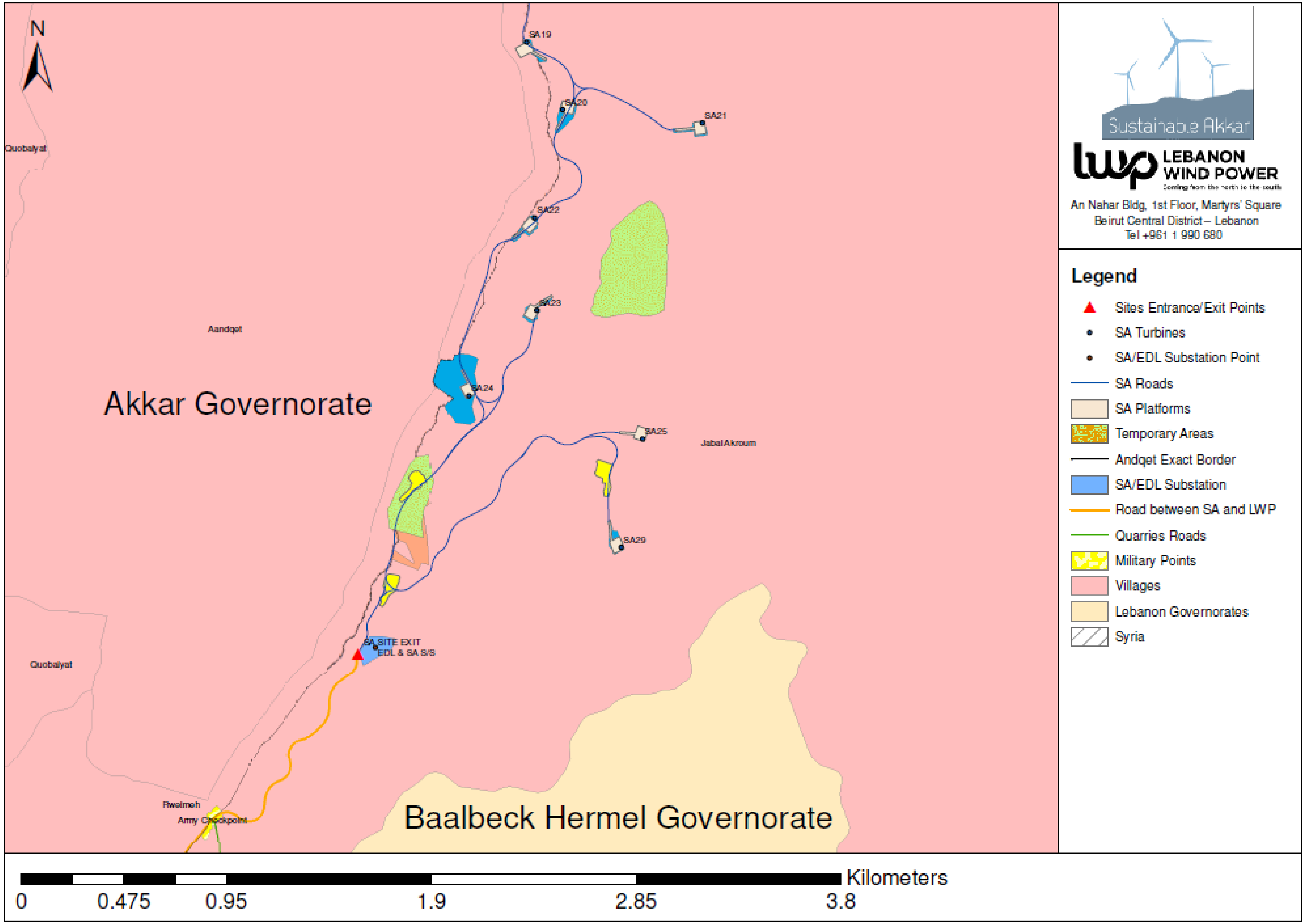


Figure 2-11c


N
SA19
SA20
SA21
Quobaiyat
SA22
SA23
Aandqet
SA24
Akkar Governorate
SA25
Jabal Akroum
SA29
SA SITE EXIT
EDL & SA S/S
Quobaiyat
Rwaimeh
Army Checkpoint
Baalbeck Hermel Governorate
Sustainable Akkar
LEBANON WIND POWER
An Nahar Bldg, 1st Floor, Martyrs' Square
Beirut Central District – Lebanon
Tel +961 1 990 680
Legend
Sites Entrance/Exit Points
SA Turbines
SA/EDL Substation Point
SA Roads
SA Platforms
Temporary Areas
Andqet Exact Border
SA/EDL Substation
Road between SA and LWP
Quarries Roads
Military Points
Villages
Lebanon Governorates
Syria
Kilometers
0
0.475
0.95
1.9
2.85
3.8

2.5 Footprint of the Project Components

This section provides an estimate on the footprint of the Project components discussed in the previous section. It is noted that the land lease or acquisition previously detailed in **Table 2-4** is significantly less than the area that will be occupied by the component. For example, while the parcels being leased for the installation of the turbine, platform, parking area and access road ranges between 3,483m^2 (WTG19) and 367,500m^2 (WTG24). As presented in **Table 2-5**, the total area of disturbance for the project is small and is significantly less than the Project area (which is 8.7km^2). This number is based on installation of a maximum of 21 turbines; it is noted that the number of turbines can be as low as 17 should GE be the selected OEM/EPC Contractor.

2.6 Overview of the Project Phases

This section presents the likely activities to take place during the Project development and which will include three distinct phases: (i) planning and construction, (ii) operation and (iii) decommissioning, each of which is summarized below. Construction is expected to begin in July 2019 and will require approximately 18 months for construction and commissioning. Operation of the Project is, therefore, expected to begin in February 2021. A Project schedule is presented in **Figure 2-12** (note: the Project schedule also shows the installation of the turbine components for Lebanon Wind Power).

2.6.1 Pre-Construction Phase

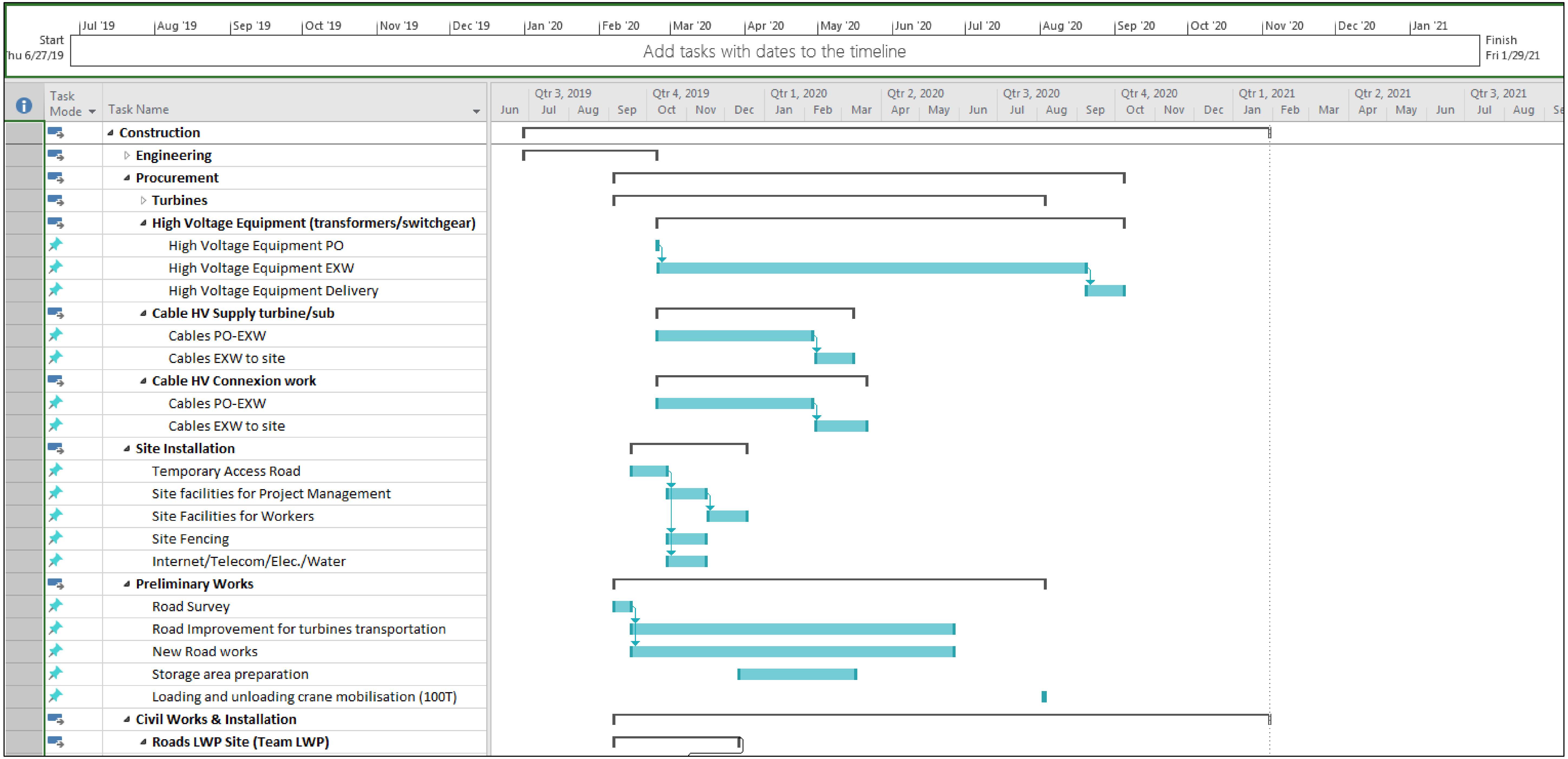
The pre-construction phase will include the following:

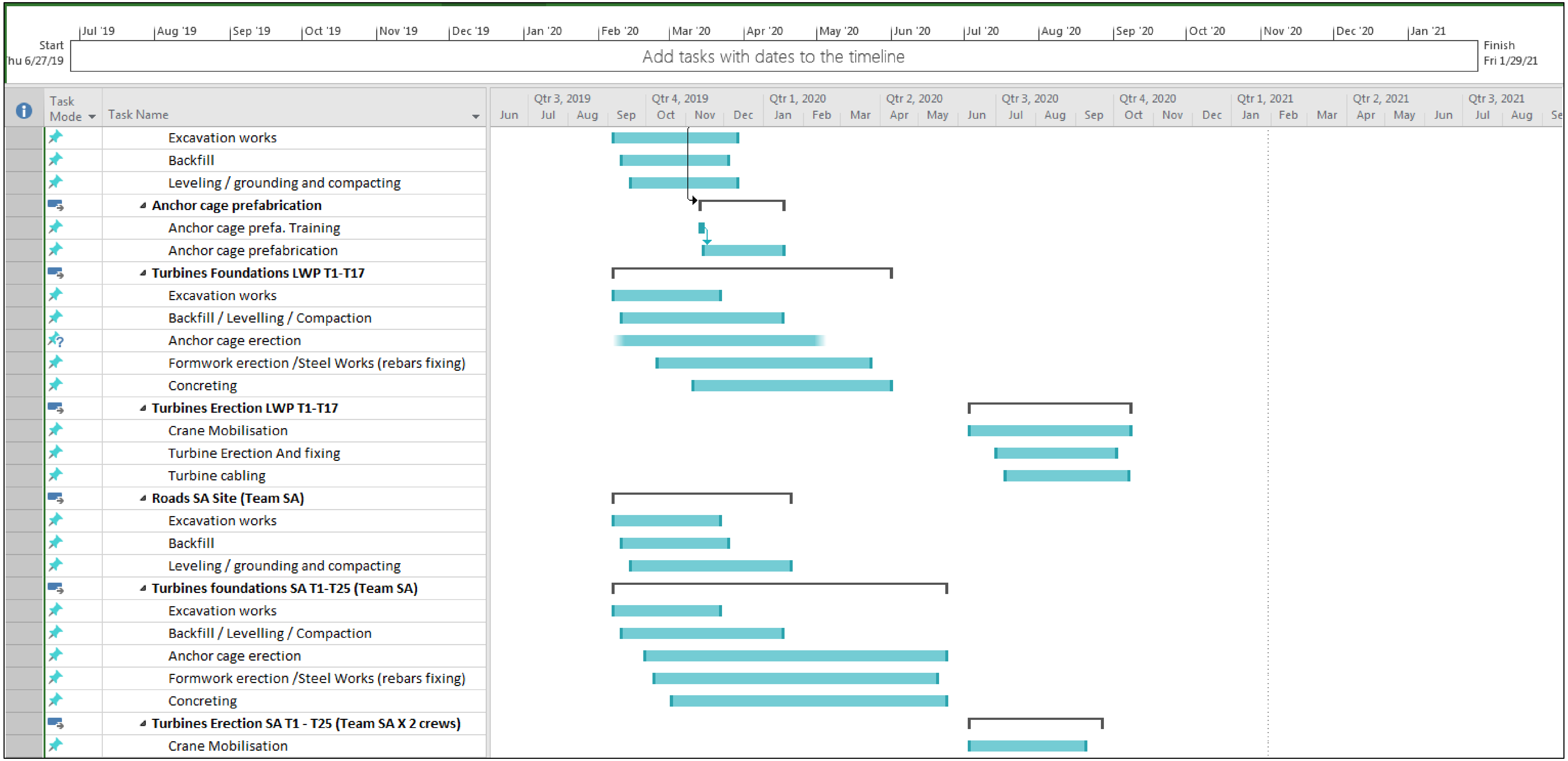
- Land Rentals: As previously summarized in **Section 2.4**, Project land will be secured through long term lease agreements with the land owners.
- Land Acquisition: The Project will be acquiring one area of land for the construction of the substation, control building and EDL building, while the remaining will be rented for 28 years.
- Selection of OEM/EPC Contractor: Vestas Wind Systems A/S and GE have been shortlisted and are currently under negotiations with the Developer.
- Surveys and Studies:
  - A final transport route review once the specific model of wind turbine has been selected and dimensions of the components are understood. This will ensure that any changes to the likely impacts along the route are identified.
  - Additional topographical surveys as required to serve as a solid basis for the specification of the works.
  - Geotechnical investigations on all proposed sites for wind turbines, substations, transformers and related structures and buildings, for structures of transmission lines, along all site road routes for the purpose of construction and further public use and at other sites.
  - The analysis of the local site conditions.
  - Planned survey / monitoring (i.e. surveying of major karstic features, groundwater mapping, water quality monitoring of groundwater, local springs, etc.) to inform detailed design and address adverse impacts during construction.

Table 2-5 Footprint of the Project Components

Component	Footprint	Description
Turbine platforms	38,220m²	This includes the footprint for the foundation and the crane pad area for each of the 21 turbines. Each crane pad is likely to be around 1,520m² in area (38m in width and 40m in length), whereas each foundation is likely to be around 300m² in area.
Substation and Warehouse and Storage facilities	3,640m²	Includes footprint of the substation area and warehouse facilities (3,500m² + 140m² = 3,640m²).
Construction Camp	NA	Construction workers shall be housed in Quobaiyat.
Temporary Buildings	TBD following design	Includes the design and construction of: • Buildings and containers. • Parking lots for heavy duty and long load transporters and other vehicles. • Cleaning point for concrete bucket trucks. • Unloading area for material on pallets (approximately 14 X 2.5m = 35m²). • Sanitary facilities. • A mobile wastewater treatment plant should be included with a capacity of 2m³/day and a 10,000L water tank. • HSE facility. • Disposal and separate waste stations, 3 containers (approximately 6m X 2.4m X 2.6m + 6.24 X 3 = 18.72m²) • Outdoor and indoor lightning. • Fencing of sensitive areas. • Installation of a manned and unmanned site security scheme. • Meeting facilities for site meetings (up to 15 persons). • Offices fully furnished with office-chairs, desks, file boards, side desks. • Toilets. • Changing rooms. • Common room including: kitchen, Refrigerator and drinking water coolers, dining area with a capacity of 12 people, electrical appliances and other necessary equipment. • Workshops. • Air conditioners. • Fully equipped with all means for communication and information transfer. • One additional sanitary container with toilets (male/female). • Storage.
Trenches for MV cables and communication cables	10,208m²	Trenches are likely to be around 12.76km in length and a width of around 80cm.
Laydown Areas	3,500m²	3 blades of 78m in length and a 4.0m X 1.35m crane laydown area.
Transmission Line (buried)	9,600m²	Approximately 8km in length and an excavation width of 120cm to accommodate a 30cm transmission line.
New asphalt road segments	33,600m²	Road network is likely to be around 4.2km in length and a width of around 8m.
New gravel road segment		This calculation is not yet available.
Total Project Footprint	**0.79km²**	**Project footprint is approximately 1,481,868m² (leased lands), plus 12,764m² (internal roads), plus 33,600m² (new asphalt road segments). Project footprint is around 17.6% of the total boundary of the Project area.**
Total Project site Boundary Area	**8.7km²**	

Figure 2-12 Project Schedule




Start
Thu 6/27/19
Jul '19
Aug '19
Sep '19
Oct '19
Nov '19
Dec '19
Jan '20
Feb '20
Mar '20
Apr '20
May '20
Jun '20
Jul '20
Aug '20
Sep '20
Oct '20
Nov '20
Dec '20
Jan '21
Add tasks with dates to the timeline
Finish
Fri 1/29/21
Task Mode
Task Name
Qtr 3, 2019
Qtr 4, 2019
Qtr 1, 2020
Qtr 2, 2020
Qtr 3, 2020
Qtr 4, 2020
Qtr 1, 2021
Qtr 2, 2021
Qtr 3, 2021
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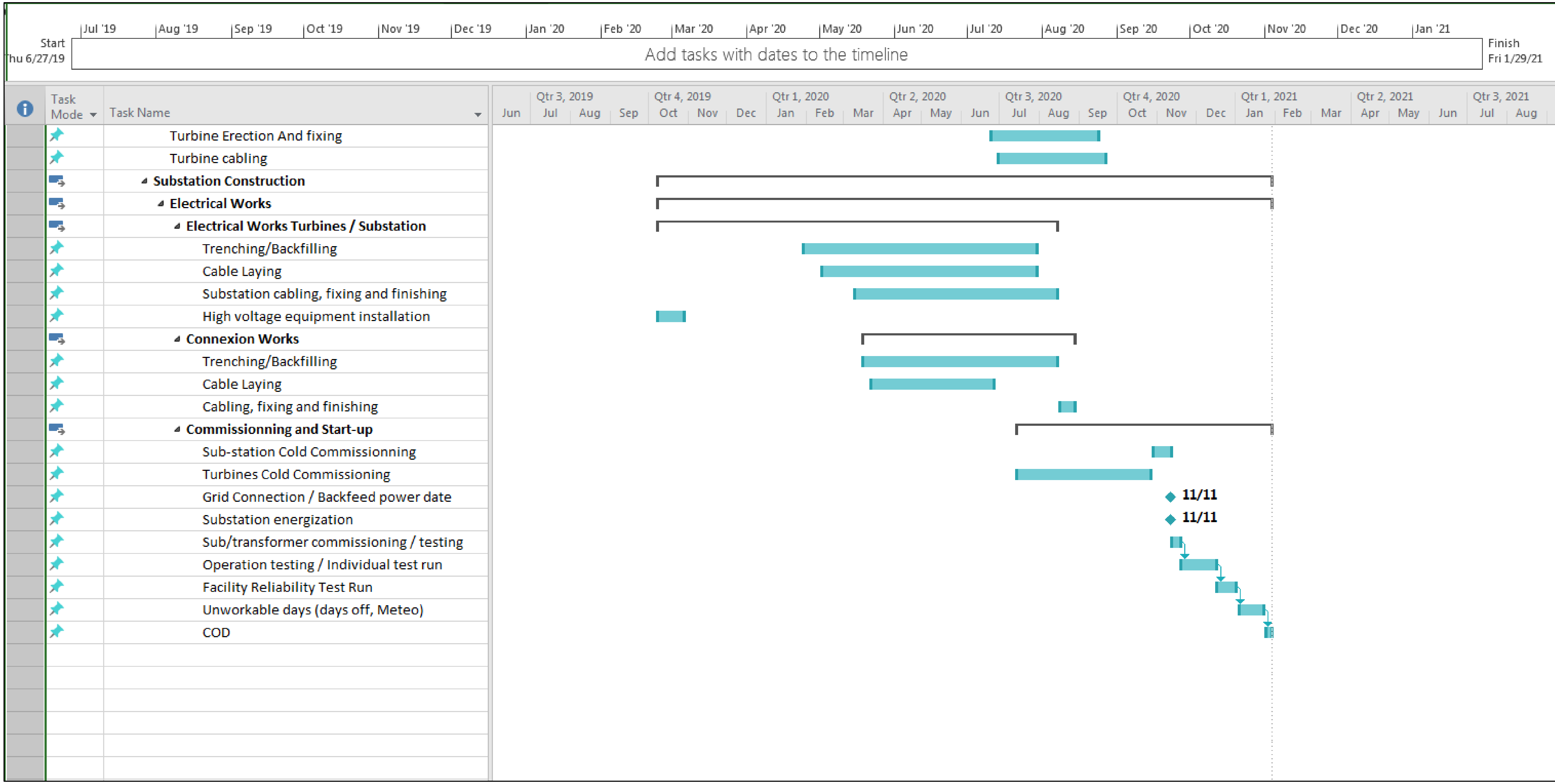
Aug
Excavation works
Backfill
Leveling / grounding and compacting
Anchor cage prefabrication
Anchor cage prefa. Training
Anchor cage prefabrication
Turbines Foundations LWP T1-T17
Excavation works
Backfill / Levelling / Compaction
Anchor cage erection
Formwork erection /Steel Works (rebars fixing)
Concreting
Turbines Erection LWP T1-T17
Crane Mobilisation
Turbine Erection And fixing
Turbine cabling
Roads SA Site (Team SA)
Excavation works
Backfill
Leveling / grounding and compacting
Turbines foundations SA T1-T25 (Team SA)
Excavation works
Backfill / Levelling / Compaction
Anchor cage erection
Formwork erection /Steel Works (rebars fixing)
Concreting
Turbines Erection SA T1 - T25 (Team SA X 2 crews)
Crane Mobilisation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Mar '20
Apr '20
May '20
Jun '20
Jul '20
Aug '20
Sep '20
Oct '20
Nov '20
Dec '20
Jan '21
Start
Thu 6/27/19
Add tasks with dates to the timeline
Finish
Fri 1/29/21
Task Mode
Task Name
Qtr 3, 2019
Qtr 4, 2019
Qtr 1, 2020
Qtr 2, 2020
Qtr 3, 2020
Qtr 4, 2020
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Turbine Erection And fixing
Turbine cabling
Substation Construction
Electrical Works
Electrical Works Turbines / Substation
Trenching/Backfilling
Cable Laying
Substation cabling, fixing and finishing
High voltage equipment installation
Connexion Works
Trenching/Backfilling
Cable Laying
Cabling, fixing and finishing
Commissionning and Start-up
Sub-station Cold Commissionning
Turbines Cold Commissioning
Grid Connection / Backfeed power date
Substation energization
Sub/transformer commissioning / testing
Operation testing / Individual test run
Facility Reliability Test Run
Unworkable days (days off, Meteo)
COD
11/11
11/11

- Detailed Design: The complete detailed design shall be provided by the selected OEM/EPC Contractor according to the scheduled milestones. To this end, the OEM/EPC Contractor shall prepare and submit the parts of the detailed design documentation, which relate to supplies and services in accordance with the applicable laws and regulations.

  During detailed design, the wind farm layout and yield calculations prepared by the Developer will be examined by the OEM/EPC Contractor to assess the best possible site configuration for installation of turbines among the 21 locations previously shown in **Figure 2-1**.

  Once the topographical survey has been completed, micro-siting will be undertaken to the degree necessary to locate the wind turbines to optimize production. However, it is noted that the site is located on a mountain ridge, and it is therefore anticipated that it will be optimal to place the turbines on rows perpendicular to the prevailing wind direction and within the confines of the leased land parcel. For this reason, it is not envisioned that the turbines will be significantly relocated during the detailed design and/or construction phase.

  The OEM/EPC Contractor's detailed design will be used by the Developer to obtain the construction permit in accordance with the applicable laws and regulations. The OEM/EPC Contractor shall provide all support and documents to the Developer for application for construction permit.

- Employment and Workforce Training: For the performance of the services during construction and operation, the OEM/EPC Contractor is encouraged to hire local personnel. After contract award, the successful bidder will be asked to present a hiring plan, including both local and international workforce. When local workforce is proposed, then the following information needs to be disclosed concerning the region from where they were hired, inter alia:

  a. The surrounding villages.
  b. The North Lebanon area.
  c. Lebanon.
  d. Lastly, international expertise.

  Construction activities will employ around 125 workers (approximately 250 workers across both Lebanon Wind Power and Sustainable Akkar) during the construction phase for a duration of approximately 18 months. This will mainly include skilled opportunities (to include engineers, technicians, consultants, surveyors.) and unskilled job opportunities (mainly labor force but will also include a number of security personnel). Approximately 3 job opportunities will be available during the operations phase for a duration of 20 years. This will include skilled job opportunities (such as technicians) and unskilled job opportunities (such as drivers.). This number does not consider the security personnel that will be required onsite.

  Taking the above into account, the Developer is aiming to hire local community members to the greatest extent possible throughout the construction and operation phase for skilled and unskilled jobs. The OEM/EPC Contractor shall provide comprehensive training to Employer's designated personnel covering all aspects of the Facility and the technical operation of the wind farm, safety at work, equipment and system for operations and maintenance. The training shall at least include the following:

- On the job training.
- Factory training.
- Wind turbine maintenance and associated planning.
- Supervisory control and data acquisition (SCADA) software and hardware training.
- Operations and maintenance staff training.

2.6.2 Preparatory Works

The preparatory works include the provision of all goods and services of a temporary nature and required in order for the OEM/EPC Contractor to fulfill its obligations with regard to construction, installation and commissioning activities:

- Site preparation including compaction of soil, filling of low areas with imported fill and grading of the entire area of the site to the required lines levels and slopes, as required.
- Provision of temporary laydown areas, warehouses, workshops, vehicles, equipment etc., all as necessary for the construction phase.
- Provision of temporary firefighting and alarm system.
- Provision of temporary site drainage, storm water and sanitary drainage as necessary for the site, site facilities, temporary laydown areas, warehouses, workshops, as required.
- Disposal of sewage, as necessary.
- Provision of temporary site fencing including gates, as necessary.
- Provision of first aid, site safety and security system for the construction phase.
- Provision of temporary offices for the Employer and their representative.
- Provision of temporary offices for the Contractor.

2.6.3 Construction Phase

The scope of works in relation to civil works includes transportation, construction, erection, testing, commissioning and guaranteeing with respect to the items listed below will be undertaken in accordance with the EPC Technical Requirements, as follows:

- Removal of obstacles along the WTG component transport route.
- New asphalt road connections and internal road network and foundation construction.
- Internal road network and foundation construction within the Hawa Akkar wind farm, Sustainable Akkar wind farm and the Project.
- Other construction works (which could include excavations, land clearing activities, etc.) for the potential access road construction or upgrade and for the building infrastructure.
- Transportation of wind turbine components to the Project site. The components are expected to arrive by ship at the Tripoli Seaport and then be transported by road to the Project site.
- Site preparation of the turbine foundations. Such activities are limited to relatively small individual footprints of the foundations and will include excavations and land clearing activities. Note: movement of turbine locations during final design will be limited to the boundary of the land lease.
- Installation of turbine components to include tower assembly, hub, rotor, and nacelle lift and rotor assembly which most likely will occur through onsite mobile cranes.
- In addition to the erection of each turbine, there is additional construction work (which could include excavations, land clearing activities, electrical work, etc.) that must be conducted to

connect each turbine to the power grid, this could include the installation and laying of transmission and communication cables, and the installation of the substation.

- Excavation for installation of the buried transmission line along Quobaiyat-Qasr Road and the existing track to the Project to connect the Project substation with the substation at the Lebanon Wind Power wind farm.
- Other construction works (which could include excavations, land clearing activities, etc.) for construction for the building infrastructure (warehouse and offices).
- The scope of works of Contractor includes connection of the Plants to the existing electrical grid and energizing the interconnection facilities and the wind farm. The scope includes communicating and cooperating with EDL in order to ensure the timely connection and energization of the Project.
- Commissioning comprises the transfer of the plant from the state of mechanical completion into the state of continuous operation. Three months prior to the proposed start of commissioning, the OEM/EPC Contractor shall submit to the Developer the commissioning plan (including test program, commissioning procedures, organization chart). Before commencement of commissioning, the OEM/EPC Contractor shall ensure that the following preconditions are fulfilled:

  - Mechanical completion certificate are submitted.
  - Approved commissioning procedures are available.
  - Any required permit has been issued by the relevant authorities.
  - Commissioning spare parts, consumables and tools.
  - All temporary installation facilities/consumables required for the commissioning are made available by the OEM/EPC Contractor on site.
  - All safety equipment is in place on site.
  - The commissioning tests shall confirm the proper, safe and functional operation of all devices, controls and apparatus.

2.6.4 Operation and Maintenance Phase

The OEM/EPC Contractor shall manage and operate the Project, including:

- Management and administration of the facility.
- Environmental, health and safety management.
- Spare parts management including delivery, shipping and logistics for all required components and parts.
- Remote monitoring 24 hours a day, 7 days a week.
- Planning and supervision of the maintenance and repair activities.
- Communication with grid operator as well as operating the wind farm to satisfy EDL requirements.
- OEM/EPC Contractor's home office technical support.

The OEM/EPC Contractor shall maintain and repair the Project, including:

- Full service including scheduled and unscheduled maintenance of the Facility including but not limited to wind turbines, access roads and crane platforms, MV and FOC networks, operation and storage buildings, MV switchgear, MV/HV transformer up to and including the interface to EDL Assets, in line with the requirements of the operation and maintenance manuals provided by the manufacturer for the equipment installed in the facility.
- All other services necessary for the safe and efficient operation of the facility.

- Perform regular (latest yearly) testing of safety equipment as required for safe operation, by the equipment manufacturer instructions or by applicable laws and regulations
- Scheduled maintenance shall be performed to examine the condition and the proper function of the wind turbines, its subsystems and components.
- Check on the tolerances foreseen in the specification of the component / system and indicate the status and remaining lifetime respectively for the required maintenance works and if required for a safe operation in accordance with the specification, replace components or systems that do not comply in this regard.
- All spare parts and consumables needed for the scheduled and unscheduled maintenance of the facility. In addition, all required services, manufacturing, delivery to site, custom clearance and installation of spare parts as required. Regular substitution of all consumables such as lubricants, brake pads etc. as required for a safe and steady operation and in accordance with the wind turbine components and system's specification.
- Maintaining all O&M facilities including Operation Building, warehouse, sanitary sewers, lighting, HVAC, plumbing and IT.
- SCADA and connectivity maintenance including required software updates, virus protections, and firewalls.
- Supply of all crane and lifting support, as required.
- Perform all necessary environmental protection activities including spill prevention, spill cleanup and disposal of all contaminated waste at an approved facility.
- Maintain all aviation lights.
- Dispose of all site generated waste at an approved facility in line with local requirements and international best practice.
- Recycle all used oils, lubricants, and scrap materials at an approved facility.
- Reporting to the Developer.

The design lifetime of the wind farm is more than 20 years, noting that the turbines may last even longer with correct and consistent maintenance. **Table 2-6** summarizes the anticipated maintenance activity types at the wind farm.

Project operation will involve planned, scheduled and prepared-for maintenance activities. These will be conducted either (i) periodically, which is applicable for preventive maintenance, and monitoring, check-ups and system diagnostics, or (ii) as required, which is applicable to corrective maintenance and emergency maintenance procedures.

Table 2-6 Maintenance Activities

Type	Description
Preventive Maintenance	Routine checks, testing and maintenance to determine whether any major maintenance work is required. Ensures minimization of corrective maintenance. Planned and scheduled. Expenditure is budgeted.
Corrective maintenance	Tasks can either be identified through or triggered by: a. Routine preventive maintenance. b. System shutdown triggered by the protective system. c. Failure of a system component. Tasks include response to or correction of: a. Issues due to degradation of component integrity or excessive wear and tear. b. Human errors. c. Design faults and operational factors (such as turbine over-speeding, loss of grid connection, excessive vibration, other). Tasks are unplanned, unscheduled. Expenditure is condition-based.
Monitoring and System Diagnostics	Tasks include: a. Metering. b. Alarms. c. System diagnostics and checks. d. Condition monitoring. Expenditure is budgeted.

The types of routine maintenance activities as part of the preventive maintenance works of the Project are listed in **Table 2-7**.

Table 2-7 Preventive Routine Maintenance Works

Preventive Routine Maintenance Works	
Maintenance of turbine components	Brake adjustment
Brake pad maintenance	Lubrication
Inspection of security of fixings	Inspection of security of cable terminations
Generator overhaul	Access roads' maintenance
Maintenance of electrical components	Maintenance of areas around turbines (bases and platforms)
Control equipment maintenance	Other

Thus, while abiding by the mitigation measures as per the ESMP, the Developer will implement a well-defined maintenance program that aims to:

- Increase efficiency and energy delivery.
- Decrease downtime (hours/annum) (while respecting and abiding by the limitations set within the ESMP).
- Ensure EHS and reducing risks.
- Extend wind farm system lifetime.
- Comply with manufacturer's warranty(ies).

Project operation will involve planned, scheduled and prepared-for maintenance activities. These will be conducted either (i) periodically, which is applicable for preventive maintenance, and monitoring, check-ups and system diagnostics, or (ii) as required, which is applicable to corrective maintenance and emergency maintenance procedures.

Concerning liquid waste materials that may possibly be used during maintenance and operation activities of the wind farm, these include oils, lubricants, paints, solvents and pesticides. Such hazardous materials that would potentially be used during operation and maintenance of the wind farm components, including transformers, may pose a risk to staff members involved in handling, storage and use.

2.6.5 Decommissioning Phase

The PPA between the Developer and the GOL will be for 20 years. The landowner's leasing contract is for 28 years. The lease agreements state that a daily rental fee will be paid during the decommissioning phase, on the basis of the number of turbines that are still producing electricity.

Decommissioning activities will adhere to the requirements of the MOE, MOEW, local authorities and international bodies (OPIC, EIB, FMO) and will be in accordance with local permits and international guidelines and requirements. Decommissioning activities will be undertaken in accordance with the Decommissioning Plan, to be approved by the Developer as part of the detailed design.

The decommissioning and restoration process comprises removal of aboveground structures, below ground structures to a depth of 1m or greater, removal of access roads if required by the land owners (or local authorities), restoration of topsoil, re-planting and re-vegetation, seeding and implementation of a two-year monitoring and remediation period, in a manner aimed at reducing the damage that may affect the land.

Any damage to the land caused by decommissioning activities will be repaired to restore the land to its original state. Aboveground structures include the turbines, transformers, substation, maintenance buildings and office in Jabal-Akroum Kfartoun.

Below ground structures include turbine foundations, transmission lines, drainage structures (if any) and internal road sub-base material. The removal of wind farm structures will involve the evaluation and categorization of components and materials for disposition according to the following sequence: 1) recondition and reuse; 2) salvage; 3) recycle; and 4) dispose.

The decommissioning of the wind farm can be divided into three different phases:

- Phase I - Project management and planning: operations are scheduled taking into account the time and costs involved, aiming to achieve the most efficient and sustainable solution.
- Phase II - Removal of wind farm structures.
- Phase III - Post decommissioning processes: monitoring the destination of the removed elements and site recovery.

Table 2-8 presents the planned decommissioning activities per element, and in their order of occurrence. In the interest of increased efficiency and minimization of transportation impacts, components and materials may be stored on site at a pre-approved location until the bulk of similar components or materials are ready for transport. The components and material will be transported to facilities for reconditioning, reuse, salvage, recycling or disposal, as appropriate.

Table 2-8 Delineation of Decommissioning Activities per Element

Element	Removal during Commissioning
Turbines	• Access roads to turbines will be widened, if needed, to sufficient width to accommodate movement of appropriate-sized cranes or other machinery required for the disassembly and removal of the turbines. • Control cabinets, electronic components and internal cables will be removed. • Blades, hubs and nacelles will be lowered for disassembly. • Tower sections will be lowered to the ground and further disassembled into transportable sections. • Blades, hubs, nacelles, and tower sections will either be transported whole for reconditioning and reuse, or dissembled into salvageable, recyclable, of disposable components.
Turbine foundation and base	• Topsoil will be removed from an area surrounding the foundation and stored for later replacement. • Turbine foundations will be excavated to a depth sufficient to remove all anchor bolts, rebar, conduits, underground cable, and concrete to a depth of 1 meter below grade. • The remaining excavation will be filled with clean sub-grade material of quality comparable to the immediate surrounding area. • The sub-grade material will be compacted to a density similar to surrounding sub-grade material. • Unexcavated areas compacted by equipment used in decommissioning shall be de-compacted to adequately restore the topsoil and sub-grade material to the proper density consistent and compatible with the surrounding area and suitable for vegetation growth – noting that de-compaction activities are not recommended to take place starting October 1st, in order to ensure sufficient vegetation growth to prevent erosion over the winter months; otherwise this activity would be postponed to Spring, specifically the month of May.
Project substation	• Disassembly of the substation will include only the areas leased to Lebanon Wind Power. • Steel, conductors, switches, transformers, etc. will be reconditioned and reused, sold as scrap, recycled, or disposed of appropriately depending upon market value. • Foundations and underground components will be removed to a depth of 36 inches and the excavation filled, contoured, and re-vegetated.
Access roads, construction and maintenance platforms	• Last step after other decommissioning activities are completed. • Gravel will be removed from access roads and platforms and transported to a pre-approved location. • Drainage structures integrated with the access road or construction pad will be removed and backfilled with sub-grade material, the topsoil replaced, and the surface contoured and re-vegetated • Access gates, if any, will remain operational until completion of decommissioning after which they will be removed unless requested by the Municipalities of Rweimeh, Karm Chbat and Fnaidek that they remain. • Ditch crossings connecting access roads to public roads will be removed unless requested that they remain by the Municipalities of Rweimeh, Karm Chbat and Fnaidek. • Improvements to village roads that were not removed after construction and installation of the wind farm will probably remain in place at the request of the Municipalities of Rweimeh, Karm Chbat and Fnaidek.

2.7 Direct Areas of Influence

The Direct Area of Influence (DAOI) for the ESIA is shown (in red) in **Figure 2-13**. The DAOI comprises the following:

- Villages where land to be leased or purchased from landowners for the installation of Project turbines, internal roads, substation and transmission line, i.e. Aandqet and Rweimeh Village.
- Villages where land will be leased and purchased for the installation of wind turbines, internal roads, substation and transmission line at the planned Lebanon Wind Power and Hawa Akkar wind farms, i.e. Fnaidek, Rweimeh Village, Karm Chbat Cadastral Area, Chadra, Machta Hammoud and Mqaible.
- Areas of the new segments of road:
  - The new 0.65km section of asphalt road to avoid impacts to Chadra, Machta Hassan and Machta Hammoud to be constructed through currently vacant land purchased from private land owners (shown as #1 in **Figure 2-7**).
  - The new 0.15km section of asphalt road to be constructed between two existing sections of asphalt road in order to avoid hairpin turns near homes (shown as #2 in **Figure 2-7**).
  - The new 3.0km section of gravel road to be constructed within the existing railroad ROW managed by Machta Hammoud Village (shown as #3 in **Figure 2-7**).
- Jabal-Akroum Kfartoun, where land is to be leased for the CRO Office.
- A 3km radius around the Project boundary to encompasses the noise, shadow flicker and visual receptors (as shown in **Figure 2-14**; note: red dots are the modeled houses).
- Villages within sightline of the wind turbines and potentially affected by the Project's visual impact (refer to **Section 16 Community Health, Safety and Security**).
- Extends up to 15km from the Project footprint, limited to sites and monuments of national importance located within the 15km and potentially affected by the Project's visual impact (refer to **Section 17 Landscape**).

These locations are summarized in **Table 2-9**.

Table 2-9 Villages/Locations in the Direct Area of Influence

Villages to the East/Northeast	Villages to the West/Northwest	Villages to the South/Southwest	Villages within Sightline of Turbines	Sites and Monuments within 15km
Jabal-Akroum Kfartoun	Aandqet	Rweimeh Village	Sahle*	Sahle (Hill)*
Mqaible	Chadra	Karm Chbat Cadastral Area	Qenia*	Al-Saifa Fortress Akkar el-Atiqa'a*
	Machta Hammoud	Fnaidek	Quobaiyat*	Qammouaah Plain*
			Aandqet	
			Kfartoun	
			Rweimeh Village	

* Not shown on **Figure 2-13**; refer to **Section 16 Community Health, Safety and Security** and **Section 17 Landscape**).

Figure 2-13 Direct Area of Influence

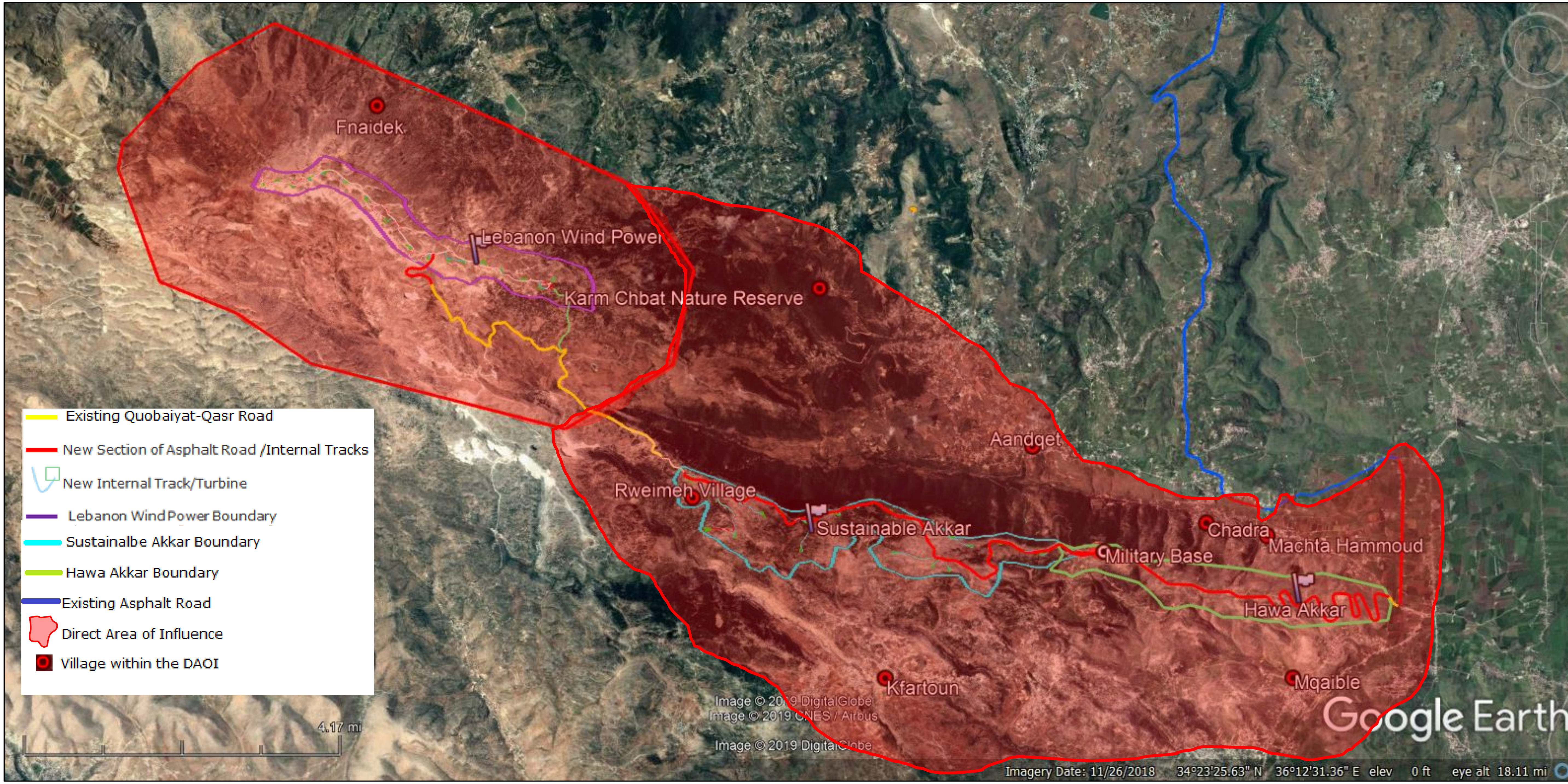
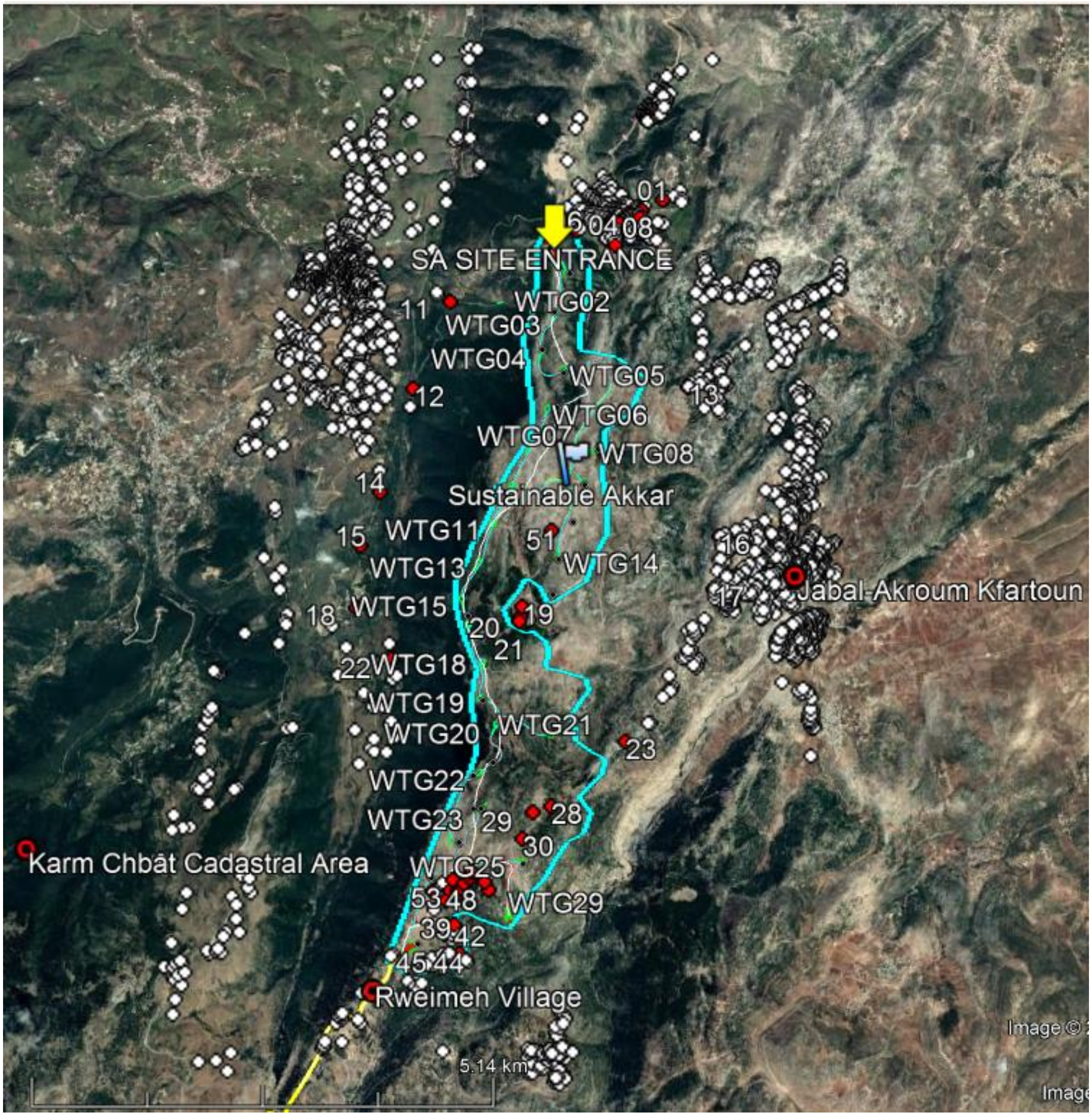


Figure 2-14 Individual Houses Near the Project



It is noted that there are other villages are within the sightline of the turbines, and therefore the DAOI; however, these villages were not included in the detailed assessment of visual impacts because of low visibility and/or because they were located at a greater distance than those villages modeled for visual impacts (refer to Section 16 Community Health, Safety and Security). Note: The IFC 2015 Wind Energy Guidelines recommend preparing wire-frame images and photomontages from key viewpoints. It goes on to recommend including viewpoints from nearby settlements. It does not require assessment of every settlement in the sightline of the turbines.

2.8 Indirect Area of Influence

The Indirect Area of Influence (IAOI) for the ESIA is shown (in blue) in **Figure 2-15**. The IAOI comprises:

- The existing transport corridor between the Tripoli Seaport and the Project, as shown in **Figure 2-16a** through **Figure 2-16g**.
- Informal settlements located within 1km of the existing road (refer to **Table 15-38** and series of maps in **Appendix F**).

These locations are summarized in **Table 2-10**.

Table 2-10 Villages in the Indirect Area of Influence

Element	Village		
Along the Transport Corridor	• Tripoli. • Beddaoui. • Deir Amar. • Borj El-Yahoudiyé. • Nabi Youcheaa. • Minie. • Zouq Bhannine. • Al Mhamra. • Bebnine. • Quobber Chamra. • Mqaiteaa. • Borj El-Yahoudiyé. • Kfar Melki Akkar.	• Rmoul. • Qaabrine. • Sammouniyé. • Tall Aabbas El-Gharbi. • Hissa. • Tall Aabbas Ech-Charqi.Tall Hmaire. • Chir Hmairine. • Hokr Jouret Srar. • Iitige. • Barcha. • Kharmoubet Akkar.	• Janine. • Qachlaq. • Aamaret El-Baykat. • Noura Et-Tahta. • Kouachra. • Dibbabiye. • Fraidis. • Qsair Akkar. • Menjez. • Rmah. • Chikhlar • Aaouaainat Aakkar. • Machta Hassan.

Further, the visual impacts from areas of influence were considered within the IAOI (refer to **Section 17 Landscape**) as follows:

- Agricultural Areas.
- Dense Abies Forests.
- Dense Pinus Forests.
- Dense Quercus Forests.
- Mixed Forests.
- Other Dense Leafy Forests.
- Rocky Land.
- Shrublands.
- Sparse Coniferous.
- Sparse Leafy Forests.
- Swamps.
- Urban Artificial.
- Urban Expansion

Figure 2-15 Indirect Area of Influence

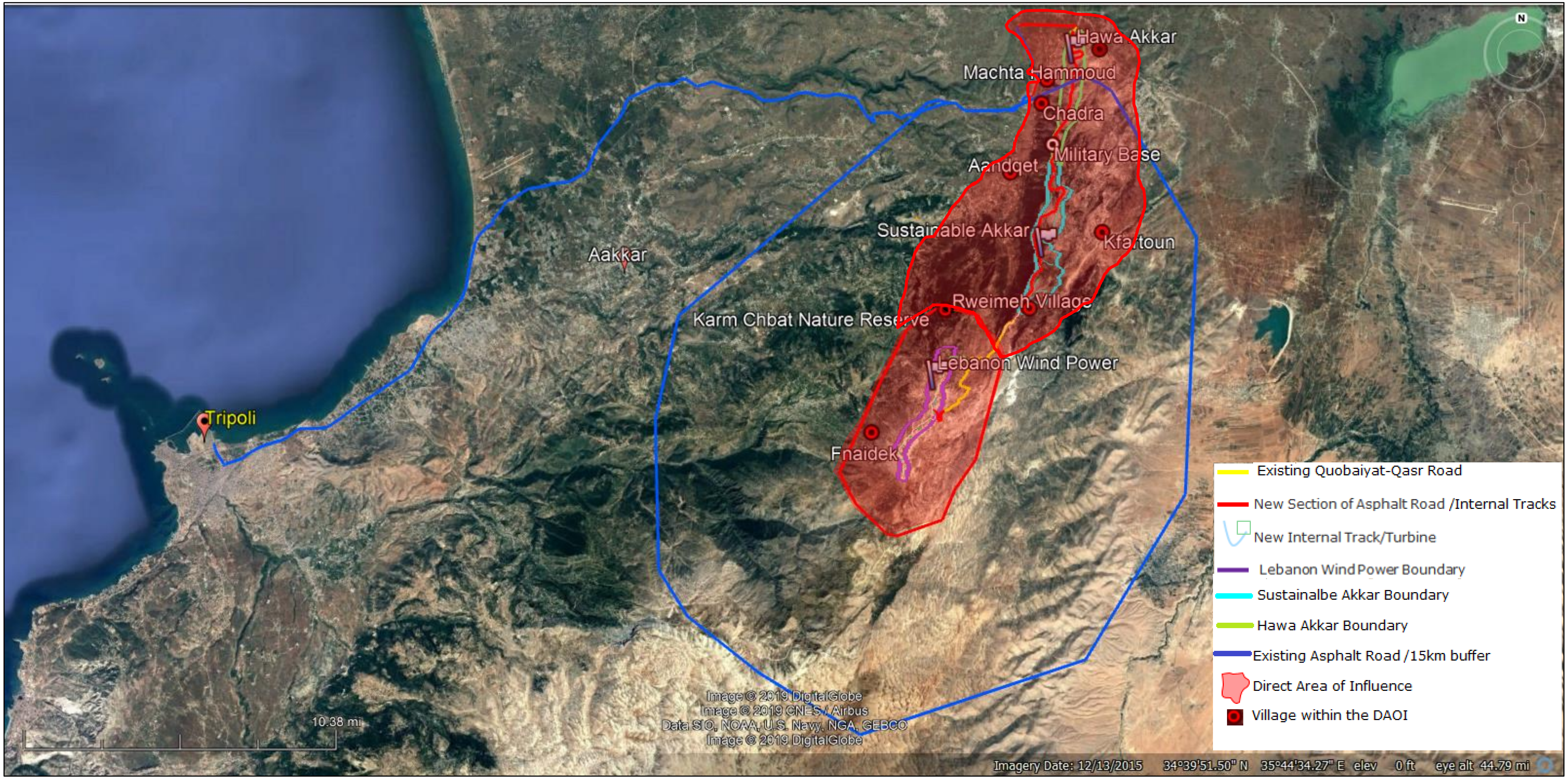


Figure 2-16a Villages Along the WTG Transport Corridor

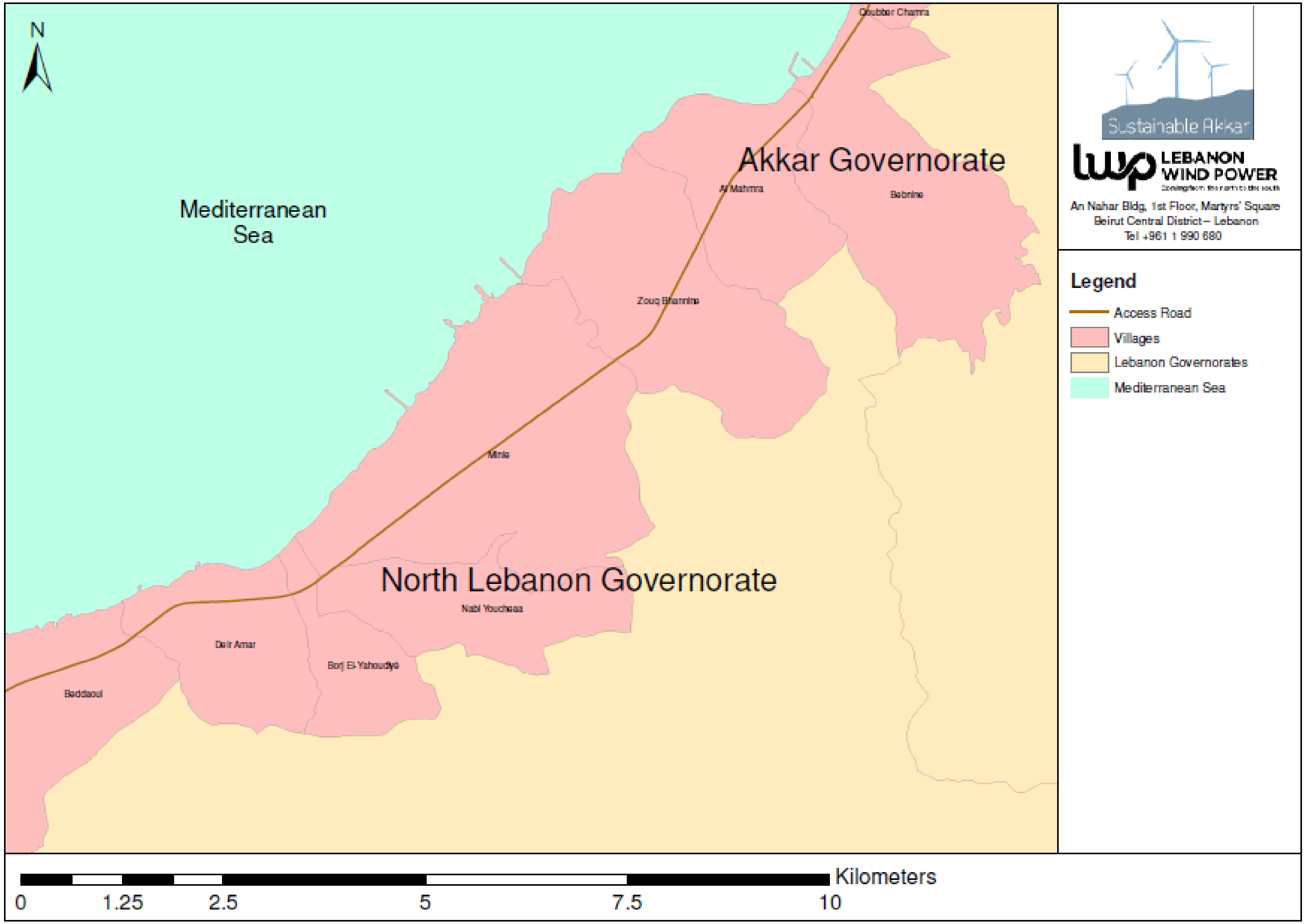


Figure 2-16b Villages Along the WTG Transport Corridor

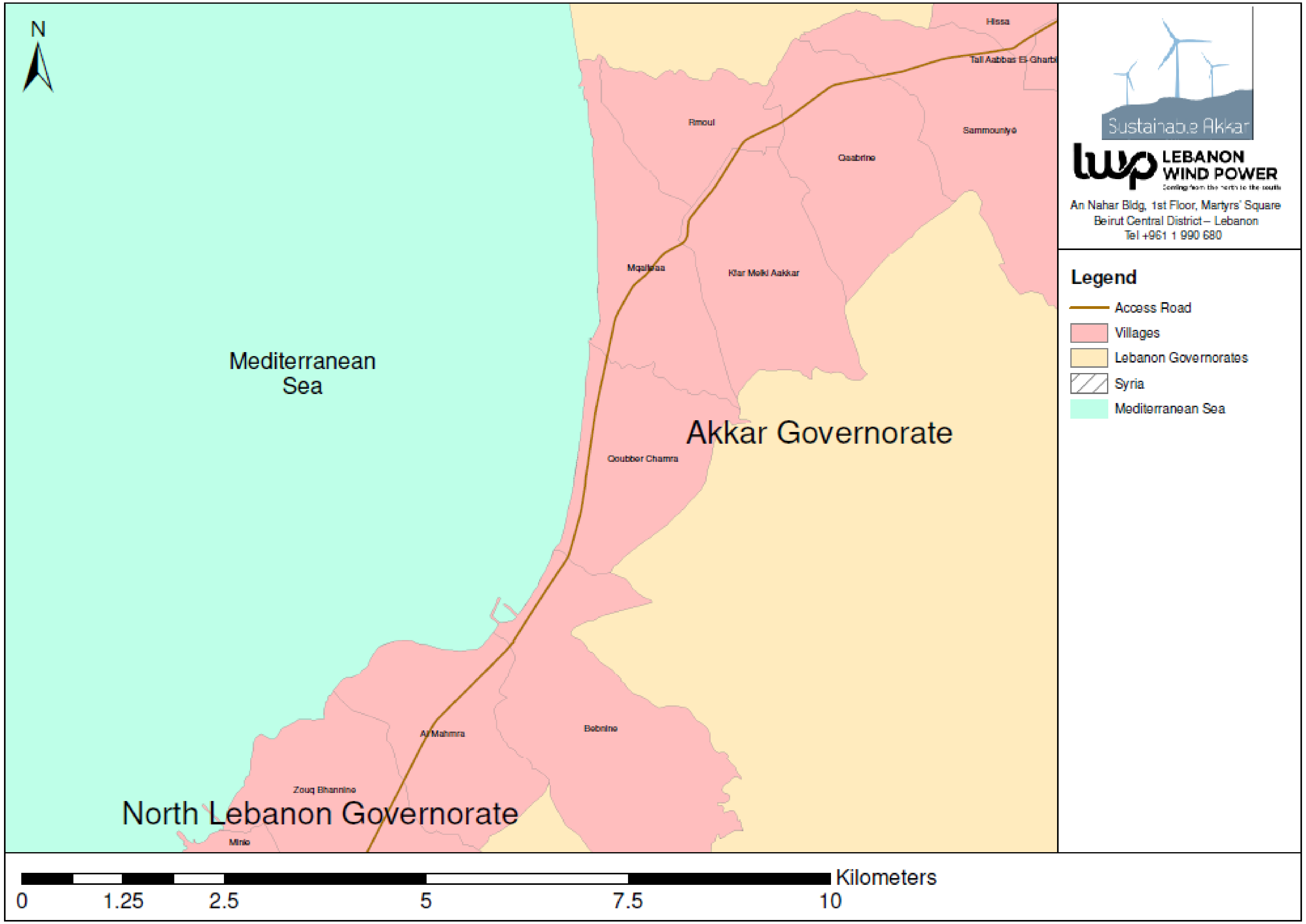


Figure 2-16c Villages Along the WTG Transport Corridor

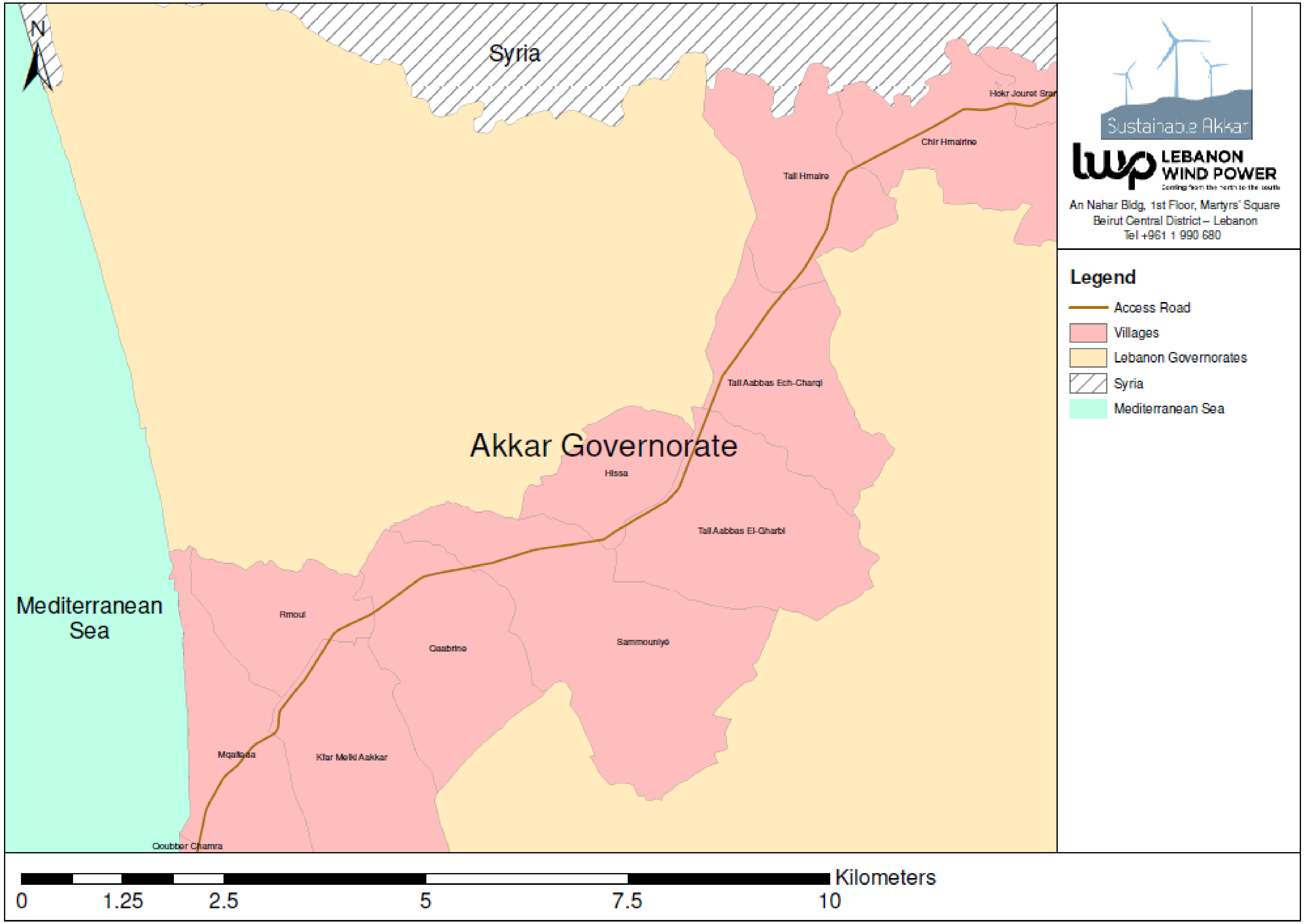


Figure 2-16d Villages Along the WTG Transport Corridor

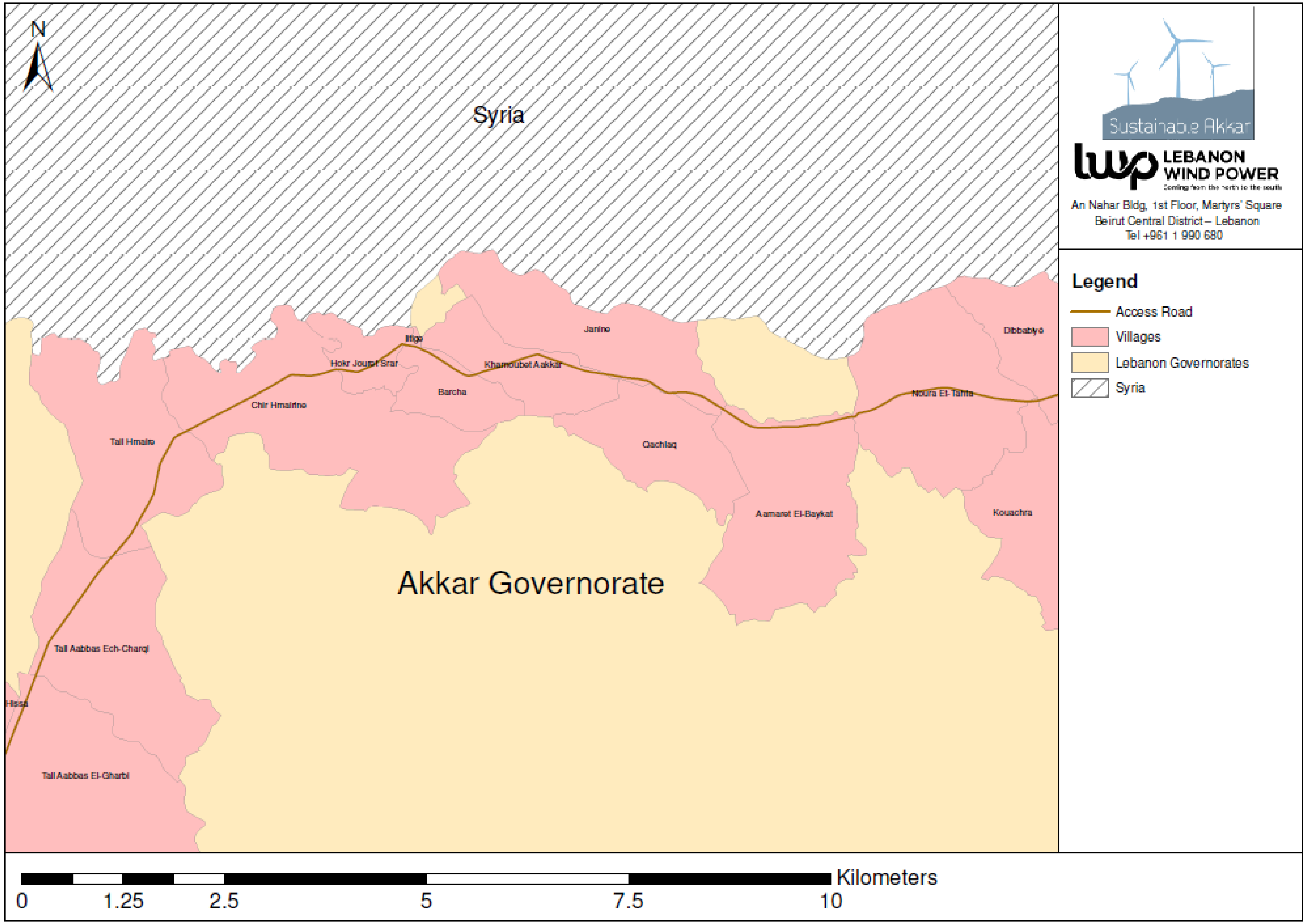


Figure 2-16e Villages Along the WTG Transport Corridor and Villages Near the Project

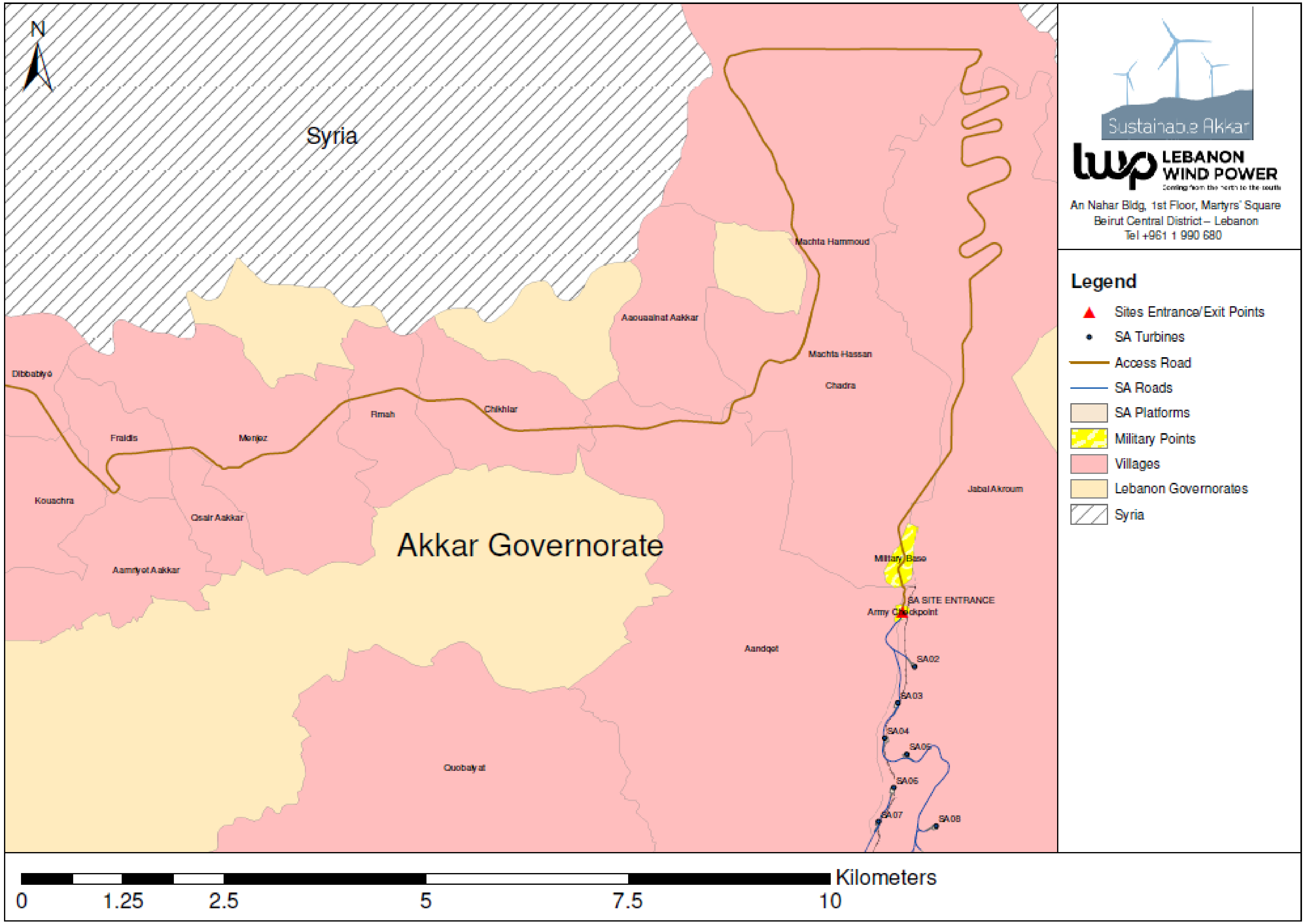


Figure 2-16f Villages Along the WTG Transport Corridor

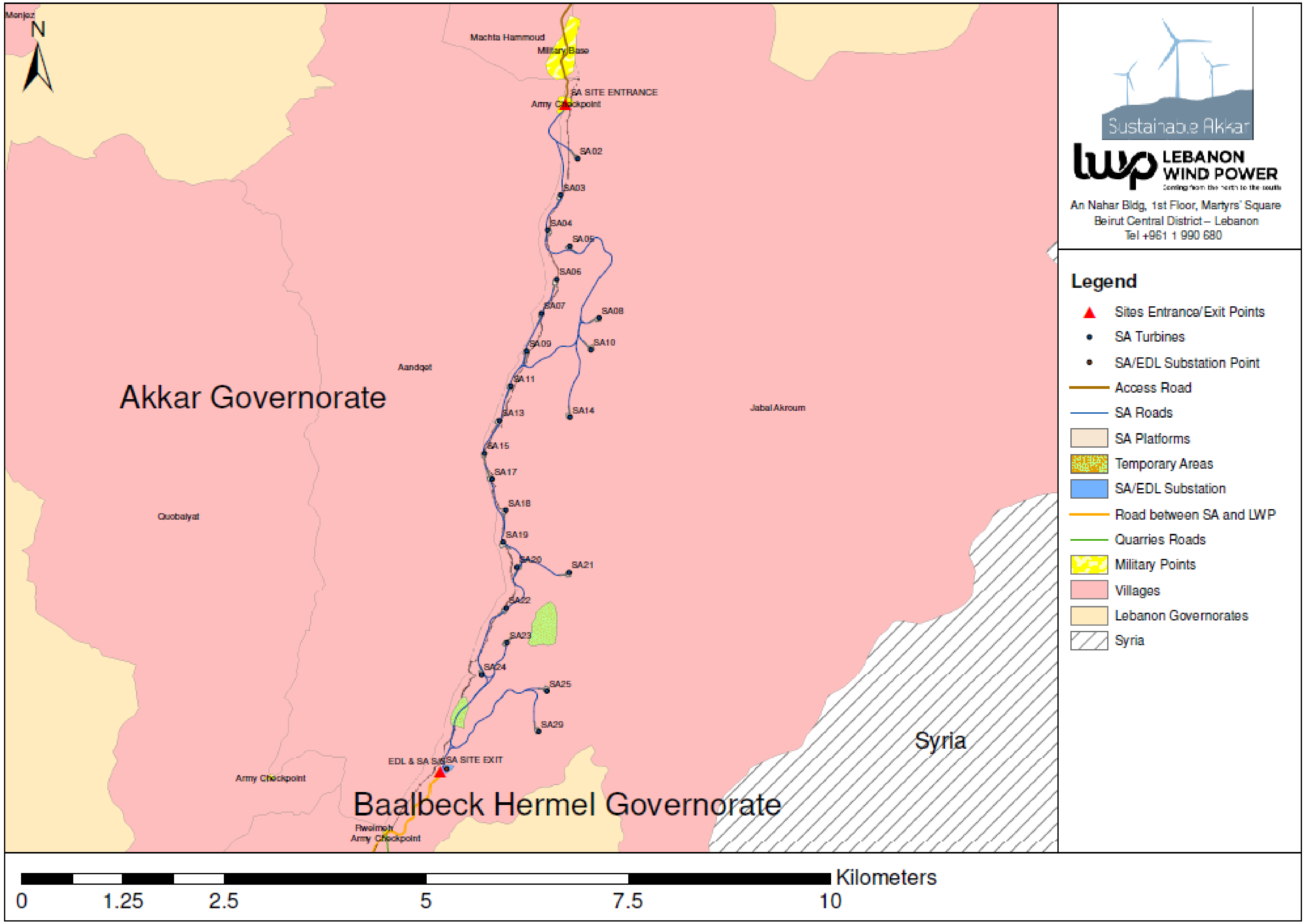
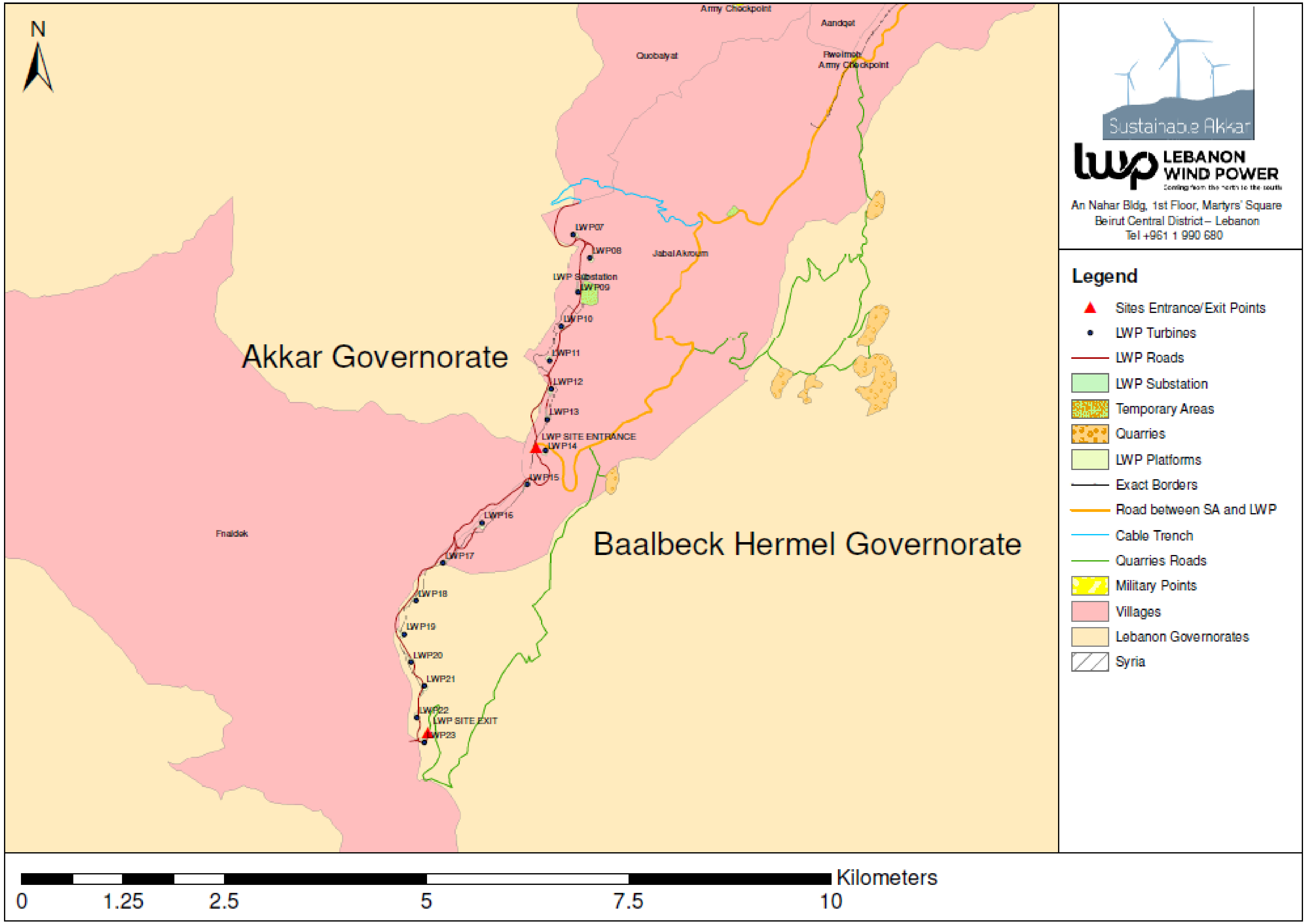


Figure 2-16g Villages Along the WTG Transport Corridor



2.9 Assessment of Individual Environmental and Social Parameters

For the assessment of individual environmental and social parameters, an appropriate thematic study area is determined for each theme on a case by case basis (i.e. ornithology). Such a thematic study area is clearly identified within the relevant section it relates to throughout this ESIA. In identifying these thematic study areas, the type and degree of the potential direct and indirect effects were taken into consideration. The core area where direct effects are likely to occur was determined, as well as the wider area of influence where indirect, combined and cumulative effects are likely to occur on the surrounding areas and communities.

2.10 Nearby Investments of Similar Nature

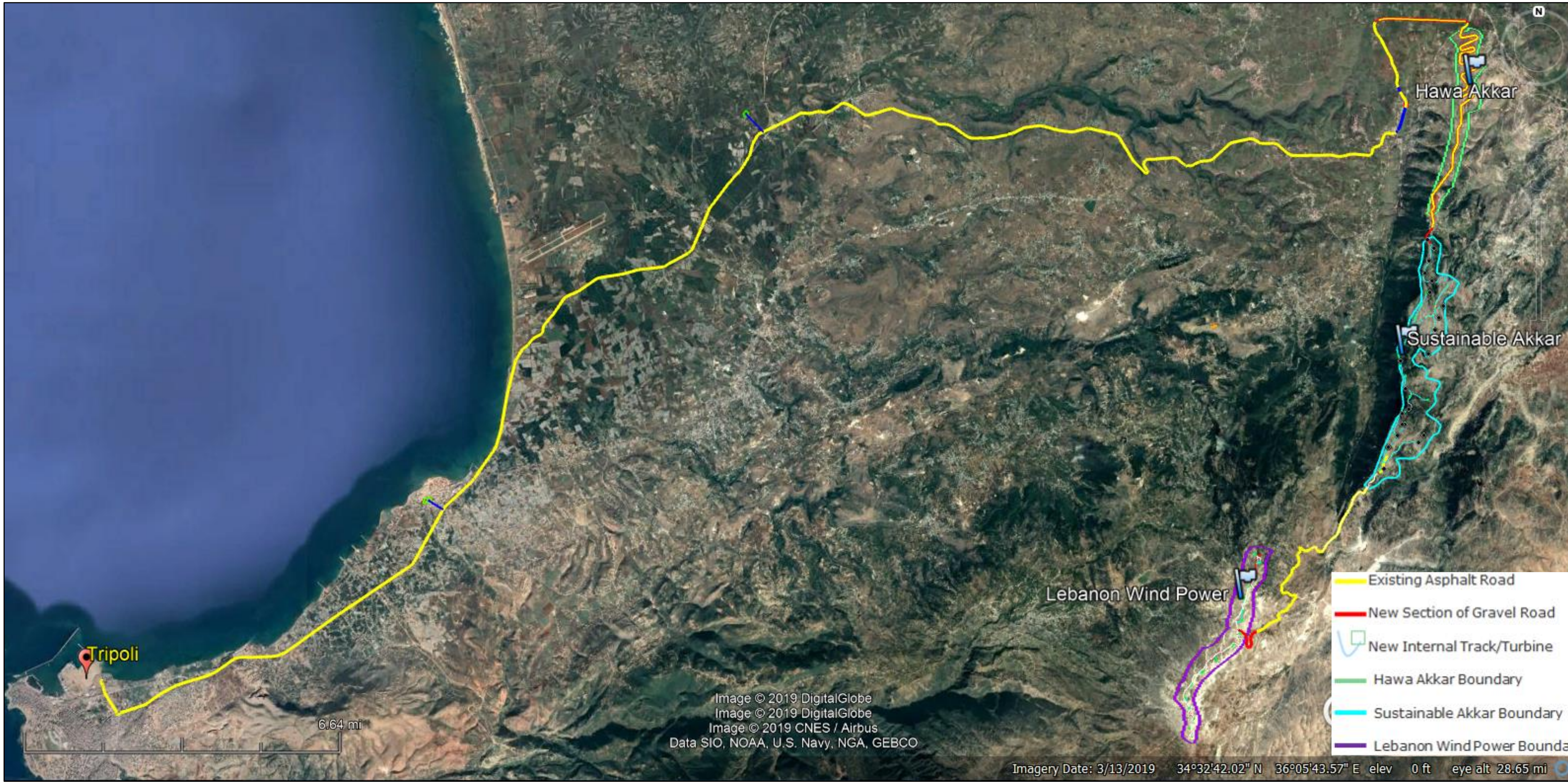
indicated in **Section 1 Introduction**, the GOL signed PPAs to purchase wind energy from three wind farms in Akkar. In addition to the Project, two other wind farms are planned:

- Lebanon Wind Power SAL is planning to establish and operate a wind farm project in Jabal Akroum, immediately south of the Project. The Project comprises the construction and operation of up to 16 wind turbines which would generate a maximum licensed capacity of 68.3MW to be delivered to the public grid.
- Hawa Akkar SAL is planning to establish and operate a wind farm project in the Wadi Khaled area in Akkar. The Hawa Akkar wind farm is expected to encompass 16 turbines which would generate a maximum licensed capacity of 68.3MW.

The proximity of the Lebanon Wind Power and Hawa Akkar wind farms to the Project are shown in **Figure 2-17**. All three wind farms will use the same route for transport of WTG components, also shown in **Figure 2-17**. As described above, the Project's Direct Area of Influence includes the footprint of land needed for the Sustainable Akkar and Hawa Akkar internal tracks, many of which will be built atop existing tracks.

Relevant ESIA studies are currently underway.

Figure 2-17 Location of Nearby Investments of Similar Nature



3. ANALYSIS OF ALTERNATIVES

The examination of alternatives is considered to be a key element of the ESIA process under good international practice, including IFC PS 1 and the associated IFC Guidance Note 1 (IFC, 2012). This section provides an analysis of certain alternatives to the Project development in relation to: 1) the Project site selection; 2) the Project design; 3) the Project route for transport of the WTG components; 4) the Project technology alternatives; and 5) the Project vs. the 'No Action Alternative', which assumes that the Project development does not take place. Based on such alternatives considered, the preferred choice for the Project was chosen as presented in **Section 2 Project Description**.

The application of the environmental and social mitigation hierarchy has been presented (i.e. to avoid, reduce, mitigate and manage, and compensate and offset), given that environmental and social considerations have been part of the planning of the Project since its inception and a core element of the decision-making process. Designing out the potential significant effects of a Project is the central tenet of the approach, encouraging adaptive management and continuous improvement to develop a more sustainable project. Specifically, the Developer endeavored to evaluate options to identify the preferred approach in consideration of the following:

- Site selection alternatives:
  - Overall Project site.
  - Turbine locations.
  - Project/EDL Substation locations.
- Design alternatives:
  - Turbine types/specifications.
  - Alternative substation designs.
  - Alternative transmission designs.
- Transportation alternatives:
  - WTG component vehicle types/modalities.
  - Alternative road transport vehicle types/modalities.
  - Alternative road alignments.
- Technology alternatives.
- The Project vs No-Project Alternative.

3.1 Site Selection Alternatives

3.1.1 Overall Project Site

Lebanon has a nationwide network of meteorological stations operated by Météo Liban (ML). In developing the Wind Atlas for Lebanon[19], ML supplied basic information and monthly wind data from 17 meteorological stations located throughout the country for the wind map analysis. In addition,

[19] The National Wind Atlas of Lebanon, Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon, 2011.

hourly, wind data from a subset of 5 meteorological stations were supplied. Further, wind data measured at 5 meteorological stations situated within Syria near to the Lebanese border were provided. These data were used to derive information about long term annual and seasonal mean wind speeds at the meteorological stations and to establish a basic understanding of the dominant wind regimes in the country. A wind map for Lebanon at 80m heights was derived in coordination with the following constraints, which presents the priority development areas for wind farms as shown in **Figure 3-1**:

- Areas of high population density.
- Areas of high political instability.
- Military sites.
- Commercial interests (e.g. mining, fisheries, etc.).
- Civilian aviation sites.
- Areas in close proximity to radar or telecommunication sites.
- National parks.
- Conservation areas e.g. cedar forests.
- Historic sites.
- Sites of religious significance.

As shown in **Figure 3-1**, the wind speeds present in the mountain ridge in Akkar represent the best wind conditions for siting a wind farm.

3.1.2 Turbine Locations

Though the energy output of turbines at each location is a high priority when assessing the micro-siting of a wind farm, it is certainly not the only measure to be taken into consideration for the final layout. The Developer assessed the various layouts according to a combination of the following criteria:

- Capacity factor of the proposed design.
- Lands available for leasing (minimum rental for up to 28 years).
- Distance from residential dwelling (minimum of 500m).
- Accessibility of the Project site.
- Requirements for civil and infrastructure work.
- Impact on the existing flora and fauna.
- Minimum distance requirement between turbines (>2.5 times the rotor diameter).

Based on the above, the number of turbine layouts were developed across the undertaking of the ESIA. **Figure 3-2** shows the changes from the original turbine layout in December 2018 and comparison to the current layout. Major changes were adopted in the different versions; these considered, among others, land availability and energy output, noting that the energy yield per turbine decreases the further south one moves in the Project, with the difference in the capacity factor between the northern and southern cluster of turbines reaching up to 15% per turbine. Accordingly, the current layout is proposing 23 potential locations for turbines out of the original 31 locations.

Figure 3-1 Wind Speeds at 80m Above Ground Level

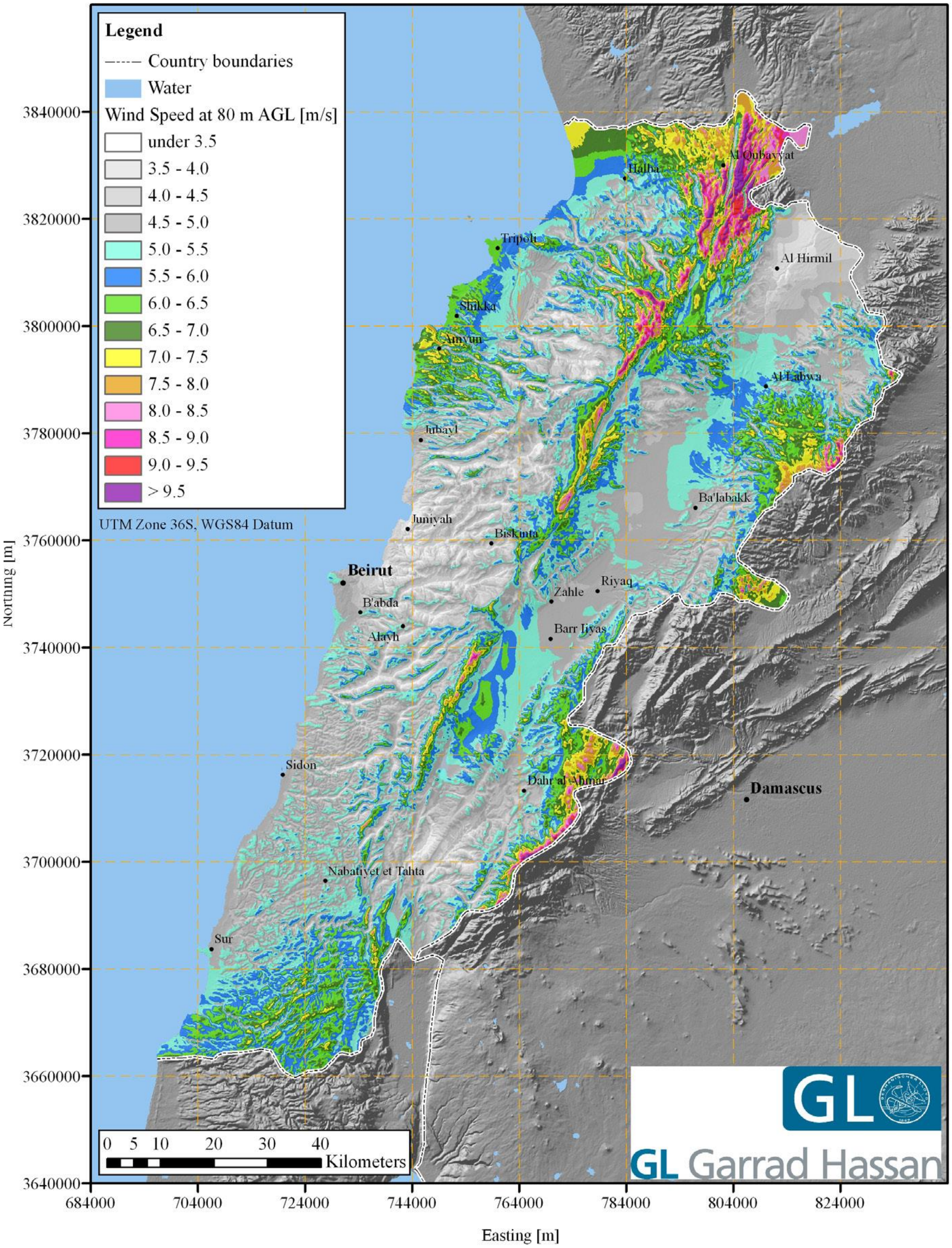


Figure 3-2 Project Turbine Layout

Scoping Report Design - December 2018

Current Design - June 2019

Turbine locations were eliminated for the following reasons:

- WTG 01 was located near the Sahle Checkpoint and near a high number of residential dwellings.
- WTG 12 and WTG 14 for their proximity to a summer house that was newly built.
- WTG 21 due to its low capacity factor.
- WTG 28 due to its proximity to the 66KV OHTL transmission line.
- WTG 30 was removed for low capacity factor of the turbine and high cost of land rental.
- WTG 31 was removed because this turbine will cover five different land parcels and despite various attempts, the turbine could not be moved into one parcel.

The main advantage to the current layout is that the main access to the Sustainable Akkar site is from the Sahle Checkpoint directly to WTG 02.

3.1.3 Project/EDL Substation Locations

Four (4) potential locations for locating the EDL substation to power the grid were assessed, as shown in **Figure 3-3**:

- Option 0 – Oudine Valley location (not shown on **Figure 3-3**).
- Option 1 - Very close to the Overhead Transmission Line (OHTL).
- Option 2 – Close to the main road.
- Option 3 - Close to EDL OHTL 66 and 220kV.

Option 0 was directly removed from consideration because it was inside the Oudine Valley, an area that is planned as a new nature reserve.

Option 1 was viewed as positive as it was close to the OHTL (under the line) and the landowner was willing to enter into negotiation with the Developer (the most expensive option). The location was situated at the southern end of the Project, at the southern end of the planned internal tracks. In addition, Rweimeh Village preferred this location above Option 2, and it provides great visibility of the Project. The noted negatives were that: 1) it was located furthest from Quobaiyat-Qasr Road (the main road that traverses Rweimeh Village); and 2) the slopes were higher than Option 2.

Option 2 was viewed as positive as it was close to the main road (Quobaiyat-Qasr Road), with acceptable slopes, and a big enough parcel to accommodate the substation (~13,000m^2). The noted negatives were that: 1) it was located furthest from the OHTL; 2) the landowner and Rweimeh Village community members were not keen on having the substation at this location; 3) the location is behind a hill, which hides the planned Project from the control room; and 4) the site is situated on agricultural lands (cherry orchard).

Option 3 was viewed as positive as it was close to the OHTL (under the line) and the landowner was willing to enter into negotiation with the Developer. The noted negatives were that: 1) it was located furthest from Quobaiyat-Qasr Road (the main road that traverses Rweimeh Village); 2) very steep slopes which would require a retaining wall for construction; 3) high density of trees; and 4) the location is behind a hill, which hides the Project from the control room.

Based on the above, Option 2 was selected.

Figure 3-3 Alternative EDL Substation Locations

3.2 Design Alternatives

3.2.1 Turbine Types/Specifications

As part of the consideration of alternative wind energy technologies, the following section will compare vertical and bladeless wind turbines with horizontal turbines which were adopted by the Project, as shown in **Figure 3-4**.

Figure 3-4 Alternative Wind Energy Technologies

Technology adopted by the Project. Horizontal Axis Wind Turbines

Alternative to the Project. Bladeless Wind Turbines

Alternatives to the Project. Different options available for vertical wind turbines.

3.2.1.1 Vertical Axis Wind Turbines

Multiple configurations of wind turbines are available on the market, the most popular of which is the vertical-axis wind turbines (VAWT). VAWTs have a number of attributes that offer some advantages over Horizontal-Axis Wind Turbines (HAWT), though mostly for offshore operations. The following comparison between the two technologies confirmed that VAWT is not an option for the Project.[20]

a. **Wind Direction.** For optimal energy output, a HAWT needs the wind to flow at a perpendicular angle to the blades. To accommodate changes in wind direction, turbines are usually equipped with a yaw drive that rotates the unit's direction. However, the drive adapts slowly to changing

[20] Papiewski, J. (2013) *Horizontal Vs. Vertical Wind Turbines*. Retrieved from: www.education.seattlepi.com

directions because it must turn the entire turbine and propeller assembly. By contrast, VAWT runs in all possible wind directions, making it better-suited to urban areas with tall buildings. Additionally, the VAWT design allows it to operate on lower wind speeds than is possible with the horizontal turbine.

b. **Efficiency.** Overall, HAWT have a higher energy output than VAWT. HAWT convert more of the wind's kinetic energy into useful mechanical motion because (i) their blades are positioned perpendicularly to wind direction, (ii) the larger blades with massive spans allow for a higher surface area that can capture wind, and (iii) the three-blade standard allows air to spin through as the wind carries blade currents downwind before the next blade passes through, whereas VAWT systems capture energy from the wind only on the front side; while winds can drag the system at the rear part of their rotation.

c. **Location.** HAWT's tall tower and long blades work extremely well in wide-open spaces, whereas VAWTs are generally better suited in compact locations, chiefly urban areas and rooftops.

d. **Design complexity.** VAWTs are generally more complex to operate and maintain than HAWTs, prompting large commercial operations to favor the HAWT technology more often than not.

e. **Safety.** HAWT rarely collapse due to lateral stress while the VAWT asymmetrical front and rear design can create stress on their bearings.

f. **Noise generation.** The larger a HAWT gets, the quieter it becomes in proportion to its energy output (a 4.5MW wind turbine is only a dB or two noisier than a 1.5MW wind turbine). Limited research is available on the noise generation of large scale VAWT wind farms.

3.2.1.2 Bladeless Wind Turbines

In response to the ever-growing popularity of wind energy and growing environmental and social concerns associated with it, a new wind turbine technology has emerged from Spain: a bladeless cylinder that oscillates or vibrates (McKenna, 2015).[21]

According to its inventor, Vortex's lightweight cylinder design has no gears or bearings. The mechanism generates electricity for 40% less than the cost of power from conventional wind turbines. However, compared to a common propeller-type wind turbine, the lack of a big surface area to be swept by the blades, the new design captures less energy, converting less kinetic energy into electricity. In addition, some industry experts are skeptical at the claims made by the manufacturer regarding the noise generation of the design, claiming that oscillating frequencies that shake the cylinder will make noise creating a sound like a freight train coming through the wind farm.

Despite the promise that this turbine is showing, this technology is still at its infancy, with numerous uncertainties that a project with the magnitude and importance to the national agenda such as Sustainable Akkar cannot afford.

Horizontal axis wind turbines dominate most of the wind industry. In large scale grid connected applications, horizontal axis wind turbine concept is the only choice, although in small wind and residential wind applications (roof top), vertical axis turbines can be deployed. The advantage of

[21] McKenna, P. (2015) *Bladeless Wind Turbines May Offer More Form Than Function.* Published by the Massachusetts Institute of Technology's MIT Technology Review. Retrieved from: www.technologyreview.com.

horizontal wind is that it can produce more electricity from a given amount of wind using lesser foot print at very competitive price. Therefore, in large-scale grid connected applications, as it is the case of this Project, horizontal axis three bladed wind turbine technology is the only option.

Based on an initial request for an Expression of Interest (EOI), wind turbines from the following manufacturers were originally considered by the Developer:

- Vestas Wind Systems A/S.
- Nordex Energy GmbH.
- Siemens-Gamesa.
- GE.

Following review, Vestas Wind Systems A/S, Siemens-Gamesa, Nordex Energy GmbH and GE were shortlisted for further consideration. In addition to comparing the types of turbines provided by various turbine manufacturers, the Developer compared several turbines within the range provided by the same manufacturer. For this reason, the Vestas 3.3MW and GE 3.8MW turbines were excluded in view of their low output capacity necessitating a larger number of locations.

In addition, customization of the Vestas 4.2MW turbine to include a blade diameter of 150m, instead of 138m, was requested by the Developer in order to reach the energy yield requirement. The energy yield from the other manufacturers satisfied the required blade diameter --- 149m for the Siemens-Gamesa 4.5MW, 149m for the Nordex Energy GmbH 4.5MW and 158m for the GE 5.3MW, as was previously summarized in **Section 2 Project Description**.

Only models with hub height lower than 125m were retained in view of the level of turbulence caused at larger heights in high wind conditions.

The turbine selection process is ongoing and includes an energy yield assessment currently being implemented by an independent energy consultant (UL DEWI), as well as a financial feasibility assessment to consider the range of prices of the 4.2MW – 5.3MW turbines based on their dimensions, capacity and presence/absence of a gearbox, as summarized **Table 3-1**.

Table 3-1 Range of Prices of Candidate Turbines

Turbine Manufacturer	Range of Price in Thousand Dollars per MW
Vestas Wind Systems A/S	$700-800
Siemens-Gamesa	$750-800
Nordex Energy GmbH	$550-650
GE	$700-900

Following receipt of proposals in response to the Developer’s Request for Proposal, Nordex Energy GmbH dropped out of the competition and Siemens-Gamesa was not shortlisted; therefore, only Vestas Wind Systems A/S and GE remain under consideration. These are the potential turbine OEM/EPC Contractors detailed in **Section 2 Project Description**.

3.2.2 Alternative Substation Designs

Two different options were compared for the substation insulation design, the gas insulated substation (GIS) versus air insulated substation (AIS) systems. A comparative analysis of the two insulation methods is provided in **Table 3-2**, showing the advantages of the GIS system.

Table 3-2 Comparison of GIS and AIS Substation Insulation Design

Criterion	GIS	AIS
Land requirements	Lower	Higher
Insulation efficiency at altitude >1,100m	Yes	No
Cost	Higher	Lower

3.2.3 Alternative Transmission Designs

Two different transmission designs were compared including the underground 33 to 66KV and the aboveground 33 to 220KV designs. The final choice is inclined towards the underground 33 to 66KV design in view of the multi-criteria comparison provided in **Table 3-3**.

Table 3-3 Comparison of Transmission Designs

Criterion	33 to 66kV	33 to 220kV
Location of lines / cables	Underground	Above ground
Need to buy lands	No (installed under roadsides)	Yes
Cost	Higher (insulation required)	Lower
Maintenance	Lower	Higher
Losses	Higher (up to 2%)	Lower (~0.1%)

3.3 Transportation Alternatives

3.3.1 WTG Component Transport Vehicle Types/Modalities

Two main transport modalities were assessed during the early project planning phase and included air (helicopter) and road transport from Tripoli Seaport to the Project site. A multi-criteria analysis was implemented, as shown in **Table 3-4**, clearly showing that road transport is more favorable than air transport in the context of the current project.

Table 3-4 Comparison of Air vs Road Transport of Turbine Parts

Criterion	Road Transport	Air Transport
Cost	5 million USD for road modifications and 6.8 million USD for transport (100,000 USD / MW)	25 million USD
Time Limitation	No limit on overall duration for transport	Transport should be completed within a 3-month periods
Suitability in High Winds	Always suitable	Not suitable when wind speed is higher than 7.5m/s
Impact on CSR	Positive	Neutral
Sustainability	Yes (improved road can continue be used during maintenance including any part replacement)	No

3.3.2 Alternative Road Transport Modalities

Three different modalities are being assessed for the transport of wind turbine parts from the Tripoli Port to the Project site is provided in **Table 3-5**, namely 1- regular trailer until reaching an intermediate storage location then blade lifter, 2- regular trailer and 3- low trailer.

Table 3-5 Comparison of Different Road Transport Means

Criterion	Regular Trailer + Blade Lifter	Regular Trailer	Low Trailer
Cost	$120,000-$150,000 USD/MW	$100,000 USD/MW	$100,000 USD/MW
Speed	< 20km/hour	> 20km/hour	> 20km/hour
Requirement of modification in pedestrian bridges to ensure clearance	Higher	Moderate	Lower
Need for road bump removal	Lower	Moderate	Higher
Tree pruning requirement	Higher	Moderate	Lower
Double handling	Yes	No	No

A multi-criteria analysis showing that the low trailer seems to be the most favorable means of road transport as it gives among others the advantage of minimization of double handling which is key to minimize damage to turbine parts. The final choice will however be made by the EPC Contractor who will be also responsible for the transport of the turbines to the Project site.

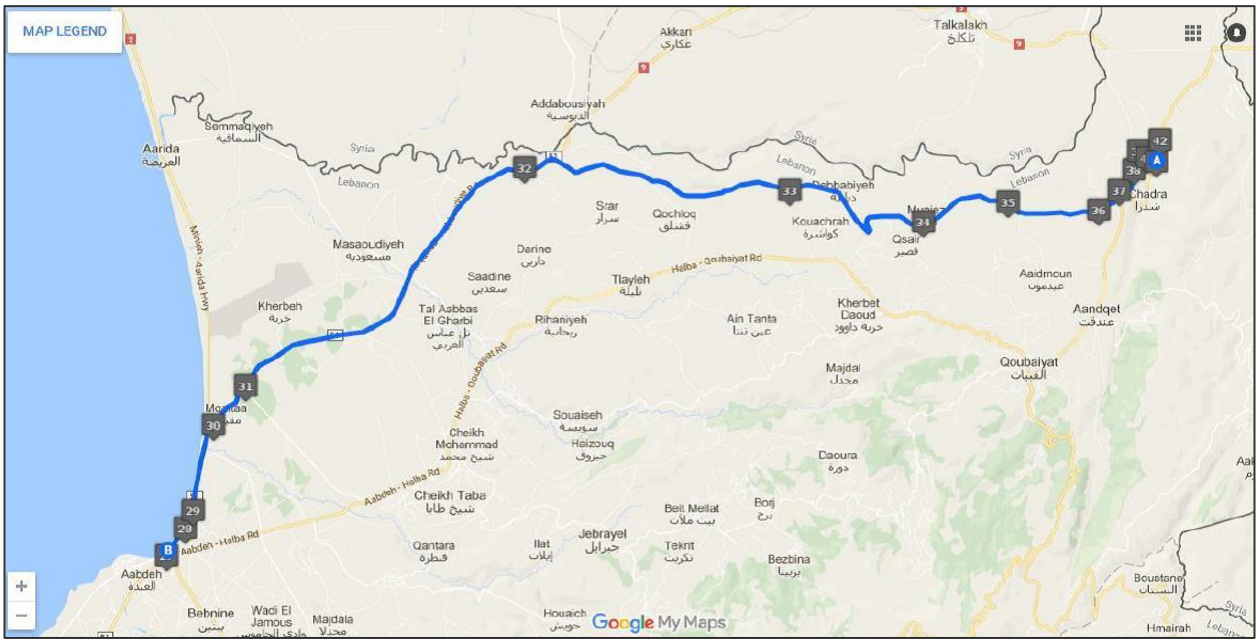
3.3.3 Alternative Road Alignments

Several alternative access roads were compared before reaching the proposed road scenario described in **Section 2 Project Description**. The following presents a comparison of the various compared road scenarios at different locations along the access road from Tripoli Port to the Project site.

Road from Abdeh to the Project Site

Two different access scenarios were compared during the early project planning phases, the first passing through Halba village until reaching Quobaiyat then to Chadra and the second being the proposed road alignment taking the seaside road instead of Halba village from Abdeh to Chadra and then to the Project site, as shown in **Figure 3-5**.

Figure 3-5 Alternative Road Scenarios After Abdeh Village



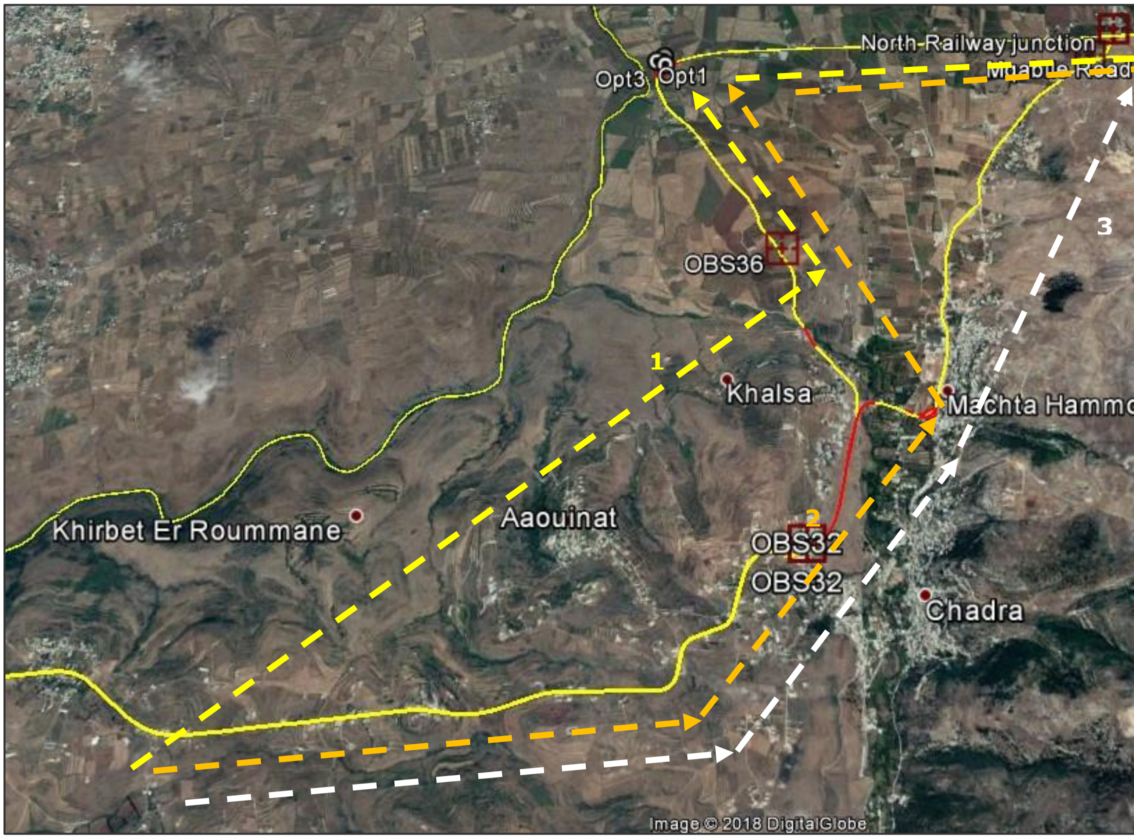
The second alternative was chosen to avoid passing through the dense residential / commercial village of Halba which may pose large disturbance to the local population. Also, the village of Halba is subject to continuous development activities that may disrupt future turbine part transport activities during project maintenance.

Road Between Khirbet Er Roummane and North Railway Junction

Three different alternative routes were assessed during the early project planning phases between the village of Khirbet Er Roummane and the North Railway Junction (see Route Nos. 1, 2 and 3 in yellow, orange and white, respectively, as shown in **Figure 3-6**).

Route #1 was eliminated as it involved the acquisition of a land which could not be secured. Later, despite giving the advantage of absence of residential areas in need to be crossed, Route #2 was eliminated at the expense of Route #3 since the latter gave the advantages of shorter distance, absence of land to be purchased, and lower financial burden as the cost of road works would be co-shared with the developers of the neighboring Hawa Akkar wind farm who will use the same route.

Figure 3-6 Alternative Access Roads Khirbet Er Roummane to North Railway Junction



Road Between Mqaible Road Junction and the Middle of the Hawa Akkar Site

Three different access roads were assessed during the project planning phases to connect the Mqaible Road Junction to the Hawa Akkar site, namely Roads 1, 2 and 3 indicated in yellow, orange and white, respectively in **Figure 3-7**. From the latter roads, Road #3 is selected so far as it clearly involves the lowest road development requirement.

A shift to Road #1 may take place later depending on the negotiations with the Hawa Akkar wind farm proponent. The decision will be based on financial analysis, i.e. the comparison of the cost of co-sharing the expenses for land purchase and road development within the Hawa Akkar site to that of road development solely along the trajectory of proposed Road #3. Road #2 has however been eliminated due to the high cost for road development.

Road Through Military Base to Sahle Checkpoint

Two alternatives for proposed new access roads were assessed during the planning phase to pass through the existing military base, as indicated in red on **Figure 3-8**. The first alternative involves the construction of a small stretch of road connecting to an existing road within the military base. Despite being small, the proposed stretch of road turned out to be unfeasible as the land encounters a very steep slope which is >17%, thus unsuitable for turbine part transport.

The other proposed alternative was selected, i.e. a longer road to be developed running parallel to military site (and not within the site, which is another advantage of the road), with the hosting land requiring much less leveling activities to satisfy the required slope.

Figure 3-7 Alternative Access Roads - Mqaible Road Junction to HA Site

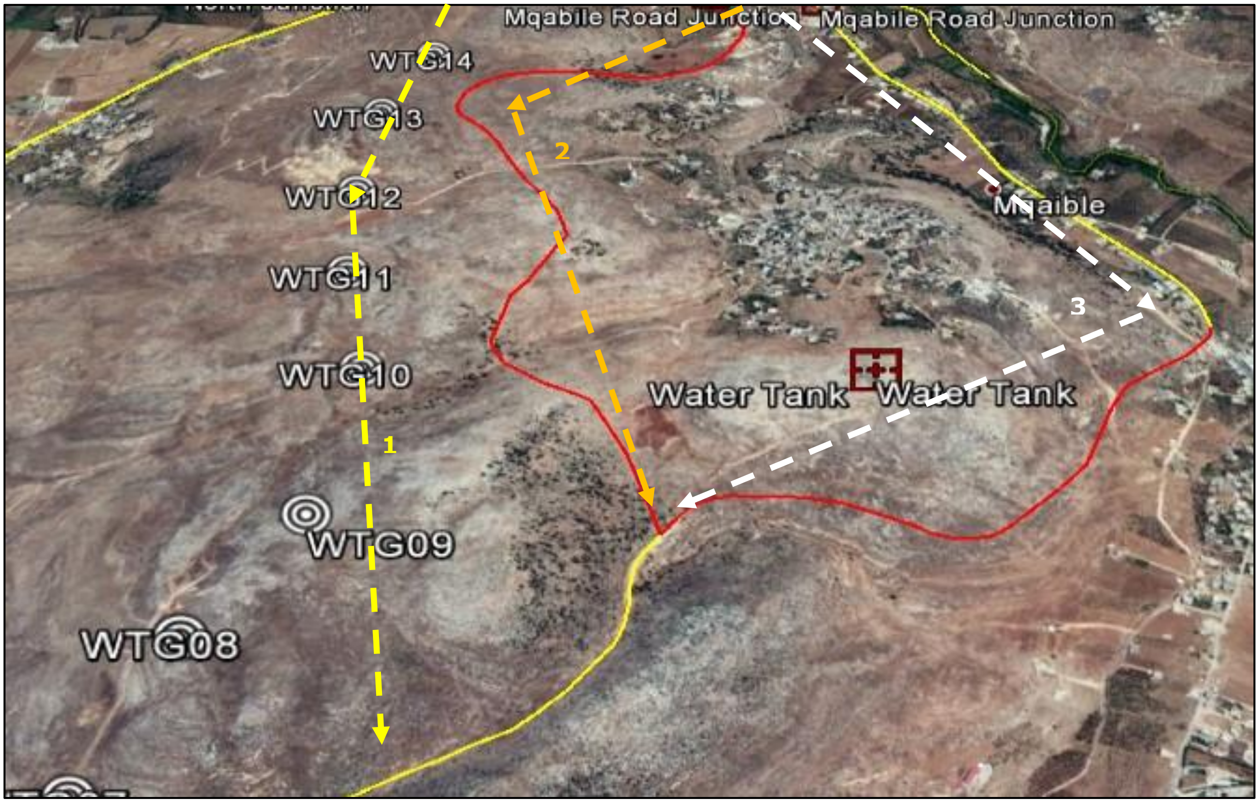


Figure 3-8 Alternative Access Roads through Military Base

Road Connecting the Hawa Akkar and the Sustainable Akkar Sites

Two alternative roads were studied and compared during the project planning phases to connect the Hawa Akkar and Sustainable Akkar wind farms. The first alternative is the proposed Project alternative shown as a red line in **Figure 3-9** involving the development of a new road to connect the two sites. The second alternative uses existing roads to connect the Sahle Checkpoint to the middle of the Sustainable Akkar wind farm; however, involves the crossing of residential villages the densest of which is the Kfartoun village bordering the Sahle Checkpoint from the east.

Given the fact that even if the existing road can connect to the Sustainable Akkar wind farm site, internal roads reaching the northernmost turbine will need to be established, the Developer found it more appropriate to develop the new road connecting the two sites, thus avoiding the use of a long and potentially disturbance causing track passing through residential villages

Figure 3-9 Alternative Connection Roads Between HA and SA Wind Farms

3.4 Comparison of Alternatives

A comparison of the alternatives considered during the planning stage is provided in **Table 3-6**. The comparison is made based on the comparative scoring of the various alternatives with respect to their feasibility from technical, environmental, social and cost points of views.

A score of 1 to 3 was assigned depending on whether the feasibility of the alternative is low, moderate or high. A score of 0 indicates that the alternative is neutral for a certain consideration. The final score is a sum of all scores. As such, the higher the score the more feasible the alternative is based on considerations during the planning phase.

Table 3-6 Comparison of Alternatives

Alternatives	Alternatives	Individual Scores*				Final Score
		Technical	Environmental	Social	Cost	
Turbine locations	WTG 01	3	1	0	0	4
	WTG 12	3	1	0	0	4
	WTG 14	3	1	0	0	4
	WTG 21	0	3	3	0	6
	WTG 28	0	3	3	0	6
	WTG 30	3	0	0	3	6
	WTG 31	0	0	3	0	3
Turbine parts transport	Road transport	3	2	3	3	11
	Air transport	3	3	0	1	7
Road transport modalities	Regular trailer + blade lifter	1	2	0	1	4
	Regular trailer	2	2	0	3	7
	Low trailer	2	3	0	3	8
Road from Abdeh to Site	Seaside road	3	3	3	3	12
	Road through Halba village	2	1	1	3	7
Road from Khirbet Er Roummane to North Railway	Road #1	1	2	2	2	7
	Road #2	2	2	2	2	8
	Road #3	3	1	1	3	8
Road from Mqaible to HA	Road #1	1	1	0	2	4
	Road #2	2	1	0	1	4
	Road #3	3	2	0	2	7
Road through military base to Sahle checkpoint	Road within military base	1	2	0	1	4
	Parallel to military base	2	2	0	2	6
Road connecting HA and SA	New road	2	2	3	1	8
	Existing through Kfartoun	3	1	1	2	7
Road for transport of construction material	Road #1	2	3	3	2	10
	Road #2	3	2	2	2	9
Substation sites	Site #1	3	1	0	2	6
	Site #2	3	2	0	2	7
	Site #3	2	1	0	1	4
	Site #4	1	2	0	3	6
Substation designs	GIS	3	2	0	1	6
	AIS	1	1	0	2	4
Transmission designs	33 to 220kV underground	3	2	3	1	9
	33 to 66kV underground	1	2	3	2	8
	33 to 220kV above ground	2	1	2	2	7

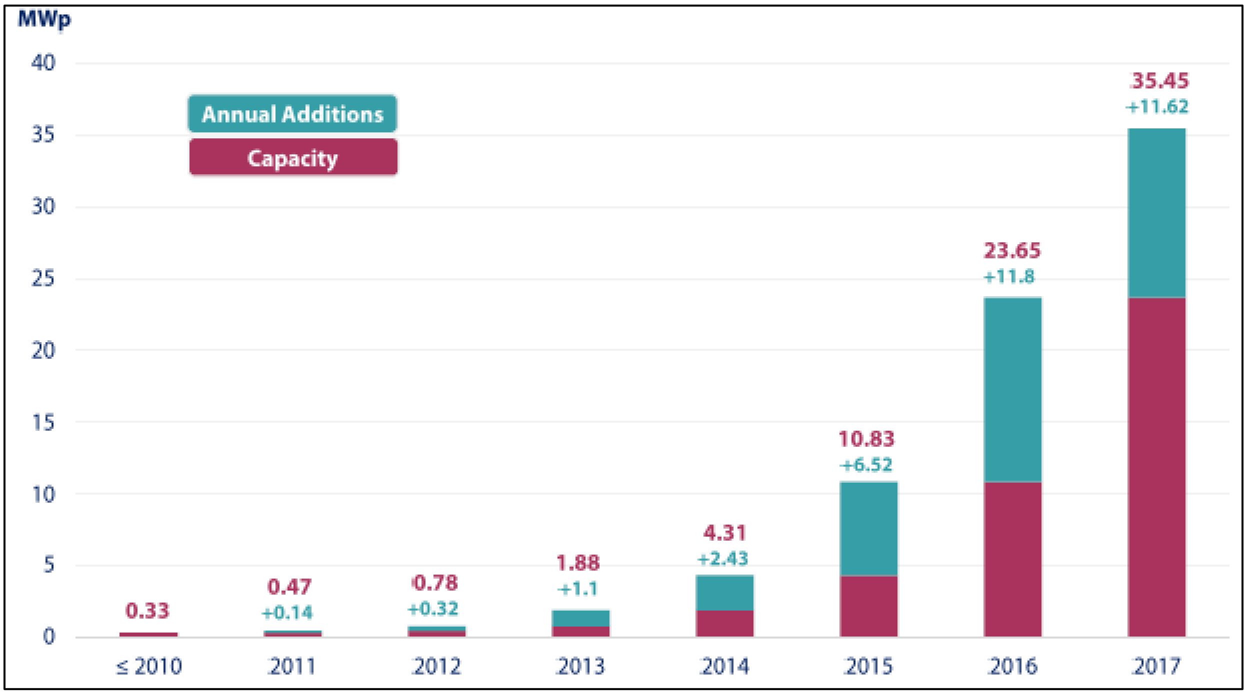
3.5 Technology Alternatives

This section discusses several alternatives besides the development of a wind farm project. This mainly includes other RE alternatives suitable for Lebanon, i.e. solar power projects and conventional thermal power plants.

3.5.1 Solar Power

According to the National Renewable Energy Action Plan (NREAP), Lebanon's decentralized solar target set at 100MW by 2020. According to the 2017 Solar PV Status Report for Lebanon, solar capacity in Lebanon continues to grow annually. By the end of 2017, Lebanon had installed 35.45MW of solar PV capacity, as shown in **Figure 3-10**.

Figure 3-10 Solar PV Capacity and Annual Additions

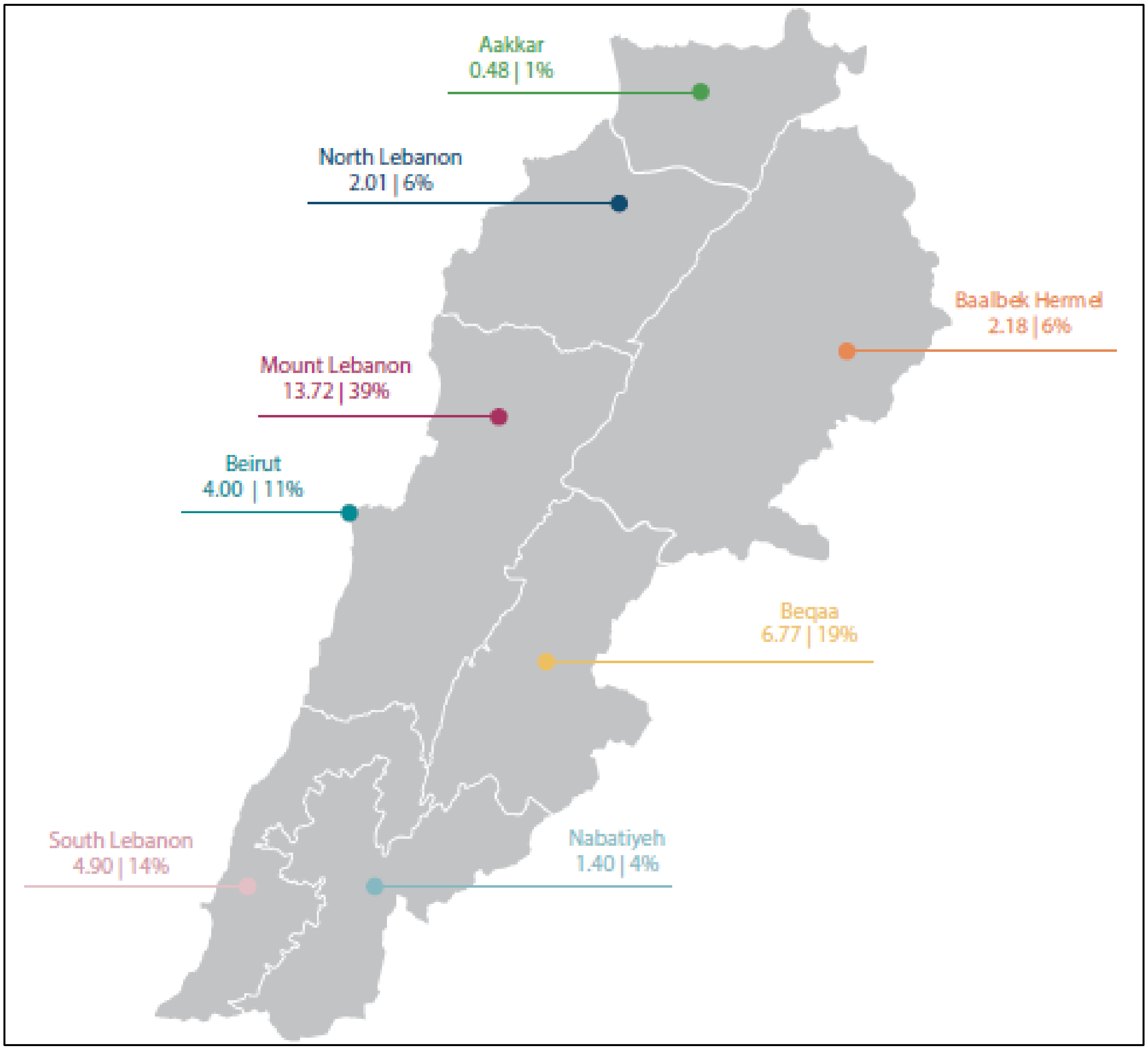


The top 3 Governorates leading the solar PV Market in Lebanon are Mount Lebanon with 13.72MWp, Beqaa with 6.77MWp, and South Lebanon with 4.90MWp. Of the 8 Districts in Lebanon, Akkar represents the lowest solar PV capacity:39% Mount Lebanon.

- 19% Beqaa.
- 14% South Lebanon.
- 11% Beirut.
- 6% Baalback/Hermel.
- 6% North Lebanon.
- 4% Nabatiyeh.
- 1% Akkar.

The solar PV capacity by Governate is shown in **Figure 3-11**.

Figure 3-11 Solar PV Capacity by Governate (MWp | %)



For the market to reach the 2020 targets of 100MWp and 160GWH per year for decentralized solar PV, solar projects need to be further encouraged and expedited. The industrial sector continues to dominate the solar PV market with 10.78MWp of installed capacity. Investing in solar PV continues to be more affordable year after year with the average turnkey price dropping from $1,872 per kWp in 2016 to $1,545 in 2017.

In February 2018, Lebanon's Center for Energy Conservation (LCEC) issued an EOI for the construction of three 100MW solar PV plants combined with large-scale battery systems across four different regions: Bekaa and Hermel, South and Nabatieh, North and Akkar, and Mount Lebanon. In each project, the minimum power capacity of one given Solar PV farm is 70MW and the maximum power capacity is 100MW with Battery Energy Storage of minimum of 70MW power with a minimum of 70MWh of storage capacity, regardless of the Solar PV sizing. In March 2018, the Lebanese Customs exempted imported solar PV panels from customs duty.

Selected bidders will be responsible for the design, development, financing, construction and operation of the facilities, which will sell power to local power utility, EDL under a long-term PPA. A detailed call for project proposals was circulated to the 75 responding consortiums in December 2018. The solar PV sector's positive effect on job creation is clear with at least 670 jobs created since 2008. Significantly more jobs will be created when Lebanon starts building its first utility-scale PV farms.

3.5.2 Power Plants

In 2009, EDL produced more than 15,000GWh through 7 major thermal power plants located in different areas of Lebanon. The thermal generation units are operating using heavy fuel oil-fired steam turbines at Zouk, Jieh and Hreysheh; diesel-fired combined cycle gas turbine (CCGT) commissioned in 1994 at Beddawi and Zahrani; and diesel-fired open cycle gas turbines (OCGT) at Tyre and Baalbeck. In addition to the thermal units, the sector includes hydroelectric power plants with a total installed capacity of 274MW, but due to their old age and the drop in water resources, the nominal generation capacity is around 190MW, constituting around 11% of the total generation capacity of the country.

GHG emissions from the power sector constituted 49% in 1994 and up to 54% of total emissions in 2004, and the sector came second behind the waste sector in having the biggest increase in GHG emissions. This is due to the significant growth in demand for electricity, due in part to the changing socio-economic conditions and to the expansion of the national grid. According to the SNC (MOE/UNDP/GEF, 2011), the sharp increase between the 1994 and 2000 emissions is due to the increase in gas/diesel oil consumption that resulted the installation and operation of the Baalbeck, Tyre, Beddawi and Zahrani diesel power plants during this period. In response, the Government of Lebanon has set a number of priorities for the development of the energy sector in general, and for the modernization and expansion of the power sector in particular. The government committed itself in Copenhagen in 2009 to a voluntary target of reaching 12% RE in the current energy mix and presented this commitment in a Policy Paper in 2010.

3.6 The Project vs No Project Alternative

The 'No Project' Alternative assumes that the 90.75MW Project will not be developed. Should this be the case, then the Project site area would remain the same. While the No Project Alternative offers the advantage of absence of disturbance to the natural environment at the Project site, the Project remains more attractive as it gives several advantages over the No Project Alternative including:

- Decreased power outage.
- Contribute to increasing energy security through development of local energy resources and reducing dependency on external energy sources.
- Increased use of RE and less reliance on conventional polluting energy production.
- Increased security (access road, lighting, cameras) in the region and thus improved protection of the nearby reserve from fires and illegal logging.
- Demonstrating the commitment by the GOL in realizing clean energy production and reducing GHG emissions.
- Positive socioeconomic impacts due to benefit from land rental and creation of job opportunities.

Should the Project not move forward, then the Project-related negative environmental impacts discussed throughout this ESIA would be averted. However, such impacts can be adequately controlled through the mitigation and management measures presented in **Section 21 Summary of Impacts and Mitigation**.

4. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This section provides an overview of the environmental clearance process for the Project as governed by the MOE. Existing national legislations and policies related to environmental protection, land classification, and environmental control requirements are presented. As the Project is seeking financing from prospective lenders, the section highlights the environmental and social policies and requirements of the IFC and EIB, which must be adhered to by the Developer.

4.1 National Framework and Requirements

4.1.1 Existing Legislation

The ESIA process follows the stipulations of key national laws and regulations which are summarized in **Table 4-1**. The major legal texts are further described in the subsections below.

The ESIA is also based on the requirements and conditions set by the MOE in their response to the Scoping Report (see **Appendix A**). The main national legal framework which is considered in this ESIA are as follows:

- Law 444/2002[22] related to Environment Protection, and its related Application Decree No. 8633/2012 on the Fundamentals for Environmental Impact Assessment.
- Law 462/2002[23] related to the Electricity Sector which sets up the rules and principles governing the Electricity sector, with the aim to bringing in the private sector as a partner in power generation in Lebanon. This law was further updated in 2014 by Law 288.
- Law 48/2017[24] related to Public Private Partnership (PPP) that encourages private sector investments in the public sector.
- Application Decree 2366/2009[25] related to the National Physical Master Plan for the Lebanese Territory (NPMPLT) covering land use and zoning of lands.
- MOE Decision No. 52/1[26] of 29 July 1996 setting air quality standards, including thresholds for air pollutants and safe noise exposure limits.
- Law No. 78 dated 19/4/2018, and Decree 3320 dated 29/6/2018 which is related to the adherence to the Convention on the Conservation of Migratory Species of Wild Animals signed in Bonn in 1979.
- Law for the Protection of Forests of 1949 and Law No. 85/1991 for the protection of shrublands and associated floral biodiversity.

[22] Chapter 4, Article 21-23 [Annex 1] of Law 444/2002.
[23] Law 462-2002 product of electricity EN, EDL, Lebanon, 2002.
[24] Article IV, Law 48 dated 7/9/2017 Regulating Public Private Partnerships.
[25] Decree No 2366 of 2009 defining the Comprehensive Plan for Lebanese Territory Arrangement.
[26] MOE Decision 52/1 of 1996: National environmental quality standards.

Table 4-1 Relevant National Legislation

Legislation	Organization	Date of Issue	Description	Relevance
LAWS				
Law for the Protection of Forests	GOL	1949	Protection of forests.	The proposed Project must protect forests.
Law 20	MOEW	1966	Establishment of MOEW resources.	Government institution directly responsible of the proposed Project.
Law 69	DGUP	1983	Urban planning law established by the Directorate General of Urban Planning (DGUP).	Governs any proposed development involving construction activities.
Law 85	MOE	1991	Protection of forests and shrublands.	The proposed Project must protect forests and shrublands.
Law 216	MOE	1993	Creation of the MOE and its responsibility to develop a management strategy for solid waste.	Government institution responsible of the Environmental Impact Assessment process.
Law 253	MOE	1993	Ratification of two treaties related to the ozone layer.	Proposed project contributes towards the protection of the ozone layer through reducing the need for thermal energy.
Law 360	MOE	1994	Ratification of the United Nation Convention on Biological Diversity signed at Rio de Janeiro.	Stresses the need for the protection of biodiversity throughout Lebanon including project area.
Law 412	MOE	2002	Authorization for the Government to join the convention on Asian/African Migratory water birds.	Any Asian / African migratory water birds observed in project area need to be protected.
Law 444	MOE	2002	Environment protection indicating the necessity to conduct EIA and IEE for development projects.	Proposed project requires the development of EIA study.
Law 462	MOEW	2002	Organization of Electricity sector.	Electricity generated by the proposed project will be sold to the Government and will be governed by this law.
Law 775	MOEW	2006	Amendment of Law 462 of 2002; No longer relevant.	Electricity generated by the proposed project will be sold to the Government and will be governed by this law.
Energy Conservation Draft Law	LCEC	2010	The ‘Energy Conservation Draft Law’ for the promotion of EE and RE in Lebanon. This draft law has not yet been approved by the Lebanese Parliament. The draft law offers a legal framework for energy audits, energy efficiency standards and labels, financial incentives for energy efficient appliances and net-metering and the institutionalization of the LCEC.	The proposed Project contributes towards the promotion of EE and RE.
Law 288	MOEW	2014	Replaced Law 775 of 2006 and is a temporary measure for “one year” and “two years” respectively during which the COM shall be in charge of granting the production permits and licenses upon the proposal of the MOEW and the MOE, this until the members of the regulatory commission, described under Law No. 462, are appointed and start carrying out with their tasks.	Electricity generated by the proposed project will be sold to the Government and will be governed by this law.
Law 48		2017	The Public Private Partnership (PPP) that encourages private sector investments in the public sector.	A PPP agreement was signed to allow the purchase of the electricity generated by the proposed project by the Government.
Law 78	MOE	2018	The law comprises 34 articles related to ambient air pollution, monitoring air pollutants, assessment of their levels in the Lebanese atmosphere, prevention, control and surveillance of the ambient air pollution from human activities.	The proposed Project must comply with the provisions of this law.
DECREES				
Decree 2866	GOL	1959	Tender regulation that applies to all State tenders over 25000L.L. except for those to the Ministry of Defense, Security Force and Public Security (amended by Decree 8703 of 1962 and Decree 13221 of 1963).	Governs any State tender which may arise from the proposed project.
Decree 13472	DGUP	1963	Law on Urban Planning.	Governs any proposed development involving construction activities.
Decree 16878	GOL	1964	Establishment of the EDL as an autonomous state-owned entity under the authority of the MOEW. This legislative text entrusts the generation, transmission and distribution of electricity across Lebanon to EDL. Article 4 of the Decree provides that no license, concession or permit generation, transmission or distribution of electricity may be granted to another entity.	Electricity generated by the proposed Project will be sold to the Government and will be governed by this decree.

Legislation	Organization	Date of Issue	Description	Relevance
Decree 7580	GOL	1974	Projects financing is mainly governed by EDL Investment System Regulation.	Electricity generated by the proposed Project will be sold to the Government and will be governed by this decree.
Decree 2604	MOE	2009	Control of ozone depleting substances.	The proposed Project contributes towards the protection of the ozone layer through reducing the need for thermal energy.
Decree 2366	Presidency of the COM	2009	The NPMPLT which was issued by the CDR in 2005 and approved as a strategic development plan for the territory of Lebanon to which all public authorities are bound.	Relevant for any development project throughout Lebanon; it is usually referred to when the proposed project falls in a zone which is not classified by a regional / local land zoning decree.
Decree 5305	COM	2010	Outlines mandatory standards for the Compact Fluorescent Lamp and the Solar Water Heating.	Serves the same purpose as the proposed Project, namely the promotion of RE.
Decree 8075	MOE	2012	Draft Law on the Protection of Air Quality/Lebanon's National Strategy for Air Quality Management.	Air quality in the project area needs to be protected.
Decree 8633	MOE	2012	The EIA Decree. EIA decree 8633 provides in its Annex 1 a list of project types requiring an EIA; included in this list are the various projects the establishment of which requires an EIA and in particular "the establishing of power generation projects" (Article 8 of Annex I). The decree also outlines the elements to be examined in an EIA Report, which are consistent with the scope of work presented herein.	The proposed Project requires the development of an EIA study.
Decree 620	MOEW	2017	Convention of the Statute of the International Renewable Energy Agency (IRENA).	The proposed Project contributes towards the promotion of RE.
Decree 3320	MOE	2018	Related to the convention for the protection of migratory species (CMS) signed in Bonn in 1979.	Migratory species need to be protected.
Decree 2251	MOEW	2018	Ratification of the modified Decree 1543 dated 25/11/1978 of the draft establishment of hypertension line 66KV between the Al Bared plant and Halba Plant for the acquired columns basis (Akkar Governorate – Akkar Caza).	Electricity generated by the proposed project will be sold to the Government and may require similar decrees.
DECISIONS				
Decision 52/1	MOE	1996	Decision by the Ministry of Environment for determining the standards and specific levels for limiting air, water and soil pollution.	The proposed Project needs to control its emissions and discharges to ensure decision limits are not breached.
Decision 8/1	MOE	2001	Specifications and Standards Relative to Air Pollutants, and Liquid Discharges from Classified Industries and Wastewater Treatment Plants.	The proposed Project needs to comply with discharge limits.
Decision 176/1	MOE	2010	Mechanism for the review of projects under the Kyoto Protocol's Clean Development Mechanism.	The proposed Project contributes towards the promotion of RE.
Decision 1	COM	2010	Consists of ten integrated and correlated strategic initiatives which are focused on remedying the problems of the energy sector in respect to infrastructure, supply and demand, and the legal framework.	Proposed project contributes towards reducing the need for thermal energy thus helping with Kyoto protocol objectives.
Decision 26	COM	2011	National Energy Efficiency Action Plan for Lebanon 2011-2015 and 2010-2020 (NEEAP) includes 14 independent but interrelated national initiatives of EE and RE proposals for enhancing the legal and regulatory framework.	The proposed Project contributes towards the promotion of EE and RE.
CIRCULARS, LETTERS				
Circular 10/1	MOE	2011	Governs an informal structure for electricity subscription (private generators) which is provided by the private sector in the status of electricity supply shortage.	Proposed project contributes towards eliminating this informal structure of electricity production.
Minister Letter 14175	MOE	2017	Stresses the requirement of ESIA study preparation for the three wind farms and describes the required scope for the three studies.	Proposed project is directly governed by this Letter.

The legal basis for EIA and its 9 annexes is established in the Environmental Law No. 444/2002 and Law No. 690/2005.[27] Law No. 444 emphasizes the principle of EIA as a tool for planning and management, and stipulates that proponents undertake assessment for all projects likely to affect the environment due to their sizes, nature, impacts or activities for review and approval by the MOE.

This legislation is further implemented by Decree No. 8633/2012: Fundamentals of Environmental Impact Assessment and the MOE's Decision 261/1 of 2015: Review Process for EIA scoping and EIA reports.[28] Further, all development projects must adhere to the environment quality standards for air, water and soil (MOE Decision 52/1 of 1996) as well as to air emission standards and wastewater discharge (MOE Decision No 8/1 of 2001).[29]

The law and the decree assign full authority to the MOE to arrange the screening, review, control, and follow-up of the EIA process and its implementation. The approval of an EIA is a prerequisite for any subsequent license or permit by any or all other relevant authorities that may be required prior to construction. The efforts of the MOE aim at improving the Lebanese environmental performance on the international level, alike all developed countries, and the coordination, cooperation and follow up between the MOE and concerned parties, as the private and public sectors or the civil society organizations that may have a real positive impact on achieving a global unified vision related to all what concerns the protection of the environment.

4.1.1.1 Environmental Quality Standards and Criteria for Air and Noise

Air quality standards, including thresholds for air toxics and criteria pollutants are specified in Ministerial Decision No. 52/1 of July 1996. While the operation of wind turbines is expected to generate negligible emissions, construction activity will result in emissions from fuel combustion and material movement. National Ambient Air Quality Standards (NAAQS) are listed in **Table 4-2**.

Table 4-2 National Ambient Air Quality Standards (NAAQS)

Parameter	NAAQS (μg/m^3)
Sulfur Dioxide (SO_2)	350 (1 hr.) 120 (24 hrs.) 80 (annual)
Nitrogen dioxide (NO_2)	200 (1 hr.) 150 (24 hrs.) 100 (annual)
Carbon monoxide (CO)	30,000 (1 hr.) 10,000 (8 hrs.)
Ground-level Ozone (O_3)	150 (1 hr.) 100 (8 hrs.)

[27] Law No. 690 of 2005 regulating the Ministry of Environment and defining its tasks and competences.
[28] Decision 261/1, 12/6/2015, MOE, EIA Review Procedures.
[29] The Minister of Environment's decision No. 8/1-2001, Setting national standards and criteria regarding air pollutants and liquid wastes generated by classified establishments and wastewater treatment plants.

Parameter	NAAQS (µg/m³)
Total Suspended Particulate (TSP)	120 (24 hrs.)
PM_{10}	80 (24 hrs.)
$PM_{2.5}$	N/A
Lead	1 (annual)
Benzene	16.2 (annual)

Safe noise exposure limits are specified in Ministerial Decision No. 52/1 of July 1996 and provided in **Table 4-3**.

Table 4-3 Limits for Noise Levels per Decision No. 52/1 of July 1996

Region Type	Limit for Noise Level dB(A)		
	Day Time (7 am-6 pm)	Evening Time (6 pm–10pm)	Night Time (10pm -7am)
Downtown/ Administrative and commercial area.	55-65	50-60	45-55
Residential areas having some construction sites or commercial activities or that are located near a road.	50-60	45-55	40-50
Urban residential areas.	45-55	40-50	35-45
Suburban residential areas with low activity.	40-50	35-45	30-40
Industrial areas.	60-70	55-65	50-60
Rural residential areas/Hospitals/Gardens.	35 – 45	30 – 40	25 – 35

Nonetheless, in July 2019, the MOE confirmed the noise limit of 55 dB(A) during the day and 45 dB(A) during night time for residential houses set by the IFC's EHS Guideline. Therefore, the noise assessment will consider the 45 dB(A) [L_{Aeq}] nighttime noise limit.

4.1.1.2 Zoning of Lands in Lebanon

The Project area is located in an area classified as natural zone N2. Development allowances and restrictions per MOE Decree No. 2366 (June 2009) are as outlined in **Table 4-4**. It is noted that the Project is considered a vital cooperative facility and is, therefore, allowable following the submission of the EIA and landscape study to the MOE.

Table 4-4 Zone N2 Description

Parameter	Description
General exploitation factor	Very low except for ski resorts.
Building heights	Low in residential areas; Very low outside residential areas.
Building setbacks	20 meters from forest borders according to Village Master Plan recommendations.
Urban expansion and its location in respect to the current urbanized area	Preferably near the urbanized village, unsuitable far from it.
Land sorting for construction	Preferably near the urbanized village, unsuitable far from it.
Large scale projects	Possible for ski resorts after the submission of EIA and landscape study.
Quarrying	Not possible.
Industries and industrial buildings	Possible for mineral water facilities, for vital cooperative facilities such as petrol stations after the submission of EIA and landscape study.

4.1.2 International Conventions, Treaties and Protocols

International conventions, treaties and protocols which are triggered by the current project are provided in **Table 4-5**.

4.2 International Guidelines

LWP is seeking Project Financing from Bank Audi, and as such, the following international guidelines apply (together with the Lebanese legislative requirements, referred to as 'the Applicable Standards'):

- IFC PSs.
- ESSs of the EIB.
- International best practice, policies and guidelines including:
  - IFC's Environmental, Health, and Safety General (EHS) Guidelines (2007).
  - IFC's EHS Guidelines for Wind Energy (2015).
  - IFC's EHS Guidelines for Toll Roads (2007).

Table 4-5 Treaties and Conventions Ratified by Lebanon

Convention Title	Year	Signature/ Adhesion/ Ratification/ Accession	Description	Relevance
ENVIRONMENT				
Convention on Migratory Species of Wild Animals (CMS); Bonn Convention"	1979	Signed in 1979: Entered to force in 1983.	Aims at conserving terrestrial, marine and avian migratory species throughout their range.	Biodiversity impacts of proposed project should be properly managed.
Convention on Biological Diversity; Rio De Janeiro.	1992	Ratification: Law No. 360 dated 11/08/1994.	This convention aims to ensure conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.	Biodiversity impacts of proposed project should be properly managed.
Convention on Wetlands of International Importance especially as Waterfowl Habitat – Ramsar.	1999	Adhesion: Law No. 23 dated 01/03/1999.	The Ramsar convention is an international treaty for the conservation and sustainable use on wetlands. Every three years, representatives of the contracting parties meet to administer the work of the convention and improve the way in which the Parties are able to implement its objectives.	Biodiversity impacts of proposed project should be properly managed.
Cartagena Protocol on Biosafety to the CBD.	2000	Ratification: Law No. 31 dated 16/10/2008.	This international treaty concluded and adopted in the framework of the Convention of Biological Diversity (CBD). The CBD has much broader aims regarding the conservation and sustainable use of biological diversity and the sharing of benefits arising from the use of genetic resources.	Biodiversity impacts of proposed project should be properly managed.
Agreement on the Conservation of African-Eurasian Migratory Water Birds (AEWA).	2002	Adhesion: Law No. 412 dated 13/06/2002.	The Agreement on the Conservation of African-Eurasian Migratory Water-birds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory water-birds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Program (UNEP), AEWA brings together countries and the wider international conservation community to establish coordinated conservation and management of migratory water-birds throughout their entire migratory range.	Biodiversity impacts of proposed project should be properly managed.
CULTURAL AND NATURAL HERITAGE				
UNESCO Convention on the protection of Cultural and Natural Heritage.	1972	Adhesion: Law No. 19 dated 30/10/1990.	This convention links together in a single document the concepts of nature conservation and the preservation of cultural properties. It recognizes the way in which people interact with nature, and the fundamental need to preserve the balance between the two.	Any cultural heritage potentially present in project area would need to be protected.
AIR and CLIMATE CHANGE				
Vienna Convention for the Protection of the ozone layer.	1985	Adhesion: Law No. 253 dated 30/03/1993.	The Vienna Convention, concluded in 1985, is a framework agreement in which States agree to cooperate in relevant research and scientific assessments of the ozone problem, to exchange information, and to adopt "appropriate measures" to prevent activities that harm the ozone layer. The obligations are general and contain no specific limits on chemicals that deplete the ozone layer.	Proposed project contributes towards reducing the need for thermal energy thus helping with the protection of the ozone layer.
Montreal Protocol on Substances that deplete the ozone layer.	1987	Adhesion: Law No. 253 dated 31/03/1993.	The Montreal Protocol on Substances that Deplete the Ozone Layer was designed to reduce the production and consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer. The	Proposed project contributes towards reducing the need for thermal

Convention Title	Year	Signature/ Adhesion/ Ratification/ Accession	Description	Relevance
			original Montreal Protocol was agreed on 16 September 1987 and entered into force on 1 January 1989. The Parties to the Montreal Protocol have amended the Protocol to enable, among other things, the control of new chemicals and the creation of a financial mechanism to enable developing countries to comply. Amendments must be ratified by countries before their requirements are applicable to those countries.	energy thus helping with the protection of the ozone layer.
Amendment to the Montreal Protocol on Substances that deplete the ozone layer; London.	1990	Adhesion: Law No. 253 dated 31/03/1993.	This was to reinforce the measures laid down in the 1987 Montreal Protocol by extending its scope to new substances and establishing financial mechanisms. The Montreal Protocol aims to protect the ozone layer through enhanced international cooperation by taking precautionary measures to control equitably total global emissions of substances that deplete it.	Proposed project contributes towards reducing the need for thermal energy thus helping with the protection of the ozone layer.
Amendment to the Montreal Protocol on Substances that deplete the ozone layer; Copenhagen.	1992	Adhesion: Law No. 120 dated 03/11/1999.	Indicates that for the adequate protection of the ozone layer a higher degree of control of chlorofluorocarbons, halons, carbon tetrachloride and 1,1,1-trichloroethane (TCA) is required than that provided by the Montreal Protocol as amended in 1990 (London Amendment). Additional controls should also be placed on methyl bromide, hydrobromofluorocarbons (HBFCs) and hydrochlorofluorocarbons (HCFCs). The first Amendment to the Protocol was adopted on 29 June 1990 and subsequently approved on behalf of the Community.	Proposed project contributes towards reducing the need for thermal energy thus helping with the protection of the ozone layer.
United Nations Framework Convention on Climate Change aiming to fight global warming.	1992	Ratification: Law No. 359 dated 11/08/1994.	The UNFCCC entered into force on 21 March 1994. It is a "Rio Convention", one of three adopted at the "Rio Earth Summit" in 1992. Its sister Rio Conventions are the UN Convention on Biological Diversity and the Convention to Combat Desertification. The three are intrinsically linked. It is in this context that the Joint Liaison Group was set up to boost cooperation among the three Conventions, with the ultimate aim of developing synergies in their activities on issues of mutual concern. It now also incorporates the Ramsar Convention on Wetlands. Preventing "dangerous" human interference with the climate system is the ultimate aim of the UNFCCC. The Convention: - Recognized that there was a problem. - Sets a lofty but specific goal. - Puts the onus on developed countries to lead the way. - Directs new funds to climate change activities in developing countries. - Keeps tabs on the problem and what's being done about it. - Charts the beginnings of a path to strike a delicate balance. - Kicks off formal consideration of adaptation to climate change.	Proposed project contributes towards reducing the need for thermal energy thus helping with the fight against global warming.
United Nations Convention to Combat Desertification; Paris.	1994	Ratification: Law No. 469 dated 21/12/1994.	This convention aims to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies by international cooperation and partnership arrangements. It is based on the principles of participation, partnership and decentralization- the backbone of Good Governance and Sustainable Development.	Proposed project involves limited land clearing activities which may contribute to desertification if improperly managed.

Convention Title	Year	Signature/ Adhesion/ Ratification/ Accession	Description	Relevance
Beijing Amendment of the Montreal Protocol.	1999	Adhesion: Law No. 758 dated 11/11/2006.	Under the amendment, countries have agreed to monitor the consumption and production of bromochloromethane which is an industrial solvent and a fire extinguisher under the name Halon-1011.	Proposed project contributes towards reducing the need for thermal energy thus helping with the protection of the ozone layer.
Kyoto Protocol.	2005	Ratification: Law No. 738 dated 15/05/2006.	The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001, and are referred to as the "Marrakesh Accords." Its first commitment period started in 2008 and ended in 2012.	Proposed project contributes towards reducing the need for thermal energy thus helping with the fight against global warming.
Euro-Mediterranean Energy Partnership HY-PA	2005	Partnership signed in 2009.	The main objective of the HY-PA is to promote and stimulate the application of Renewable Energy and Hybrid Systems in Mediterranean Partner Countries (MPC) for the provision of sustainable energy services based on locally available resources and to support policy making activities in the field of Renewable Energies. The HY-PA comprises three competent actors from Europe: Germany, Greece and France, as well as four Mediterranean Partner Countries Jordan, Lebanon, Morocco and Tunisia.	Proposed project involves the promotion of the use of wind energy.
International Renewable Agency (IRENA)	2009	Ratification: Decree No. 620 dated 4/5/2017.	Promotes the widespread adoption and sustainable use of all forms of RE, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.	Proposed project involve the promotion of RE.

4.2.1 IFC Performance Standards

The IFC is a sister organization of the World Bank and member of the World Bank Group (WBG). It is the largest global development institution focused exclusively on the private sector in developing countries. The WBG has set two goals for the world to achieve by 2030: end extreme poverty and promote shared prosperity in every country.

The IFC aims at leveraging products and services to create markets that address the biggest development challenges. It applies financial resources, technical expertise, global experience, and innovative thinking to help clients and partners overcome financial, operational, and other challenges. IFC is also a leading mobilizer of third-party resources for projects.

IFC's PSs on Social and Environmental Sustainability, previously published in April 2006 and updated in January 2012, including IFC's General EHS Guidelines (2007), IFC's EHS Guidelines for Wind Energy (2015) and IFC's EHS Guidelines for Toll Roads (2007), will be applied. The relevant Performance Standards, and where they are addressed in the ESIA, are shown in **Table 4-6**.

The IFC and regional development banks have well established ESIA procedures which apply to their lending activities and projects undertaken by borrowing countries. Although their operational policies and requirements vary in certain aspects, they follow standardized procedures for the preparation and approval of ESIA reports.

The IFC's PSs are considered the most comprehensive standards available to international finance institutions working with the private sector. The PSs define a project's role and responsibilities for managing health, safety, environmental, and community issues to receive and retain IFC and/or Equator Principle Financial Institution (EPFI) lender support.

4.2.2 IFC EHS Guidelines

IFC's EHS Guidelines will also be considered for the Project. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities at reasonable costs by existing technology. The applicability of the EHS Guidelines may need to be established for each project based on the results of an environmental, health, safety and social assessment where site-specific variables, such as host country context, assimilative capacity of the environment, and consideration of other project factors. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

The EHS Guidelines are technical reference documents and provide relevant industry background and technical information. This information supports actions aimed at avoiding, minimizing, and controlling environmental, health, and safety impacts during the construction, operation, and decommissioning phases of a project or facility. The General EHS Guidelines are organized to capture common themes which are applicable to any industry sector and project. The General EHS Guidelines and the Industry Sector EHS Guidelines are designed to be used jointly and include:

- Environmental Health and Safety Guidelines for Wind Energy (2015).
- Environmental Health and Safety Guidelines for Toll Roads (2007).
- Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution (2007).

Table 4-6 Relevant IFC Performance Standards

Performance Standard	Comment	ESIA Section
PS 1: Assessment and Management of Environmental and Socials Risks and Impacts	Performance Standard 1 applies to all projects that have environmental and social risks and impacts and underscores the importance of managing environmental and social performance throughout the life of a project. The objectives are: • To identify and evaluate environmental and social risks and impacts of the project. • To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment. • To promote improved environmental and social performance of clients through the effective use of management systems. • To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately. • To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.	Section 6 – Stakeholder Consultation and Engagement Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
PS 2: Labor and Working Conditions	Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection for basic rights of workers. The objectives are: • To establish, maintain and improve the worker-management relationship. • To promote the fair treatment, non-discrimination and equal opportunity of workers, and compliance with national labor and employment laws. • To protect the workforce by addressing child labor and forced labor. • To promote safe and healthy working conditions, and to protect and promote the health of workers.	Section 2 – Project Description Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
PS 3: Resource Efficiency and Pollution	Performance Standard 3 recognizes that increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level. The objectives are: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote the reduction of emissions that contribute to climate change.	Section 3 – Analysis of Alternatives Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
PS 4: Community Health, Safety, and Security	Performance Standard 4 recognizes that project activities, equipment, and infrastructure often bring benefits to communities including employment, services, and opportunities for economic development. The objectives are: • To avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances. • To ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security.	Section 21 – Summary of Impacts and Mitigation
PS 5: Land Acquisition and Involuntary Resettlement	Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on people who own or use that land. The objectives are: • To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs. • To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that	Section 6 – Stakeholder Consultation and Engagement Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation

Performance Standard	Comment	ESIA Section
	resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. • To improve or at least restore the livelihoods and standards of living of displaced persons. • To improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.	
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The objectives are: • To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.	Section 3 – Analysis of Alternatives Section 6 – Stakeholder Engagement and Consultation Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
PS 7: Indigenous Peoples	Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalized and vulnerable segments of the population. The objectives are: • To ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples. • To avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts, and to provide opportunities for development benefits, in a culturally appropriate manner. • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when they will be impacted by a project. • To establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project. To foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples. To respect and preserve the culture, knowledge and practices of Indigenous Peoples. Performance Standard 7 does not apply because there are no Indigenous Peoples in Lebanon. However, vulnerable segments of the population, including Syrian and Palestinian refugees, have been considered in the avoidance and minimization of and compensation for impacts.	Section 3 – Analysis of Alternatives Section 6 – Stakeholder Engagement and Consultation Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
PS 8: Cultural Heritage	Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. The objectives are: • To protect cultural heritage from the adverse impacts of project activities and support its preservation. • To promote the equitable sharing of benefits from the use of cultural heritage in business activities. Performance Standard 8 does not apply because a review of secondary information does not support the presence of cultural heritage assets or resources in the Direct AOI of the Project. A Chance Find Procedure has been developed and incorporated in the ESMP for the Project.	Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation

It is important to note in this context the IFC General EHS Guidelines for noise exposure which are summarized in **Tables 4-7** and **4-8**.

In addition, the WBG/IFC sector Guidelines for Wind Energy recommend that the predicted duration of shadow flicker effects experienced at a sensitive receptor not exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario.

Table 4-7 Noise Level Guidelines per IFC General EHS Guidelines

Receptor	One Hour L_{Aeq}	
	Daytime (07:00-22:00)	Nighttime (22:00-07:00)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Table 4-8 Noise Limits for Various Working Environments per IFC EHS Guidelines

Location / Activity	Equivalent Level L_{Aeq}, 8h	Maximum L_{Amax}, Fast
Heavy industry (no demand for oral communication)	85 dBA	110 dBA
Light industry (decreasing demand for oral communication)	50-65 dBA	110 dBA
Open offices, control rooms, service counters or similar	45-50 dBA	-
Individual offices (no disturbing noise)	40-45 dBA	-
Classrooms, lecture halls	35-40 dBA	-
Hospitals	30-35 dBA	40 dBA

4.2.3 EIB Environmental and Social Standards

As the long-term financing body of the European Union (EU), the EIB promotes EU policies through its financial and other support to sustainable investment projects. The increasing prominence given to environmental and social considerations within the EU and throughout the other regions of operation of the Bank is reflected in its priority lending objectives as well as in the regular review and revision of its environmental and social requirements and operational practices. The relevant ESSs, and where they are addressed in the ESIA, are shown in **Table 4-9**.

Table 4-9 Relevant EIB Environmental and Social Standards

Performance Standard	Comment	ESIA Section
ESS 1: Assessment and Management of Environmental and Socials Risks and Impacts	ESS 1 underscores the importance of managing environmental and social impacts and risks throughout the life of an EIB project through the application of the precautionary principle. The objectives are: • The development of an effective environmental and social management and reporting system that is objective and encourages continual improvements and developments. • Requirements for stakeholder engagement and disclosure throughout the life of the project.	Section 6 – Stakeholder Consultation and Engagement Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
ESS 2: Pollution Prevention and Abatement	ESS 2 recognizes the importance of avoiding and minimizing pollution from EIB-supported operations. The objective is: • A Project-level approach to resource efficiency and pollution prevention and control in line with best available techniques and internationally disseminated practices.	Section 8-19 – Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
ESS 3: Biodiversity and Ecosystems	ESS 3 recognizes the intrinsic value of biodiversity and that its operations may have a potential impact on biodiversity and ecosystems. The objectives are: • The promoter has to take an approach and measures to protect and conserve all levels of biodiversity. • The standard applies to all habitats (marine and terrestrial) whether or not previously disturbed or legally protected. • Focus on major threats and supports the sustainable use of renewable natural resources and the equitable sharing of benefits from the project's use of natural resources.	Section 6 – Stakeholder Consultation and Engagement Section 8-19 - Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
ESS 4: Climate-Related Standards	ESS 4 is aligned with EU climate policies, which should be taken into account at all stages of the project cycle, in particular regarding the assessment of the economic cost of GHG emissions and the climate vulnerability context. The objective is: • The promoter specifically must ensure that all projects comply with appropriate national and, where applicable, EU legal requirements, including multilateral agreements, related to climate change policy.	Section 8-19 – Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
ESS 5: Cultural Heritage	ESS 5 recognizes the central role of cultural heritage within individual and collective identity, in supporting sustainable development and in promoting cultural diversity. The objectives are: • Identification, management and protection of tangible and intangible cultural heritage that may be affected by project activities consistent with the applicable international conventions and declarations. • Emphasize the need for the implementation of a "chance-find procedure", which outlines the actions to be taken if previously unknown cultural heritage is encountered.	Section 8-19 – Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
ESS 6: Involuntary Resettlement	ESS 6 recognizes that projects sometimes necessitate land acquisition, expropriation and/or restrictions on land use, resulting in the temporary or permanent resettlement of people from their original places of residence or their economic activities or subsistence practices. The objectives are: • Respect and protection of the rights to property and to adequate housing, and of the standard of living of all affected people and communities.	Section 6 – Stakeholder Consultation and Mitigation Section 8-19 - Baseline Environment and Impact Assessment

Performance Standard	Comment	ESIA Section
	• Mitigation of any adverse impacts arising from their loss of assets or restrictions on land use. • Assisting all affected persons to improve or at least restore their former livelihoods and living standards and adequately compensate for incurred losses.	
ESS 7: Rights and Interests of Vulnerable Groups	ESS 8 seeks to protect all vulnerable project-affected individuals and groups, whilst seeking that these populations duly benefit from EIB operations. The objectives are: • Full respect for the dignity, human rights, aspiration, cultures and customary livelihoods of vulnerable groups including indigenous peoples. • The free, prior and informed consent of affected Indigenous groups.	Section 8-19 – Baseline Environment and Impact Assessment Section 21 – Summary of Impacts and Mitigation
ESS 8: Labor Standards	ESS 8 recognizes the importance of good labor practices and the use of appropriate codes of conduct to ensure the fair treatment, non-discrimination and equality of opportunity of workers. The objectives are: • Ensuring that promoters of EIB projects comply with the core labor standards of the International Labour Organisation and with national labor and employment laws. • The establishment, maintenance and improvement of worker-management relationships.	Section 21 – Summary of Impacts and Mitigation
ESS 9: Occupational and Public Health, Safety and Security	ESS 9 recognizes the importance of protecting and securing public and occupational health, safety and security and promote the dignity of the affected community in relation to project-related activities. The objectives are: • Particular attention to vulnerable groups. • Promoters to adhere to the international norms and relevant human rights principles when using security services.	Section 21 – Summary of Impacts and Mitigation
ESS 10: Stakeholder Engagement	ESS 10 promotes the right to access to information, as well as public consultation and participation. The objectives are: • Promoters to uphold an open, transparent and accountable dialogue with all project affected communities and relevant stakeholders in an effective and appropriate manner. • The value of public participation in the decision-making process is stressed throughout the preparation, implementation and monitoring phases of a project. • The right to access to remedy, including through grievance resolution, is actively required.	Section 6 – Stakeholder Consultation and Mitigation

4.3 Additional Relevant Guidance

In addition to the prediction and evaluation tools and methodology recommended in IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015), policy or guidance that is relevant to landscape and visual effects included Environmental Impact Assessment, CEDRO, Guideline Report, 2012 and Beeinträchtigungen des Landschaftsbildes durch mastartige Eingriffe, Nohl, Kirchheim bei München 1993/2001 (Limitations of Landscape Image by Mast Like Operations).

4.4 Institutional Framework

The main stakeholder in the energy sector is the Ministry of Energy and Water (MOEW). Other stakeholders of importance to the project include the Ministry of Environment (MOE), the Ministry of Public Works and Transport (MOPWT), the Ministry of Interior and Municipalities (MOIM), as well as several local and international agencies and programs.

4.4.1 Ministry of Environment

The MOE is the lead government agency responsible for environmental permitting based on the submission of the EIA report by the Developer. The MOE was established by Law 216/1993, amended by Law 690/2005, and then restructured by Decree 2275/2009. This decree defined the functions and responsibilities of each administrative unit including staff size and qualifications. According to Article 20 of Decree 2275/2009, the Service of Natural Resources at MOE is responsible for the protection of natural resources in the country including fauna and flora species, habitats, mountains, etc.

According to Article 25 of Decree 2275/2009, the Service of Environmental Technology - Department of Integrated Environmental Systems at MOE is responsible for adopting clean and RE sources as well as reducing the use of polluting energy sources in the country. Moreover, the MOE is also responsible for meeting Lebanon’s reporting obligations under the United Nations Framework Convention on Climate Change, particularly the Third National Communication on Climate Change (which includes emission data for the energy sector).

The Third National Communication, inventorying emissions for base-year 2005 and time-series covering the period from 1994 to 2010 was published and presented to the Government and national stakeholders in 2014. The third national communication gives an updated analysis of potential GHG mitigation measures as well as an updated assessment of potential impacts of climate change in Lebanon and adaptation measures.

4.4.2 Ministry of Energy & Water

The MOEW is the lead government agency responsible for producing energy and for licensing RE projects and programs, including SA. The MOEW was first established by Law 20/66 (dated 29/03/1966) amended several times and lastly (13 years ago) by Law 247 (dated 07/08/2000). Decree 5469 (dated 07/09/1966), that defined the functions and responsibilities of every Directorate (2 Directorates) at the Ministry and each administrative unit including staff size and qualifications was not amended and remains valid since 1966.

Under the Directorate of Water and Electrical Resources (1st Directorate at MOEW), the Directorate of Electrical Resources studies and implements Electricity Projects in the Country. Supervising all activities related to water and electricity at the MOEW are performed by the Directorate of Investment (2nd Directorate at MOEW).

The MOEW is the most active public body attempting to promote Energy Efficiency and Renewable Energy programs in Lebanon. To date, the most noteworthy achievement is the sponsoring of the Lebanese Center for Energy Conservation Program (LCECP) further discussed below as well as the development of the Policy Paper for the Electricity Sector.

4.4.3 Electricité du Liban

EDL was established in 1964 (Decree 16878 dated 10/07/1964). With the exception of four private concessions (Zahle, Jbeil, Alay and Bhamdoun representing about 82,000 subscribers) and private/semi-private hydroelectric power plants (Nahr Ibrahim and Kadisha) as well as a public hydropower plant owned by the Litani River Authority, EDL has quasi total monopoly over electricity production, transmission and distribution in the country; it controls around 90% of the Lebanese electricity sector.

4.4.4 Ministry of Interior and Municipalities

The MOIM has jurisdiction over Lebanon's estimated 994 municipalities organized according to Decree-Law 118 (dated 30/06/1977). The Akkar Caza counts 175 municipalities of which 6 are immediately affected by the proposed wind farm. Municipal councils are elected by their constituency and consist of 9, 12, 15, 18, 20 or 24 (Beirut and Tripoli only) members depending on the size of the constituency.

Municipalities are local administrations charged with the day-to-day management of all public works located inside their jurisdiction (municipal boundaries). Specific responsibilities are wide and diverse including landscaping and beautification works, water and wastewater networks, street lighting, waste disposal, internal roads, recreational facilities, as well as urban planning in coordination with the Directorate General of Urban Planning (Article 49).

Municipal Councils have also to approve all projects related to re-designing major roads in their municipal boundaries as well as any activity regulating the traffic in the municipal area (Article 51 of Decree-Law 118-1977 and Article 389 of Law 243-2012).

4.4.5 Ministry of Public Works and Transport

In 2000, the Ministry of Transport was cancelled, and the two Directorates were affiliated to the Ministry of Public Works by Law 247 (dated 07/08/2000). The Ministry of Public Works became, then, the MOPWT which studies (technically and financially), evaluates and monitors the implementation and maintenance of public construction projects (buildings, road networks, etc.) and regulates land, sea and air transport.

The MOPWT comprises three directorates including the General Directorate of Urban Planning (DGUP), which is responsible for permitting all construction projects including the Project. The Ministry of Public Works was first established in 1959 by Decree 2872 (dated 16/12/1959) and included four

Directorates; two of them were later affiliated to the MOEW (Law 20/66 – 1966). The MOT was first established by Law 214 in 1993 and included two Directorates: 1) the Directorate General of Civil Aviation; and 2) the Directorate General of Land and Maritime Transport.

4.4.6 Directorate General of Urban Planning

The DGUP falls under the authority of the MOPWT. Its mandate is to develop urban regulations and coordinate urban planning activities. Lebanon is divided into governorate (mohafazah), district (caza) and municipalities. The DGUP also plays a key role in the construction permitting process through the regional Departments of Urban Planning in each caza.

4.4.7 The Lebanese Center for Energy Conservation

Established in 2002, the Global Environment Facility funded the LCECP which is currently hosted at the MOEW and managed by UNDP. Registered under the name of the LCEC (Attestation No. 172 dated 27/1/2011), the organization addresses end-use energy conservation and RE at the national level by supporting the Government of Lebanon in developing and implementing national strategies that promote EE and RE at the consumer level.

The LCEC has implemented RE and EE projects in Lebanon including the installation of domestic solar water heaters (DSWH) in south Lebanon, management of the DSWH project "One DSWH for every house" aiming at installing no less than 1 million m² of collectors by 2020, management of the 3 million compact fluorescent lamp (CFL) lamps project, etc. LCEC is financially and administratively independent and operates under the direct supervision of the Minister of Energy and Water.

4.4.8 Community Energy Efficiency and Renewable Energy Demonstration Project

The Community Energy Efficiency and Renewable Energy Demonstration Project (CEDRO) is a partnership created in 2007 between the MOEW/Ministry of Finance (MOF)/Ministry of Economy & Trade (MOET)/Lebanon Recovery Fund (LRF)/Council for Development and Reconstruction (CDR)/United Nations Development Program (UNDP), with a five-year mandate and a budget of $9.73 million funded by the LRF by means of a donation from Spain. Its aim is to promote EE and RE in Lebanon through awareness, capacity building, market incentives for EE and RE installations, as well as country-wide research and development activities.

CEDRO also initiated and financed several national milestone research documents related to RE including (1) the national bio-energy strategy that shed the light on available bioenergy resources in the country, and (2) the national Wind Atlas that establishes an understanding of the dominant wind regimes (onshore & offshore) in the country, essential to determine best areas to build wind farms in the country. CEDRO's January 2019 publication, Renewable Energy Sector in Lebanon, National Studies, concluded that:

- Wind energy can potentially employ up to 2,753 people under the optimistic scenario in 2021, roughly half of them in direct jobs.
- The largest number of jobs will be in the service sector and during the construction phase.
- The transport of wind energy equipment will also create employment wherever infrastructure is needed, be it at the port or along the roads. Roads have to be widened and the area around the roads has to be cleared.

4.5 International Organizations

4.5.1 The International Renewable Energy Agency

The IRENA was first established in January 2009. IRENA acts in accordance with the purposes and principles of the United Nations to promote peace and international cooperation, in conformity with UN policies and sustainable development. IRENA promotes the widespread and increased adoption and sustainable use of all forms of RE and provides advice and support to governments worldwide on RE policy, capacity building, financing and technology transfer. The GOL is an applicant for IRENA membership.

4.5.2 The Global Wind Energy Council

The Global Wind Energy Council (GWEC) was established in 2005 to provide a credible and representative forum for the entire wind energy sector at an international level. It is a member-based organization that represents the entire wind energy sector including manufacturers, developers, component suppliers, research institutes, national wind and renewables associations, electricity providers, finance and insurance companies. GWEC's mission is to (1) communicate the benefits of wind power to national governments, policy makers and international institutions, (2) provide authoritative research and analysis on the wind power industry around the world, (3) work with governments to give them transparent information about the benefits and potential of wind power, enabling them to make informed decisions about national energy policies and (4) support collaboration between policy makers in different countries to help them share best practices and experiences in adding clean power to their energy mix. The GWEC has no Lebanese members yet.

4.5.3 BirdLife International

Founded first in 1922 as the *International Council for Bird Preservation,* BirdLife International, named as such in 1993, is a global Partnership of conservation organizations that strives to protect birds by conserving their habitats and biodiversity worldwide, working with people towards sustainability in the use of natural resources. It is the World's largest partnership of conservation organizations, with over 100 partner organizations including the Society for the Protection of Nature in Lebanon (SPNL – founded in 1983).

4.5.4 UNDP/CEDRO EIA for Wind Farm Developments Guideline Report

In addition to best international practices applicable to ESIA studies for wind farms, the UNDP/CEDRO Environmental Impact Assessment for Wind Farm Developments Guideline Report (2011) was considered in the current ESIA study, including guidance for monitoring and mitigation of impacts to resources, particularly avifauna and bats.

4.6 Policy Setting

4.6.1 The Policy Paper for the Electricity Sector

In 2010, the MOEW developed the Policy Paper for the Electricity Sector which seeks to redress the country's ailing electricity sector by 2015. It was unanimously approved by the COM in June 2010 (COM decision No.1 dated 21/06/2010). The Policy Paper is articulated along three strategic areas and formulates actions over three-time horizons (short 2010-2012, medium 2012-2014, and long term 2015 and beyond):

1. Infrastructure: electricity generation, transmission and distribution.
2. Supply and demand: choice of fuel and outsourcing, RE, EE, and tariffs.
3. Legislation: norms and standards, corporatization of EDL, and legal status.

On the generation side, the goal is to achieve 4,000MW of generating capacity by 2014 through new thermal power plants (2,200MW), rehabilitation of Zouk and Jieh (100MW) and upgrade of Beddawi, Zahrani, Baalbeck & Tyr (145MW). The Policy Paper also aims to increase hydropower by 40MW, harvest 60-100MW of wind power and 15-25MW through waste-to-energy plants. Consequently, at least 2,600MW of added capacity will be implemented in partnership with the private sector (Independent Power Producers).

The Lebanese COM agreed in March 2012 to lease power-generating ships to produce 270MW for a period of three years, and to build 1,500MW power plants. Effectively, in February 2013 the first Turkish power barge "Fatimaghoul Sultan" entered and moored in Lebanese shores; it will generate electricity to fill the gap caused when the Zouk Power Plant goes offline for rehabilitation for a period of three years.

4.6.2 The National Energy Efficiency Action Plan

The NEEAP developed by the LCEC was adopted by the COM in November 2011.[30] The Action Plan included 14 initiatives related to EE and RE with proposed milestones and targets. The spectrum of available technologies envisaged is quite wide including wind turbines, photo-voltaics, domestic solar water heaters and waste to energy and geothermal heat pumps. Already many initiatives are being implemented to favor the penetration of these technologies in the Lebanese market. Of importance to our project is initiative 6 of the NEEAP related to electricity generation from wind power [2]: "*introduce wind power via the private sector by building wind farms (60-100MW)*" which has prompted the CEDRO project to prepare the Wind Atlas for Lebanon mentioned earlier. Consequently, several firms (e.g. the Developer, Lebanon Wind Power SAL, Hawa Akkar SAL) have stepped forward and showed great interest in investing in wind energy. RE in Lebanon will be a tremendous advantage as it will contribute to solving two of the thorniest issues facing the energy sector in the country namely energy security and energy acceptability.

[30] Lebanese Center for Energy Conservation, The Second National Energy Efficiency Action Plan for the Republic of Lebanon, NEEAP 2011-2015.

The Second National Energy Efficiency Action Plan for the Republic of Lebanon (NEEAP 2016-2020) was published in March 2016 and builds on the first NEEAP 2011-2015.[31] NEEAP 2016–2020 is divided into two main sections: the power sector measures and the end-use measures. The power sector measures tackle EE in electricity generation, transmission, and distribution. The end-use section includes five chapters: 1) horizontal end-use measures; 2) end-use measures in the building sector; 3) end-use measures in industry and agriculture; 4) measures in mobility and transport; and 5) end-use measures in the public sector. Moreover, NEEAP 2016–2020 includes different types of measures regarding policies, regulations, action plans, and implementation. The sum of the overall estimated savings of the proposed measures over the five years of the second NEEAP's implementation are 686.1GWH for the power sector and 828.1GWH for end-use energy which implies a total saving of 1,514.2GWH over the five years and leading to average yearly savings of 302.9GWH. By implementing the second NEEAP's 26 initiatives, the actual electric power growth rate of 7% could be reduced to 5.81% in 2020.

4.6.3 National Renewable Energy Action Plan

The MOEW/LCEC prepared Lebanon's National Renewable Energy Action Plan (NREAP 2016 – 2020).[32] The NREAP is the main national document that will lead the way for Lebanon to develop the different RE technologies needed to reach the 12% target by the year 2020. By adopting this document, the MOEW is creating the path that all national efforts and international support need to follow to develop RE in Lebanon. Being the main authority to develop the energy sector, MOEW, through the work of LCEC, is striving to align all efforts towards sustainable energy.

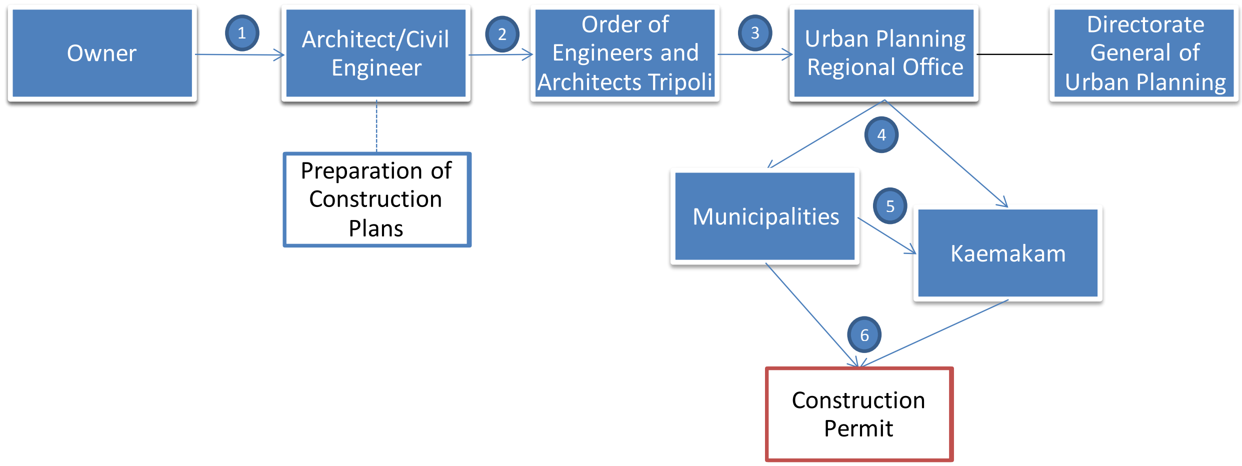
4.7 Licenses and Permits

The permitting process of the Project is required at the level of several national institutions which mainly include the following:

- Municipalities or the Kaemakam (i.e. the title used for the governor of a provincial district) of the district clears the construction and operation permits as presented in **Figure 4-1**; municipalities, federation of municipalities, Governors, and Kaemakam fall under the MOIM.
- DGUP approval of the Project is required given that the surface area allocated to the Project exceeds 10km^2 in light of allocation of Aandqet municipality of an area of 6km^2 to the Project due to lack of a land survey, thus increasing the total area of the Project.
- MOE's approval of the ESIA is required, MOE has also a role in inspecting the different phases of the Project.
- Ministry of Public Works and Transport issues permits for obstruction of aviation airspace as well as radar interference clearances.

[31] Lebanese Center for Energy Conservation, The Second National Energy Efficiency Action Plan for the Republic of Lebanon, NEEAP 2016-2020.
[32] Lebanese Center for Energy Conservation, The National Renewable Energy Action Plan for the Republic of Lebanon, NREAP 2016-2020.

Figure 4-1 Construction Permit Process



It should be noted that the Developer has already obtained the following permits:

- PPA between MOEW and the Developer signed in February 2018 allowing the government to purchase power from the private sector and Sustainable Akkar will be able to seek a connection to the grid from EDL.
- Rental contract agreements with land owners have been established by the Developer (as provided in **Appendix E**).

Table 4-10 summarizes the implications of each ministry for the project phases.

Table 4-10 GOL Roles and Responsibilities in Relation to the Project

Ministry	Project Phase	Implications for the Project
Environment	Planning	• Review and approve EIA Report.
	Construction	• Inspect the construction of the Project to verify compliance with the Developer's ESMP and mitigation measures by the OEM/EPC Contractor (wind turbine supplier) as per the ESIA Report.
	Operation	• Inspect the operation of the Project to verify compliance with the Developer's ESMP by the OEM/EPC Contractor (wind turbine supplier) as per the ESIA Report.
	Decommissioning	• Inspect the decommissioning of the Project to verify compliance with the Developer's ESMP by the OEM/EPC Contractor (wind turbine supplier) as per the ESIA Report.
Energy and Water	Planning	• Review and approve Developer's Proposal (along with the ESIA Report). • Issue a permit for Sustainable Akkar to produce/distribute electricity though a PPA.
Interior and Municipalities	Construction	• Traffic Management Agency (TMA) issues a permit for transporting materials (with specifications not included in Law 243/2012). • Municipalities and TMA monitor the transport operation.
Public Works and Transport, including DGUP	Design	• Delivers aviation airspace clearance permit. • Delivers construction permit.
	Construction	• Monitor the transport operation.
Municipalities	Construction	• Municipality or the Kaemakam clears construction permit.
	Operation	• Municipality or the Kaemakam clears operation permit.

5. ESIA APPROACH AND METHODOLOGY

This section describes the approach and methodology that was adopted for the ESIA study including the following:

- Approach to the scoping and assessment phase.
- Approach for the analysis of alternatives.
- Approach to stakeholder consultation and engagement.
- Approach to determining the spatial and temporal study area.
- Methodology for assessment of the baseline environmental and social conditions.
- Methodology used to assess the potential environmental and social impacts of the Project – including the approach to determining significance, development of mitigation measures and the assessment of residual effects.
- Approach used for the assessment of cumulative and trans-boundary effects.
- Approach for development of an ESMP.
- Gaps in contemporary knowledge.

It is noted that this ESIA was prepared based on the scope developed and data collected by SES and other specialists at the direction of the Developer. Following gap analysis by Ramboll and review by the international lenders, additional data collection was requested by Ramboll. In some instances, the scope and level of detail of this additional data collection was not provided; as such, it is acknowledged that this ESIA contains some gaps in contemporary knowledge.

Nonetheless, it is emphasized that the information provided herein is adequate for meeting the environmental and social performance requirements of international lenders, including public disclosure and consultation requirements, and was of a sufficient nature and extent to have both focused the impact assessment and inform management measures and mitigation.

Given some limitations on data, the approach that was taken to satisfy and/or principally satisfy lender requirements are presented in each relevant section, with material gaps highlighted and reason the gap exists elaborated upon. These gaps are carried over to **Section 21 Summary of Impacts and Mitigation,** and the Developer will undertake additional work to address these gaps, supplement the identification of stakeholders, continue ongoing consultation and engagement and confirm management measures and mitigation ahead of construction, as agreed with the lenders during the May 2019 Workshop in Paris, France.

It is further noted that the stand-alone SEP and ESMP accompanying this ESIA are currently framework documents that will need to be further developed once the additional works and data collection and selection of the OEM/EPC Contractor have been completed. The Developer has engaged a consultant to prepare the following ESMPs in coordination with the selected OEM/EPC Contractor and the Developer's operational partner, (Name removed) and their existing management procedures:

- An integrated Environmental and Social Management System (ESMS) that generally meets the objectives of ISO14001 and OHSAS 18001 (but need not be certified). The ESMS will establish and maintain an emergency preparedness and response system so that the Developer, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated with the Project in a manner appropriate to prevent and mitigate any harm to people and/or the environment.
- Stakeholder Engagement Plan (SEP).

- Environmental and Social Management Plans (ESMPs) that include detailed monitoring procedures and cost estimation for implementation of the following:
  - Design Change Management Plan.
  - Biodiversity Management Plan, to include bird management and monitoring
  - Resource Efficiency and Pollution Prevention Plan.
  - Waste/Hazardous Substances Management Plan.
  - Traffic Management Plan.
  - Human Resources Policy.
  - Air Quality Management Plan.
  - Noise Management Plan.
  - Shadow Flicker, Visual and Landscape Management.
  - Chance Finds Procedure.
  - Emergency Preparedness and Response/Safety Management Plan (natural disasters, accidents and emergencies).
  - Influx Management Plan (if required, based on number of workers hired from outside the local Project area).
  - Security Management Plan.
  - Erosion Control, Soil and Spoil Plan.
  - Employee Training Plan.
  - Occupational Health and Safety Plan.
  - Community Health and Safety Plan.
  - Contractor Management Plan.
  - Community Benefit-Sharing Plan (Corporate Social Responsibility (CSR) Plan).
  - Livelihood Restoration and Compensation Plan.
  - Labor Accommodation Plan.
  - Local Hiring and Procurement/Labor Conditions/Workforce Management Plan.
  - Sustainability Policy.

5.1 Scoping and Assessment

A Scoping Report (**Appendix A**) was submitted solely to the MOE by the Developer (as prepared by Ecodit) and reviewed by an internal committee. In their letter of response to the Scoping Report (also in **Appendix A**), the MOE indicated the following:

- The scoping report is approved with a note on the necessity of addressing the comments of the reviewing committee and ensuring compliance with the following:
  - Lebanon's Strategic Environmental Assessment (SEA) study for the RE sector.[33] The SEA requires that the design of wind turbines should consider a number of criteria (as applicable):
    - Avoid the Karm Chbat Nature Reserve and a 500m buffer --- it is noted that this is not applicable as the individual wind turbines are located on privately owned land within the Karm Chbat Cadastral Area. It is noted that no Project turbines will be installed within the boundaries of the Karbm Chbat Cadastral Area (refer to **Section 2 Project Description**).

[33] MOE/UNDP, 2014. Strategic Environmental Assessment of Lebanon's Renewable Energy Sector. Beirut, Lebanon.

  - Avoid the Upper Mountains of Akkar-Donnieh Important Bird Area (IBA) --- it is noted that the Mountains of Akkar-Donnieh IBA is located 5k from the Project (refer to **Section 2 Project Description**).
  - Not be located in areas with low incidence of fog and mist --- it is noted that fog and mist are present across the Akkar Mountain region, as evidenced by the images in the **Figure 5-1a – 5-1h** series.
  - Be designed to have the least impact on avifauna --- it is noted that, even accounting for likely population decreases over the lifespan of the project, significant impacts are not considered to exist (refer to **Section 14 Ornithology**).
  - Be at least 700m from nearest housing and 200m from nearest road --- it is noted that this requirement is not met for WTG 24, WTG 25 and WTG 29; however, these houses are located in Rweimeh Village, are only seasonally occupied, and are associated with land owners providing the land rental for the location of the turbines under land lease agreements (refer to **Section 2 Project Description**).
- MOE letter to Minister of Energy and Water No. 14175/B 2017 dated 19/12/2017.
- EIA Guidelines developed by the Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon (CEDRO).[34]
- Include in the ESIA relevant documents required in Decision 9/1 of 2014[35] and the rental agreements for the Project area.
- Include in the ESIA emergency plans for the management of earthquakes, fires, storms and lightning --- it is noted that the Project is not located in an earthquake zone (refer to **Section 10 Geophysical Ground and Seismicity**) and that the risk of ignition is assessed in **Section 8 Climate and Climate Change**.

- A preliminary assessment of expected environmental impacts was performed by Ecodit as part of the Scoping Report development, and the following impacts were scoped out with the understanding that they are expected to have negligible significance:
  - Noise and vibration impacts during the construction and decommissioning phases.
  - Impact of solid waste and loss of vegetative cover during the construction phase.
  - Visual impact from the storage of aggregate materials, construction equipment and excavation waste during the construction phase.
  - Visual impact from the onsite temporary storage of solid waste during the decommissioning phase.
  - Pressure on the existing solid waste management infrastructure in the study area during the construction and operation phases.

No scoping responses were received by any other consultees.

[34] UNDP, Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon, Environmental Impact Assessment for Wind Farm Developments, A Guideline Report 2012.
[35] Circular No. 9/1 dated 26/06/2014 (Relevant documents to be annexed to IEE and EIA reports as per Decree No. 8633 dated 07/08/2012 - published in the Official Gazette No. 35 on 16/08/2012).

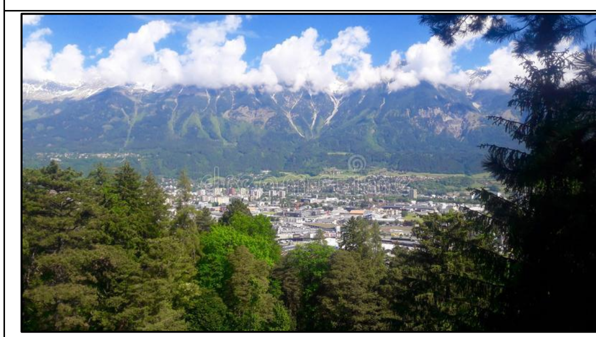
Figure 5-1a – 5-1h Akkar Mountain Region Fog and Mist

a

b

c

d



e

f

g

h

The assessment was carried out to:

- Describe the components and activities of the Project.
- Characterize baseline conditions within the Project's DAOI and IAOI, leveraging the scientific body of knowledge that has previously been undertaken as well as additional studies that are specific to the Project.
- Identify and assess the potential direct, indirect, and cumulative environmental and social impacts that could credibly result from the Project, ancillary activities or facilities during the construction, operation and decommissioning stages.

5.2 Analysis of Alternatives

The examination of alternatives is also considered to be a key element of the ESIA process under good international practice, including IFC PS 1 (IFC, 2012) and the associated IFC Guidance Note 1 (IFC, 2012). Environmental and social considerations have been part of the planning of the Project and a core element of the decision-making process.

The analysis of alternatives was previously presented in **Section 3 Analysis of Alternatives**. This section discussed and compared alternatives for the Project development in relation to: 1) site selection alternatives; 2) design alternatives; 3) transportation alternatives for the provision of WTG components; 4) technology alternatives; and 5) the Project vs. No Project Alternative, which assumes that the Project does not take place.

5.3 Stakeholder Consultation and Engagement

Stakeholder consultation and engagement is an essential part of the ESIA process and has been carried out in accordance with the requirements in Lebanon and international best practice – to include requirements identified within the Law 444/2002 related to Environment Protection, and its related Application Decree No. 8633/2012 on the Fundamentals for Environmental Impact Assessment, as well as IFC Performance Standard 1 (IFC, 2012), EIB Environmental and Social Standard 1 and EIB Environmental and Social Standard 10.

Stakeholder consultation and engagement activities undertaken for the Project are discussed in detail in **Section 6 Stakeholder Consultation and Engagement**. Activities included high level consultation with municipalities, detailed engagement with family leadership of affected communities, meetings with key informants, public disclosure meetings, meetings with landowners, focus group meetings, meetings with the Lebanese Army and meeting with mayors and officials representing towns along the transport route. The results of the consultation and engagement are reflected in the ESIA Report and have been incorporated into the project design and planning, where relevant.

5.4 Delineation of Study Boundaries and Scope of Assessment

5.4.1 Definition of Spatial Study Area

As previously presented in **Section 2.7**, the DAOI and IAOI for the ESIA comprises the following:

DAOI:

- Villages where land to be leased or purchased from landowners for the installation of Project turbines, internal roads, substation and transmission line, i.e. Jabal-Akroum Kfartoun, Aandqet and Rweimeh Village.
- Villages where land will be leased and purchased for the installation of wind turbines, internal roads, substation and transmission line at the planned Lebanon Wind Power and Hawa Akkar wind farms, i.e. Fnaidek, Karm Chbat Cadastral Area, Rweimeh Village, Chadra, Machta Hammoud and Mqaible.
- Areas of the new segments of road.
  - The new 0.65km section of asphalt road to avoid impacts to Chadra, Machta Hassan and Machta Hammoud to be constructed through currently vacant land purchased from private land owners (shown as #1 in Figure 2-7).
  - The new 0.15km section of asphalt road to be constructed between two existing sections of asphalt road in order to avoid hairpin turns near homes (shown as #2 in Figure 2-7).
  - The new 3.0km section of gravel road to be constructed within the existing railroad ROW managed by Machta Hammoud Village (shown as #3 in Figure 2-7).
- Jabal-Akroum Kfartoun, where land is to be leased for the CRO Office.
- A 3km radius around the Project boundary to encompasses the noise, shadow flicker and visual receptors (as shown in **Figure 2-14**; note: red dots are uninhabited houses --- also refer to **Section 16 Community Health, Safety and Security**).
- Villages within sightline of the wind turbines and potentially affected by the Project's visual impact (refer to **Section 16 Community Health, Safety and Security**).
- Extends up to 15km from the Project footprint, limited to sites and monuments of national importance located within the 15km and potentially affected by the Project's visual impact (refer to **Section 17 Landscape**).

IAOI:

- The existing transport corridor between the Tripoli Seaport and the Project, as shown in **Figure 2-16a** through **Figure 2-16g**.
- Informal settlements located within 1km of the existing road (refer to **Table 15-38** and series of maps in **Appendix F**).
- It further includes visual impacts to key landscape units.

In identifying these thematic study areas, the type and degree of the potential direct and indirect effects were taken into consideration. The core area where direct effects are likely to occur was determined, as well as the wider area of influence where indirect, combined and cumulative effects are likely to occur on the surrounding areas and communities.

5.4.2 Temporal Scope of the Assessment

The Project will be developed in a three-phase sequence, as follows: 1) Construction Phase; 2) Operations and Maintenance Phase; and 3) Decommissioning Phase.

Construction Phase

This includes construction activities which will be undertaken by the OEM/EPC Contractor. This mainly includes preparing the detailed design and layout of the Project, transportation of Project components to the Project site, as well as site preparation and construction activities for installation of wind turbines, foundations, internal access roads, buildings, etc.

Operations and Maintenance Phase

This includes activities to be undertaken by the Project Operator. Activities expected to take place mainly include the normal daily operation of the wind turbines and the routine maintenance activities.

Decommissioning Phase

At the conclusion of the PPA term, the Project will be completely decommissioned by the Developer. The anticipated impacts throughout the decommissioning phase are similar in nature to impacts assessed during the construction phase – and specifically in impacts related to soil, air quality, and occupational health and safety. Therefore, the assessment of impacts for those receptors and mitigation identified during the construction phase is assumed to apply to this phase in particular without the need to reiterate or emphasize this throughout this section.

5.5 Environment & Social Baseline Conditions

As part of the ESIA process, the baseline environmental and social conditions of the study area were established. Describing the baseline includes identifying and defining the importance and sensitivity of the various environmental and social resources and receptors likely to be impacted, i.e. within the study area. Understanding the value or sensitivity of the resources and receptors to impacts and changes is an important consideration when determining the significance of effects and allows for better identification of the most appropriate measures that could be employed to avoid impacts, and to mitigate any adverse impacts.

The description of environmental and social baseline conditions has considered a wide range of data and information gathered from various sources, including:

- Desk-based studies and literature reviews.
- Data from stakeholders.
- Field surveys and site investigations.

Studies have covered all the environmental and social aspects related to the Project and represent those conditions which would prevail in the absence of the Project. Studies of the environment and social baseline are described under each section respectively and include the following:

- Section 8 - Climate and Climate Change.
- Section 9 - Geology and Hydrology.
- Section 10 - Geophysical Ground and Seismicity.
- Section 11 - Air Quality.

- Section 12 – Transport and Traffic.
- Section 13 - Biodiversity.
- Section 14 - Ornithology.
- Section 15 - Socioeconomic Conditions (to include Land Use).
- Section 16 - Community Health, Safety and Security (to include Noise, Shadow Flicker, Visual Amenity and Traffic).
- Section 17 – Landscape.
- Section 18 - Archaeology and Cultural Landscape.
- Section 19 - Occupational Health and Safety.

Within each section, the methodology which was undertaken for assessment of each of those baseline conditions is described in detail.

5.6 Impact Assessment Methodology

The ESIA commences with an assessment of the positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Lebanon currently faces (refer to **Section 3 Analysis of Alternatives**). It then moves forward and within each section (in **Sections 8 – 19 Baseline Environment and Impact Assessment**) the assessment of impacts on environmental and social parameters is undertaken as required. The following section provides a description of the approach, methodology and process adopted for the impact assessment presented within this ESIA.

The adverse and beneficial environmental and social impacts of the Project have been identified and assessed against the established baseline. A consistent approach to the assessment of impacts was followed to enable environmental and social impacts to be broadly compared across the ESIA. A set of generic criteria were used to determine significance which were applied across the various social and environmental parameters. As far as possible, environmental and social impacts were quantified. Where it was not possible to quantify impacts, a qualitative assessment was conducted using professional experience, judgment and available knowledge, and including the consideration of stakeholder views. Where there were limitations to the data, and/or uncertainties, these have been recorded in the relevant chapters, along with any assumptions that were taken during the assessment.

In order to determine the significance of each impact, two overall factors are considered:

- The importance and/or sensitivity of the environmental and social receiving parameter, as determined during the assessment of baseline conditions.
- The magnitude and nature of the impact.

Potential impacts are assessed using quantitative tools such as noise modeling, and qualitative techniques based on professional judgment such as biodiversity. However, uncertainty is inevitable when dealing with a live resource that varies and evolves with time and is affected by several natural and anthropogenic factors in addition to the Project. Where qualitative assessments were necessary, these have been based on professional judgement. The significance of impacts has been based on a conservative 'worst case' basis in accordance with the precautionary principle.

The quality of baseline data also affects the accurateness of the assessments made. Therefore, it was necessary to list the key assumptions made and any limitations identified, in producing this ESIA as can be seen in the appropriate technical sections. In general, the ESIA assumes that:

- The principal land use in the surrounding area will remain unchanged throughout the Project lifetime.
- The Project will be developed as outlined in **Section 2 Project Description**.
- The mitigation and monitoring measures stipulated in the ESMP will be implemented as appropriate.

5.6.1 Sensitivity of Receptors

Receiving parameter sensitivity was determined using information taken from the baseline description on the importance, significance or value of the social or environmental component under examination. It is important to understand the sensitivity of the receiving parameter, as this is a measure of the adaptability and resilience of an environmental parameter to an identified impact. The following categories of sensitivity were applied to the assessment:

- High: The environmental parameter/receptor is fragile, and an impact is likely to leave it in an altered state from which recovery would be difficult or impossible.
- Medium: The parameter/receptor has a degree of adaptability and resilience and is likely to cope with the changes caused by an impact, although there may be some residual modification as a result.
- Low: The parameter/receptor is adaptable and is resilient to change.

The sensitivity of the receiving environment to changes caused by the Project was determined within each of the technical chapters using professional judgement, and existing information, where possible.

5.6.2 Impact Severity

The following factors are taken into consideration when evaluating impact severity:

- Likelihood or Probability of Occurrence: How likely the event is to occur during the Project lifecycle.
- Magnitude and Duration: The magnitude of the induced change such as size of area damaged, proportion of a species that is affected or a resource that is lost. The magnitude of the impact is the scale of change which the impact may cause compared to the baseline and how this change relates to accepted thresholds and standards, as presented in **Table 5-1**.
- Extent: The geographical area that could be affected by the impact.
- Reversibility: Whether the impact will or will not be reduced and disappear over time once the Project ceases.

Evaluation of impact severity also considers the following factors:

- Regulations and Guidelines: The degree of compliance with regulations and standards (e.g. environmental limit values). Relationship and alignment with national policies.
- Outcomes of public consultation: Carried out as part of the study.

Table 5-1 Magnitude Criteria

Impact Severity	Definition
No Change	Where the Project would not cause any changes to the receiving environment, or the changes are unlikely to be noticeable.
Slight/Minor	Where the Project would cause very little change to the receiving environment. It is typically reversible, temporary (<1 year), and limited to the site only (immediate zone). The probability of occurrence is less than 20%.
Low	Where the Project would cause noticeable deterioration of the existing environment. It is typically reversible, short-term (1-5 years), and limited to the local area (Middle zone). Likelihood is 20-40%.
Medium	Where the Project would cause moderate deterioration of the existing environment. It is typically recoverable (with a degree of intervention). Medium-term (5-10 years) and expected to affect the Furthest zone. Likelihood is 40-60%.
High	Where the Project would cause significant and long-term deterioration of the existing environment, expected to last on the long-term (10-20 years) or the Project lifetime. It affects an area that is nationally important/ or has macro-economic consequences. Its probability of occurrence is 60-80%.
Very High	Where the Project would cause irreversible and permanent damage to the existing environment, typically enduring substantially beyond the Project lifetime, or permanently. It affects globally important resources. Its likelihood is 80-100% (i.e. the impact will occur).

5.7 Mitigation and Management Measures

Based on the impact assessment undertaken a set of mitigation and management measures are identified for each impact which aims to address it. Mitigation and management measures include the following:

- Additional Requirements: those are generally regulatory requirements which have been identified and which must be considered at a later stage.
- Additional Studies: for certain environmental/social receptors additional studies must be undertaken at a later stage. Such studies and their scope, timing, etc. have been highlighted where relevant.
- Mitigation Measures: a vital step in the ESIA process is the identification of measures that can be taken to ensure that impacts are mitigated or reduced to acceptable levels. The ESIA will firstly consider the significance of any impacts caused by the Project and then assign mitigation options through applying the following hierarchy:
  - Avoiding or 'designing out' impacts wherever possible.
  - Considering alternatives or modifications to the design to reduce the impacts wherever possible.
  - Applying measures to minimize and manage impacts on the receptor.
  - As a last resort, identifying fair compensation, remediation and offsetting measures to address any potentially significant residual effects.

- Some negative impacts can be easily mitigated, whilst others cannot or are too difficult and costly to mitigate. The various potential impacts are described in this ESIA, along with the provision of 'feasible mitigation measures' that can be implemented.
- Recommendations: for positive impacts, it is not possible to identify mitigation measures, but rather recommendations have been identified which aim to enhance the positive impact.

If there are mitigation measures, it is then necessary to assess the 'residual significance' after mitigation has been taken account. A re-assessment of Project impacts is then made, considering the effect of the proposed mitigation measures in order to determine the significance of the residual effects. Residual effects are discussed for each environmental and social theme in the ESIA sections.

5.7.1 Determining Impact Significance

Impacts are defined as the changes in baseline conditions due to the Project construction and/or operation. Impacts can be Direct (i.e. resulting from the Project), Indirect (i.e. resulting from activities caused by the Project), Secondary (i.e. impact occurrence causing a subsequent interaction within the environment) and Cumulative (i.e. impacts caused by the combination and/or interaction of Project-related activities with those from other activities including third-party projects and plans.

The significance of each impact is determined by associating the impact severity with the sensitivity of the receptor in the matrix, *following implementation of mitigation and management measures*, as provided in **Table 5-2**.

Table 5-2 Matrix for Determining Impact Significance

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

The definitions of impacts and their severity are shown in **Table 5-3**.

Table 5-3 Definition of Impacts and Significance

Significance	Definition
Positive Impact	An Impact that is considered to represent an improvement on the baseline or introduces a new desirable factor.
Negligible Impact	No or imperceptible impact / Magnitude of change is comparable to natural variation (without the Project).
Minor Impact	Barely perceptible deterioration of the existing environment; impact is well within applicable standards, and/or receptor sensitivity is low.
Moderate Impact	Impact is within applicable standards and limits and leads to noticeable deterioration of the existing environment; normal functioning is altered but the baseline condition prevails, although in a modified state; should be mitigated to demonstrate that the impact has been reduced to a level that is As Low As Reasonably Practicable (ALARP).
Major Impact	Impact exceeds accepted limits and standards, or receptor sensitivity/value is high. Causes significant or complete modification of the baseline situation; must be mitigated to eliminate any high adverse residual impacts.
Critical Impact	Intolerable impact; not amenable to mitigation; alternatives or compensation measures must be identified.

5.8 Assessment of Cumulative Impacts

For each of the impacts assessed, the ESIA investigates the cumulative impacts which could result from incremental impacts from other known existing and/or planned developments in the area and based on currently available information on such existing/planned developments. Assessment of cumulative impacts is presented in **Section 20 Cumulative Impact Assessment**.

5.9 Development of an ESMP Framework

Based on the results of the impact assessment, a framework ESMP for the development of mitigation measures and development of a monitoring plan was prepared as a separate, stand-alone document. The ESMP will be a key document and will list the environmental/social requirements and detail the procedures necessary for managing the significant environmental/social issues connected to proposed Project activities.

The ESMP will be developed specifically to provide flexibility in the nature and exact location of operations, while ensuring all potential impacts are identified and properly mitigated and monitored throughout the later stages of the Project. The framework ESMP will be further developed by the Developer in collaboration with the selected OEM/EPC Contractor and their operational partner, (Name removed).

5.10 Gaps in Contemporary Knowledge

Gaps in contemporary knowledge are summarized below:

- Data regarding the plans for the collection, storage and disposal of solid waste and hazardous waste, generated volumes and the disposal facilities will be developed in future by the selected OEM/EPC Contractor.
- The Project will reduce GHG emissions since it will be displacing a largely fossil fuel-based electricity generating system and save water in comparison to oil-burning power plants which utilize water for cooling. Calculations for metric tons of CO_2 displaced and millions of m^3 in water savings annually will be undertaken in future by the selected OEM/EPC Contractor.
- Additional habitat surveys were undertaken in Summer 2019 with the aim of updating the mapping of boundaries between habitat types and the locations of existing features (such as tracks and borrow pits) to refine the habitat loss calculations. It is noted that the reporting received as an outcome of the additional surveys contained less detailed mapping than requested by Ramboll. Therefore, the habitat loss calculation could not be completed in the expected way by Ramboll. It may be that in the next phase, post ESIA submission, that more detailed mapping is required to be developed; however, at this stage, the assessment has been based on the information supplied, and the findings used to inform mitigation.
- Additional consultation was undertaken by the Developer in Jabal-Akroum Kfartoun, Machta Hammoud, Mqaible, Rweimeh Village and Machta Hassan. It is noted that the information received as an outcome of the additional consultation did not include survey of all landowners or noise, shadow flicker and visual receptors of the Project, or shepherds (identified by the Developer in July 2019 as Palestinian and Syrian refugees) using grazing areas within or near the Project boundaries, as requested by Ramboll. It may be that in the next phase, post ESIA submission, that additional consultation is required; however, at this stage, the assessment has been based on the information supplied, and the findings used to inform mitigation.
- Additional socioeconomic data was provided by Statistics Lebanon for villages within the DAOI and villages along the transport corridor in May 2019. This data was used to replace and/or supplement the data previously presented (refer to **Section 15 Socioeconomic Conditions**), and the findings used to inform mitigation.
- The presence of Palestinian and Syrian refugees and members of the Dom People (gypsies) in Fnaidek, and a few Syrian refugees in Rweimeh Village, was identified by the Developer in July 2019. The Developer did not specifically identify these vulnerable stakeholders and/or consult or engage with them separately regarding the Project; however, it is noted that all Rweimeh Village and Fnaidek community members were invited to the Initial and Final Disclosure Meetings (refer to **Section 6 Stakeholder Consultation and Engagement**). It may be that in the next phase, post ESIA submission, that additional consultation is required; however, at this stage, the assessment has been based on the information supplied, and the findings used to inform mitigation.

  Again, it is asserted that the information provided herein is adequate for meeting the environmental and social performance requirements of international lenders, and have satisfied public disclosure and consultation requirements, focused the impact assessment and informed management measures and mitigation. The Developer has committed to undertake the additional works to close out the acknowledged data gaps ahead of construction to ensure the following:

- That all stakeholders in the DAOI have been identified and engaged with (particularly vulnerable groups). The Developer will take special effort to identify and analyze all vulnerable groups or individuals (i.e. women, elderly people, resource-based or women-headed households, gypsies, shepherds, etc.) that might be adversely or disproportionately impacted by the Project activities. Vulnerable groups will be engaged either directly by the Developer or through NGOs working in the Akkar Region. Information on project activities will be disclosed to Syrian refugees and gypsies in the project area of influence (both direct and indirect), through local municipalities/NGOs. The ESMPs to be developed by others as outlined earlier in this section will be prepared to include the appropriate mitigation as necessary. Leaflets with Project information will be prepared by the Developer. The SEP references that specific measures will be developed to address these community members.
- Identification of key flora species during the pre-construction survey to provide detailed habitat mapping; if it is not possible to avoid examples or areas of the species listed in the baseline, every effort shall be made to reduce the impact and further offsetting would be required. Offsetting plans will form part of the Biodiversity Management Plan to be developed by others, to include possible reforestation and management prescriptions and evidence that no net loss of biodiversity can be achieved.
- Further ornithology data collection is essential during the migratory period of mid-August 2019 to mid-November 2020 to provide a minimum baseline and inform the pre-construction monitoring.
- Re-calculation of the cumulative collision risk mortality when suitable data has been collected and analyzed from the Project and the planned Hawa Akkar wind farm. It is essential that survey data from the Project and Hawa Akkar are urgently analyzed for suitability for inclusion in this assessment and where data gaps are identified then further data should also be urgently collected.

6. STAKEHOLDER CONSULTATION AND ENGAGEMENT

This section discusses in detail the stakeholder consultation and engagement undertaken as part of the ESIA process for the Project and provides an overview of the findings. In addition, this section refers to the separate and stand-alone Stakeholder Engagement Plan (SEP) which summarizes the previous and ongoing activities that are to take place as part of the Project development.

6.1 Introduction

Stakeholder consultation and engagement is an integral part of ESIA good practice and is a statutory requirement of the national EIA legal framework in Lebanon, within the IFC Performance Standards and EIB Environmental and Social Standards. The Developer is committed to a technically and culturally-appropriate approach to consultation and engagement with all stakeholders affected either directly or indirectly by the Project.

A stakeholder is defined as any individual or group who is potentially affected by the proposed Project or can themselves affect the proposed Project directly or indirectly. Stakeholder consultation is an inclusive process for sharing information that enables stakeholders to understand the risks, impacts, and opportunities of a development or Project, allowing them to express their views and articulate their perceptions towards it.

The consultation and engagement program for the Project is based on informed consultation and participation in line with national, IFC and EIB requirements with affected people and is designed to be both fair and inclusive. Consultation activities have been an ongoing process since March 2017.

6.2 Objectives

The objective of stakeholder consultation and engagement is to ensure that a participatory approach takes place, which in turn, documents concerns of all stakeholder groups and makes sure that such concerns are considered, responded to, and incorporated into the decision-making process of the development. Stakeholder consultation needs to be a two-way communication process that imparts information to stakeholders, but also obtains additional and on-the-ground information from them. Stakeholder consultation and engagement must take place at the inception phase of the ESIA process and be implemented all through the study period.

The specific objectives of this section are to:

- Summarize national and international legal & policy requirements for stakeholder engagement.
- Describe and identify the stakeholders affected and/or with an interest in the Project.
- Summarize stakeholder engagement and consultation conducted to date. In addition, describe how the views and issues raised have informed and influenced the development of the Project.
- Outline the future approach to stakeholder engagement.

6.3 Requirements and Policy Requirements for Stakeholder Engagement

6.3.1 Lebanon Legal and Policy Standards

Based on the Application Decree No. 8633/2012 related to the "Fundamentals for Environmental Impact Assessment", if an EIA is required, the project proponent should ensure local participation at several stages of the EIA process. At the scoping stage, Article 7 of the decree stipulates the following requirement concerning public participation:

- The Ministry of Environment will require that the Project owner informs all concerned stakeholders including ministries, municipalities and NGOs of the preparation of an EIA Report.
- Once advised, the municipality (or the governor or commissioner in case there is no municipalities) where the Project will be located, should immediately advertise the Project to inform the public. The advertisement should be placed on a public bulletin board and at the location of the Project for a period of 15 days requesting comments from the public. The Ministry of Environment will also give the public a chance to provide feedback to the Ministry or the official department concerned within one month from the date of the advertisement publication.
- The Project owner shall submit to the MOE report pertaining to the EIA scoping of the project including attachments of the remarks communicated to him, all incoming comments, the original minutes of public dialogue meetings or the minutes of bilateral meetings with the parties involved.

For the EIA report, Article 12 of the decree related to "Information Publication" confirms the right of the public and the parties involved in the project to have access to the final EIA Report. Moreover, Law 28 of 2017 on the Right to Access to Information has confirmed the right of any person, to access to information and documents available within the administration.

Based on the above, the national regulations require an initiation of the consultation process supporting public participation at the outset of the EIA/ESIA process and allow continuous access to information related to the Project.

6.3.2 Requirements in IFC Performance Standards on Environmental & Social Sustainability (2012)

The IFC PSs form part of their Sustainability Framework, where IFC PS 1 (IFC, 2012) sets out the following recommendations for stakeholder engagement:

- Stakeholder Engagement as an on-going process that may involve: stakeholder analysis & planning, disclosure and dissemination of information, consultation & participation, grievance mechanism, and on-going reporting to local communities directly affected by the project (the Affected Communities).
- A SEP must be developed and implemented that is scaled to the Project risks and impacts and development stage, and to be tailored to the characteristics and interests of the Affected Communities.
- Affected Communities will be provided with access to relevant information on: 1) the purpose, nature and scale of the project; 2) the duration of proposed Project activities; 3) any risks to and potential impacts on such communities and relevant mitigation measures; 4) the envisaged stakeholder engagement process; and 5) the grievance mechanism.
- When Affected Communities are subject to identified risks and adverse impacts from a Project, a process of consultation will be undertaken in a manner that provides the Affected Communities with

opportunities to express their views on Project risks, impacts and mitigation measures, and allows the client to consider and respond to them.
- The extent and degree of engagement should be commensurate with the Project's risks and adverse impacts and concerns raised by Affected Communities.
- The consultation process will be tailored to language preferences of Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups.
- For projects with potentially significant adverse impacts, the client will conduct an informed consultation and participation.
- A grievance mechanism will be established to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance.

6.3.3 Requirements in EIB Environmental and Social Standards (2009)

The ESSs of the EIB, as well as the operational practices of the EIB, recognizing the importance of open and transparent engagement with Project stakeholders as an essential element of good international practice:

- Establish a systematic approach to stakeholder engagement that will help Borrowers identify stakeholders and build and maintain a constructive relationship with them, in particular project-affected parties.
- Assess the level of stakeholder interest and support for the project and to enable stakeholders' views to be considered in Project design and environmental and social performance.
- Promote and provide means for effective and inclusive engagement with Project-affected parties throughout the Project life cycle on issues that could potentially affect them.
- Ensure that appropriate Project information on environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format.
- Provide project-affected parties with accessible and inclusive means to raise issues and grievances and allow Borrowers to respond to and manage such grievances.

6.4 Stakeholder Engagement Plan

The SEP has been included in the ESIA package. The SEP includes stakeholder identification and analysis, the roles and responsibilities for the External Relations Manager, hired in 2018, and the first of three Community Relations Officers (CRO) to be hired in 2019, and describes the stakeholder engagement and information disclosure activities that have been conducted to date and those that are planned throughout the life of the Project. As stated in the description of the Project Communication Plan included in the SEP, the Community Relations team will meet monthly with each Affected Community throughout the Construction Phase, in accordance with a schedule mutually agreed upon among the parties (day and time), the Project CRO assigned to each village will deliver and install the Monthly Project Poster in the Bulletin Box in each village and will deliver a few copies of the Monthly Project Poster to the village mayor and conduct a meeting with the village mayor, key-people and anyone from the community who would like to participate

The Community Grievance Mechanism is also included in the SEP. Suggestion boxes will be installed at the Community Relations Office in Jabal-Akroum Kfartoun and in each of the Affected Communities, so all Affected Communities will have access to the Community Grievance Mechanism, and Grievance forms will be made available at each location to allow for the submission of confidential grievances.

The SEP also mentions that a copy of the Non-Technical Summary of the ESIA (in both Arabic and English) will be made available at the Community Relations Office in Kfartoun and in each municipal office within the DAOI.

6.5 Stakeholder Identification and Analysis

The Project has been identifying potential stakeholders since March 2017. Project stakeholders and key informants were identified by the Developer and team based on the following: 1) categories of population usually affected by similar projects; 2) specific knowledge of the governance and social structure in the Project area; and 3) preliminary discussions with the MOE and their recommendations.

The Project has a wide range of stakeholders ranging from national and regional government institutions, in addition to communities within the area of influence of the Project. As such stakeholders have been identified at all geographic levels, including national, regional and local levels.

The three principal categories of stakeholders are as follows:

- National governmental institutions, including the MOE, MOEW, MOPWT, MOIM and other bodies involved in the permitting and ESIA process; and governmental authorities at the regional level, including the Governorate level (Governors) and District level (Kaemmakam).
- Affected Communities, defined as the local community as well as other people directly affected by the Project and/or those who have been identified as most vulnerable to change and who need to be engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measures.

  Specifically, within the affected communities, vulnerable groups must be identified. Vulnerable groups include those expected to be disproportionally affected by the Project, and therefore require special consideration throughout the consultation process. Vulnerable groups are project specific and depend on a range of issues which must be understood such as project location, socio-economic and demographic context, as well as the nature of the development and type of impacts anticipated. The vulnerable groups within this context were identified and included the following:

  - Women: due to cultural norms in Lebanon (and specifically within the context and setting of the Project area), the participation of women in the decision-making process is limited which could result in overlooking any specific concerns they might have.
  - Elderly: due to civil status and potential decline, this could limit their participation in the decision-making process which could result in overlooking any specific concerns they might have.
  - Informal settlements and Syrian and Palestinian refugees in Lebanon in general, and in Akkar in particular: people that have fled from their home to seek safety in Lebanon, many of whom are excluded from key facets of social, political and economic life. As they face restrictions on legal status and human rights, this could limit their participation in the decision-making process which could result in overlooking any specific concerns they might have.

- Other Interested Parties, defined as people and organizations that are interested in the Project and/or could affect the Project in some way. Those generally include universities and non-governmental organizations as follows:
  - Universities and research centers, such as the Lebanese Agriculture Research Center (LARI), the Lebanese University and the University of Balamand.
  - A national NGO (MADA) is also active in the region, including the Project area. Mada is a non-partisan, non-sectarian Lebanese NGO which aims to reinforce the relationship between local communities and their natural environment for the satisfaction of their substantial needs.

A Stakeholder Analysis Matrix is presented in **Appendix G**. Specific measures to address each of the above stakeholder categories are described in the SEP.

Additional consultation was undertaken by the Developer in Jabal-Akroum Kfartoun, Machta Hammoud, Mqaible, Rweimeh Village and Machta Hassan in May 2019. It is noted that the information received as an outcome of the additional consultation did not include survey of all landowners or noise, shadow flicker and visual receptors of the Project, or shepherds (identified by the Developer in July 2019 as Palestinian and Syrian refugees) using grazing areas within or near the Project boundaries, as requested by Ramboll. In addition, it is noted that the presence of Palestinian and Syrian refugees and members of the Dom People (gypsies) in Fnaidek, and a few Syrian refugees in Rweimeh Village, was identified by the Developer in July 2019. The Developer did not specifically identify these vulnerable stakeholders and/or consult or engage with them separately regarding the Project; however, it is noted that all Rweimeh Village and Fnaidek community members were invited to the Initial and Final Disclosure Meetings (refer to **Section 6 Stakeholder Consultation and Engagement**).

Ahead of construction, the Developer will take special effort to identify and engage all stakeholders in the DAOI, including vulnerable groups or individuals (i.e. women, elderly people, resource-based or women-headed households, gypsies, shepherds, etc.) that might be adversely or disproportionately impacted by the Project activities. Vulnerable groups will be engaged either directly by the Developer or through NGOs working in the Akkar Region. Information on project activities will be disclosed to Syrian refugees and gypsies in the project area of influence (both direct and indirect), through local municipalities/NGOs. The ESMPs to be developed by others as outlined earlier (refer to **Section 5 ESIA Approach and Methodology**) will be prepared to include the appropriate mitigation as necessary. Leaflets with Project information will be prepared by the Developer. The SEP references that specific measures will be developed to address these community members.

It is acknowledged that this additional stakeholder identification, consultation and engagement is required; however, at this stage, the assessment has been based on the information supplied, and the findings used to inform mitigation. This approach largely satisfies lender requirements, including public disclosure and consultation requirements, as it is reported that Palestinian and Syrian refugees have largely assimilated within the communities (i.e. do not live in informal settlements or tents), and the scope of the engagement undertaken was of a sufficient nature and extent to have both focused the impact assessment and inform management measures and mitigation. As consultation and engagement is part of an ongoing process to be implemented over the life of the Project as outlined in the SEP, the Developer is committed to implementing relevant and appropriate measures to address the potential needs of these community members.

6.5.1 Affected Communities

The affected communities have been identified based on: 1) detailed understanding of the Project site location, its nature, administrative setup and the nearby surrounding receptors; and 2) the nature of the anticipated impacts from the Project throughout its various phases. Based on the above, the affected communities include the local communities of the Project area (including women and the elderly) and informal settlements. As discussed earlier, the Project site is located within Akkar Governorate and specifically within Akkar District. The communities that are likely to be affected by the Project development logically include those located within the vicinity of the Project site, and which are therefore anticipated to be impacted the most from the Project's activities (during construction, operation and decommissioning). This in turn was determined based on the detailed understanding of the nature and extent of the Project's impacts. The main anticipated impacts which could affect the nearby communities (as discussed in further detail in each of the relevant sections) are described in the following sections.

6.5.1.1 Direct Area of Influence (DAOI)

The villages in the DAOI were so designated to encompass anticipated impacts from the following:

1. Land lease/acquisition for location of WTGs and components for the Project and the planned Sustainable Akkar and Hawa Akkar wind farms.
2. Impacts to socioeconomic conditions (including land use access for shepherds and hunters) from the Project (refer to **Section 15 Socioeconomic Conditions**).
3. Impacts to community health, safety and security impacts (refer **Section 16 Community Health, Safety and Security**) from the Project within a 3km radius of the Project comprising individual receptors of:
   - Noise impacts generated by the operating turbines.
   - Shadow flicker generated from the operating turbines.
   - Visual impacts from the presence of turbines. In case a receptor has an unrestricted view and is located less than 3km from the wind farm, visual impacts could be significant; therefore, views from less than 3km were considered a direct impact. Impacts on receptors in a distance greater than 3km from the wind farm were also considered but were classified as indirect impacts (refer to **Section 6.5.1.2**).
   - Localized traffic impacts for movement of construction materials during the construction phase (limited to Rweimeh Village).
4. Villages within sightline of the turbines:
   - Sahle.
   - Qenia.
   - Quobaiyat.
   - Aandqet.
   - Kfartoun.
   - Rweimeh Village.
5. Sites/monuments of national importance located within the 15km and potentially affected by the Project's visual impact:

- Sahle (Hill).
- Al-Saifa Fortress Akkar el-Atiqa'a.
- Qammouaah Plain.

Note: villages within the 15km radius within sightline of the turbines were scoped out based on low visibility or because they were of greater distance than those settlements evaluated in detail (refer to **Section 2 Project Description**).

6.5.1.2 Indirect Area of Influence (IAOI)

There are 44 villages in the IAOI, as described in **Section 2.7**:

- Villages along the transport corridor (it is noted that some of these villages also have visual impacts, but are outside the 3km radius assessed):

- Tripoli.
- Beddaoui.
- Deir Amar.
- Borj El-Yahoudiyé.
- Nabi Youcheaa.
- Minie.
- Zouq Bhannine.
- Al Mhamra.
- Bebnine.
- Quobber Chamra
- Mqaiteaa
- Borj El-Yahoudiyé
- Kfar Melki Aakkar.
- Rmoul.
- Qaabrine.
- Sammouniyé.
- Tall Aabbas El-Gharbi.
- Hissa.
- Tall Aabbas Ech-Charqi.
- Tall Hmaire.
- Chir Hmairine.
- Hokr Jouret Srar.
- Iitige.
- Barcha.
- Kharmoubet Akkar.
- Janine
- Qachlaq.
- Aamaret El-Baykat.
- Noura Et-Tahta.
- Kouachra.
- Dibbabiye.
- Fraidis.
- Qsair Akkar.
- Menjez.
- Rmah.
- Chikhlar
- Aaouaainat Aakkar.
- Machta Hassa

In addition, informal settlements located within 1km of the existing road (refer to **Table 15-38** and series of maps in **Appendix F**).

Further, the visual impacts from key landscape units were considered within the IAOI (refer to **Section 17 Landscape**) as follows:

- Agricultural Areas.
- Dense Abies Forests.
- Dense Pinus Forests.
- Dense Quercus Forests.
- Mixed Forests.
- Other Dense Leafy Forests.
- Rocky Land.
- Shrublands.
- Sparse Coniferous.
- Sparse Leafy Forests.
- Swamps.
- Urban Artificial.
- Urban Expansion.

6.6 Public Participation Activities Undertaken to Date

The following sections describe the public participation activities undertaken to date. It is recognized that public participation is an on-going and continuous process, undertaken throughout all Project phases, inclusive of construction, operation and decommissioning.

6.6.1 2017 Activities

6.6.1.1 Engagement with Family Leadership in Affected Communities

The Project developer began early engagement with family leadership of the Affected Communities in advance of the ESIA activities, as shown in **Table 6-1**. It is noted that, as the Project and planned Lebanon Wind Power wind farms are adjacent, engagement was undertaken to support the planned development of both wind farms.

Table 6-1 Face-To-Face Meetings with Family Leadership in Affected Communities

Name	Village Represented	Date
Abbas Jaafar, Kamel Jaafar, Mohamad Jaafar and Abdo Jaafar	Karm Chbat	2-Mar-17
Hussein Jaafar, Youssef Jaafar	Rweimeh Village	8-Mar-17
Hussein Ahmad Salah, Mohamad Ali Salah and Hussein Ali Salah	Kfartoun	27-Mar-17
Mohamad Khaled Abed Al Rahman and Ahmad Abed Al Rahman	Kfartoun	4-Apr-17
Mohamad Hussein and Khaled Mohamad Hussein	Kfartoun	18-Apr-17
Ahmad Ali Youssef Salah, Hasan Hasan Salah and Adnan Ali Salah	Kfartoun	9-May-17
Moustafa Hada	Kfartoun	9-May-17
Richdi Khaled Al Adraa, Hani Khaled Al Adraa and Mohamad Khaled Al Adraa	Kfartoun	24-May-17
Ahamad Ahmad Al Adraa and Hani Al Adraa	Kfartoun	6-Jun-17
Hani Al Adraa	Kfartoun	12-Jul-17
Ahmad Ali Daher	Kfartoun	12-Jul-17
Ahmad Abou Amcha, Hasan Khoder Abou Amcha and Mouhamad Hasan Abou Amcha	Kfartoun	14-Aug-17
Khaled Hasan Khoder	Kfartoun	1-Sep-17
Ali Jaafar, Toaan Jaafar and Noura Jaafar	Karm Chbat	11-Sep-17
Khoder Hussein Melhem, Urki Hussein Melhem and Jamil Hussein Melhem	Kfartoun	7-Oct-17
Hassan Jaafar, Ahmad Jaafar and Medhit Jaafar	Rweimeh Village	9-Oct-17
Riyad Jaafar, Imad Jaafar and Mohamad Jaafar, Ali Jaafar and Ajaj Jaafar and Rached Jaafar	Rweimeh Village	16-Nov-17
Maher Chawki Al Adraa, Ahmad Hasan Al Adraa and Ahmad Moustafa Al Adraa	Kfartoun	13-Mar-18

6.6.2 2018 Activities

6.6.2.1 Meetings with Key Informants

Meetings were organized with key informants to discuss their opinions regarding the Project and to describe the household survey campaign to be implemented, as shown in **Table 6-2.**

Table 6-2 Meetings with Key Informants

Name	Role	Date	Meeting Type
Mr. Ahmad Baarini	Mayor of Fnaidek	20-7-2018	Face-To-Face Phone Call
Mr. Omar Zahraman	Electrical Engineer at EDL	20-7-2018	Face-To-Face
Mr. Mohamad Salaheldin	Municipal Official Fnaidek	20-7-2018	Face-To-Face
Mr. Samira Tannous	Mayor Secretary Quobaiyat	25-7-2018	Face-To-Face Phone Call
Mr. Abdo Abdo	Mayor Quobaiyat	25-7-2018	Face-To-Face Phone Call
Mr. Ahmad Omar	Association for Development of Akkar	6-8-2018	Face–To-Face
Mr. Farah Sankary	Akkar Network for Development	6-8-2018	Face–To-Face
Dr. Antoine Daher	Environmental Council	11-8-2018 20-10-2018	Phone Call Face-To-Face
Mr. Abdo Jaafar	Focal Point of Rweimeh Village	28-9-2018	Phone Call

District level data regarding demographics, sources of income and cultural aspects was obtained during the meetings. The findings from the Key Informant Meetings are provided in **Section 15 Socioeconomic Conditions**.

6.6.2.2 Initial Public Disclosure Meeting

The Initial Public Disclosure Meeting took place on 15 May 2018. Announcements related to the Project were prepared and filed at the municipalities of the villages which own land in the Project area, namely Quobaiyat, Fnaidek and Rweimeh Village (includes the Karm Chbat Cadastral Area) and were posted on the municipal building entrance doors or information boards.

Rweimeh Village has no municipality; therefore, the meeting announcement was placed at Jouar El Hachich, a nearby village as per the recommendation of a representative of the local people, as shown in **Figure 6-1**. A copy of the announcement, formally registered invitation letters to the MOE, MOIM and MOEW, and list of attendants are also provided in **Appendix H**.

Figure 6-1 Placement of Public Announcements

a - Quobaiyat

b - Fnaidek

c – Rweimeh Village/Jouar El Hachich

Project-related discussions were undertaken with the Head of the Municipality of Fnaidek and the other meeting attendants. A seminar presentation was given by SES and included a description of the proposed project, the ESIA objective and scope and a summary of the major anticipated impacts and associated mitigation measures, also presented in **Appendix H**. The **Figure 6-2a** – **Figure 6-2j** series shows photographs taken during the meeting.

Overall, a positive atmosphere prevailed and was encouraged by communicating:

1. The inclusion of environmental and social management measures during all Project phases.
2. The commitment of the Project Proponent to implement the latter measures.

The seminar was followed by a discussion whereby SES responded to the concerns raised by meeting attendants and committed to addressing them in the ESIA study. The discussions which took place during and after the meeting are summarized in **Table 6-3**.

Overall, a positive atmosphere prevailed and was encouraged by communicating:

1. The inclusion of environmental and social management measures during all Project phases.
2. The commitment of the Project Proponent to implement the latter measures.

The seminar was followed by a discussion whereby SES responded to the concerns raised by meeting attendants and committed to addressing them in the ESIA study. The discussions which took place during and after the meeting are summarized in **Table 6-3**.

Figure 6-2 Photographs of the Initial Public Disclosure Meeting

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Table 6-3 Summary of Discussions During/Following the Public Consultation Meeting

Remark / Concern	Response
Mr. Majid Hachem, MOIM representative, was concerned about the status of the ownership of the parcels located at the top of the mountain i.e. whether they are public / municipal or private properties. He also advised that an official survey be implemented.	Mr. Ahmad Abdo Albaarini, Head of Municipality of Fnaidek, replied that these are municipal properties. He explained that Fnaidek municipality on the west side of the mountain ridge and Al Jaafar families from the east side have agreed on the border between their respective properties. It is the line separating the water catchments on the eastern and western slopes of the ridge. Mr. Jules Assi noted that the lands for the Project are not surveyed and have no title deeds. He added with the head of municipality of Fnaidek that they are going to proceed with علم وخبر with the help of the local head of municipalities and mayors (مخاتير) as well as a surveyor and the police, then the documents would be filed for certifying at the governorate of Akkar.
Mr. Majid Hachem noted that SES will be looking at the impact of the wind farm on the existing facilities without considering the depreciated value of surrounding land.	Dr. Abi Esber replied that there are 24 potential locations for the turbines and the latter will be compared to select the ones which will have the least adverse impact on the surroundings all while considering electricity production potential in the assessment; once selected the land(s) which will be leased for the turbines span up to 3,500m^2 around the turbine which increase the compensation potential for land owners. She finally added that the fact that most of the lands are publicly owned decreases the significance of the depreciation impact and make this area particularly attractive for the proposed development.
Mr. Jeff Gerges recommended that SES take into consideration the obligations of Lebanon under the international conventions (CBD and AEWA). He also added that the significance of the impact in terms of bird casualties needs to be evaluated in comparison to international guidelines which are available in this respect. He also enquired about the radar's mechanism and whether it can automatically shut down the relevant turbine	Dr. Abi Esber ascertained that all relevant signed / ratified conventions will be considered. With respect to bird casualties, Dr. Abi-Esber explained that Dr. Jaradi, who is the Project's avifauna expert, is training the ESIA project team on the identification of birds in the study area, which is instrumental for the implementation of monitoring activities during operation; the latter would identify any important bird casualties evidently considering the relevant international guidelines. Mr. Jules Assi replied that the radar will detect the birds' presence and flyways and based on the latter info, it will be determined when to shut off the turbines. Fast internet communication will be established between radar, the management team and the operation team (including representatives of the international turbine supplier) so that the command to shut off the turbine is quickly executed. A decision was made by the Lebanese Government to favor the shut-down of the turbines during migration periods. The decision stipulates that the Lebanese government will cover the financial losses from the shut off of turbines during migration periods in order to protect important migrating birds. Mr. Ahmad Abdo Al Baarini added that birds in the area commonly fly on the sides of the mountains, not on the top which is very high, and this should minimize any adverse impacts to birds.
Mr. Majid Hachem enquired about the number of turbines and the total production capacity.	Dr. Abi Esber replied that based on the final layout of favorable locations, the number and size of turbines will be decided; only large turbines will be used (3.8MW-5MW) to minimize the environmental footprint.
Mr. Majid Hachem asked whether it is possible to disclose free of charge the meteorological data collected by the met masts.	Dr. Abi Esber replied that the data are the property of the Project proponent and that access to data needs to be negotiated with them. Mr. Jules Assi added that not all types of meteorological data are collected, only those relevant for turbine operation, i.e. wind speed and direction, pressure temperature and humidity. Other essential meteorological data like rainfall and cloud cover are not being collected.
Mr. Jeff Gerges asked for more information regarding the de-icing mechanism of turbines.	Mr. Jules Assi mentioned that turbines which are located in snowy areas will be equipped with a de-icing mechanism which is more expensive but can ensure sound operation during snowy periods. Mr. Bachir El Marj said that the technology resembles that used in airplanes.
Ms. Nathalie Karam stressed that the ESIA study under preparation needs to consider the following: • SEA for the RE sector. • The letter sent from MOE to MOEW concerning the scope of the ESIA of the three wind farms. • An assessment of bats in addition to birds. • An assessment of floral species in the area indicating those with high ecological value. • The decommissioning phase. • The extended producer responsibility concept to be included in contracts with turbine suppliers in case of broken parts.	Dr. Abi Esber replied that the preliminary studies done by Dr. Jaradi, the Project bird expert, has shown that there are no bats. She added that a complete site survey will be conducted where all kinds of fauna and flora will be recorded; the survey will be done when the layout of proposed sites is finalized. Mr. Jules Assi assured that any defect or broken items will be the responsibility of the operating company.
Mr. Jules Assi asked Ms. Nathalie Karam whether the Ministry would mind if the three ESIA consultants involved in the ESIA studies of the three proposed wind farms undertake a single cumulative impact study to avoid redundant efforts.	Ms. Nathalie Karam ascertained that this is not a problem as long as findings from the cumulative study are reported within the three ESIA studies.

6.6.2.3 Site Visit by LCEC/Family Leader Meeting

A Site Visit was undertaken on 4 June 2018, to provide LCEC with an overview of the Project site, potential turbine locations and the substation location, as shown in **Figure 6-3**. The site visit was followed by a meeting with the focal point of Rweimeh Village (Abdo Jaafar), General Daher and the Aandqet Municipality Mayor.

Figure 6-3 Site Meeting with LCEC

6.6.2.4 Iftar for Affected Communities

A public participation dinner was prepared on Ramadan (7 June 2018) for several of the Affected Communities, including Akroum, Kfartoun and Rweimeh Village, as shown in **Figure 6-4**. The dinner was held to provide a better understanding of the Project design execution and the implications on the surrounding environment. Iftar is one of the religious observances of Ramadan and is often done as a community, with people gathering to break their fast together.

6.6.2.5 Land Rental/Ownership Impact Meetings with Officials

Discussions were undertaken with officials regarding land rentals and potential ownership impacts from turbines such as noise, shadow flicker and visual amenity as follows:

- 20 July 2018 - Meeting with Mayor of Fnaidek, Mr. Ahmad Baarini.
- 20 July 2018 - Meeting with Municipal Official from Fnaidek, Mr. Mohamad Aalah El Din.
- 25 July 2018 - Meeting with Mayor Secretary of Quobaiyat, Mr. Samira Tannous.

Discussions included what job opportunities would be created by the Project, along with the general terms of the rental contract.

Figure 6-4 Iftar for Affected Communities

6.6.2.6 2-Day Visit by Bank Audi/SLR

A 2-day site visit was undertaken by the Project Proponent with representatives of Bank Audi and their ESIA Reviewer, SLR, on 2 October 2018. The purpose of this visit was to provide an overview of the Project area, including the general physical environment, road development, power substation, transmission lines and operation buildings, and to discuss land ownership. In addition, meetings were held in Tripoli with the Mayor of Fnaidek, Mr. Ahmad Baarini and with Mr. Abdo Jaafar, focal point of the Jaafar Family to discuss the potential negative and positive impacts of the wind farms projects. The site visit was followed by a meal as shown in **Figure 6-5**.

On the second day (3 October 2018), several meetings were undertaken to discuss the potential negative and positive impacts of the wind farms projects as shown in **Figure 6-6**:

- A meeting with the Vice-Mayor of Aandqet, Mr. Marwan Greig.
- A meeting with a local NGO, the Environment Council in Quobaiyat.
- A meeting with General Khaled El Daher and representatives of the families of Kfartoun.

6.6.2.7 2-Day Visit by International Lenders

The purpose of this 2-day visit 8-9 October 2018 was to have an overview of the Project, the physical environment, road development, land ownership, the substation location, the underground transmission line and the location of the operation buildings, as shown in **Figure 6-7**. International lenders Bank Audi, EIB, Proparco and Finance in Motion attended the site visit. In addition, the lenders met the mayor of Aandqet, Daher Family (General Khaled El Daher), and with the family of Jaafar, where representatives from all the communities of the project were invited, as shown in **Figure 6-8**.

Figure 6-5 Day 1: 2-Day Visit by Bank Audi/SLR

Figure 6-6 Day 2: 2-Day Visit by Bank Audi/SLR

Figure 6-7 Site Visit by International Lenders

Figure 6-8 Meeting with General Daher and Representatives of the Families of Kfartoun

6.6.2.8 Site Visit by Potential OEMs

A site visit was undertaken by the Project Proponent with representatives of three of the four potential OEMs, Siemens, GE and Nordex, on 12 October 2018, as shown in **Figure 6-9**. The purpose of this visit was to provide an overview of the Project area, including the general physical environment, road development, power substation, transmission lines and operation buildings, and to discuss land ownership.

Figure 6-9 Site Visit by Potential OEMs

6.6.2.9 2-Day Visit to Lebanon by VESTAS

A site visit was undertaken by the Project Proponent with representatives of Vestas on 24 October 2018. The purpose of this visit was to provide an overview of the Project area, including the general physical environment, road development, power substation, transmission lines and operation buildings, and to discuss land ownership. This was followed on the same day with a meeting between the Vestas Head of Security and Amid Daher to discuss security conditions in the Project area, the Vestas approach to security, and Vestas' intent to employ locals. During the second day of the visit, the Vestas Head of Security met in Beirut with Mr. Abdo Jaafar (focal point of the Jaafar Family) and Mr. Omar Massoud (the Mayor of Aandqet) to discuss security conditions in the Project area, the Vestas approach to security, and Vestas' intent to employ locals.

6.6.2.10 Focus Group Meetings

Two focus group meetings were organized on 2 and 4 November 2018, with a group of hunters who usually hunt in or in close proximity to the area where the Project turbines will be installed and a locally active NGO, the Environment Council in Quobaiyat (مجلس البيئة - القبيات). After introducing the Project to both groups, feedback was collected regarding their knowledge of the wind energy technology and the proposed Project. Their perceptions regarding the Project and its effects, along with the management mitigation measures that the Project Proponent will be adopting to eliminate or reduce impacts were discussed, especially potential impacts to the natural reserve adjacent to the Project site. Photographs of the Focus Group Meetings are presented in **Figure 6-10** (Note: the hunters have requested anonymity).

Figure 6-10 Photographs of Focus Group Meetings

The hunters in attendance were specifically engaged regarding the use of one of the existing tracks used by hunters for construction of the underground transmission line between the Project and Lebanon Wind Power wind farm, shown in blue in **Figure 6-11** (Note: the hunters have requested anonymity).

During the meetings, the hunters were advised they would be prohibited from using this track during installation of the transmission line. The hunters advised that the track is only one of many used by hunters, and that hunting only occurs as a hobby --- not for subsistence or to support livelihoods. The findings from the focus group meetings are provided in **Section 15 Socioeconomic Conditions**.

Figure 6-11 Existing Track through Karm Chbat Nature Reserve for Underground Transmission Line

6.6.2.11 Visit to Turkish Wind Farms by Locals and EDL

A site visit to a wind farm in Turkey was undertaken on 21 November 2018, along with representatives of Lebanon Wind Power, so that land owner representatives, the Mayor of Kfartoun, Ahmad el Zein, Kanaan Family representatives, Adraa Family representatives, and Daher Family representatives, could observe the operation of the wind farm and its potential negative and positive environmental effects, as shown in **Figure 6-12**.

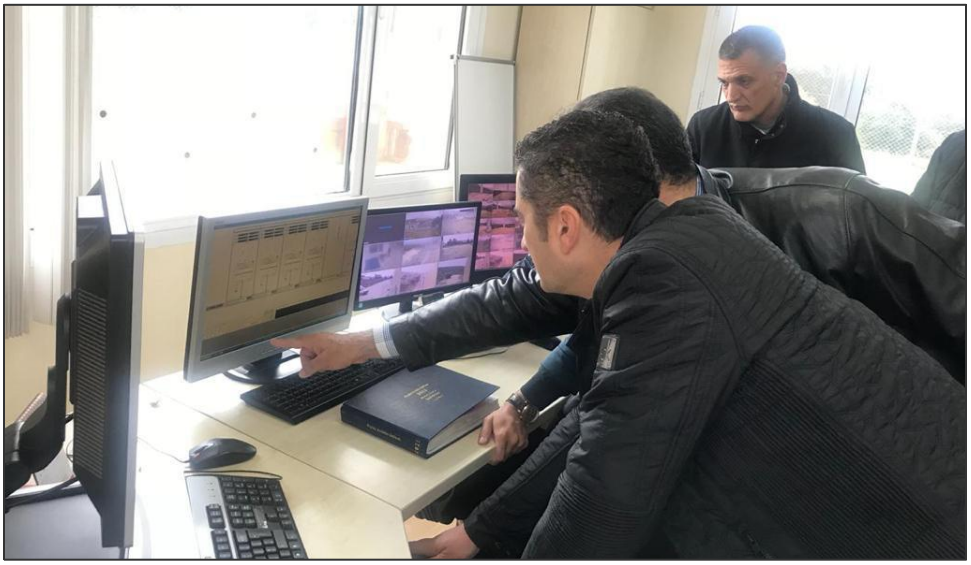
Figure 6-12 Visit to Turkish Wind Farms

Neighbors of the Turkish wind farm were visited and consulted regarding their opinion about wind farms. On the same day, a team of seven EDL Heads of Units visited three wind farms in Turkey, along with representatives of the Sustainable Akkar and Lebanon Wind Power teams, to discuss the challenges they may face with the operators. The Turkish wind farm operators showed them the WTG performance monitoring system and SCADA data analysis, as shown in **Figure 6-13**.

6.6.2.12 November 2018 Hawa Akkar Public Meeting

Invitations to the villages were sent out 2 weeks prior to the public meeting undertaken by Hawa Akkar on 8 November 2018, in both written and oral form (i.e. with an official registered letter, or phone or personal communication/visit). The interest was low, as no one from the villages along the road corridor were noted in the attendees.

Figure 6-13 Review of WTG Performance Monitoring System and SCADA Data Analysis



6.6.2.13 Final Public Disclosure Meeting

A final public disclosure meeting took place on 1 December 2018 at the Qammouaah Plain in Fnaidek Village. Similar to the Initial Public Disclosure Meeting, announcements related to the meeting schedule and location were prepared and filed at the municipalities of the villages which own lands in the study area (refer to **Appendix H**) and were posted on the municipal building entrance door or on information boards. Two newspaper announcements were published twice on the most read newspapers in Lebanon (An-Nahar and L'Orient Le Jour) in addition to announcements of the social media and inside the villages of Fnaidek, Rweimeh Village, Quobaiyat, and Jouar El Hachih. Announcements regarding the meeting were also published in two popular local newspapers, Annahar and L'Orient Le Jour. The MOE, MOIM and MOEW were invited to the meeting through formally registered invitation letters.

A seminar presentation was given by SES and included a description of the proposed Project and a summary of the findings of the ESIA studies, including analysis of impacts and the proposed Environmental and Social Management Plan, the general findings of the ESIA study being conducted, and actions that were taken by the developer in order to mitigate any potential negative impact of the wind farm on the environment. The seminar was followed by a discussion whereby SES and the project developer replied to the concerns of the meeting attendants and committed to addressing them during project implementation and operation.

Overall, a positive atmosphere prevailed including lively discussions and exchange of ideas. The project developer committed to addressing all concerns and invited the attendants from the local public to apply for job opportunities offered by the project. **Table 6-5** summarizes the discussions which took place during and after the Final Public Disclosure Meeting.

Figure 6-14 shows photographs taken during the meeting.

Table 6-4 Summary of Discussions During/Following the Final Public Disclosure Meeting

Remark / Concern	Response
Mr. Mohammad Al Sayed, electrical engineer, was concerned about the accuracy of the deadlines. He said: since 2014 the Lebanese government was talking about the wind farms and promised RE in 2018, now we are in December 2018 and the current deadline is 2020. He suspects that 4 months are not enough for project implementation, knowing that in Europe, the implementation of such wind farm needs up to 18 months.	Mr. Jules Assi, LWP Project Coordinator, advised that work on the wind farms could not be mobilized before November 2017, when LWP, Sustainable Akkar and Hawa Akkar signed the PPP agreement and they were allowed to start working. They have a 36-month term for the final delivery of the project.
Mr. Mohammad Al Sayed asked about the infringements made on the public power grid and what is the solution provided by LWP.	Mr. Jules Assi replied that the LWP agreement with MOEW includes producing electrical power and supplying it to the public grid. The solution for the infringements is not within the scope of the project developer.
Mr. Ahmad Zakaria, teacher holding a degree in the RE domain, asked if the wind farms can provide enough electrical power to satisfy the commitment by the government to supply 12% energy demand through RE sources. He also asked whether the implementation of the wind farms would cover the electrical power shortage.	Mr. Jules Assi replied that the planned 3 wind farms are able to satisfy a significant portion of the commitment, and that they will supply 25% of the shortage.
Mr. Mohammad Al Sayed asked where the remaining 75% of the shortage will be supplied from.	Mr. Jules Assi advised that this is a concern which needs to be taken care of by the Lebanese government.
Mr. Georges Ghattas, representative of the TBWA Agency, was concerned about the noise, knowing that at an air speed of 20m/s makes a remarkable noise even without the existence of a wind turbine. He also asked whether a study was made on the impact on any future buildings that are to be constructed around the turbines. He asked who is going to recruit the HSE expert. He finally enquired about the wind speed at which there will be electrical energy production.	Mr. Jules Assi advised that the wind turbines will stop working at wind speeds exceeding 25m/s which is a self-protection mechanism to maintain the integrity of the turbine. Dr. Layale added that noise next to the turbine may be more than 100dBA but will decrease substantially at a distance of 200m from the turbine and people should not consider building houses at a distance lower than this. She also added that a vast majority of the lands surrounding the turbines are public lands with no title deeds, and therefore with limited potential for investment in projects other than those supplying governmental services, a fact which decreases the significance of the latter noise impact. Mr. Jules mentioned that noise from any electrical appliance inside a house could be more than 60dBA. He also replied that LWP will recruit its own HSE expert who will be responsible for the follow up on environmental management at the Lebanon Wind Power wind farm. He advised that electrical energy production starts at a minimum wind speed of 5m/s.
Dr. Mohammad Nour EL Din Ali, lecturer at the Arab University, asked if the number of trees that will be cut was quantified. He also asked if the Ministry of Environment will monitor the project implementation and functioning. He also enquired about the party who will monitor noise levels during the operation of the wind farm. He finally asked about the fate of the 3 met masts present onsite whether other masts will be installed.	Dr. Layale advised that the number of trees present in the immediate construction zone were quantified and referred to the relevant tables about the matter in the presentation. Dr Layale also added that LWP is responsible for recruiting an HSE specialist who would need to properly implement all ESMP requirements. She also added that the Ministry of Environment would conduct inspections in the future to ascertain that the ESMP is implemented and that the latter inspections may involve actual measurements. Mr. Jules added that the lending banks also have third party auditing processes who would check for ESMP implementation and compliance with environmental standards before giving clearances to release payments to the project developer. Mr. Jules also added that the 3 meteorological masts will stay until February 2019, and afterwards another 3 will likely be added by the turbine manufacturer all while keeping one of the old 3 met masts for calibration purposes. Mr. Jules advised that the Lebanese government will also be supervising their work.
Mr. Ahmad Khaled Zakaria, mechanical engineer, was concerned about the coordination between LWP and the municipality in the selection of turbine locations. He also asked who is going to benefit from the project? What is the approximate turbine size? And what is the turbine height?	Mr. Jules advised that once a turbine manufacturer is selected and the final places of the turbines are chosen, the municipality will directly be notified about the latter. In terms of benefits, Mr. Jules explained that there will be recruitment of up to 200 persons during construction from the local community in addition to several jobs during operation. He also added that the local municipalities and communities will benefit from road widening activities and the development of new roads. With respect to turbine size, Mr. Jules answered that it is not yet decided, but that the hub height will be approximately 105m.
Mr. Georges Ghattas was concerned if there is an impact on the groundwater	Dr. Layale explained that wind farms are not associated with a negative impact on the groundwater. She also added that the groundwater is very deep in the project area, and that WWTPs will be installed at wastewater generation points to ensure the safe treatment and disposal of wastewater.
Mr. Abed EL Ileh Zakaria, head of the union of the municipalities in Mqaiteaa, was concerned about the road to be taken when the construction starts. Is it going to be through Quobaiyat? He suggested a road from El Deniyyeh to Fnaidek.	Mr. Jules answered that the road to be taken starts from Tripoli port and continues to Al Minie, Al Asbdeh, seaside road, Chadra, train railway, Wadi Khaled, Hawa Akkar site, Sustainable Akkar site, Rweimeh Village, then the Project site. He also added that the project developer does not mind discussing further the feasibility of the new proposed road with the municipality.
Mr. Ahmad Naaman, principal of Fnaidek public high school, was concerned about what parts of the turbine may present malfunctioning. He also asked about what can be done to help the locals, so they can have better chances to be recruited?	Mr. Jules answered that bad weather conditions, e.g. ice, very high wind speed may harm the turbine parts. He also added that the turbines have a de-icing mechanism when located at high altitude and will be stopped in extremely windy conditions. The monitoring and control of the turbines will be implemented by the turbine manufacturer in collaboration with a local control and support office. Mr. Jules also answered that there will be online and onsite training courses so that the chances of recruitment of the locals would be increased.

Figure 6-14 Photographs Taken During the Final Public Disclosure Meeting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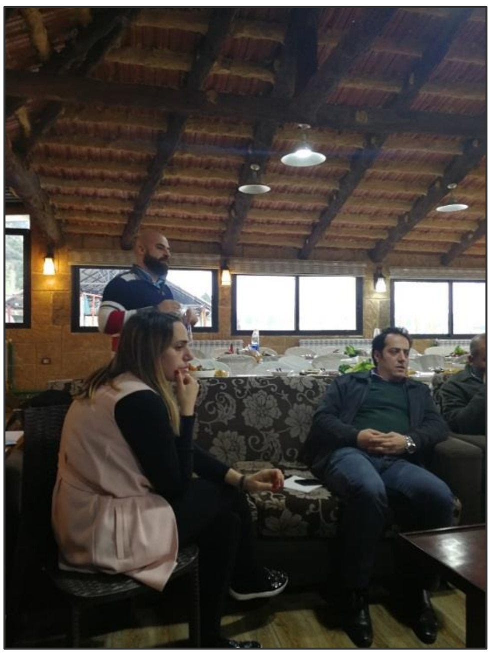
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6.6.2.14 Meetings with the Fnaidek Municipality

On 6 December 2018, several meetings were held between Lebanon Wind Power Project Management Team and representatives of the Municipality of Fnaidek to discuss the terms of the rental contract between the two institutions. Fnaidek municipality was represented by the Mayor Mr. Ahmad Baarini and Dr. Mohamad Ali while SA/LWP was represented by Me. Adele Halabi (lawyer of SA/LWP), Mr. Jules Assi and Eng. Sarkis Farah.

The main topics discussed during the meeting included the following:

1. Duration of this contract?

28 years. The rental contract is divided into three phases:

- Phase 1: Study and construction: 2 years.
- Phase 2: Operation of the wind farm: 25 years.
- Phase 3: Decommissioning: 1 year.

2. Number of parcels to be rented for the Project?

The municipality suggested renting out all the ridge, instead of renting parcels where turbines will be placed, at the same price of 7,000$/ MW installed capacity.

3. Price clarification as suggested by the companies?

The municipality asked if the 7,000 USD/MW was per installed capacity or per produced. The companies replied that the suggestion is per installed capacity. Therefore, if the selected EPC ultimately chooses to install 20MW on their lands, the total rental value will be as follow:

- Phase 1: During Construction: 700$ x 20MW = 14,000 USD / year; installation phase.
- Phase 2: Following Erection of Turbines: 7,000$ x 20MW = 140,000 USD/year, plus a 2% escalation per year; operations phase.
- Phase 3: During Decommissioning of Turbines: the final escalated yearly rate, paid on a monthly basis until decommissioning is completed.

4. Will a copy of the Lebanon Wind Power ESIA be provided?

Once the study is completed, it will be published on all of the lenders' websites for comment, and therefore, Lebanon Wind Power will share it with the municipality.

6.6.3 2019 Activities

6.6.3.1 Ramboll Meetings with Family Leaders and Officials

Between 19 and 21 January 2019, Ramboll conducted discussions with Mr. Abdo Jaafar (of the Jaafar Family), General Amid Daher (of the Daher Family), Mr. Ahmad Baarini (the Mayor of Fnaidek), and Omar Massoud, as shown in **Figure 6-15**. Ramboll provided an overview of the ESIA and sought feedback regarding the baseline environment, analysis of impacts and the preparation of Environmental and Social Management Plans. All three leaders communicated the full support by the communities they represent.

Figure 6-15 Ramboll Meeting with Omar Massoud

6.6.3.2 February 2019 Public Meeting for Hawa Akkar

Hawa Akkar held a Public Meeting on 15 February 2019. Attendance at the Hawa Akkar Public Meeting is relevant to the Project, and presented herein, as both projects will share the same WTG transport route. Invitations were sent out 2 weeks prior to the public meeting in written form (official registered letters) and by phone calls. Again, interest was noted as low, with one representative of a Union of Municipalities noted in attendance. In addition, representatives from the following NGOs were invited to this meeting, along with leadership from the villages noted above, as shown in **Table 6-5**.

Two of the NGOs were interested in attending and requested information via email since they could not attend:

- **Committee of Employee Women Union – CEWU**

  Address: Halba, Main Road, center Fakhoury, Facing Auxilia – First Floor
  Tripoli, Al Maarad Street, Badi Najjar Building near Crystal Marhaba - Third Floor
  Tel/Fax: +961 6 382 280
  Facebook Page: **Committee of Employee Women Union**

- **Society for the Protection of Nature in Lebanon (SPNL) who are associated with BirdLife International and represent BirdLife Lebanon**

  An Memorandum of Understanding (MOU) was signed between Hawa Akkar and SPNL earlier in 2012 for involvement and cooperation regarding bird watching and presence on-site , office for BirdLife within Hawa Akkar offices once project is operational, etc. Hawa Akkar met with SPNL in 2011, 2012 and 2019 for additional discussions, however they could not attend the February 2019 meeting.

Table 6-5 NGOs Invited to Hawa Akkar Public Meeting

NGOs	
Conseil De L'Environment - Quobaiyat*	Organization for Human and Social Services in North Lebanon
SPNL (Society for the Protection of Nature in Lebanon)	Committee for Conserving the Environment in North Lebanon
ALMEE (Lebanese Association for Energy Saving & for Environment)	Safadi Foundation
Wild Animals and Birds Research & Information Center	Committee of Employee Women Union in North Lebanon (CEWU)
Committee of Bentael National Park	North Lebanon Economic Development Agency (North LEDA)
Communal Council for the Development of Tannourine	Live Akkar
Conservation of Environment Committee- Besharry	Inmaa Koura Akkar
Association For Development In Akkar	Akkar Network For Development
Horizon of Cultural Development	Machta Hammoud Youth Group

* Present in previous public sessions in 2018 (9 June 2018 and 8 November 2018), but not on 15 February 2019.

6.6.3.3 Meeting with Lebanese Army Representatives

On February 7, 2019, Lebanon Wind Power and Sustainable Akkar team met with the Lebanese Army at the Chadra Military Base, as shown in **Figure 6-16**.

Mr. Jules Assi, Engineer Bachir El Marj and Engineer Sarkis Farah engaged in a general discussion about Project details with General Youssef Haddad, Army Regional Director in Chadra.

The main topics discussed during the meeting were:

- How Lebanon Wind Power and Sustainable Akkar will benefit from the Lebanese Army presence.
- Facilitating the procedure of acquiring necessary permits from the Lebanese Army to visit the site, especially for international personnel.
- Discussing the main concerns of the Lebanese Army, which included the following:
  - The noise impact of turbines on their barracks and the distance that should be maintained between the barracks and the turbines.
  - Shadow flicker and the length of the effect that will be visible for receptors.
  - The transport of the turbines, when and how it will be conducted, during which hours and the duration.

At the end of the meeting, General Youssef Haddad appointed Captain Abdallah Al Zohbi as the contact person between the Lebanese Army and the Project, in order to help with day to day tasks that may arise and requests, i.e. short notice permits for international personnel visiting the site.

Figure 6-16 Meeting with the Lebanese Army

6.6.3.4 Consultation with Villages Along the Wind Turbine Component Transport Corridor

Consultation activities were undertaken on 19-20 February 2019 with mayors representing the villages along the WTG component transportation route, from Tripoli to Sahle, and included the following, as summarized in **Table 6-6**.

<u>Al Fayhaa Union of Municipalities</u>

- On February 19, 2019, the Lebanon Wind Power and Sustainable Akkar team met with the mayors of the coastal line municipalities within the Northern Governorate, starting at the Al Fayhaa Union of Municipalities (representing Tripoli, Al Beddaoui, Al Minie and Qalamoun) to the Akkar Governorate limit, i.e. the Al Mhamra Municipality.

Table 6-6 Consultations with Municipalities & Governors

Name	Villages Represented	Date
Al Fayhaa Union of Municipalities	Tripoli, Al Beddaoui, Minie and Qalamoun	19-Feb-19
Deir Ammar Municipality	Deir Amar, Borj El-Yahoudiyé	19-Feb-19
Al Minie Municipality	Al Minie and Al Nabi Kzaiber Village	19-Feb-19
Zoug Bhannine Municipality	Zoug Bhannine	19-Feb-19
Al Mhamra Municipality	Al Mhamra	19-Feb-19
Talmaaiyan Union of Municipalities on behalf of the Akkar Countryside Municipalities	Mqaiteaa, Kfar Melki Akkar, Rmoul, Qaabrine, Sammouniyé, Hissa, Tall Aabbas El-Gharbi, Tall Aabbas El-Charqi, Tall Hmaire, Chir Hmairine, Hokr Jouret Srar,	20-Feb-19
Quobber Chamra Municipality	Quobber Chamra	20-Feb-19
Mqaible Municipality	Mqaible	20-Feb-19
Governor of the Akkar Region	Akkar Region	20-Feb-19
Quobaiyat Union of Municipalities on behalf of the North Akkar Municipalities	Iltigo, Barcha, Khamoubet Akkar, Janine, Qachlaq, Aamaret El-Baykat, Noura El Tahta, Kouachra, Dibbabiyé, Amayaret Akkar, Fraidis, Qsair Akkar, Menjez, Rmah, Chikhlar Quobaiyat, Chadra, Machta Hassan, Aaoaainat Akkar and Machta Hammoud,	26-Feb-19
Governor of North Lebanon	North Lebanon	26-Feb-19

Eng. Bachir El Marj and Eng. Sarkis Farah met each of the 4 mayors of the Al Fayhaa Union during their weekly meeting, as shown in **Figure 6-17**. The meeting was constructive, many questions were asked about the timeline of the transport of WTG components, the schedule of each transport, potential obstacles on the road and potential traffic blockage. The main concern of the Mayors was the timing of the transport. The Mayors advised to undertake transport after 12am, when the traffic is at its lowest, and to avoid transport on weekends as much as possible as many people travel north (including Akkar) to/from Beirut where they work during the week. The Project team answered the Mayor's questions as follows:

- Timetable: Between 11pm to 4am.
- Timeline of transport: 2 times roundtrip per week during weekdays.
- Number of trucks per transport: Total of 12 trucks roundtrip per transport day / 2 days per week during weekdays = total of 24 trucks roundtrip per week.
- Number of trips: Maximum of 21 turbines at Sustainable Akkar = 24 trucks roundtrip per week for total of 13 weeks.

Figure 6-17 Al Fayhaa Meeting with Mayors of Tripoli, Al Beddaoui, Al Minie and Qalamoun

The Project team also informed mayors that a communications protocol is being developed between the Project companies and the MOIM for the transport of the turbines from Tripoli to the Project site. Once this protocol is ready, it will be distributed to the Mayors two to three months prior to the start of the transport. At the end of the meeting, Mayors emphasized their willingness to provide further coordination across the municipalities and Project companies and assisting in accomplishing the Project as the fastest possible.

Deir Ammar Municipality

On February 19, 2019, the Project team met with Eng. Khaled Dhaybi, Mayor of Deir Amar, as shown in **Figure 6-18**. Deir Amar is located at the first Lebanese Army Checkpoint along the WTG transport corridor.

Mayor Dhaybi was welcoming and offered to assist the Project companies by providing a Municipal Police escort to facilitate the transport of the WTG components. The Mayor's main concerns regarded the provision of electricity in the northern region and if Deir Amar will benefit from the Project, as Deir Amar has an Electric Power Plant and is a link between the north and other Lebanese regions. The Project team explained the Project details, including the output of the Project in megawatts (68.3MW for Lebanon Wind Power and 82.5MW for Sustainable Akkar), and explained that the Project boundary ends when the companies connect to EDL's National Grid.

Mayor Dhaybi also asked about the presence of pedestrian bridges in Deir Amar. The Project team assured the Mayor that no pedestrian bridges will be completely removed to accommodate transport of the WTG components; however, they will be elevated to achieve the needed height clearance of 5m. In addition, the Project team confirmed that costs associated with any road improvements will be borne by the Company.

Figure 6-18 Deir Amar Meeting with Mayor Dhaybi

Al Minie Municipality and Al Nabi Kzaiber Village

On February 19, 2019, the Project team met with the Mayor of the Municipality of Al Minie, Mr. Zafer Zrayka, as shown in **Figure 6-19**. The Mayor informed the Project team that Al Nabi Kzaiber Village does not have a municipality and is under Al Minieh's municipal authority.

The Mayor welcomes the Project and gladly expressed that finally some investment will be coming to the north area of Lebanon --- after being left by the central government of Lebanon. Mayor Zrayka was friendly and willing to cooperate with the Project companies. During the WTG component transport phase, the Al Minie municipal police will provide an escort for the convoy.

The Mayor's only question regarded the speed bumps in the area. He expressed his opposition to removing them because there are many exits, and speed bumps are the only way to ensure the safety of the road. The Project team suggested replacing the asphalted speed bumps with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. Mr. Zrayka welcomed the idea, especially since the Project companies will be responsible for the expense of removing and reinstalling the speed bumps.

Zoug Bhannine Municipality

On February 19, 2019, the Project team met with the Mayor of Bhannine, Mr. Abou Tala Webheh , as shown in **Figure 6-20**. The proposed plan for the transport of WTG components was explained, and the Mayor advised that he was fine with all aspects. However, he noted that the Bhannine Municipality does not have an available police force to assist with the escort.

Figure 6-19 Al Minie and Al Nabi Kzaiber Village Meeting

Figure 6-20 Meeting with Zoug Bhannine Municipality

Mr. Webheh was also concerned about the speed bumps in the area, and the Project team proposed the same solution of replacing the asphalted speed bumps with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. The Mayor raised another concern regarding people going to and from Akkar during the WTG transport. The Project team informed the Mayor of the planned steps that the Project companies will be adopting to mitigate this potential negative impact, as itemized below:

- Transport Timetable: Between 11pm to 4am.
- Announcements will be made along the WTG transport route (i.e. from Tripoli to the entrance of the Project site).
- A communications protocol is being developed between the Project companies and the Ministry of Interior for the transport of the turbines from Tripoli to the Project site. Once this protocol is ready, it will be distributed to the Mayors two to three months prior to the start of the transport.

<u>Al Mhamra Municipality</u>

On February 19, 2019, the Project team met with the Mayor of the Municipality of Al Mhamra, Mr. Abed Elkader Osman, as shown in **Figure 6-21**. The Mayor was aware of the Project as he had attended the Hawa Akkar Public Meeting on 15 February held in Machta Hassan. The concerns raised by the Mayor were very aligned with the other municipalities, with the addition of concerns regarding the Abdeh Roundabout.

Figure 6-21 Meeting with Municipality of Al Mhamra

The Project team informed the Mayor that some modification might be needed on this roundabout, but any modification will be discussed with the municipality as it is under their authority. The Project team concluded the meetings by confirming that the cost of any modification to the roundabout that might be needed will be borne by the Project companies.

Meetings with Akkar Countryside Municipalities

On February 20, 2019, the Project team met with all 8 mayors of Akkar countryside municipalities within the Akkar Governorate at the Talmaaiyan Union of Municipalities, based on a request to gather all municipal leadership in the area, as shown in **Figure 6-22**.

Figure 6-22 Meeting with the Talmaaiyan Union of Municipalities

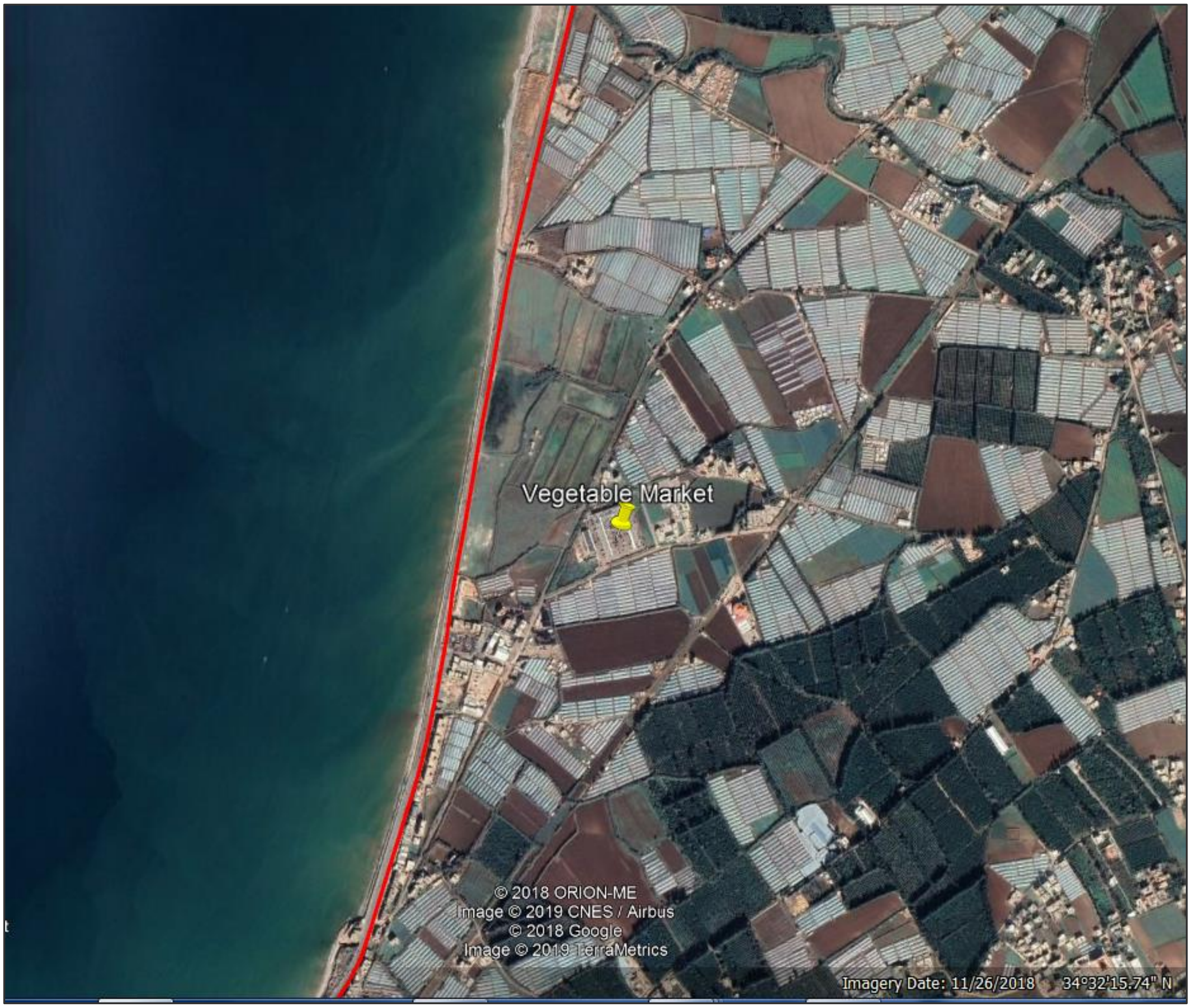
The Talmaaiyan Union of Municipalities is located next to Qlaiyaat Military Airport on the coastal countryside of Akkar, and includes the following:

- Talmaaiyan (Mayor Mohamad Masri).
- Aarida (Mayor Ali Assaad Khaled).
- Knaisse (Mayor Khodor Idris).
- Massoudiyeh (Mayor Mohamad Ayash).
- Tal Bireh (Mayor Abd alhamid Saker).
- Tal Abbas East (Mayor Mohsen Saleh).
- Hissa (Mayor Mohamad Ali Hsein).
- Abboudiyeh (Mayor Mohamad Al Masoumaaii).

The Project team introduced the Project and the purpose of the meeting. During the meeting, many questions were asked about the Project regarding electricity generation, road conditions, the timeline of the transport, the schedule of each transport, obstacles on the road and traffic blockage as follows:

- **Road conditions:** The road segment with the Talmaaiyan Union of Municipalities is only one lane in each direction, despite that it is the main road linking Akkar to the rest of Lebanon (as well as the main link between Lebanon and Syria). The following suggestions were made:
  - From Al Aabde to Sheikh Ayash, widen the road by at least 1m on each side.
  - Improve the road quality by fixing potholes and maintaining the asphalt.
  - Put pressure on the government fund the Project with $800 million to widen the road.
- **Access to the Akkar Vegetable Market**: Farmers take their crops every day to the Akkar Vegetable Market, located ~0.35km east of the transport corridor between Al Aabde and Khane as shown in **Figure 6-23**, leaving at 2am and returning at 3am. It was suggested that the transport of Project trucks requires coordination with the Ministry of Interior as the Akkar countryside is the main supplier of vegetables to the northern territories and all of Lebanon. It is noted that access to the Akkar Vegetable Market is provided by other roads.
- **Transit:** The road is the main access for trucks going to and from the Lebanese-Syrian border; therefore, close coordination between the Ministry of Interior and Project companies in order not to affect the international trade between Lebanon and rest of countries.
- **Speed bumps:** Speed bumps should be replaced by rubber ones which can be removed and reinstalled after each transport.
- **Potholes:** Maintain the road and fix the potholes on the road from Abde to Sheikh Ayash.
- **Cars parked on the road:** This has to be coordinated with the Municipal Police prior to the beginning of each transport.
- **Electrical cables:** Cables lower than the clearance height should be replaced and increased to higher than 5.5m.
- **Electricity:** They urged to increase the electricity supply in Akkar countryside region, where many farmers need electricity to power water pumps to grow their crops.
- **Employment:** The Talmaaiyan Union asked the Project team to employ people from the Akkar countryside, noting the unemployment rate in this region as one of the highest in Lebanon.
- **Closing the Al Minieh-Al Abde exits:** Closing these exits will ensure that people won’t crush the transport convoy by going against the traffic. This will ensure the safety of the transport.
- **Timetable and schedule of transport:** the transport will be two times per week from 11pm to 4am. The convoy will consist of 12 trucks roundtrip per transport.

Figure 6-23 Location of the Akkar Vegetable Market



Quobber Chamra Municipality

On February 20, 2019, the Project team met with the Mayor of Quobber Chamra Municipality, Mr. Hussein Ali Ibrahim, as shown in **Figure 6-24**.

In the meeting, the Mayor expressed his wish to cooperate with the Project's team to ensure the smooth transport within Quobber Chamra. The Mayor's main concern was the time of the transport; the Mayor advised to undertake transport between 12am and 3am to ensure that the Akkar Vegetable Market won't be affected by the convoy. The Mayor insisted on keeping the speed bumps on the 3km segment of road in Quobber Chamra, which is located at the exit of the vegetable market.

Figure 6-24 Meeting with the Quobber Chamra Municipality

Mqaible Municipality

On February 20, 2019, the Project team met with the Mayor of Mqaible Municipality, Mr. Ali Hassan Alsaiid. The Mayor expressed his readiness to cooperate; however, he requested an accurate map of the access road from Mqaible to ensure that the road won't create any conflict between the communities. The Project team promised to give him the map(s) once it is finalized.

The Project team discussed the road condition in Mqaible, and the Mayor advised them to improve the quality of the road, i.e. use asphalt when opening the access to ensure better transport conditions from Mqaible to Akroum.

Akkar Governorate

On February 20, 2019, the Project team met with the Governor of the Akkar Region in Halba, Mr. Imad Labaki, as shown in **Figure 6-25**.

The Project team provided an overview of the Project and technical information about the transport plan, timetable, schedule and number of trucks going from the Tripoli Seaport to the site. The Governor appreciated the visit and offered help in any legal and technical issues which can facilitate the transport of the trucks.

Figure 6-25 Meeting with the Governor of the Akkar Region

North Akkar Municipalities

On February 26, 2019, the SA/LWP team met all seven mayors of North Akkar area based on a request to gather all municipalities in the area. The meeting took place in Quobaiyat Union of Municipalities. The Quobaiyat Union of Municipalities includes the following municipalities: Quobaiyat (Al Aabdeh), Chadra (Simon Hannah), Machta Hassan (Mhamad Ahmad), Machta Hammoud (Mhamad Khaled), Aaoaainat Akkar (Georges Wehbi), Rmah (Georges Elias), Aaydamoun (CL. Youssef Abboud), as shown in **Figure 6-26**.

Figure 6-26 Meeting with North Akkar Union of Municipalities

Many questions were asked about the project, electricity, road condition, timeline of the transport, schedule of each transport, obstacles on the road and traffic blockage. Below is a summary of the concerns and ideas that have been discussed during the meeting:

- **Road condition:** The road was slightly better than the rest of the Akkar area, but it needs some improvement in order to successfully transport the turbines from the Tripoli Port to the Project site. The road needs some quality improvement by fixing potholes and maintaining asphalt in some section in Machta Hassan and Machta Hammoud area. Note: the internal roads of Machta Hassan and Machta Hammoud will not be used for transport.
- **Solar lighting poles:** When the team introduced the project, Quobaiyat and Machta Hamoud Mayors explained the issue of some RE solution that been implemented in the area, such as solar lighting poles. The mayors explained the high maintenance cost of these poles, from the expensive batteries to transformers which have a life cycle of a maximum 2 years. The team explained the difference between solar and wind which does not require any storage system.
- **Quarry:** the road is main access of the trucks transporting rocks and gravel from Boustan area east-southeast of the Project site. The quarries are constantly maintaining the roads in the area in order to get support from the communities. The same maintenance activities have to be done by the Project Proponent.
- **Speed bumps:** Surprisingly, all mayors were against using speed bumps especially on Abboudiye-Rmah highway. They have no problem at all with removing the speed bumps in this section of the road; however, they urged the Project team to keep the speed bumps in Machta Hassan and Machta Hammoud because it is a highly populated area and the roads are pretty narrow. Mayors told the team that the speed bumps should be built based on international standards: 3.75m long and 8cm in height. Note: the internal roads of Machta Hassan and Machta Hammoud will not be used for transport.
- **Potholes:** Maintain the road and fix the potholes on the road from Chadra to Machta Hammoud. Note: the internal roads of Chadra, Machta Hassan and Machta Hammoud will not be used for transport.
- **Electricity supply:** they urged to increase the electricity supply in North Akkar region because this area is the closest to the Project site and Quobaiyat has the main power plant which distribute the electricity to the whole region. The Mayors asked the Project team to put pressure on EDL to provide 24/7 electricity supply to the area, providing an example of the Shouff Area where a new landfill has been constructed there and the community put a pressure on EDL to provide 24/7 electricity supply to the area. The team explained that the municipalities in the area have to apply the pressure on the government and that the Project company has no right to change the electricity supply.
- **Employment:** the Union asked us to employ people from North Akkar area to work on the Project. The employment has to be divided equally on each municipality region. The Project team explained that the top priority is to employ people from the area surrounding the Project.
- **Chadra Roundabout:** Mayor Simon Hannah said that Chadra municipality paid around $50,000 to fix the Chadra entrance and created a roundabout in order to facilitate the traffic flow from Machta Hassan and Machta Hammoud. If this roundabout is going to be removed during the transport

phase, the Project team has to reconstruct it on its own expense. The team explained that based on the road survey study, the roundabout will not be removed.

- **Development:** the Project will contribute positively on the area, where people working on site will need accommodation, restaurants, and general services in the area.
- **Helicopter Option for Transport of WTG Components**: The Mayor of Machta Hammoud asked about using the helicopter option to transport the turbines to the site. The Project team explained that the road will be used for the transport of WTG components, noting that the Project company will maintain the road all the way from Tripoli Port to the Project site which will benefit the people using these roads.
- **Karm Chbat Nature Reserve:** The Mayor of Quobaiyat asked the Project team to put pressure on the government to declare the Karm Chbat Nature Reserve. Declaring the forest as a natural preserve will stop farmers from grazing goats there. Grazing is the main threat to the forest, where the goats constantly graze small trees; this is why there is only big trees in the forest, and it is really rare to see newly trees growing. In addition to stopping the grazing, making the forest a natural reserve will stop people from the area from cutting tree just to use it as a heat source during winter.
- **Timetable and schedule of transport:** The transport of WTG components will be undertaken a maximum of two times per week from 12am to 4am. The convoy will consist of 11 trucks.

<u>North Lebanon Governor</u>

On February 25, 2019, Eng. Bachir El Marj and Eng. Sarkis Farah met with the North Lebanon Governor (Ramzi Nohra) in Tripoli, as shown in **Figure 6-27**. The meeting was constructive, the team explained the transport plan, timeline of the transport, schedule of each transport, obstacles on the road and traffic blockage. The Governor was supportive and promised to facilitate any issue we will be facing before and during the transport.

Figure 6-27 Meeting with Governor of North Lebanon

6.6.3.5 Project Presentation at Beirut Arab University

On March 9, 2019, Eng. Jules Assi and Eng. Bachir El Marj presented the Project at the Beirut Arab University, Department of Mechanical Engineering, focusing on RE and EE, as shown in **Figure 6-28**. The team introduced the Project to University staff and students. Students expressed happiness about the Project and asked about requirements needed to apply for a job during the construction phase. The team offered an internship program for students wiling to learn and get experience about wind farms.

Figure 6-28 Project Presentation at Beirut Arab University

6.6.3.6 Public Participation Outcomes

As indicated in the previous sections, extensive public participation activities have been undertaken since early 2017. Activities have included participatory planning, disclosure and dissemination of information, consultation & participation, an informal grievance mechanism (formalized herein as an outcome of the ESIA in the ESMP), and on-going reporting to local communities.

All affected communities have been engaged to: 1) support the collection of social demographic data; 2) gain an understanding of community access to energy, consumption, and how the lack of a reliable energy supply may affect livelihoods; 3) understand attitudes of the local population toward the Project and expectations around better energy supply. The prevalent response of those engaged has been extremely positive, with community leaders and members anxiously awaiting the construction and operation of the Project.

It is noted that Sunni and Shiite landowners in the Project area have historically disputed the division of land. After becoming knowledgeable about the Project details, the need for acquisition and leasing of land, and the Project's commitment to fairly distribute compensation through the location of wind turbines and substation, agreement concerning the division of land was reached over a short, 2-day period.

Project-related benefits have been expressed by community members as follows:

- Potential employment during construction and operations phases.
- Income generated by sale of land and land lease.
- Economic stimulus through provision of worker accommodation and meals at local hotels, apartments and restaurants.
- Provision of electricity to the grid to reduce or eliminate blackout periods.

There have been no objections raised by NGOs. The concerns expressed by stakeholders have been clearly documented and addressed as part of the decision-making process of the Project. Specifically, concerns have been incorporated into decisions regarding the following:

- Land rental agreements and compensation.
- Siting of wind turbines to avoid noise, shadow flicker and visual impacts to receptors.
- Road development, route selection and timing for the WTG components and construction materials.
- Employment opportunities.
- Maintaining access to hunting tracks and grazing areas.
- Minimizing impacts to the Karm Chbat Nature Reserve.
- Maintaining a buffer around the Lebanese Army Military Base.
- Common traffic management plan for Lebanon Wind Power, Sustainable Akkar and Hawa Akkar wind farms.
- Quantifying potential impacts to migratory birds.

High level meeting minutes from engagement with Akkar leaders is summarized in **Table 6-7**. Though not present in the DAOI, particular attention was paid to vulnerable groups, i.e. Syrian and Palestinian refugees and the location of informal settlements, was considered. Based on the findings of the ESIA, vulnerable groups are not disproportionately affected by Project impacts (refer to **Section 15 Socioeconomic Conditions**).

Table 6-7 High Level Meeting Minutes

Mayor of Fnaidek , July 20, 2018 at 11:00 am:	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	• **How many people are living in the village now?** It varies but approximately between 2,000 and 3,800 residents. • **Can you be specific?** I can't since we don't have any exact data of that but this from my knowledge • **Is the area still considered an agricultural village?** Yes, but not much since most work now outside the agriculture but some still care for their lands and some have leased it to others to care for it. We have about 4,000 farmers and 2,000 farmer residents working in farming on and off season. • **How many subscription generators are there?** I think 7 now and they are all managed by the owners of these generators. • **Are there companies and businesses that rely on the generators?** Yes, all of them, we don't get enough power, so we need to use generators. • **How about farmers?** Also, they rely on generators but depending on what they are doing since it is seasonal practice. • **Do you and the municipality welcome the idea of green energy?** Yes of course. • **Do you think that the supply of power from the windmill will help the area and its people?** Absolutely, it will enrich our struggling economy and support SMEs and households and it will bring contentment to people once they know they have power more. • **Do you think that SMEs and businesses here are affected by the cost of energy?** Yes of course, shops and companies that have high consumption from 50 to 100 and 150Kw pay high. • **Do you think this will have a better economic impact once the project is operational?** Yes ,100% we are in a small village and central, if we have more electricity, shops will open longer and more often, and we will benefit from more trade and exchange of goods and sales. • **What do you know about green energy?** It is clean and effective way for getting electricity. • **What do you know about the windmill project and its energy?** I know what we have been told about it and how effective it is for remote areas. • **Do you think your village is ready for such project?** Yes, we are ready. • **Do you think it will supply the village well?** Yes, if it is done well and if it is effective and cheaper than generators. • **What impact do you see it can bring on the residents, households and companies?** It will save them money. • **Do you prefer that the windmill be managed by the company?** Yes, and we are ready to assist in anyway. • **What are your expectations from this project, and do you support and promote the idea?** The expectation is for sure positive and I do support and promote it. We are expecting that this supply of energy will increase commercial and touristic activities and have positive economic impact on the region, and this is why I want this project strongly and I am willing to provide all support from the municipality since it is a project long been waited for and its benefits

	are plenty and inshallah it will have great economic and livelihood impact.
Meeting with Omar Zahraman, Member of Municipal Council of Fnaidek, Electrical Engineer at the Electricité de Liban Akkar, 20/07/2018, at 12:30 pm	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	**Are you aware of the Lebanon Windmill Project?** Yes, of course. **Do you think it will happen?** Yes, and they are working on it. **What is in your technical opinion the level of consumption of electricity per household?** I pay, for example, around 100,000 lira per month for generators and around 50,000 for government electricity. It varies based on consumption, but the important part is that here the fees are 0.5 $ per KW and you have the monthly subscription of 25,000 lira. Generator owners do give less sometimes depending on the family but in general this is the charge. **What is the power outage in the area?** It also varies, but from 10 hours to 20 hours at times. **What are your thoughts on this project?** It is a great project for the region, and we have long waited for it and wished for it to happen. It will definitely have positive impact on all sectors especially livelihoods since it will bring clean effective and affordable energy supply to the village and the region.
Meeting with Mohamed Salaheldine, Municipality Council Member, Fnaidek, 20/07/2018	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	**Do you know about the project?** Yes of course, I believe the rumors have already spread about it and many know by now. **Are you personally supportive of this project?** Yes, for sure and especially the municipality. **What do you think about the project?** It is a good and if implemented and does not get any obstacles like other projects benefiting Akkar. **Any anticipated impact?** Saving money, increased supply of electricity, the whole region will be feeling better and of course better livelihood.
Meeting with Dr. Antoine Daher, Environmental Counsel on 11 August 2018	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	Dr. Daher is fully aware of the project and all its details since he is part of the environmental counsel of Akkar. The phone meeting focused on his perspective and views on the project and the impact that it might carry on the region. Dr Daher stated his support for this Project as he is a believer in clean effective alternative energy, but within this scope of green energy lies many environmental aspects that can be harmful to nature and is looking to see the Company's feedback on the environmental assessment. For example, would the sound of the mills create noise and distortion on the households, what is the impact of the migrating birds flying at certain elevation? Also, no technical awareness or publication has been posted to enlighten us about it, so we can support more especially that there are groups fighting this project in several villages and they are creating a negative lobby against it. Here it is the role of the company to engage us and allow us to better support them and present the facts concerning our environmental fears. These lobbyists are the ones who will or did not get to benefit from the project financially and are spreading negative rumors and wrong facts about its impact. More, we still need to know from the company what will be their plan of electricity supply and will effectively the Akkar villages will benefit or it will

	be as the rumors are saying that most of the electricity generated will go to support other regions outside the north and we will only get a fraction. So overall, there are plenty of clarifications that are needed, and the company should be more proactive with us to make this project transparent and clear in terms of its objectives and goals.
Ahmad Omar, Head of Akkar Development Association, 06/08/2018	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	He is in support of the project and aims that it will bring positive impact on the region since neighboring villages will also benefit. He also said that it will make the electricity burden less on households and improve overall livelihoods expressed in less spending and more saving. Also, he wished that the Project will have also positive environmental impact and it will be far from houses. He is aware of the green energy solutions and knows about the project. His information regarding consumption and costs are similar to all answers obtained and his wishes was expressed that the project will eventually reduce the cost of energy and allow businesses to operate and work more since it will affect the positive chain or reaction effecting livelihoods. He also indicated that women and kids are the primary target benefiting from the clean energy and the supply of electricity since they are the ones who spend most of their time at home. He also wished that the project as planned will provide consistent supply and not rationed supply and not benefit the region.
Mr. Abdo Abdo, Quobaiyat Municipality Mayor and Samira Tannous, Mayor Secretary of Quobaiyat -25 July 2018	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	Mayor Abdo expressed that this project is a good project since it finally brings a viable solution that is not harmful to nature and it will bring effective and affordable energy to the region, however, he expressed concerns about the environmental pollution such as noise, birds, land use, and so on. He is supportive of the project and will do all it takes but he would like to see the engagement of the company also towards the citizens and enlighten them about the full scope and benefits of the project on Quobaiyat and other villages that shall benefit from the project. They are not interested in just being a land donor without enjoying the benefits of the project being installed on their land. As for Mrs. Samira Tannous, she also anticipates the financial and livelihood benefits the windmill shall bring and looking forward to seeing the impact as expected from this project especially when power outage has been a major livelihood problem across Lebanon and especially in rural areas.
Mr. Abdo Jaafar, Focal Point of Rweimeh Village Area, 27 July 2018	
The meeting was to enquire about the Project, understand the position of the municipality and get some related information.	Mr. Abdo expressed his full support from his side, and he wishes that the project brings good and prosperity to the region and villages around especially in term of improving livelihood through more supply of electricity.

6.6.3.7 May 2019 Consultation

In May 2019, the Developer undertook consultation with various stakeholder groups as part of the ongoing engagement activities described in the SEP. The purpose of the engagement was to assess the level of general knowledge about wind farms and the planned Lebanon Wind Power, Sustainable Akkar and Hawa Akkar wind farms, to gain a sense of whether stakeholders thought the projects' objectives were going to be achieved, to understand stakeholder views regarding the projects' impacts (both positive and negative), and to assess stakeholder support for the projects. In addition, some basic socioeconomic information was collected and has been included in **Section 15 Socioeconomic Conditions**.

A standardized questionnaire was developed and used by the CRO to survey stakeholders. The English translation and compilation of results are presented in **Appendix G**.

<u>Landowners in Jabal-Akroum Kfartoun</u>

Twenty-two (22) landowners who will be leasing parcels for the development of the planned Sustainable Akkar wind farm were engaged, specifically landowners for the parcels associated with WTG 02 (6 landowners), WTG 08 (1 landowners), WTG 10 (2 landowners), WTG 14 (1 landowner), WTG 19 (1 landowner), WTG 20 (1 landowner), WTG 21 (1 landowner), WTG 22 (1 landowner), WTG 23 (4 landowners), WTG 25 (1 landowner) and WTG 27 (2 landowners). The results of the survey are summarized in **Table 6-8**.

Table 6-8 Consultation Survey Results – Landowners in Jabal-Akroum Kfartoun

<table>
<tr><th colspan="6">Knowledge and Source of Knowledge of Wind Farms</th></tr>
<tr><th colspan="2">Very Good</th><th colspan="2">Slight</th><th colspan="2">None</th></tr>
<tr><td colspan="2">19</td><td colspan="2">1</td><td colspan="2">1</td></tr>
<tr><th colspan="6">Source of Wind Farm Knowledge (more than 1 response allowed)</th></tr>
<tr><th>Word of Mouth</th><th colspan="2">Municipal Gathering</th><th>Internet</th><th>Education</th><th>Media</th></tr>
<tr><td>19</td><td colspan="2">0</td><td>2</td><td>1</td><td>1</td></tr>
<tr><th colspan="6">Assessment of Success Level in Reaching Project Objectives</th></tr>
<tr><th colspan="2">Yes/Good</th><th colspan="2">Affected/Maybe/Normal</th><th colspan="2">No Response/NA</th></tr>
<tr><td colspan="6">Improve Environmental Conditions/Reduce Emissions</td></tr>
<tr><td colspan="2">16</td><td colspan="2">3</td><td colspan="2">2</td></tr>
<tr><td colspan="6">Reduce Electricity Cuts in Villages</td></tr>
<tr><td colspan="2">19</td><td colspan="2">3</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Ensure Reliance on RE</td></tr>
<tr><td colspan="2">20</td><td colspan="2">2</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Strengthen Local Economic Activity and Job Creation in Village</td></tr>
<tr><td colspan="2">22</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Decrease Cost of Electricity Consumption</td></tr>
<tr><td colspan="2">19</td><td colspan="2">2</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Enhance Living Conditions in Village</td></tr>
<tr><td colspan="2">19</td><td colspan="2">2</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Boost State through Reduction in Fuel Oil Imports</td></tr>
<tr><td colspan="2">19</td><td colspan="2">2</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Easing of Electricity Crisis</td></tr>
<tr><td colspan="2">15</td><td colspan="2">7</td><td colspan="2">0</td></tr>
<tr><td colspan="6">Decrease State Expenditure through Private Sector Participation in Electricity Production</td></tr>
<tr><td colspan="2">19</td><td colspan="2">2</td><td colspan="2">0</td></tr>
</table>

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
1	1	19
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
19	2	0
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
13	8	1
Economic Activity in Village		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
14	7	1
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
7	13	1
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
4	16	2
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad/NA*
0	20	1
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
16	4	2
Environmental Diversity at Project Site and Vicinity		
Yes	*No*	*No Response/NA*
0	*0*	*22*
Noise Pollution		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
13	7	2
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
16	1	5
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
19	3	0
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
13	8	1
Economic Activity in Village		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
17	5	0
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
15	7	0
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
15	4	3
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
12	*6*	*4*
Image of Region		
Good	*Affected/Maybe/Normal*	*No Response/NA*
13	7	2

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
17	4	1
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
13	7	2
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	9	1
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
16	4	2
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
7	0	15
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
16	3	3
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
13	8	1
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
9	12	0
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
11	11	0
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
4	18	0
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
5	5	12
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
7	14	1
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
9	12	1
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	10	4
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
11	6	5
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
5	12	5

Stakeholders Support for the Wind Farm Project		
Yes	**Affected/Maybe/Normal**	**No Response/NA**
Respondent		
21	1	0
Municipality		
1	3	18
Private Businesses		
12	1	9
Opinion Leaders		
21	1	0
Residents		
16	6	0
Local NGOs		
1	0	21
Landowners		
21	0	0
Owners of Generators		
0	3	19

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
18	4	0	0

Residents of Machta Hassan

Fourteen (14) residents of Machta Hassan were engaged. Machta Hassan is located due west of the planned Hawa Akkar wind farm, however no land lease/acquisition is from this village and a new asphalt road segment will be constructed to avoid impacts to the village centers of Chadra, Machta Hassan and Machta Hammoud. The results of the survey are summarized in **Table 6-9**.

Table 6-9 Consultation Survey Results – Residents of Machta Hassan

Knowledge and Source of Knowledge of Wind Farms		
Very Good	**Slight**	**None**
1	6	7

Source of Wind Farm Knowledge (more than 1 response allowed)				
Word of Mouth	**Municipal Gathering**	**Internet**	**Education**	**Media**
11	3	2	0	0

Assessment of Success Level in Reaching Project Objectives		
Yes/Good	**Average/Maybe/Normal**	**No Response/NA**
Improve Environmental Conditions/Reduce Emissions		
6	0	8
Reduce Electricity Cuts in Villages		
14	0	0
Ensure Reliance on RE		
7	0	7
Strengthen Local Economic Activity and Job Creation in Village		
12	2	0
Decrease Cost of Electricity Consumption		
12	0	2
Enhance Living Conditions in Village		
14	0	0
Boost State through Reduction in Fuel Oil Imports		
13	0	1
Easing of Electricity Crisis		
14	0	0
Decrease State Expenditure through Private Sector Participation in Electricity Production		
14	0	0

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	0	14
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
3	3	8
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
1	0	13
Economic Activity in Village		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
3	4	7
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	7	7
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	13	1
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad*
0	8	6
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
1	13	0
Environmental Diversity at Project Site and Vicinity		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	*14*	*0*
Noise Pollution		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	14	0
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
14	0	0
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	7	7
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	0	14
Economic Activity in Village		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
2	2	10
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	12	2
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
0	0	14
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
1	0	13
Image of Region		
Good/Improving	*Affected/Maybe/Normal*	*Bad/NA*
2	10	1

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	14	0
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	14	0
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	14	0
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	14	0
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	12	2
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	12	2
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
5	0	6
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
5	1	8
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
6	4	4
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
7	3	4
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
2	5	7
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*Affected/NA*
0	10	4
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*Affected/NA/No Response*
0	0	14
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*Affected/NA/No Response*
0	0	14
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*Affected/NA/No Response*
0	0	14
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*Affected/NA/No Response*
7	0	7

Stakeholders Support for the Wind Farm Project		
Yes	**No**	**No Response/NA**
Respondent		
3	11	0
Municipality		
0	0	14
Private Businesses		
0	0	14
Opinion Leaders		
0	0	14
Residents		
0	0	14
Local NGOs		
0	0	14
Landowners		
0	0	14
Owners of Generators		
0	0	14

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
4	9	1	0

Residents of Machta Hammoud

Twenty (20) residents of Machta Hammoud were engaged. Machta Hammoud is located due west of the planned Hawa Akkar wind farm, and land lease/acquisition is needed for construction of the planned Hawa Akkar wind farm. The results of the survey are summarized in **Table 6-10**.

Table 6-10 Consultation Survey Results – Residents of Machta Hammoud

Knowledge and Source of Knowledge of Wind Farms		
Very Good	**Slight**	**None**
0	4	16

Source of Wind Farm Knowledge (more than 1 response allowed)				
Word of Mouth	**Municipal Gathering**	**Internet**	**Education**	**Media**
19	1	0	0	0

Assessment of Success Level in Reaching Project Objectives		
Yes/Good	**Average/Maybe/Normal**	**No Response/NA**
Improve Environmental Conditions/Reduce Emissions		
19	1	0
Reduce Electricity Cuts in Villages		
20	0	0
Ensure Reliance on RE		
18	1	1
Strengthen Local Economic Activity and Job Creation in Village		
19	0	1
Decrease Cost of Electricity Consumption		
19	0	1
Enhance Living Conditions in Village		
19	0	1
Boost State through Reduction in Fuel Oil Imports		
19	0	1
Easing of Electricity Crisis		
19	0	1
Decrease State Expenditure through Private Sector Participation in Electricity Production		
19	0	1

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*No Affect*	*No Response/NA*
18	2	
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
20	0	0
Income Sources for Residents		
Yes	*Affected/Maybe//Normal*	*No Response/NA*
19	0	1
Economic Activity in Village		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
17	3	0
Attractiveness of Region to Visitors		
Yes	*Affected/Normal/Maybe*	*No Affect/NA*
10	9	1
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	20	0
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad*
0	18	2
Pollution at the Project Site and Vicinity		
No Affect	*Affected/ Maybe/Normal*	*Bad/NA*
18	2	0
Environmental Diversity at Project Site and Vicinity		
Yes	*No*	*No Response*
0	*0*	*20*
Noise Pollution		
No Affect	*Affected/Normal*	*Yes/Affected*
18	0	2
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*NA*
20	0	0
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*NA*
20	0	0
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*NA*
19	0	1
Economic Activity in Village		
Yes/Improving	*Affected/Maybe/Normal*	*NA*
19	1	0
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*NA*
16	4	0
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*Bad/NA*
18	0	2
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*NA/No Response*
18	0	2
Image of Region		
Good/Improving	*Affected/Maybe/Normal*	*Bad/NA*
20	0	0

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	5	0
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
11	9	0
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	5	0
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	8	0
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
14	5	1
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	5	0
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
19	0	1
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
19	0	1
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
19	0	1
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
13	1	6
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
9	0	11
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	8	0
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*Affected*
18	0	2
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	0	10
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	0	10
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	6	2

Stakeholders Support for the Wind Farm Project		
Yes	**No**	**No Response/NA**
Respondent		
16	4	0
Municipality		
2	0	18
Private Businesses		
0	0	20
Opinion Leaders		
0	0	20
Residents		
0	0	20
Local NGOs		
0	0	20
Landowners		
0	0	20
Owners of Generators		
0	0	20

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
14	5	1	0

Residents of Mqaible

Thirty-six (36) residents of Mqaible were engaged. Mqaible is located due east of the planned Hawa Akkar wind farm, and land lease/acquisition is needed for construction of the planned Hawa Akkar wind farm. The results of the survey are summarized in **Table 6-11**.

Table 6-11 Consultation Survey Results – Residents of Mqaible

Knowledge and Source of Knowledge of Wind Farms		
Very Good	**Slight**	**None**
0	29	7

Source of Wind Farm Knowledge (more than 1 response allowed)				
Word of Mouth	**Municipal Gathering**	**Internet**	**Education**	**Media**
36	2	0	0	0

Assessment of Success Level in Reaching Project Objectives		
Yes/Good	**Affected/Maybe/Normal**	**No Response/NA**
Improve Environmental Conditions/Reduce Emissions		
36	0	0
Reduce Electricity Cuts in Villages		
36	0	0
Ensure Reliance on RE		
36	0	0
Strengthen Local Economic Activity and Job Creation in Village		
36	0	0
Decrease Cost of Electricity Consumption		
36	0	0
Enhance Living Conditions in Village		
36	0	0
Boost State through Reduction in Fuel Oil Imports		
36	0	0
Easing of Electricity Crisis		
36	0	0
Decrease State Expenditure through Private Sector Participation in Electricity Production		
36	0	0

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
0	3	33
Job Opportunities for Locals		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
36	0	0
Income Sources for Residents		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
34	1	1
Economic Activity in Village		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
35	1	0
Attractiveness of Region to Visitors		
Yes	*No Affect/ Normal/Maybe*	*No Response/NA*
10	26	0
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
1	34	1
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad*
0	30	6
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
33	2	1
Environmental Diversity at Project Site and Vicinity		
Yes	*No*	*No Response/NA*
0	*0*	*36*
Noise Pollution		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
32	2	1
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Economic Activity in Village		
Yes/Improving	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
25	11	0
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
32	1	3
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
32	1	3
Image of Region		
Good/Improving	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
26	8	2
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
18	16	2
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
23	10	3
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
20	12	4
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
23	2	11
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
28	2	6
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
35	1	0
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
35	1	0
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*NA*
35	1	0
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
24	6	6
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
17	1	18
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
20	16	0
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
25	1	10
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
19	1	16
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
19	1	16
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
30	5	1

Stakeholders Support for the Wind Farm Project		
Yes	**No**	**No Response/NA**
Respondent		
36	0	0
Municipality		
21	0	15
Private Businesses		
0	0	36
Opinion Leaders		
9	0	27
Residents		
10	0	26
Local NGOs		
0	0	36
Landowners		
26	0	10
Owners of Generators		
0	0	36

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
25	9	1	1

Residents of Chadra

Twenty-two (22) residents of Chadra were engaged. Chadra is located due west of the planned Hawa Akkar wind farm. The results of the survey are summarized in **Table 6-12**.

Table 6-12 Consultation Survey Results – Residents of Chadra

Knowledge and Source of Knowledge of Wind Farms		
Very Good	**Slight**	**None**
13	7	1

Source of Wind Farm Knowledge (more than 1 response allowed)				
Word of Mouth	**Municipal Gathering**	**Internet**	**Education**	**Media**
19	18	12	1	2

Assessment of Success Level in Reaching Project Objectives		
Yes/Good	**Affected/Maybe/Normal**	**No Response/NA**
Improve Environmental Conditions/Reduce Emissions		
16	4	1
Reduce Electricity Cuts in Villages		
18	3	1
Ensure Reliance on RE		
17	2	3
Strengthen Local Economic Activity and Job Creation in Village		
17	1	4
Decrease Cost of Electricity Consumption		
15	2	5
Enhance Living Conditions in Village		
15	2	5
Boost State through Reduction in Fuel Oil Imports		
15	2	5
Easing of Electricity Crisis		
19	0	2
Decrease State Expenditure through Private Sector Participation in Electricity Production		
17	2	21

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
15	0	7
Job Opportunities for Locals		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
18	3	1
Income Sources for Residents		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
7	7	8
Economic Activity in Village		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
14	4	4
Attractiveness of Region to Visitors		
Yes	*No Affect/ Normal/Maybe*	*No Response/NA*
6	11	5
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
2	14	6
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad*
0	20	1
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	5	7
Environmental Diversity at Project Site and Vicinity		
Yes	*No*	*No Response/NA*
0	*0*	*22*
Noise Pollution		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
6	11	5
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
21	1	0
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
18	3	1
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
10	8	4
Economic Activity in Village		
Yes/Improving	*Affected/Maybe/Normal*	*No Response/NA*
16	5	1
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
13	5	4
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
11	4	7
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
2	13	7
Image of Region		
Good/Improving	*Affected/Maybe/Normal*	*No Response/NA*
12	7	3

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	5	2
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
13	7	2
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	9	3
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	6	4
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
4	6	12
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
2	19	1
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
13	7	2
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
8	13	1
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*NA*
10	11	1
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
2	19	1
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
5	8	9
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	6	1
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
7	15	1
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	11	1
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	8	4
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
6	11	5

Stakeholders Support for the Wind Farm Project		
Yes	**No**	**No Response/NA**
Respondent		
2	0	20
Municipality		
21	0	1
Private Businesses		
13	0	9
Opinion Leaders		
16	0	6
Residents		
17	2	3
Local NGOs		
1	2	19
Landowners		
19	0	3
Owners of Generators		
2	1	19

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
15	5	1	1

Residents of Akroum

Sixteen (16) residents of Akroum were engaged. Akroum is located due east of the planned Hawa Akkar wind farm. The results of the survey are summarized in **Table 6-13**.

Table 6-13 Consultation Survey Results – Residents of Akroum

Knowledge and Source of Knowledge of Wind Farms		
Very Good	**Slight**	**None**
0	12	1

Source of Wind Farm Knowledge (more than 1 response allowed)				
Word of Mouth	**Municipal Gathering**	**Internet**	**Education**	**Media**
16	0	0	0	0

Assessment of Success Level in Reaching Project Objectives		
Yes/Good	**Affected/Maybe/Normal**	**No Response/NA**
Improve Environmental Conditions/Reduce Emissions		
16	0	0
Reduce Electricity Cuts in Villages		
16	0	0
Ensure Reliance on RE		
16	0	0
Strengthen Local Economic Activity and Job Creation in Village		
16	0	0
Decrease Cost of Electricity Consumption		
16	0	0
Enhance Living Conditions in Village		
16	0	0
Boost State through Reduction in Fuel Oil Imports		
16	0	0
Easing of Electricity Crisis		
16	0	0
Decrease State Expenditure through Private Sector Participation in Electricity Production		
16	0	0

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
0	1	15
Job Opportunities for Locals		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
15	0	1
Income Sources for Residents		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
9	1	6
Economic Activity in Village		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
15	0	1
Attractiveness of Region to Visitors		
Yes	*No Affect/ Normal/Maybe*	*No Response/NA*
4	8	4
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
2	12	2
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad*
0	9	7
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	6	0
Environmental Diversity at Project Site and Vicinity		
Yes	*No*	*No Response/NA*
1	*2*	*13*
Noise Pollution		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
12	3	1
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
0	1	15
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
15	0	1
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
9	1	6
Economic Activity in Village		
Yes/Improving	*Affected/Maybe/Normal*	*No Response/NA*
15	0	1
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
10	5	1
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	4	2
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
13	1	2
Image of Region		
Good/Improving	*Affected/Maybe/Normal*	*No Response/NA*
16	0	0

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	6	0
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	6	0
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	6	0
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
8	7	1
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
6	6	4
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
8	7	1
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
14	1	1
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	0	1
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*NA*
14	1	1
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
9	0	7
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
5	1	10
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
14	2	0
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
15	1	0
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
11	0	5
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
11	0	5
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
10	6	0

Stakeholders Support for the Wind Farm Project		
Yes	**No**	**No Response/NA**
Respondent		
16	0	0
Municipality		
4	0	12
Private Businesses		
0	0	16
Opinion Leaders		
8	1	7
Residents		
7	1	8
Local NGOs		
0	0	16
Landowners		
9	0	7
Owners of Generators		
0	0	16

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
12	4	0	0

Residents of Sahle

Thirty-six (36) residents of Sahle were engaged. Sahle is located on the south end of the planned Hawa Akkar wind farm. The results of the survey are summarized in **Table 6-14**.

Table 6-14 Consultation Survey Results – Residents of Sahle

Knowledge and Source of Knowledge of Wind Farms		
Very Good	**Slight**	**None**
0	29	7

Source of Wind Farm Knowledge (more than 1 response allowed)				
Word of Mouth	**Municipal Gathering**	**Internet**	**Education**	**Media**
34	2	0	0	0

Assessment of Success Level in Reaching Project Objectives		
Yes/Good	**Affected/Maybe/Normal**	**No Response/NA**
Improve Environmental Conditions/Reduce Emissions		
35	0	1
Reduce Electricity Cuts in Villages		
16	0	0
Ensure Reliance on RE		
36	0	0
Strengthen Local Economic Activity and Job Creation in Village		
36	0	0
Decrease Cost of Electricity Consumption		
36	0	0
Enhance Living Conditions in Village		
36	0	0
Boost State through Reduction in Fuel Oil Imports		
36	0	0
Easing of Electricity Crisis		
36	0	0
Decrease State Expenditure through Private Sector Participation in Electricity Production		
36	0	0

Project Impacts During Construction		
Financial Resources of Municipality		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
0	2	34
Job Opportunities for Locals		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
36	0	0
Income Sources for Residents		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
34	1	1
Economic Activity in Village		
Yes	*No Affect/Normal/Maybe*	*No Response/NA*
35	1	0
Attractiveness of Region to Visitors		
Yes	*No Affect/ Normal/Maybe*	*No Response/NA*
11	20	5
Traffic Conditions on the Main Road to the Village		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
0	36	0
State and Quality of Village Roads		
Good	*Affected/Maybe/Normal*	*Bad*
0	36	0
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
33	2	1
Environmental Diversity at Project Site and Vicinity		
Yes	*No*	*No Response/NA*
0	*0*	*36*
Noise Pollution		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
32	2	2
Project Impact Assessment during Operations Phase		
Financial Resources of Municipality		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Job Opportunities for Locals		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Income Sources for Residents		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Economic Activity in Village		
Yes/Improving	*Affected/Maybe/Normal*	*No Response/NA*
36	0	0
Attractiveness of Region to Visitors		
Yes	*Affected/Maybe/Normal*	*No Response/NA*
25	11	0
Pollution at the Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
32	2	2
Environmental Diversity at Project Site and Vicinity		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
32	1	3
Image of Region		
Good/Improving	*Affected/Maybe/Normal*	*No Response/NA*
35	1	0

Potential Project Impacts on Resources		
Wild Animals		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
25	9	2
Edible/Wild Herbs		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
18	16	2
Livestock/Grazing Areas		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
23	11	2
Resident Breeding Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
20	12	4
Bats		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
23	4	9
Migratory Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
28	3	5
Potential Negative Impacts on Resources		
Ice Shards to Passers By		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
35	1	0
Light Gleam from Rotor		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
35	1	0
Shadow Flicker		
No Affect	*Affected/Maybe/Normal*	*NA*
35	1	0
Transmissions Lines Near Dwellings		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
23	9	4
Soil and Groundwater Contamination from Oil Spill		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
17	1	18
Aesthetic/Natural Views on Mountain Tops		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
22	14	0
Safety of Migratory and Resident Birds		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
29	2	5
Noise During Daytime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
18	16	2
Noise During Nighttime		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
18	1	17
Real Estate Prices		
No Affect	*Affected/Maybe/Normal*	*No Response/NA*
30	5	1

Stakeholders Support for the Wind Farm Project		
Yes	**No**	**No Response/NA**
Respondent		
36	0	0
Municipality		
21	0	15
Private Businesses		
0	0	36
Opinion Leaders		
9	0	27
Residents		
10	0	26
Local NGOs		
0	0	36
Landowners		
25	3	8
Owners of Generators		
0	0	36

Bird Hunting Prohibition			
Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Totally Dissatisfied**
25	9	1	1

Based on the above engagement, the following activities should be carried forward in the SEP:

1. Additional information regarding wind farms should be shared with the communities of Machta Hassan, Machta Hammoud and Mqaible. Given their proximity to the wind farms, it is anticipated that other nearby villages could benefit from increased knowledge about wind farm operations and potential impacts.
2. The primary source of knowledge regarding wind farms is word of mouth, suggesting the potential for transmittal of incorrect information. Distribution of newsletters, fact sheets, and other educational materials could help to ensure that the correct technical information is being shared.
3. It would appear that most of those engaged believe the projects will be successful in meeting their intended objectives.
4. While responses varied, it would appear that stakeholders view the impacts of project construction and operation as largely positive.
5. Potential negative impacts were acknowledged by stakeholders, identifying the opportunity to elaborate on the management and mitigation measures that will be implemented to minimize potential impacts.
6. Very few respondents expressed a lack of support for the projects. However, it is noted that this must be tempered by the lack of responses regarding the level of support by the municipality, private businesses, opinion leaders, residents, local NGOs, landowners and owners of generators. Again, this suggests the opportunity for wider information sharing such that the level of support by affected communities is better understood.

6.6.3.8 June 2019 Consultation with Rweimeh Village Members

Consultation was conducted on June 26, 2019 with approximately 20 Rweimeh Village members Rweimeh, including men, women and youth as shown if **Figure 6-29**.

Figure 6-29 Consultation with Rweimeh Village Members

The meeting was held in the Al Tayyara Restaurant in Rweimeh Village, in the presence of the following:

- 2 Representatives from the MOE.
- A team of experts from the Netherlands Commission for Environmental Assessment engaged by the MOE for independent review of the ESIA for the Project.
- 1 representative from (name removed).
- Representatives of the Project and planned Lebanon Wind Power wind farm teams.
- Representatives of the Ramboll team.

Among others, the meeting addressed the locations of the batching plant and the substation within Rweimeh Village, as well as the associated increased traffic/vehicles and transport of construction materials between the batching plant and the wind farm sites during the construction phase.

The community advised:

- They have been consulted on a regular basis since 2011.
- They are informed about the Project impacts but are conscious that the Project advantages outweigh the potential disadvantages.

Concerning their expectations, they said: "*We know that the Project might not improve our direct energy supply as a community. However, we know that this Project will improve energy supply at a national level. This is a gift, from Akkar to all of Lebanon*."

6.6.3.9 July 2019 Consultation with Livestock Owners

In July 2019, the CRO engaged the livestock owners who use the Project area for grazing. It was found that the shepherds using the Project area for grazing (refer to **Section 15 Socioeconomic Conditions**) are Syrians employed by local livestock owners. Therefore, discussed the loss of access to grazing areas for a period of 18 months during the construction phase with the livestock owners.

Based on the discussions, the livestock owners expressed the following concerns:

1. Livestock owners rely on livestock for livelihood.
2. Access to alternative grazing areas will not be allowed by:
    a. Owners of the alternative grazing lands.
    b. Owners of the lands they need to cross to be able to access alternative grazing areas.

The loss of livelihood is passed on from the livestock owners to the Syrian shepherds. The impact of loss of access to grazing and mitigation is explored further in **Section 15 Socioeconomic Conditions**.

7. OVERVIEW OF STRATEGIC ENVIRONMENTAL AND ECONOMIC IMPACTS

It is understood that the Project will results in several site specific environmental and social impacts on various receptors throughout the Project phases to include planning and construction phase and operation phase. Such impacts are discussed in the subsequent sections for each environmental receptor. Nevertheless, the Project will result in significant and crucial positive environmental and economic impacts on the strategic and national level given the current challenges the energy sector in Lebanon is facing which have serious implications on energy security as well as major economic burdens to the Lebanese economy. Such positive impacts are important to highlight, consider, and consider before investigating the potential negative environmental impacts anticipated from the Project, as discussed in the following sections. The anticipated positive environmental and economic impacts on the strategic level are discussed and highlighted below.

7.1 Lebanon's Energy Sector

Lebanon still relies on fossil fuel, a non-renewable resource, for its energy consumption. EDL is the main public establishment responsible for the generation, transmission, and distribution of electrical energy in the country. Founded by Decree No. 16878 dated July 10, 1964, it currently controls over 90% of the Lebanese electricity sector. Unfortunately, due to decades of civil unrest and lack of political will, EDL has underserved the power demand of the country.

Overall, Lebanon relies on six principal sources of primary energy: 1) imported hydrocarbon fuels in liquid; 2) gaseous form; 3) imported electricity; 4) locally produced hydroelectricity; 5) biomass; and 6) alternative energy. EDL is responsible for seven thermal power plants and three hydro-power plants generate electricity in the country with an installed capacity of 3,022MW, as shown in **Table 7-1**.

Table 7-1 EDL Generating Capacity in 2018 (EDL (2018) and Fardoun et al. (2012))

Thermal Power Plants		Capacity MW	Hydraulic Power Plants		Capacity MW	Total
Zouk	Onshore plant	805	Litani	Awali	108	
	Power barge	198		Joun	48	
Jieh	Onshore plant	408		Abdl Aal	34	
	Power barge	198	Bared	Bared (1)	13.5	
Sour		70		Bared (2)	3.7	
Baalbek		70	Safa		13.4	
Zahrani		465	Nahr Ibrahim	Nahr Ibrahim (1)	15	
Der Ammar		465		Nahr Ibrahim (2)	12.5	
Al Hreesha		70		Nahr Ibrahim (3)	4.5	
			Kadisha	Balouza	8.4	
				Abu Ali	7.4	
				Mar Lichaa	3.1	
				Bsharre	1.6	
Total Thermal Capacity		**2,749**	**Total Hydraulic Capacity**		**273.1**	**3,022**

According to the 2016 NREAP, 68% the primary energy sources of Lebanon are generated through the power plants of EDL. The distribution network consists of 68 substations converting power from medium to low voltage and using more than 15,000 transformers to deliver electricity to every subscriber (EDL, 2018). The Quobaiyat Substation located 5km north of the Project (see **Figure 7-1**) and Halba Substation located 23km northwest of the Project transmit and distribute electricity to Akkar Caza.

EDL's transmission network consists of many types of high voltage power lines including 66, 150, 220 and 400kV lines converting power from high voltage to medium voltage. In addition, the network includes more than 1,540km (1,336km of overhead lines and 178km of underground cables) of various voltages used for transmission and distribution.

Almost half the generation capacity of EDL (Zouk & Jiyeh Steam Plants) is nearing retirement while the operation of the other half (gas turbines) is sub-optimal since the plants run on gasoil instead of natural gas. Making the matters worse is the raising costs of electricity generation by the government, which has reached 0.17USD/KWH, while EDL insist on adopting a freezing tariff policy since 1994 (0.095USD/KWH for residential units, and 0.076USD/KWH for industries).

Approximately 7.5% of the total electricity production in 2009 was purchased from Syria (589GWH) and Egypt (527GWH) through regional interconnections. In addition to the deficit in electricity supply, the Lebanese electricity sector was facing several problems such as load shedding, technical losses, and the aging of power plants. This situation resulted in technical and financial impacts on customers, the Government, and the entire economy, and Lebanese end users were forced to rely on diesel generators to overcome the electricity shortages (MOEW/LCEC, 2016).

Figure 7-1 Quobaiyat Substation

As part of their effort to close the demand gap, the GOL has carried various actions including:

- For over two decades, the GOL has been purchasing electric power from Egypt and Syria through regional interconnections. In 2017, the GOL requested an increased electrical supply from Syria from 240MW to 300MW. This supply is usually accounted in the EDL official power generation records.
- The MOEW signed a contract in 2012 with the Turkish company Karadeniz Holding to provide power barges to serve as a stop-gap solution and supply 270MW into the national power grid. By June 2018, the contract was renewed for another three years under new terms; the company will provide Lebanon with more than 370MW by employing another power barge.[36]
- In 2017, the Lebanese government increased the power capacity of the Zouk and Jieh Power Plants through the addition of an installed capacity of 198MW in each plant, (EDL, 2017).[37] EDL is currently looking into the rehabilitation of the both power plants, in term of increased capacity, removal of obsolete material (asbestos), rehabilitation of soil, and even an overhaul of the Jieh Power Plant complete with dismantling of current units and construction of a new power plant (CDR, 2017).[38]

The country has yearlong power deficit that can reach up to 1,400MW during the summer. As of 2016, the peak power demand reached 3,594MW while the effective power production by EDL only reached 2,108MW[39], generating to 21 hours of electricity supply in Beirut and 14 hours outside of the capital. In response to the frequent power rationing by the government, local residents rely on private back-up generators.

As of 2010, private generators are satisfying 77% of the blackouts (LCEC, 2016).[40] Private generators operate using gas oil at notoriously low efficiencies rates, by comparison, the average generation efficiency of EDL from cradle to consumer gate is about 30% higher (MOE/UNDP/ECODIT, 2011);[41] thus, any given private generator is a wasteful and a major contributor to air pollution and costing the consumer 4.74 times more (per KWH) than government generated electricity.

In brief, Lebanon is plagued by chronic power rationing affecting economic growth and national satisfaction. This power production/generation deficit, the highest in the Middle East and North Africa (MENA) region (World Bank (WB), 2013)[42], is the result of three decades of technical and non-technical shortcomings including inadequate tariffs, misappropriation, war-related physical damages, ineffective regulatory framework, decrepit infrastructure caused by a dearth in investments, and the historic absence of a broad-based political commitment to resolve the energy crisis.

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[36] Azhari, T. (2018, June 17). EDL Extends Lease of Two Power Barges. *Daily star.* Retrieved from Dailystar.com.lb.
[37] EDL (2017) Enterprise Facilities. Retrieved from: http://www.edl.gov.lb/page.php?pid=37.
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[40] LCEC (2016) The Second National Energy Efficiency Action Plan for the Republic of Lebanon [NEEAP]. Retrieved from http://climatechange.moe.gov.lb/viewfile.aspx?id=229.
[41] MOE/UNDP/ECODIT (2011) State of the Environment Report (SoER). [Chapter 9 – Energy Crisis].
[42] Enterprises Surveys. (2018). Infrastructure. World Bank Group. Retrieved from www.enterprisesurveys.org.

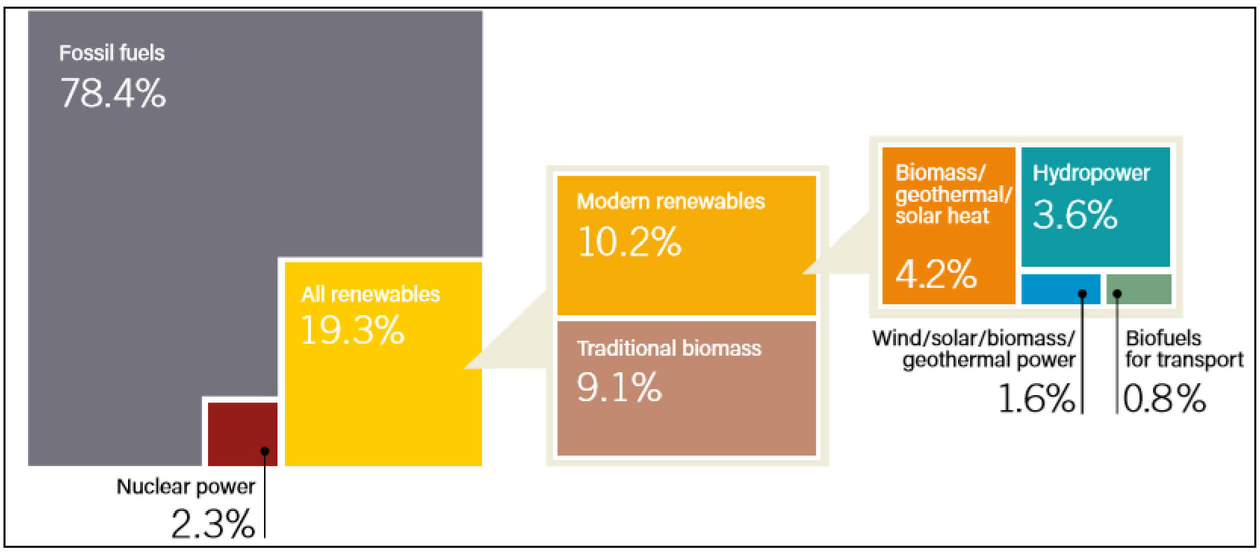
7.2 Energy Strategy for Lebanon

Clean RE that comes from continually replenished resources such as sunlight, wind, rain, tides, waves and geothermal heat is becoming increasingly important as the world is facing the threats of climate change and depletion of fossil fuel reserves. Governments and world leaders started adopting laws and regulations to stimulate and commercialize RE sources.

Modern renewables have continued to grow strongly in all end-use sectors: power, heating, cooling and transport. In the power sector, renewable accounted for almost half of the estimated 921GW of electric capacity added globally during 2016. Wind and solar photovoltaics (PV) accounted for almost 47.8% and 33.65% respectively followed by the energy form biomass (~20%). Policymakers are increasingly aware of the wide range of benefits from renewables including energy security, reduced import dependency, reduction of GHG emissions, rural development and energy access.

By 2015, RE supplied an estimated 19.3% of global energy consumption (a 2.6% total increase from 2010); of which 10.2% derive from modern renewables such as hydropower (3.6%) and wind / solar / biomass / geothermal power (1.6%), as shown in **Figure 7-2**.

Figure 7-2 2015 Renewable Energy Share of Global Final Energy Consumption (REN21, 2017)



In a bid to decrease the environmental footprint of its energy sector and align itself with the international efforts to reduce global GHG emissions, the GOL officially pledged to meet 12% of its energy consumption from RE sources by 2020 at the 2009 Copenhagen Climate Change Conference.

The MOEW published the 2010 Policy Paper for the Electricity Sector that was approved by the Council of Ministers (COM) on 21 June 2010. In addition to proposing a strategic solution to the electricity sector in Lebanon, the Policy Paper built on the 12% commitment of RE by 2020 to propose some future milestones.

On the wind front, the MOEW published the *Wind Atlas of Lebanon*[43] and a 2013 Request for Proposal (RFP) for developing the first utility-scale wind farm in Lebanon sparked private sector interest. At the

[43] Atlas was produced in 2011 by CEDRO and funded by the UNDP.

U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) in Paris in December 2015, the GOL also pledged to reach a 15% reduction in GHG and 3% reduction in power demand by 2030 relative to a business-as-usual scenario:

- A 15% GHG emissions reduction as unconditional, or 30% as conditional.
- A 15% of the power and heat demand in 2030 generated by RE sources as unconditional, or 20% conditional.
- A 3% reduction in power demand through energy-efficiency measures in 2030 compared to the demand under the BAU as unconditional, or 10% conditional.

On the national level, several strategies and Action Plans have been put forth by different ministries to achieve these targets, most importantly the MOEW's 2010 Policy Paper for the Electricity Sector (PPES), the National Energy Efficiency Action Plan 2016-2020 (NEEAP), and the National Renewable Energy Action Plan 2016-2020 (NREAP). In detail, the PPES presents a detailed plan to revamp the electricity sector in Lebanon and aims to achieve 12% RE contribution to *"electrical and thermal supply"* (PPES Section 5). However, the 12% RE coverage is an extremely ambitious goal especially for a country that has still to make important outlays to rehabilitate a deficient electricity sector. In energy terms, the current electrical energy demand is estimated at 16,400GWH; it is projected to reach around 20,000GWH in 2020 assuming a 3% yearly increase. Thus, by then, RE (hydro and non-hydro combined) should provide 2,400GWH of electrical energy to meet the RE target.

The NEEAP states 14 initiatives put together in compliance with the PPES to help Lebanon become an energy efficient country with a particular focus on RE. The electricity generation from the wind power initiative aims to reach up to 200GWH per year by implementing small wind farms of capacity ranging between 60MW and 100MW.[44]

The NREAP considers four main technologies including eight energy sources in Lebanon to reach the projected 767 Kilotons of oil equivalent by 2020. The wind, solar, hydroelectric and biomass energy sources will account respectively for 2.05%, 4.05%, 3.24% and 2.5% of the total Lebanese energy produced. As of September, the GOL has launched bids for wind, solar, and is expected to launch bids for geothermal.

The current electrical energy demand is estimated at 16,400GWH, and is projected to reach around 20,000GWH in 2020 assuming a 3% yearly increase. Thus, RE (hydro and non-hydro combined) must provide 2,400GWH of electrical energy in order to meet the RE target. In February 2018, the minister of energy and power Cezar Abi Khalil signed the first power purchase agreement with companies of the private sector to build three wind farms of an individual capacity 200MW.[45] The energy ministry's signing of the agreements represents Lebanon's first PPA with the private sector in electricity generation as part of efforts to close an estimated 1GW gap between current electrical supply and demand in the country.

[44] LCEC. (2011). The National Energy Efficiency Action Plan for Lebanon. Ministry of Energy and Water. Retrieved from www.rcreee.org

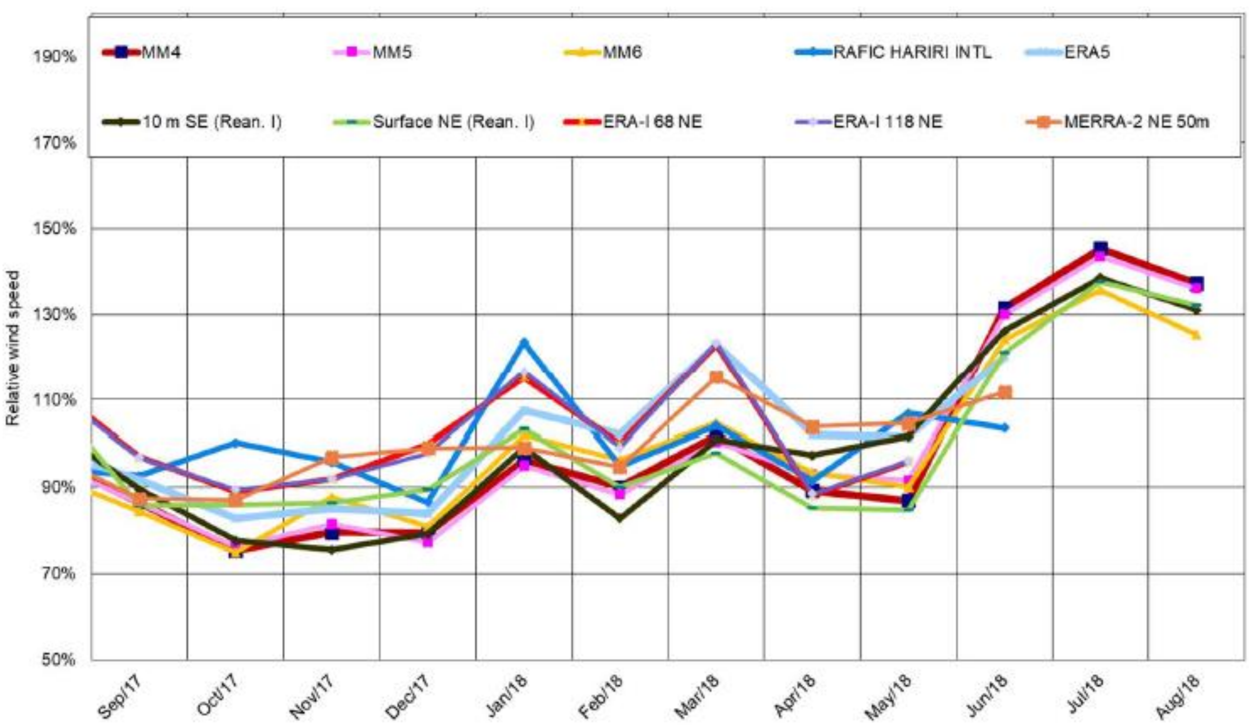
[45] LBCI. (2018). Lebanon signs wind Power Purchase Agreement. News Bulletin Reports. Retrieved from www.lbcgroup.tv.

7.3 Project Rationale

In assessing the feasibility, efficiency and cost effectiveness of the Project, wind resource potential, considering direction, speed and were considered. Wind resource potential was assessed using broad indicators sourced from existing information regarding wind activity, such as publicly available studies, the National Wind Atlas of Lebanon, historical measurements of wind speed and direction at various weather stations, etc. Wind potential data was also extrapolated from meteorological figures and wind data in nearby areas. Considering that energy generated by wind is proportional to wind speed, a localized 'wind atlas' of the planned wind farm was developed based on local wind speed data.

For more accurate and extensive assessment, three meteorological masts, MM4, MM5 and MM6 (Enisolar 80m and 60m models) were installed on site. The mast installations have been performed by ENISOLAR and were supervised by the Developer's third-party wind expert, UL DEWI. In addition to an aviation light and a top lighting rod, each mast includes first class advanced top and low anemometers, wind vanes, a humidity and temperature sensor, an air pressure transducer, a data logger box. The data recorded by the mast is automatically sent twice daily to the Project team via internet. As is the case across the Lebanese coastal zone, most winds blow from a westerly origin. Utility-scale wind power plants require minimum average wind speeds of 6m/s (13mph). **Figure 7-3** shows the comparison of the monthly mean wind speed of Akkar masts (correlated data for the period 09-01-2017 through 08-31-2018) and the considered long-term data sets.

Figure 7-3 Proportional Variation of Monthly Means of Wind Speed at the Project Site



The plots of the wind speed distribution show the parameters of the overall Weibull distribution (scale factor A, shape factor k) as well. The prevailing wind direction is west. The average wind speeds during the measurement periods are 8.88m/s at MM4, 6.65m/s at MM5 and 6.86m/s at MM6. The measured wind direction and wind speed distributions for the masts for the highest measuring height are shown in **Figure 7-4** through **Figure 7-6**.

Figure 7-4 Measured Wind Direction and Wind Speed Distribution at the Sustainable Akkar Site – Mast 4

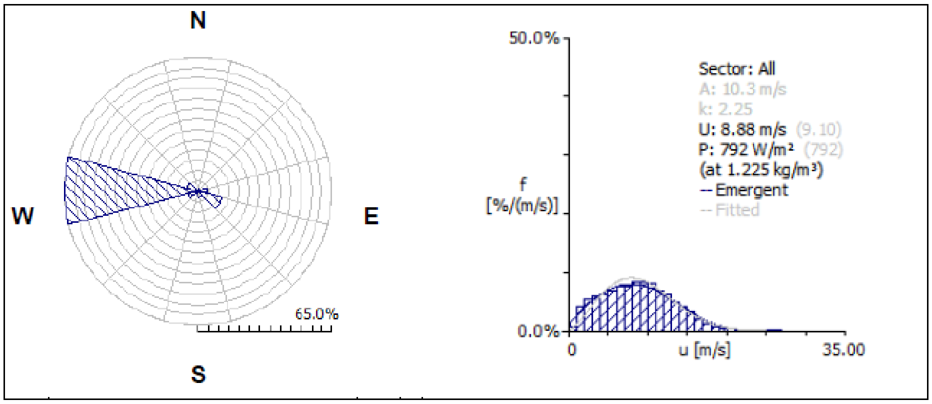


Figure 7-5 Measured Wind Direction and Wind Speed Distribution at the Sustainable Akkar Site – Mast 5

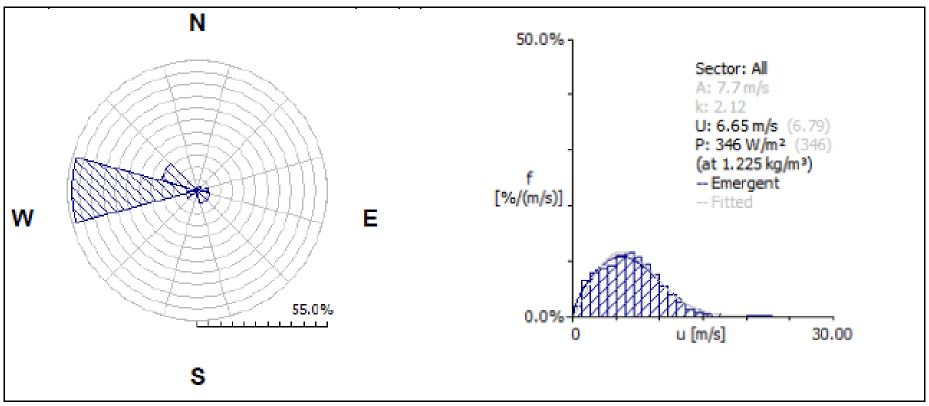
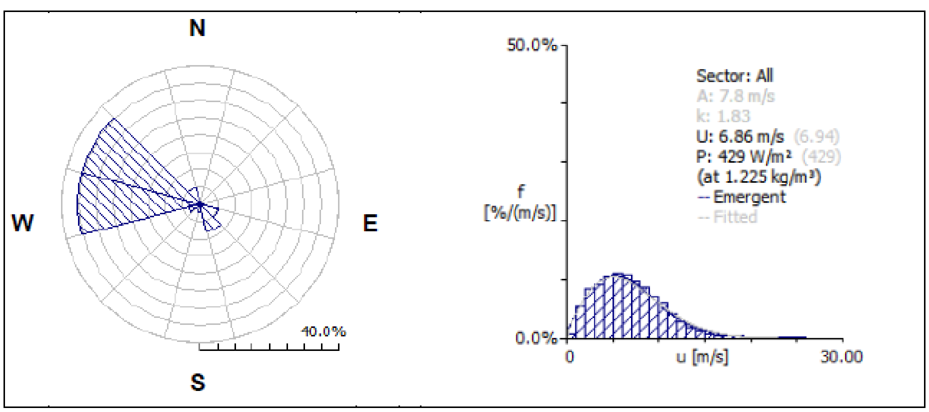


Figure 7-6 Measured Wind Direction and Wind Speed Distribution at the Sustainable Akkar Site – Mast 6



An advanced time series correlation (MCP) was performed in order to extend the measured time series to a period of 1 year. The MCP-method applied has the added benefit of accurately predicting the wind distribution if sufficiently high-quality data is available in both a high temporal and physical resolution. The entire correlation procedure is carried out depending on the wind direction, meaning that a relationship of the wind directions is calculated and that wind speed relationships are calculated for different direction sectors. These relationships are calculated for sectors, which are variable in size and depend on the amount of data in the sector.

To correct the short-term measurement to a long-term period, the monthly mean values measured at the Project site were correlated with the data from 10m SE (Damascus). **Table 7-2** presents the wind speed mean value for the short-term period and the resulting wind speed mean value for the long-term period. Wind turbine data from Vestas, Nordex, Siemens-Gamesa, GE and Senvion was then considered to calculate the resulting power curves in line with site-specific air density and the thrust coefficient.

Table 7-2 Resulting Mean Wind Speeds and Scaling Factors for Long-Term Correction

Mast	MM4	MM5	MM6
Wind speed mean value for the 1-year period 09-01-2017 through 08-31-2018	8.47m/s	6.37m/s	6.47m/s
Wind speed mean value for long-term period 09-01-2006 through 08-31-2018	8.46m/s	6.36m/s	6.46m/s
Scaling factor for the site data to period 09-01-2006 through 08-31-2018	99.9 %		

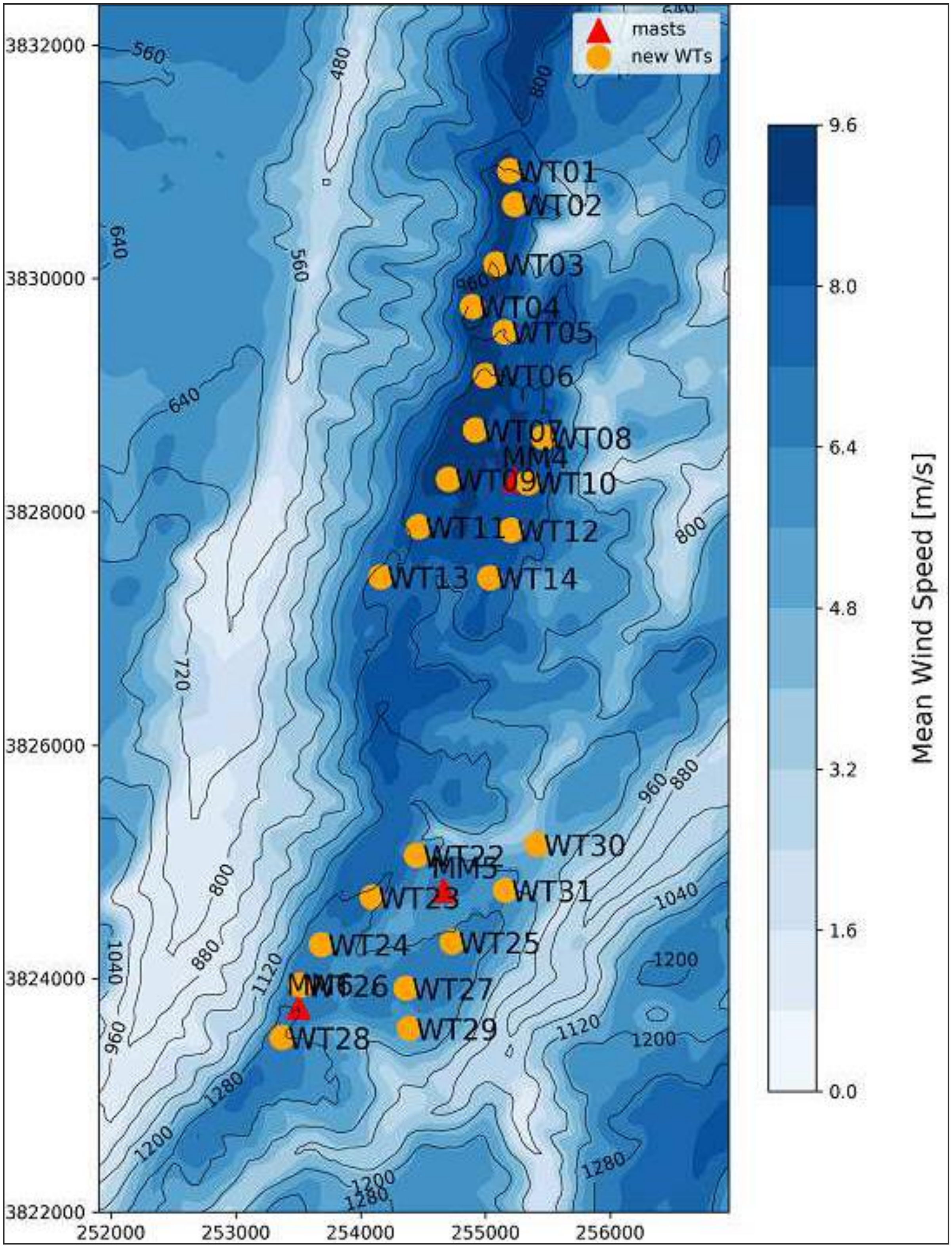
Modeled Results

The following results are based on modeling the Project site meteorological mast wind data (corrected to the long-term average of 12-year (period 09-01-2006 through 08-31-2018). The spatial variation of the mean wind speed for Lebanon Wind Power at the hub height of 110 m is depicted as different colors, as shown in **Figure 7-7**. The topography of the terrain is depicted as height contour lines. The positions of the reference points and of the wind turbines are marked in the map.

The gross energy yields were calculated by applying the power curves and thrust curves referenced above. The results are based on the site-specific time series using meteorological input data, calculated for each of the wind turbine positions. The results presented consider the potential farm losses caused by the adjacent Lebanon Wind Power wind farm.

Table 7-3 summarizes the gross energy yield calculations for the entire Sustainable Akkar wind farm, noting that all modeled capacities exceed 30%. It is noted that wind farm capacities above 30% are considered an economically viable project.

Figure 7-7 Calculated Average Wind Speed for Hub Height of 110m[46]



[46] Note: WTG 01, WTG 16, WTG 26 and WTG 28 were removed as part of the ESIA process to mitigate Project impacts

Table 7-3 Gross Energy Yield Calculations

WTG Type	Hub Height [m]	# of WTGs	Free Gross Energy Yield (entire farm) [MWh/a]	Gross Farm Energy Yield (entire farm) [MWh/a]	Gross Farm Energy Yield (per WTG) [MWh/a]	Farm Eff. [%]	Avg Wind Speed [m/s]	Farm Capacity Factor [%]
GE 5.3-158 and GE 4.8-158	101 and 121	17	388,197	377,320	22,195	97.2	8.4	48.6
VESTAS V150/4 200	105	21	391,853	382,005	18,191	97.5	8.2	49.4

Considering the above, the proposed Project is highly important for the region and is considered nationally significant as it will be one of the first grid connected wind power plants in Lebanon. Depending on the manufacturer selected, the Lebanon Wind Power Wind Farm will contribute the following electrical energy toward reaching Lebanon's RE target.

The Project will:

- Assist in solving the problem of electricity shortage on the local and national scales.
- Assist in achieving the commitment to 12% supply of energy through RE.
- Reduce GHG emissions since it will be displacing a largely fossil fuel-based electricity generating system.

7.4 Environmental Benefits

The negative environmental impacts from generating electricity through conventional fossil fuel burning at thermal power plants are very well known. This most importantly includes air pollutant emissions such as ozone, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), particulate matter, and other gases which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

In addition, the burning of fossil fuels results in carbon dioxide emissions; a primary GHG emitted through human activities which contributes to global warming. The main human activity that emits CO_2 is the combustion of fossil fuels for electricity production and transportation. Concurrently, global climate change has become an issue of concern and so reducing GHG emissions have also emerged as primary issues to be addressed as the world searches for a sustainable energy future.

According the Biennial Update Report to the UNFCCC, published in 2017, Lebanon emitted 26,285 Gg CO_2eq. in 2013 with the most significant GHG being carbon dioxide, primarily produced from the burning of fossil fuels. The main contributor to GHG emissions is the energy sector (including transport) with 79% of GHG emissions, followed by industrial processes (10%) and waste sector (7%).

The emissions from Energy Industries, i.e. Electricité du Liban, is 7,392.08 Gg CO_2eq. representing 28% of the total for the production of 11,725GWh in 2013, resulting in 630 t CO_2eq/GWh. CO_2

removals from the land use, land use change and forestry category amounted to 3,518.80 Gg CO_2, bringing Lebanon's net emissions down to 22,766 Gg CO_2eq.

Compared with the current conventional way of producing electricity in Lebanon through thermal power plants using heavy fuel oil and/or natural gas, generating electricity through wind power is expected to reduce consumption of fossil fuels, and will thus help in reducing GHG emissions, as well as air pollutant emissions. The Project will:

- Assist in solving the problem of electricity shortage on the local and national scales.
- Assist in achieving the commitment to 12% supply of energy through RE.
- Reduce GHG emissions since it will be displacing a largely fossil fuel-based electricity generating system, displacing metric tons of CO_2 annually.
- Saving millions of cubic meters of water per year in comparison to an oil-burning power plant which utilizes water for cooling.

8. CLIMATE AND CLIMATE CHANGE

8.1 Baseline Methodology

No rain gauges were installed at the Project site. Climate and climate change conditions were obtained through literature review and assessment of data collected from three meteorological masts installed on site.

8.2 Baseline Findings

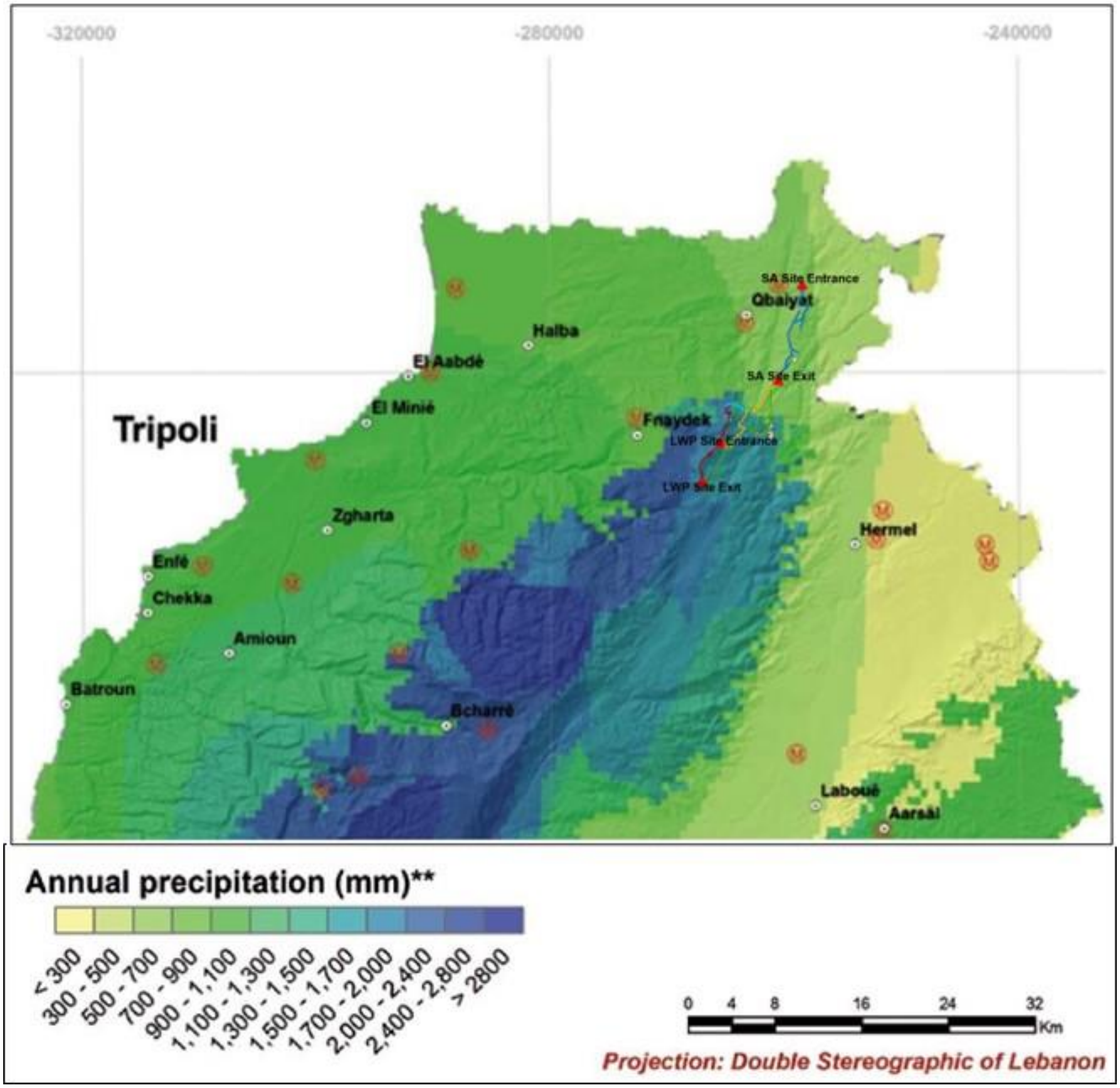
The climate in the study area is mediterranean and is characterized by hot summers and relatively cold winters. The dry period extends from May to September whereas most rainfall occurs between December and January. Jabal Akroum is also characterized by the predominance of the Foehn effect. Incoming air masses moving in from the West and WSW pass through Wadi Oudine and meet the mountains perpendicularly; they follow the terrain heated by sunlight and rise. If the humidity is quite high initially in the air masses, the water vapor condenses to form clouds, as shown in **Figure 8-1**.

Figure 8-1 Foehn Effect in Jabal Akroum (as seen from Aandqet)

Condensation is usually followed by precipitation on the top and windward sides of the mountain (Wadi Oudine side). If the air is stable over the mountain, air masses cannot continue to rise once passing the top and descend on the leeward side. Because the air has lost much of its original water vapor content, the descending air creates an arid region on the leeward side of the mountain.

A rainfall map of the region is provided in **Figure 8-2**.

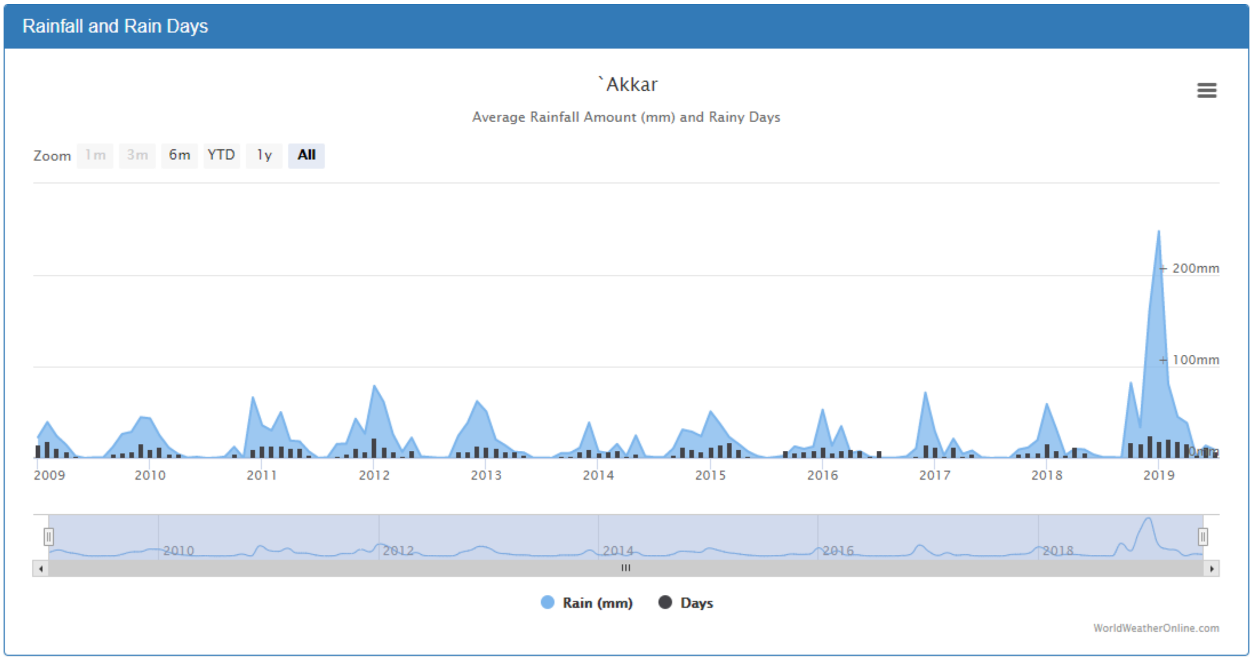
Figure 8-2 Annual Rainfall Map of the Region – 2011-2012



(MOE/UNDP, 2014)

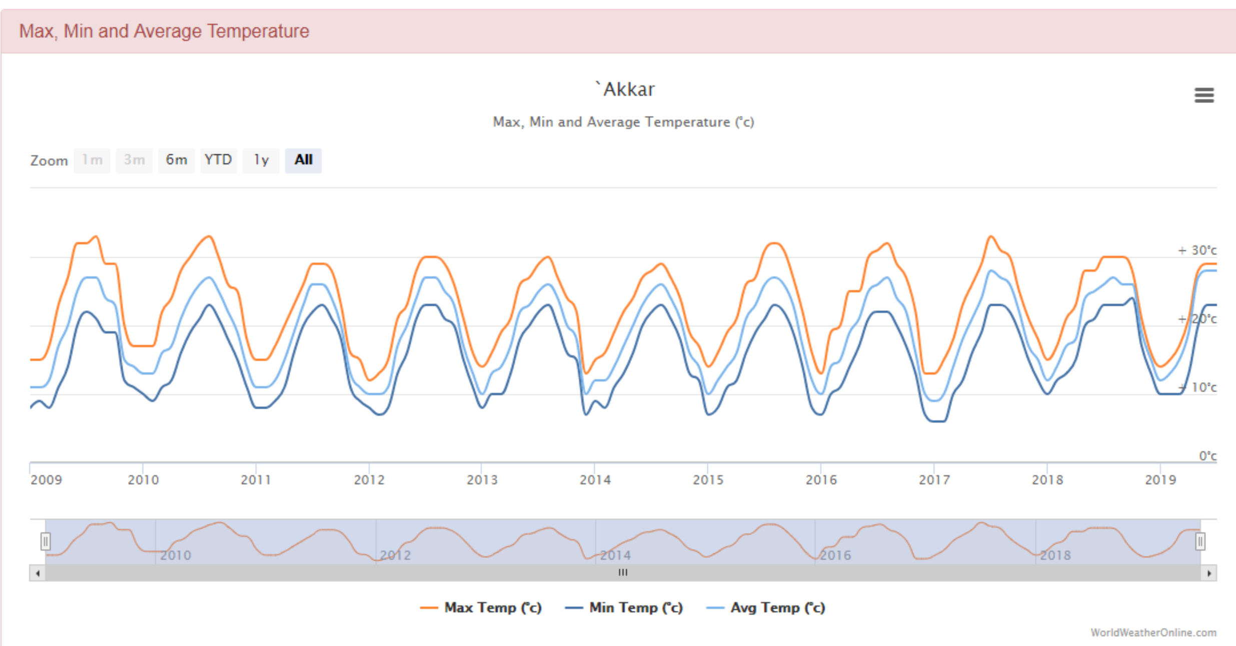
Annual rainfall measured in the Akkar region is shown in **Figure 8-3**.

Figure 8-3 Average Rainfall Amounts and Rainy Days in Akkar



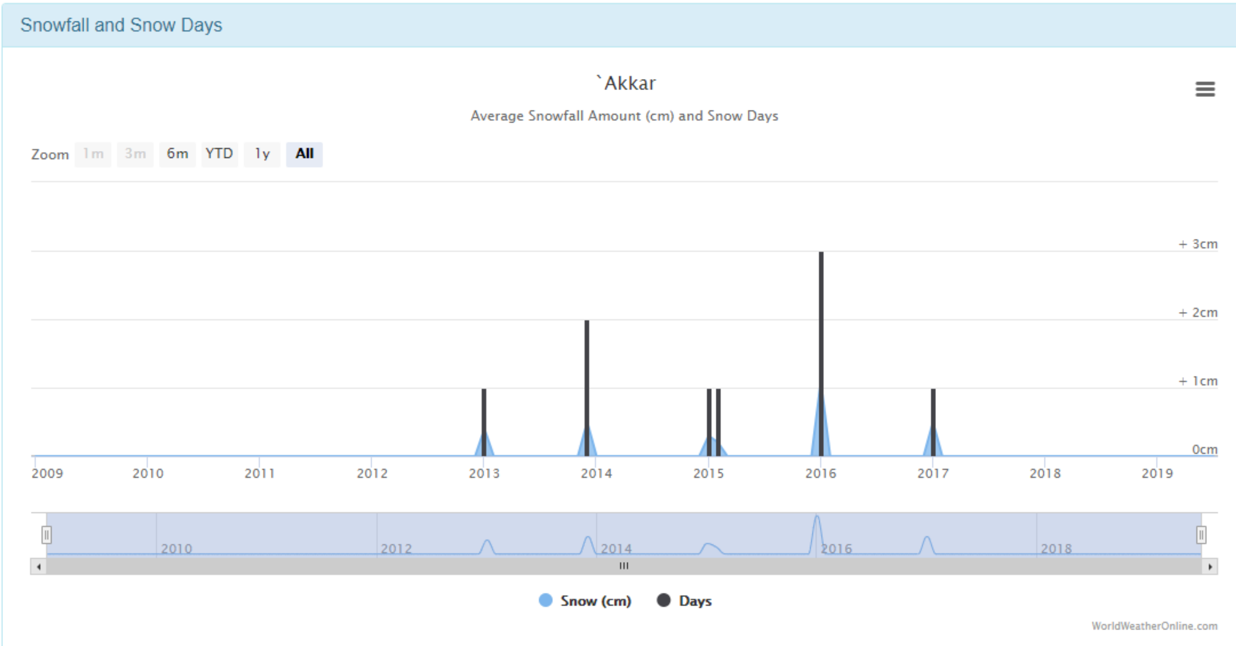
The average temperature measured in the Akkar region is shown in **Figure 8-4**.

Figure 8-4 Maximum, Minimum and Average Temperature in Akkar



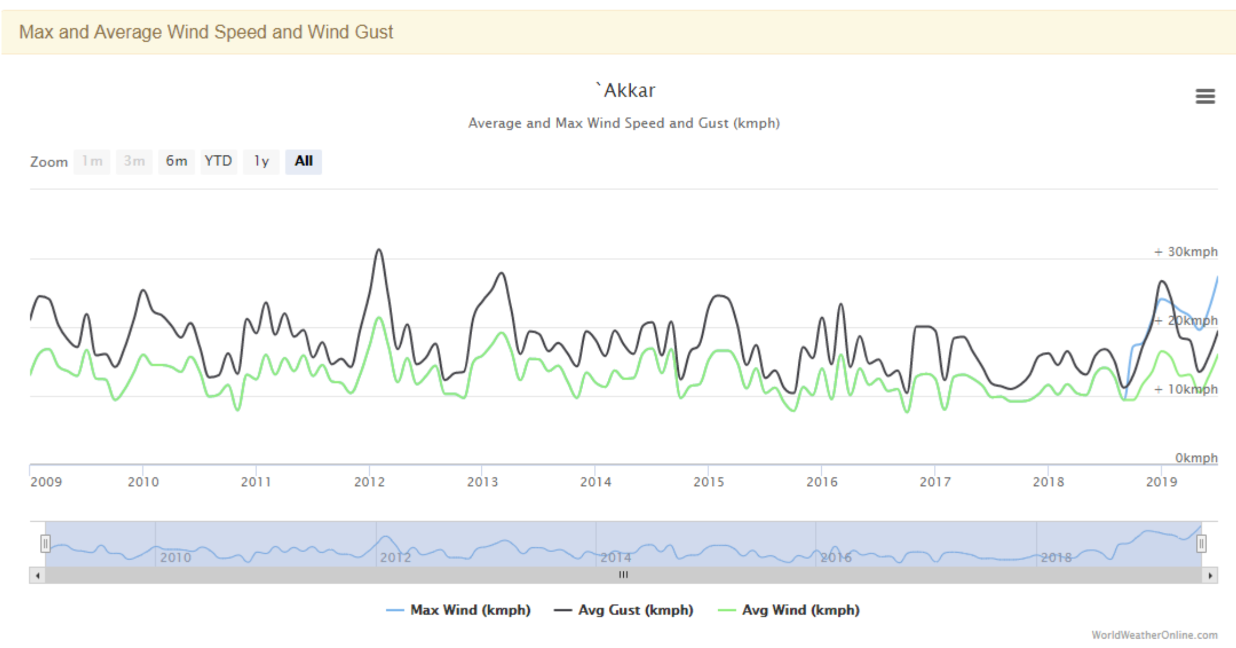
Snowfall and snow days measured in the Akkar region are shown in **Figure 8-5**.

Figure 8-5 Snowfall and Snow Days in Akkar



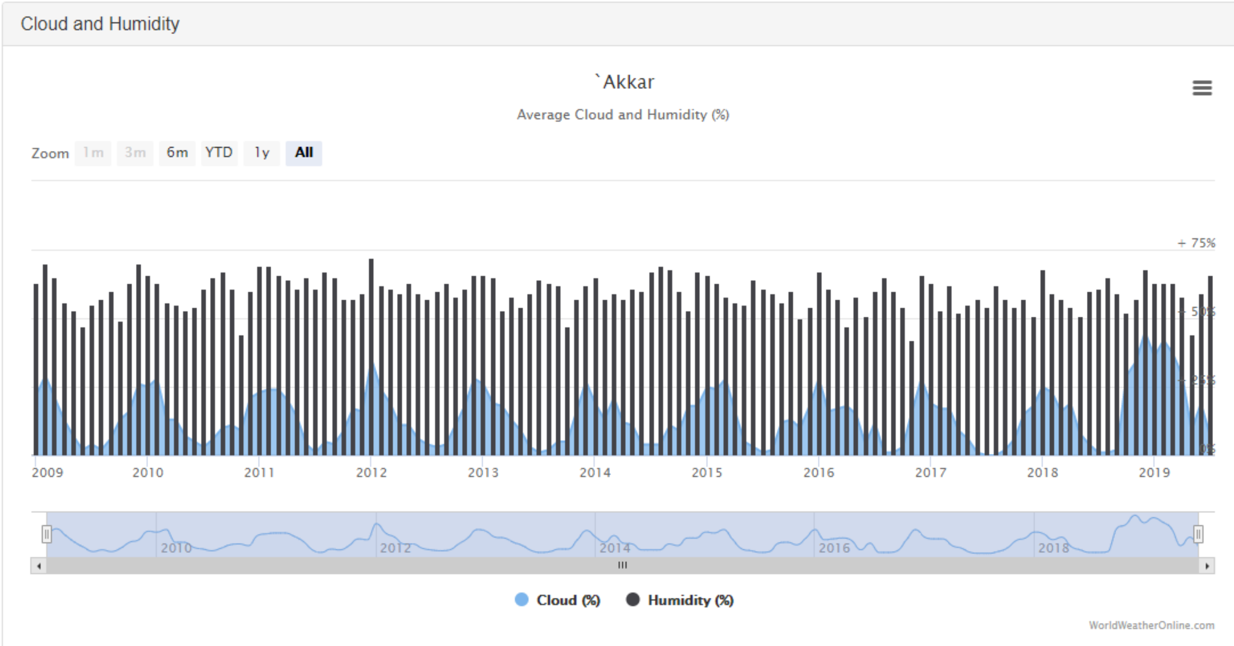
Maximum and average wind speed and wind gust in Akkar is shown in **Figure 8-6**.

Figure 8-6 Maximum and Average Wind Speed and Wind Gust in Akkar



Average cloud and humidity measured for the Akkar region is shown in **Figure 8-7**.

Figure 8-7 Average Cloud and Humidity in Akkar



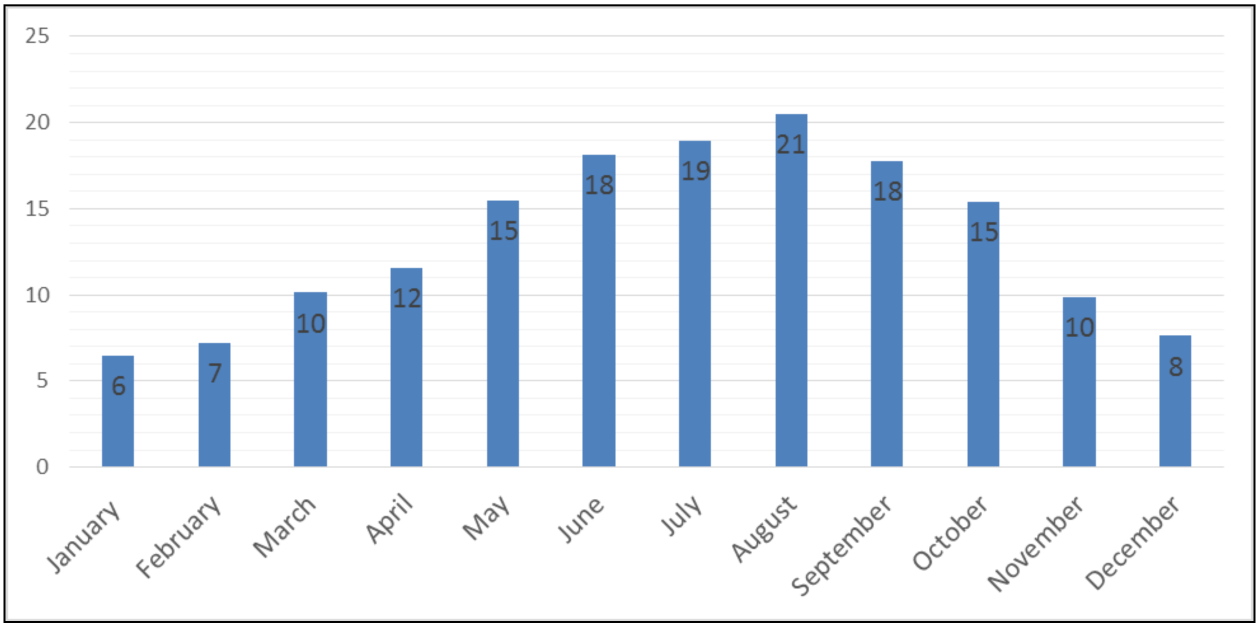
Wind conditions at the site, as recorded by the site's three meteorological masts MM4, MM5 and MM6. Data obtained from the meteorological tower installed onsite is shown in **Figure 8-8**.

Climate change is expected to have the following effects in Lebanon:[47]

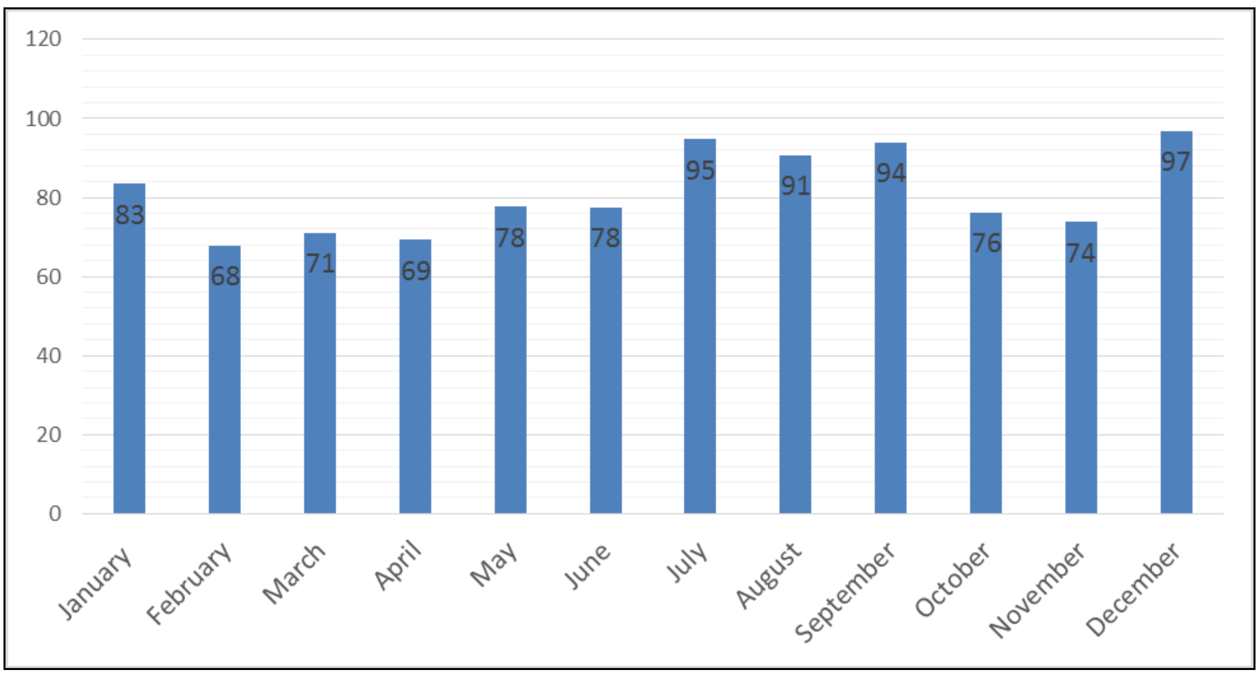
- Increases in mean annual temperatures between 1-2°C by mid-century and 3.5°C-5°C by the end of the 21st century.
- Decrease in annual average precipitation of 10-20% by 2040 and 45% by 2090.
- Reduced snow cover of 40–70 percent and decreased snow residence time from 110 days to 45 days by the end of the 21st century.
- Increased incidence of drought conditions by 9-18 days relative to present day by 2090.
- Increase in wildfire risk.
- Continued sea level rise, rising by a total of 30-6 cm in the next 30 years.
- Increased frequency of heat waves and decreased number of frost days.
- Less precipitation falling as snow, with snow line currently at 1,500m shifting to 1,700m by 2050, and to 1,900m by 2090.

[47] MOE website on climate change vulnerability and adaptation http://climatechange.moe.gov.lb/vulnerability-and-adaptation http://climatechange.moe.gov.lb/vulnerability-and-adaptation

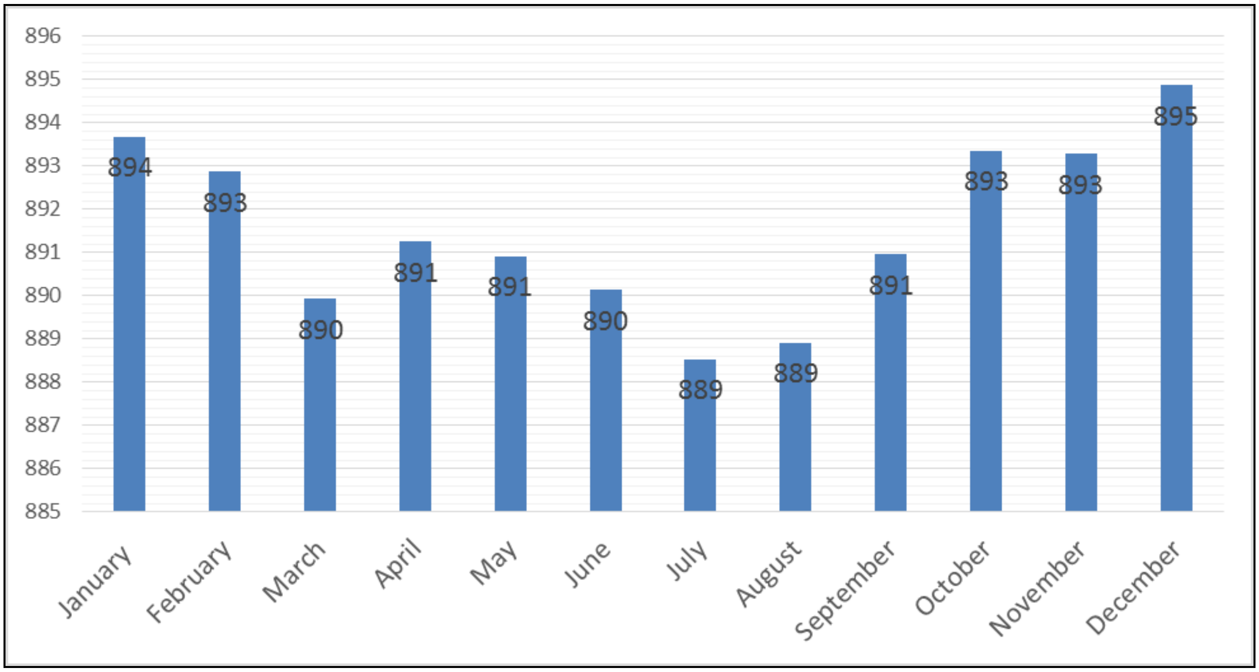
Figure 8-8 Average Temperature, Humidity and Pressure Measured at the Sustainable Akkar Wind Farm for the Year 2014



a - Average Temperature (°C)



b- Average Humidity (%)



c - Average Pressure (hPa)

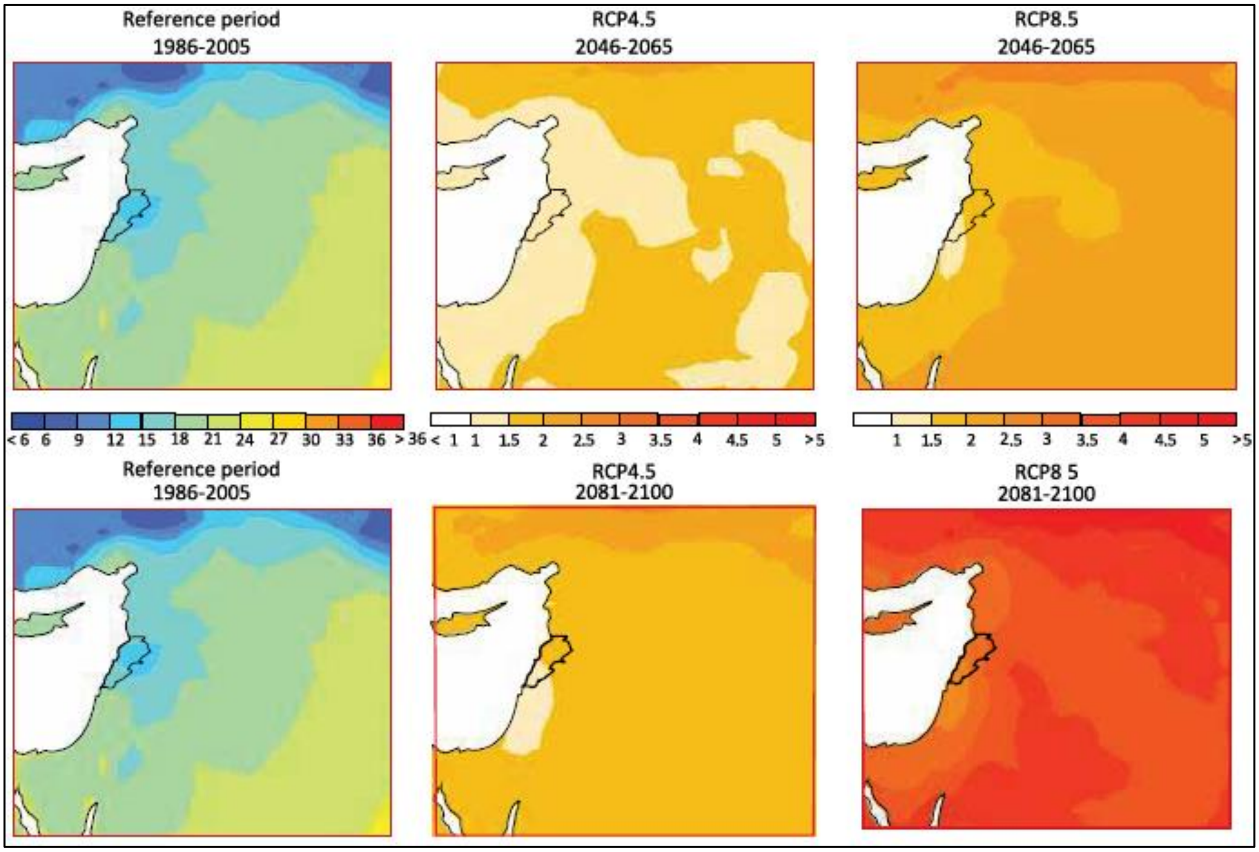
Climate change is expected to have the following effects in Lebanon:[48]

- Increases in mean annual temperatures between 1-2°C by mid-century and 3.5°C-5°C by the end of the 21st century.
- Decrease in annual average precipitation of 10-20% by 2040 and 45% by 2090.
- Reduced snow cover of 40–70 percent and decreased snow residence time from 110 days to 45 days by the end of the 21st century.
- Increased incidence of drought conditions by 9-18 days relative to present day by 2090.
- Increase in wildfire risk.
- Continued sea level rise, rising by a total of 30-6 cm in the next 30 years.
- Increased frequency of heat waves and decreased number of frost days.
- Less precipitation falling as snow, with snow line currently at 1,500m shifting to 1,700m by 2050, and to 1,900m by 2090.

A more recent ensemble of high-resolution regional climate model projections was developed under CORDEX (Coordinated Regional Downscaling Experiment; Gutowski, 2016) indicate an increase of 1.2°C-1.7°C in annual average temperatures in Lebanon by mid-century and an increase of up to 3.2°C by 2100 compared to the 1986-2005 baseline period, as shown in **Figure 8-9**. The range accounts for uncertainty in future increases in GHGs.

[48] MOE website on climate change vulnerability and adaptation http://climatechange.moe.gov.lb/vulnerability-and-adaptation http://climatechange.moe.gov.lb/vulnerability-and-adaptation

Figure 8-9 CORDEX Temperature Projections for the 21st Century for GHG[49]

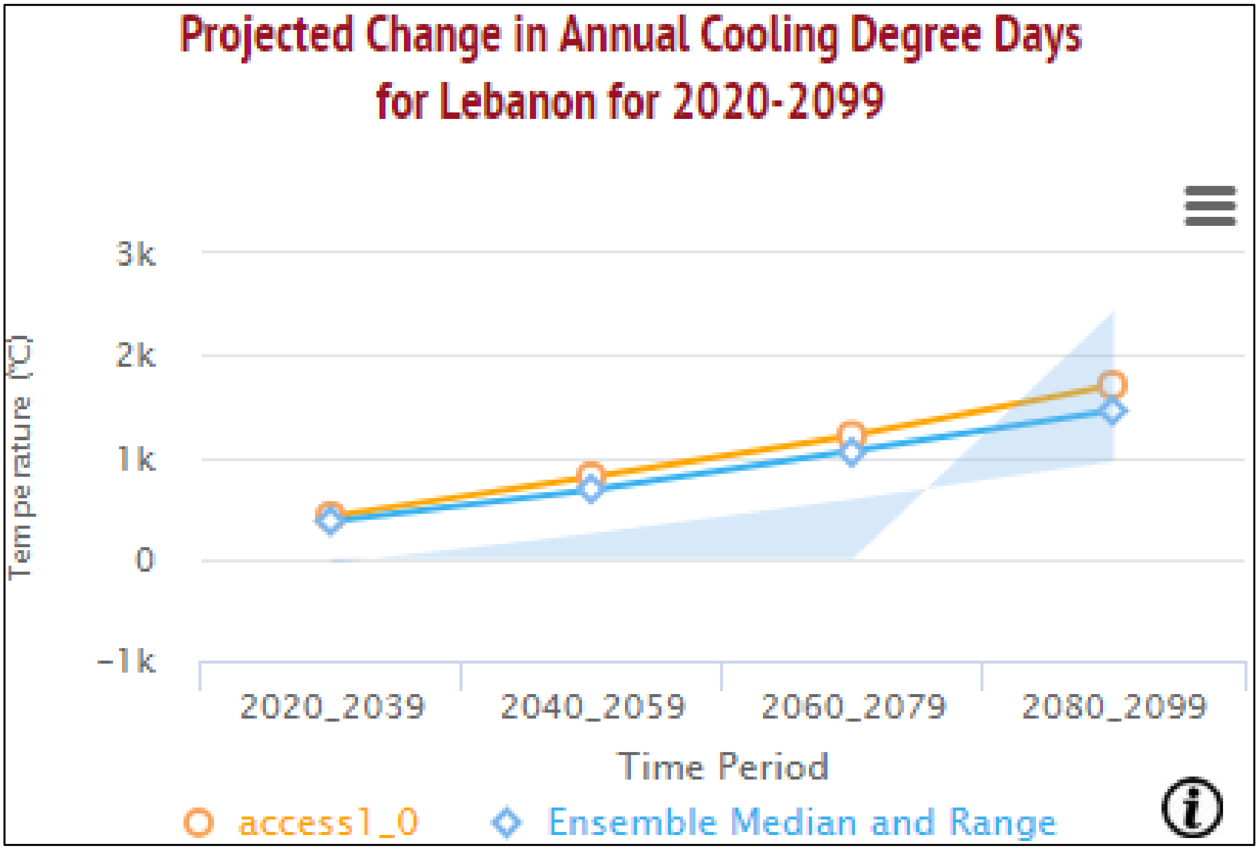


Lebanon's 3rd National Communication to the UNFCCC (MOE, 2016) projects an increased demand for cooling due to rising temperatures. Increased demand for cooling is predicted to drive higher electricity consumption (1.8% for a 1°C increase in temperature, and 5.8% for a 3°C increase in temperature). The annual number of cooling degree days is an indicator of how much energy is required to cool buildings. This increased demand enhances the importance of the additional generating capacity of the Project.

Global climate model projections for changes in annual cooling degree days in Lebanon are shown in **Figure 8-10** and indicate a steady increase in cooling degree days during the 21st century. Projections are from 35 global climate models (GCMs) run for the IPCC 5th Assessment Report (Taylor et al., 2012). The blue line shows the median result among the 35 models and the blue shading shows the model range. Calculation uses reference indoor temperatures of 65°F. On a day when the average outdoor temperature is 85°F, reducing the indoor temperature by 20 degrees over 1 day requires 20 degrees of cooling multiplied by 1 day, or 20 cooling degree days. Utility companies use cooling degree days to estimate the annual amount of energy people will use to cool buildings.

[49] Projected changes in temperatures in Lebanon, adapted from ESCWA, 2015, scenarios for Business as Usual (RCP 8.5) and GHG mitigation by mid-century (RCP 4.5).

Figure 8-10 Projected Trends in Annual Cooling Degree Days for Lebanon[50]



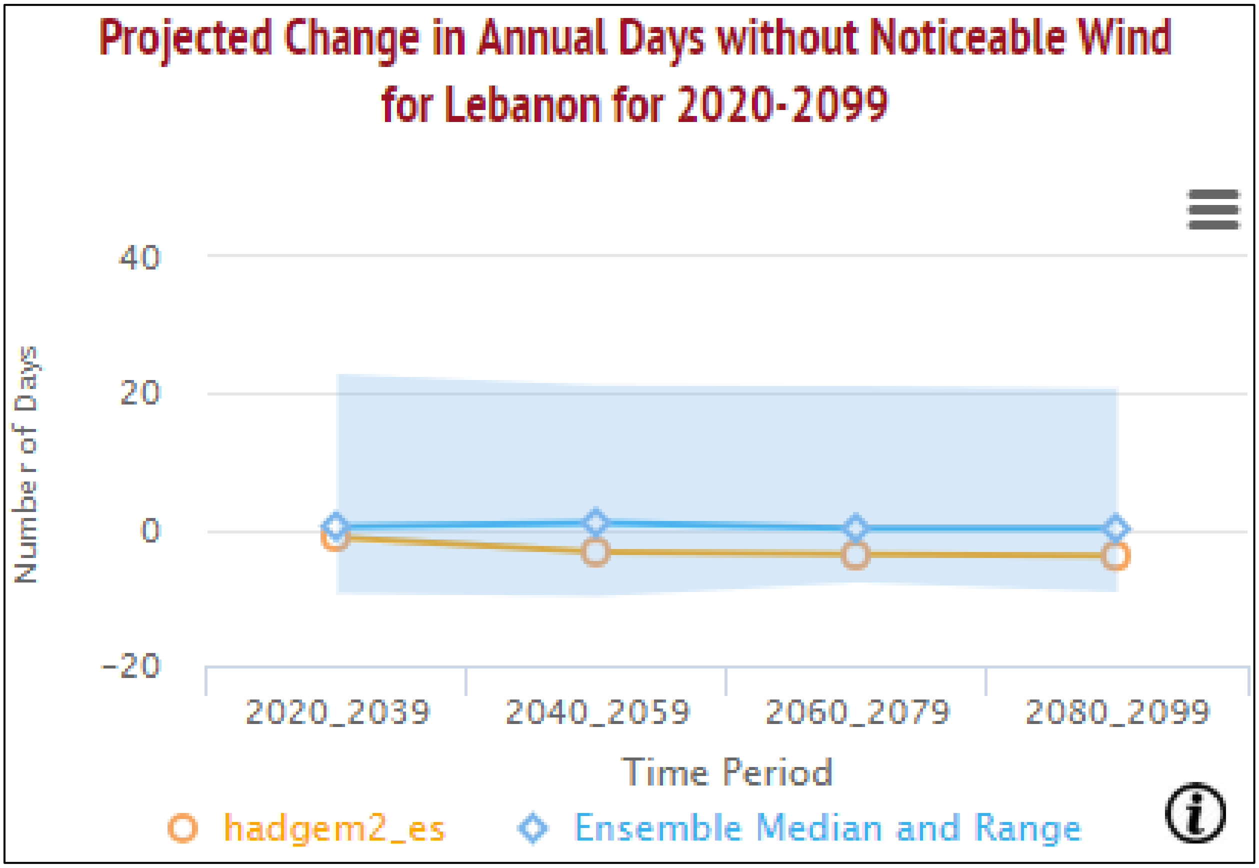
In addition to changes in temperature and rainfall, climate change may also affect winds. In order to run a WTG, a minimum wind speed is required to rotate the blade. This threshold wind speed allows us to estimate how many days in a year the mean wind in a location is likely below the level necessary to produce energy from wind. Climate model vertical grid cell sizes are too coarse to resolve the different wind speeds at the surface and the WTG hub, so the models near surface wind speed is used as a proxy for the hub wind speed.

The World Bank Climate Change Portal's 1m/s threshold is likely lower than the wind speed required for WTG operation but serves as an indicator for changes in wind speeds during the 21st century. This indicates that the number of days available for generation of electricity from wind by the Project is expected to remain relatively stable.

Figure 8-11 indicates that climate projections show little change in the number of days per year without noticeable wind in Lebanon.

[50] http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Middle%20East&ThisCcode=LBN#

Figure 8-11 Projected Trends in Annual Days without Noticeable Wind for Lebanon[51]



Uncertainty in Climate Model Projections

The preceding discussion is based on projections of the future from climate models. While climate models are our best available tool for understanding future impacts from climate change, they have important limitations.

Several challenges introduce uncertainty into climate model projections of the future: 1) predictions regarding the future change in atmospheric GHG concentrations remain highly uncertain; 2) climate models are subject to limitations in resolution and skill in simulating processes that affect climate; 3) different global climate models may result in similarly valid projections for a given site yet with different outcomes (e.g. one model shows an increase in annual average wind speed while another model shows a decrease); 4) different downscaling methods may give different results when starting from the same global climate model simulation; and 5) the climate system has intrinsic natural variability that can be more influential than the climate change signal depending on the variable and time scale of interest.

The results described above are based on ensembles of climate model simulations and encompass a range of future GHG scenarios and downscaling methods. However, the results should be viewed with caution, and estimates of changes in winds have been shown to be highly model dependent (e.g.

[51] http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Middle%20East&ThisCcode=LBN#

Pryor and Barthelmie, 2013), with the climate change signal often smaller than the natural variability of the winds.

In summary, WTGs are designed to be accommodate extremes in wind speed and temperatures and are expected to be relatively resilient to the changing climate (Pryor and Barthelmie, 2013). Increasing temperatures may increase demand for the energy the Project will generate and reduce the potential for ice formation on the WTGs. However, The Project is located well inland and is not exposed to rising sea levels.

8.3 Impact Analysis

8.3.1 Construction Phase

8.3.1.1 GHG Emissions

GHG emissions are estimated using the IPCC Tier 1 methodology (IPCC, 1997, 2000) using the quantity of fuel burnt by source for CO_2, CH_4, N_2O. Fuel consumption was estimated based on activity data presented in **Appendix I** for the three phases of the Project. The emission factors for each category are presented in **Table 8-1**.

Table 8-1 GHG Emission Factors

Source	Unit	CO_2	CH_4	N_2O
Transport – Diesel	g/L	2,652.42	0.1498	0.06656
Transport – Gasoline	g/L	2,287.15	0.6675	0.01997
Energy - Diesel	g/L	2,645.60	0.1082	0.02155

To calculate the CO_2eq. emissions, a Global Warning Potential (GWP) of 1 was used for CO_2, 21 for CH_4 and 310 for N_2O.

Table 8-2 shows the quantities of GHG emissions during the construction, operations and decommissioning phases of the Project.

Table 8-2 GHG Emissions During Project Phases

Phase	CO_2 em. (kg)	CH_4 em. (kg)	N_2O em. (kg)	CO_2eq. em. (kg)
Construction	2,632,223.2	161.1	54.9	2,652,619.6
Operation (1yr)	199,744.9	34.8	1.8	201043.5
Decommissioning	193,826.4	16.5	4.5	195561.0

Note: the operation of the batching plant was not considered in the GHG emissions calculations for the construction phase, as the batching plant is already existing, operational, and operated independently by an external company.

The GHG emissions showed that the main GHG from the Project is CO_2 with the construction phase being again the highest emitter. The assessment of impacts was therefore based on the construction phase, representing the worst-case scenario. The impact severity was considered Low, and the sensitivity of the receptor considered Medium, resulting in a Minor impact as shown in **Table 8-3**.

Table 8-3 GHG Assessment for Construction Phase (Worst-Case Scenario)

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

8.3.2 Operations Phase

8.3.2.1 Flood Risk

While global climate model projections for precipitation extremes indicate that the Project area is not expected to experience increase flood risk,[52] heavy rainfall could create a potential risk of local flood hazard within the Project site during rainy season, including flash flood events. Such risks must be taken into consideration throughout the detailed design of the Project, as they could inflict damage to the Project and its various components.

Mitigation Measures

The following identifies the mitigation measures that must be considered by the selected OEM/EPC Contractor at a later stage:

- The selected OEM/EPC Consultant will undertake a flood risk assessment to investigate such risks. The assessment should be on study of the catchment area's rainfall, runoff and flood flow.
- It is recommended that the selected OEM/EPC Contractor, as part of the detailed design prepared for the Project, avoid locating any of the Project components within the buffer distances developed under the flood risk assessment to eliminate any risks for flood.
- A detailed hydrological study must be undertaken to identify and determine the required engineering structures to be considered as part of the detailed design for new asphalt and gravel road segment and internal tracks (e.g. drainage structures, culverts).

Following the implementation of these mitigation measures, the impact severity is considered Slight, and the sensitivity of the receptor as Medium, resulting in a residual impact categorized as Negligible as shown in **Table 8-4**.

[52] http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Middle%20East&ThisCcode=LBN

Table 8-4 Flood Risk Assessment

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	**Negligible √**	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

8.3.2.2 Wildfire Risk

Increasing temperatures and decreasing precipitation may also increase the potential for wildfires, which could affect the Project infrastructure and/or interrupt access to the site. Such risks must be taken into consideration throughout the detailed design of the Project, as they could inflict damage to the Project and its various components.

Mitigation Measures

The following identifies the mitigation measures that must be considered by the selected OEM/EPC Contractor at a later stage:

- It is recommended that the selected OEM/EPC Contractor, as part of the detailed design prepared for the Project, avoid locating any of the Project components within the buffer distances (if any) developed for the Karm Chbat Nature Reserve.
- The selected OEM/EPC Contractor must identify and determine the required fire detection and protection equipment to be considered as part of the detailed design.

Following the implementation of these mitigation measures, the impact severity is considered Low, and the sensitivity of the receptor as High, resulting in a residual impact categorized as Moderate as shown in **Table 8-5**.

Table 8-5 Wildfire Risk Assessment

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High √**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	Minor	Minor	**Moderate √**
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

8.4 Carbon Payback Period

It is noted that the assessment did not consider the offsetting beneficial impact of generating clean energy through the operation of the wind farm. The Carbon Payback Period (P), measured in days, is defined as the time needed to generate the emissions from the turbine's life cycle when using the fossil fuel electricity mix of the national electricity company EDL.

Therefore, a life cycle assessment was undertaken to calculate the GHG equivalent to CO_2. It comprises all phases of the Project, i.e. the manufacturing, shipping, construction, operation, decommissioning, shipping for disposal, recycling and landfilling.

Since the OEM/EPC Contractor is not yet determined, several assumptions were made to calculate the *approximate* Carbon Payback Period. These assumptions are presented in **Table 8-6**.

The expected energy output from SA is 315.75GWh/year resulting in 6,315GWh over 20 years. The total emissions from the LCA (lifespan 20 years) results in 61179.31 tons of CO2eq, as shown in **Table 8-7**.

Since EDL emission rate is 630 t CO_2eq/GWh, the carbon payback period is 113 days, which is expected when compared to the literature.

Table 8-6 Assumptions for Calculation of GHG for the Project LCA

Manufacturing			
Item	**Material**	**Share of Total Weight**	**Emission Factor (t CO_2eq/t of Material)**
Nacelle (share normalized to 1)	Steel	0.806	2.49
	Copper	0.082	6.60
	Aluminum	0.031	3.47
	Glass	0.010	0.57
	Iron	0.071	1.35
Generator	Steel	0.800	2.49
	Copper	0.200	6.60
Blade	Fiberglass	0.600	1.39
	Epoxy resin	0.400	3.98
Tower	Steel	1.000	2.49
Other assumptions: • Above assumptions from: Smoucha EA, Fitzpatrick K, Buckingham S, Knox OGG (2016) Life Cycle Analysis of the Embodied Carbon Emissions from 14 Wind Turbines with Rated Powers between 50Kw and 3.4Mw. J Fundam Renewable Energy Appl 6: 211. doi:10.4172/20904541.1000211 • Number of Wind Turbines: 21 • Weight of Nacelle considered: 80 tons • Weight of Generator considered: 68 tons • Weight of Blade considered: 22 tons for one blade, 66 tons in total (33 blades) • Weight of Tower considered: 315 tons			
Shipping to Lebanon			
Assumptions: • From EMEP/EEA 2016: General cargo, fuel consumption 204g/kWh (50% Medium speed diesel, 50% Slow Speed Diesel), Main engine 2,555kW, Auxiliary engine 588kW, Cruising only considered, speed 23km/h, Fuel type: Bunker Fuel Oil • Travel distance: 10,000km • Number of ships: 5 • Emission factors: IPCC (1996, 2000)			
Construction - Calculated in Climate Change paragraph			
Operation - Calculated in Climate change paragraph for 1 year, lifespan 20 years			
Decommissioning -Calculated in Climate change paragraph			
Shipping - from Lebanon same as Shipping to Lebanon			
Assumptions: • From EMEP/EEA 2016: General cargo, fuel consumption 204g/kWh (50% Medium speed diesel, 50% Slow Speed Diesel), Main engine 2,555kW, Auxiliary engine 588kW, Cruising only considered, speed 23km/h, Fuel type: Bunker Fuel Oil • Travel distance: 10,000km • Number of ships: 5 • Emission factors: IPCC (1996, 2000)			

Recycling			
Material	**Share Recycled**	**Share Landfilled**	**Emission Factor for recycling (t CO_2eq / t of material recycled)**
Steel	0.90	0.1	1.819
Aluminum	0.95	0.05	0.738
Copper	0.95	0.05	3.431
Iron (considered same as iron)	0.90	0.1	1.819
Other	0	1	0
Above recycling data from: Kabir MR, Rooke B, Dassanayake M, Fleck BA (2012) Comparative life cycle energy, emission, and economic analysis of 100kW nameplate wind power generation. Renew Sustain Energy Rev 37: 133-141.			
Landfilling			
All material, Emission factor regardless of material type: 0.0009 t CO_2eq / t of landfilled material			
Above landfilling data from: Kabir MR, Rooke B, Dassanayake M, Fleck BA (2012) Comparative life cycle energy, emission, and economic analysis of 100kW nameplate wind power generation. Renew Sustain Energy Rev 37: 133-141.			

Table 8-7 CO_2eq Emissions from the Project Wind Turbine Life Cycle

Stage	Emissions CO_2eq (t)
Manufacturing	29,190.86
Shipping to Lebanon	4,295.06
Construction	2,652.62
Operation	4,020.87
Decommissioning	195.56
Shipping from Lebanon	4,295.06
Recycling	16,527.16
Landfilling	2.12
Total	**61,179.31**

9. GEOLOGY AND HYDROLOGY

9.1 Baseline Methodology

Information regarding the Project site geology was obtained through literature review. It is noted that there are no water-related ecologically important habitat locally (refer to **Section 13 Biodiversity**).

9.2 Baseline Findings

9.2.1 Geology

The study area falls on a Middle Cretaceous formation (Sannine Maameltein, C4-C5), characterized as thinly bedded to widely exposed and highly karstified limestone overlying pale gray fractured fine and thick bedded limestone, as presented in **Table 9-1**.

Table 9-1 Formations Encountered in Project Area

Formation Name	Code	Description
Maameltein	C5	Massive to thinly bedded white gray limestone and marly limestone.
Sannine-Maameltein	C4-C5	Combining the above limestone formations to create one of the major water towers in Lebanon, widely exposed and highly karstified, with major recharge coming from snow.
Sannine	C4a, C4b, C4c	Pale gray fractured fine and thick bedded limestone and marled limestone with geodes and chert.

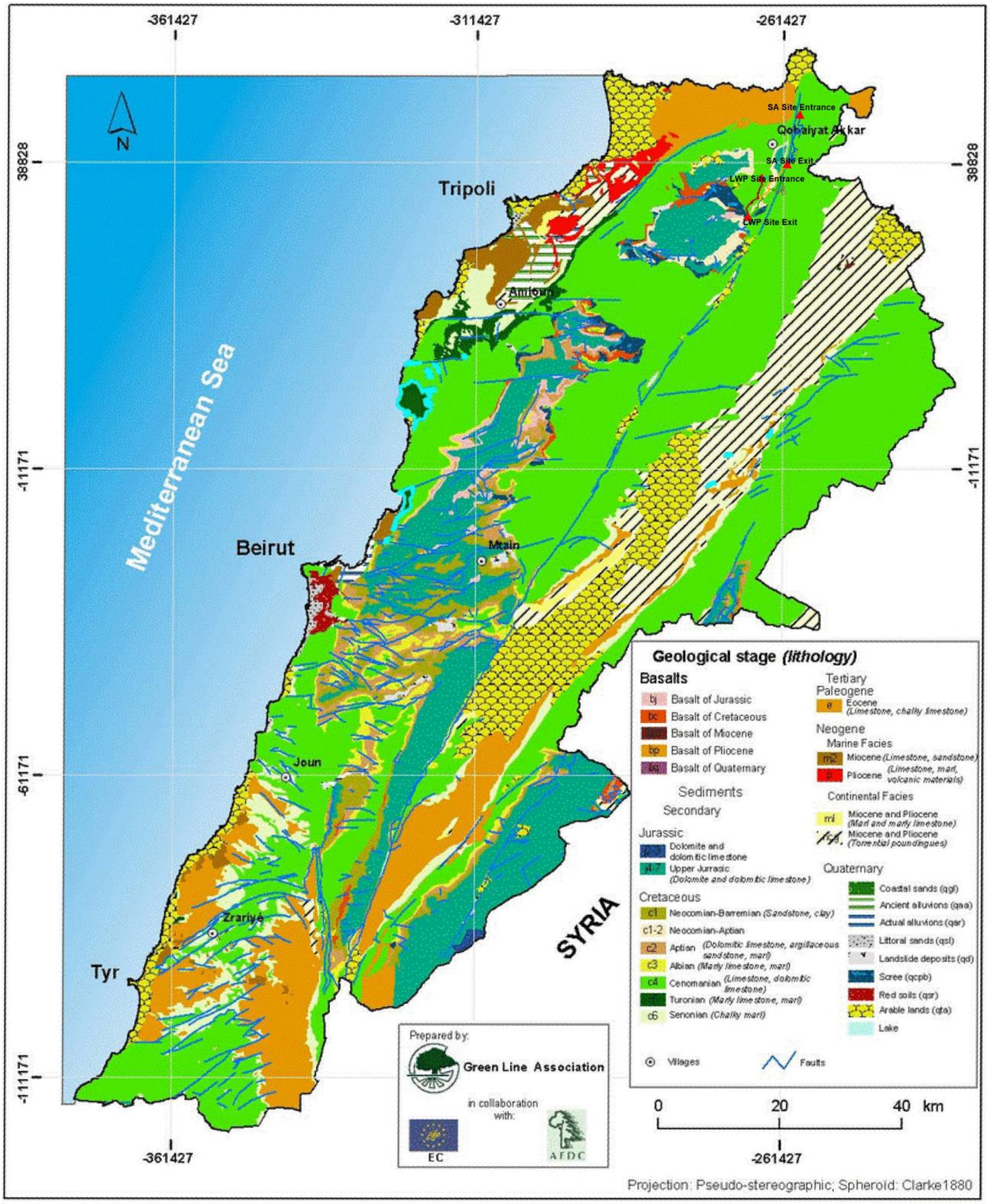
The structural features were shaped by the major tectonic events recorded in the geological history of Lebanon and have an impact on controlling the groundwater flow directions --- serving as a preferential pathway or as a flow-restricting boundary.

The primary structures are divided into: 1) primary faults Yammouneh, Rashaya, Hasbaya, Roum and Serghaya; 2) primary folds North Mount Lebanon Anticline, Barouk-Niha Anticline, Bekaa Syncline/garben, North Anti-Lebanon Anticline and Mount Hermon Anticline; and 3) platforms (Akkar, Tyr and Saida-Damour.

The secondary structures are divided in to secondary faults, which are trending in a NW-SE, NE-SW, ENE-WSW and E-W and secondary folds, mainly trending in a NNE-SSW direction parallel to the primary faults.

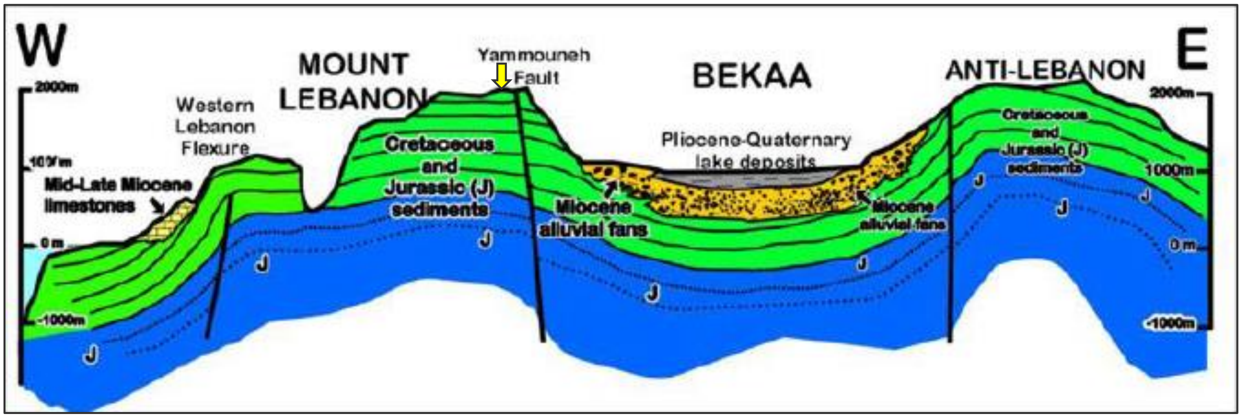
The geological map of Lebanon is shown in **Figure 9-1**. A cross-section of northern Lebanon is shown in **Figure 9-2**.

Figure 9-1 Geological Map of Lebanon[53]



[53] Geological map of Lebanon, Dubertret, 1955.

Figure 9-2 Cross-Section of Northern Lebanon[54]



Onsite observations confirmed the prevalence of limestone rocks in the Project area, as shown in **Figure 9-3**.

Figure 9-3 Limestone Outcroppings in the Project Area

The Project site is situated east of the Yammouneh Fault, as shown in **Figure 9-2** and **Figure 9-4**. Topography is presented in **Figure 9-5**.

[54] Ground Study Report, Lebanon Wind Power Project, Akkar Region – Southern Ridge, Lebanon, 2018.

Figure 9-4 Faults of Lebanon

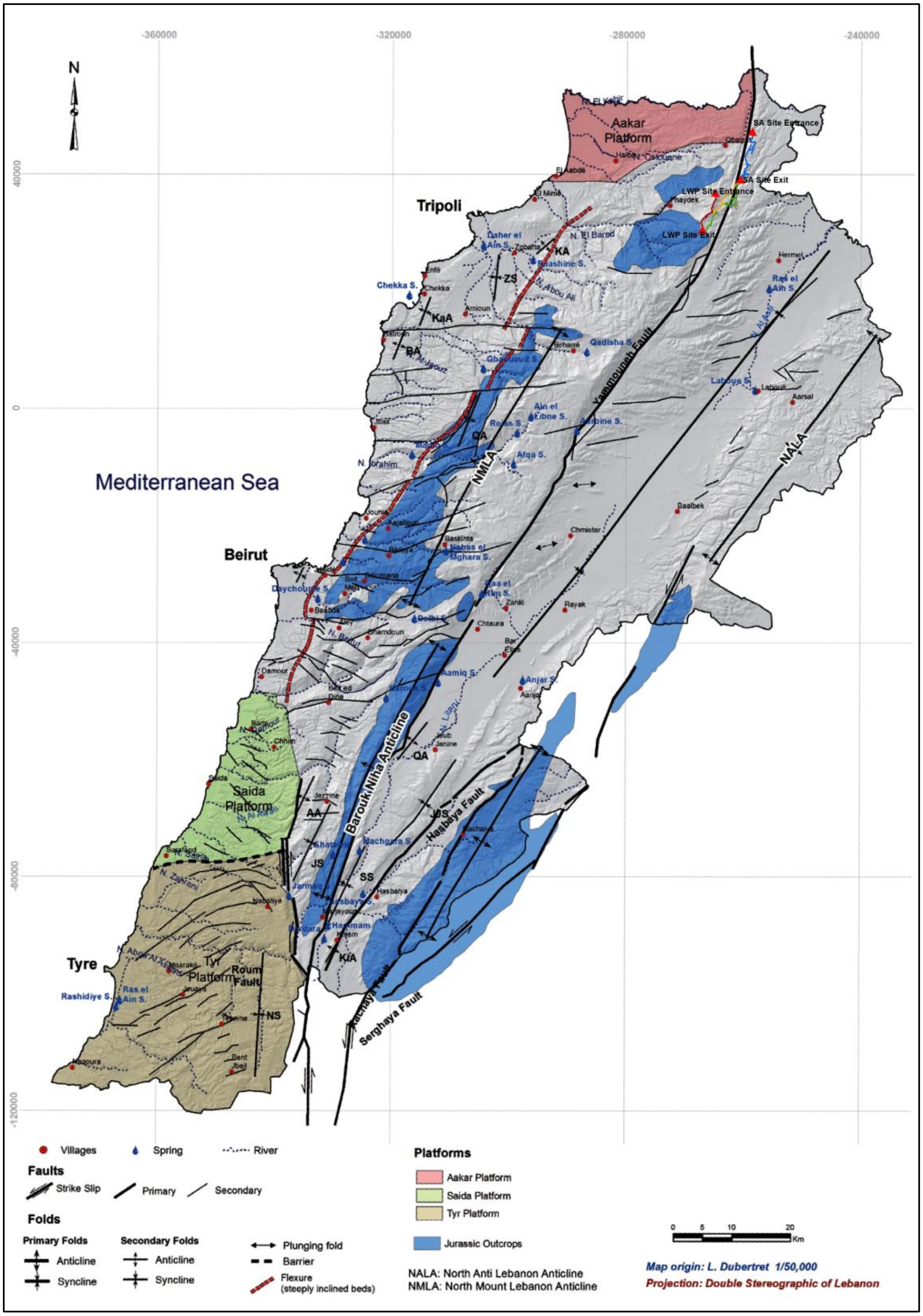
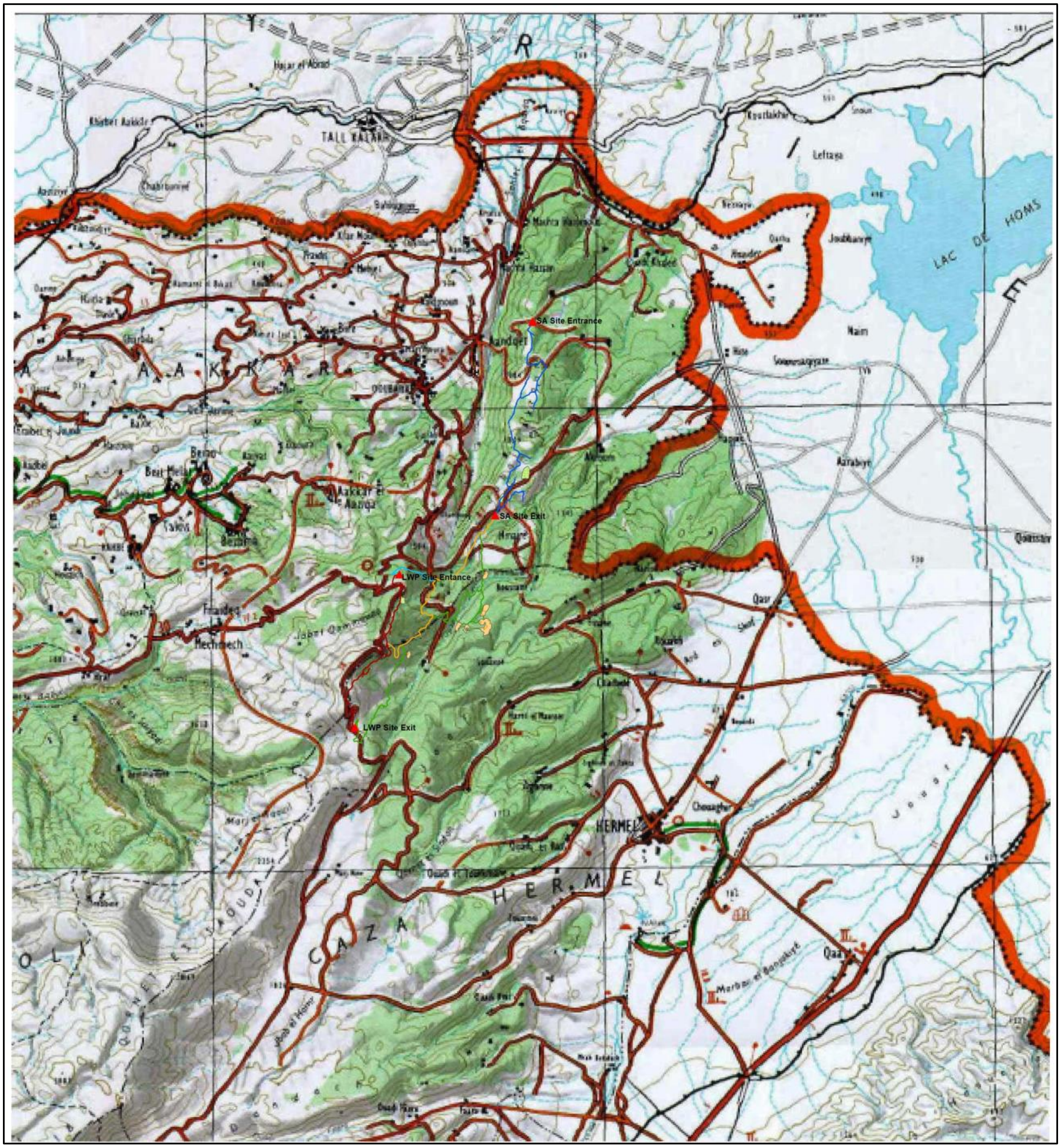


Figure 9-5 Topography of Northern Lebanon[55]



[55] Vidiani, 2019.

9.2.2 Groundwater

9.2.2.1 Hydrostratigraphy

The relationship between stratigraphy and hydrostratigraphy is shown in **Figure 9-6.** The main aquifer underlying the Project site is the Sannine-Maameltain Aquifer, which is lithologically composed of karstic limestone, i.e. soluble rock where voids, caverns, open fractures, and caves have formed due to weathering by aggressive water. Combining these two formations creates one of the major water towers in Lebanon. The Project site is situated west of the Mediterranean-Interior Province Divide in the Qammoua Groundwater Basin, which covers an area of 43.3km^2 (UNDP Assessment of Groundwater Resources, 2014).

According to the UNDP Groundwater Resources Report[56], the Sannine Maameltein, C4-C5 formation lies within a karst area classified as Area 2 – Moderate Karst Exposure (MKE) as shown in **Figure 9-7**, where relatively high infiltration rates, groundwater flow is present, and normal surface runoff with diffused losses reflect the effects between surface water and the groundwater basin. Major recharge of this aquifer is from snow and groundwater is stored and transmitted in fractures and conduits and is not an area that is recharged by natural and/or wastewater sites, as shown in **Figure 9-8.** Water infiltrated from within the study area will feed regional groundwater and feed public wells and springs. As indicated in **Section 15 Socioeconomic Conditions**, minor springs present locally are an important source of water for residents of the local villages (also refer to **Section 9.2.2.2**).

Shallow and deep groundwater flow in the basin is shown in **Figure 9-9** (as indicated by small and large blue lines). According to the UNDP Groundwater Resources Report, the aquifer is not under stress, as shown in **Figure 9-10**.

The recharge potential of the groundwater basin underlying the Project site is shown in **Table 9-2**.

Table 9-2 North Lebanon Cretaceous Basin Recharge Potential[57]

GW-BASIN	VOLUME OF POTENTIAL RECHARGE (MCM/YEAR)		TOTAL VOLUME OF POTENTIAL RECHARGE (MCM)	% OF ARTIFICIAL RECHARGE TO NATURAL RECHARGE	% OF ARTIFICIAL RECHARGE TO NATURAL RECHARGE
	NATURAL SOURCES	WASTE-WATER EFFLUENT		(2010-2011)*	(2011-2012)*
North Lebanon Cretaceous Basin (Basin 18)	10.5 - 20.9	0.5 - 0.6	11 - 21.5	4.1 - 8.1	2.6 - 5.1

[56] UNDP, Ministry of Energy and Water, Assessment of Groundwater Resources of Lebanon, 2014.
[57] Ground Study Report, Lebanon Wind Power Project, Akkar Region – Southern Ridge, Lebanon, 2018.

Figure 9-6 Stratigraphy and Hydrostratigraphy

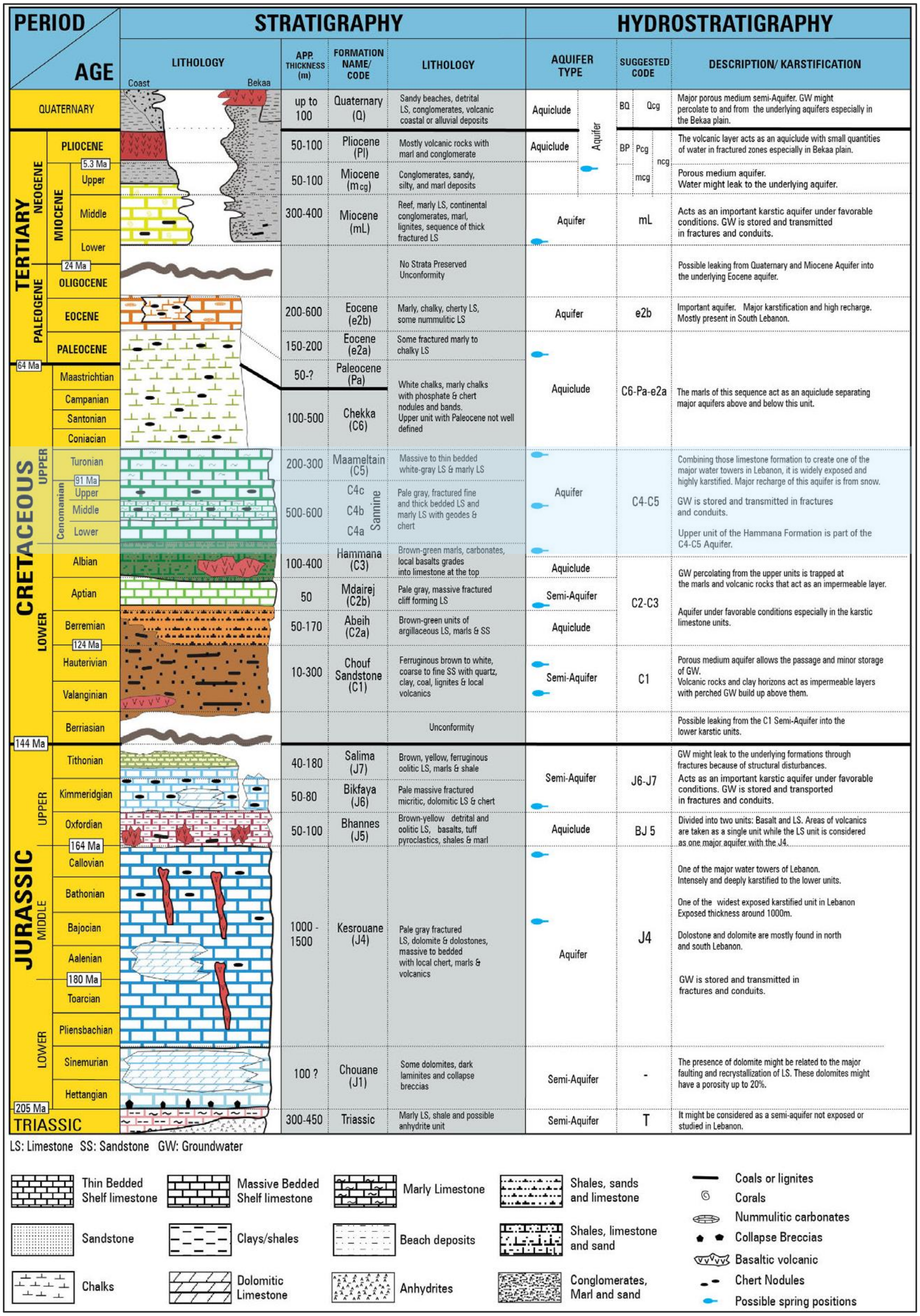


Figure 9-7 Karstic Map of Lebanon

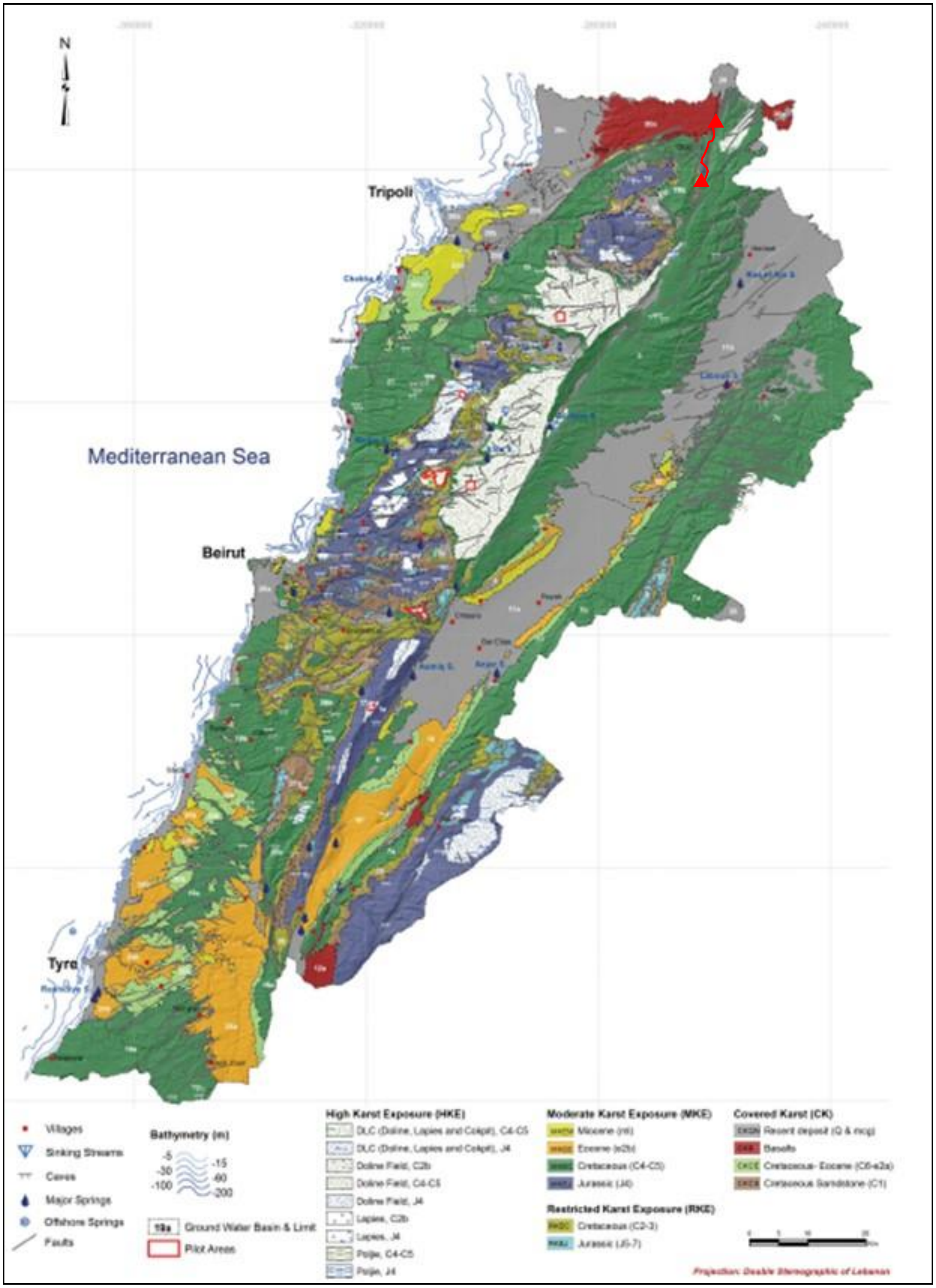


Figure 9-8 Hydrogeology Map

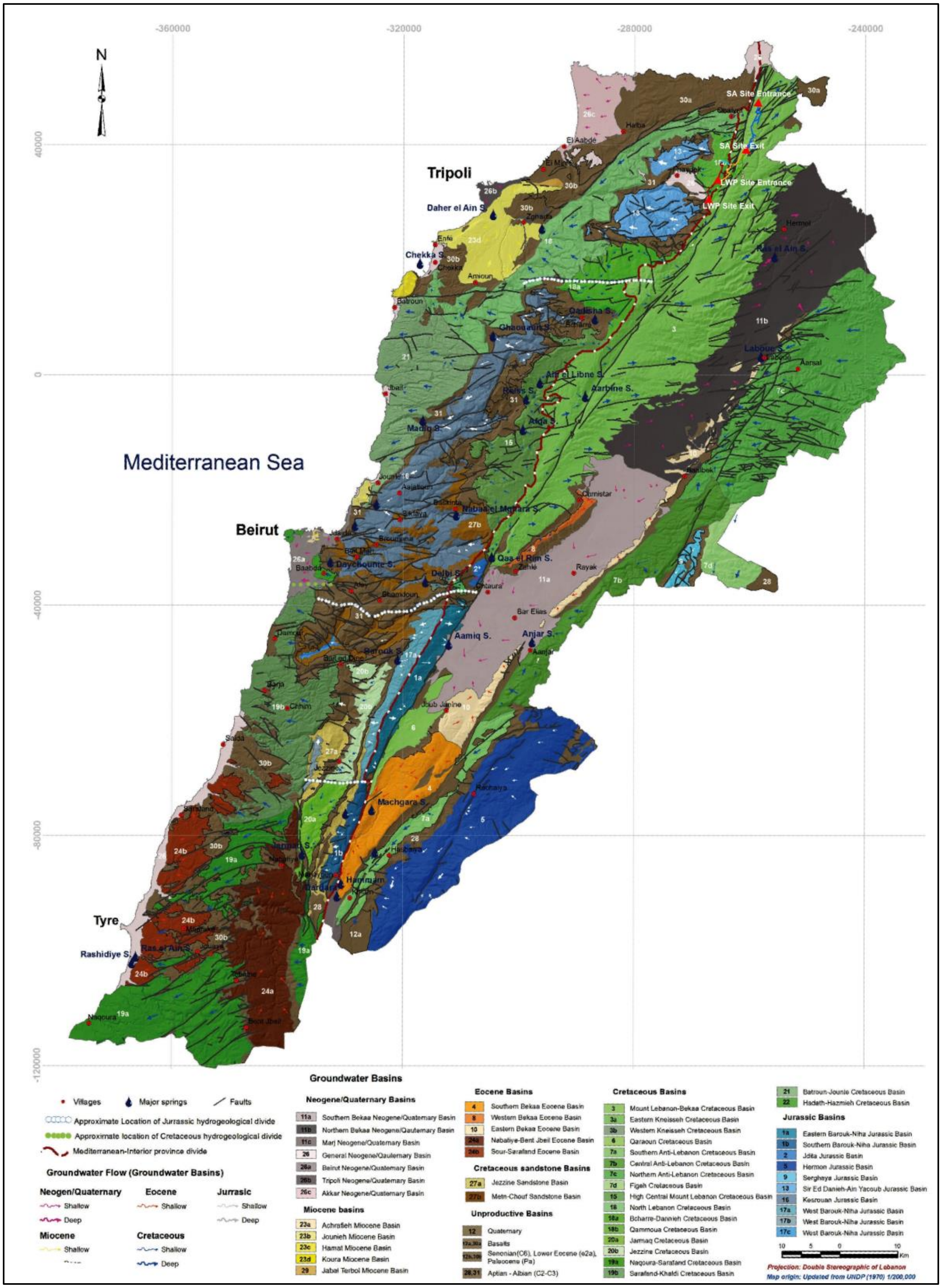


Figure 9-9 Shallow and Deep Groundwater Flow Direction in the Basin

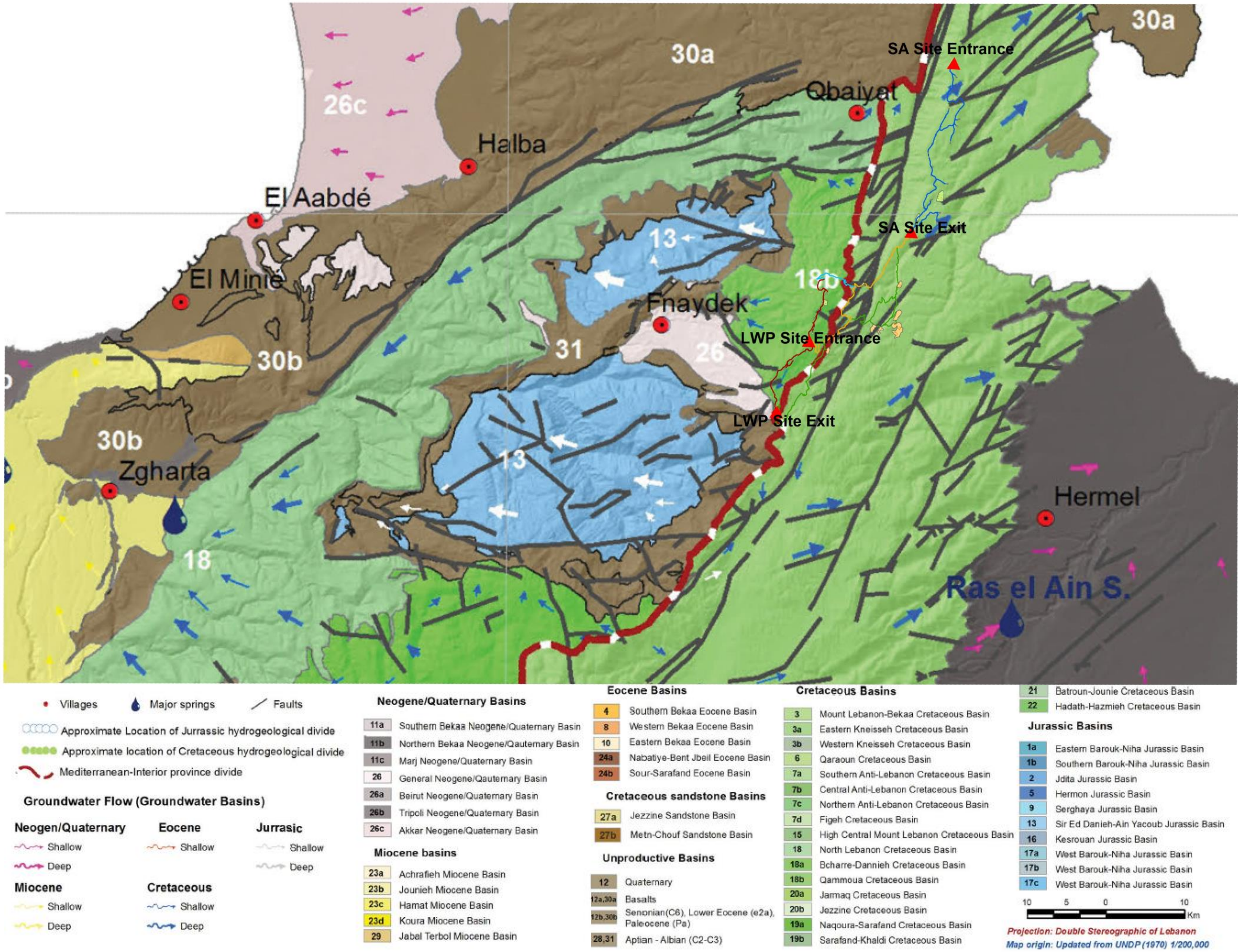
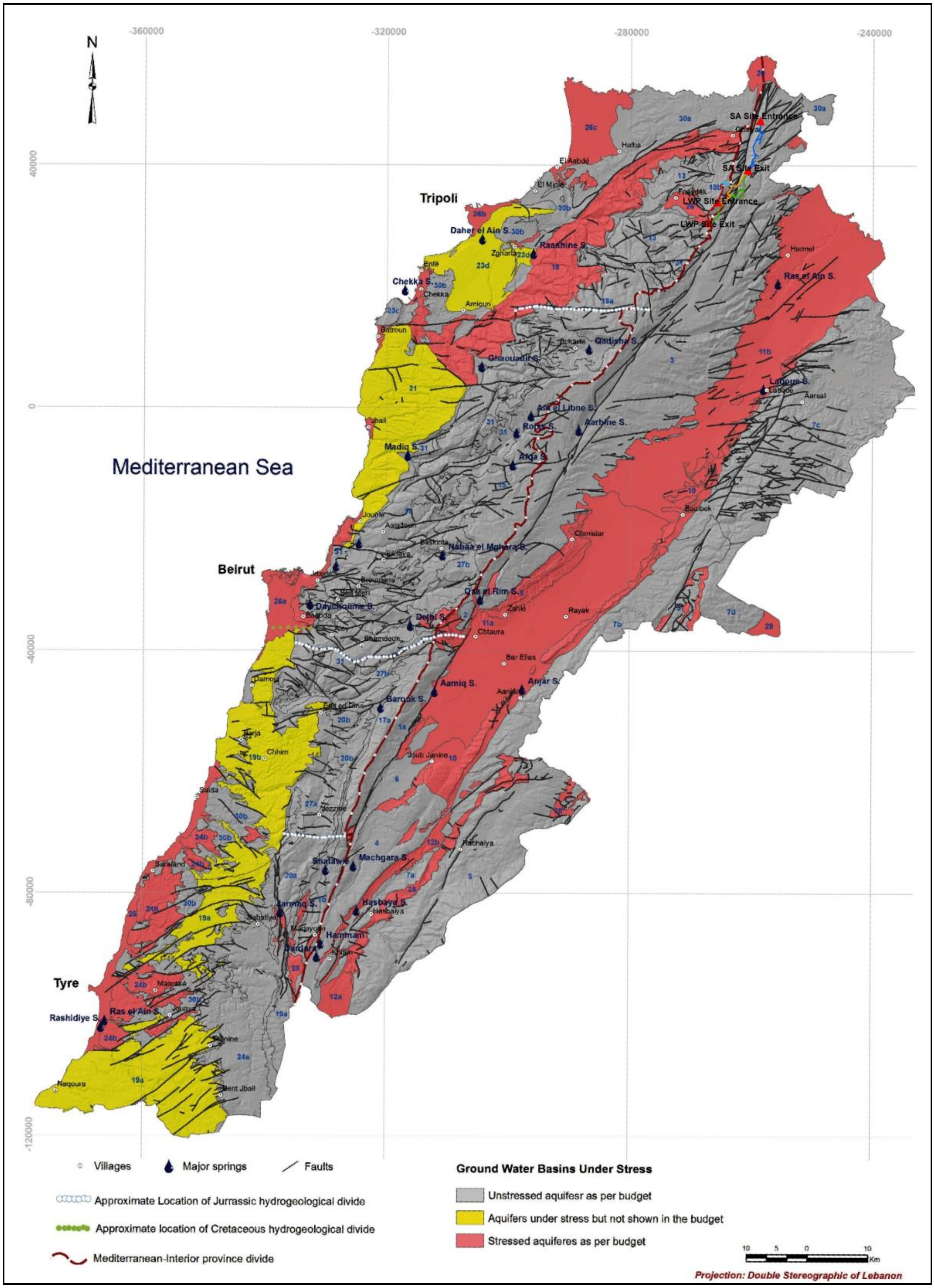


Figure 9-10 Groundwater Basins Under Stress



Data on groundwater recharge are limited, however the UNDP Assessment of Groundwater Resources in Lebanon (2014) states that recharge to groundwater is calculated as the excess of precipitation over real evapotranspiration and surface runoff, and the estimated volumes, which includes both deep percolation and retention in the vadose zone for the four hydrological cycles vary from 4,116 to 6,651 MCM, with an average of about 55% of the total precipitation.[58] Therefore, without additional data, it is assumed that 55% of the total rainfall enters the aquifer (note: this assumption likely overstates the actual recharge volume). The hydrochemical composition is Ca-Mg-HCO_3, with a shift toward salt water intrusion, as shown in **Table 9-3**.

Table 9-3 North Lebanon Cretaceous Basin Hydrochemical Composition[59]

GW BASIN NO	NO. OF SAMPLES	FACIES FROM PIPER	GW BASIN NO.	NO. OF SAMPLES	FACIES FROM PIPER
Mediterranean Province					
18	3	Ca-Mg-HCO_3 With shift towards salt water intrusion for SS2 values	19a	6	Ca-Mg-HCO_3

9.2.2.2 Groundwater Extraction

The 2014 UNDP Study summarized the public well survey conducted between November 14, 2011 and February 13, 2012. The survey revealed the presence of 841 public wells in the country, as shown in **Figure 9-11**, out of which 44 wells are abandoned and 68 are non-operational. Flow meters were installed in 287 public wells. The survey showed that the operational public wells are exploiting the various aquifers at an estimated rate of about 248.7 million m^3/year.

The Project site is located within Lebanese Water Establishment **NLWE**, of which 27% is abstracted from the C4-C5 Aquifer. The number of public wells, piezometers and total extraction rates by Water Establishment is summarized in **Table 9-4**.

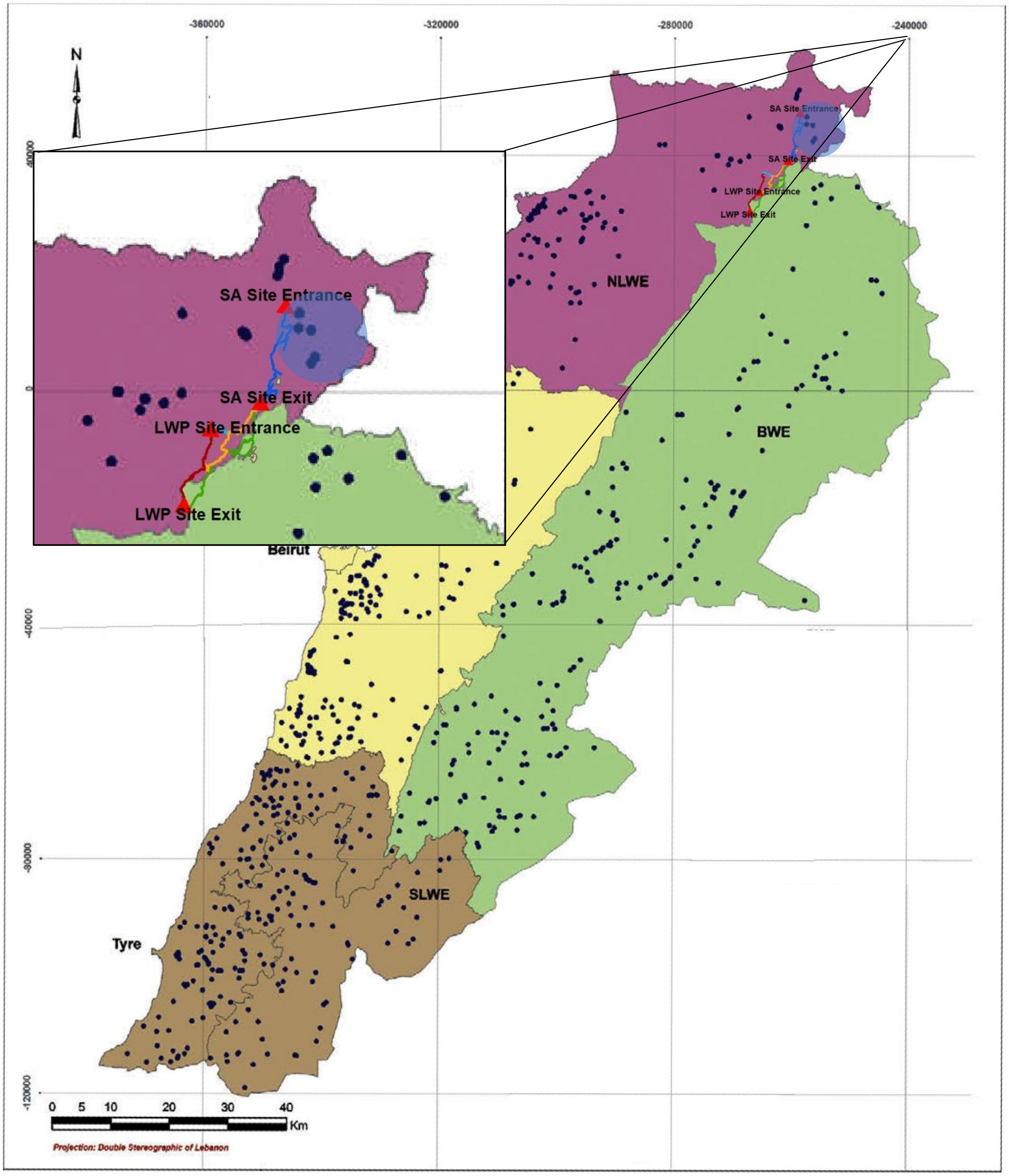
Table 9-4 NLWE Water Establishment Wells and Extraction Rates[60]

ESTABLISHMENT	TOTAL NO. OF WELLS SURVEYED IN THE FIELD	TOTAL EXTRACTION (rate m^3/day)	TOTAL EXTRACTION RATE (million m^3/year)	TOTAL NUMBER OF PIEZOMETERS
BMLWE	218	193,642	71	38
BWE	209	90,422	33	42
SLWE	277	309,128	113	7
NLWE	137	88,383	32	25
Total	841	681,576	249	112

[58] UNDP, Ministry of Energy and Water, Assessment of Groundwater Resources of Lebanon, 2014.
[59] Ground Study Report, Lebanon Wind Power Project, Akkar Region – Southern Ridge, Lebanon, 2018.
[60] Ground Study Report, Lebanon Wind Power Project, Akkar Region – Southern Ridge, Lebanon, 2018.

It is noted that the Project is located east of the Yamounneh Fault; therefore, the groundwater underlying the Project site would flow to the east, toward the group of wells circled in **Figure 9-10**.

Figure 9-11 Public Well Locations



There are no private water supply wells within the Project area; however, it was reported that 80% of Rweimeh Village use springs and 0% use water wells, while 40% of Jabal-Akroum Kfartoun use springs and 20% use water wells (refer to **Section 15 Socioeconomic Conditions**).

It is noted that the Project is located east of the Yamounneh Fault; therefore, the groundwater underlying the Project site would flow to the east, toward the group of wells circled in **Figure 9-11**. The wells located east/southeast are approximately 3.2km from the Project and are separated from the Project by a vertical change of approximately 220m.

Additional survey work was undertaken by the Developer to identify the number and location of public and private wells near the Project. One (1) private well and 2 public wells were identified as follows:

Private Well #1: 34°35'38.4"N 36°19'53.8"E and 34.593985, 36.331600;

https://www.google.com/maps/place/34%C2%B035'38.4%22N+36%C2%B019'53.8%22E/@34.5944975,36.3290125,17.5z/data=!4m5!3m4!1s0x0:0x0!8m2!3d34.5939853!4d36.3316003?hl=en

Public Well #2: 34°36'11.8"N 36°20'29.0"E and 34.603288, 36.341389;

https://www.google.com/maps/place/34%C2%B036'11.8%22N+36%C2%B020'29.0%22E/@34.6032875,36.3391999,17z/data=!3m1!4b1!4m5!3m4!1s0x0:0x0!8m2!3d34.6032875!4d36.3413886?hl=en

Public Well#3: 34°35'20.1"N 36°20'34.9"E and 34.588916, 36.343014;

https://www.google.com/maps?q=34.5889157,36.3430142&z=17&hl=en

As can be seen in **Figure 9-12**, the locations of these wells are immediately north, northeast of the Project.

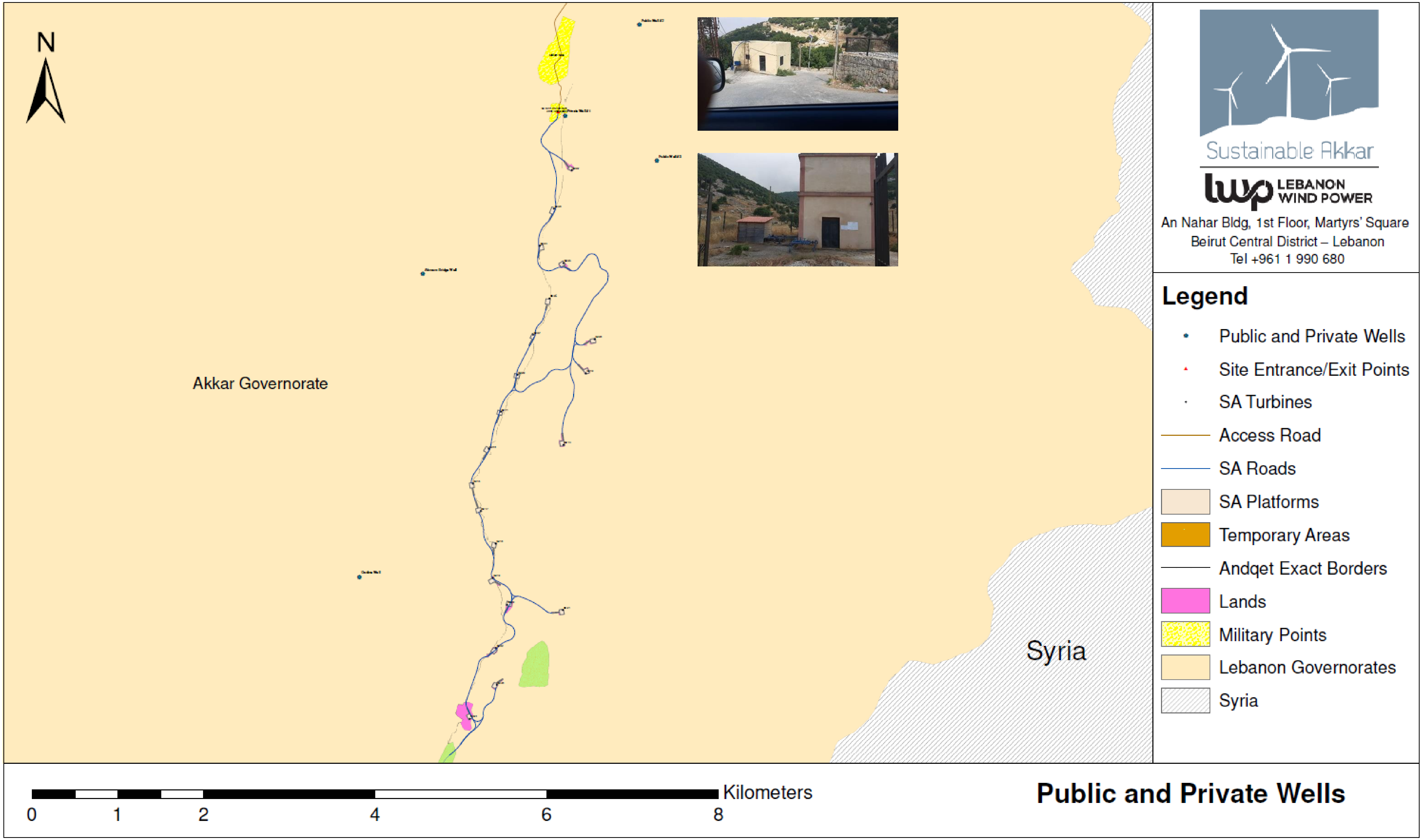
Although highly unlikely, a potential spill from the Project site could therefore result in pollution of groundwater. It is noted, however, that given the low likelihood of this scenario (i.e. that: 1) a spill that occurs at a volume that is not observed and cannot quickly be contained per implementation of good housekeeping practices; 2) construction will occur outside of winter months; and 3) flow through karsts and fractures in the Project area are moderate), this potential impact was not considered as part of the cumulative impact assessment included in **Section 20 Cumulative Impact Assessment** of the ESIA. However unlikely, it is acknowledged that there may remain a residual risk to groundwater resources.

9.2.3 Water Sources

9.2.3.1 Surface Water

Lebanon has 28 rivers, 22 of which originate on the western face of the Lebanon range and run through the steep gorges and into the Mediterranean Sea, the other 6 arise in the Beqaa Valley. Although the country is well watered and there are many rivers and streams, there are no navigable rivers, nor is any one river the sole source of irrigation water. Drainage patterns are determined by geological features and climate. Although rainfall is seasonal, most streams are perennial.

Figure 9-12 Private and Public Well Locations



The five rivers that flow within the North Lebanon Governorate (Mohafaza) are: Al Kabir River (Nahr Al Kabir), Oustuene River, Al Bared River (Nahr Al Bared), El Jaouz River (Nahr El Jaouz) and Abou Ali/Kadisha River (Nahr Abou Ali), as shown in **Figure 9-13**.[61]

The Al Kabir is the main river in the area that extends along 58km, noting that the villages of Aandqet, Quobaiyat, Chadra, Machta Hammoud and Machta Hassan form part of its drainage basin or watershed. **Figure 9-14**[62] shows the villages in the Project area and Al Kabir River passing through Chadra and Machta Hassan

The El Kabir River has an average flow rate of about 9.13m^3/s, with a minimum and a maximum of 1.42m^3/s and 190.8m^3/s, respectively. The river, as many others in the country, suffers from pollution. **Table 9-5**[63] shows some indicative pollutant values in the Al Kabir, Al Bared and Abou Ali/Kadisha Rivers in North Lebanon. These values were taken during the dry season, namely during the months of July, August and September of 2004.

Table 9-5 Parameters for Selected Main Rivers in North Lebanon in the Dry Season

Parameter	Al Kabir River / Nahr Al Kabir	Al Bared River / Nahr Al Bared	Abou Ali River / Nahr Abou Ali	Limit Value
BOD_5 (mg/l)	14.4	28.2	39.3	Nil*
NO_3 (mg/l)	3	2.8	3.4	50*
TDS (mg/l)	270	225	280	600*
SO_3 (mg/l)	20	28	22	250*
Total Coliforms (TC) (c/100ml)	300	610	26,500	500**
E. coli (c/100ml)	20	17	300	100**

* WHO (2006) standards for drinking water
** MOE Decision 52/1-1996: requirement for bathing water quality including sea, rivers and lakes.

According to **Figure 9-15**,[64] the Project lies in a water vulnerable zone.

9.2.3.2 Springs

Approximately 5,050 springs are depicted in the 1:20,000 topographic maps of Lebanon. 409 springs distributed throughout the 51 GW basins have some reliable discharge flow data. Only 9 springs are currently being monitored on a regular basis. A 2014 spring assessment by the UNDP categorized and classified springs into types (based on emergence mechanism) and classes (based on discharge flow rates), in addition to analyzing hydrographs of springs with continuous data.

[61] Shared Water Resources of Lebanon, Amin Raban, 2017.
[62] LocaLiban, 2012.
[63] MOE, 2010.
[64] DAR-IAURIF, 2005.

Figure 9-13 Lebanon River Locations

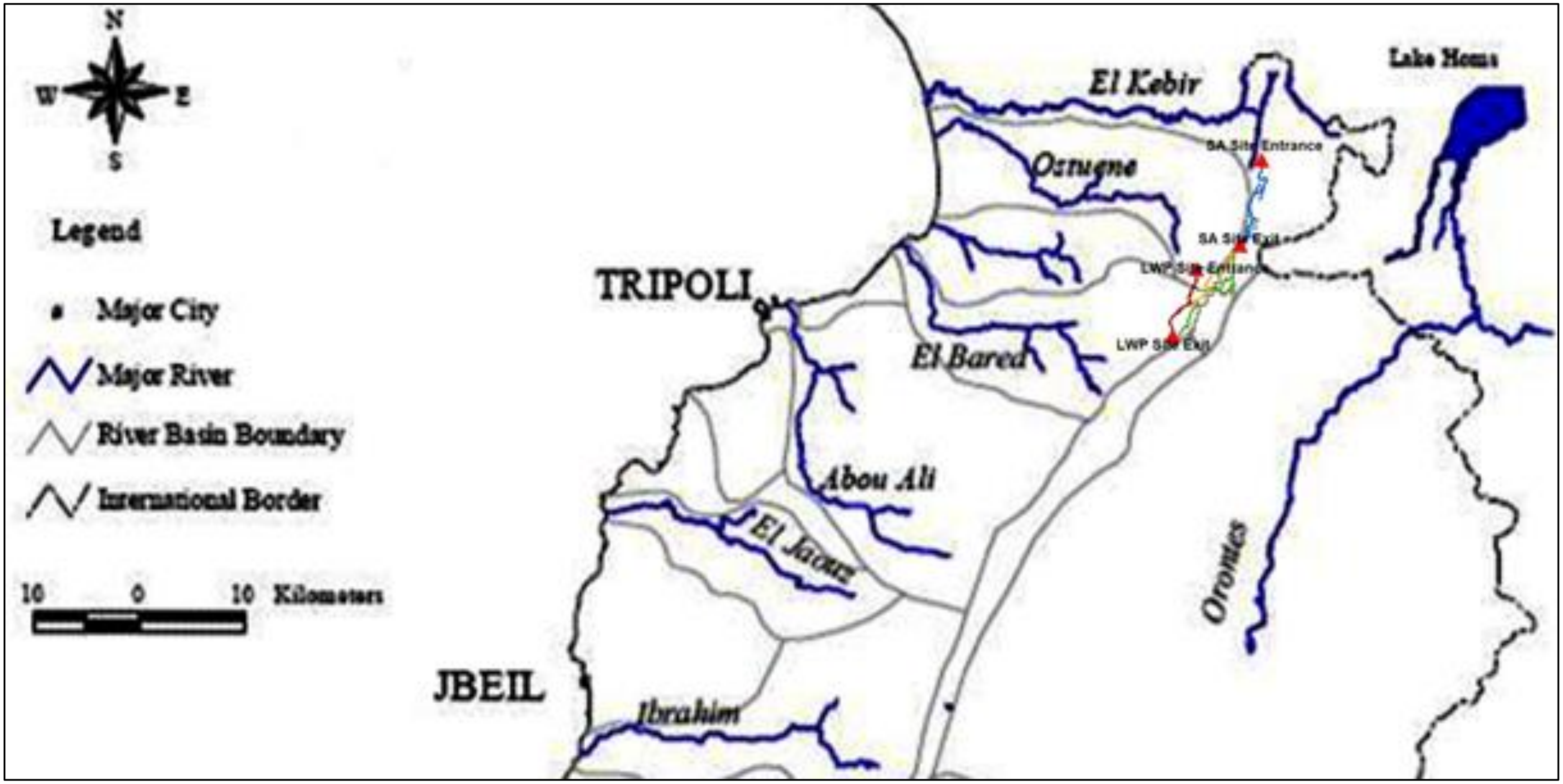


Figure 9-14 Water Resources Map of the Project Area

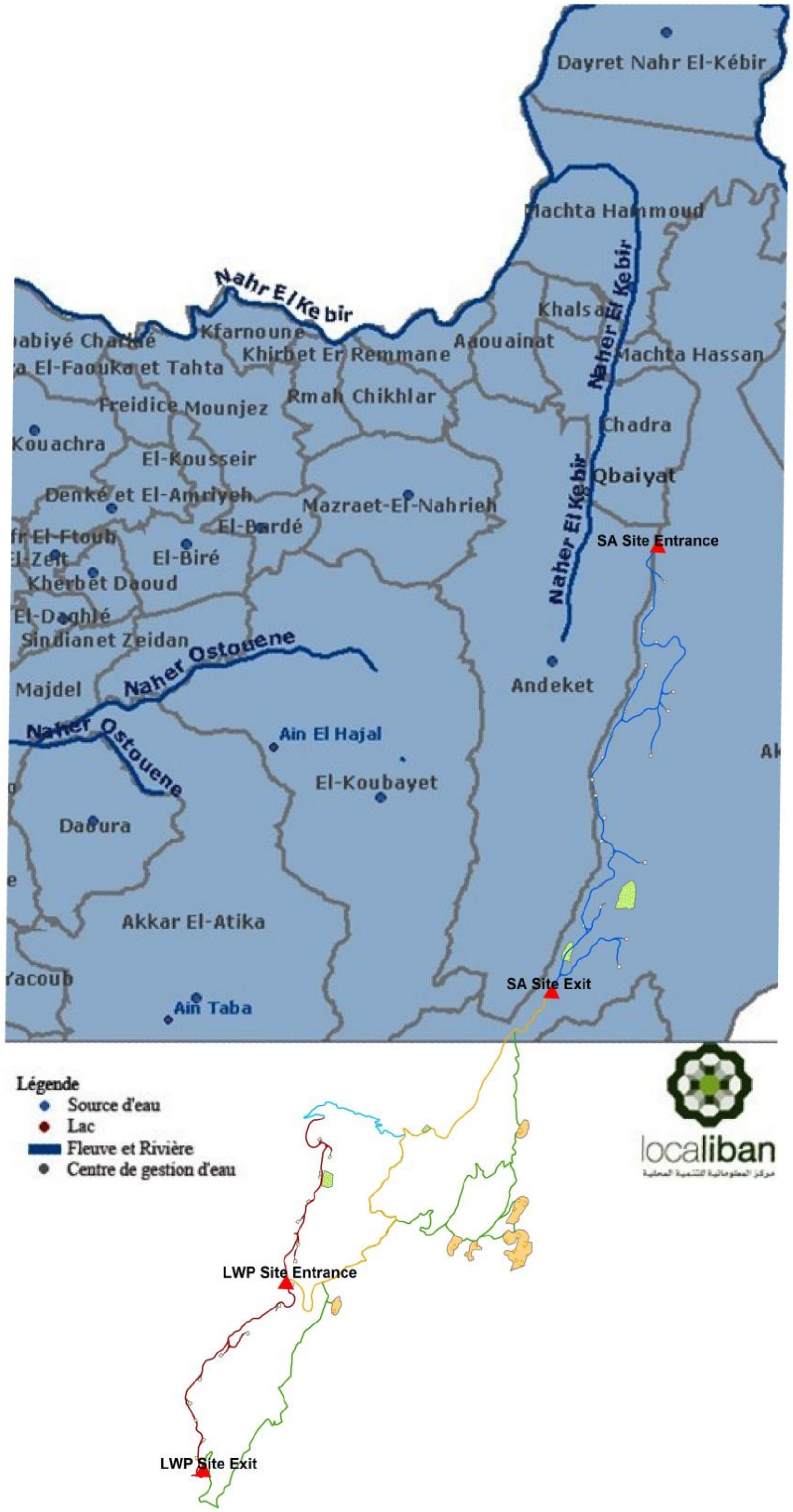
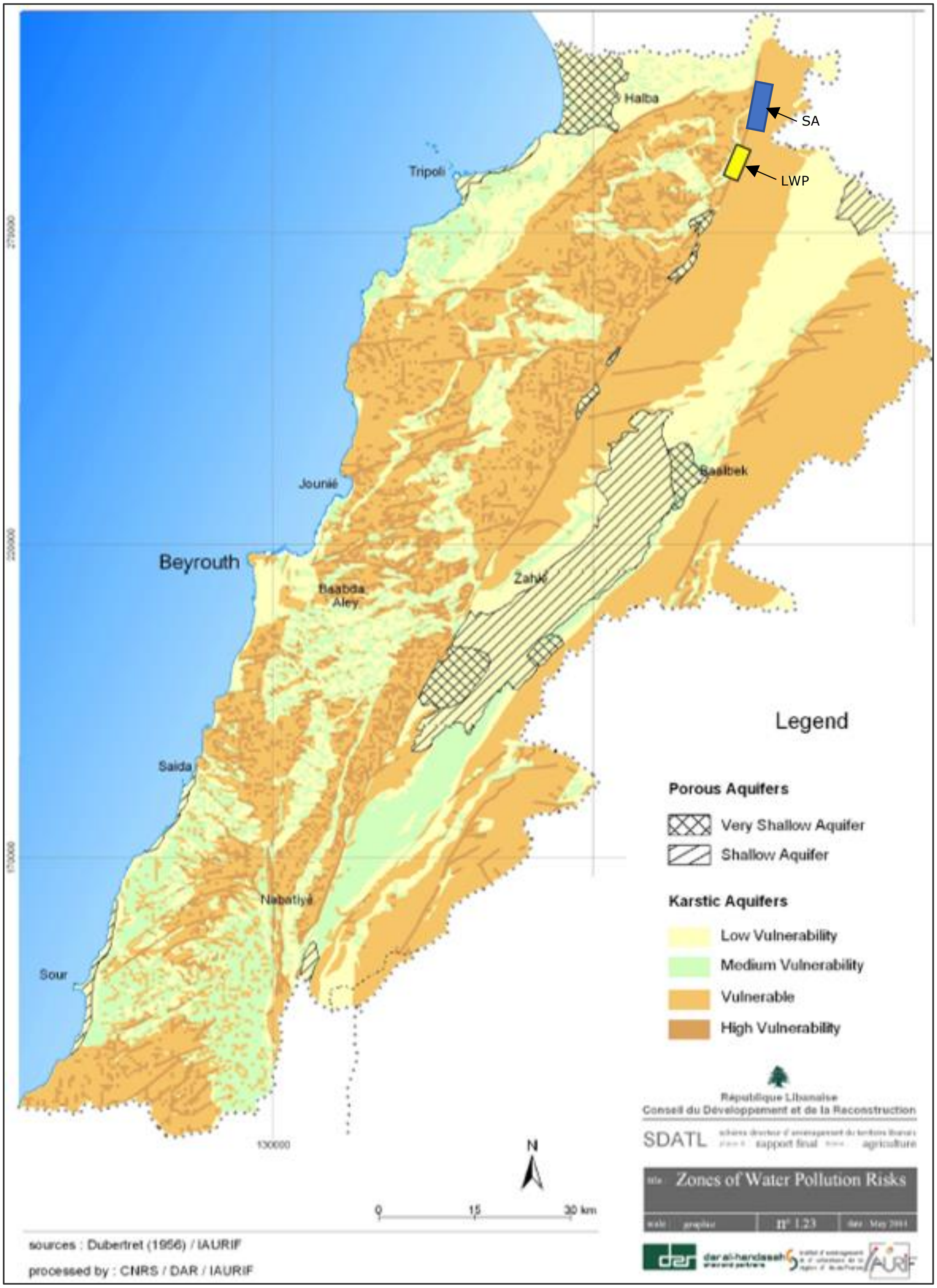


Figure 9-15 Water Resource Vulnerability Map of Lebanon



About 81 major springs, with sufficient reliable information, were categorized into 9 types. Each type is characterized by its specific emergence mechanism which includes a combination of spring hydrodynamic characteristics (i.e. draining flow, overflow, artesian, or a combination of two of these flow types) and geological controlling features (i.e. structural and stratigraphic control/barriers).Only 5 springs were found to belong to Class 2, which is characterized by a discharge rate ranging between 1 to 10 m^3/s.

There are no major springs in the study area, with the closest being the Ras El Ain Spring in Hermel, as previously shown in **Figures 9-7** through **Figure 9-10**. There are, however, several small water springs as depicted in **Figure 9-16**.

With regard to how springs are supported, there is a paucity of data. Spring discharges are not well measured, might be underestimated or overestimated, and retention and storage is not well defined. However, the UNDP provides the conceptual model as shown in **Figure 9-17**.

9.3 Impact Analysis

This section identifies the anticipated impacts to soil and groundwater from the Project activities during the construction, operation and decommissioning phases. It is noted that the selected OEM/EPC Contractor will undertake planned survey / monitoring (i.e. surveying of major karstic features, groundwater mapping, water quality monitoring of groundwater, local springs, etc.) to inform detailed design and address adverse impacts during construction. In addition, monitoring of key receptors shall be extended through the construction phase to ensure that any adverse impacts on groundwater are identified.

9.3.1 Potential Impacts to Groundwater Quality during the Construction and Decommissioning Phases

Elevated risk to groundwater is possible, primarily during the construction and decommissioning phases. Potential sources of pollution include but are not limited to the following:

- Spills of fuels and oils in plant stored at the site.
- Use of cementitious material in foundations, as well as disposal of water used as washdown of equipment/vehicles used to transport batched cement.
- Generation of turbid runoff from disturbed land, spoil heaps and new tracks.

While typically not a groundwater issue, control of these pollution sources in a karstic environment is necessary to preclude impacts to groundwater.

<u>Mitigation</u>

Such impacts are controlled through the implementation of general best practice housekeeping measured expected to be implemented by the selected OEM/EPC Contractor. These practices include following the Construction Health and Safety Plan, staging of work areas, provision of washout/washdown facilities with filter/neutralization prior to discharge, installation of silt fencing, erosion and sediment control, excavation and grading containment, provision of spill response equipment, etc.

Figure 9-16 Minor Spring Locations

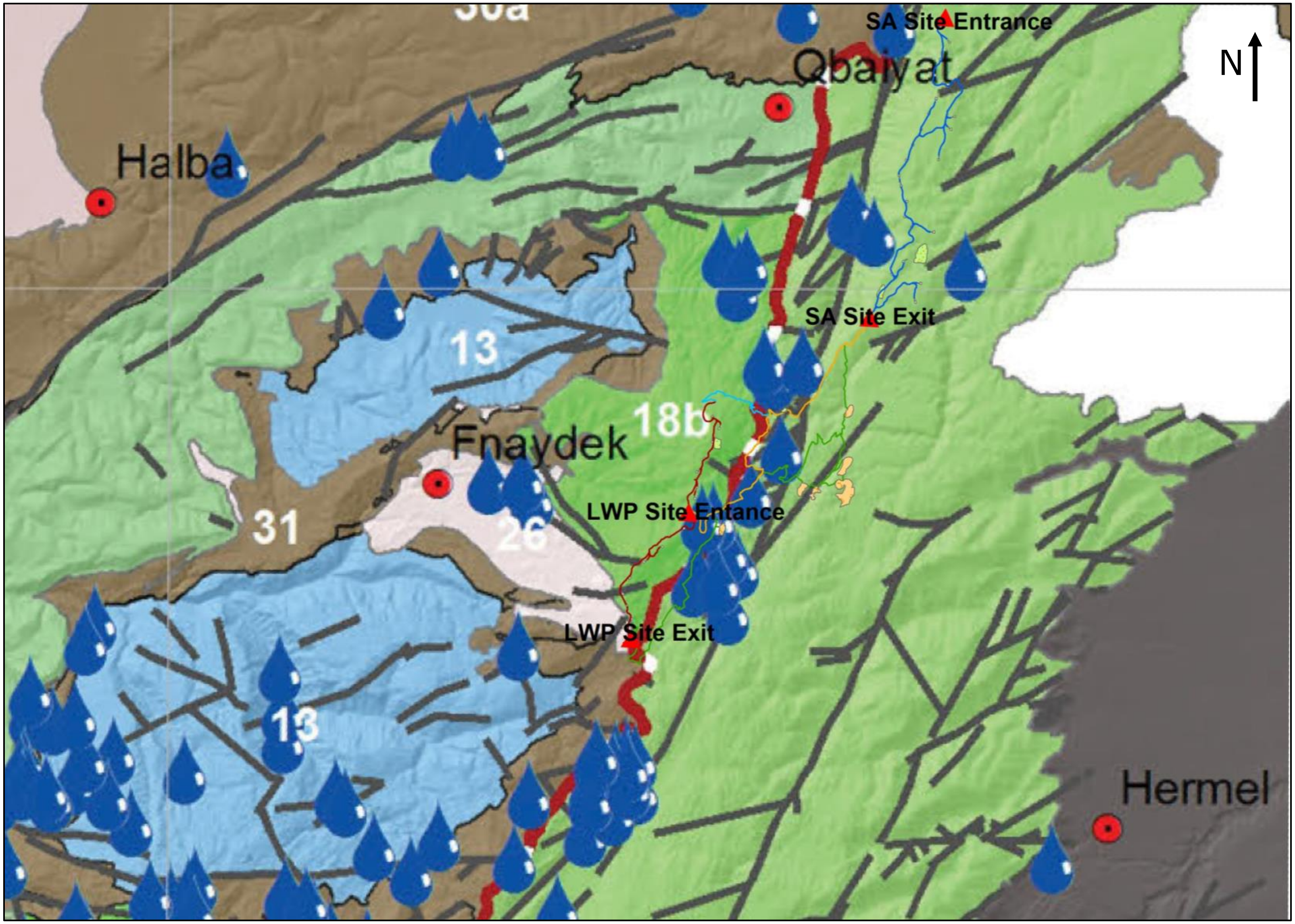
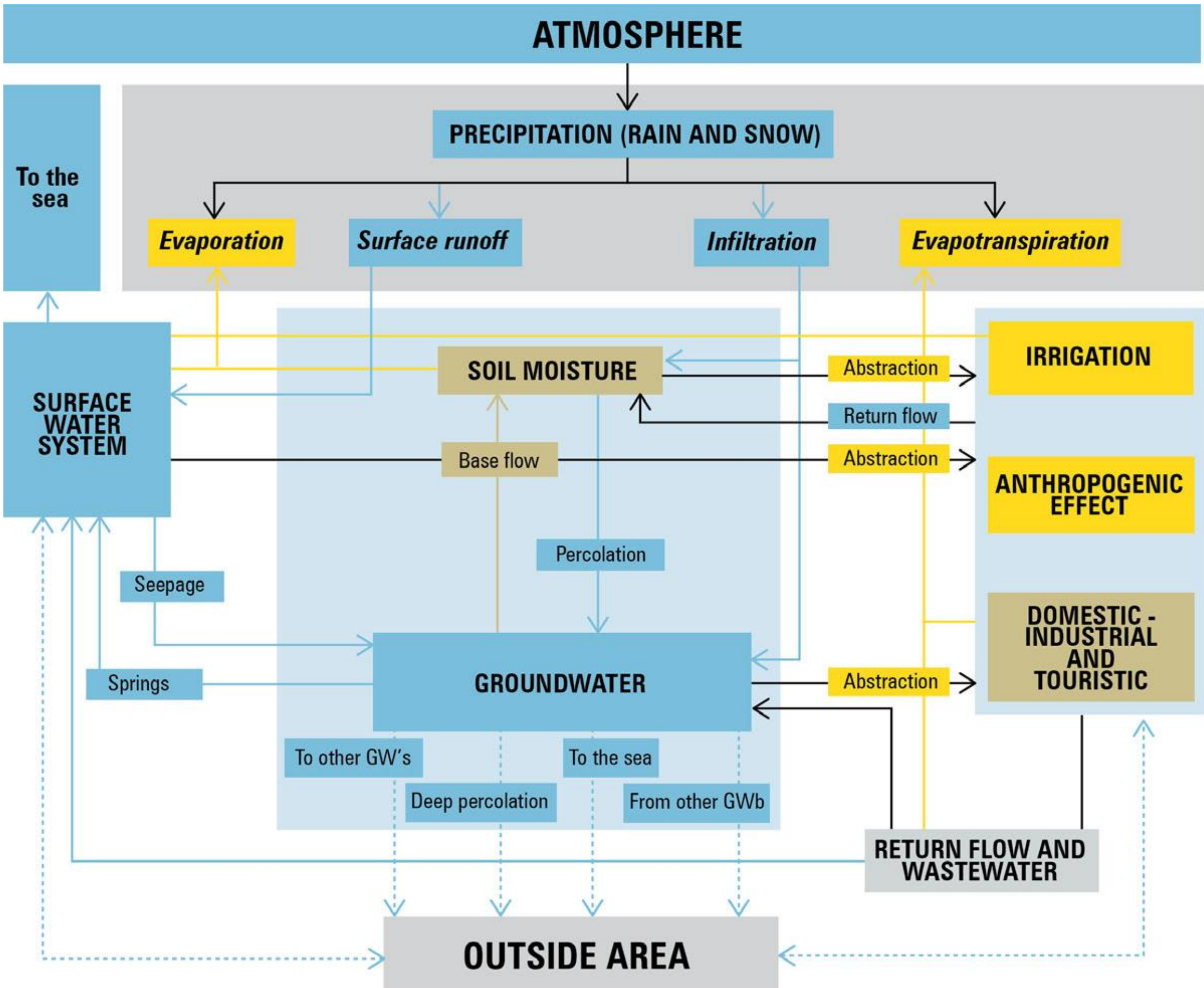


Figure 9-17 UNDP Conceptual Groundwater Model of Lebanon



Further, additional protection shall be afforded by scheduling major earthworks, pouring of cement and other major activities with high potential for the generation of water pollution away from the snow melt season when the large majority of recharge is believed to occur.

9.3.2 Potential Impacts to Groundwater Quality during the Operations Phase

Elevated risk to groundwater is possible during the operations phase. Potential sources of pollution include spills of fuels and oils, particularly oils spilled at the substation locations.

Mitigation

Such impacts are controlled through the implementation of general best practice housekeeping measured expected to be implemented by the selected OEM/EPC Contractor. These practices include following the Construction Health and Safety Plan, daily inspections, provision of spill response equipment, etc. Additional protection shall be afforded by scheduling major activities with high potential for the generation of water pollution away from the snow melt season when the large majority of recharge is believed to occur.

9.3.3 Potential Impacts from Improper Management of Waste Streams during Construction and Operation

The generic nature of the impacts for the construction and operation phases of the Project include potential impacts from improper housekeeping practices (e.g. improper management of waste streams, improper storage of construction material and of hazardous material, etc.). Improper housekeeping practices during construction and operation (such as illegal disposal of waste to land) could contaminate and pollute soil which in turn could pollute groundwater resources. This could also indirectly affect flora/fauna and the general health and safety of workers (from being exposed to such waste streams).

The potential impacts from improper management of waste streams could be of a long-term duration throughout the construction and operations phases. Such impacts are considered of low magnitude as they are generally controlled through the implementation of general best practice housekeeping measures. The receiving environment is considered of medium sensitivity. Following the implementation of the mitigation measures highlighted throughout this section, the residual significance can be reduced to not significant.

<u>Mitigation</u>

Generally, such impacts can be adequately controlled through the implementation of general best practice housekeeping measures as highlighted throughout this section, and which are expected to be implemented by the selected OEM/EPC Contractor throughout the construction and operations phases.

9.3.3.1 Solid Waste Generation

Solid waste is expected to be generated from construction and operational activities. Solid waste generated will likely include construction waste (such as debris) and municipal solid waste (during construction and operation such as cardboard, plastic, food waste, etc.). Municipal and construction waste generated will likely be collected and stored onsite and then disposed to the closest municipal approved area for disposal.

<u>Mitigation</u>

The mitigation measures to be applied by the OEM/EPC Contractor during the construction and operations phases include the following:

- Coordinate with the appropriate Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved disposal area.
- Prohibit fly-dumping of any solid waste to the land.
- Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste".
- During construction, distribute a sufficient number of properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. Where possible, the OEM/EPC Contractor must seek ways to reduce construction waste by reusing materials (for example through recycling of concrete for road base course).
- Implement proper housekeeping practices on the construction site at all times.

- Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas.

9.3.3.2 Wastewater Generation

Wastewater is mainly expected to include black water (sewage water from toilets and sanitation facilities), as well as grey water (from sinks, showers, etc.) generated from workers during the construction and operation phase. Wastewater quantities are expected to be minimal. It is expected that wastewater will be collected and stored in fully contained septic tanks and then collected and transported by transportation tankers to be disposed at an appropriate wastewater treatment plant (WWTP).

Mitigation

The following mitigation measures are to be implemented by the selected OEM/EPC Contractor during the construction and operations phases:

- Coordinate with Akkar Water Directorate to hire a private contractor for the collection of wastewater from the site to the appropriate WWTP.
- Prohibit illegal disposal of wastewater to the land.
- Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.
- Ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil.
- Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing.

9.3.3.3 Hazardous Waste Generation

Hazardous waste is expected to be generated throughout both the construction and operation phase to include consumed oil, chemicals, paint cans, etc. Given the nature of the Project, hazardous waste quantities are expected to be relatively low. Nevertheless, hazardous waste generated will be collected and stored onsite and then disposed at an appropriate hazardous waste treatment facility.

Mitigation

The following mitigation measures are to be implemented by the selected OEM/EPC Contractor during the construction and operations phases:

- Coordinate with the MOE and hire a private contractor for the collection of hazardous waste from the site to the hazardous waste treatment facility.
- Follow the requirements for management and storage as per hazardous waste management and handling of the MOE.
- Prohibit illegal disposal of hazardous waste to the land.
- Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing.

- Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at the hazardous waste treatment facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas.

9.3.3.4 Hazardous Materials

The nature of construction and operational activities entail the use of various hazardous materials such as oil, chemicals, and fuel for the various equipment and machinery. Improper management of hazardous material entails a risk of leakage into the surrounding environment either from storage areas or throughout the use of equipment and machinery.

Mitigation

The following mitigation measures are to be implemented by the selected OEM/EPC Contractor during the construction and operations phases:

- Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another.
- Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must present at all times. Spilled material should be tracked and accounted for.
- Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.).
- Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage (such as refueling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material.
- Ensure that a minimum of 1,000 liters of general-purpose spill absorbent is available at hazardous material storage facility. Appropriate absorbents include elite, clay, peat and other products manufactured for this purpose.
- If spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.
- A guarantee will be obtained that the substation equipment will have no or minimal leakage of sulfur hexafluoride (SF_6) and/or leak detectors will be included and action taken if any leakage occurs.

9.3.4 Potential Impacts to Related Infrastructure and Utilities

9.3.4.1 Potential Impacts on Water Resources during the Construction and Operations Phases

It is expected that the Project throughout the construction and operation phase will require water for potable usage (drinking, personal cleaning, etc.) and non-potable usage (e.g. cleaning of turbines and spray to suppress dust (refer to **Section 11 Air Quality**)). The water requirements throughout the construction phase will be required temporary (for construction period only) and are considered minimal and not significant. The additional water demand would ideally have been factored into the assessment; however, this will be considered by the selected OEM/EPC Contractor. While an impact to

Project cost, it is envisaged that additional water will be tinkered in and does not jeopardize overall Project viability.

Water will be required during the operation phase and mainly for drinking and other personal use of onsite staff (around 3 personnel). During operation, water will also be required for the cleaning of the blades. It is expected that the cleaning will take place once every 3–5 years, thus amounting to 5–9 times during the lifetime of the Project. The amount of water required per wash is around $48m^3$ (equivalent to around $1m^3$ per turbine, i.e. for a maximum of 16 turbines X 3 blades per turbine); thus, the maximum amount of water required during the lifetime of the Project is around $336m^3$ (assuming 7 washes are undertaken).

The anticipated impacts on the local water resources and utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operation phase. Such impacts are expected to be of low magnitude and of low sensitivity given the minimal water requirements of the Project. To this extent, the impact is considered not significant. As such, there are no mitigation measures to be applied. However, the selected OEM/EPC Contractor should coordinate with the Akkar Water Directorate to secure the water requirements of the Project.

9.3.4.2 Potential Impacts on Wastewater Disposal Utilities during the Construction and Operation Phases

The Project is expected to generate wastewater during both the construction and operation phases to include black water (sewage water from toilets and sanitation facilities) and grey water (from sinks, showers, etc.). Wastewater quantities generated are expected to be minimal and not significant at all during both phases of the Project and are likely to be easily handled.

Generally, the approximate estimated wastewater to be generated from the Project can be accounted as follows. Throughout the construction phase, 150 construction workers are anticipated, whereas during the operation phase 3 workers are anticipated. The water requirements per capita during the construction and operation are currently being calculated by the Developer. The wastewater generated will most likely be collected by tankers from the Project and disposed offsite at a wastewater treatment facility. Such wastewater generated from the Project during the construction and operation phase reveals that such quantities are negligible.

Taking all of the above into account, the anticipated impacts on wastewater utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operations and maintenance phase. Such impacts are expected to be of low magnitude given the minimal wastewater quantities generated, and of low sensitivity as they will be easily handled. Given the above impact is considered not significant. As such, there are no mitigation measures to be applied. However, the selected OEM/EPC Contractor must coordinate with the Akkar Water Directorate to obtain list of authorized contractors for disposal of wastewater.

9.3.4.3 Potential Impacts on Solid Waste Disposal Utilities during the Construction and Operation Phases

The Project is expected to generate solid waste during both the construction and operation phases to include construction waste (i.e. dirt, rocks, debris, etc.) as well as general municipal waste (such as food, paper, glass, bottles, plastic, etc.). Solid waste quantities generated are expected to be minimal and not significant at all during both phases of the Project and are likely to be easily handled as either municipal waste and/or construction debris. Such quantities are negligible when compared to the total volume of solid waste received by such facilities daily.

The anticipated impacts on solid waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operations phase. Such impacts are expected to be of low magnitude given the minimal solid waste quantities generated, and of low sensitivity as they will be easily handled by the landfill. Given the above impact is considered not significant. As such, there are no mitigation measures to be applied. However, the selected OEM/EPC Contractor must:

- Undertake discussions with the appropriate municipal landfills to determine where there is sufficient capacity to easily handle construction debris generated from the Project.
- Coordinate with the appropriate municipality or hire a competent private contractor for the collection of construction waste from the site to the approved landfill.
- Coordinate with the appropriate municipality or hire a competent private contractor for the collection of solid waste from the site to the approved landfill.

9.3.4.4 Potential Impacts on Hazardous Waste Disposal Utilities during the Construction and Operation Phases

The exact quantities of hazardous waste that will be generated from the Project are not determined; however, given the nature of construction and operation they are expected to be minimal. Such hazardous waste streams include simple types of waste such as oil, chemicals, and fuel for the various equipment and machinery. Hazardous waste quantities are likely to be easily handled by the hazardous waste treatment facility.

Taking all of the above into account, the anticipated impacts on hazardous waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operations and maintenance phase. Such impacts are expected to be of low magnitude given the minimal hazardous waste quantities generated, and of low sensitivity as they will be easily handled appropriately by the hazardous waste treatment facility.

Given the above, the impact is considered not significant. As such, there are no mitigation measures to be applied. However, the selected OEM/EPC Contractor must coordinate with the MOE to hire a competent private contractor for the collection of hazardous waste from the site and disposal at the hazardous waste treatment facility.

9.3.5 Impact Assessment Summary

Table 9-6 Impact Assessment for Sources of Pollution to Groundwater and Improper Management of Waste Streams

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High √**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	Minor	Minor	**Moderate √**
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

10. GEOPHYSICAL GROUND AND SEISMICITY

10.1 Baseline Methodology

A geophysical ground investigation was implemented in April-June 2018 to determine the engineering parameters for the wind turbine and plant foundations, platforms and roads to be constructed, as presented in the Terifrom Ground Study presented in **Appendix J**.

A 12-channel DOREMI engineering seismograph recorder was used for the MASW studies. It consists of a tablet PC for system records, a sensor for detecting seismic tracks, a trigger, a sledgehammer, 12 vertical geophones (4.5 Hz geophone) and special connection units, as shown in **Figure 10-1**.

Figure 10-1 Seismic Device

Multichannel Analysis Surface Waves (MASW) measurements were taken in the field and 2D-3D models and evaluations were used in the analysis of S-type seismic velocity (Vs) among other parameters. The resulting Vs30 measurements characterize the Ground Groups encountered at the data point, as shown in **Table 10-1**, indicative of the stability of soils.

Table 10-1 Vs30 Values and Corresponding Ground Groups

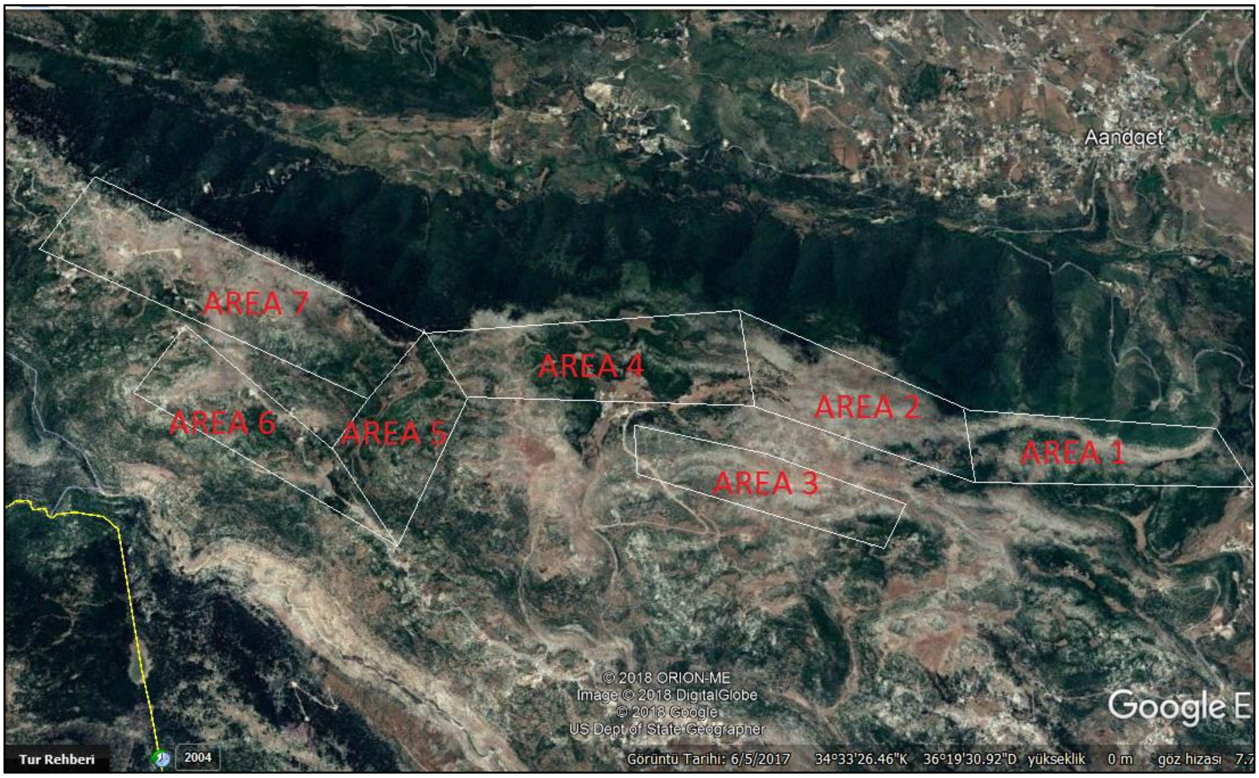
Vs30 Value (m/sec)	Ground Group	Definition
Vs30 > 800	A	Rock or other similar formations
Vs30 > 360, but < 800	B	High hard sand pebbles very hard clay
Vs30 > 180 but < 360	C	Tight to medium tight sand, gravel or hard clay
Vs30 < 180	D	Cohesionless ground from loose to medium tight

Measurements were collected at each of the wind turbine locations under consideration at the time of the survey. Depending on the ground conditions observed at each turbine location, differing numbers of measurements were collected to provide recommendations for excavation prior to construction in suitable soils with appropriate bearing capacity.

10.2 Baseline Findings

Measurement points and findings in terms of Vs30 dispersion map are provided in Figure 10-2.

Figure 10-2 Ground Study Areas



Measurement points and findings in terms of Vs30 dispersion map are provided in **Figure 10-3** through **Figure 10-9**. Overall, Ground Groups of A through C were encountered at most locations; it is noted that no Vs30 values lower than 200 recorded and very few locations recorded Vs30 values lower than 300, indicating relatively hard formations. The profile measured at each potential turbine location, the soil conditions encountered at each turbine location, and the recommendations provided for excavation ahead of construction are provided in **Appendix J**.

Depending on the ground conditions observed at each turbine location, differing numbers of measurements were collected to provide recommendations for excavation prior to construction in suitable soils with appropriate bearing capacity.

Area 1 sampling locations are shown in **Figure 10-3**.

Area 2 sampling locations are shown in **Figure 10-4**.

Area 3 sampling locations are shown in **Figure 10-5**.

Area 4 sampling locations are shown in **Figure 10-6**.

Area 5 sampling locations are shown in **Figure 10-7**.

Area 6 sampling locations are shown in **Figure 10-8**.

Area 7 sampling locations are shown in **Figure 10-9**.

Figure 10-3 Ground Study Areas

Figure 10-4 Ground Study Areas

Figure 10-5 Ground Study Areas

Figure 10-6 Ground Study Areas

Figure 10-7 Ground Study Areas

Figure 10-8 Ground Study Areas

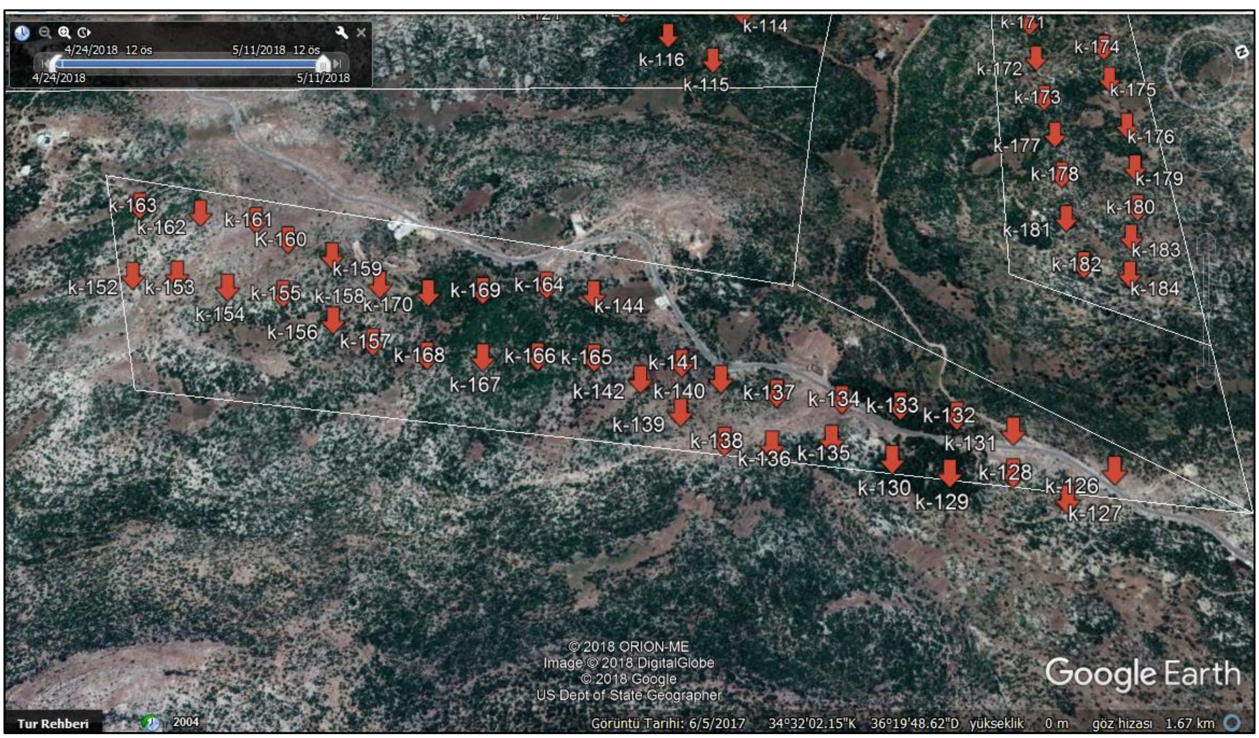
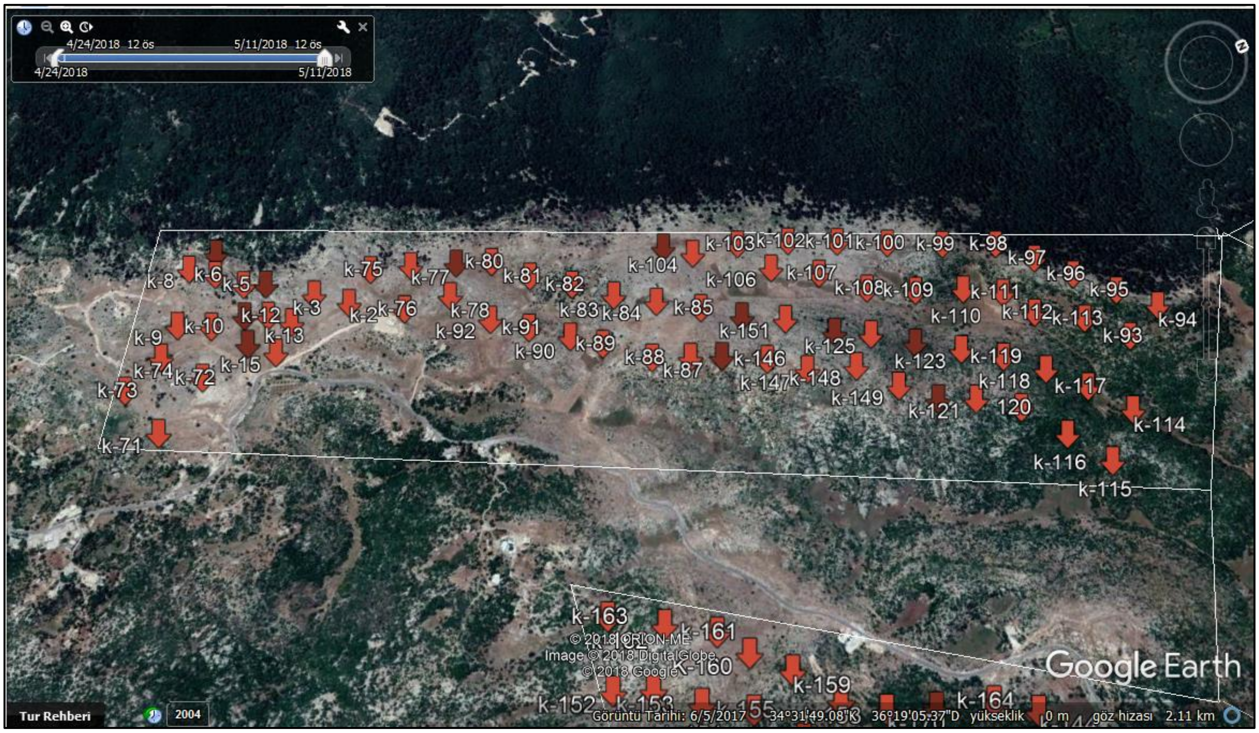
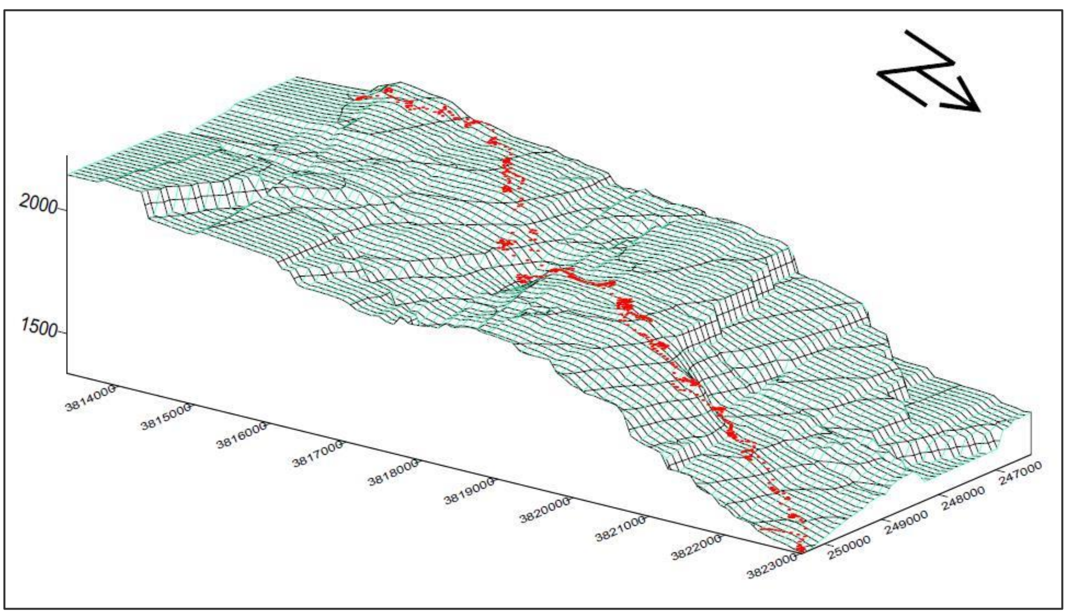


Figure 10-9 Ground Study Areas

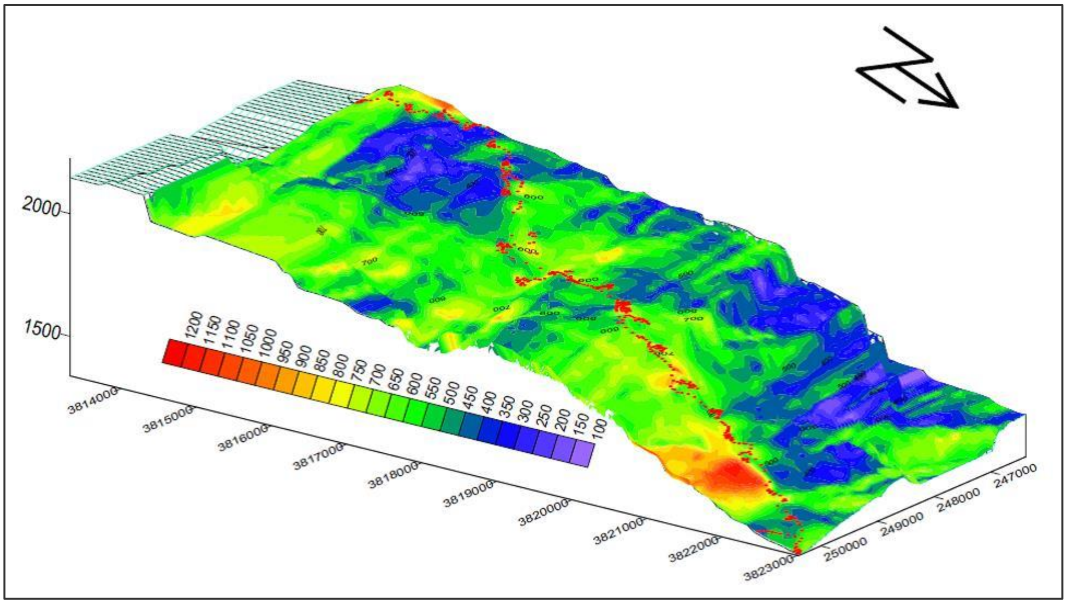


Overall, Ground Groups of A through C were encountered at most locations; it is noted that no Vs30 values lower than 200 recorded and very few locations recorded Vs30 values lower than 300, indicating relatively hard formations. The profile measured at each potential turbine location are shown in **Figure 10-10** and presented in **Appendix J**.

Figure 10-10 MASW Measurements



a - Measurements Points



b - Vs30 Dispersion Map

Area 1

Layer 1 thickness varies between 1.49m and 6.85m. The beginning of Layer 2 is between 1.49m and 6.85m, and the ending is between 6.68m and 18.29m. The beginning of Layer 3 is between 6.68m and 18.29m. All profiles in Area 1 reached Ground Group A by Layer 2, with the exception of Profile-59 which reached Ground Group A by Layer 3.

Area 2

Layer 1 thickness varies between 1.04m and 10.94m. The beginning of Layer 2 is between 1.0m and 10.94m, and the ending is between 4.64m and 26.48m. The beginning of Layer 3 is between 4.64m and 26.48m. All profiles in Area 2 reached Ground Group A by Layer 2, with the exception of Profile-217, Profile-221, Profile-222, Profile-238, Profile-241, Profile-242 and Profile-244. All reached Group A by Layer 3, with the exception of Profile-242 and Profile-243.

Area 3

Layer 1 thickness varies between 1.96m and 6.48m. The beginning of Layer 2 is between 1.96m and 6.48m, and the ending is between 10.92m and 33.78m. The beginning of Layer 3 is between 10.92m and 33.78m. All profiles in Area 3 reached Ground Group A by Layer 2.

Area 4

Layer 1 thickness varies between 1.64m and 9.63m. The beginning of Layer 2 is between 1.64m and 9.63m, and the ending is between 7.36m and 29.23m. The beginning of Layer 3 is between 7.36m and 29.23m. All profiles in Area 1 reached Ground Group A by Layer 2, with the exception of Profile-263 which reached Ground Group A by Layer 3.

Area 5

Layer 1 thickness varies between 2.16m and 4.89m. The beginning of Layer 2 is between 2.16m and 4.89m, and the ending is between 9.66m and 28.33m. The beginning of Layer 3 is between 9.66m and 28.33m. All profiles in Area 1 reached Ground Group A by Layer 2.

Area 6

Layer 1 thickness varies between 1.91m and 7.74m. The beginning of Layer 2 is between 1.91m and 7.74m, and the ending is between 6.02m and 28.83m. The beginning of Layer 3 is between 6.02m and 28.83m. All profiles in Area 1 reached Ground Group A by Layer 2, with the exception of Profile-131, Profile-132, Profile-141, Profile-153, Profile-158, Profile-161 and Profile-164 which reached Ground Group A by Layer 3, with the exception of Profile-132.

Area 7

Layer 1 thickness varies between 1.73m and 7.19m. The beginning of Layer 2 is between 1.73m and 7.19m, and the ending is between 5.44m and 21.92m. The beginning of Layer 3 is between 5.44m and 21.92m. The results indicate that Area 7 would be difficult to excavate without explosives.

10.3 Seismicity

The report of Terifrom Ground Report (2018) states that the epicenters of the strongest three seismic events in this century (1907, 1956, and 1997) are located in the Roum Fault Zone, including the Chouf Region and its offshore area (highlighted in green) as shown in **Figure 10-11**.

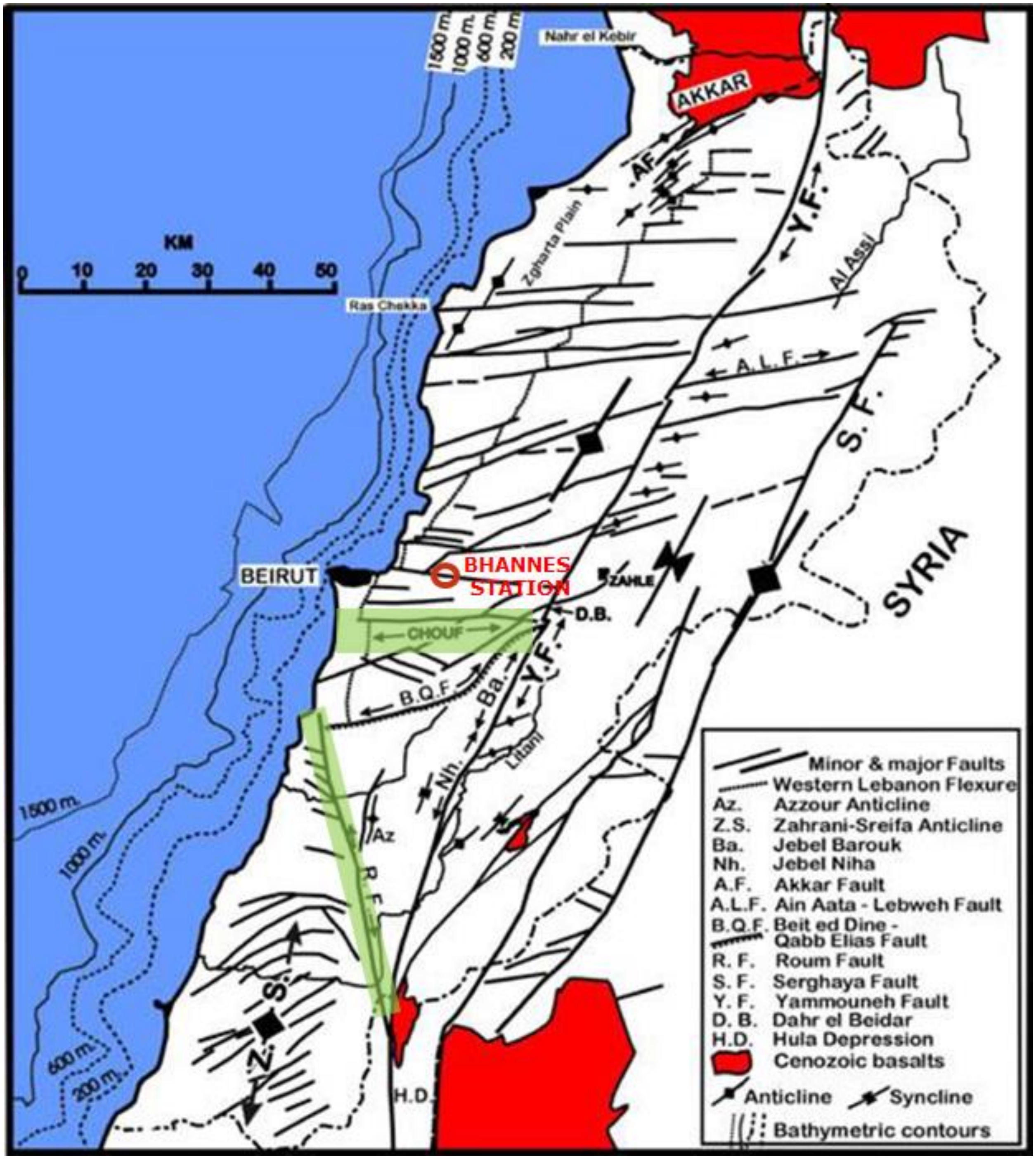
This implies that the epicenter of this event could be relocated northward to become closer to the epicenters of its own aftershock and of the 1907 and 1956 events. Hence, the Chouf Area with its complicated structural setting, probably, constitutes a locked (northern) segment of the Roum Fault Zone, which probably terminates near Damour River. Moreover, information issued by the Lebanese Geophysical Center through its seismological station at Bhannes (the only recording station in Lebanon) indicated that the distance from the epicenter of the main 1997 event to the station is only 33km.

The earthquakes of 1907, 1956, and 1997 had a recurrence interval of 40 to 50 years. However, no major seismic events are known in Lebanon after the destructive 1837 earthquake, which has affected northern Palestine and southern Lebanon. The epicenter of this earthquake has been located by many investigators near Salad in the Huleh Depression, where the Dead Sea Transform Fault (DSTF) bifurcates into its Lebanese fault branches.

10.4 Impact Analysis

The Project will be located at the highest altitude points of the Akkar region and is not be expected to be exposed to flood or flooding due to its geological structure and elevation. Further, since the Akkar region is not within a landslide area, it is considered that there will not be any slope stability issues.

Figure 10-11 Fault Zones



Further, since the Akkar region is not within a landslide area, it is considered that there will not be any slope stability issues. The Project site is situated within the rising block of the formation. The areas where active fault movements are observed are generally within the falling block. For this reason, earthquake impact and related problems are not predicted in the Akkar region.

A new seismicity catalogue for the area of Lebanon (32ø-35øN, 34ø-37øE) was compiled in 1997 (with 1,725 events including both historical earthquakes and instrumentally recorded tremors (Butler *et al.*, 1997). They concluded that changing (decreasing northward) seismicity characteristics along the Roum Fault Zone suggest a change in faulting mechanism, resulting in a slightly higher earthquake hazard for southwest Lebanon.

As such, the potential for earthquake at the Project site is minimal.

Mitigation

During the construction and operations phases, steps will be taken by the OEM/EPC Contractor to ensure that temporary infrastructure does not exacerbate flood risk, for example, through the transfer of significant flow between different surface water catchments.

Ground stability problems are not expected due to high resistance values and safe carrying power values evidenced by the seismic measurements. During detailed design, the OEM/EPC Contractor will incorporate the recommendations of the seismic study for excavation at the platform foundation locations to a depth where stable soils are encountered.

Following the implementation of these mitigation measures, the impact severity is considered Low, and the sensitivity of the receptor as High, resulting in a residual impact categorized as Moderate as shown in **Table 10-2**.

Table 10-2 Geophysical Ground and Seismicity Assessment

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	**Negligible √**	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

11. AIR QUALITY

11.1 Baseline Methodology

Air quality information was obtained through literature review. The Project is located in a rural area of Jabal Akroum. No industrial point sources of air pollution have been identified within the Project boundary. There are sensitive receptors (i.e., residents, hospitals, schools) near the Project area. Background concentrations for criteria pollutants ozone (O_3), particulate matter less than 2.5 microns in diameter (PM2.5), particulate matter less than 10 microns in diameter (PM10), carbon monoxide (CO), nitrogen oxides (NOx), and sulfur dioxide (SO_2), at the locations shown in **Figure 11-1**. This data was collected in 2011 and published by the MOE in 2015.

It should be noted that in North Lebanon, the Tripoli Environment and Development Observatory (TEDO) operates several urban and background monitoring stations in Tripoli. Additionally, the MOE launched its first two phases of the Air Quality Monitoring Network (AQMN), with the support of the UNEP and UNDP, and the EU, which allowed to install 15 background air quality monitoring stations and 10 meteorological stations to provide real time air quality monitoring data in Lebanon. While the AQMN has been fully operational since 2017, data management and analysis are still underway and has not been published yet.

The emission sources for activities by phase and emission factors and fuel consumption are as presented in **Appendix I**

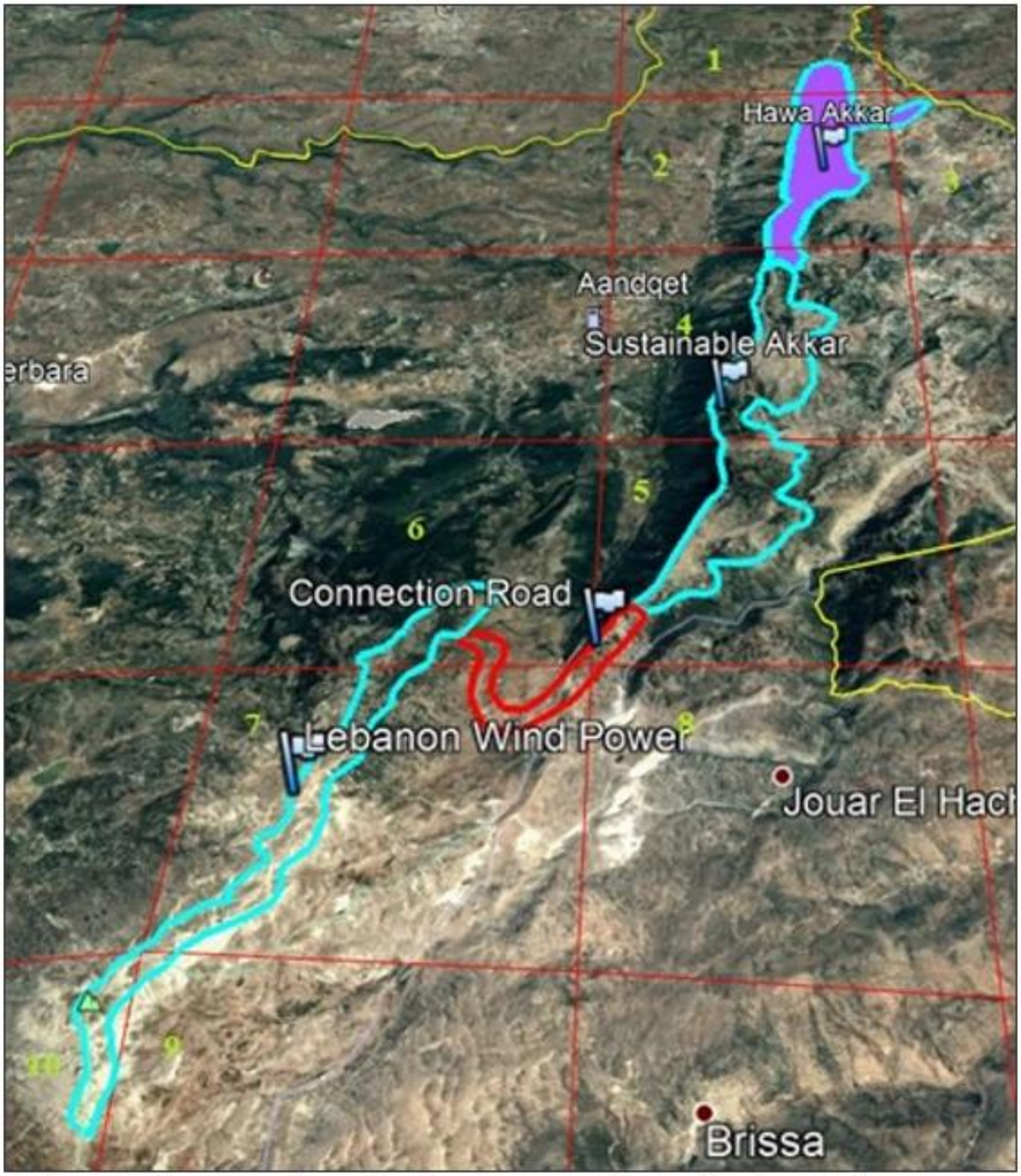
11.2 Baseline Findings

The 2011 background concentrations for priority pollutants are summarized in **Table 11-1**.

Table 11-1 Background Concentrations of Priority Pollutants in the Project Area (ug/m^3)

Cell ID	NO_2	O_3	PM10	PM2.5	SO_2	CO
1	9.169	83.319	17.740	15.420	10.070	201.113
2	11.879	81.668	17.613	15.469	10.554	206.054
3	10.483	81.116	17.116	15.061	9.950	199.545
4	11.097	82.540	16.436	14.555	9.555	201.673
5	9.995	82.868	15.382	13.658	8.592	195.067
6	12.006	81.465	16.219	14.296	9.761	203.033
7	6.460	85.945	14.304	12.484	6.356	185.880
8	7.000	85.618	14.078	12.452	6.512	184.593
9	4.694	87.115	13.383	11.665	4.988	175.124
10	7.071	85.847	14.283	12.369	6.463	183.716

Figure 11-1 MOE 2011 Air Monitoring Locations



The three wind farm sites are located in cell numbers 1 to 10, (each cell is 5km x 5 km):

<table>
<tr><td></td><td></td><td>N</td><td></td><td></td></tr>
<tr><td></td><td colspan="3" rowspan="3">1 to 10</td><td></td></tr>
<tr><td>W</td><td>E</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td><td>S</td><td></td><td></td></tr>
</table>

Review of the baseline information indicates that concentrations of criteria pollutants are low in the Project area. Moreover, the latest national air quality assessment has been conducted as part of the environmental impacts of the Syrian crisis and it indicated that the impacts of the Syrian crisis in terms of air quality is negligible in the Project area. As such, it is expected that any negative deterioration on the air quality since 2011 would also be insignificant[65].

Background sources of air pollution include quarrying activities to the east of the Project which generate dust. Another source of air pollution is the transport sector emitting exhaust related pollutants such as PM, CO, NO_x, SO_x and hydrocarbons. However, the significance of the latter emissions on the Project area is low and the site can be considered located in a relatively pristine area with clean air and low air pollution levels.

11.3 Impact Analysis

11.3.1 Air Quality Standards

The World Health Organization (WHO) has developed a set of guidelines for air quality that serve as an international benchmark and offers guidance in reducing the health impacts of air pollution (WHO, 2006). They are set based on a review of the accumulated scientific evidence. **Table 11-2** presents the WHO Air Quality Guidelines for some pollutants (WHO, 2006). The IFC/World Bank Group (WB) adopts the WHO Air Quality Guidelines in the absence of national air quality regulations.

Table 11-2 WHO Air Quality Guidelines

Pollutant	Maximum Concentration	Averaging Period
Sulfur dioxide (SO_2)	500 $\mu g.m^{-3}$	10 minutes
	20 $\mu g.m^{-3}$	24 hours
Nitrogen dioxide (NO_2)	200 $\mu g.m^{-3}$	1 hour
	40 $\mu g.m^{-3}$	1 year
Ozone (O_3)	100 $\mu g.m^{-3}$	8 hours
Carbon monoxide (CO)	100,000 $\mu g.m^{-3}$	15 minutes
	60,000 $\mu g.m^{-3}$	30 minutes
	30000 $\mu g.m^{-3}$	1 hour
	10,000 $\mu g.m^{-3}$	8 hours
Total suspended particles (TSP)	*Not available*	
Particulate matter smaller than 10 µm (PM_{10})	50 $\mu g.m^{-3}$	24 hours
	20 $\mu g.m^{-3}$	1 year
Particulate matter smaller than 2.5 µm ($PM_{2.5}$)	25 $\mu g.m^{-3}$	24 hours
	10 $\mu g.m^{-3}$	1 year
Lead	0.5 $\mu g.m^{-3}$	1 year
Benzene	No safe level of exposure can be recommended	Excess lifetime risk of leukemia at a concentration of 1 $\mu g.m^{-3}$ is 6×10^{-6}

[65] MOE/EU/UNDP, 2014. Environmental Impact of the Syrian Crisis. Available at http://www.moe.gov.lb/الوزارة/Agreements-Plans-and-Reports/تقارير/Lebanon-Environmental-Assessment-of-the-Syrian-Con.aspx.

In 1996, the MOE issued in 1996 Decision 52/1 proposing national air quality guidelines. Annex 14 of the Decision provides ambient air standards (averaging periods and values) as shown in **Table 11-3**, presenting standards for SO_2, NO_2, O_3, CO, TSP, PM_{10}, Lead, and Benzene. Based on the IFC/WB EHS guidelines, since Lebanese regulations exist, they shall apply to this project.

Table 11-3 Air Quality Guidelines According to Lebanese Decision 52/1

Pollutant	Maximum Concentration	Averaging Period
SO_2	350 $\mu g.m^{-3}$	1 hour
	120 $\mu g.m^{-3}$	24 hours
	80 $\mu g.m^{-3}$	1 year
NO_2	200 $\mu g.m^{-3}$	1 hour
	150 $\mu g.m^{-3}$	24 hours
	100 $\mu g.m^{-3}$	1 year
O_3	150 $\mu g.m^{-3}$	1 hour
	100 $\mu g.m^{-3}$	8 hours
CO	30,000 $\mu g.m^{-3}$	1 hour
	10,000 $\mu g.m^{-3}$	8 hours
TSP	120 $\mu g.m^{-3}$	24 hours
PM_{10}	80 $\mu g.m^{-3}$	24 hours
Lead	1 $\mu g.m^{-3}$	1 year
Benzene	5 ppb	1 year

Moreover, the IFC/WB indicates that emissions resulting from a project shall not contribute to more than 25% of the applicable air quality standards to allow additional, future sustainable development in the same airshed. Consequently, based on the IFC guidelines which indicates the use of the national air quality standards, the Project shall not result in more than the values presented in **Table 11-4**.

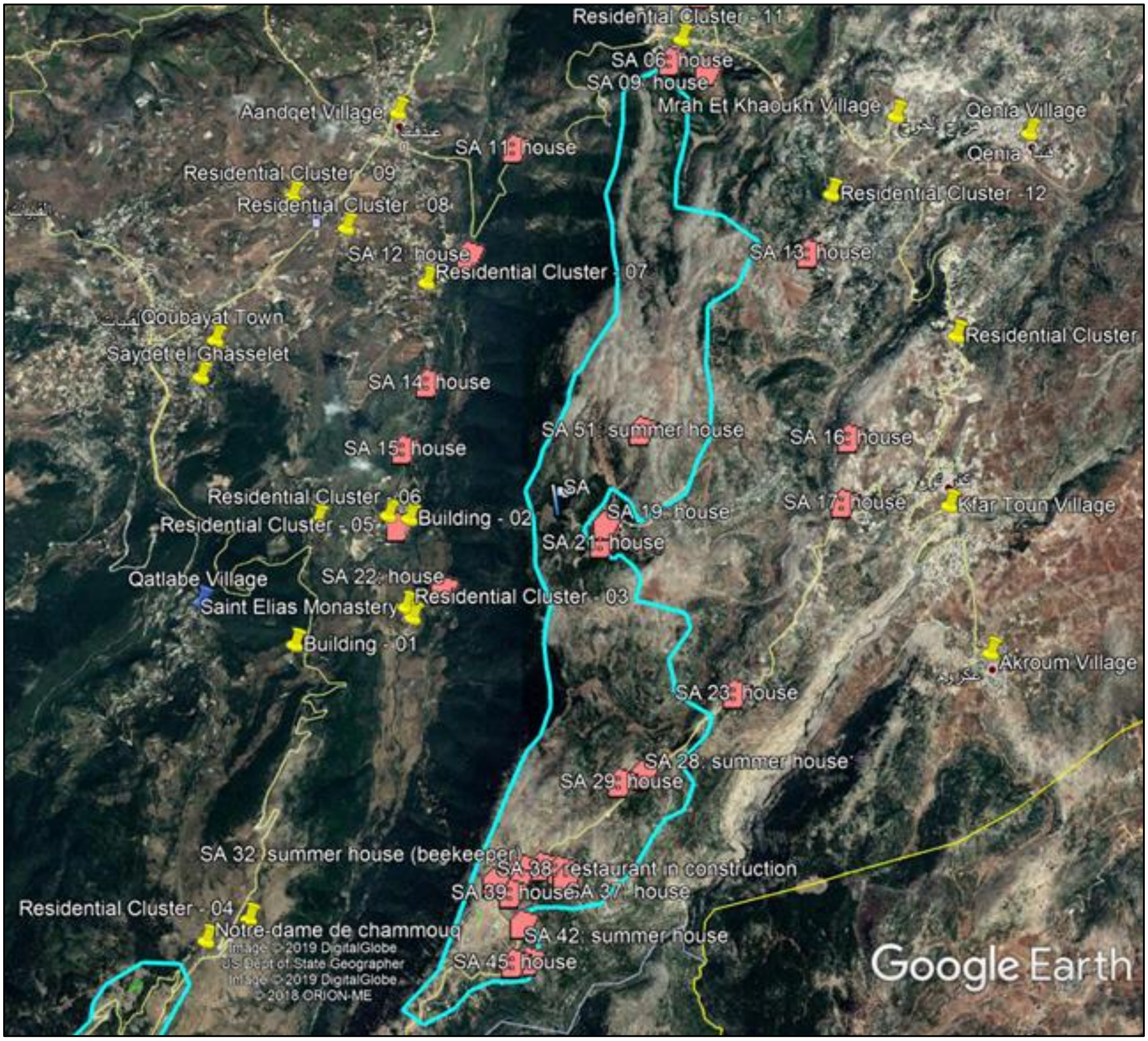
Table 11-4 Maximum Allowed Concentration Increments from the Project

Pollutant	Maximum Allowed Concentration	Averaging Period
SO_2	87.5 $\mu g.m^{-3}$	1 hour
	30 $\mu g.m^{-3}$	24 hours
	20 $\mu g.m^{-3}$	1 year
NO_2	50 $\mu g.m^{-3}$	1 hour
	37.5 $\mu g.m^{-3}$	24 hours
	25 $\mu g.m^{-3}$	1 year
CO	7500 $\mu g.m^{-3}$	1 hour
	2500 $\mu g.m^{-3}$	8 hours
TSP	30 $\mu g.m^{-3}$	24 hours
PM_{10}	20 $\mu g.m^{-3}$	24 hours

11.3.2 Sensitive Receptors

Many villages and houses exist near the Project site but are all more than 350m from the wind turbines locations at Lebanon Wind Power as shown in **Figure 11-2** and per the 'Institute of Air Quality Management' guidance on the assessment of dust from demolition and construction.

Figure 11-2 Location of Sensitive Receptors near the Project



The main residential clusters and villages are more than 350m from the construction sites. Few houses, sometimes occupied for a small period in summer, are more than 50m from the internal roads where the construction vehicles pass (note: the 50m reference relates to the 'Institute of Air Quality Management' guidance on the assessment of dust from demolition and construction, and specifically the 'track out' phase. The track out phase only relates to 500m distance from the point of entry to the construction compound. However, given the likely dusty/loose surface of the road over which construction vehicles will access the site, it is considered precautionary and appropriate to apply this assessment approach.

11.3.3 Emissions Estimation

Emissions were estimated for the construction phase, the operation phase (including maintenance), and the decommissioning phase of the Project. The sources considered for the three phases are combustion of fuel and fugitive emissions. The combustion sources encompass vehicle tailpipe and stacks, while the fugitive emissions consider mainly the dust entrainment generated by vehicles while running, and emissions from loading/unloading of material, bulldozing, etc.

Emission factors were acquired from the EMEP/EEA Guidebook (2016) for on-road and off-road vehicles, while the fuel consumption was provided by actual contractors (MAN and DAKO). The sulphur content used is the upper limit of the Lebanese regulations: 10ppm maximum for automotive fuel while it is of 350ppm for diesel used for boilers and reciprocating engines.

11.3.4 During Construction

Air emissions during the construction phase can come from multiple sources including dust emissions/ particulate matter (PM) from site preparation (land clearing, excavation schemes, cut and fill operations), material sourcing, movement of trucks and heavy-duty equipment, and stockpiling activities.

Dust and PM emissions at the wind farm are particularly concerning given the high-wind velocity location of the Project site. Fugitive dust and other emissions from vehicular traffic and construction machinery can also contribute to degraded air quality. The use of construction equipment on-site is also expected to release vehicular induced pollutants such as carbon monoxide, nitrogen oxides, sulfur oxides, particulate matter (PM) and hydrocarbons (HC).

Emission sources are shown in **Table 11-5**.

Note: as previously indicated in **Section 8 Climate and Climate Change**, the operation of the batching plant was not considered in the GHG emissions calculations for the construction phase, as the batching plant already exists and is operational, and operated independently by an external company.

Table 11-5 Emission Sources Considered

Emission Source	Emission Type	Fuel Type
Main crane	Exhaust	Diesel
Auxiliary crane	Exhaust	Diesel
LDV for personnel movement on site and out of site	Exhaust	Gasoline
Tractor FH440	Exhaust	Diesel
Bus	Exhaust	Gasoline
Trucks 20m^3	Exhaust	Diesel
Jackhammer	Exhaust	Diesel
Caterpillar D9	Exhaust	Diesel
Excavator	Exhaust	Diesel
Concrete Mixer Truck	Exhaust	Diesel

Emission Source	Emission Type	Fuel Type
Concrete Pump	Exhaust	Diesel
Skidoo	Exhaust	Gasoline
Bulldozing Moisture 1%, silt 5%	Fugitive	-
Loading/Unloading	Fugitive	-
Dust entrainment from paved roads - Truck 40t on average, silt 5g/m^2	Fugitive	-
Dust entrainment from paved roads - LDV 1.8 t, silt 5g/m^2	Fugitive	-
Dust entrainment from paved roads - Bus 5t, silt 5g/m^2	Fugitive	-
Dust entrainment from unpaved roads - Trucks 40t on average	Fugitive	-
Dust entrainment from unpaved roads - LDV 1.8t	Fugitive	-
Dust entrainment from unpaved roads - Bus 5t	Fugitive	-

Results of the emissions estimation are presented in **Table 11-6**. The construction phase exhibits generally the highest emissions of the pollutants. The highest emissions are those of the PM and originate mainly from fugitive emissions (>99%).

Table 11-6 Emissions from the Construction Phase

Emissions in kg	NOx	PM10	PM2.5	SO_2	CO
Construction	18,669.7	833,429.9	167,621.2	137.1	4,845.2

Impact of NOx Emissions

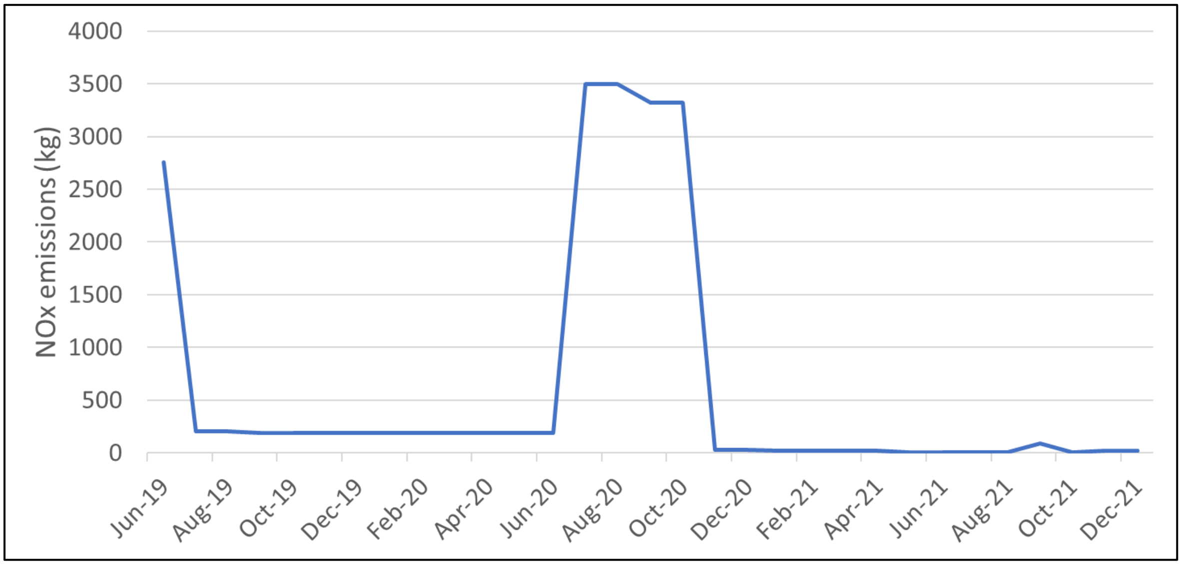
Figure 11-3 shows the monthly variation of the NOx emissions from the construction phase. NOx comes from the combustion of fuel (transport but also reciprocating engines and boilers). The increase in mid-2020 relate to the turbine platform construction and erection.

Impact of Particulate Matter

The fugitive emissions constitute one of the main concerns in construction and demolition activities (IAQM, 2016). The earthworks will pose greater impacts on human receptor since large quantities of material will be excavated and moved. Vehicle speeds for heavy-duty vehicles (HDV) are generally low, approximately 15-16km/hr. In addition, less than 50 HDV will be passing along the Project roads per day.

According to IAQM "*Guidance on the assessment of dust from demolition and construction*" (2016), particles originating from a construction site have low impact if a "human receptor" is located beyond 350m. This is the case for most of the receptors of the Project, with the exception of a single sensitive receptor located 40m from the road that will be used by construction vehicles. Therefore, the above-mentioned impact applies before the implementation of any mitigation measures even though it is of short duration and reversible.

Figure 11-3 NOx Emissions During Construction Phase



Mitigation

IAQM (2016), the Mojave Desert (2013) and Good International Industry Practice (GIIP).suggest the following mitigation measures:

- Use of wind screens or enclosures around dusty activities or the site boundary. Mojave Desert Air Quality Management District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75 percent.
- Water spray is also used to reduce fugitive dust as it increases the moisture content of the material. Therefore, and according to Mojave Desert too, Water spray (Application point) will ensure a control efficiency of 75%. This is very useful for exaction for example.
- For unpaved roads, water flushing is the essential with 0.48 gallons per square yard twice per day to maintain a control efficiency above 50%.
- For paved roads, water flushing with 0.48 gallons per square yard followed by sweeping is very effective and can reach 96%. If conducted directly before the passage of the turbines convoy or the morning and evening passages of the project vehicles to and from the site, a consequent decrease will occur.
- A combination of the different above-mentioned measures will give a higher control efficiency that when applied individually.

It is acknowledged that the total emissions calculated are presented in kilograms, and therefore cannot be directly compared to the Maximum Allowed Concentration Increments for the Project presented in **Table 11-4**. However, after the mitigation actions as described above, the overall mitigation efficiency is around 50% for PM; emissions of gaseous pollutants are not impacted. Since villages and the residential clusters are relatively far from the site, the PM impact after mitigation is considered negligible. One additional point to be considered is that the site is very large, and activities will occur mainly in localized areas and for a limited period of time.

Given the temporary and short-term nature of the construction activities, air emissions impacts are expected to be of low to moderate significance. The sensitivity of the area is Low; however, since construction workers are mainly impacted the sensitivity of the receptor is considered Medium, resulting in a Minor impact as shown in **Table 11-7**.

Table 11-7 Air Quality Assessment for the Construction Phase (Worst-Case Scenario)

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

11.3.5 During Operations and Maintenance

During the operations phase, vehicular traffic on unpaved access tracks can produce dust and PM emissions that can have negative impacts on air quality. Emissions from the operations phase are shown in **Table 11-8**. With proper management, air emission impacts during project operation are not expected to be significant.

Table 11-8 Total Emissions from the Operations and Maintenance Phase

Emissions in kg	NOx	PM10	PM2.5	SO_2	CO
Operations and Maintenance Phase (1yr)	223.4	45,182.4	6,702.0	19.4	256.5

11.3.6 During Decommissioning

Dust and PM emissions are expected from equipment and turbine removal, from the movement of trucks and heavy-duty equipment, and from the transport and stockpiling of deconstruction materials. Carbon monoxide, nitrogen oxides, sulfur oxides, PM and HC are also expected to be released from vehicles and equipment onsite. Emissions from the Decommissioning phase are shown in **Table 11-9**.

Table 11-9 Emissions from the Decommissioning Phase

Emissions in kg	NOx	PM10	PM2.5	SO_2	CO
Decommissioning	1,745.6	27,705.1	5,415.3	1.2	615.6

Air emissions during the construction phase are temporary in nature, thus the impact outside the Project site is only expected to be minor, especially given the implementation of an appropriate and endorsed ESMP. Mitigation measures are recommended to address PM emissions and specifically, fugitive PM. IAQM (2016), the Mojave Desert (2013) and Good International Industry Practice (GIIP).suggest the following mitigation measures:

- Use of wind screens or enclosures around dusty activities or the site boundary. Mojave Desert Air Quality Management District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75%.
- Water spray is also used to reduce fugitive dust as it increases the moisture content of the material. Therefore, and according to Mojave Desert too, Water spray (Application point) will ensure a control efficiency of 75%. This is very useful for exaction for example.
- For unpaved roads, water flushing is the essential with 0.48 gallons per square yard twice per day to maintain a control efficiency above 50%.
- For paved roads, water flushing with 0.48 gallons per square yard followed by sweeping is very effective and can reach 96%. If conducted directly before the passage of the turbines convoy or the morning and evening passages of the project vehicles to and from the site, a consequent decrease will occur.
- A combination of the different above-mentioned measures will give a higher control efficiency that when applied individually.

As with the Construction Phase, it is acknowledged that the total emissions calculated for the Decommissioning Phase are presented in kilograms, and therefore cannot be directly compared to the Maximum Allowed Concentration Increments for the Project presented in **Table 11-4**. However, after the mitigation actions as described above, the overall mitigation efficiency is around 50% for PM while emissions of gaseous pollutants are not impacted. Since villages and the residential clusters are relatively far from the site, the PM impact after mitigation is considered negligible. One additional point to be considered is that the site is very large, and activities will occur mainly in localized areas and for a limited period of time. Given the temporary and short-term nature of the decommissioning activities, air emissions impacts are expected to be of low to moderate significance. The sensitivity of the area is Low; however, since construction workers are mainly impacted the sensitivity of the receptor is considered Medium, resulting in a Minor impact as shown in **Table 11-10**.

Table 11-10 Air Quality Assessment for the Decommissioning Phase

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

12. TRANSPORT AND TRAFFIC

12.1 Baseline Methodology

The traffic and transport baseline investigations were designed to assess existing road conditions to support the preferred route for WTG transport. Two route surveys and a Traffic Impact Study were undertaken as follows:

- In April 2018, Lebanon Wind Power and Sustainable Akkar commissioned a route survey undertaken by Madgelni to assess the conditions for the practical and safe transport of WTG components to the Lebanon Wind Power and Sustainable Akkar projects, as presented in **Appendix K**. The April 2018 survey identified existing clearances and did not assume a turbine blade length
- In June 2018, the Ghorayeb International Freight Forwarding Co. (GIFCO) S.A.L. was engaged to assess potential routes for transporting the WTG components from the Tripoli Seaport to the Sustainable Akkar wind farm site, also presented in **Appendix K.** The June 2018 survey assumed a blade length of 63.45m.
- In October 2018, a Traffic Impact Study was undertaken by Dr. Dima Jawad to review 8 key road segments, survey of existing peak hour traffic volumes at key junctions and conducting 3-day automatic traffic counts at key road links and manual counts at peak hours at critical junctions, also presented in **Appendix K**. The October 2018 survey assumed transport of the Vestas 150 turbine, having the largest blade size of 75m. It is noted that the GE blades are 78m, but come in two parts; therefore, the Vestas turbine represents the largest single blade that was assumed.

The methodologies for the separate studies are presented in the following sections.

12.1.1 Route Survey (Madgelni, April 2018)

Madgelni's route survey considered the two routes shown in **Figure 12-1**. The survey was undertaken to observe conditions, determine the necessity of civil works and precautions to be taken, starting from Tripoli Port to the Project Site entrance. A survey also considered the use of existing or newly constructed route segments as alternatives for reaching the site(s).

The route shown in red is referenced as the Aabde to Chadra Route, while the route shown in yellow and orange are referenced as the OBS33 Alternative Route. The OBS33 Alternative Route would use an existing road, as shown in **Figure 12-2**, until reaching OBS34, where a new segment of road would be constructed (shown in orange) to reach the existing asphalt road west of Machta Hammoud.

12.1.2 Route Survey (GIFCO, June 2018)

GIFCO's route survey considered the two routes shown in **Figure 12-3**. The survey can be viewed as a journey management exercise from the perspective of a freight shipment provider seeking to identify pinch points that may cause restrictions and/or obstacles between the Tripoli Port and the destination(s).

Figure 12-1 Routes Surveyed by Madgelni

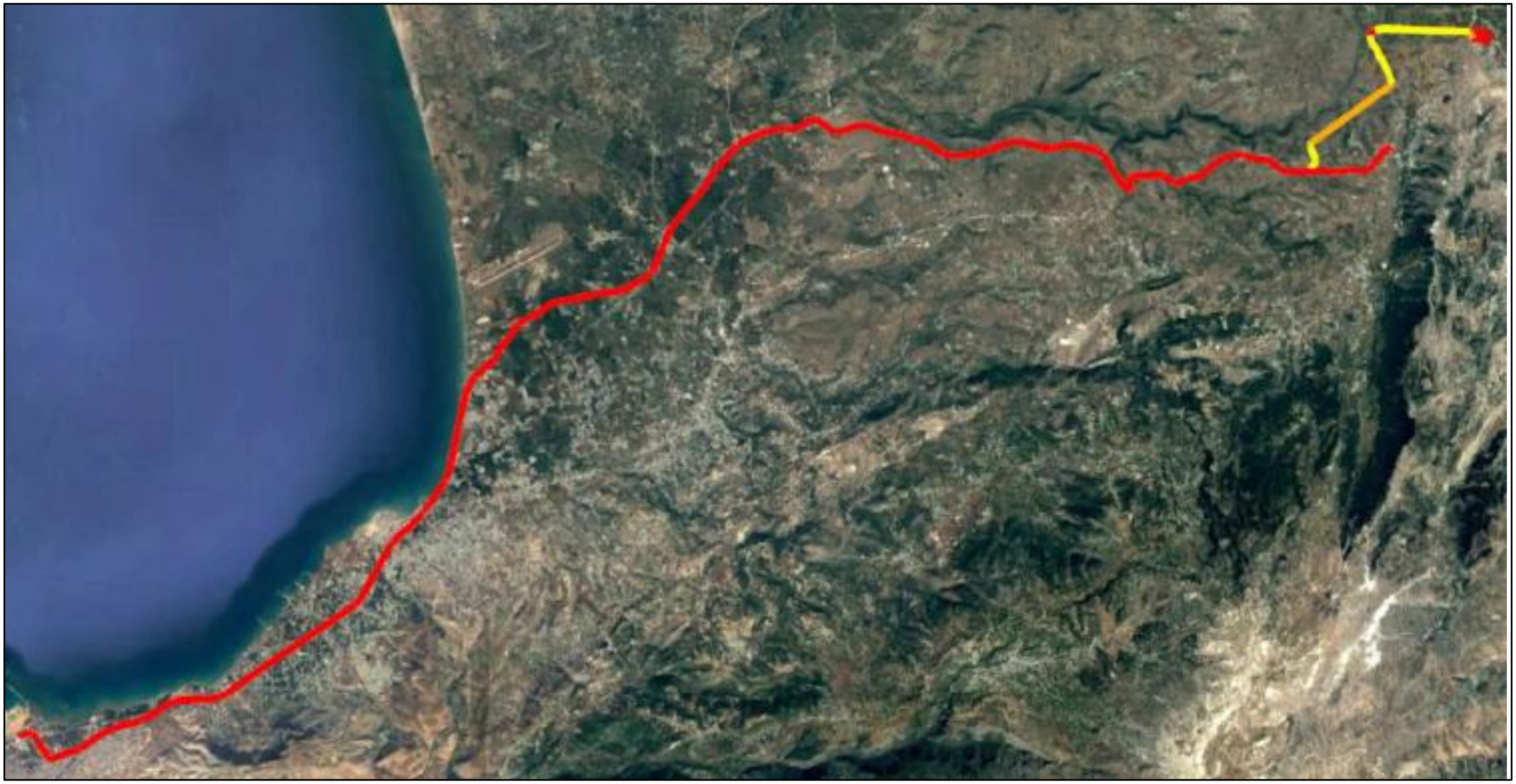
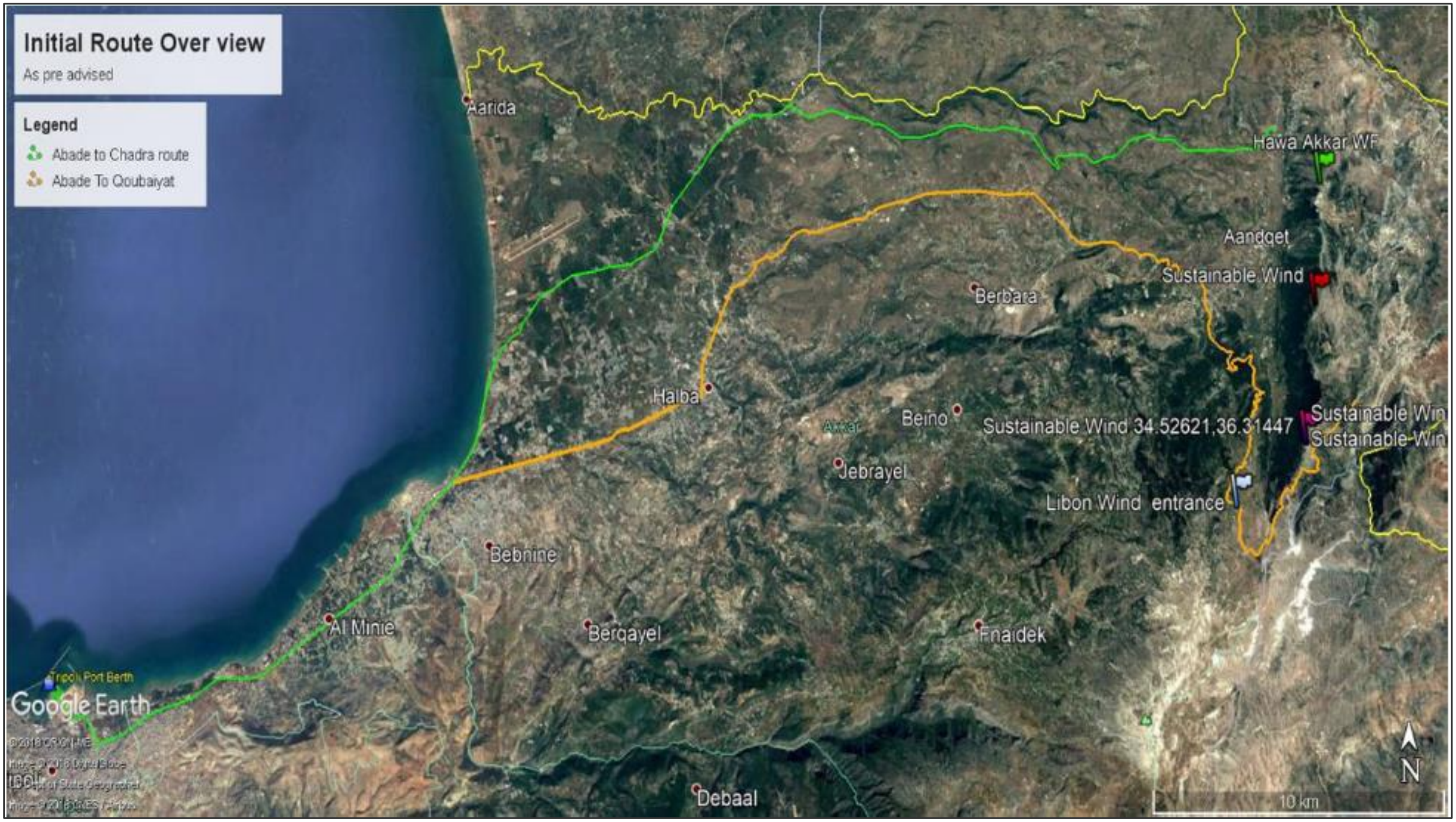


Figure 12-2 Start of Alternative Route Surveyed by Madgelni

a – Aerial view of Obstacle 33

b – Pedestrian view of Obstacle 33 and start of Alternative Route north

Figure 12-3 Routes Surveyed by GIFCO



The route shown in green is referenced as the Aabde to Chadra Route. The study assessed the Aabde to Chadra route for the WTGs transport according to critical turning points, bridges, motorway bridges and pedestrian overpasses, the existing geometric clearances with swept path analysis of potential routes and identified the needed modifications and upgrades along the route so it can be suitable for transporting the WTGs. Note: the route shown in yellow is referenced as the Halba to Quobaiyat Route (and starts approximately 1km north of Aabde). The Halba to Quobaiyat Route was identified by GIFCO as a potential alternative route.

12.1.3 Transport Impact Study (October 2018)

The TIS was conducted as per Institute of Transportation Engineers (ITE) published guidelines, and its main objective was to determine the impact of the generated traffic by the proposed Project on the surrounding road network and identify the extent of required improvements, if any, to adequately and safely accommodate the additional generated traffic. Therefore, the assessment of traffic and transport comprised the following:

- Review of historical traffic growth patterns to inform estimation of the likely traffic volume growth across the road network, excluding traffic generated by the Project.
- Inspection of the road network from the Tripoli Seaport to Chadra, as well as rural distributors west-southwest of the Project site.
- Survey of existing peak hour traffic volumes at key junctions.
- Conducting 3-day automatic traffic counts at key road links and manual counts at peak hours at critical junctions.

12.1.3.1 Selected Roads and Junctions

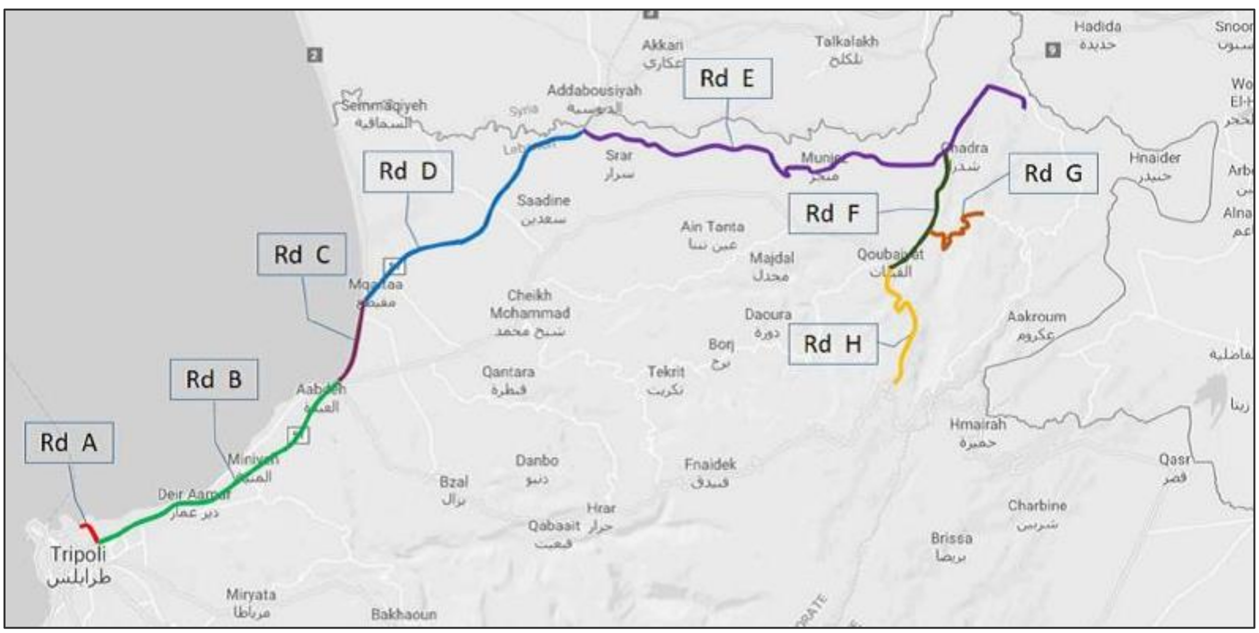
Based on the potential WTG transport routes, 8 key existing road segments were identified for the baseline traffic study, as summarized in **Table 12-1** and shown in **Figure 12-4**.

Table 12-1 Selected Road Characteristics

Road	Description	Lanes	Median Type	Width
A	*Tripoli Port – Abu Ali Roundabout* Urban major distributor, bidirectional and divided asphalt road that travels north along the coast of Lebanon. This road is in the vicinity of the construction site of the new Tripoli Freeway.	4	Concrete Jersey Blocks	15m
B	*Abu Ali Roundabout to Al Beddaoui* Urban arterial, bidirectional, divided 6-lane asphalt road with a parallel parking on each side. The majority of the junctions along this road are grade-separated, however uncontrolled junctions are also present.	6	Raised Median varied width	30m
C	*Al Beddaoui to Al Aabdeh* urban minor arterial, bidirectional and divided asphalt road with a raised median with concrete blocks. A few junctions along this road segment are grade-separated, while others are uncontrolled junctions or roundabouts (i.e. the junction at	4	Concrete Jersey blocks	18m

Road	Description	Lanes	Median Type	Width
	Halba Road).			
D	*Al Aabdeh to Mqaitea* Urban minor arterial, bidirectional, divided asphalt road with concrete blocks.	4	Concrete Jersey blocks	16m
E	*Mqaitea – Aabboudiye* Rural arterial connecting Lebanon to the Syrian border. It is a bidirectional and undivided 2-lane asphalt road.	2	Painted	10m
F	*Menjez – Chadra* Rural distributor, bidirectional and undivided asphalt road that travels east to Chadra. This road is rolling/mountainous road with a grade that varies up to 9%.	2	Painted	10m
G	*Aandqet – Quobaiyat* Rural distributor, bidirectional, undivided asphalt road connecting Aandqet to Quobaiyat.	2	Painted	9-10m
H	*Quobaiyat - Qatlabe* Rural distributor, bidirectional, undivided asphalt road.	2	Painted	8m

Figure 12-4 Selected Roads Surveyed



12.1.3.2 Traffic Counts

24-hr automatic traffic counts were conducted at different locations along the selected road segments for a period of three days between 15 and 30 September 2018 inclusive. This period was chosen to ensure normal traffic operation in the absence of special events that may affect traffic. In addition, manual traffic counts were conducted at key junctions during the peak hours to determine turning movement counts. **Figure 12-5** shows pneumatic tubes installed for automatic traffic counts.

Figure 12-5 Images of Automatic Traffic Counts

12.2 Baseline Findings

12.2.1 Route Survey (Madgelni, April 2018)

The Madgelni Route Survey identified 32 obstacles along the Aabde to Chadra route and 11 obstacles along the OBS33 Alternative Route, as summarized in **Table 12-2**.

Table 12-2 Potential Obstacles Identified by Madgelni

Obstacle	Type	Coordinates	Description/Suggestion
OBS01	Storage Yard	N 34°27’29” E 35°49’45”	It was confirmed that the required storage area 10,000m² can be provided.
OBS02	Concrete debris	N 34°27’08” E 35°50’09” Km: 0+000	Debris should be removed.
OBS03	Parallel parking on road	N 34°27’11” E 35°50’26” Km: 1+200	Second-row car park should not be allowed during the transportation.
OBS04	Bridge	N 34°27’06” E 35°50’33” Km: 1+450	Bridge height is over 6m. It is suitable for passing.
OBS05	Roundabout	N 34°26’44” E 35°50’47” Km: 2+400	Car parking should not be allowed during transportation.
OBS06	30m on-site cast bridge in Tripoli	N 34°26’44” E 35°50’51” Km: 2+500	Suitable for passing.

Obstacle	Type	Coordinates	Description/Suggestion
OBS07	Pedestrian overpass in Tripoli	N 34°26'48" E 35°51'04" Km: 2+900	Height is over 5.77m. It is suitable for passing.
OBS08a	Highway overpass in Tripoli	N 34°26'54" E 35°51'24" Km: 3+200	Vertical curve should be checked during test drive.
OBS08b		N 34°26'54" E 35°51'24" Km: 3+200	Distance of Span: 24m. It is suitable for passing.
OBS09	Pedestrian overpass in Tripoli	N 34°27'07" E 35°51'46" Km: 4+100	Height is over 5.70m. It is suitable for passing.
OBS10	Pedestrian overpass in Tripoli	N 34°27'13" E 35°51'60" Km: 4+500	Height is over 5.00m. It should be checked after WTG selection.
OBS11	Overhead placard in Tripoli	N 34°27'30" E 35°52'58" Km: 6+300	Height is over 5.50m. It is suitable for passing.
OBS12	Deir Amar Army Control Point	N 34°27'47" E 35°53'31" Km: 7+200	Concrete and steel barriers should be removed during the transportation
OBS13	Pedestrian overpass	N 34°27'48" E 35°54'12" Km: 8+100	Height is over 5.60m. It is suitable for passing.
OBS14	Pedestrian overpass	N 34°28'24" E 35°55'24" Km: 10+300	Height is over 5.15m. It should be checked after WTG selection.
OBS15	Pedestrian overpass	N 34°28'50" E 35°56'11" Km: 11+800	Height is over 5.25m. It should be checked after WTG selection.
OBS16	Pedestrian overpass	N 34°29'42" E 35°57'28" Km: 14+300	Height is over 5.19m. It should be checked after WTG selection.
OBS17	Overhead placard	N 34°30'13" E 35°57'49" Km: 15+300	Height is over 5.60m. It is suitable for passing.
OBS18	Pedestrian overpass	N 34°30'31" E 35°58'01" Km: 16+100	Height is over 5.40m. It is suitable for passing.
OBS19	Roundabout fencing	N 34°31'03" E 35°58'40" Km: 17+500	Fencing should be removed during the transportation period.
OBS20	Roundabout curbs	N 34°31'03" E 35°58'40" Km: 17+500	Concrete curbs should be removed during the transportation period.
OBS21	Roundabout poles	N 34°31'03" E 35°58'40" Km: 17+500	Poles and signboard should be removed during the transportation period.

Obstacle	Type	Coordinates	Description/Suggestion
OBS22	3 span on-site cast bridge	N 34°32'58" E 35°59'31" Km: 21+400	It is suitable for passing.
OBS23	7 span on-site cast bridge	N 34°35'46" E 36°03'46" Km: 30+400	It is suitable for passing.
OBS24	Trees	N 34°36'09" E 36°04'02" Km: 31+000	Trees should be pruned prior to transportation.
OBS25	Car/truck park	N 34°37'43" E 36°06'11" Km: 35+800	Car/truck parking should not be allowed during the transportation.
OBS26a	Old Customs Building	N 34°37'44" E 36°06'16" Km: 35+900	Section of the building should be removed.
OBS26b	Old Customs Building	N 34°37'44" E 36°06'16" Km: 35+900	Building wall should be removed and pole moved.
OBS27	Sharp right turn	N 34°37'53" E 36°06'47" Km: 36+800	Ground should be compacted, and pole removed.
OBS28	2 span on-site cast bridge	N 34°36'39" E 36°13'32" Km: 48+400	It is suitable for passing. Side slopes to be checked during test drive.
OBS29	1 span on-site cast bridge	N 34°36'46" E 36°14'27" Km: 50+300	It is suitable for passing.
OBS30	Army Control Point	N 34°36'50" E 36°14'41" Km: 50+800	Barrels and hut should be removed during the transportation.
OBS31	Chadra Control Point	N 34°37'17" E 36°18'45" Km: 57+800	All concrete blocks and huts should be removed during the transportation.
OBS32	End point	N 34°37'22" E 36°19'00" Km: 58+200	The defined route is not convenient for transport after this point.
OBS33	Obstacle 33 Alternative Route	N 34°36'58" E 36°17'16" Km: 55+500	30m X 10m area should be filled and compacted. Pole and trees should be removed.
OBS34	Unpaved road	N 34°37'08" E 36°17'22" Km: 56+000	Road surface should be improved. The minimum road width should be 5m.
OBS35	New road between OB35 and OB36	N 34°37'27" E 36°17'17" Km: 56+500	New road should be constructed from OBS35 and OBS36. The minimum road width should be 5m and dimensioned according to turbine transport guidelines.
OBS36		N 34°38'30" E 36°19'02" Km: 61+500	
OBS37	Unpaved road	N 34°39'02" E 36°18'44" Km: 62+750	The road surface should be improved. The minimum road width should be 5m. Temporary or permanent relocation of electric poles and other obstacles must be studied separately.

Obstacle	Type	Coordinates	Description/Suggestion
OBS38	Right turn	N 34°39’19” E 36°18’33” Km: 63+500	Vegetated area on inside of turn should be removed.
OBS39	Sharp right turn	N 34°39’24” E 36°18’35” Km: 63+700	One of two alternative bypass roads should be constructed.
OBS40	Unpaved road	N 34°39’25” E 36°18’39” Km: 63+750	The road should be improved from this point to OBS41, about 3 km. There are unused railway tracks under the surface. This needs to be checked with railway authority for any revision.
OBS41	2 alternative roads	N 34°39’24” E 36°20’39” Km: 67+000	Alternative 1 : OBS41 – OBS 42 –OBS44 Alternative 2 : OBS41 – OBS 43 –OBS44
OBS42	Alternative 1: OBS41 – OBS 42 –OBS44	N 34°39’16” E 36°20’47” Km: 67+300	New by-pass road of about 300 m., passing through the fields at each turn, should be constructed from OBS41 to OBS42.
OBS43	Alternative 2: OBS41 – OBS 43 –OBS44	N 34°39’22” E 36°21’02” Km: 67+600	Right turn through field (20m X 40m area) should be filled / compacted until road level.
OBS44	Same endpoint of 2 alternative roads	N 34°39’14” E 36°21’04” Km: 68+000	Alternative 1 has three sharp turns to reach PSEP (OBS45) Alternative 2 seems to be a better option, as it has a single right turn and reaches straight towards the Project site entrance point.
OBS45	Project site entrance	N 34°39’10” E 36°21’08” Km: 68+200	Connection to Project site entrance.

The most significant concern noted by the route survey was the need for the construction of a new connection road between OBS35 and OBS36. This segment is to be studied and designed separately. In addition:

- All electric and phone cables over the road must have a clearance of 6m above ground.
- The access and site road longitudinal gradient must be a maximum of 8° (14%).
- Additional pulling units are required during transportation for gradient above 14%.
- Minimum transverse inclination of road is to be 2% to one or both sides in within the Project site.
- The load bearing capacity of all site roads must have a compaction of min. 95%.

The location of the obstacles identified are shown in **Figures 12-6** through **12-8**.

12.2.2 Route Survey (GIFCO, June 2018)

The GIFCO Route Survey identified 33 obstacles along the Aabde to Chadra route, as summarized in **Table 12-3**.

Figure 12-6 Obstacles OBS01 through OBS21

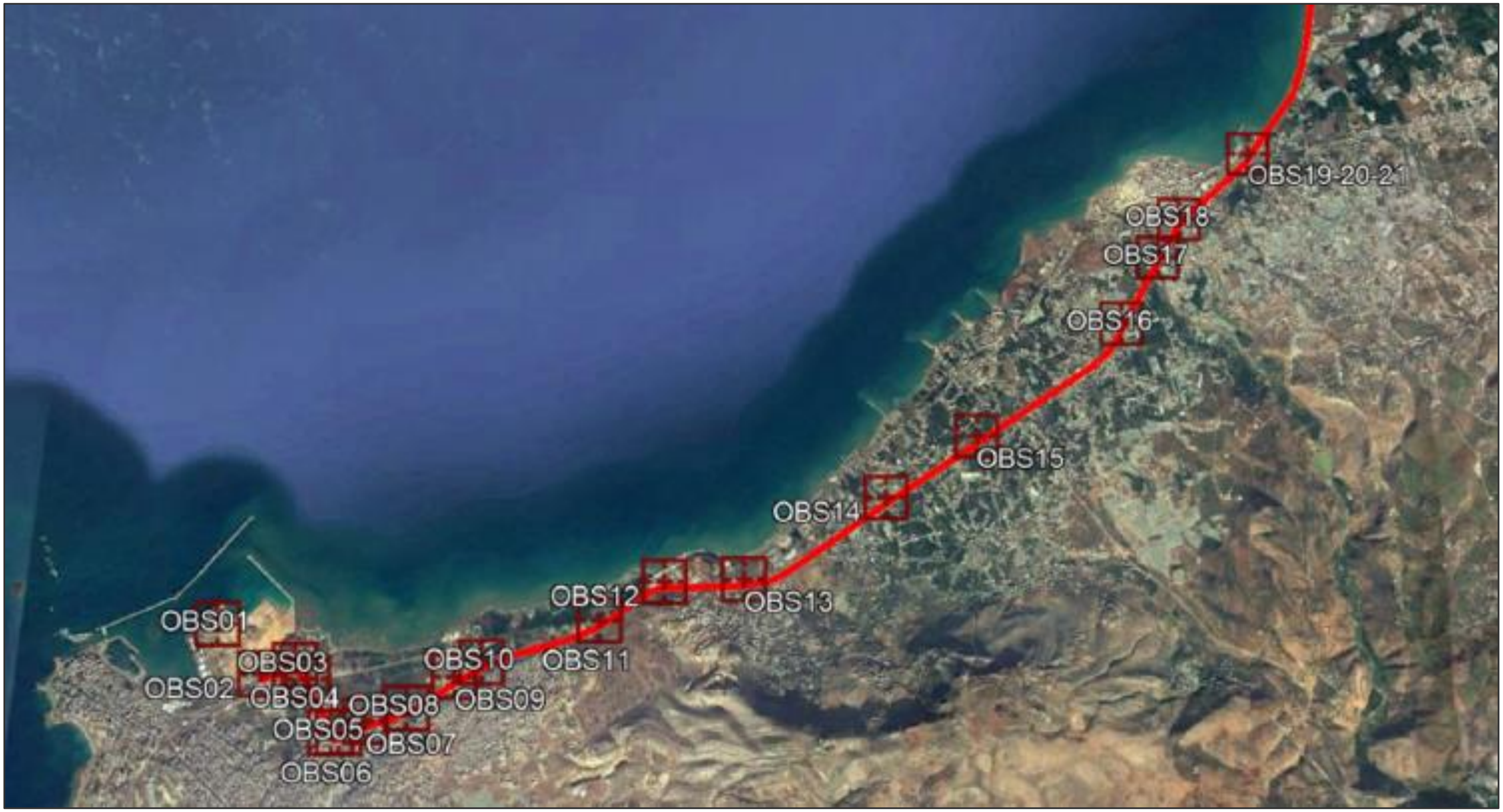


Figure 12-7 Obstacles OBS22 through OBS29

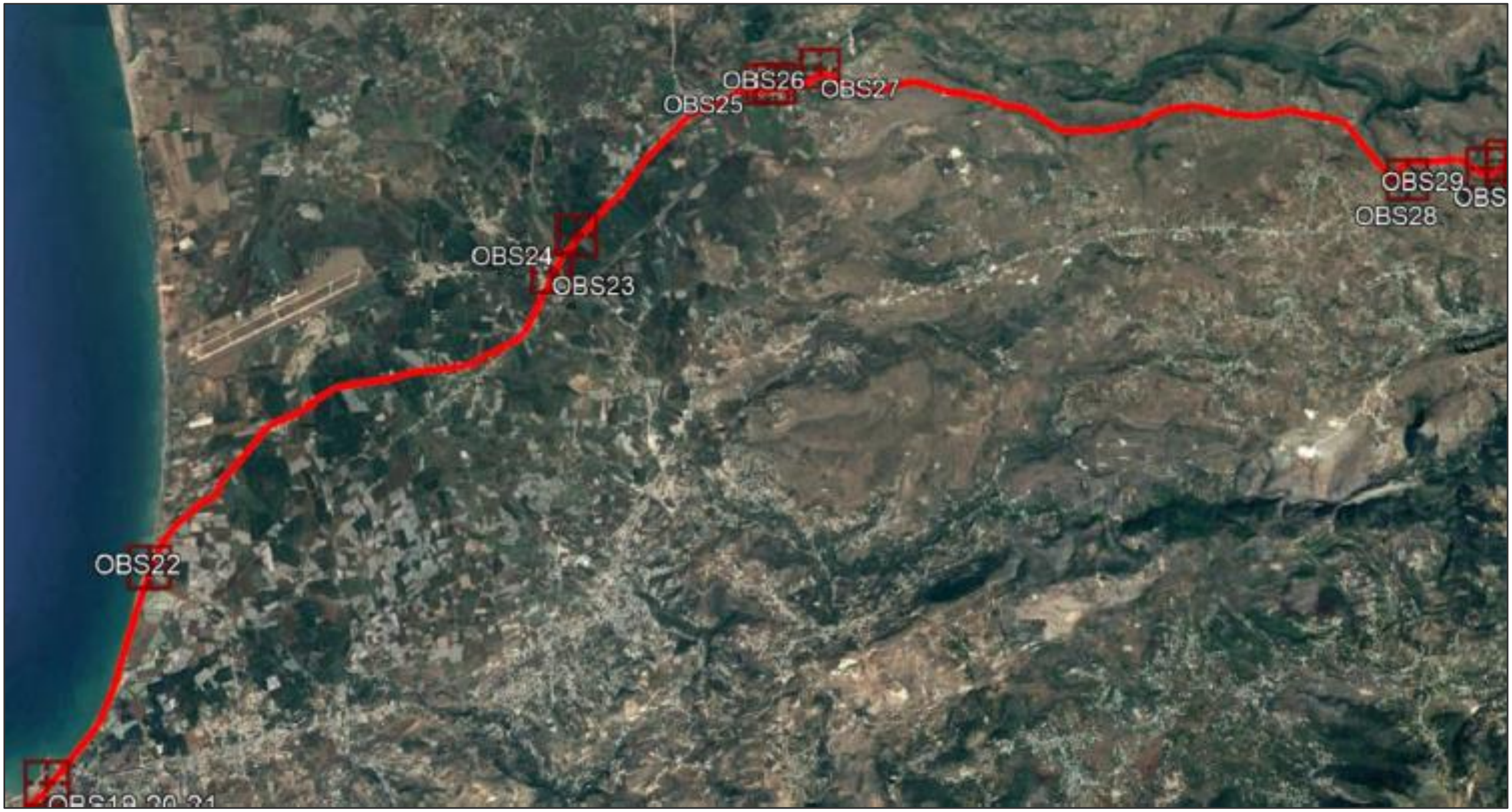


Figure 12-8 Obstacles OBS30 through OBS45

Table 12-3 Potential Obstacles Identified by GIFCO

Pinch Point	Type	Coordinates (where provided)/Description/Suggestion	
PP01	Tripoli Port Customs Hall	Within the port and on the exist route, there is a Customs Hall that all vehicles transit. Measurement of the facility was not possible at the time of the survey. Currently, there is no bypass road around this facility. However, there is suitable vacant land to the immediate side of the hall.	
PP02	Port internal access road	The port internal access road by the exit gate is approximately 19m wide, reducing to approximately 15m nearer the exit gate. Each side is bordered by concrete bund walls surmounted by steel poles and wire mesh infills. They appear to be movable, should it be necessary to increase the clear over-sail and overhang sweep area to allow the WTG blades to exit the port unhindered.	
PP03	Port exit gate	The exit from the Port is by a commercial gate which is approximately 13m wide. There are concrete bund walls approximately 3m X 6m. In addition, a small security/personnel/car access gated building is located to the left.	
PP04	Port exit	Various concrete block items require removal, and the ground/roadway improved such that the vehicles can utilize all of the available area.	
PP05	Overhead cables	Subject to a topographic survey; overhead cables and supporting pylons may need to be temporarily repositioned, removed or permanently relocated.	
PP06	New road construction	N 34.451849° E 35.842352°	A new road is being constructed with a concrete beamed bridge passing over the main port road. The measured minimum heights are 6.7m X 6.7m.
PP07	Over bridge	N 34.453341° E 35.840381°	Between the port gate and the over bridge, there is a sweeping curve to the right. This area is lined on the left with commercial properties and young trees on the central reserve. The surveyor recommends that this area be cleared of all parked vehicles and traffic flow before and while transport passes.
PP08	About Ali Roundabout	2.2km	The Abou Ali Roundabout is approximately 140m X 84m and fluctuates between 13 and 18m wide. Entry into the roundabout is from a 15m wide road. This is split by a divider reducing the road to 10m.
PP09	Lamp post	N 34.446588° 3 35.846541°	On the left side of the road, set back approximately 22m from the diameter apex, there is a lamp post which may need to be removed to allow entry into the roundabout.
PP10	Blank in report		
PP11	Roundabout	2.4km	This roundabout is intersected by a river, through its short axis, and passed over by a single span concrete bridge of 30m which if full width of the surrounding road. It was not possible to ascertain the condition and type of construction. Further investigation into load support and

Pinch Point	Type	Coordinates (where provided)/Description/Suggestion	
			permissible axle loads should be provided. It is estimated that the bridge is structurally sound and a minimum of a 50B rating. All parked vehicles and traffic should be removed during transit.
PP12	Footbridge	2.78km	Minimum clearance of 5.7m is required.
PP13	Ramp	3.1km	A fly over ramp with an angle of 3.5o over a longitudinal length of 95., with an apex of approximately 5.45, gradually descending back to ground level after 600m. More information from the Ministry of Roads is required to clarify structural integrity and suitability for proposed load configurations.
PP14	Concrete footbridge	N 34.451930º E 35.863013º	The bridge measures from 5.1m in height to the left and lowering to 4.49m to the right. The calculated maximum height of the cylindrical load center is 4.88m. The is the lowest structural height restriction encountered along the route, and the limiting factor on traveling height of all loads out of Tripoli.
PP15	Footbridge with sign	N 34.27123o E 35.151583^{0}	The sign over the road measured 5.7m on the left 12m wide roadway.
PP16	Military checkpoint	N 34.463103º E 35.892431^{0}	Military checkpoint with concrete blocks.
PP17	Sign	N 34.464440º E 35.903116º	Height of sign is 5.7m on the left and 5.75m on the right.
PP18	Underpass tunnel	N 34.463815º E 35.906872º	To the right there is a slip road off and back onto the main highway. The bypass road has no overhead restrictions and is suitable for transport.
PP19	Footbridge	N 34.473213º E 35.923225º	Footbridge measures 5.52 on the left and 5.63 on the right. The road width is 11m.
PP20	Footbridge	N 34.480712º E 35.936339º	Footbridge measures 5.1m on the left and 5.13m on the right.
PP21	Footbridge	N 34.494877º E 35.957846º	Footbridge measured 5.1m on the left and 5.33m on the right.
PP22	Underpass tunnel	N 34.49882º E 35.960169º	To the right there is a slip road off and back onto the highway. This bypass road has no overhead restrictions and is suitable for transport.
PP23	Overhead sign	14.7km	Measured 5.6m on the right side. Traffic too heavy for left side measurement.
PP24	7 span concrete bridge	N 34.503154º E 35.963379º	Measured overall span of 36m bearing to bearing. Each span is 5m resting on supports of 30cm for the full width of the roadway. Details of the bridge capacity and structural status should be obtained from MoR. However, the bridge is expected to be suitable for transport.
PP25	Footbridge	N 34.508707º E 35.966972º	This bridge measured 5.5m on the right side. Traffic was too substantial to measure the left side.

Pinch Point	Type	Coordinates (where provided)/Description/Suggestion	
PP26	Roundabout	17.4km	Major intersection of the highway to Halba. One exit to the right to Halba, second exit to Aarida toward Syria. Due to the numerous street furniture, lamps, fencing etc., as well as substantial traffic volume, a topographic survey is recommended to assess transport at this location.
PP27	3 span concrete bridge	N 34.54968° E 35.99218°	Overall span of the bridge is 17m bearing to bearing. Support columns are approximately 40cm thick. Details of the bridge capacity should be obtained from MoR.
PP28	Roundabout	N 34.553346° E 35.993084°	At this roundabout, the highway splits. The left fork continues along the coast toward Aarida and the Syrian border crossing. The right fork leads toward Aabboudiye.
PP29	Customs Hall		This facility is made up of three halls, two narrow halls joined in the center with office and inspection kiosks/tables. With a separate wider and higher hall to the right that is clear of obstacles. Removal of a portion of the Customs Hall is recommended.
PP30	Right turn	N 34.631685° E 36.113019°	The right turn leads toward Kouchara and is a 14m wide road flanked on each side by commercial properties and an area with small trees onto a 25m dual carriageway with a low concrete divider. The trees and the power pylon should be removed.
PP31	U bend in the valley	N 34.610594° E 36.225503°	Between Dibbabiye and Fraidis there is a U bend in a valley with two separated single span cast in place concrete bridges. The single span bridges are 13m each. The road's inner radius is 50m with an outer radius of 60m. Due to gradient changes between the approach road and the egress road, the angles and gradient will require plotting to ensure they are within the wing trailer's maneuvering capability. In addition, the rock face near the apex of the bend requires review for wing trailer's maneuverability.
PP32	Curve between Fraidis and Menjez	N 34.612789° E 36.240019°	The radii of curbs to be surveyed to ensure blade over-sail and overhang are not encroached.
PP33	Security checkpoint	N 34.610594° E 36.225503°	Remove any checkpoint obstacles.

It is noted that GIFCO's survey ended once it was observed that Chadra through Machta Hammoud was impassable. In response, GIFCO identified the following alternative routes:

- Halba to Quobaiyat route (refer to the yellow route in **Figure 12-9**).
- A potential road upgrade linking the Halba to Quobaiyat route to the Aabde to Chadra route, starting at Begdadhi, linking Begdadhi to Noura El Tahta, as shown in **Figure 12-10**. This route is currently serving villages, farms and residential properties.
- A potential new road link connecting the Aabboudiye/Chadra route with the Aabde to Chadra route. This option would involve improving a steep gradient with a sharp turn, as shown in **Figure 12-8**.

12.2.3 Transport Impact Study (October 2018)

Table 12-4 summarizes the average daily traffic volumes recorded along the selected road segments.

Table 12-4 Existing Average Daily Traffic Along Selected Roads

ID	Road Designation	ADT (PC)	ADT (HV)	ADT (Total)
A	Tripoli Port - Abu Ali Roundabout	12,740	1,771	14,511
B	Abu Ali Roundabout – Al Beddaoui	33,173	3,219	36,392
C	Al Beddaoui – Al Abdeh	19,230	1350	20,580
D	Abdeh - Mqaitea	14,927	1080	16,007
E	Mqaitea - Aabboudiye	11,350	720	12,070
F	Menjez - Chadra	2,265	28	2,293
G	Aandqet - Quobaiyat	2,279	1,291	4,470
H	Quobaiyat – Qatlbe (beyond Quobaiyat)	670	110	780

Figure 12-11 is provided to represent the collected hourly traffic volumes at Abu Ali Roundabout – Beddaoui to illustrate the peak traffic hours occurring on the main coastal road.

Figure 12-9 GIFCO Alternative between at Begdadhi and Nour El Tahta

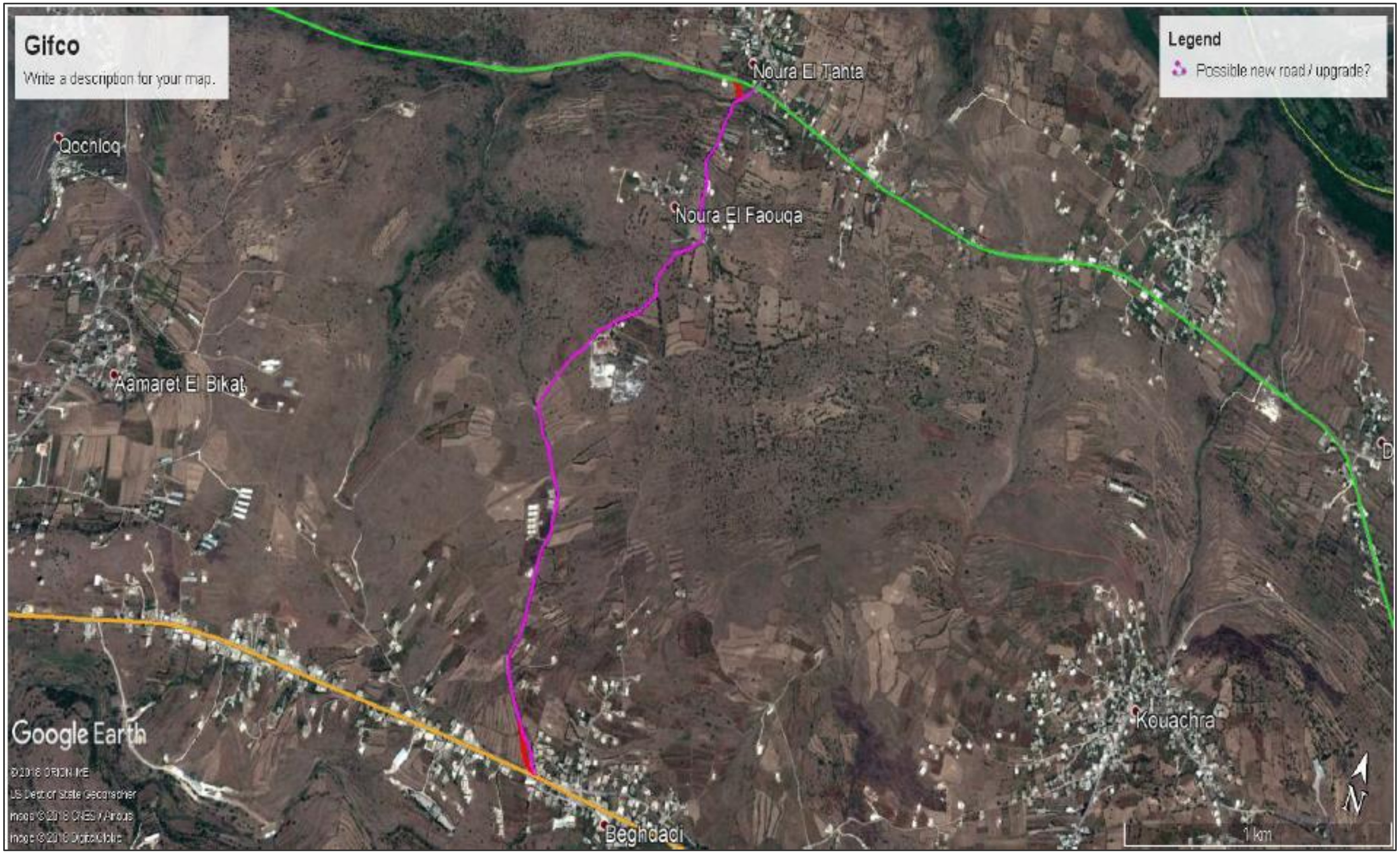
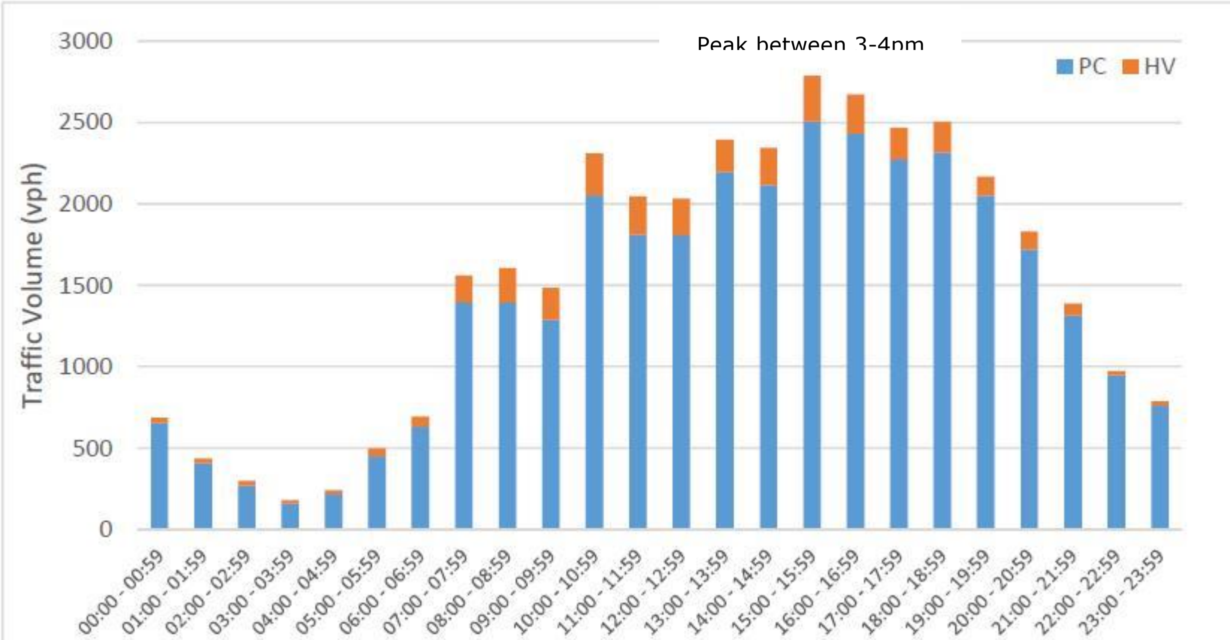


Figure 12-10 GIFCO Alternative between the Aabboudiye/Chadra Route with the Aabde to Chadra Route

Figure 12-11 Classified Average Hourly Volume from Abu Ali Roundabout – Beddaoui



The North American Highway Level of Service (LOS) standards use letters A through F, with A being the best and F being the worst as described in **Table 12-5**.

Table 12-5 Level of Service Definitions

Level of Service	Description
A	Free flow. Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The average spacing between vehicles is about 167m or 27 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. LOS A generally occurs late at night in urban areas and frequently in rural areas.
B	Reasonably free flow. LOS A speeds are maintained, maneuverability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 100m or 16 car lengths. Motorists still have a high level of physical and psychological comfort.
C	Stable flow, at or near free flow. Ability to maneuver through lanes is noticeably restricted and lane changes require more driver awareness. Minimum vehicle spacing is about 67m or 11 car lengths. Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect, but localized service will have noticeable effects and traffic delays will form behind the incident. This is the target LOS for some urban and most rural highways.
D	Approaching unstable flow. Speeds slightly decrease as traffic volume slightly increase. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease. Vehicles are spaced about 160 ft(50m) or 8 car lengths. Minor incidents are expected to create delays. Examples are a busy shopping corridor in the middle of a weekday, or a functional urban highway during

Level of Service	Description
	commuting hours. It is a common goal for urban streets during peak hours, as attaining LOS C would require prohibitive cost and societal impact in bypass roads and lane additions.
E	Unstable flow, operating at capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 6 car lengths, but speeds are still at or above 80km/hr. Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. Drivers' level of comfort become poor. This is a common standard in larger urban areas, where some roadway congestion is inevitable.
F	Forced or breakdown flow. Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS because LOS is an average or typical service rather than a constant state. For example, a highway might be at LOS D for the AM peak hour, but have traffic consistent with LOS C some days, LOS E or F others, and come to a halt once every few weeks.

The LOS calculated for the selected road segments are presented in **Table 12-6**.

Table 12-6 Existing Level of Service

Segment	Description	Volume Veh./hr	Flow Rate Veh./hr/lane	Speed Km/hr	LOS
A	Tripoli Seaport - Abu Ali Roundabout	245	138	94.8	A
B	Abu Ali Roundabout – Al Abdeh	563	215	92.4	A
C	Al Abdeh – Mqaitea	313	169	91.4	A
D	Mqaitea – Aabboudiye	250	144	91.2	A
E	Aabboudiye – Chadra	434	284	59.4	A
F	Chadra to Aandqet	110	109	63.4	A
G	Aandqet – Quobaiyat	431	327	60.3	B
H	Quobaiyat – Qatlbe	78	106	63.6	A

Across the 8 road segments, 3 key junctions were identified where the transport of WTG components could potentially create bottlenecks, as summarized in **Table 12-7**.

Table 12-7 Key Selected Junctions

No	Segment	Junction	Description	Number of Directions
1	E	Chadra Entrance	Mini roundabout	3
2	F	Aandqet	T junctions	3
3	F/H	Quobaiyat Roundabout	Mini roundabout	4

Figure 12-12 shows the location of these junctions within the study area. The three junctions were not included for traffic count analysis as WTG transport along this corridor would result in a travel delay in a range between 100–300 seconds, reducing the junction LOS to F. Note: Junctions 1, 2 and 3 are not included in the preferred WTG transport corridor (refer to **Section 3 Analysis of Alternatives**).

During the Traffic Impact Study, the following obstacles and associated civil works were identified between Tripoli and Chadra, as presented in **Table 12-8**. These recommendations will be combined with those provided by Madgelni and GIFCO, as applicable, to the preferred route selected. Obstacle removal activities which will be undertaken by the Developer in close coordination with the concerned local authorities. Obstacles will be removed either temporarily (concrete blocks, selected poles) or permanently before being moved to another location (selected poles) or reinstated with an improved design (roundabout islands).

12.3 Impact Analysis

The transport route for the WTG components will begin at the Tripoli Port and proceed to the Project site using existing roads and new road or links, as described in **Section 2 Project Description**. During the baseline survey, the average daily traffic (ADT) and associated LOS for 8 road segments between the Tripoli Port and Chadra were determined, with peak traffic volumes occurring between 3pm and 4pm.

The assessment of traffic and transport impacts was based on the following:

- The nature, duration and receptor sensitivity of the obstacle removal and road development activities during construction and decommissioning.
- The addition of traffic and related changes to the LOS during construction, operation and decommissioning.
- The addition of traffic related to transport of construction materials from existing quarries to the Project site during construction.
- The outcomes of consultation with communities along the planned transport corridor, on existing and new road segments.

It is noted that community health, safety and security impacts from transport and traffic are presented in **Section 16 Community Health, Safety and Security**.

Figure 12-12 Location of Key Junctions

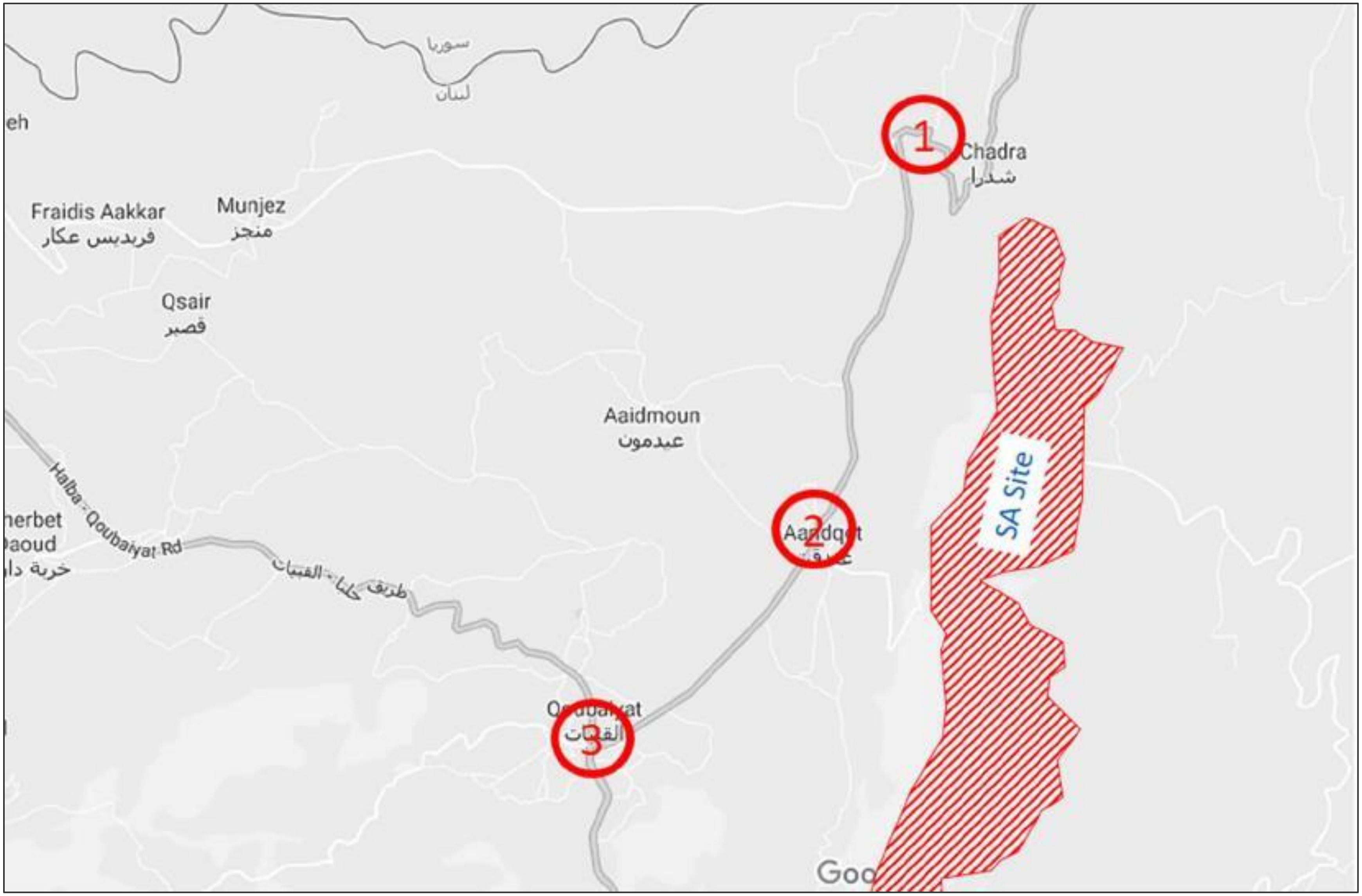


Table 12-8 Obstacles and Associated Civil Works

KM	Civil Works / Measures to be Taken
0.0	• Outer wall of port premises needs to be demolished at a length of 45m. • The curbs between the light poles need to be removed/levelled. • Light poles and electricity poles need to be removed. • The concrete blocks opposite the port exit gate need to be removed. • The curbs between the 2 traffic lanes opposite the port exit gate need to be removed/levelled.
0.3	• Roads must be free of any advertising board and sales booth. • All trees along the midway need to be removed.
3.4	• Pedestrian bridge (concrete) needs to be lifted up to a clearance of +560cm.
8.9	• Pedestrian bridge (concrete) needs to be lifted up to a clearance of +560cm.
10.4	• Pedestrian bridge (concrete) needs to be lifted up to a clearance of +560cm.
12.8	• Pedestrian bridge (concrete) needs to be lifted up to a clearance of +560cm.
13.0	• 2 light poles at the right need to be removed or shifted to the right for 2m.
14.4	• Pedestrian bridge (concrete) needs to be lifted up to a clearance of +560cm.
15.8	• Steel fence needs to be removed. • The curbs, steel fence and small trees in the roundabout-center need to be removed. • Curbs. steel fence at roundabout-exit need to be removed at a length of 20m.
26.2	• Electricity pole and traffic sign at the left need to be shifted leftwards 1.5m. • Electricity pole at the right needs to be shifted rightwards 1.5m.
30.3	• Electricity pole at the right needs to be shifted rightwards 3.5m.
34.0	• Boundary wall on the right (before the check point) needs to be removed. • Electricity pole on the right (before the check point) needs to be removed. • 50m after passing the check point an area of 15m on the right needs to be levelled.
34.2	• 4 electricity poles on the right (after passing the check point) need to be shifted rightwards. • Trees. bushes. electricity pole on the left need to be removed at a width of 4m.
34.8	• Before the right-turn the road needs to be extended to the left side on 75m length and 10m width (levelling/paving). • An electricity pole needs to be removed.
46.1	• 4-9m of the terrain and rock face right along the curve need to be cleared, levelled and drainage needs to be filled up. • At the curve vertex approx. 8m of the rock face need to be removed in order to widen the road clearance to the right.
48.2	• On the outer curve the rock face needs to be removed at a length of 85m/width 5.5m. • 3 light poles on the left (inner) side of the curve to be removed. • Light poles & crash barrier on the left (inner) side of the curve need to be removed. • Incline left beside the inner curve needs to be filled up and levelled at a length of 50m.
49.1	• All wooden poles on the right need to be removed. • Road need to be cleared of bushes and branches on both sides for a minimum of 45m. • Earth mounds on both sides need to be levelled at a width of 4m.

KM	Civil Works / Measures to be Taken
	• Bushes. poles and trees need to be removed.
54.9	• 5 poles on the inner (left) side of the curve need to be removed or shifted to the left for a minimum of 2.5m. • 2 poles on the outer (right) side of the curve need to be shifted to the right for 4m.
55.1	• Curve entry: 2 poles on the left need to be shifted leftwards for approximately 3.5m. • 4 further poles on the left need to be shifted leftwards for approximately 3.5m. • A tree on the left needs to be removed. • A pole on the right needs to be shifted rightwards for 3.5m.
55.4	• 3 marked poles on the left need to be shifted to the left for approximately 3.5m.
55.8	• Inner (right) curve needs to be widened to the right.
55.9	• All poles on the left need to be removed throughout the whole curve. • On the right all poles. trees and bushes need to be removed at a length of 90m.
56.0	• Center of roundabout needs to be levelled/curbs to be removed.
56.1 – 56.8	• A bypass road of 700m needs to be constructed.
57.0	• A bypass road of 150m length needs to be constructed.
57.9	• At the end of the bypass road an electricity pole needs to be removed or shifted.
57.9	• S-curve: a fence mounted on a low wall. smaller trees and bushes on the left side need to be removed. • The boundary wall needs to be removed at a length of 20m. • A foundation on the right needs to be removed for a minimum 3-4m; the electricity pole needs to be shifted to the right for 3-4m.
58.0	• Left of the road all poles. trees and other obstacles need to be removed at a length of 68m and a width of 1-9m. • Right before the junction all obstacles (poles, trees, walls, fences) need to be removed at a length of 25m and a width of 4m.
58.3	• 90° left-turn: an area of approx. 1.200m² on the left needs to be cleared. reinforced and levelled down to road-level, • The wall on the left needs to be removed.
58.9	• Poles on the left need to be shifted leftwards for 4m – bushes/trees need to be removed. • All trees and bushes on the right need to be cut off at a width of 3m. • Sunshades/canopies on the right need to be closed or removed.
59.6	• Bushes and trees on the right need to be removed at a width of 3m. • 4 solar light poles on the right need to be removed. • Further electricity pole needs to be shifted rightwards for 3.0m.
60.0	• Wall on the right side (outer curve) needs to be removed; the electricity pole needs to be shifted to the right for 3m. • 2 electricity poles and total 6 solar light poles on the left of the road need to be removed or shifted to the left for approximately 4m. • The curbs on the left need to be removed at a length of approximately 75m and the area left behind needs to be filled up/levelled.
60.1	• On the outer curve all poles, trees and bushes need to be removed at a length of 74m and a width of 3m.

12.3.1 During Construction

12.3.1.1 Road Obstacle Removal

During the traffic and transport studies undertaken by Madgelni (April 2018), GIFCO (June 2018) and Dr. Dima (October 2018), potential obstacles were identified as summarized in **Tables 12-2, 12-3** and **12-8**. It is noted that some of the potential obstacles overlap, and as such have been summarized in **Table 12-9**. The following minor civil works will be necessary for trucks carrying the WTG components to navigate from the Tripoli Port to the Project site:

- The Port: Temporary concrete bund, curb, electric pole and overhead removal, will be necessary for trucks to navigate the Port. At the Port exit, 45m of concrete wall will need to be demolished to facilitate exit by trucks carrying the WTG components.
- Ramps, roundabouts and curves: Car parking will be prohibited during transport and removal of curbs, electric poles, trees, lamp posts, and fencing will be necessary.
- Pedestrian bridges: Raising of the bridges to provide a vertical clearance of 570cm will be required.
- At significant curves: Ground leveling and compaction to facilitate maneuverability.

Identification of potential obstacles between Chadra and Sahle Checkpoint was undertaken as part of developing the preferred WTG component transport route.

Mitigation

- An additional route survey will be undertaken once the OEM/EPC Contractor is selected:
  - The completion of a route review for the specific WTG components, to include additional swept path analysis, will identify any potential issues related to the transport of these larger components, specifically the longer turbine blades.
- Should the GE turbine model be chosen for the LWP wind farm, the blades will be over 7m longer than what has been assessed. While the extra length may simply require more engineering works to accommodate the transport of the blade through constrained locations, the extent and cost of these works is not currently understood. It may also be necessary to obtain additional land, land that has not been included in any acquisition discussions and negotiations and may not be easy to acquire.
- The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition of the 45m of concrete wall be coordinated with the Port Authority.
- Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport.
- Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass.
- Any modification required for the Al Abdeh roundabout will be discussed with the municipality as it is under their authority.
- Such works will be coordinated and permitted by the Project Proponent and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest

Table 12-9 Potential Obstacles Between the Tripoli Port and Chadra

Location	KM/ Coordinates	Civil Works / Measures to be Taken
Tripoli Seaport	0.0	• Internal Roads: Temporarily move concrete bund walls with steel poles and wire mesh. • Outer wall of Port premises: Demolish a length of 45m, remove curbs and light poles; improve road such that the vehicles can utilize all of the available area. • Overhead: Overhead cables and supporting pylons may need to be temporarily moved.
Outside Port Exit	0.3	• The concrete blocks opposite the port exit gate need to be removed. • The curbs between the 2 traffic lanes opposite the port exit gate need to be removed/levelled. • Roads must be free of any advertising board and sales booth. • All trees along the midway need to be removed. • Between the Port exit and the bridge, car parking prohibited during transport. • Lamp post removal on the left side of the road at N 34.446588° and 3 35.846541°, to allow entry into the roundabout.
Roundabout	2.4	• Parking around roundabout prohibited during transport.
Concrete Pedestrian Bridge	2.7	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Ramp	3.1	• A fly over ramp with an angle of 3.5° over a longitudinal length of 95m, with an apex of approximately 5.45m, gradually descending back to ground level after 600m. More information from the Ministry of Roads is required to clarify structural integrity and suitability for proposed load configurations.
Concrete Pedestrian Bridge	3.4	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Concrete Pedestrian Bridge	4.5	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Deir Amar Army Checkpoint	7.2	• Concrete blocks should be temporarily removed during transport.
Concrete Pedestrian Bridge	8.1	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Concrete Pedestrian Bridge	8.9	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Concrete Pedestrian Bridge	10.4	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Concrete Pedestrian Bridge	11.8	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Concrete Pedestrian Bridge	12.8	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Light Poles	13.0	• 2 light poles at the right need to be removed or shifted to the right for 2m.
Concrete Pedestrian Bridge	14.1	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Overhead Sign	14.7	• Sign needs to be lifted up to a clearance of +570cm.
Roundabout	15.8	• Steel fence needs to be removed. • The curbs, steel fence and small trees in the roundabout-center need to be removed. • Curbs and steel fence at roundaboutexit need to be removed at a length of 20m.
Concrete Pedestrian Bridge	16	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Roundabout	17.5	• Fencing, curbs, poles and signboard should be temporarily removed during transport.

Location	KM/ Coordinates	Civil Works / Measures to be Taken
Concrete Pedestrian Bridge	N 34.508707º E 35.966972º	• Pedestrian bridge needs to be lifted up to a clearance of +570cm.
Electric Poles/Traffic Sign	26.2	• Electric pole and traffic sign at the left need to be shifted leftwards 1.5m. • Electric pole at the right needs to be shifted rightwards 1.5m.
Electric Pole	30.3	• Electricity pole at the right needs to be shifted rightwards 3.5m.
Trees	31.0	• Trees to be pruned prior to transportation.
Customs House	34.0	• Boundary wall on the right (before the check point) needs to be removed. • Electricity pole on the right (before the check point) needs to be removed. • 50m after passing the check point an area of 15m on the right needs to be levelled.
Electric Poles/Trees	34.2	• 4 electricity poles on the right (after passing the check point) need to be shifted to the right. • Trees, bushes, electricity pole on the left need to be removed at a width of 4m.
Right Turn	34.8	• Before the right-turn the road needs to be extended to the left side on 75m length and 10m width (levelling/paving). • An electric pole needs to be removed. • Due to gradient changes between the approach road and the egress road, the angles and gradient will require plotting to ensure they are within the wing trailer's maneuvering capability. In addition, the rock face near the apex of the bend requires review for wing trailer's maneuverability.
Car Park	35.8	• Car parking probibited during transport.
Ground Surface	36.8	• Ground should be compacted.
Curve between Fraidis and Menjez	N 34.612789º E 36.240019º	• The radii of curbs to be surveyed to ensure blade oversail and overhang are not encroached.
Curve	46.1	• 4-9m of the terrain and rock face right along the curve need to be cleared, levelled and drainage needs to be filled up. • At the curve vertex approx. 8m of the rock face need to be removed in order to widen the road clearance to the right.
Curve	48.2	• On the outer curve the rock face needs to be removed at a length of 85m/width 5.5m. • 3 light poles on the left (inner) side of the curve to be removed. • Light poles & crash barrier on the left (inner) side of the curve need to be removed. • Incline left beside the inner curve needs to be filled up and levelled at a length of 50m.
Road Clearance	49.1	• All wooden poles on the right need to be removed. • Road need to be cleared of bushes and branches on both sides for a minimum of 45m. • Earth mounds on both sides need to be levelled at a width of 4m. • Bushes. poles and trees need to be removed.
Chadra Army Checkpoint	50.8	• Temporarily remove checkpoint obstacles.

Location	KM/ Coordinates	Civil Works / Measures to be Taken
Electric Poles	54.9	• 5 poles on the inner (left) side of the curve need to be removed or shifted to the left for a minimum of 2.5m. • 2 poles on the outer (right) side of the curve need to be shifted to the right for 4m.
Curve	55.1	• Curve entry: 2 poles on the left need to be shifted leftwards for approximately 3.5m. • 4 further poles on the left need to be shifted leftwards for approximately 3.5m. • A tree on the left needs to be removed. • A pole on the right needs to be shifted rightwards for 3.5m. • 3 marked poles on the left need to be shifted to the left for approximately 3.5m. • Inner (right) curve needs to be widened to the right. • All poles on the left need to be removed throughout the whole curve. • On the right all poles, trees and bushes need to be removed at a length of 90m.

As such, the impact severity is considered Slight and the receptor sensitivity considered Medium, resulting in a Minor Impact as shown in **Table 12-10**.

Table 12-10 Assessment of Minor Civil Works Required for Obstacle Removal

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	**Negligible √**	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

12.3.1.2 New Road Development

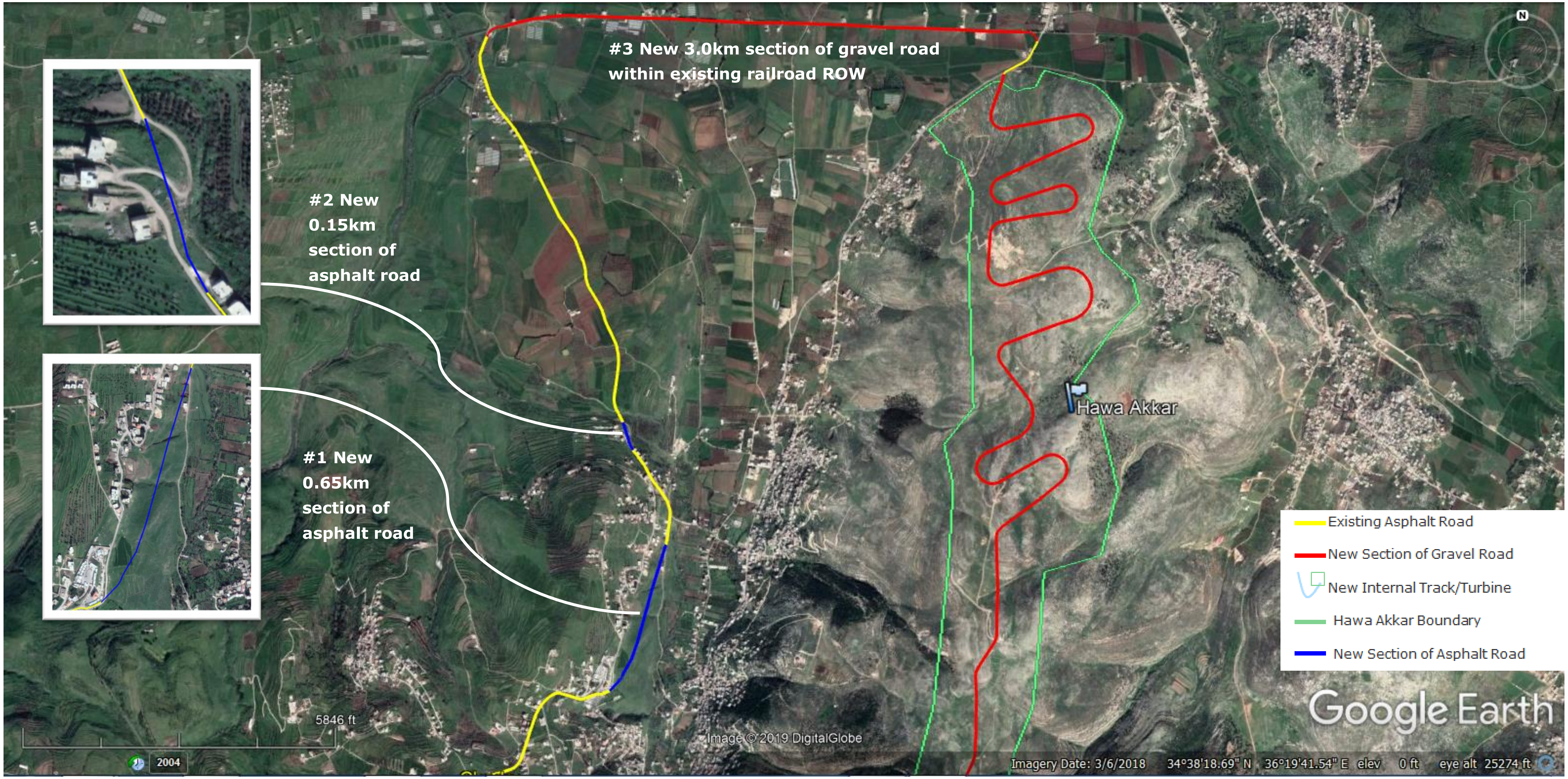
New road segments will be developed as follows:

- In order to avoid impacts to Chadra, Machta Hassan and Machta Hammoud, a new 0.65km section of asphalt road will be constructed through currently vacant land purchased from private land owners (shown as #1 in **Figure 12-13**). The new road section will connect with the existing asphalt road outside of Machta Hammoud.
- A new 0.15km section of asphalt road will be constructed (shown as #2 in **Figure 12-13**) between two existing sections of asphalt road in order to avoid hairpin turns near homes.
- A new 3.0km section of gravel road will be constructed within the existing railroad right of way (ROW) managed by Machta Hammoud Village (shown as #3 in **Figure 12-13**), traveling east before connecting to an existing asphalt road to enter the Hawa Akkar Wind Farm.

Identification of potential obstacles between Chadra and the Sahle Checkpoint was undertaken at a high level as part of developing the preferred WTG component transport route as follows:

- No obstacles were identified along the 0.9km segment of asphalt road to be constructed through the ~12.5ha parcel of land.
- No obstacles were identified along the 1.7km segment of track to be constructed between the existing Hawa Akkar internal track and the Sahle Checkpoint. The track alignment was selected to match the existing contours of the land and provide adequate buffer between the track and the Lebanese Army Military Base.

Figure 12-13 New Road Segments



Mitigation

The construction of asphalt roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army. It is considered that construction of the internal tracks will have no impact on access to and operations at the Lebanese Army Military base and/or residents of Mqaible. Therefore, the impact severity is considered Low and the receptor sensitivity considered Medium, resulting in a Minor Impact as shown in **Table 12-11**.

Table 12-11 Assessment of New Road Development

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

12.3.1.3 Transport of WTG Components, Construction Materials and Workers

The construction phase will include the transport of WTG components, transport of construction materials and transport of construction workers to the Project site.

Transport of WTG Components

Several assumptions were considered in the assessment to calculate vehicle trips, as shown in **Table 12-12**.

Table 12-12 Vehicle Trips Required for Transport of WTG Components[66]

Component	Quantity	Maximum Turbines	Units	Vehicle Type	Estimated Roundtrips From Tripoli Port to Project Site		
					Max. Trips per Week	Max. Truck Trips per Week	Duration = 16 turbines, Twice per Week
Tower	5 sections per tower per turbine	21	105	5 oversize trucks per tower per turbine	2	10	13 weeks
Nacelles	2 sections per nacelle per turbine	21	42	2 oversize trucks per nacelle per turbine		4	
Hub	1 hub per turbine	21	21	1 oversize truck per hub per turbine		2	
Blades	3 blades per turbine	21	63	3 oversize trucks per turbine		6	
		Totals	**231**	**12 oversize trucks per turbine**	**2**	**24**	
Substation	1 substation	NA	1	1 oversize truck per substation	1	NA	
Switchgear	1 switchgear	NA	1	1 semi-trailer (20-ton) per switchgear	1	NA	

[66] Each turbine transport consists of 11 overweight / oversized components, each to be transported on a separate truck. A full set of WTG components are to be transported in one night. Two sets of WTG components are to be transported per week.

To assess impacts from the transport of WTG components, the vehicle trips were added to the existing ADT and LOS (as summarized in **Table 12-4** and **Table 12-6**) along the 5 road segments. The truck traffic for transport of the WTG components was then added to the 5 road segments to assess the increase in traffic volume, an increase of 0.015% as shown in **Table 12-13**. Note: the ADTs for personal cars (PC) and heavy vehicles (HV) presented in **Tables 12-4** were multiplied by 7 to estimate the weekly ADTs.

Table 12-13 Weekly Traffic Along WTG Transport Route

ID	Road Designation	ADT (PC)/ Week	ADT (HV)/ Week	Total Weekly ADT	Total Weekly ADT with WTG Trucks
A	Tripoli Port - Abu Ali Roundabout	89,180	12,397	101,577	101,599
B	Abu Ali Roundabout – Al Aabdeh	232,211	22,533	254,744	254,766
C	Al Aabdeh- Mqaitea	134,610	9,450	144,060	144,082
D	Mqaitea - Aabboudiye	104,489	7,560	112,049	112,071
E	Aabboudiye - Chadra	79,450	5,040	84,490	84,512
	Totals	**639,940**	**56,980**	**696,920**	**697,030**
				Δ = 0.015%	

The increase in weekly ADT was used to undertake capacity analysis of the 5 road segments to be used, Road Segments A, B, C, D, and E, under three scenarios:

1. The existing traffic conditions (year 2018); This scenario uses the existing traffic volumes collected through automatic and manual counts.
2. Future background traffic conditions (year 2020) without the Project; this projection applied a conservative traffic growth rate of 3%.
3. Future traffic conditions (year 2020) with the Project; the projection was derived after assigning the generated trips for the transport of the WTG components in combination with the projection generated under Item 2.

The resulting LOS was then calculated for the selected road segments under the three scenarios to illustrate the impact of the additional traffic, as shown in **Table 12-14**. As an extra measure of conservatism, the LOS was calculated between 10pm and 11pm (a period of higher traffic volume), whilst the WTG component transport will be undertaken between 11pm and 4am.

As a result of WTGs transport, the LOS of Road Segment A will be reduced from A to B, Road Segment B will be reduced from A to C, Road Segment C will be reduced from A to B, and Road Segment D will be reduced from A to B. For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road. For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic.

Table 12-14 Projected Level of Service Change for Transport of WTG Components

Road		Year 2018 Existing Traffic	Year 2020 Traffic without Project	Year 2020 Traffic WITH Project
No.	Description	LOS	LOS	LOS
A	Tripoli Port - Abu Ali Roundabout	A	A	B
B	Abu Ali Roundabout – Al Aabdeh	A	A	C
C	Al Aabdeh- Mqaitea	A	A	B
D	Mqaitea - Aabboudiye	A	A	A
E	Aabboudiye - Chadra	A	A	C

Different performance indicators were used as types of these roads vary, volume to capacity ratio, density and percent time spent on the road. All roads have a configuration that is more than adequate to carry current and future background traffic during the time of WTG component transport. It is noted that the calculated decrease in LOS will only occur temporarily, two times per week over a total period of 13 weeks. Further, the LOS will not decrease below LOS C, which:

- Is the target LOS for some urban and most rural highways.
- Represents stable flow, at or near free flow.
- Noticeably restricts lane maneuverability and land changes require more driver awareness.
- Provides comfort to most experienced drivers, with roads remaining safely below but efficiently close to capacity and posted speed is maintained.
- May result in no effect from minor incidents, but localized service will have noticeable effects and traffic delays will form behind the incident.

Transport of Construction Materials

The transport of construction materials will be undertaken as follows as shown in **Figure 12-14**:

- All rock excavation will be generated within the Project site, will remain within the Project site, and will not result in the addition of traffic to external roads.
- All backfilling from excavation will remain on the Project site and will not result in the addition of traffic to external roads.
- The destination of all surplus excavated earth material will be the 6 quarries, using tracks internal to the Project site, the existing asphalt road (in red) and the existing quarry tracks (in green).
- The highest traffic volumes are anticipated between the quarry and the Project site (yellow route near the Project entrance).
- All ready-mix concrete will be sourced from the Batch Plant to be constructed in Rweimeh Village and will be transported to the Project site using the existing asphalt road (in yellow.
- Sand and gravel will be sourced from the 6 quarries using the existing quarry tracks (in yellow), the existing asphalt road (in red), and tracks internal to the Project site.
- All cement will be sourced from Chekkah, south of Tripoli and the location of two large cement plants. The location of Chekkah is shown in **Figure 12-15.**
- Reinforced steel will be sourced from Tripoli, approximately 1 truck per day for a period of 80 days. The addition of 2 additional trucks per day along the WTG transport route for the transport of cement and reinforced steel will not affect the LOS C determined by the Traffic Impact Study.

Figure 12-14 Quarries and Existing Tracks (Green) Joining Existing Road (Yellow)

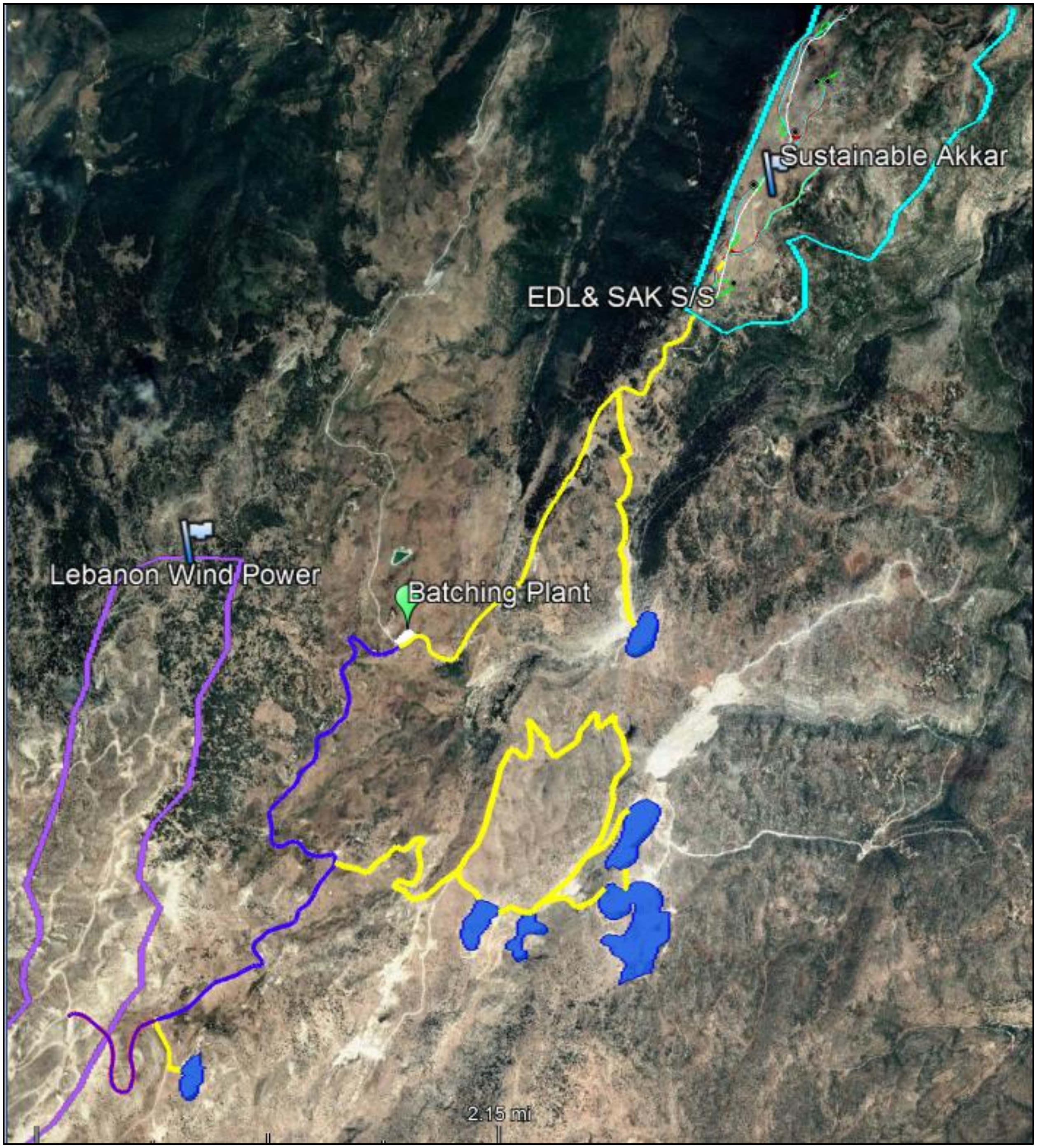
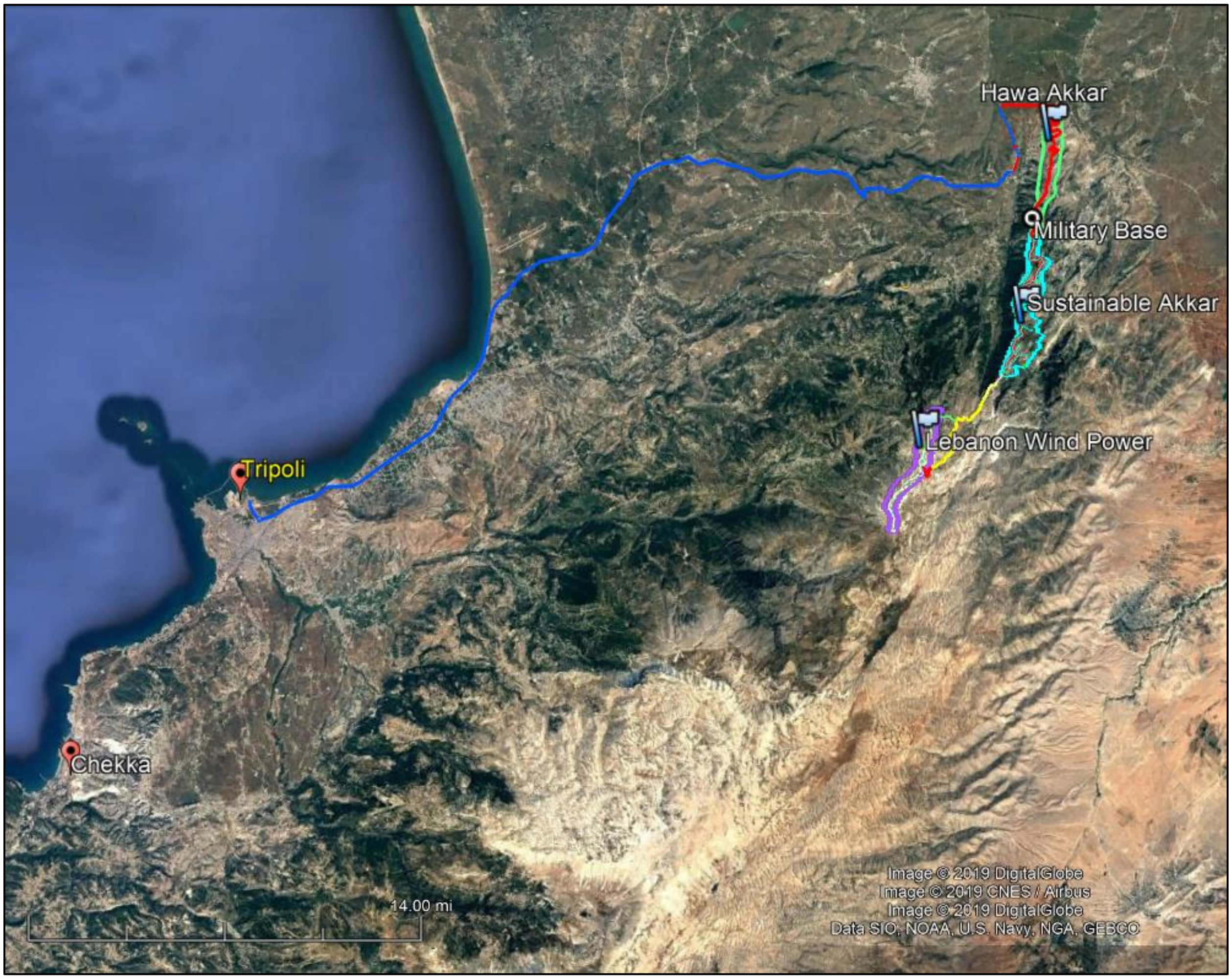


Figure 12-15 Location of Chekkah and Cement Plants



The vehicle trips for transport of construction materials are calculated as shown in **Table 12-15**.

Transport of Construction Workers

The construction phase may require a worst-case scenario of up to 150 staff working in a single day, across a total construction period of 344 days.

Approximately 25% of the workers (up to 40) will be hired from the local communities in the northeastern part of Akkar, including Wadi Khaled. The EPC Contractor will be required to transport local workers from local villages through carpooling and/or van transport to minimize traffic impacts to rural roads.

The balance of the workforce will be accommodated in nearby villages in hotels and/or apartments. Again, the EPC Contractor will be required to provide carpooling and/or van transport of workers to reduce traffic impacts to rural roads. The exact details are to be determined following selection of the EPC Contractor and the location of hired construction workers.

Table 12-15 Vehicle Trips Required for Transport of Construction Materials

Sustainable Akkar	Quantities		Transport		Total Number of Trips		No. of Working Days	Total Number of Trips/Day		
	Low Range	High Range	Description	Capacity	Low Range	High Range		Low Range	High Range	Average
Rock excavation in m^3	456,432	570,539	Semi-Trailer (m^3)	20	22,822	28,527	NA			
Backfilling (from excavation) in m^3	273,859	342,324	Semi-Trailer (m^3)	20	13,693	17,116	70	195.61	244.52	220.07
Surplus from excavation to be managed in m^3	182,573	228,216	Semi-Trailer (m^3)	20	9,129	11,411	90	101.43	126.79	114.11
Ready-mixed concrete in m^3	14,263	17,116	Concrete Mixer Truck (m^3)	10	1,426	1,712	90	15.85	19.02	17.43
Cement in tonnes	5,705	6,846	Powder Cement Tank Trailer (tonnes)	45	127	152	80	1.58	1.90	1.74
Sand in m^3	5,705	6,846	Semi-Trailer (m^3)	20	285	342	80	3.57	4.28	3.92
Gravel in m^3	11,411	13,693	Semi-Trailer (m3)	20	571	685	80	7.13	8.56	7.84
Construction steel in tonnes	1,426	1,997	Semi-Trailer (m3)	20	71	100	80	0.89	1.25	1.07

Mitigation

As presented in **Section 6 Stakeholder Consultation and Engagement**, engagement was undertaken with village leadership along the WTG component transport corridor in February 2019.

The main concerns of the mayors was the timing of the transport and agreed with the plant to undertake transport of the WTG components between 11pm and 4am when the traffic is at its lowest.

Most of the municipalities offered to provide a police escort of the WTG components and emphasized a willingness to provide further coordination across the municipalities and Project companies in accomplishing the Project as quickly as possible. In particular, the North Lebanon Governor was supportive and promised to facilitate any issue Lebanon Wind Power will be facing before and during the transport.

In addition, the members of Rweimeh Village are supportive of the location of both the Substation and the Batching Plant within the village, as:

1. They will be fairly compensated for the acquisition of land for the Substation.
2. They will be fairly compensated for the lease of land for the temporary location of the Batching Plant.
3. They are accustomed to transport of quarry materials along the existing asphalt roads to supply the north Akkar region with sand and gravel.
4. Over 90% of Rweimeh Village members are only present 3 months of the year.

- A communications protocol being developed for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport. A final transport route map will be provided to all municipalities.
- All three wind farms will use the same traffic access plan.
- Announcements will be made to all villages along the WTG transport route from the Tripoli Port to the entrance of the Project site).
- WTG components will be transported 2 days per week, a total of 24 trucks roundtrip per week.
- Municipal police will provide an escort for the WTG transport convoy.
- Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market.
- The road that passes through Rweimeh Village is the main access of the trucks transporting rocks and gravel, and maintenance activities will be undertaken by the Project Proponent.
- For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road.
- For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic.
- Once the EPC Contractor has been selected, and the number and location of construction numbers are known, measures will be put in place to maximize mitigation of traffic impacts through carpooling and group transport by van.

Given the above, the impact severity of traffic and transport from transport of WTG components, construction materials and workers during the construction phase is considered Low and the receptor sensitivity considered Medium, resulting in a Minor Impact as shown in **Table 12-16**.

Table 12-16 Assessment of WTG Component, Construction Materials and Worker Transport during Construction

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

12.4 During Operation

Traffic impacts during the operational phase are expected to be low to negligible and relate only to travel to the Project site by the EPC Contractor for periodic maintenance activities at the Project site.

12.5 During Decommissioning

During the decommissioning phase, the wind turbines will need to be dismantled and removed from the Project site. Traffic impacts are expected to be similar to that of the construction phase but will require assessment at the time to capture the most up-to-date traffic conditions along the expected disposal route.

13. BIODIVERSITY

This section details of the biodiversity assessment of the Project site and surrounding area. It does not include assessments related to ornithology as this is covered by in **Section 14 Ornithology**. This section is further subdivided as follows:

- Assessment Methodology and Significance Criteria.
- Baseline Conditions.
- Assessment of Potential Impacts.

Details of all survey methodologies are provided along with all survey results. Where surveys are ongoing or proposed or survey results not yet been provided, desk study data has been used to develop the likely baseline conditions.

The biodiversity assessment follows the approach previously described in this ESIA, considering both DAOI and IAOI. In keeping with the surveys previously completed, it considers an immediate zone (or Project site), a middle zone up to 3km from the Project site boundary and a furthest zone extending to 15km out. The three zones make up the study area. Where the assessment has considered features outwith those study areas, this is made clear in the text.

It is noted that the reporting received as an outcome of the additional habitat surveys undertaken in June 2019 surveys contained less detailed mapping than requested by Ramboll. It contained mapping to a higher level, which did not delineate individual habitat types or features such as bare ground or tracks as had been requested by Ramboll. Therefore, whilst it provided more accurate information than desk based habitat delineation, the habitat loss calculation could not be completed in the expected way by Ramboll. In addition, a full year of bat surveys would have ideally been completed prior to the ESIA completion. However, it is noted that the initial survey data was gathered during the time of highest bat activity, and in consultation with Dr. Abi-Said is considered sufficient to develop the initial scope of appropriate mitigation measures which can be updated as required following collection of the data from ongoing surveys.

Therefore, the assessment has been based on the information that was supplied and the findings used to inform mitigation. The mitigation measures have been developed to represent the most likely scenario, erring on the precautionary side where necessary, as evidenced by the data and results available at the time of ESIA preparation. Whilst the absence of full survey season results for e.g. flora or bats remains a limitation, Ramboll is confident that the measures proposed and outlined in the BAMP (provided as an appendix to the stand-alone ESMP) are proportionate and appropriate for the predicted impacts. Further data will allow refinement of the measures, potentially reducing or refocusing them, but it is not considered likely that the type or magnitude of mitigation required would be significantly altered.

Similarly, the Critical and Natural Habitats Assessment (CHA) presented in **Appendix L** has also been developed based on the most likely scenario, erring on the precautionary side where necessary, as evidenced by the data and results available at the time of ESIA preparation. Whilst the absence of full survey season results for e.g. flora or bats remains a limitation, Ramboll is confident that the measures proposed and outlined in the BAMP to deliver no net loss or net gain are proportionate and appropriate for the predicted impacts. Further data will allow refinement of the measures, potentially reducing or refocusing them, but it is not considered likely that the type or magnitude of mitigation required would be significantly altered. Even in those cases where there is uncertainty over the presence of floral species potentially triggering critical habitat, the overall approach to mitigation and enhancement for floral species on site remains a valid approach to delivering net gain.

Identification of key flora species during the ongoing further pre-construction survey will be undertaken to provide the necessary detailed habitat mapping. If it is not possible to avoid examples or areas of the species listed in the baseline, every effort shall be made to reduce the impact and further offsetting would be required. Offsetting plans will form part of the Biodiversity Management Plan to be developed by others, to include possible reforestation and management prescriptions and evidence that no net loss of biodiversity can be achieved.

Further data collection for bats is ongoing and will carry on for one year (building on the spring data collected May-June 2019). A revised assessment can then be completed to confirm recommendations and inform mitigation measures more effectively.

13.1 Assessment Methodology and Significance Criteria

13.1.1 Method of Baseline Characterization

13.1.1.1 Habitats and Flora

Information regarding habitats was obtained through a combination of literature review, field surveys and data analysis. Three field visits were conducted, one in summer (September 2017), another in spring (March 2018) and the final in early summer (June 2019), to identify the type of habitats present within the study area along with the associated flora species. To complement the findings of the field visits, a literature review was undertaken focussing on developing a general description of the study area, identifying the sampled flora and identifying critically endangered or endangered floral species[67] which might occur within the study area. The literature review also supported the assessment of the ecological value of the habitats/species based on their extent of occurrence on both national and global levels, the degree of endemism and their respective plant life form.

An approximate delineation of the area that was covered by the field surveys in September 2017 and March 2018 is shown in **Figure 13-1**. After an initial visit to the Project site using a general floristic description of the different habitats, a sampling size of seven plots was set. Each plot location was determined to be in a natural undisturbed environment (i.e. with minimal anthropogenic activity), and close to sites where the turbines are planned to be installed. The plots were selected based on accessibility to cover the different types of habitats that were identified in the area.

The detailed methodology for the September 2017 and March 2018 flora surveys is provided in **Appendix M**. The methodology was established based on several criteria including plot size, identification, classification and abundance. A score for the degree of endemism was attributed for each species and another score was attributed for its extent of occurrence in Lebanon. Species were also classified according to their life forms and attributed a score and the ecological value of the species was calculated. The taxa with a high ecological value score (above 10) are considered to be sensitive features. Conservation measures for each species and their actual status were checked from the IUCN red list and from Lebanese law, whenever available. Conservation status was consequently scored.

[67] Focussing on information available on the IUCN red list website: www.redlist.org

Additional habitat surveys were undertaken by an experienced botanist (Dr. Myrna Semaan) in June 2019, appointed directly by Sustainable Akkar SAL to implement a scope of work prepared by Ramboll. The surveys are ongoing in Summer 2019, with the aim of updating the mapping of boundaries between habitat types and the locations of existing features (such as tracks and borrow pits) and focusing on the areas of proposed infrastructure to refine the habitat loss calculations. In addition, the survey aimed to verify the potential presence of threatened and/or endemic floral species. A full description of the survey methodology is provided in **Appendix N**.

13.1.1.2 Terrestrial Fauna

A combination of literature review and field surveys were used to obtain information on terrestrial fauna in the proposed development site. The literature review used information from surveys that were carried out within a 10km buffer zone of the proposed site as these results were considered relevant for this Project.

The following approaches were used to survey for non-flying mammals at nine locations in the field: nocturnal surveys, camera trapping and rodent trapping. A nocturnal survey was carried out by searching the site from a vehicle with a spotlight in order to detect any animals present. These surveys were conducted at two intervals and the same path was taken each time; dusk until midnight and midnight until dawn. All identifiable animals and their corresponding GPS locations were recorded.

Camera trapping surveys were carried out by choosing random locations within each site to distribute five camera traps. These traps consisted of pre-baited active and passive remote cameras which are triggered by heat and motion.

Preliminary rodent trapping was also conducted with 9 trapping stations at the proposed development site. Full methods and results of the mammal survey are included as **Appendix O**, combined with the results of the spring bat activity surveys.

13.1.1.3 Bats

Knowledge of bat diversity and distribution in Lebanon is limited, with baseline information for this assessment based partly on reviews of records, field studies and museum specimens[68]. Information regarding bat species likely to occur within the region was obtained through extensive review of available literature detailed below.

In addition to desk studies, baseline bat surveys for the Project site took place between May-June 2019, encompassing the spring activity period for bats. Surveys were completed by Dr. Mounir Abi-Said, a Lebanese bat expert who was appointed directly by Sustainable Akkar SAL to implement the scope of surveys developed by Ramboll. The first progress report, detailing all findings from the surveys completed in those months is included as **Appendix O**. Bat surveys consist of both active and passive surveys and are ongoing, due to last for one year as to encompass late spring, summer, autumn and winter bat activity across the site.

[68] Benda, P., Abi-Said, m., Bou Jaoude, I., Karanouh, R., Lucan, R K., Sadek, R., Sevcik, M., Uhrin, M. and Horacek, I. (2016) Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 13. Review of distribution and ectoparasites of bats in Lebanon. Acta Soc. Zool. Bohem. 80: 207-316.

Preliminary findings from the spring activity surveys, have been used to inform mitigation, which will be updated by the Developer following a full years' worth of survey and analysis. All surveys were undertaken based on good practice guidance recommended by Scottish Natural Heritage (SNH)[69] and EUROBATS[70].

Passive Surveys

Anabat Swift passive bat detectors were placed at nine locations across the Project Site recording bat activity for 10 consecutive nights. Locations were selected based on proposed turbine locations and habitats present on site, based on good practice guidance. Passive detector locations are shown on **Figure 13-2.** Three detectors were deployed at the southern end of the site at potential turbine locations SA21, SA23, and SA24 between 5-15 May 2019. An additional detector was then installed at the SA2 Met mast between 25 May-3 June 2019 to ensure effective coverage of the southern extent of the site. Five detectors were then installed towards the northern site extent at proposed turbine sites SA2, SA6, SA9, SA20 and SA Met1 between 15-25 May. Note that SA1 MET and SA2 MET are meteorological monitoring masts, the detector was thus placed at height of ~30m.

Active Surveys

Transect surveys were undertaken across the site across two nights to record bat activity during crepuscular and nocturnal hours (one hour before sunset to sunrise). The transect followed the existing track, passing proposed wind turbine locations. Surveyors stopped at each proposed turbine location for 3 minutes to record bat activity. Transect surveys were undertaken three times (two nights each) on the evenings of 16-18 May, 24-28 May and 1-3 June 2019 using Anabat Walkabout Active Detectors. Note that transects were conducted in conjunction with surveys for the planned Lebanon Wind Farm site situated to the south of the Project. As a continuous transect was followed across both sites, it has not been possible to separate recordings between sites therefore results are reported for both to give an overall indication of activity across the combined area.

Analysis

Data from passive and active surveys were analyzed using Analook and Anabat Insight software. Analysis enabled the identification of species occurring across the site and the number of calls (i.e. passes; one or two calls in quick succession) per location, per night. Note that recorded passes are representative of bat activity and are not indicative of bat numbers or population sizes.

Hibernation and Roost Surveys

A preliminary field study was carried within the Project site and surrounding area to identify hibernation or cave roosts. These surveys involved a daytime walkover assessment of the regions between December 2017 and March 2018.

[69] https://www.nature.scot/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation, Accessed on 5th July 2019

[70] http://www.eurobats.org/publications/eurobats_publication_series, accessed on 5th July 2019.

13.1.2 Assessment of Potential Impacts

In order to follow good practice guidance on ecological impact assessment[71], the biodiversity impact assessment follows a similar approach to the other assessments within this ESIA. Features are evaluated, and impacts are characterized in a similar fashion. However, rather than a matricized approach that provides a scale of impact significance from negligible to critical, it follows an approach of identifying whether an impact would lead to an "ecologically significant effect" for the feature, e.g. species or habitat type. An ecologically significant effect is an effect that either undermines or, in the case of a positive impact, supports biodiversity conservation objectives for 'important ecological features' or for biodiversity in general.

13.1.2.1 Feature Evaluation

Habitats and species (i.e. biodiversity features) identified within the study area have been assigned values using the standard CIEEM scale that classifies biodiversity features within a defined geographic context[72]. The classification uses recognized and published criteria[73,74] where the biodiversity features are assessed in relation to their size, diversity, naturalness, rarity, fragility, typicalness, connectivity with surroundings, intrinsic value, recorded history and potential value. **Table 13-1** describes the frame of reference that has been used for the impact assessment.

Table 13-1 Geographic Importance

Geographic Importance	Examples
International	Internationally designated sites including Important Bird Areas (IBA) other Key Biodiversity Areas (KBA) Ramsar Site, Biogenetic Reserve, World Heritage Site, Biosphere Reserve, and potential Ramsar Sites; discrete areas which meet the published selection criteria for international designation, but which are not themselves designated as such. Resident or regularly occurring populations of species which may be considered at an international level, the loss of which would adversely affect the conservation status or distribution of the species at an international level; or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.
National	Nationally designated sites, Nature Reserves Marine Nature Reserve; discrete areas which meet the published selection criteria for national designation, but which are not designated as such. Resident or regularly occurring populations of species, the loss of which would adversely affect the conservation status or distribution of the species across Lebanon or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.

[71] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[72] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[73] Ratcliffe, D. (1977), *A Nature Conservation Review*. Cambridge: Cambridge University Press.
[74] Wray, S., Wells, D., Long, E. and Mitchell-Jones, T. (2010), *Valuing Bats in Ecological Impact Assessment*. In Practice. December 2010 pp23-25. Winchester: CIEEM.

Geographic Importance	Examples
Regional	Viable areas of key habitat identified as being of Regional value or smaller areas of such habitat which are essential to maintain the viability of a larger whole. Resident or regularly occurring populations of species, the loss of which would adversely affect the conservation status or distribution of the species across the region; or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.
Local	Features of local value include areas of habitat or populations/communities of species considered to appreciably enrich the habitat resource within the immediate surrounding area, for example, species-rich hedgerows. Resident or regularly occurring populations of species, the loss of which would adversely affect the conservation status or distribution of the species across the immediate surrounding area; or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.

13.1.2.2 Criteria for Characterizing Impacts

The potential impacts upon biodiversity features have been considered in relation to the Project. The impacts have been assessed without consideration of any specific mitigation measures that might be employed. The assessment of likely impacts has been made in relation to the baseline conditions of the study area. The likely impacts of development activities upon biodiversity features have been characterized as detailed in **Table 13-2**.

It is noted that the assessment only describes those characteristics relevant to understanding the impact and determining the significance of the effect.

Table 13-2 Impact Characterization

Parameter	Description
Direction	Impacts are either adverse (negative) or positive.
Magnitude	This is defined as high, moderate, low or negligible, with these being classified using the following criteria: High: Total/near total loss of a population due to mortality or displacement or major reduction in the status or productivity of a population due to mortality or displacement or disturbance. Total/near total loss of a habitat. Medium: Partial reduction in the status or productivity of a population due to mortality or displacement or disturbance. Partial loss of a habitat. Low: Small but discernible reduction in the status or productivity of a population due to mortality or displacement or disturbance. Small proportion of habitat lost. Negligible: Very slight reduction in the status or productivity of a population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the ‘no change’ situation. Slight loss of habitat that is barely discernible from the habitat resource as a whole.
Extent	The area over which an impact occurs, i.e. the impact’s area of influence.

Parameter	Description
Duration	The time for which the impact is expected to last prior to recovery of the biodiversity feature or replacement of the feature by similar resource (in terms of quality and/or quantity). This is expressed as a short term, medium term, or long-term effect relative to the biodiversity feature that is impacted.
Reversibility	Irreversible impacts: permanent changes from which recovery is not possible within a reasonable time scale or for which there is no reasonable chance of action being taken to reverse it. Reversible impact: temporary changes in which spontaneous recovery is possible or for which effective mitigation (avoidance/cancellation/reduction of impact) or compensation (offset/recompense/offer benefit) is possible.
Frequency and timing	The number of times an activity occurs will influence the resulting effect (if appropriate, described as low to high and quantified, where possible). The timing of an activity or change may result in an impact if it coincides with critical life-stages or seasons e.g. the badger breeding season.

13.1.2.3 Significance Criteria

Impact significance was evaluated using the approach specified in Annex 9 of Decision 261/1 (June 2015) for the review of EIA studies at the MOE, whereby various sources of impacts are addressed for the Project's different implementation phases.

Significant effects are assessed with reference to the geographical importance of the biodiversity feature. However, the scale of significance of an effect may not be the same as the geographic context in which the feature is considered important. For example, an effect on a species which is on a national list of species of principal importance for biodiversity may not have a significant effect on its national population.

The potential for significant effects, in the absence of mitigation, has been determined with reference to the geographic conservation importance and the criteria in **Table 13-1**. By referring to the criteria in **Table 13-2**, the assessment seeks to characterize the magnitude of the effects in space and time.

Mitigation and/or compensation is proposed for all effects considered to be significant. Where appropriate, as a good practice measure, additional controls and/or compensation may be proposed.

Residual effects are characterized as either positive or adverse and either significant or not significant, taking account of mitigation and/or compensation proposals.

13.1.3 Limitations

The habitat and faunal surveys provide a snapshot of ecological conditions and do not record plants or animals that may be present in the Project site at different times of the year. The absence of a particular species cannot definitely be confirmed by a lack of field signs and only concludes that an indication of its presence was not located during the survey effort.

Some flora species are not identifiable from the surveys completed to date as the surveys were not completed during their growth or flowering period. The project's botanical specialist, Dr. Myrna

Semaan, has identified that the Project site has the potential to support certain species that were not observed during the surveys. Their presence will be confirmed by further survey and this data will be used to update the Critical Habitat Assessment and/or the Biodiversity Action and Management Plan (BAMP).

The bat data collected as part of this assessment only represents spring bat activity. Ideally, based on good practice, a minimum of a years' worth of data should be used. Data collection is ongoing and will carry on for one year (building on spring data collected May-June 2019). A revised assessment can then be completed to inform recommendations and mitigation measures more effectively.

13.2 Baseline Conditions

13.2.1 Habitats and Flora

13.2.1.1 Desk Study

Lebanon, which is considered a hotspot for biodiversity in the Mediterranean Basin[75], is characterized by the coexistence of plants with diverse biogeographical origins and a large number of narrow endemic taxa. The combination of geological variation and altitude, along with strong climatic variation among different slopes, created a marked heterogeneity in the ecological forces acting on the evolution of plant differentiation. Its floristic richness is estimated at 2,612 vascular plant taxa, of which 108 are endemic to Lebanon[76].

Forests in north Lebanon cover approximately 21% of the northern governorate and encompass most of the forest species present in the country (El-Hajj, Al-Jawhary, Moukaddem, & Khater, 2014). The study area is situated between 800m and 1,400m, covering two vegetation levels (Meso-Mediterranean and Supra-Mediterranean) and encompassing different ecosystems and habitats, including: Calabrian pine forests, evergreen oak woods, juniper woodland, mixed forests, grassland, cliffs and rocky habitats. This zone is part of Qammouaa-Dinnyeh-Jurd Hermel Important Plant Area (*IUCN Important Plant Areas of the south and east Mediterranean region, 2011)* as shown on **Figure 13-3.**

Based on a 2018 study[77], species richness values for the Qammouaa-Dinnyeh Jurd Hemel IPA range between 200-337 species per $3m^2$. The Qammouaa-Dinnyeh Jurd Hermel IPA contains the largest continuous stands of natural forests in Lebanon. A huge diversity of forest types occur in the IPA, including Calabrian pines, mixed cedar, fir and juniper, mixed fir and cedar, pure fir, evergreen oak and relic turkey oak stands. The area covers four vegetation series: the Eu-, Supra, Mountainous and Oro-Mediterranean and it is characterized by a wide variety of landscapes, including valleys, forests, rivers, gorges, rocky cliffs and mountains[78].

Three hundred and twenty plant species have been recorded, with 82 species restricted to the eastern Mediterranean, six endemic to Lebanon, Syria and Palestine, 17 to Lebanon and Syria, nine to Lebanon, Syria and Turkey, 10 to Lebanon and 2 threatened species according to experts' opinion

[75] Médail & Quézel, 1997; Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000.
[76] Tohmé and Tohmé, 2004, Tohmé and Tohmé, 2011, Tohmé and Tohmé, 2014.
[77] Setting conservation priorities for Lebanese flora—Identification of important plant areas, Magda Bou Dagher-Kharrat, Hicham El Zein, Germinal Rouhan, Journal for Nature Conservation Volume 43, June 2018.
[78] Médail & Quézel, 1997; Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000.

(IUCN Important Plant Areas of the south and east Mediterranean region, 2011). The Qammouaa-Dinnyeh Jurd Hermel IPA is classified for nine threatened species.

Qammouaa-Dinnyeh Jurd Hermel IPA Species:

- *Alkanna prasinophylla*.
- *Astragalus angulosus*.
- *Cousinia libanotica*.
- *Erophila gilgiana*.
- *Helichrysum virgineum*.
- *Melissa inodora*.
- *Ranunculus schweinfurthii*.
- *Silene grisea*.
- *Stachys hydrophilia*.

The Project site also lies within the Western Akroum Key Biodiversity Area (KBA)[79] designated for Cilician fir *Abies cilicica,* an endemic species with a restricted range. The Karm Chbat Nature Reserve, shown previously on **Figure 13-3,** lies approximately 2.5km southwest of the Project site. It was created in October 1995 (Ministerial Decision No. 14) and covers an area of approximately 520ha at an elevation of 1,400m-1,900m. The Karm Chbat Nature Reserve is a protected area identified by the MOE but is not an international designation.

The Aandqet Forest Proposed Reserve, which is currently unconfirmed and undesignated, and therefore not shown on **Figure 13-3**, and for which a variety of studies have been completed, lies immediately adjacent to the western boundary of the Project site. The forest extends for most of the Oudine Valley and would be managed as an ongoing resource but with nature conservation a core component of that management.

Juniperus forest, comprising many different juniper species is located at higher altitudes than the pine forests. It occurs on the western slopes of Qalaat Arouba, in Qamouaa, and on the north eastern slopes of Karm Chbat, down to Rweimeh Village and on the eastern slopes towards Hermel. Juniper forest is rarely pure (as shown on **Figure 13-4**) and integrates in addition to *Juniperus excelsa*, other junipers such as *J. foetidissima, J. oxycedrus* and the rare presence of *J. drupacea*.

At altitudes between approximately 1,300m and 1,400m, between Jabal-Akroum and the Karm Chbat Cadastral Area, climatic conditions are favorable for the development of species requiring significant moisture and cool temperatures. A mixed forest composed of the abovementioned evergreen broadleaved species is mixed with junipers and *Quercus infectoria, Prunus ursina,* and to a lesser extent relic species such as *Ostrya carpinifolia, Fraxinus ornus, Quercus cerris*, as shown on **Figure 13-5**.

These forests and woodlands extend from Chambouq, towards Karm Chbat, Rweimeh Village and Hmaire, and are located at the southern tip of the study area. Herbaceous and shrubby species include: *Bellevalia flexuosa, Galium sp., Geranium sp., Hyacinthus orientalis, Smyrnium sp.,*

[79] BirdLife International (2019) The World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society. Downloaded from http://www.keybiodiversityareas.org on 28/02/2019.

Ranunculus sp., Thalspi sp., Valeriana dioscoridis, etc. Threats in mixed forests are similar to those in evergreen broadleaved forests. This type of ecosystem has the highest biodiversity richness of those found within the study area.

Grassland and barren lands are located close to the summit line of Jabal-Akroum, and constitute a large portion of the study area, (see **Figure 13-6** and **Figure 13-7**, respectively), especially the northern and central parts. Due to wind recurrence and consistency, trees are found only in leeward direction or hundred meters below the summit line, leaving large areas barren. The main species of the grassland are from the Poaceae family and include *Avena sterilis, Bromus fasciculatus, Poa sp.,* and *Capsella sp., Lagoecia cuminoides, Hypecoum imberbe, Sedum sp.,* and *Teucrium sp.* Grazing activities are intense. To the south, altitude increases grasslands are accompanied with few shrubby trees. The grazing is less intense, allowing better soil conditions and the presence of many other herbaceous species such as *Pisum fulvum, Medicago orbicularis, Lathyrus blephycarpus, Taraxacum sp., Ranunculus sp.,* etc. This ecosystem has the lowest richness of those found within the study area.

The Aandqet Forest is dominated by Calabrian pine *Pinus brutia* and is the largest *Pinus brutia* forest in Lebanon. It is approximately 10,000ha and extends from Aandqet, through Quobaiyat towards Aakkar El Atiqa'a, on the western slopes of Jabal-Akroum, Karm Chbat and Qamouaa. Some Calabrian pine stands can be found on the north eastern slopes between Rweimeh Village and Boustane, and between Rweimeh Village and Kfartoun (on the limit of the mid-zone study area). The western edge of parts of the Project site contains similar forest. The pines are accompanied by other species including: *Quercus calliprinos*, *Q. infectoria, Phillyrea media, Arbutus andrachne, Acer obtusifolium, Crataegus monogyna*, *Cercis siliquastrum*, *Cupressus sempervirens*, and herbaceous species such as *Cistus sp., Erica manipuliflora, Hypericum thymifolius, Oreganum libanoticum, Salvia fruticosa, Cyclamen persicum, Osyris alba,* etc. The main serious threat for this ecosystem is forest fire.

These are mixed on the lower altitude with broadleaved species and above 1,400m, with *Abies cilcica* in Qamouaa, and *Cedrus libani*, mostly in Karm Chbat (all within the furthest zone study area). The latter species and forests are of high ecological value and are located 3km to the south of Jabal-Akroum. The accompanying shrubby and herbaceous species include *Rhamnus cathartica, Rubia tenuifolia, Phlomis chrysophylla, Arabis caucasica, Euphorbia kotschyana, Geranium sp., Ranunculus sp.,* etc. These forests are subject to various threats including overgrazing and uncontrolled cutting. This ecosystem has high biodiversity richness.

Evergreen broadleaved forest and woodlands cover large areas above the pine forest on the western slopes of Jabal-Akroum and all the eastern slopes towards Kfartoun, up to 1,200 m. They are mostly dominated by *Quercus calliprinos*, and accompanied by *Phillyrea media, Pyrus syriaca, Styrax officinalis, Crataegus monogyna,* and *Arbutus andrachne.* The lower strata are covered by many *Poaceae* species along with species such as *Origanum syriacum, Ruscus aculeatus, Asphodelus microcarpus and Dianthus tripuncatus.*

This type of vegetation is common in the northern, central and eastern parts of the study area. Cutting of trees for wood to be used as fuel and overgrazing are the major threats and vary in intensity from one location to another. This ecosystem has a variable richness and is highly affected by grazing intensity. Evergreen broadleaved forests and woodland are also present in the Project site as dense and sparse *Quercus sp.* forests.

Figure 13-8 shows an overview of land use habitat types identified during the desk study as an indication of habitat types that may be present on the Project site.

The floral species considered to be present in each of the land use habitat types (based on literature review complemented by casual field observations) and their IUCN status are provided in **Table 13-3**.

Table 13-3 Flora Species Present in Each Land Use Habitat Type in Project Site

Habitat	Species	IUCN Status*	IUCN Trend*
Dense Pinus sp. forest	*Pinus brutia*	Least concern	Increasing
	Quercus calliprinos	Least concern	Stable
	Quercus infectoria	Least concern	Unknown
	Cistus creticus	NA	NA
	Phillyrea media	Least concern	Stable
	Arbutus andrachne	Least concern	Stable
	Acer obtusifolium	Least concern	Stable
	Crataegus monogyna	Least concern	Unknown
	Cercis siliquastrum	Least concern	Unknown
	Cupressus sempervirens	Least concern	Unknown
	Erica manipuliflora	NA	NA
	Hypericum thymifolius	NA	NA
	Origanum libanoticum	NA	NA
	Salvia fruticosa	Least concern	Unknown
	Cyclamen persicum	NA	NA
	Osyris alba	NA	NA
Dense Quercus sp. forest	*Quercus calliprinos*	Least concern	Stable
	Phillyrea media	Least concern	Stable
	Pyrus syriaca	Least concern	Stable
	Styrax officinalis	Least concern	Stable
	Crataegus monogyna	Least concern	Unknown
	Arbutus andrachne	Least concern	Stable
	Origanum syriacum	NA	NA
	Ruscus aculeatus	NA	NA
	Asphodelus microcarpus	Least concern	Stable
	Dianthus tripuncatus	Least concern	Stable
	Abies cilicica	Near threatened	Decreasing

Habitat	Species	IUCN Status*	IUCN Trend*
Sparse Juniperus sp. forest	*Juniperus drupacea*	Least concern	Stable
	Juniperus excelsa	Least concern	Stable
	Juniperus foetidissima	Least concern	Stable
	Juniperus oxycedrus	Least concern	Stable
	Rhamnus cathartica	Least concern	Stable
	Rubia tenuifolia	NA	NA
	Phlomis chrysophylla	NA	NA
	Arabis caucasica	NA	NA
	Euphorbia kotschyana	NA	NA
	Alkanna prasinophylla	NA	NA
	Astragalus angulosus	NA	NA
	Cousinia libanotica	NA	NA
	Erophila gilgiana	NA	NA
	Helichrysum virgineum	NA	NA
	Clinopodium libanoticum	Endangered	Unknown
	Ranunculus schweinfurthii	Vulnerable	Stable
	Silene grisea	NA	NA
	Stachys hydrophila	NA	NA
	Alyssum libanoticum nyaradi	NA	NA
Dense mixed forest (including mixed Quercus sp. and Calabrian pine)	*Quercus infectoria*	Least concern	Unknown
	Quercus cerris	Least concern	Unknown
	Prunus ursina	Least concern	Unknown
	Ostrya carpinifolia	Least concern	Unknown
	Fraxinus ornus	Least concern	Unknown
	Bellevalia flexuosa	NA	NA
	Hyacinthus orientalis	NA	NA
	Valeriana dioscoridis	NA	NA
Shrublands	*Juniperus drupacea*	Least concern	Stable
	Quercus calliprinos bushes	Least concern	Stable
	Viola libanotica	Endangered	Unknown

Habitat	Species	IUCN Status*	IUCN Trend*
	Milk-vetch Astragalus sp.	NA	NA
	Condalia warnockii kearneyana	NA	NA
	Inula crithmoides	NA	NA
	Acantholimon libanoticum	NA	NA
	Alyssum libanoticum nyaradi	NA	NA
Grassland and barren land (including sparse and moderately dense herbaceous vegetation)	*Avena sterilis*	Least concern	Stable
	Bromus fasciculatus	Least concern	Stable
	Lagoecia cuminoides	NA	NA
	Hypecoum imberbe	NA	NA
	Pisum fulvum	NA	NA
	Medicago orbicularis	NA	NA
	Lathyrus blephycarpus	NA	NA
	Ranunculus cuneatus	NA	NA
	Milk-vetch Astragalus sp.	NA	NA
	Acantholimon libanoticum	NA	NA
	Arabis caucasica	NA	NA

*Note: IUCN status and trend from www.iucnredlist.org

13.2.1.2 Field Surveys

No aquatic habitats are present in the Project site. As a result, aquatic flora and fauna are not assessed further.

Flora biodiversity richness, as depicted from the plots visited in September 2017 and March 2018, varied from 11 species (in a single visit on the northern plot, which is also the lowest in altitude, and the windiest, and in a grassland), to 28 species (in two visits, in the southernmost plot, which is the least windy, and in a mixed forest). The detailed list of species that were encountered within the plots during the two visits are included in **Appendix M**. Some species that were not found but listed in the literature were also added but labelled “0” in the first column. Out of 103 species, four were identified only by their family.

Based on these findings, the taxa that have high ecological value and are considered to be sensitive features are the following: *Fraxinus ornus*, *Juniperus drupacea*, *Juniperus excelsa*, *Juniperus oxycedrus*, *Origanum libanoticum*, *Ostrya carpinifolia*, *Phillyrea media*, *Ranunculus cuneatus*, and *Rhamnus cathartica*.

Figure 13-9 shows an overview of habitat types recorded across the entire survey area in the June 2019 survey. **Figure 13-10a** through **Figure 13-10c** present this information in more detail. The Project site contains three main habitat types:

- Mixed oak woodland of the middle mountain bioclimatic zone. This habitat is the dominant type in the areas of proposed infrastructure.
- Juniperus excelsa coniferous forest of the high mountain system.
- Pinus brutia coniferous forest of the north-western slopes in the area to become the Oudine reserve.

Table 13-4 provides the area of the habitats recorded in the Project site.

Table 13-4 Habitat Types and Area in Project Site

Habitat Type	Area (ha)
Juniperus excelsa dominance	13.76
Mixed oak woodland 1	471.63
Mixed oak woodland 2	238.07
Oak/J. exclesa mix 1	20.11
Oak/J. exclesa mix 2	28.59
Oak woodland 5	13.33
Oak/pine mix	115.93
Pine forest dominance 1	0.12
Pine forest dominance 2	42.30
Pine forest dominance 3	0.17
Total Area	**944.01**

Full details of the results of the June 2019 survey are provided in **Appendix P**. **Table 13-5** provides a summary of the dominant habitat types and flora species encountered at each proposed infrastructure location.

Table 13-6 contains an overview of the mixed oak woodland habitat type, which constitutes the dominant habitat type in the Project site. **Table 13-5** details variations to the mixed oak woodland habitat type where it occurs around the proposed infrastructure or refers to **Table 13-6** where there are no variations. Other habitat types are also described in **Table 13-5**.

Table 13-7 details the key floral species expected to be present in the Project site.

Table 13-5 List of Habitat Types and Floral Species Encountered at Proposed Project Infrastructure Locations

Infrastructure Location	Dominant Habitat Type	Species	IUCN Status*	IUCN Trend*	Endemic to Lebanon
WTG 2, 3 and 4	Degraded rocky terrain with few bushes. Turbine 3 occurs next to agricultural land	*Pinus brutia*	Least concern	Increasing	No
WTG 5	Ground-level bushes with woodland on north-eastern slopes	None recorded	NA	NA	NA
Road to WTG 5	Degradation of oak woodland to ground-level bushes. Slopes are more wooded	*Pistacia terebinthus*	Least concern	Stable	No
WTG 6	Degraded mixed oak woodland with ground-level bushes	See **Table 13-7**	NA	NA	NA
WTG 7, 8, 9, 10, 11 and 14	Exposed rock and grazed grassland with minor bushes of mixed oak woodland habitat. Coned valleys important for water collection	*Phlomis chrysophylla*	No data	No data	Possibly
		Quercus coccifera	Least concern	Stable	No
WTG 13 and connecting road	Same forested habitat as WTG 15 and 17. Turbine on periphery of forest in more degraded area	See WTG 15 and 17 below	NA	NA	NA

Infrastructure Location	**Dominant Habitat Type**	**Species**	**IUCN Status***	**IUCN Trend***	**Endemic to Lebanon**
WTG 15 and 17 and connecting road	Pine-oak habitats with narrow integration zone. Thick woodland has been previously felled	*Pinus brutia*	Least concern	Increasing	No
		Cephalanthera longifolia or *C. rubra*	Least concern	C. longifolia unknown C. rubra decreasing	No
		Epipactis sp.	NA	NA	NA
Road to WTG 17	Bush land and dense, disturbed mixed oak woodland	See **Table 13-7**	NA	NA	NA
WTG 18	Mixed oak woodland	See **Table 13-7**	NA	NA	NA
Road to WTG 18	Mixed oak woodland with pine forest on north-western slopes beyond a felled area	See **Table 13-7**	NA	NA	NA
WTG 19	Grassland and ground-level bushes remnants of mixed oak woodland. Close to upper limit of the pine forest	None recorded	NA	NA	NA
Road to WTG 19	Bushes of mixed oak woodland habitat plus *Juniperus excelsa*	*Juniperus excelsa*	Least concern	Stable	No
WTG 20		*Quercus coccifera*	Least concern	Stable	No

Infrastructure Location	Dominant Habitat Type	Species	IUCN Status*	IUCN Trend*	Endemic to Lebanon
	Mixed oak woodland with unpaved roads already felled into forest	*Pinus brutia*	Least concern	Increasing	No
		Juniperus oxycedrus	Least concern	Stable	No
		Juniperus excelsa	Least concern	Stable	No
WTG 21 and connecting road	Mixed oak woodland	*Quercus coccifera*	Least concern	Stable	No
		Quercus infectoria	Least concern	Unknown	No
		Juniperus oxycedrus	Least concern	Stable	No
		Juniperus excelsa	Least concern	Stable	No
		Salvia hierosolymitana	No data	No data	Possibly
		Styrax officinalis	Least concern	Stable	No
		Cistus creticus	No data	No data	No
		Phlomis chrysophylla	No data	No data	Possibly
		Origanum syriacum	No data	No data	No
		Calicotome villosa	No data	No data	No
WTG 22	Mixed oak woodland by unpaved road	*Quercus coccifera*	Least concern	Stable	No
		Pinus brutia	Least concern	Increasing	No
		Juniperus oxycedrus	Least concern	Stable	No
		Juniperus excelsa	Least concern	Stable	No
		Phillyrea media	Least concern	Stable	No
		Rhamnus punctata	No data	No data	No
WTG 24 and connecting road		*Juniperus excelsa*	Least concern	Stable	No

Infrastructure Location	Dominant Habitat Type	Species	IUCN Status*	IUCN Trend*	Endemic to Lebanon
	Oak woodland/mixed oak woodland	*Quercus coccifera*	Least concern	Stable	No
		Phillyrea media	Least concern	Stable	No
WTG 25 and connecting road	Pine-oak transition from *Juniperus excelsa* to *Quercus coccifera* from the high mountain to the middle mountain bioclimatic zone	*Quercus coccifera*	Least concern	Stable	No
		Quercus infectoria	Least concern	Unknown	No
		Juniperus oxycedrus	Least concern	Stable	No
		Juniperus excelsa	Least concern	Stable	No
		Pinus brutia	Least concern	Increasing	No
		Ostrya carpinifolia	Least concern	Unknown	No
		Sorbus torminalis	Least concern	Unknown	No
		Styrax officinalis	Least concern	Stable	No
		Pistacia terebinthus	Least concern	Stable	No
		Phillyrea media	Least concern	Stable	No
		Avena sp.	NA	NA	NA
		Triticum sp.	NA	NA	NA
		Rubus canescence	No data	No data	No data
		Teucrium polium	No data	No data	No
		Phlomis chrysophylla	No data	No data	Possibly
		Phlomis syriaca	No data	No data	No
		Sideritis sp.	NA	NA	NA
		Inula viscosa	No data	No data	No

Infrastructure Location	Dominant Habitat Type	Species	IUCN Status*	IUCN Trend*	Endemic to Lebanon
		Osyris alba	No data	No data	No
		Origanum libanoticum	No data	No data	Yes
		Asphodelus ramosus	Least concern	Unknown	No
		Echinops viscosus	No data	No data	No
		Prunus ursina	Least concern	Unknown	No
		Pyrus syriaca	Least concern	Stable	Yes
		Cercis siliquastrum	Least concern	Unknown	No
		Arbutus andrachne	Least concern	Stable	No

*Note: IUCN status and trend from www.iucnredlist.org

Table 13-6 List of Floral Species in Mixed Oak Woodland Habitat Type

Species	Frequency	IUCN Status*	IUCN Trend*	Endemic to Lebanon
Quercus coccifera	High abundance characterizes the habitat type	Least concern	Stable	No
Pistacia terebinthus	Almost two-thirds the frequency of *Q. coccifera*	Least concern	Stable	No
Phillyrea media	Same frequency or half as frequent as *Pistacia*	Least concern	Stable	No
Juniperus oxycedrus	Varies	Least concern	Stable	No
Styrax officinalis	Low	Least concern	Stable	No
Rubus canescence	Not provided	No data	No data	No data
Teucrium polium	Not provided	No data	No data	No
Phlomis chrysophylla	Not provided	No data	No data	Possibly
Phlomis syriaca	Not provided	No data	No data	No
Sideritis sp	Not provided	NA	NA	NA
Rhamnus punctata	Not provided	No data	No data	No
Origanum libanoticum	Not provided	No data	No data	Yes
Origanum syriacum	Not provided	No data	No data	No
Teucrium divaricatum	Not provided	No data	No data	No
Teline monspessulana	Not provided	No data	No data	No
Ballota antilibanotica	Not provided	No data	No data	Possibly
Micromeria graeca	Not provided	No data	No data	Possibly
Stachys cretica vacillans	Not provided	No data	No data	No
Quercus cerris	Found at limited sites with higher humidity	Least concern	Unknown	No
Quercus infectoria	Low (single trees)	Least concern	Unknown	No
Cercis siliquastrum	Only in areas with 100% tree cover	Least concern	Unknown	No
Prunus ursina	Low	Least concern	Unknown	No
Fraxinus ornus	Single record	Least concern	Unknown	No

*Note: IUCN status and trend from www.iucnredlist.org

Table 13-7 List of Floral Species Expected in Project Site

Species	IUCN Status*	IUCN Trend*	Endemic to Lebanon
Eleocharis macrantha	Least concern	Stable	Yes
Origanum ehrenbergii	Vulnerable	Decreasing	Yes
Romulea phoenicia	Vulnerable	Decreasing	Yes
Romulea nivalis	Vulnerable	Decreasing	Yes
Silene reuteriana	No data	No data	Yes
Salvia peyronii	No data	No data	Yes

*Note: IUCN status and trend from www.iucnredlist.org

13.2.1.3 Habitats and Flora Summary

No critical habitat is considered to be present in the Project site. The areas of oak woodland and mixed woodland habitat in good condition around Turbines 22-18 and Turbines 13, 15, and 17 are considered to be natural habitats. Further details can be found in the Critical and Natural Habitats Assessment (CHA) in **Appendix L.**

None of the species that led to the classification of the area as an IPA were recorded during surveys. Species considered to have high ecological value from the September 2017 and March 2018 surveys are as follows:

- *Fraxinus ornus*.
- *Juniperus drupacea*.
- *Juniperus excelsa*.
- *Juniperus oxycedrus*.
- *Origanum libanoticum*.
- *Ostrya carpinifolia*.
- *Phillyrea media*.
- *Ranunculus cuneatus*.
- *Rhamnus cathartica*.

During the June 2019 surveys, a single record of *Fraxinus ornus* is present in the mixed oak woodland habitat type in 2019. *Juniperus excelsa* and *Phillyrea media* are present in the mixed oak woodland, oak woodland and oak/pine habitat types. *Juniperus oxycedrus* and *Origanum libanoticum* are present in the mixed oak woodland and oak/pine habitat types. *Ostrya carpinifolia* is present in the oak/pine habitat type. *Juniperus drupacea*, *Ranunculus cuneatus* and *Rhamnus cathartica* were not recorded in the 2019 survey.

No threatened species were recorded during surveys, but the following vulnerable species are expected to be present:

- *Origanum ehrenbergii*.
- *Romulea nivalis*.
- *R. phoenicia*.

The following endemic species were also recorded during surveys:

- *Phlomis chrysophylla* in the mixed oak woodland habitat type at Turbines 7, 8, 9, 10, 11, 14 and 21 (WTGs 7, 8, 9, 10, 11, 14 and 21) and the oak/pine habitat type at Turbine 25 (WTG 25) and its connecting road.
- *Salvia hierosolymitana* in the mixed oak woodland habitat type at Turbine 21 (WTG 21) and its connecting road.
- *Origanum libanoticum* in the mixed oak woodland habitat type, and the oak/pine habitat type at Turbine 25 (WTG 25) and its connecting road.
- *Pyrus syriaca* in the oak/pine habitat type at Turbine 25 (WTG 25) and its connecting road;
- *Ballota antilibanotica* in the mixed oak woodland habitat type.
- *Micromeria graeca* in the mixed oak woodland habitat type.

Two further endemic species, *Silene reuteriana* and *Salvia peyronii*, were not recorded during surveys but are expected to be present.

13.2.2 Terrestrial Fauna

13.2.2.1 Mammals

A total of twelve mammal species (excluding bats) were recorded at the Project site, as shown in **Table 13-8**.

- Hedgehog *Erinaceus concolor*.
- Red fox *Vulpes*.
- Common jackal *Canis aureaus syria*.
- Pine marten *Martes foina syriaca*.
- Wild boar *Sus scrofa lybicus*.
- Indian crested porcupine *Hysterix indica indica*.
- Lesser mole rat *Spalax leucodon ehrenbergi*.
- Broad-toothed field mouse *Apodemus mystacinus*.
- Common field mouse *Apodemous flavicollis*.
- Mount Harmon field mouse *Apodemous harmonensis*.
- Field vole *Microtus guentheri*.
- Snow vole *Microtus nivalis*.

The mammal survey results are presented in the Mammal and Bat Survey Report provided in **Appendix O**. The location of mammal records was not provided for the purposed of this assessment. However, it is acceptable to assume that species recorded are present across the site, given the ecology of terrestrial mammals, for instance red fox and pine marten are likely to roam sizable distances whilst foraging across suitable habitat.

Table 13-8 Mammal Survey Results

Species		IUCN Status and Trend
Order Eulipotyphla		
Hedgehog	*Erinaceus concolor*	Least concern, unknown
Order Carnivora		
Red fox	*Vulpes vulpes*	Least concern, stable
Common jackal	*Canis aureaus syria*	Least concern, increasing
Pine marten	*Martes foina*	Least concern, stable
Order Artiodactyla		
Wild boar	*Sus scrofa lybicus*	Least concern, unknown
Order Rodentia		
Indian crested porcupine	*Hysterix indica indica*	Least concern, stable
Lesser mole rat	*Spalax leucodon ehrenbergi*	Data deficient, decreasing
Broad-toothed field-mouse	*Apodemus mystacinus*	Least concern, stable
Common field mouse	*Apodemus flavicollis*	NA
Mount Harmon field mouse	*Apodemus harmonensis*	NA
Field vole	*Microtus guentheri*	Least concern, stable
Snow vole	*Microtus nivalis*	Least concern, unknown

13.2.2.2 Reptiles

No incidental sightings of reptiles were recorded during other surveys on the Project site. It is possible that along with other, common species, three endangered species of reptile are present within the Project site as their known ranges occur close to the south. These species and their IUCN status are provided in **Table 13-9**. These reptile species occur in alpine areas with sparse vegetation. Their closest known ranges lie 10-12km to the south of the Project site.

Table 13-9 Endangered Reptile Species Potentially found on Project Site

Name	IUCN Status*	IUCN Trend*
Lebanese viper *Montivipera bornmuelleri*	Endangered	Decreasing
Fraas' lizard *Parvilacerta fraasii*	Endangered	Decreasing
Unnamed lizard *Phoenicolacerta kulzeri*	Endangered	Decreasing

*Note: from www.iucnredlist.org

It is not intended to complete any reptile surveys on the Project site as there is abundant suitable habitat and it has been assumed that the species are likely to be present and efforts should focus on avoidance of damage to habitats or incidental or intentional killing of any reptiles.

13.2.2.3 Invertebrates

The invertebrates typically encountered in the habitats present on the Project site and their IUCN status are provided in **Table 13-10**.

Table 13-10 Invertebrate Species Typically Encountered in Habitats Present on Project Site

Name	IUCN Status*	IUCN Trend*
False Apollo *Archon apollinus*	Near threatened	Unspecified
Unnamed butterfly *Polyommatus ellisoni*	Data deficient	Unknown
Unnamed butterfly *Polyommatus larseni*	Data deficient	Unknown
Unnamed butterfly *Polyommatus isauricoides*	Data deficient	Unknown

*Note: from www.iucnredlist.org

13.2.3 Bats

13.2.3.1 Desk Study and Literature Review

According to known records[80], the distribution of bat species in Lebanon is strongly associated with the countries' varied altitudinal gradient; varying from low coastal regions to the west, the mountainous areas of Mount Lebanon and Anti-Lebanon ranges to the north and east and the Beqaa plains to the south. Species most frequently recorded at lower altitudes include; Egyptian fruit bat, Mediterranean horseshoe bat, Blasius's horseshoe bat, Botta's serotine and greater mouse-tailed bats. At medium altitudes, where habitat is dominated by coniferous and mixed woodlands, records of greater mouse-eared, long-fingered and bent-winged bats are most frequent. Records of serotine and Savi's pipistrelle were recorded at higher altitudes where habitats consist of mixed woodland and alpine scrub. Records of common pipistrelle, Kuhl's pipistrelle, noctule, free-tailed bat, lesser mouse-eared bat, Natterer's bat, Geoffroy's bat, greater horseshoe bat and lesser horseshoe bat appear across the majority of the gradient, suggesting a wider altitudinal range.

According to comprehensive reviews of records and field studies[81], 21 species of bat are known to occur within Lebanon. These species and their commonality and conservation status are detailed in **Table 13-11**.

[80] Benda, P., Abi-Said, m., Bou Jaoude, I., Karanouh, R., Lucan, R K., Sadek, R., Sevcik, M., Uhrin, M. and Horacek, I. (2016) Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 13. Review of distribution and ectoparasites of bats in Lebanon. Acta Soc. Zool. Bohem. 80: 207-316.
[81] *Ibid*

Table 13-11 Bat Species in Lebanon from Available Literature

Species		Commonality in Lebanon*	Conservation Status**
Rousettus aegyptiacus	Egyptian fruit bat	Frequent	Lc/ Stable
Rhinopoma microphyllum	Greater mouse-tailed bat	Rare	Lc/ Stable
Rhinolophus ferrumequinum	Greater horseshoe bat	Common	Lc/ Decreasing
R. hipposideros	Lesser horseshoe bat	Common	Lc/ Decreasing
R. Euryale	Mediterranean horseshoe bat	Common	Nt/ Decreasing
R. blasii	Blasius' horseshoe bat	Rare	-
Myotis myotis	Greater mouse-eared bat	Rare	Lc/ Stable
M. blythii	Lesser mouse-eared bat	Rare	Lc/Decreasing
M. nattereri	Natterer's bat	Frequent	Lc/ Stable
M. emarginatus	Geoffroy's bat	Rare	Lc/ Stable
M. mystacinus	Whiskered bat	Rare	Lc/ Unknown
M. capaccinii	Long-fingered bat	Rare	Vu/ decreasing
Eptesicus serotinus	Serotine	Common	Lc/Unknown
E. anatolicus,	Botta's serotine	Rare	Lc/Unknown
Hypsugo savii	Savi's pipistrelle	Common	Lc/ Stable
Pipistrellus pipistrellus	Common pipistrelle	Common	Lc/ Stable
P. kuhlii	Kuhl's pipistrelle	Common	Lc/ Unknown
Nyctalus noctula	Noctule	Rare	Lc/ Unknown
Plecotus macrobullaris	Alpine long-eared bat	Rare	Lc/ Decreasing
Miniopterus schreibersii	Bent-winged bat	N/A	Nt/ Decreasing
Tadarida teniotis	European free-tailed bat	Rare	Lc/ Unknown

*Based on distributions noted in Dietz, *et al* (2007) and comprehensive review of survey records in Benda, *et al* (2016).
**ICUN status: Vu= Vulnerable, Nt= Near threatened Lc= Least concern, r = rare, c= common, endemic or endangered on the National level.

13.2.3.2 Bat Activity Surveys

As part of the baseline assessment for bats across the SA site, active and passive surveys were undertaken during the spring activity season (May-June) based on good practice guidelines[82][83]. The main objectives of these surveys were to determine which species of bat are present and to

[82] https://www.nature.scot/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation, Accessed on 5th July 2019
[83] http://www.eurobats.org/publications/eurobats_publication_series, Accessed on 5th July 2019.

understand bat activity, temporally and spatially, across the site. Bat activity was assessed based on bat calls recorded by bat detectors, a series of two or more calls counting as a pass by one bat.

Eleven species were recorded within the study area for SA by both passive and active surveys methods, as summarized in **Table 13-12**. Of the eleven species detected during the course of these surveys, long fingered bat is classed as Vulnerable whereas greater horseshoe and bent winged bat are Near Threatened in the Mediterranean according to the ICUN Red List[84]. The other seven species are classed as Least Concern.

The species recorded passing each turbine location has been summarized in **Table 13-13** to demonstrate commonality and variation of species present across the site as a whole.

13.2.3.3 Passive Survey Results

In total, the passive bat detectors recorded 10,972 bat calls across the 10 days with an average of 1,214.1 passes per night per detector. Across the site activity ranged from 1 to 2003 passes per night. Common and Kuhl's pipistrelle were the most frequently recorded species at each location during passive surveys. The most commonly recorded species was common and Kuhl's pipistrelle, recorded at each survey location and accounting for 67.63% of the overall activity recorded. Serotine were also recorded at each survey location, accounting for 24.87% of total activity recorded. Whiskered bat was the least commonly recorded, calls of which accounting for 0.01% of overall activity at only three survey locations as detailed in **Table 13-13**.

Mean bat activity recorded by passive detectors varied the site. Over the 10 days the detectors placed at SA MET2 and SA 21 recorded the least activity with an average of 10 passes per night. The detector placed at SA2 recorded the most activity per night, with an average of 736 passes per night. SA2 in close proximity to an urban area, which may explain the high levels of activity. Detectors at SA 6, SA 9 and SA 20 also recorded high levels of activity, as detailed in **Table 13-14**.

Overall, peaks in bat activity occurred between 22:00-23:00 hours after sunset and then between 01:00-02:00 hours before sunrise. Furthermore, Pipistrelle species had the highest mean activity between 22:00-23:00 hours whereas serotine was the most active species between 01:00-02:00 hours. European free-tailed bat was the most consistently active species between 22:00-03:00 hours.

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[84] https://www.iucnredlist.org/. Accessed on 5th July 2019.

Table 13-12 Summary of Bat Species Recorded within the Study Area (Ascending order from most commonly recorded to least recorded species across the site)

Species	Species Ecology in Lebanon	Baseline Survey Results
Kuhl's pipistrelle	Common in Lebanon. Records are widespread but most frequently observed in the west of the country. Roosts occur mainly in buildings and cracks in rock faces. Records suggest a more limited altitudinal range than other pipistrelle species in Lebanon, with most records occurring below 1,000m, suggesting a preference for lower altitudes. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 15m-1,446m.	The most common species recorded as part of the spring activity assessment accounting for **38.27%** of all activity across the SA site. Detected by both passive and active detectors.
Common pipistrelle	Largely sedentary species. Summer and winter roosts are not normally over 20km apart. Roosts in crevices within trees/buildings/rocks. Commonly found across a wide altitudinal gradient in Lebanon. Records occur throughout Lebanon but are concentrated to the west, namely the western slopes of Mount Lebanon. **Approximate altitudinal range*** of species recorded in Lebanon (min-max)* = 13m-2,170m.	The second most common species recorded as part of the spring activity assessment accounting for **29.36%** of all activity across the SA site. Detected by both passive and active detectors.
Serotine	Records show this species to be common throughout Lebanon and generally focused along the Mt Lebanon range. This species tends to forage over open habitats in mid-range altitudes. Roosts are generally found in caves and buildings. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 15m-1,494m.	Recorded as part of the spring activity assessment accounting for **24.87%** of all activity across the SA site. Detected by both passive and active detectors.
European free-tailed bat	Records from central and northern Lebanon. Species is believed to be widespread. Recorded across a wide altitudinal range across Lebanon. Typically forages over woodland, roosting in rock crevices. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 92m-2,005m.	Recorded as part of the spring activity assessment accounting for **2.34%** of all activity across the SA site. Detected by both passive and active detectors.

Species	Species Ecology in Lebanon	Baseline Survey Results
Savi's pipistrelle	Believed to be common and widespread throughout Lebanon, with most records observed in the west and along the main ridge of the Lebanon mountains. Records occur across a wide altitudinal range but suggest a clear preference for higher altitudes. This species roosts in small crevices (i.e. buildings, rock faces) and tends to forage across a mosaic of habitat types, including meadows, waterbodies and human settlements. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 42m-2,170m.	Third most commonly recorded species as part of the spring activity assessment accounting for **1.79%** of all activity across the SA site. Detected by both passive and active detectors.
Greater mouse-eared bat	Records of this species in Lebanon are scarce, however they are believed to be widespread[85]. Recorded across coastal regions and on the western slopes of the Mt Lebanon range. Records are distributed across a very narrow range, tending to be at lower altitudes. This species tends to forage at low heights, roosting in buildings/structures in summer and moving to caves/mines in winter. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 140m-1,175m.	Recorded as part of the spring activity assessment accounting for **0.96%** of all activity across the SA site. Detected by both passive and active detectors. A large colony was recorded within Sustainable Akkar wind farm study site during hibernation surveys (Dec-Mar 2018). The colony was believed to be the largest discovered in Lebanon to date. However, prior to the second survey visit, the colony had been destroyed. Nevertheless, this species was also recorded using active detectors during bat activity surveys within the study area.
Bent winged bat	A rare species across Lebanon. Mostly recorded in Northern Lebanon, across the ridges of the Lebanon and Anti-Lebanon Mountains. The species has been recorded in the areas across a medium-wide range of altitudes. This species is strictly cave-dwelling year-round. The highest hibernaculum cave recorded at 1,440m in the Lebanon Mountains. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 45m-1,440m.	Recorded as part of the spring activity assessment accounting for **0.38%** of all activity across the SA site. Detected by both passive and active detectors. This species is classed as **Near Threatened** in the Mediterranean according to the ICUN Red List.

[85] *Benda, P., Abi-Said, m., Bou Jaoude, I., Karanouh, R., Lucan, R K., Sadek, R., Sevcik, M., Uhrin, M. and Horacek, I. (2016) Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 13. Review of distribution and ectoparasites of bats in Lebanon. Acta Soc. Zool. Bohem. 80: 207-316.*

Species	Species Ecology in Lebanon	Baseline Survey Results
Common noctule	Records for Lebanon are sparse and mostly recorded on the western slopes of the Mt Lebanon range, across a broad altitudinal range. Typically found roosting in trees within hardwood forests and rock crevices. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 56m-163m.	Recorded as part of the spring activity assessment accounting for **0.18%** of all activity across the SA site. Detected by both passive and active detectors.
Long-fingered bat	Records suggest this species is widespread across Lebanon, with a narrow altitudinal range, preferring mid-range altitudes in summer before moving to higher altitudes to roost in winter. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 42m-1,285m.	Recorded as part of the spring activity assessment accounting for **0.14%** of all activity across the SA site. Detected by both passive and active detectors and observed during hibernation surveys (2018). This species is classed as **Vulnerable** in the Mediterranean according to the ICUN Red List.
Greater horseshoe bat	Large number of records observed throughout Lebanon, scattered across the altitudinal gradient but tending to more montane areas. Typically roosting in caves and mines, foraging at low heights in highly variable landscapes, including woodland and dense scrub habitat. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 5m-1,720m.	Recorded as part of the spring activity assessment accounting for **0.07%** of all activity across the SA site. Detected by both passive and active detectors. Roosts were located in caves during the hibernation surveys (2018). None of these roosts were present when caves were visited for a second time. This species is classed as **Near Threatened** in the Mediterranean according to the ICUN Red List.
Whiskered bat	Records suggest that this species is rare across Lebanon. Only two records can be determined from literature, both recorded in south Lebanon. Thus, little is known regarding the altitudinal ranges of the species in Lebanon. In Europe this species is known to roost in houses or trees during summer and winter in caves or mines. **Approximate altitudinal range*** of species recorded in Lebanon (min-max) = 1,034m-N/A.	Recorded as part of the spring activity assessment accounting for **0.01%** of all activity across the SA site. Detected by both passive and active detectors.

**Based on comprehensive review of survey records in Lebanon (Benda, et al., 2016)

Table 13-13 Species Recorded at Each Detector Location

Species	SA 2	SA 6	SA 9	SA MET 10	SA 20	SA MET 2	SA 21	SA 24	SA 25
Common pipistrelle	x	x	x	x	x	x	x	x	x
Kuhl's pipistrelle	x	x	x	x	x	x	x	x	x
Savi's pipistrelle	x	x	x	x	x	x		x	x
Bent winged bat	x	x	x		x	x	x	x	x
Long fingered bat		x			x			x	x
Greater mouse-eared bat	x	x	x	x	x	x	x	x	x
Whiskered bat		x			x			x	
Noctule	x	x	x		x			x	x
Serotine	x	x	x	x	x	x	x	x	x
European free-tailed bat	x	x	x	x	x	x	x	x	x
Greater horseshoe bat	x	x	x						x

Table 13-14 Averages Bat Passes per Detector per Night Across the Project Site (Ranked)

Detector Location	Average Passes/Night
SA2	736
SA6	222
SA9	178
SA20	134
SA24	103
SA25	27
SA MET10	30
SA MET2	10
SA21	10

Table 13-15 Hibernation Roost Survey Results

Species	Scientific Name	Hibernating/Active	National & International Status
Greater horseshoe bat	*Rhinolophus ferrumequinum*	Hibernating	Leb: common; Int: Least concern
Lesser horseshoe bat	*Rhinolophus hipposideros*	Hibernating	Leb: common; Int: Least concern
Mediterranean horseshoe bat	*Rhinolophus euryale*	Hibernating	Leb: near threatened; Int: near threatened.
Greater mouse-eared bat	*Myotis myotis*	Active	Leb: rare; Int: least concern
Long-fingered bat	*Myotis cappaccinii*	Hibernating	Leb: rare; Int: vulnerable

13.2.3.4 Active (Transect) Survey Results

As described in **Section 13.1.2**, it was not possible to determine activity data recorded solely with the SA section of the transect, as the transect consisted of a continuous route along existing tracks through and between both the SA and Lebanon Wind Power project sites. Nevertheless, the combined results are still useful in giving an indication of bat activity across the greater landscape with both site areas combined.

Over the course of the three active transect surveys 892 bat calls were recorded. Kuhl's pipistrelle was the most common (45.85% of total passes) followed by common pipistrelle (41.93% of total passes). Serotine was the least common species recorded by this survey type constituting 2.24% of total passes. It was possible to determine foraging activities occurring at many locations across the SA site with the highest recorded within oak forestry, between the gate of Adra Farm up to SA9 and SA MET10. More specific details are not available at the time of writing however will be picked up upon during future survey efforts.

13.2.3.5 Hibernation/Roost Surveys

Seventeen (17) caves were identified during the hibernation and roost search surveys. Nine (9) were found to contain hibernating bats, two caves contained bat guano but no bats, and six caves did not contain any bats or signs of bats. Although the location of these caves was provided to us as part of this assessment, the location of the active roost caves was not, therefore it is not possible to pin point which caves contain roosts, and which do not. Nevertheless, survey results indicated that five species were recorded hibernating at the nine confirmed roost locations as presented in **Table 13-15**. Within one cave a large colony, thought to be the biggest recorded in Lebanon to date, of greater mouse-eared bats was recorded. Unfortunately, this colony was found to have been destroyed upon a subsequent survey visit. Consequently, in the interest of conservation, the location of all caves identified as part of this study have not been included in this report to prevent location information from entering the public domain.

Nevertheless, it is possible to state that two of the identified caves occur within the Project site boundary along the a third occurring within 100m of the site. Again, it was not possible to confirm whether or not these caves were active roosts. The next closest cave identified is within 500 m, with the remainder all occurring out with 500m.

13.2.3.6 Summary of Bat Survey Results

Overall, 11 species were recorded within the study area for SA, as detailed in **Table 13-12**. SA2 was the most active site in terms of bat activity, followed by SA6, SA9 and SA20. The least active sites were SA MET2 and SA21. Common pipistrelle, Kuhl's pipistrelle and serotine were the most frequently recorded species across the SA study area, recorded using active and passive bat detectors at all detector locations. Whiskered bat was the least commonly recorded species, recorded at only SA6, SA20 and SA24. Listed as Vulnerable on the IUCN Red list, long fingered bat was recorded at four locations (SA6 SA20, SA24 and SA25) with an overall low activity level (0.14% of total calls). Activity by greater horseshoe bat and bent-winged bat, listed as Near Threatened on the ICUN Red list, was also low overall comprising 0.07% and 0.38% of total bat calls recorded across the whole site. Bent winged-bat was however recorded at all but one (SA MET10) locations across the site, whereas greater horseshoe was only recorded at SA2, SA6, SA9 and SA25. In addition, most bat activity was recorded 2-3 hours after sunset and 3 hours before sunrise, peak hours of which are consistent with similar studies[86]. Feeding activity was recorded across the SA site, mostly focused around the oak forestry between farmland, SA9 and SA MET10.

Furthermore, cave roosts of five species (**Table 13-12**) were identified within the region of the SA project site. Only two caves occur within the survey site, the next closest of which is within 100m of the site boundary, the status of these three caves as roosts has not been made available to us as part of this assessment.

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[86] Arnett, E., Huso, M., Reynolds, S. and Schirmacher, M. (2007). Patterns of pre-construction Bat Activity at a Proposed Wind Facility in Northwest Massachisetts. *Annual Report prepared for the Bats and Wind Energy Cooperature. Sept 2007.* Pp. 1-34.

13.2.4 Summary

The baseline assessment has identified a number of key biodiversity features that require further consideration within the assessment. These are summarized in **Table 13-16**. Potential impacts on the features are detailed in **Section 13.3**.

Table 13-16 Summary of Importance of Biodiversity Features

Feature	Importance	Justification
Western Akroum Key Biodiversity Area	International	This KBA, along with the Eastern Akroum KBA in Syria, contains the range of the endemic tree species Cilician fir *Abies cilicica* and is considered to be of international importance.
Designated sites (Qammouaa-Dinnyeh-Jurd Hermel IPA)	International	The IPA contains the largest continuous stands of natural forests in Lebanon and is classified for the presence of several threatened species. As such, this site is considered to be of international importance.
Aandqet Forest Proposed Reserve	National	Aandqet Forest Proposed Reserve is currently unconfirmed and undesignated. However, large stands of natural forest are uncommon in Lebanon and, as such, this site is considered to be of national importance.
Juniperus excelsa dominance	Regional	Forestry provides habitat for a broad range of species, such as birds and bats. Large stands of natural forest are uncommon in Lebanon and the areas within the site boundary contain a sensitive species, *Juniperus excelsa*. As a result, this habitat is considered to be of regional importance
Mixed oak woodland (including oak/*J. excelsa* mix)	National	Forestry provides habitat for a broad range of species, such as birds and bats. Large stands of natural forest are uncommon in Lebanon and the areas within the site boundary contain sensitive and endemic species, such as *Origanum libanoticum*. As a result, this habitat is considered to be of national importance.
Oak woodland	Regional	Forestry provides habitat for a broad range of species, such as birds and bats. Large stands of natural forest are uncommon in Lebanon and the areas within the site boundary contain sensitive species, such as *Phillyrea media*. As a result, this habitat is considered to be of regional importance.
Pine forest dominance	Regional	Forestry provides habitat for a broad range of species, such as birds and bats. Large stands of natural forest are uncommon in Lebanon. As a result, this habitat is considered to be of regional importance.
Oak/pine mix	National	Forestry provides habitat for a broad range of species, such as birds and bats. Large stands of natural forest are uncommon in Lebanon and the areas within the site boundary contain sensitive species, such as *Ostrya carpinifolia*, and endemic species, such as *Pyrus syriaca*. As a result, this habitat is considered to be of national importance.
Terrestrial Mammals	Local	The species present are least concern species with increasing or stable populations and are, therefore, less vulnerable to

Feature	Importance	Justification
		change. As a result, terrestrial mammals are considered to be of local importance.
Reptiles	International	Three endangered species of reptile Lebanese viper *Montivipera bornmuelleri*, Fraas' lizard *Parvilacerta fraasii* and the unnamed lizard *Phoenicolacerta kulzeri* might be found on site. All have decreasing populations and, as such, are vulnerable to change. As a result, reptiles are considered to be of international importance.
Bats	National	Although, no specific legislation protects bat species in Lebanon, there are two near threatened and one vulnerable species present in the Project site. All have decreasing populations and, as such, are vulnerable to further change. As a result, bats are considered to be of national importance.

13.3 Assessment of Potential Impacts

13.3.1 During Construction

13.3.1.1 Habitats and Flora

This section assesses the potential impacts of the Project on the terrestrial ecology (flora) at the Project site and in the surrounding area during construction.

As described in **Section 13.2.1**, taxa with high ecological value are considered to be sensitive features for the Project. These are: *Fraxinus ornus, Juniperus drupacea, Juniperus excelsa, Juniperus oxycedrus, Origanum libanoticum, Ostrya carpinifolia, Phillyrea media, Ranunculus cuneatus,* and *Rhamnus cathartica*. No IPA or other threatened species were recorded on the Project site, although three vulnerable species are expected to be present (Ehernberg's marjoram *Origanum ehrenbergii,* snow romulea *Romulea nivalis and R. phoenicia*). Including *Origanum libanoticum*, six endemic species also occur on the Project site.

Construction activities have the potential to degrade or destroy terrestrial habitat either directly through excavation, compaction, or modification (e.g. vegetation removal) or indirectly as a result of dewatering or from the accidental release of fuels, lubricants or other chemicals. The construction of turbine foundations, new access tracks and the substation would cause permanent habitat loss. Habitat loss and modification includes all areas replaced and potentially modified by project infrastructure, e.g. turbine foundations and permanent hardstanding, access tracks and the substation site.

Table 13-17 sets out the area potentially lost or modified for each habitat type as a result of construction of the proposed development.

Table 13-17 Potential Habitat Loss and Modification

Habitat Type	Total Within Project Site (ha)	Direct Loss (ha)	Indirect Modification (ha)	Total Loss/Modification (%)
Juniperus excelsa dominance	13.76	1.77	0.92	19.55
Mixed oak woodland 1 and 2	709.70	16.83	25.56	5.97
Oak/*J. excelsa* mix 1 and 2	48.70	2.89	4.70	15.59
Oak woodland 5	13.33	0.70	0.95	12.39
Oak/pine mix	115.93	5.82	8.15	12.05
Pine forest dominance 2	42.30	3.20	3.96	16.93
Total	**943.72**	**31.22**	**44.25**	**8.00**

Direct loss and indirect modification from the proposed development could total up to 75.47ha out of 943.72ha (8%) in the Project site, i.e. the overall habitat loss as a result of the proposed development would be low and in itself is not considered to constitute an ecologically significant effect. However, the following sections consider the importance of certain habitat types and sensitive features and the potential significance of any effects resulting from habitat loss impacts. A minor adverse impact is considered to occur if the habitat loss involves less than 10% of the habitat present in the Project site and a moderate adverse impact if the habitat loss involves 10-20% of the habitat present in the Project site. A major adverse impact is considered to occur if the habitat loss involves greater than 20% of the habitat present in the Project site. The significance of the effect is considered in relation to the magnitude of the impact, the habitat present in the wider region (where information is available) and the ecological importance of the habitat. A significant effect is considered to occur where the impact would lead to an adverse effect on the function or status of a habitat (including the extent, abundance and distribution of flora species).

Sensitive Features

Nine (9) sensitive features were recorded on the Project site. The sensitive features were recorded in the *Juniperus excelsa* dominance (*Juniperus excelsa*), mixed oak woodland, including the oak/*J. excelsa* mix (*Fraxinus ornus*, *Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Phillyrea media*, *Ranunculus cuneatus* and *Rhamnus cathartica*), oak woodland (*Juniperus excelsa* and *Phillyrea media*) and oak/pine habitat types (*Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Ostrya carpinifolia*, *Phillyrea media* and *Rhamnus cathartica*).

The total area of *Juniperus excelsa* dominance likely to be lost or modified as a result of the proposed development is 2.69ha (19.55%). This is considered to be a **Moderate** adverse impact on *Juniperus excelsa* in a habitat of regional importance. The total area of mixed oak woodland and oak/*J. excelsa* mix habitat types likely to be lost or modified as a result of the proposed development is 49.98 ha (6.59%). This is considered to be a **Minor** adverse impact on *Fraxinus ornus*, *Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Phillyrea media*, *Ranunculus cuneatus* and *Rhamnus cathartica* in a habitat of national importance. The total area of oak woodland likely to be lost or modified as a result of the proposed development is 1.65ha (12.39%). This is considered to be a **Moderate** adverse impact on *Juniperus excelsa* and *Phillyrea media* in a habitat of regional importance. The total area of oak/pine habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). This is considered to be a **Moderate** adverse impact on *Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Ostrya carpinifolia*, *Phillyrea media* and *Rhamnus catharticain* a habitat of national importance. However, as only a very small part of these habitat types is likely to contain these species, the loss or modification is not considered to lead to an ecologically significant effect. The impacts are minor in habitats of national importance apart from the oak/pine habitat type, which has a moderate impact in a habitat of national importance. However, the oak/pine habitat type is well-distributed in the region, with better quality habitat than is represented on the Project site, particularly in the Aandqet Forest, therefore this effect is also considered to be not significant.

However, as the species are sensitive features, as detailed in **Section 13.2.1**, measures will be taken to offset any losses of the species as a result of the proposed development.

Vulnerable Species

Three (3) vulnerable species are expected to be present (Ehernberg's marjoram, snow romulea and *Romulea phoenicia*). Ehernberg's marjoram is likely to occur in coniferous woodland. Snow romulea and *Romulea phornicia* are likely to occur in coniferous woodland, mixed oak woodland and oak woodland.

The total area of pine forest dominance 2 habitat types likely to be lost or modified as a result of the proposed development is 7.16ha (16.93%). The total area of oak/pine habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). The total area of mixed oak woodland and oak/*J. excelsa* mix habitat types likely to be lost or modified as a result of the proposed development is 49.98ha (6.59%). The total area of oak woodland likely to be lost or modified as a result of the proposed development is 1.65ha (12.39%). These are considered to be **Moderate** adverse impacts that would not result in ecologically significant effects.

However, as the species are vulnerable, as detailed in **Section 13.2.1**,measures will be taken to offset any losses of the species as a result of the proposed development.

Endemic Species

Six (6) endemic species were recorded on the Project site, with two further endemic species not recorded on the site but expected to be present (*Silene reuteriana* and *Salvia peyronii*). The endemic species were recorded in the mixed oak woodland (*Phlomis chrysophylla*, *Salvia hierosolymitana, Origanum libanoticum*, *Ballota antilibanotica* and *Micromeria graeca*) and oak/pine habitat types (*Phlomis chrysophylla*, *Origanum libanoticum* and *Pyrus syriaca*).

The total area of mixed oak woodland and oak/*J. excelsa* mix habitat types likely to be lost or modified as a result of the proposed development is 49.98ha (6.59%). This is considered to be a **Minor** adverse impact on *Phlomis chrysophylla*, *Salvia hierosolymitana, Origanum libanoticum*, *Ballota antilibanotica* and *Micromeria graeca* in a habitat of national importance. The total area of oak/pine habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). This is considered to be a **Moderate** adverse impact on *Phlomis chrysophylla*, *Origanum libanoticum* and *Pyrus syriaca* in a habitat of national importance. However, as only a very small part of the habitat types are likely to contain these species, the loss or modification is not considered to lead to an ecologically significant effect. Although a moderate impact is considered to occur in a habitat of national importance, the oak/pine habitat type is well-distributed in the region, with better quality habitat than is represented on the Project site, particularly in the Aandqet Forest, therefore this effect is also considered to be not significant.

However, as the species are endemic, as detailed in **Section 13.2.1**, measures will be taken to offset any losses of the species as a result of the proposed development.

Natural Habitats

The areas of oak woodland and mixed woodland habitat (oak-pine mix) in good condition around Turbines 22-18 and Turbines 13, 15, and 17 are considered to be natural habitats in the CHA, as detailed in **Appendix L**. The total area of oak woodland likely to be lost or modified as a result of the proposed development is 1.65ha (12.39%). The total area of oak-pine mix habitat types likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). These are considered to be **Moderate** adverse impacts that would not result in ecologically significant effects but as these habitats are considered to be natural habitats, mitigation would need to provide a no net loss of biodiversity for these areas.

13.3.1.2 Terrestrial Fauna

Loss or Disturbance of Resting Places

Faunal species typically inhabit locations for sleeping, breeding and/or hibernating (hereafter "resting places") either underground or within vegetation, e.g. in a tree. The construction of the proposed development has the potential to damage or destroy resting places within vegetation and underground.

The loss (destruction) of a resting place would be an adverse one-time, high magnitude, permanent, direct impact upon the individual or population of a species inhabiting the resting place and cause them to seek shelter elsewhere, in possibly less favorable locations where it would be necessary to find or construct a new resting place. The impact would be limited to the extent of the individual or population using the resting place.

Assuming a worst-case scenario based on the species identified in the mammal desk study and field survey, that the species impacted is of regional importance and the resting place forms a key part of the species' life cycle, the impact would result in a significant ecological effect.

For reptiles, were any of the three endangered reptile species to be impacted by the loss of a resting place, those species are of international importance and as any resting place likely forms a key part of the species' life cycle, given how mobile reptiles are but how dependent they are on breeding (egg laying) locations or hibernation locations, the impact would result in a residual significant ecological effect.

Impacts associated with disturbance of a resting place rather than loss of the resting place would be similar but likely to be of moderate or low magnitude depending on the type of impact. A disturbance impact would occur as a result of construction noise, construction light or habitat alteration in the vicinity of the roost and could result in a residual ecologically significant effect. However, it is considered that both types of impact are reversible, i.e. mitigation measures are possible which would avoid or reduce the impacts and ensure that even if any residual effects occur, they would not be significant. Full details of all mitigation measures for terrestrial fauna are provided in **Section 13.4**.

13.3.1.3 Bats

Mammals can be affected by wind power projects in various ways: habitat fragmentation and destruction, noise effects, visual impacts, vibration and shadow flicker effects, increase of direct mortality on wind farm roads, among others (de Lucas et al. 2005; Santos et al. 2010; Lovich and Ennen 2013). Impacts vary according to the nature of the site, and lifecycle stage of the installation.

Bats are the most affected by wind farms among other mammals. Many international studies have demonstrated the effect of wind turbines and the prevailing environmental conditions on some bat species. For example, Rydell et al. (2014) reported the negative effect of wind turbines in Northwestern Europe on certain bat species, and Arnett et al. (2008) described bat fatalities from 21 post-construction sites in the USA and Canada. Kunz et al. (2007) estimated that bats are killed at the rate of 30-40 bats per turbine per year in the Appalachian Mountains in eastern United States.

Bats are highly sensitive by nature. Even though they live the longest relative to their size (typically up to 30 years), they are characterized by very special niche requirements and slow reproduction rates. Bats give birth to a single "baby" (or pup) per year, which makes them among the slowest reproducers with respect to their size.

These characteristics put bats among the most threatened species of mammals in the world. In Lebanon all bat species are at risk from habitat destruction, putting fire in caves, hunting, drying of wetlands, elimination of their feeding sites, and excessive use of pesticide (Horáček et al. 2008, 2009, Benda et al. 2016).

Wind turbines can induce bat mortality either through 1) collision; or 2) barotrauma (Arnett et al. 2008, Baerwald et al. 2008, Grodsky et al. 2011). Several hypotheses propose that bats are killed by barotrauma caused by rapid air pressure reduction near the moving blades (Arnett et al 2008, Kunz et al. 2007). However recent research into the likelihood of barotrauma impacts has concluded that for an impact to occur, bats would have to be so close to a turbine blade as to be more at risk from collision (Rollins et al, 2012, Lawson et al 2018).

In recent years, many studies were conducted on bat fatalities in connection to wind projects. Bats have different behaviors and flight styles, which is why they are affected in varying degrees by wind turbines (Rydell et al. 2010, Camina 2012, Amorim et al. 2012). Bat species that fly and forage in open space like the Pipistrellus spp. and those that migrate long distances at high altitude like the Nyctalus spp. are more at risk of collision with the wind turbines. On the other hand, gleaning bats that fly close to vegetation like the Rhinolophus spp. face less risk of collision with wind turbines.

Some animals might adjust their behavior, but habitat fragmentation and destruction, human activity, sound pollution and opening of roads will expose these species to more threats. In addition, lack of resources including feeding, roosting and hibernating sites will affect their population size.

Loss or Disturbance of Roosts

Bat species typically roost in one of three main roost types, trees, natural features such as caves or features constructed by humans, such as houses, bridges or mines. The construction of the proposed development has the potential to damage or destroy two of those potential roost features, namely trees and caves. The loss (destruction) of an active roost feature would be an adverse one-time, high magnitude, permanent, direct, impact upon the population(s) of bats using the roost feature and cause them to forage elsewhere, in possibly less favorable habitats[87]. The impact would be limited in extent to the roost feature being lost.

Seventeen caves were identified as containing bats or within signs of previous bat usage, including the largest greater mouse-eared bat colony known to be in Lebanon. Nine of these caves were found to have hibernating bats. All caves containing bats are considered to be features of at least regional importance, with the larger caves being of national importance. Impacts on these have the potential to result in a significant ecological effect.

Impacts associated with disturbance of a roost rather than loss of the roost would be similar but likely to be of moderate or low magnitude depending on the type of impact. A disturbance impact would occur as a result of construction noise, construction light or habitat alteration in the vicinity of the roost and could result in an ecologically significant effect.

However, it is considered that both types of impact are reversible, i.e. mitigation measures are possible which would avoid or reduce the impacts and ensure that even if any residual effects occur, they would not be significant.

Full details of all mitigation measures for bats are provided in **Section 13.4** and include pre-construction surveys to identify roost locations and the protection of roosts by installing metal grates across their entrances. The latter measure would provide a significant ecological benefit to the bat species using the roost by removing the potential for human interference, whether deliberate or accidental. This has the potential to be a lasting ecological benefit from the proposed development.

Loss of Foraging Habitat

Both permanent and temporary loss of bat foraging habitat during construction is possible. It is likely to be limited to the northern part of the Project site where construction activities could result in changes in vegetation cover and any associated flying invertebrate resource. The permanent loss of foraging areas, e.g. felling of areas of forest or clearance of shrubland, would be an adverse one-time, high magnitude, permanent, direct impact upon the population(s) of bats feeding in the area of lost habitat and would cause them to seek alternative foraging locations.

Without more detailed survey data, it is difficult to establish the sensitivity of the bat population as that would depend on factors such as the species present, the numbers of bats using the foraging area and for how much of the year and whether that is during particularly sensitive periods, e.g. the breeding season when female bats need to gather sufficient prey to be of sufficient health to feed dependent young. The impact would extend to all populations of bats which use the foraging resource. Assuming a likely worst-case scenario that the population(s) of bats using the foraging habitat is (are) of national importance, the impact would result in a significant ecological effect.

Impacts associated with temporary loss of a foraging area, e.g. temporary construction infrastructure upon areas of sparse herbaceous vegetation, rather than the permanent loss of the foraging area would be similar but likely to be of moderate or low magnitude. It is considered possible that it could result in an ecologically significant effect. However, it is considered that both types of impact are reversible, i.e. mitigation measures are possible which would avoid or reduce the impacts and ensure

[87] Bach, L. and Rahmel, U., 2004. Summary of wind turbine impacts on bats—assessment of a conflict. Bremer Beiträge für Naturkunde und Naturschutz, 7, pp.245-252.

that even if any residual effects occur, they would not be significant. Full details of all mitigation measures for bats are provided in **Section 13.4**.

13.3.2 During Operation

13.3.2.1 Habitats and Flora

Improved access to forested areas via the newly constructed wind farm tracks could lead to an increase in tree felling activities undertaken by local people, leading to a further loss of oak, *Juniperus excelsa* and pine habitat types. However, as unpaved tracks already occur in the Project site and some areas show signs of being previously felled, this is considered to be a **Minor** adverse impact and is not considered to lead to an ecologically significant effect.

Improved access could also lead to an increase in the burning of vegetation for warmth or cooking. Due to the dry nature of the landscape, if fires were allowed to get out of control, this could have a **Major** adverse impact on the habitats and potentially lead to an ecologically significant effect.

13.3.2.2 Terrestrial Fauna

No impacts leading to significant ecological effects are considered to exist. Hunting bans will be enforced within the area highlighted in **Figure 14-4**. No impact from traffic movements during operation are predicted.

13.3.2.3 Bats

Collision Risk

The operation of a wind farm can have direct impacts on bats, the severity of which can be determined by the ecology of each species. Bat species that occupy higher altitudes and species that tend to fly at greater heights whilst foraging or migrating, such as Pipistrellus or Nyctalus species, are at greater risk of turbine collision during operation than low flying species that tend to remain at lower altitudes, such as horseshoe and Myotis species. **Table 13-18** summarizes the level of collision risk with turbines of the bat species considered likely to occur within the Project site.

Table 13-18 Collision Risk Level for Each Species Likely to Occur Within the Study Site Based on Species Ecology

High Risk	Medium Risk	Low Risk
Common pipistrelle*	Serotine*	Greater horseshoe*
Kuhl's pipistrelle*	Bent winged	Whiskered
Savi's pipistrelle		Greater mouse-eared*
Common noctule*		Long-fingered*
European free-tailed*		

* Species recorded during active and passive surveys.

Commonly recorded throughout Lebanon, greater horseshoe bats tend to forage close to the ground, therefore collision risk is considered to be low for these species. However, as this species tends to move to higher altitudes to roost during winter months, the risk of collision could be greater as colonies undertake this migration. Data on bat migrations in Lebanon are limited therefore this cannot be confirmed. Greater horseshoe bat activity was recorded at low level during the passive surveys (0.07% of total activity recorded) mostly towards the northern end of the Project site.

The typical activity of all Myotis species (long fingered, whiskered and greater mouse-eared bats), makes these species low risk for collision. All species have narrow altitudinal ranges and these species typically forage below typical collision heights. A low levels of activity of greater mouse-eared bats was recorded during passive surveys (0.96%) also accounting for a small proportion of activity recorded during transect surveys (2.58%). Activity from long fingered bats recorded during passive surveys was low (0.14%) and was not recorded during transect surveys. Similarly, low levels of whiskered bat activity was recorded during passive surveys (0.01%).

Both serotine and bent-winged bat are considered to be of a medium collision risk as these species are known to reach collision height when foraging. These species prefer to forage over woodland and open habitats at mid-range altitudes. During passive surveys, serotine were recorded at all detector locations in with high levels of activity overall (24.36%). Low levels of activity were recorded for this species during transect surveys (2.24%). Bent winged bats were recorded infrequently but occurred widely across the site during passive surveys (0.38%) with no records made during transect surveys.

Common, Kuhl's and Savi's pipistrelle species are considered to be at high risk of collision, with wide altitudinal ranges, typically reaching collision height whilst foraging. European free-tailed bat has a high collision risk and this species typically forages at height (10-300m) and can reach altitudes of 3,000m[88] when migrating between summer and winter roosts. High activity from Kuhl's and common pipistrelle was recorded during passive surveys (38.27% and 29.36% respectively) and were recorded across all survey locations. Savi's pipistrelle was less commonly recorded (1.79%) but present across all sites apart from SA21. Common and Kuhl's pipistrelle were also the most commonly recorded species during active transect surveys, constituting 41.93% and 45.85% of all activity recorded, respectively where as Savi's pipistrelle was less commonly recorded during transects (2.80%). European free-tailed bat was recorded across the entire site, at all survey locations during passive surveys with relatively low levels of activity (2.34%). Low levels of activity from this species was also recorded as part of the active transect surveys (2.80%).

Common noctules are also at a high risk of collision as their typical activity patterns coincides with typical collision zones for turbines. This species covers large distances whilst foraging (up to 26km) above 100m and are commonly reported to be the most frequently recorded fatality at wind farm sites[89]. As such, collision risk for bats has the potential to be an adverse, high-magnitude long term impact for many of the bat species likely to be present at the Project site, populations of which are considered to be potentially up to national importance. Noctule was recorded at six locations spread

[88] Williams, T. C., Ireland, L. C. & Janet M. Williams, J. M. 1973. High Altitude Flights of the Free-Tailed Bat, *Tadarida brasiliensis*, Observed with Radar. Journal of Mammalogy, 54:807-821.

[89] Rodrigues, L., L. Bach, M.J. Dubourg-Savage, B. Karapandza, D. Kovac, T. Kervyn, J.Dekker, A. Kepel, P. Bach, J. Collins, C. Harbusch, K. Park, B. Micevski, J. Minderman.2015. Guidelines for consideration of bats wind farm projects – Revision 2014.

out across the length of the project site (SA2, SA6, SA9, SA20, SA42 and SA25). The level of recorded noctule activity on site, as per spring activity surveys, is low (0.18%) according to passive detectors.

Activity data used in this assessment is based on spring activity of bats across the SA project site. Good practice guidance[90,91] requires that a full year of assessment is completed in effectively inform impact assessment. As only spring activity has been collected and analyses thus far, it is no possible to determine an accurate collision rate prediction per species. Once a full year of survey is completed a revised assessment can be undertaken, thus able to consider significant variables such as summer and winter migration/hibernation movements. As such, it is only possible to estimate if, based on a temporally limited dataset, a predicted collision risk for each species would result in an ecologically significant effect or whether any fatalities might not result in significant effects on those populations.

Overall, significant impacts are predicted on common pipistrelle, Kuhl's pipistrelle and serotine based on the species vulnerability to collision risk and their recorded usage of the site. Ecologically significant effects are still possible for the other species recorded during the bat surveys. However, it is considered that the impact of collision risk is reversible, i.e. mitigation measures are possible which would avoid or reduce the impacts and ensure that even if any residual effects occur, they would not be significant. Full details of all mitigation measures for bats are provided in **Section 13.4.4**.

13.3.3 During Decommissioning

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

13.3.4 Critical and Natural Habitats Assessment

A CHA for the Project has been undertaken. The assessment is provided in **Appendix L**, and referred to in the text, where relevant.

13.4 Mitigation

Full details of mitigation will be set out in a Biodiversity Action and Management Plan (BAMP) to be developed by others, including the measures proposed, when they will be implemented, who will be responsible for implementation and how much they will cost. A framework BAMP has been provided with the ESIA, as an appendix to the stand-alone ESMP.

A suitably qualified and experienced Ecological Clerk of Works (ECoW) would be employed to input into the BAMP and oversee the implementation of ecological mitigation measures during construction.

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[90]. https://www.nature.scot/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation, Accessed on 5th July 2019

[91] EUROBATS Publication Series No. 6 (English version). UNEP/EUROBATS Secretariat,Bonn, Germany, 133pp http://www.eurobats.org/publications/eurobats_publication_series, Accessed on 5th July 2019.

13.4.1 Habitats and Flora

13.4.1.1 During Pre-Construction

- Completion of a pre-construction flora survey to identify habitats and key flora species as identified in the baseline section.
- Micrositing of infrastructure to avoid or reduce oak woodland and mixed woodland removal.
- Preparation of a final BAMP outlining the measures required to deliver no net loss for areas of natural habitat, such as oak woodland and mixed woodland. A framework BAMP has been provided with the ESIA, as an appendix of the stand-alone ESMP.

13.4.1.2 During Construction

- Offsetting for the loss of natural habitats will be required to deliver no net loss of biodiversity in these areas. Full details of the measures to achieve no net loss will be provided in the final BAMP. Measures would include additional tree planting to produce new areas or improve degraded areas of oak-dominated woodland and mixed woodland. The translocation of tree species would also be considered.
- Preparation and provision of workforce toolbox talks and monitoring to ensure all staff understand the importance of the biodiversity controls in place, what they entail and how these controls should be followed. Particular key early tasks in workforce education will include implementation of a hunting ban on the Project site and prohibition of burning of vegetation for warmth or cooking.
- Minimization of the project footprint within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure construction.
- If any key flora species are identified during the pre-construction survey, areas of habitat inhabited by the plants would be avoided. If it is not possible to avoid examples or areas of the species detailed in the baseline, every effort would be made to reduce the impact and further offsetting would be required.
- Implementation of rehabilitation measures to mitigate the loss of habitat, such as vegetation remediation, translocation or creation of new habitat areas. Full details of these measures will be provided in the final BAMP to be developed by others.
- Proper management of excavation materials. Rubble from site excavations should not be allowed to spread down slopes. Clear working procedures should be defined, implemented and supervised.
- Separation and storage of top soil for use in restoration of all temporary project infrastructure and areas of temporary disturbance, e.g. track margins. Segregation of the topsoil of different habitat types will be required.
- Soil management would also include observance of appropriate biosecurity controls to prevent the spread of invasive plants or floral diseases. This would involve washing vehicles and equipment to remove particles of vegetation and loose soil, with this done in specific "wash down" areas. Any invasive plants that are removed during vegetation clearance would need to be disposed of appropriately, in a safe way that does not allow it to spread.
- Good construction environmental management on site based on good practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents.

13.4.1.3 During Operations and Maintenance

- Monitoring of all habitat reinstatement, translocation, recreation, offsetting or enhancement as identified and implemented as required following pre-construction surveys.
- Remove invasive plant species during routine vegetation maintenance.
- Monitor power-line right-of-way vegetation to avoid fire risk. Remove blowdown and other high-hazard fuel accumulations.

13.4.1.4 During Decommissioning

Typically, the same controls set out for construction will apply.

- Minimization of activities within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure decommissioning.
- Good construction environmental management on site based on good practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents.
- Preparation and provision of workforce toolbox talks to ensure all staff understand the importance of the biodiversity controls in place and exactly what they entail.

13.4.2 Terrestrial Fauna

13.4.2.1 During Pre-Construction

- Completion of pre-construction fauna walkover survey to identify potential habitat for key mammal and reptile species, followed by camera trapping to confirm species considered to be present/status of any dens found.
- Preparation of a final BAMP (to be developed by others) setting out the measures required based upon the findings of the further surveys. A framework BAMP has been will be included with the ESIA, as an appendix of the stand-alone ESMP.

13.4.2.2 During Construction

- If any mammal or reptile species are encountered during works, they would be allowed to disperse or would be translocated outwith the construction area.

13.4.2.3 During Operations and Maintenance

- If found to be present during pre-construction surveys, monitoring of populations of endangered reptiles as appropriate, including monitoring of any offsets or enhancements for those species.

13.4.3 Bats

13.4.3.1 During Pre-Construction

- A full year of activity surveys will be competed pre-construction, adding to the information gathered from the spring activity surveys used to inform this assessment. As per best guidance, a full year of survey data will allow for a more accurate understanding of bat activity across the site, temporally and spatially, which will enable a more accurate and informed impact assessment which in turn will determine the most effective mitigation required.

13.4.3.2 During Construction

- A presumption for avoidance of all artificial light as far as possible. All lights should be cowled and downward facing and avoid light spill onto surrounding non-construction areas.

13.4.3.3 During Operations and Maintenance

- Once the pre-construction survey results have been analyzed, it will be possible to develop an appropriately focused scope of operational period bat surveys. Surveys would cover up to three years' activity periods.
- Given the high levels of activity recorded at SA2, SA6, SA9 and SA20 and predominately from species identified as high or medium risk in terms of collision (common pipistrelle, Kuhl's pipistrelle and serotine) it is recommended that turbines situated at these locations are subject to operational adjustments. Raising the cut-in speed at which the turbine begins to generate electricity, thus preventing movement in low winds, notably decreases bat mortality rates[92] along with feathering of blades i.e. adjusting the angle f the blade parallel to the wind or turning the unit away from the wind[93]. In addition, operational times could be altered – stopping turbines at these locations between the most active periods i.e. 20:00-05:00.
- Monitoring of bat collision fatalities under and around each turbine following a standardized methodology potentially using trained dogs. Monitoring to be completed monthly and concurrently with bird collision monitoring.
- Preparation and subsequent implementation of plan to identify and protect key bat roost caves in the area on and around the Project site from human persecution, such as identified elsewhere in the area.

13.4.3.4 Additional Good Practice

- To prevent further persecution and destruction of bat roost caves protective metal grates should be installed across the entrances of all bat roost caves identified during the December 2017-March 2018 surveys. These would prevent members of the public from accessing the caves and disturbing or damaging the roosts, as observed previously.

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[92] Horn J.W., Arnett E.B. & Kunz T.H. (2008) Behavioral responses of bats to operating wind turbines. *The Journal of Wildlife Management,* 72, 123–132.

[93] Hein, C, D and Schirnacher, M, R. (2016). Impact of Wind Energy on bats: A Summary of our Current Knowledge. Human-Wildlife Interactions 10 (1), Pp 19-27.

13.5 Residual Effects

13.5.1 Habitats and Flora

Following the implementation of mitigation, no residual effects on habitats or flora are predicted.

13.5.2 Terrestrial Fauna

Following the implementation of mitigation, no residual effects on terrestrial fauna are predicted.

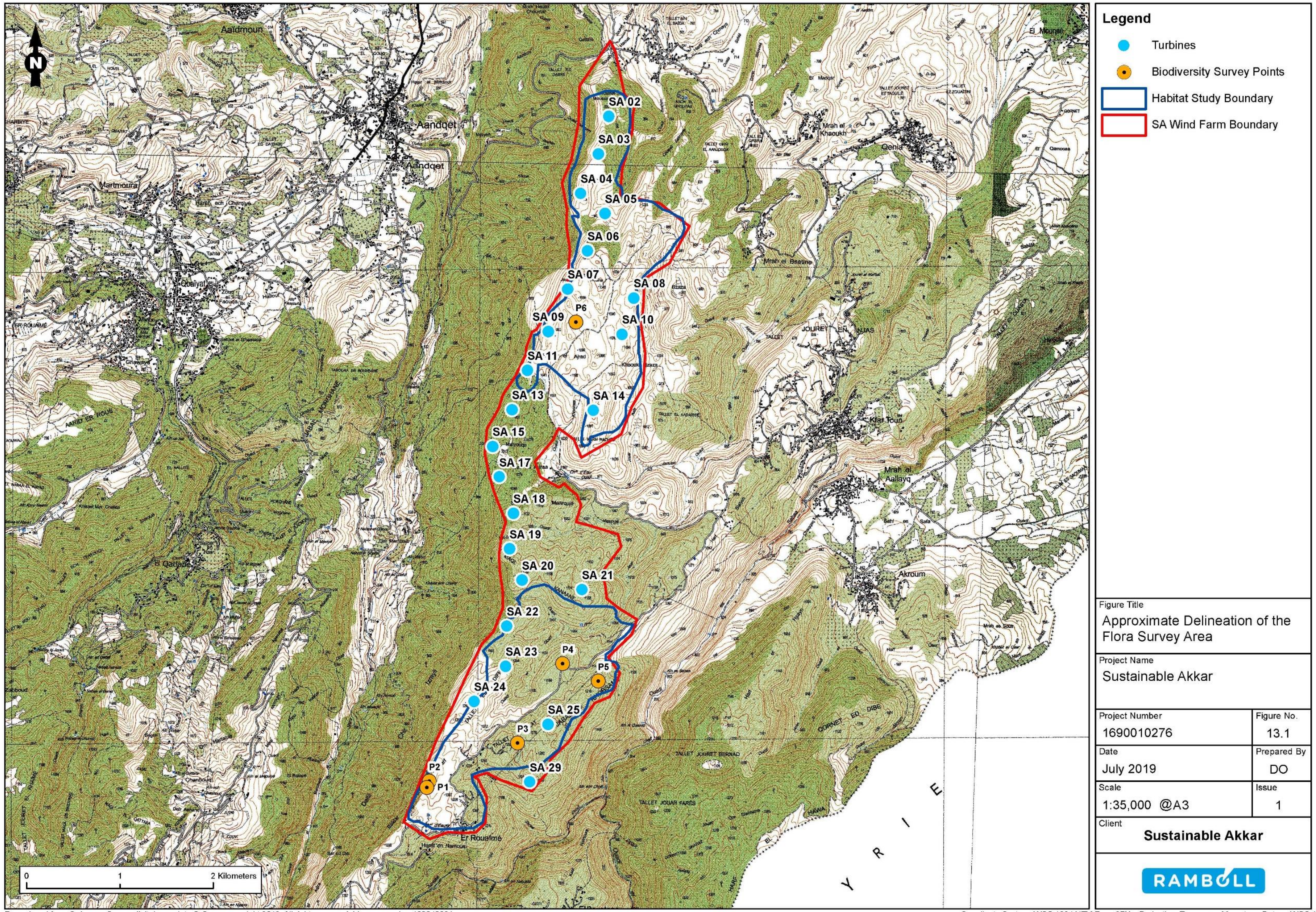
13.5.3 Bats

Following the implementation of mitigation, no residual effects on bats are predicted.

13.6 Section 13 Figures

All figures referenced in the text are provided below.

Figure 13-1 Approximate Delineation of the Flora Survey Area



Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 13-2 Location of Passive Bat Detectors Across SA Site

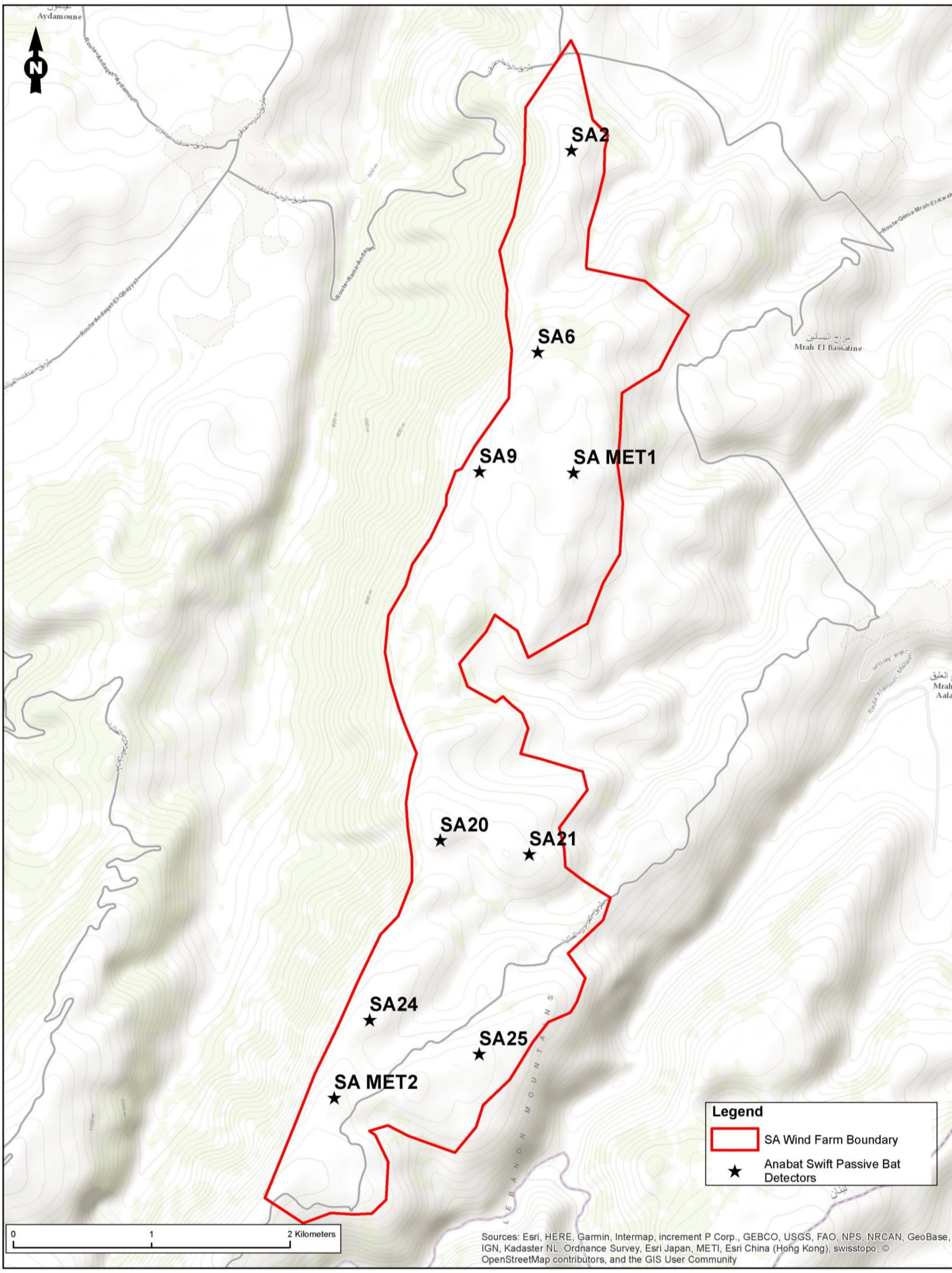
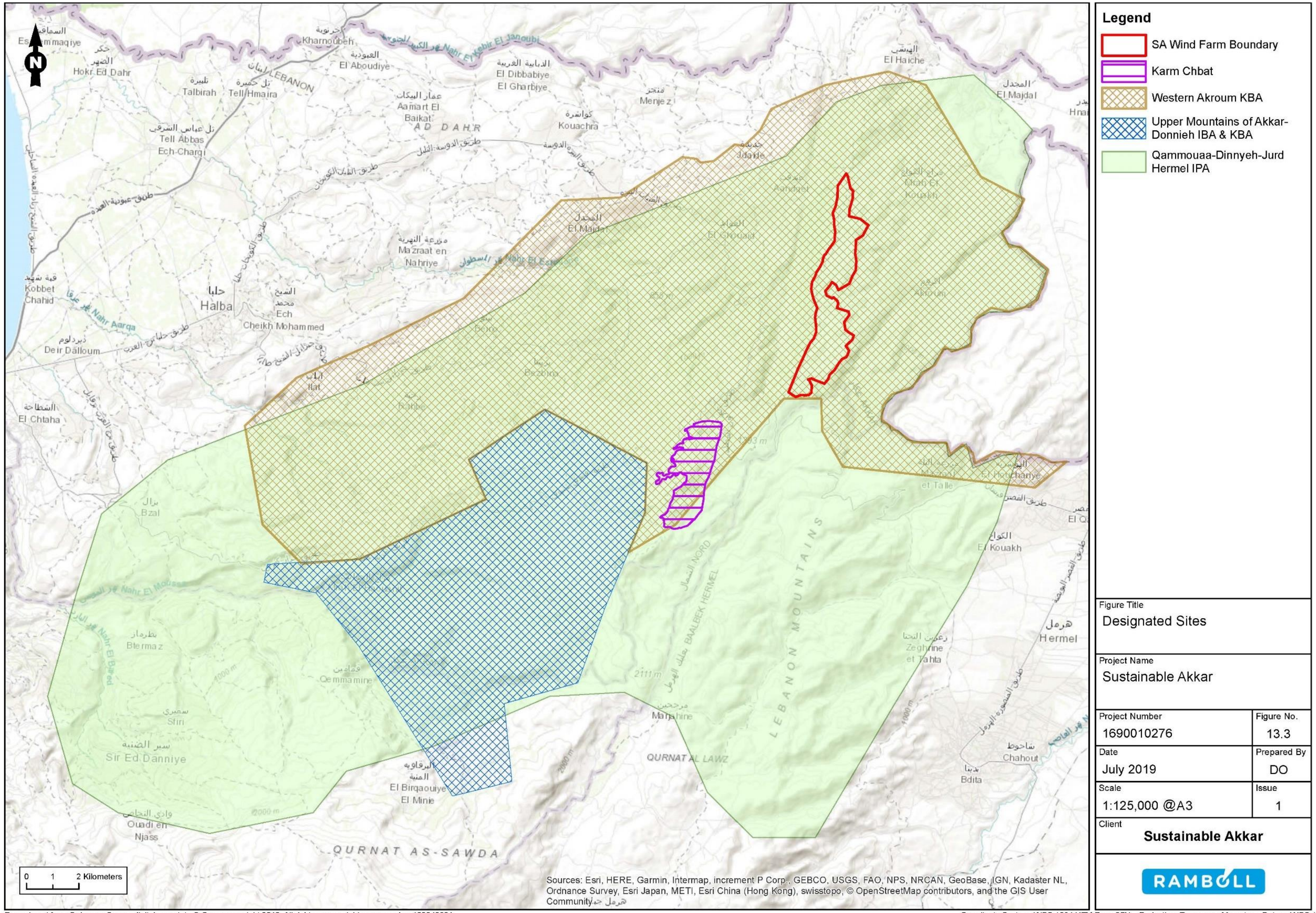


Figure Title	Project Number	Figure No.	Client
Location of Passive Bat Detectors Across SA Site	1690010276	13.2	Sustainable Akkar
	Date: July 2019	Prepared By: EB	
Project Name: Sustainable Akkar	Scale: 1:25,000 @A3	Issue: 1	RAMBOLL

Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 13-3 Designated Sites



Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

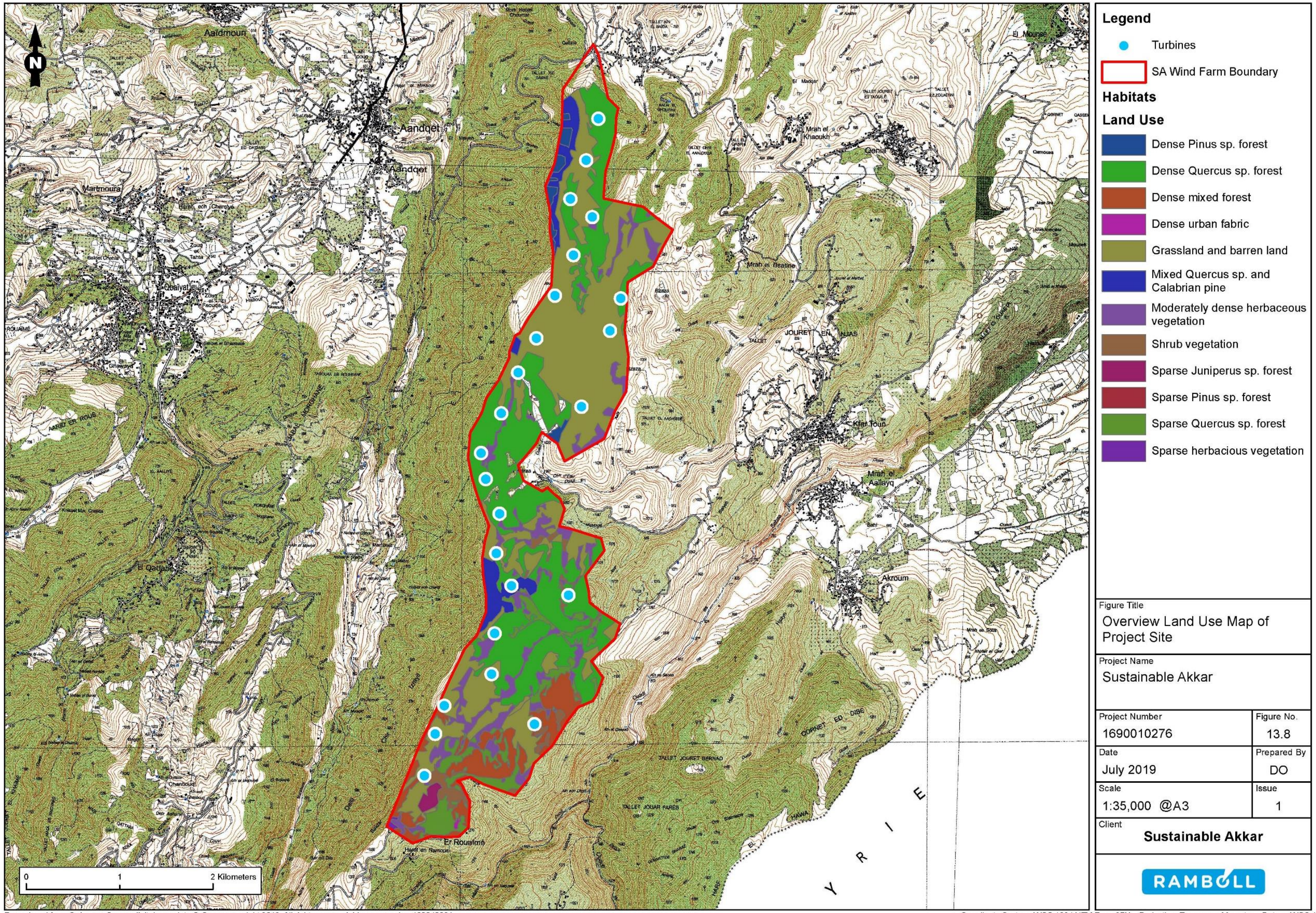
Figure 13-4 Grassland and Juniper Forest Edge in Roueimeh

Figure 13-5 Mixed Forest Edge in Rweimeh

Figure 13-6 Plot in Grassland with Trees in Rweimeh

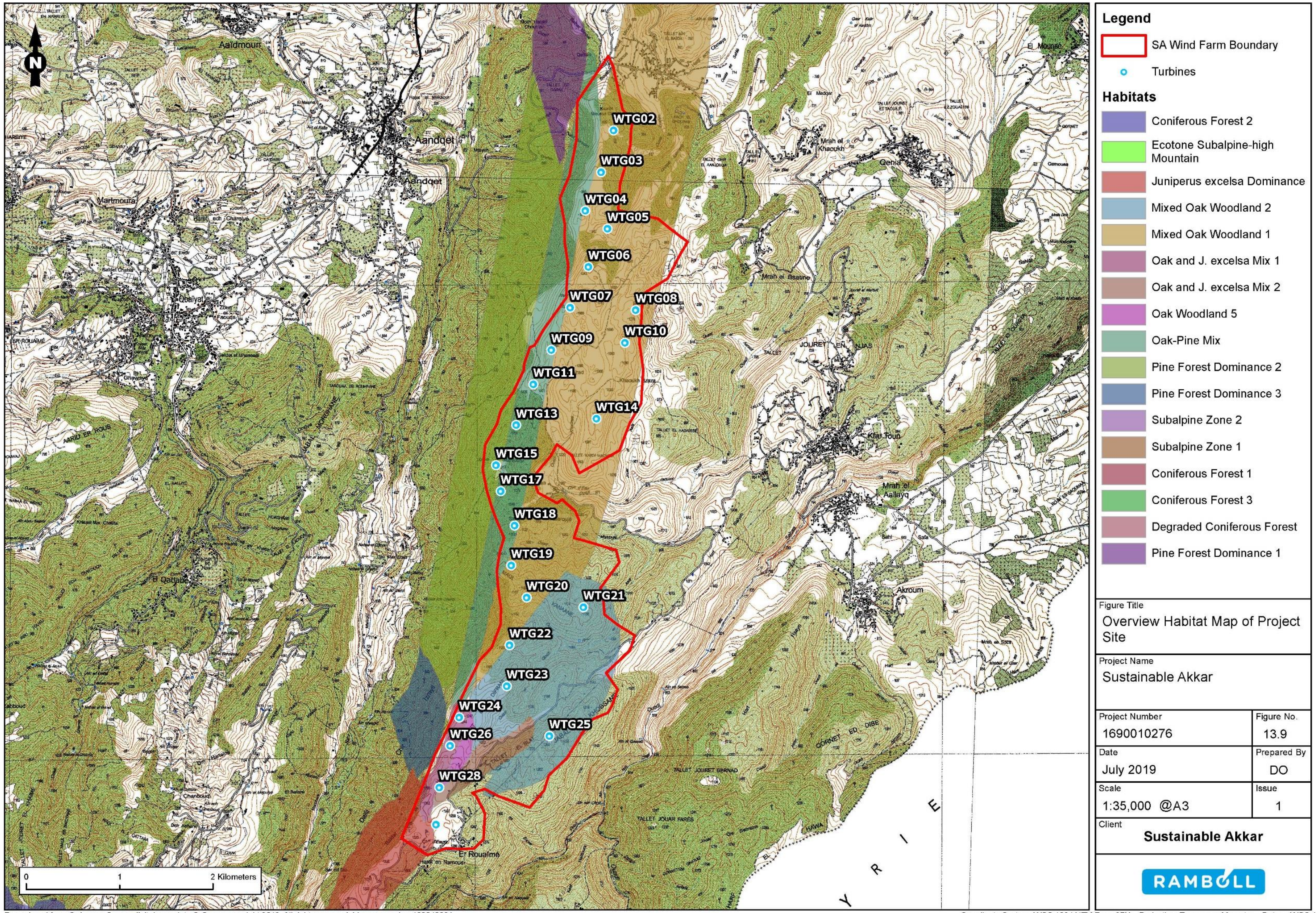
Figure 13-7 Barren Land and Grassland in Khokh Bziza (Kfartoun)

Figure 13-8 Overview Land Use Map of Project Site



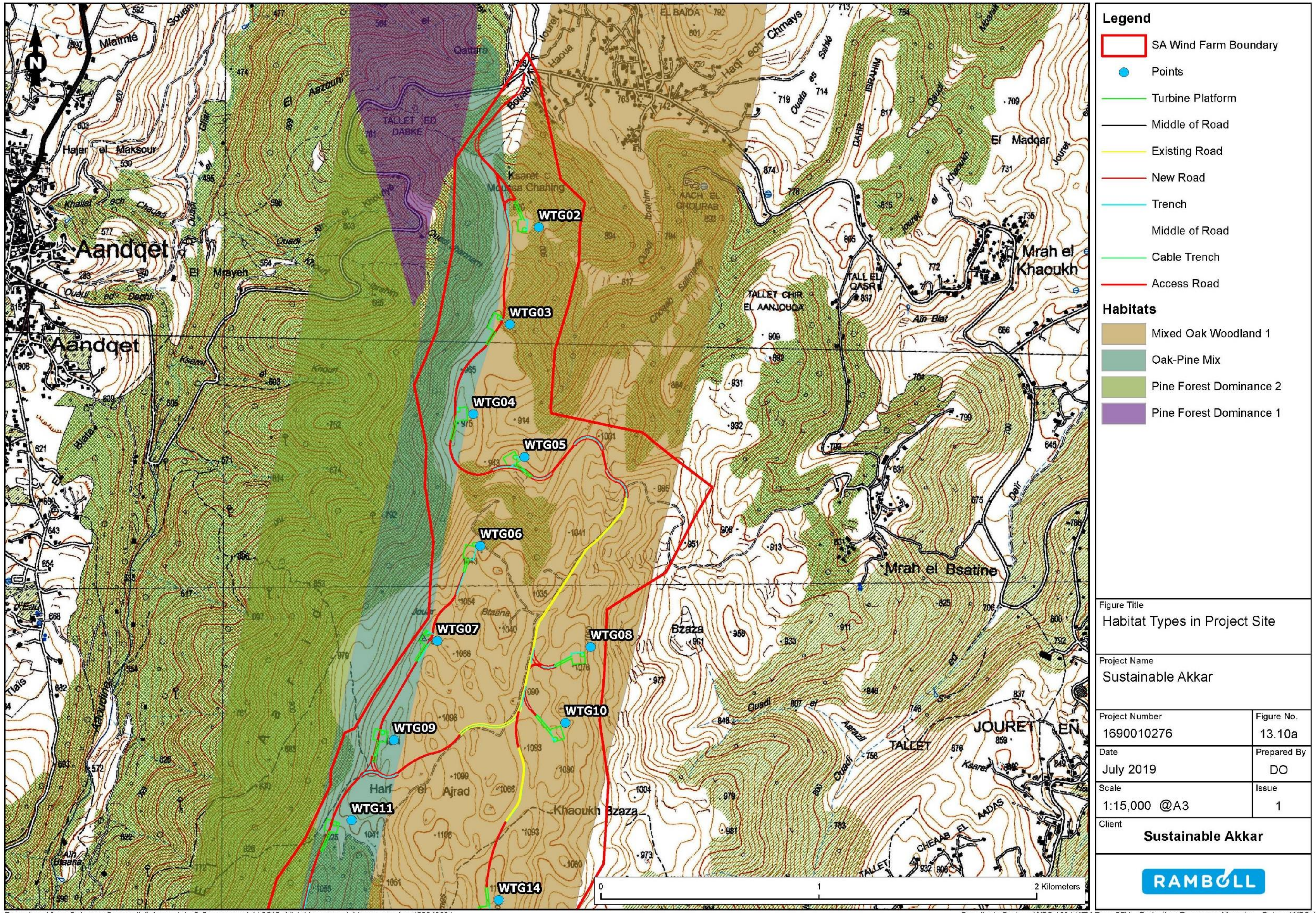
Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 13-9 Overview Habitat Map of Project Site



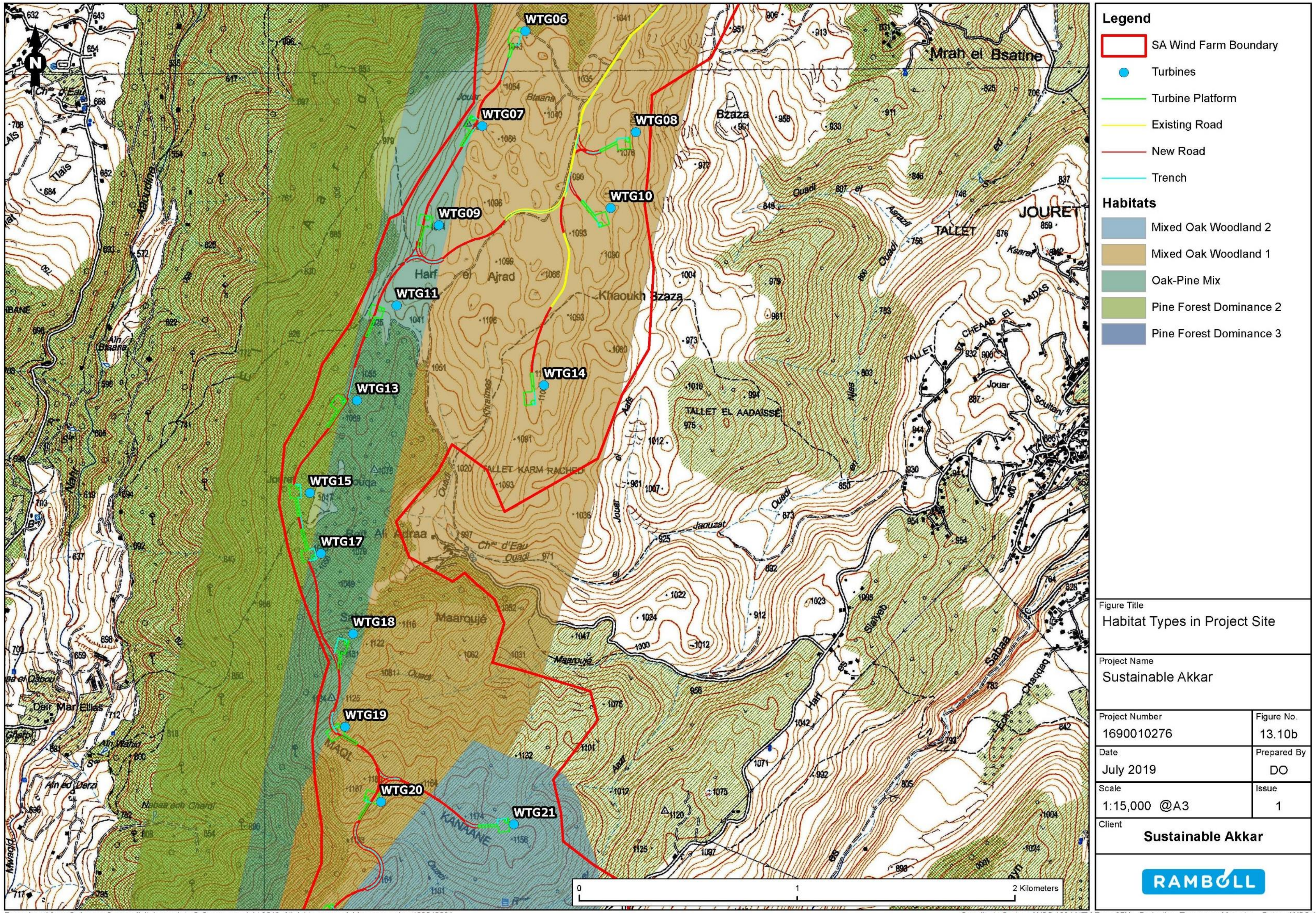
Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 13-10a Habitat Types in Project Site



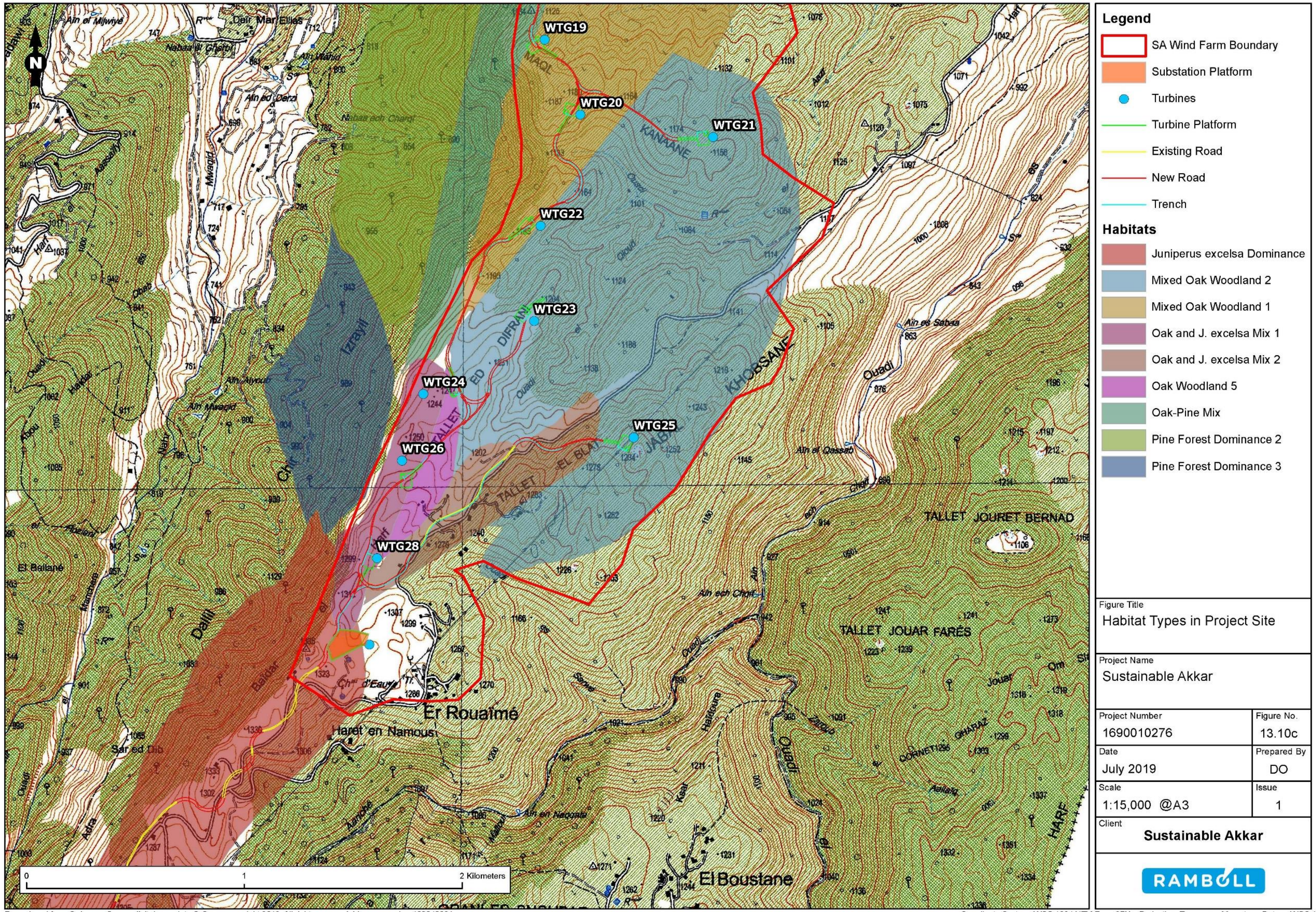
Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 13-10bHabitat Types in Project Site



Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 13-10c Habitat Types in Project Site



Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

14. ORNITHOLOGY

14.1 Introduction

The assessment of ornithological impacts of the Project has been undertaken on a dataset collected by local specialists at the direction of the Developer prior to the involvement of Ramboll in the Project. While it is acknowledged that this data was not collected following prescribed best practice guidance, it is emphasized that the data collected does, however, contain enough information to use as the basis for understanding the bird species, number of birds, flight length (time), flight height and whether the birds flew across the footprint of the proposed development and to undertake a Collision Risk Assessment (CRA), of which has subsequently been undertaken as described herein.

Survey data for the planned Hawa Akkar Wind Farm, located directly north of the Project, has also been used to undertake a separate CRA to provide alternative results.

Figures referenced are provided at the end of this section of the report.

14.1.1 Assessment Methodology and Significance Criteria

14.1.2 Method of Baseline Characterization

14.1.2.1 Desk Study

An ornithological desk study was undertaken reviewing reports on previous monitoring carried out for the area between 1997 and 2017. Baseline population data was sourced from online journals and scientific literature, these are reference in the text.

14.1.2.2 Field Survey

The ornithological field survey comprised three surveys:

- 20-minute point count (PC) survey.
- Vantage point (VP) surveys.
- Raptor nest survey incorporating an aerial survey to locate raptor nests on/within 5km of the site.

The primary impacts on bird species identified are collision risk, disturbance (including nest destruction) and displacement. The surveys undertaken, and the data collected allow assessment of these impacts to be undertaken. The ornithology assessment used the same definitions of Immediate, Middle and Far Zone as defined earlier.

Survey periods were scheduled to cover the full range of daylight hours. Observation days were divided into two periods, morning (6am-12pm) and afternoon (12pm-6pm). The surveys were conducted by Dr. Ghassan Ramadan-Jaradi (Senior Ornithologist). Additional well-regarded Lebanese birdwatchers (Fouad Itani, Bassel Jumaa, Antoine Faissal, Michel Sawwan) contributed to the bird surveys.

Additionally, two trained people from the local community were used in the survey work. At the beginning of the campaign, the senior ornithologist delivered training to the trainees on the identification of species, filling in the field sheet and the application of the different methods described in this report. At the end of each survey day, each observer was responsible for inspecting his data forms for completeness, accuracy, and legibility. The senior ornithologist periodically reviewed data forms to ensure completeness and legibility and asked for the correction of any problems. The senior ornithologist reviewed species records and rejected records of species unlikely to be recorded on the site or at the wrong time of year. Any changes made to the data forms were signed and dated by the person making the change. Details of the training methodology is provided in **Appendix Q**.

It should be noted that the field surveys undertaken were initially done so for academic research and this continues to be a use of the data collected. The surveys were not designed to collected data to be used to assess potential impacts from a wind farm. However, the data collected did include sufficient information to undertake a CRA; including species recorded, number of birds, height flown at, time recorded for and sufficient location information to define if the records cross the Project site at collision risk height. Following discussion with the senior ornithologist and a review of the many ornithological publications he has produced in Lebanon it is considered that the dataset provided is comprehensive and robust.

Point Count Survey

The Point Count (PC) survey was undertaken over multiple years (1997[94]-2019). This survey was designed to record passerine and songbird species that would not be recorded during the other flight surveys, however larger species of bird were recorded with sufficient information to supplement flight survey data. Surveys were spread throughout the year, as shown in **Table 14-1**. The semi-quantitative '20-minute point-count method' was used whereby all species noted during this time period are recorded (Ramadan-Jaradi, 1975; Ramadan-Jaradi, 1984). The bird expert completing the surveys was familiar with the identification of birds not only through sightings but also through their calls and songs from a distance. The 25 survey visits with 20 minutes of survey each time resulted in 8 1/3 hours of survey coverage. Eight survey points were used with each point count covering a circle of 500 m diameter. These PC locations are shown on **Figure 14-1**. It is noted that the PC survey was not designed and/or intended to provide territory maps for the species recorded and cannot be used to inform potential spatial mitigation.

[94] Surveys undertaken between 1997-2010 were carried out sporadically, not following a strict survey schedule as such.

Table 14-1 Point Count Survey Visits and Previous Surveys

Survey Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sporadic Surveys 1997-2010	X	X	X	X	X	X	X	X	X	X	X	X
2013			1,2									
2014			3	4	5	6						
2016			7	8								
2017					9	10		11	12,13	14	15	
2018		16	17	18				19,20	21			
2019		22	23,24	25								

Vantage Point Surveys

A program of (VP) surveys was also undertaken at the site. Three (3) VP locations were used to cover the site with each covering a 2km viewshed. The VP locations are shown on **Figure 14-2**. Full 360° viewsheds are provided as the surveys undertaken would record species approaching from any direction. These surveys were designed to capture detailed flight information of birds crossing the proposed development and characterize their flight activity, particularly migrating and soaring birds that are vulnerable to collision with the proposed development. The data collected was similar to the PC survey; species, number of birds, flight length (time), flight height and whether the birds flew across the footprint of the proposed development. This data was then used to undertake the CRA. Surveys were undertaken as shown in **Table 14-2**, with each survey lasting eight hours.

Table 14-2 Vantage Point Survey Schedule

VP Visit	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7	Visit 8
VP Location 1	08/03/13	06/05/14	14/04/16	03/11/16	07/08/17	27/03/18	13/09/18	05/11/18
VP Location 2	16/03/14	07/03/16	08/05/17	04/09/17	03/10/17	26/04/18	09/10/18	05/11/18
VP Location 3	25/03/13	05/04/14	02/06/14	17/09/17	16/10/17	11/05/18	21/10/18	05/11/18

This resulted in a total of 58 hours of survey effort per VP completed across multiple years. Even when supplemented by the PC survey effort, an additional 8 1/3 hours, this is recognized as being short of the recommended survey effort; 36 hours per survey season (breeding and non-breeding) totaling 72 hours over the course of a single year[95]. A total of 96 hours (32 hours per VP) of Spring Migration

[95] SNH (2017) Recommended bird survey methods to inform impact assessment of onshore wind farms, version 2. SNH Guidance.

survey was completed, with 78 hours (26 hours per VP) of Autumn migration survey. Further surveys are proposed to further inform the CRA. These are described in **Section 14.8.1**.

The survey results for the Project have been supplemented by the results of similar surveys at the planned Hawa Akkar, a proposed wind farm that lies directly north of the Project on the same topographical feature. This survey was completed over a shorter period (over one year) with a level of survey effort that meets the SNH Guidance, with 96 hours of VP data and 59 hours of PC data collected. Data from these surveys is considered suitable to be used to supplement the Sustainable Akkar data as both projects exist on the same geographical feature. Birds flying south on migration would pass both Hawa Akkar and Sustainable Akkar wind farms and the same is true for when birds are returning north.

Raptor Nest Surveys

Raptor Nest Surveys were undertaken to identify any raptor territories within the zone of influence of the wind farm. The focal species for the nesting surveys were common kestrel *Falco tinnunculus* (resident) and short-toed snake eagle *Circaetus gallicus* (summer breeding). All are known to breed in the vicinity of the study area. Surveyors were familiar with their identification and their reproduction behavior and calls when they bring food to the nest.

14.1.3 Assessment of Potential Impacts

In order to follow best practice guidance on ecological impact assessment[96], the biodiversity impact assessment follows a similar approach to the other assessments within this ESIA. Features are evaluated, and impacts are characterized in a similar fashion. However, rather than a matricized approach that provides a scale of impact significance from negligible to critical, it follows an approach of identifying whether an impact would lead to an "ecologically significant effect" for the feature, e.g. species or habitat type. An ecologically significant effect is an effect that either undermines or, in the case of a positive impact, supports biodiversity conservation objectives for 'important ecological features' or for biodiversity in general.

14.1.3.1 Feature Evaluation

Habitats and species (i.e. biodiversity features) identified within the study area have been assigned values using the standard CIEEM scale that classifies biodiversity features within a defined geographic context[97]. The classification uses recognized and published criteria.[98,99] where the biodiversity features are assessed in relation to their size, diversity, naturalness, rarity, fragility, typicalness, connectivity with surroundings, intrinsic value, recorded history and potential value. **Table 14-3** describes the frame of reference that has been used for the impact assessment.

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[96] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[97] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.
[98] Ratcliffe, D. (1977), *A Nature Conservation Review*. Cambridge: Cambridge University Press.
[99] Wray, S., Wells, D., Long, E. and Mitchell-Jones, T. (2010), *Valuing Bats in Ecological Impact Assessment*. In Practice. December 2010 pp23-25. Winchester: CIEEM.

Table 14-3 Geographic Importance

Geographic Importance	Examples
International	Internationally designated sites including Important Bird Areas (IBA) other Key Biodiversity Areas (KBA) Ramsar Site, Biogenetic Reserve, World Heritage Site, Biosphere Reserve, and potential Ramsar Sites; discrete areas which meet the published selection criteria for international designation, but which are not themselves designated as such. Resident or regularly occurring populations of species which may be considered at an international level, the loss of which would adversely affect the conservation status or distribution of the species at an international level; or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.
National	Nationally designated sites, Nature Reserves Marine Nature Reserve; discrete areas which meet the published selection criteria for national designation, but which are not designated as such. Resident or regularly occurring populations of species, the loss of which would adversely affect the conservation status or distribution of the species across Lebanon or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.
Regional	Viable areas of key habitat identified as being of regional value or smaller areas of such habitat which are essential to maintain the viability of a larger whole. Resident or regularly occurring populations of species, the loss of which would adversely affect the conservation status or distribution of the species across the region; or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.
Local	Features of local value include areas of habitat or populations/communities of species considered to appreciably enrich the habitat resource within the immediate surrounding area, for example, species-rich hedgerows. Resident or regularly occurring populations of species, the loss of which would adversely affect the conservation status or distribution of the species across the immediate surrounding area; or where the population forms a critical part of a wider population; or the species is at a critical phase of its life cycle.

14.1.3.2 Criteria for Characterizing Impacts

The potential impacts upon biodiversity features have been considered in relation to the Project. The impacts have been assessed without consideration of any specific mitigation measures that might be employed. The assessment of likely impacts has been made in relation to the baseline conditions of the study area. The likely impacts of development activities upon biodiversity features have been characterized as detailed in **Table 14-4**.

It is noted that the assessment only describes those characteristics relevant to understanding the impact and determining the significance of the effect.

Table 14-4 Impact Characterization

Parameter	Description
Direction	Impacts are either adverse (negative) or positive.
Magnitude	This is defined as high, moderate, low or negligible, with these being classified using the following criteria: High: Total/near total loss of a population due to mortality or displacement or major reduction in the status or productivity of a population due to mortality or displacement or disturbance. Total/near total loss of a habitat. Medium: Partial reduction in the status or productivity of a population due to mortality or displacement or disturbance. Partial loss of a habitat. Low: Small but discernible reduction in the status or productivity of a population due to mortality or displacement or disturbance. Small proportion of habitat lost. Negligible: Very slight reduction in the status or productivity of a population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the 'no change' situation. Slight loss of habitat that is barely discernible from the habitat resource as a whole.
Extent	The area over which an impact occurs, i.e. the impact's area of influence.
Duration	The time for which the impact is expected to last prior to recovery of the biodiversity feature or replacement of the feature by similar resource (in terms of quality and/or quantity). This is expressed as a short term, medium term, or long-term effect relative to the biodiversity feature that is impacted.
Reversibility	Irreversible impacts: permanent changes from which recovery is not possible within a reasonable time scale or for which there is no reasonable chance of action being taken to reverse it. Reversible impact: temporary changes in which spontaneous recovery is possible or for which effective mitigation (avoidance/cancellation/reduction of impact) or compensation (offset/recompense/offer benefit) is possible.
Frequency and timing	The number of times an activity occurs will influence the resulting effect (if appropriate, described as low to high and quantified, where possible). The timing of an activity or change may result in an impact if it coincides with critical life-stages or seasons e.g. the badger breeding season.

14.1.3.3 Significance Criteria

Impact significance was evaluated using the approach specified in Annex 9 of Decision 261/1 (June 2015) for the review of EIA studies at the MOE, whereby various sources of impacts are addressed for the Project's different implementation phases.

Significant effects are assessed with reference to the geographical importance of the biodiversity feature. However, the scale of significance of an effect may not be the same as the geographic context in which the feature is considered important. For example, an effect on a species which is on a national list of species of principal importance for biodiversity may not have a significant effect on its national population.

The potential for significant effects, in the absence of mitigation, has been determined with reference to the geographic conservation importance and the criteria in **Table 14-3**. By referring to the criteria in **Table 14-4**, the assessment seeks to characterize the magnitude of the effects in space and time.

Mitigation and/or compensation is proposed for all effects considered to be significant. Where appropriate, as a good practice measure, additional controls and/or compensation may be proposed.

Residual effects are characterized as either positive or adverse and either significant or not significant, taking account of mitigation and/or compensation proposals.

14.1.3.4 Collision Risk Assessment

Collision risk models are used to predict the potential collision risk that a development presents to flying birds. There are many different models that have been proposed, each with their own strengths and weaknesses. This assessment has been undertaken following the "Band" Model"[100] developed by Scottish Natural Heritage (SNH). This model is the accepted method of collision risk assessment used on wind farm developments in the United Kingdom. It is a simple model with the only inputs relating to the bird species recorded and the design of the wind farm/individual turbines. For this reason, the model can be applied to the Project. The Band Model can be used to assess two scenarios:

1. Where birds are recorded making regular flights across a proposed wind farm location.
2. Where birds are recorded regularly using the airspace of a proposed wind farm location.

Scenario 1: Birds Making Regular Flights Across the Project Site

In this scenario, birds are transiting the Project site twice each year: Once migrating north in the spring, and again migrating south in the autumn. This method is relevant for all but two of the species for which collision risk is considered to present a potential risk. All species, apart from common kestrel and short-toed snake eagle, pass the Project site only during the spring and autumn migration seasons.

The data gathered during the two field survey programs, the VP and the point count surveys, were used to estimate the hourly activity rate for each species. The number of active daylight hours was calculated using the latitude of the Project site for March, April and May (the spring season) and for August, September and October (the autumn season). These were the months when the migration season VP surveys were undertaken.

The estimate of hourly activity was then multiplied by the hourly activity rate to provide an estimate of the number of birds passing through the Project site each year. The number was then decreased by calculating the probability of a bird being hit by a turbine blade. This is a complicated calculation that is based on a spreadsheet provided by SNH[101]. Traits like longer wingspans, longer body length or slower flights result in an increased likelihood of collision.

[100] SNH (2000) Windfarms and Birds: Calculating a Theoretical Collision Risk Assuming No Avoiding Action. SNH Guidance.
[101] https://www.nature.scot/wind-farm-impacts-birds-calculating-probability-collision, accessed 14 February 2019.

All of the above calculations assume no avoiding action on the behalf of the bird. Different species have different capabilities to avoid turbines based off their flight style and wing loading (i.e. the weight of the bird compared with the surface area of its wings). SNH provide guidance[102] for the use of avoidance rates, which is based on post-construction monitoring data from wind farms across the world. Where a specific avoidance rate is not provided, and a proxy species cannot be defined, a default avoidance rate of 98% is defined.

The estimate of collision mortality for a year is then calculated as follows:

Estimate of Flights Crossing the Wind Farm per Year	x	Probability of Collision With a Turbine Blade	x	Avoidance Rate	=	Estimate of Collision Mortality

Scenario 2: Birds Using the Airspace of the Project Site

Common kestrels are resident within the Project site and short-toed snake eagles are summer visitors to the Project site, with both species assessed by the model that considers birds using the airspace of the Project site. In this scenario, the total time that a species spends flying at collision risk height within the Project site is calculated. This is scaled up, as in the previous method, to provide an estimate of total flight time across a year. This is multiplied by the total volume of the Project site that is swept by the turbine blades to calculate the bird occupancy of the rotor swept volume. This is then multiplied by the time it takes for a bird to pass through this rotor swept area to calculate the total number of birds passing through the rotor swept area per year.

Similar to Scenario 1, this number is reduced by multiplying by the probability of collision with a turbine blade and the avoidance rate as below:

Number of Birds Passing Through Rotors per Year	x	Probability of Collision With a Turbine Blade	x	Avoidance Rate	=	Estimate of Collision Mortality

14.1.3.5 Limitations and Assumptions

Limitations of the point count method occurred during breeding seasons due to the fact that on days of heavy bird movement, it was not possible to individually count the number of passing birds, and an estimate had to be made as a result. In addition, some birds were only identified through capture with a camera from a distance. Surveys were frequently undertaken by more than one surveyor to assist with recording large numbers of birds.

The 58 hours of migration season VP data collected at each location is less than the minimum survey effort required in guidance from SNH[103], which sets out 72 hours collected across a full year, 36 hours in the breeding season and 36 hours in the non-breeding season. The data collected has already been supplemented by PC data collected over 25 visits, which includes visits in winter and summer months

[102] SNH (2018) Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model. SNH Guidance.
[103] SNH (2017) Recommended bird survey methods to inform impact assessment of onshore wind farms. SNH Guidance Series.

when VP surveys were not undertaken. The data has also been supplemented with similar data collected at the planned Hawa Akkar wind farm, located directly north of the proposed development. The level of survey effort (96 hours of VP survey and 60 hours of PC survey) undertaken at the planned Hawa Akkar between February 2018 and January 2019 is more than the level recommended by SNH Guidance.

The study area boundaries are being refined as part of the process to update the ESIA. However, the use of the existing study area is not considered to be a material gap in this assessment.

14.2 Baseline Conditions

14.2.1 Protected Sites

The Upper Mountains of Akkar-Donnieh Important Bird Area (IBA) is located approximately 5km to the south-west of the Project site, as shown in **Figure 14-3,** at the end of this report. It contains habitats very similar to those found within the Project site, namely pine, oak and juniper dominated woodland types with high altitude sparsely vegetated alpine areas. The IBA trigger species are mostly small resident or breeding song birds, namely:

- *Poecile lugubris* (sombre tit).
- *Hippolais languida* (Upcher's warbler).
- *Sitta neumayer* (western rock nuthatch).
- *Irania gutturalis* (white-throated robin).
- *Oenanthe finschii* (Finsch's wheatear).
- *Carpospiza brachydactyla* (pale sparrow).
- *Serinus syriacus* (Syrian serin).

It is also noted that up to 50,000 soaring birds pass through the area each year, with the IBA being more important in the autumn when large flocks of *Accipiter brevipes* (Levant Sparrowhawk), *Pelecanus onocrotalus* (Great White Pelican) *Grus grus* (Common Crane) and *Ciconia ciconia* (White Stork) pass over it[104]. Reports of the migration activity around the Project site are provided in **Appendix Q**.

The citation also lists the following species, although they are not classed as IBA trigger species:

- Tawny owl *Strix aluco*.
- Masked shrike *Lanius nubicus*.
- Sardinian warbler *Sylvia melanocephala*.
- Black-eared wheater *Oenanthe hispanica.*
- Crimson-winged finch *Rhodopechys sanguineus*.
- Black-headed bunting *Emberiza melanocephala*.

14.2.2 Endangered Species

Three endangered and one critically endangered bird species are found in Lebanon:

[104] BirdLife International (2018) Important Bird Areas factsheet: Upper Mountains of Akkar-Donnieh. Downloaded from http://www.birdlife.org on 25/10/2018.

- Steppe Eagle *Aquila nipalensis* Endangered (passage).
- Saker Falcon *Falco cherrug* Endangered (passage and wintering).
- Egyptian Vulture *Neophron percnopterus* Endangered (passage breeding).
- Sociable Lapwing *Vanellus gregarius* Critically endangered (passage).

14.2.3 Site Conditions

Further details on the site conditions and observations from the field surveys are provided in **Appendix Q.**

14.2.4 Field Survey Results

14.2.4.1 Non-Collision Risk Species

Based on the Point Counts, a species list was generated that includes all resident breeding species, summer breeding species, wintering, and migratory birds. A total of 102 species of bird were recorded during the PC surveys for Sustainable Akkar. A summary of this is presented in **Table 14-5**, showing the degree of occurrence during the surveys.

Table 14-5 Summary of Point Count Results

Degree of Occurrence	Number of Species	% of Species
Common	31	36
Uncommon	31	36
Scarce	14	16
Rare	6	7
Very Rare	4	5

The rare species recorded were:

- Alpine accentor *Prunella collaris*.
- Blue rock thrush *Monticola solitarius*.
- Common reed bunting *Emberiza schoeniclus*.
- Greater spotted eagle *Clanga clanga*.
- Stock dove *Columba oenas*.
- Winter wren *Troglodytes troglodytes*.

The very rare species recorded include:

- Cinereous vulture *Gyps monachus*.
- Egyptian vulture *Neophron percnopterus*.
- Eurasian Griffon Vulture *Gyps fulvus*.
- Imperial eagle *Aquila heliaca*.

Of the species for which the Mountains of Akkar-Donnieh IBA is classified, western rock nuthatch and pale rockfinch *Carpospiza brachydactyla* were both recorded during the PC surveys. However, given the distance of the IBA from the Project site (approximately 5km) it is extremely unlikely that birds from the IBA would be also recorded on the project site, due to the small territories that passerines typically use.

Of the endangered species recorded in Lebanon, steppe eagle and Egyptian vulture were both recorded at a very low level and no records were made of saker falcon or sociable lapwing.

14.2.4.2 Collision Risk Species

Survey results for the species considered to be vulnerable to turbine collision risk, collected during the PC and VP surveys, are summarized in **Table 14-6**. Further survey results are presented in **Appendix Q**. The baseline population for each species, used to assess the predicted collision mortality against in the CRA, is highlighted in bold.

Table 14-6 Species Accounts of Collision Risk Species

Species	Species Account
Common Name: White stork **Scientific Name:** *Ciconia ciconia* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant **Assessment Importance:** International	White stork flights were recorded during the migration season VP surveys in March 2013, May 2014, March 2016, May 2017, May 2018 and October 2018. The seven flights recorded involved 93 birds, with groups of one, four, seven, 12 and 17 birds and two flocks of 26 birds recorded. Of the 93 birds recorded, one was recorded crossing the site at collision risk height. White stork was recorded during the year-round PC surveys in March 2013, March and June 2014, March 2016, June 2017, February, March and June 2018 and February and March 2019. The 14 records involved 127 birds. Of these 127 birds, three were recorded crossing the site at collision risk height. White storks are a common summer migrant species in Lebanon and recorded in large numbers. The population migrating over Lebanon is approximately **14,300 birds**[105]. These birds are a significant part of the estimated European population of 447,000–495,000[106]. The white storks using the Project site are considered to be of international importance. White stork are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Black Stork **Scientific Name:** *Ciconia nigra* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant	Black stork flights were recorded during the migration season VP surveys in April, October and November 2018. The three flights recorded involved eight and nine (two records) birds. None of these birds were recorded crossing the site at collision risk height. Black stork flights were not recorded during the year-round PC surveys. Black storks migrate through Lebanon in much lower numbers than white storks. The population migrating over Lebanon is approximately **1,300 birds**[107]. This is a significant proportion of

[105] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[106] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[107] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.

Species	Species Account
Assessment Importance: International	the estimated European population of 19,500 to 27,800 birds[108]. The population of black storks using the Project site are considered to be of international importance. Black stork are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Great white pelican **Scientific Name:** *Pelecanus onocrotalus* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant **Assessment Importance:** International	White pelican flights were recorded during the migration season VP surveys in April 2014, June and November 2016, October 2017 and November 2018 (two flights). The six flights recorded involved 94 birds, with groups of four, six, seven, 11, 21 and 45 birds. Of the 94 birds recorded, none were recorded crossing the site at collision risk height. White pelican was recorded during the year-round PC surveys in April 2014, May and November 2017, February, April and September 2018 and March and April 2019. The ten records involved 109 birds, with groups of between four and 21 birds. Of the 109 birds recorded, 11 were recorded crossing the site at collision risk height. Great white pelicans are a common summer migrant species in Lebanon and recorded in large numbers. The population migrating over Lebanon is approximately **2,366 birds**[109]. This is a significant proportion of the estimated European population of between 9,700–11,100 birds (Birdlife International, 2015)[110]. The great white pelicans using the Project site are considered to be of international importance. White pelican are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: European honey buzzard **Scientific Name:** *Pernis apivorus* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant **Assessment Importance:** International	Honey buzzard flights were recorded during the migration season VP surveys in May and June 2014, April 2016 and May, August and September 2017, April, May and September and October 2018. The 18 flights recorded involved 177 birds, with groups of between one and 33 birds. Of the 177 birds recorded, one was recorded crossing the site at collision risk height. Honey buzzard was recorded during the year-round PC surveys in June 2014, April 2016 and May, June, August and September 2017 and August 2018. The 12 records involved 89 birds. Of these 89 birds, four were crossing the site at collision risk height. Honey buzzards are a common summer migrant species in Lebanon and recorded in large numbers. The population migrating over Lebanon is approximately **4,685 birds**[111]. These birds are a significant part of the estimated world population of 280,000–420,000[112]. The honey buzzards using the Project site are considered to be of international importance.

[108] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[109] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[110] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[111] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[112] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
	Honey buzzard are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Black kite **Scientific Name:** *Milvus migrans* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant, Winter Visitor **Assessment Importance:** Regional	Black kite flights were recorded in March, September, October and November 2018. The four flights recorded involved 22 birds. None of the birds recorded crossed the site at collision risk height. Black kite was recorded during the year-round PC surveys in April 2014, September 2017, April and September 2018 and April 2019. The five records involved 26 birds. Of these 26 birds, none were recorded at collision risk height or crossing the site. Black kites are a summer migrant species in Lebanon and recorded in medium numbers. The population migrating over Lebanon is approximately **222 birds**[113]. These birds are not a significant part of the estimated European population of 162,000–218,000[114]. The black kites using the Project site are considered to be of regional importance. Black kite are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Egyptian vulture **Scientific Name:** *Neophron percnopterus* **IUCN Status:** Endangered **Seasonality on Site:** Passage Migrant **Assessment Importance:** Regional	An Egyptian vulture flight was recorded during the migration season VP surveys in September 2017. The flight recorded involved a single bird which was not recorded at collision risk height or crossing the site. Egyptian vultures were not recorded during the year-round PC surveys. Egyptian vultures are a rare summer migrant species in Lebanon and recorded in small numbers. No population given for Lebanon[115]. Over a five-year period in the mid-nineties an average of **143 birds** were recorded migrating over Palestine[116]. These birds are not a significant part of the estimated European population of 6,000–9,400[117]. The Egyptian vultures using the Project site are considered to be of regional importance. Egyptian vulture are listed on Annex 1 of the Birds' Directive as a European threatened species.

[113] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[114] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[115] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[116] Shirihai, Hadoram & Yosef, Reuven & Alon, Dan & Kirwan, Guy & Spaar, Reto. (2000). Raptor Migration in Israel and the Middle East: A Summary of 30 Years of Field Research.
[117] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Cinereous vulture **Scientific Name:** *Aegypius monachus* **IUCN Status:** Near Threaten **Seasonality on Site:** Passage Migrant **Assessment Importance:** Regional	A cinereous vulture flight was recorded during the migration season VP surveys in April 2014. The flight recorded involved a single bird which was not recorded at collision risk height or crossing the site. Cinereous vultures were not recorded during the year-round PC surveys. Cinereous vultures are a rare summer migrant species in Lebanon and recorded in small numbers. Prior to surveys for Sustainable Akkar, no cinereous vulture flights had been recorded during the previous decade[118,119]. The baseline population has been set at **one bird**. These birds are not a significant part of the estimated European population of 4,600–5,000[120]. The cinereous vultures using the Project site are considered to be of regional importance.
Common Name: Levant sparrowhawk **Scientific Name:** *Accipiter brevipes* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant **Assessment Importance:** International	Levant sparrowhawk flights were recorded during the migration season VP surveys in March 2013, April 2014, April 2016, September and October 2017, April, September and October 2018 and April 2019. The 15 flights recorded involved 327 birds, with groups of between two and 150 birds. Of the 327 birds recorded, none were recorded crossing the site at collision risk height. Levant sparrowhawk was recorded during the year-round PC surveys in March and May 2014, March and April 2016, September and October 2017, April and September 2018 and April 2019. The 11 records involved 111 birds. Of these 111 birds, none were recorded at collision risk height and crossing the site. Levant sparrowhawk are a common summer migrant species in Lebanon and recorded in large numbers. The population migrating over Lebanon is approximately **3,210 birds**[121]. These birds are a significant part of the estimated world population of 10,000–19,999[122]. While it is noted that the global population has decreased between these population estimates, the clear pattern is that a significant proportion of the global population migrates over Lebanon. The levant sparrowhawk using the Project site are considered to be of international importance. Levant sparrowhawk are listed on Annex 1 of the Birds' Directive as a European threatened species.

[118] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[119] As an indication of the level of hunting in Lebanon, the bird recorded during these surveys, potentially the first bird to fly over the country in a decade, was shot and killed after passing the site.
[120] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[121] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[122] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Eurasian sparrowhawk **Scientific Name:** *Accipiter nisus* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant, Winter Visitor **Assessment Importance:** Regional	Eurasian sparrowhawk flights were recorded during the migration season VP surveys in September and October 2017, May and October 2018 and April 2019. The five flights recorded involved seven birds. Of the seven birds recorded, one was recorded crossing the site at collision risk height. Eurasian sparrowhawk was recorded during the year-round PC surveys in April 2016, September 2017 and February 2018. These three records involved six birds, with one bird recorded crossing the site at collision height. Eurasian sparrow hawks are a summer migrant species in Lebanon and recorded in small numbers. The population migrating over Lebanon is approximately **124 birds**[123]. These birds are not a significant part of the estimated European population of 805,000–1,160,000[124]. The Eurasian sparrowhawks using the Project site are considered to be of regional importance.
Common Name: Steppe buzzard **Scientific Name:** *Buteo buteo vulpinus* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant, Winter Visitor **Assessment Importance:** Regional	Steppe buzzard flights were recorded during the migration season VP surveys in March 2014, March, April and November 2016, August and October 2017 and March, April, September, October and November 2018. The 14 flights recorded involved 52 birds, with groups of between one and 11 birds. Of the 52 birds recorded, none were recorded crossing the site at collision risk height. Steppe buzzard was recorded during the year-round PC surveys in March 2013, March, April and May 2014, April 2016, May, August, September, October and November 2017, February, March and August 2018 and March and April 2019. The 20 records involved 50 birds. Of these 50 birds, one was recorded crossing the site at collision risk height. Steppe buzzards are a summer migrant species in Lebanon and recorded in medium numbers. The population migrating over Lebanon is approximately **1,591 birds**[125]. The population estimate is 540,000–920,000[126]. The steppe buzzards migrating through Lebanon are not a significant part of this estimated population. The steppe buzzards using the project set are considered to be of regional importance.

[123] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[124] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[125] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[126] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Long-legged buzzard **Scientific Name:** *Buteo rufinus* **IUCN Status:** Least Concern **Seasonality on Site:** Resident, Passage Migrant, Winter Visitor **Assessment Importance:** Regional	Long-legged buzzard flights were recorded during the migration season VP surveys in March 2013, March and June 2014, April 2016, August and September 2017 and March and September 2018. The nine flights recorded involved 12 birds, with no groups of more than three birds. Of the 12 birds recorded, one was recorded crossing the site at collision risk height. Long-legged buzzard was recorded during the year-round PC surveys in March 2013, April and May 2014, March 2016, June, August and September 2017, February, March and August 2018 and March and April 2019. The eighteen records each involved 21 birds, with one bird recorded crossing the site at collision risk height. A long-legged buzzard nest was recorded approximately 2.5km to the west of the site. Long-legged buzzards are a rare summer migrant species in Lebanon and recorded in very small numbers. The population migrating over Lebanon is approximately **117 birds**[127]. These birds are not a significant part of the estimated world population of 139,000–226,000[128]. The long-legged buzzards using the Project site are considered to be of regional importance. Long-legged buzzard are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Lesser spotted Eagle **Scientific Name:** *Clanga pomarina* **IUCN Status:** Least Concern **Seasonality on Site:** Non-breeding Summer Visitor, Passage Migrant, Winter Visitor **Assessment Importance:** International	Lesser spotted eagle flights were recorded during the migration season VP surveys in March 2013, March, April and May 2014, March 2016, September and October 2017 and March, April, May, September and October 2018. The 24 flights recorded involved 182 birds, with no groups of between one and 34 birds. Of the 182 birds recorded, 19 were recorded crossing the site at collision risk height. Lesser spotted eagle was recorded during the year-round PC surveys in March 2013, March, April and May 2014, April 2016 and May, September and October 2017 and March 2019. The 14 records involved 58 birds. Of these 58 birds, four were recorded crossing the site at collision risk height. Lesser spotted eagles are a common summer migrant species in Lebanon and recorded in large numbers. The population migrating over Lebanon is approximately **5,234 birds**[129]. These birds are a significant part of the estimated world population of 44,900–60,500[130]. The lesser spotted eagles using the Project site are considered to be of international importance. Lesser-spotted eagle are listed on Annex 1 of the Birds' Directive as a European threatened species.

[127] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[128] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[129] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[130] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Greater spotted eagle **Scientific Name:** *Clanga clanga* **IUCN Status:** Vulnerable **Seasonality on Site:** Passage Migrant, Winter Visitor **Assessment Importance:** Regional	A greater spotted eagle flight was recorded during the migration season VP surveys in April 2016. This flight of a single bird was not at collision risk height and did not cross the site. Greater spotted eagle was not recorded during the year-round PC surveys. Greater spotted eagles are a rare summer migrant species in Lebanon and recorded in very small numbers. The population migrating over Lebanon is approximately **ten birds**[131]. These birds are not a significant part of the estimated world population of 5,000–13,200[132]. The greater spotted eagles using the Project site are considered to be of regional importance. Greater spotted eagle are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Eastern imperial eagle **Scientific Name:** *Aquila heliaca* **IUCN Status:** Vulnerable **Seasonality on Site:** Passage Migrant **Assessment Importance:** Regional	An imperial eagle flight was recorded during the migration season VP surveys in October 2017. The record involved a single bird but not at collision risk height and did not cross the site. No imperial eagle flights were recorded during the year-round PC surveys. Imperial eagles are a rare summer migrant species in Lebanon and were recorded in very small numbers. The population migrating over Lebanon is approximately **14 birds**[133]. These birds are not a significant part of the estimated world population of 3,750–14,999[134]. The imperial eagles using the Project site are considered to be of regional importance. Imperial eagle are listed on Annex 1 of the Birds' Directive as a European threatened species.

[131] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[132] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[133] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[134] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Steppe eagle **Scientific Name:** *Aquila nipalensis* **IUCN Status:** Endangered **Seasonality on Site:** Passage Migrant **Assessment Importance:** Regional	Steppe eagle flights were recorded during the migration season VP surveys in October 2017 and April and October 2018. The records each involved a single bird, with none of these records crossing the site at collision risk height. A steppe eagle flight was recorded during the year-round PC surveys in April 2014. The record involved three birds but not at collision risk height and did not cross the site. Steppe eagles are a rare summer migrant species in Lebanon and were recorded in small numbers. The population migrating over Lebanon is approximately **16 birds**[135]. These birds are not a significant part of the estimated world population of 62,744[136]. The steppe eagles using the Project site are considered to be of regional importance.
Common Name: Booted eagle **Scientific Name:** *Hieraaetus pennatus* **IUCN Status:** Least Concern **Seasonality on Site:** Breeding Summer Visitor, Passage Migrant, Winter Visitor **Assessment Importance:** Regional	Booted eagle flights were recorded during the migration season VP surveys in April 2016, May and September 2017 and March, September and October 2018. The six flights recorded involved six birds. Of the six birds recorded, none were recorded crossing the site at collision risk height. Booted eagle was recorded during the year-round PC surveys in March and April 2014, September 2017 and April and September 2018. The six records each involved a single bird, with none crossing the site at collision risk height. Booted eagles are a rare summer migrant species in Lebanon and recorded in small numbers. The population migrating over Lebanon is approximately **56 birds**[137]. These birds are not a significant part of the estimated world population of 149,000–188,000[138]. The booted eagles using the Project site are considered to be of regional importance. Booted eagle are listed on Annex 1 of the Birds' Directive as a European threatened species.

[135] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[136] BirdLife International (2019) Species factsheet: Aquila nipalensis. Downloaded from http://www.birdlife.org on 10/07/2019.
[137] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[138] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Short-toed snake eagle **Scientific Name:** *Circaetus gallicus* **IUCN Status:** Least Concern **Seasonality on Site:** Breeding Summer Visitor, Passage Migrant **Assessment Importance:** Regional	Short-toed snake eagle flights were recorded during the migration season VP surveys in March 2013, April 2014, September and October 2017 and April and October 2018. The seven flights recorded involved 17 birds, with no groups of more than six birds. Of the 17 birds recorded, nine were recorded crossing the site at collision risk height. Short-toed snake eagle were recorded during the year-round PC surveys in March 2013, March, April and June 2014, September and October 2017, April and September 2018 and April 2019. The twelve records involved 27 birds. Of these 27 birds, four were recorded crossing the site at collision risk height. A short-toed snake eagle nest was recorded approximately 2.5km to the south-east of the proposed development. Short-toed snake eagles are a common summer visitor to Lebanon and are frequent on passage. The population migrating over Lebanon is approximately **488 birds**[139]. These birds are not a significant part of the estimated European population of 35,100–41,800[140]. The short-toed snake eagle using the Project site are considered to be of regional importance. Short-toed snake eagle are listed on Annex 1 of the Birds' Directive as a European threatened species.
Common Name: Common kestrel **Scientific Name:** *Falco tinnunculus* **IUCN Status:** Least Concern **Seasonality on Site:** Resident, Passage Migrant, Winter Visitor **Assessment Importance:** Local	Kestrel flights were recorded during the migration season VP surveys in March 2013, March, April and June 2014, March, April and November 2016, May and October 2017 and March, September and October 2018. The 13 flights recorded involved 22 birds, with no groups of more than five birds. Of the 22 birds recorded, four were recorded crossing the site at collision risk height. Kestrels were recorded during the year-round PC surveys in March 2013, March and June 2014, March 2016, October 2017, February, April, August and September 2018 and March and April 2019. The seventeen records involved 25 birds. Of these 25 birds, nine were recorded crossing the site at collision risk height. Common kestrels are common and widespread in Lebanon. The population of common kestrels using the site are considered to be of local importance, and comprise **four birds** (the two couples, based on a similar population estimate made for Lebanon Wind Power, a development of similar size).

[139] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[140] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Eurasian hobby **Scientific Name:** *Falco subbuteo* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant **Assessment Importance:** Regional	No hobby flights were recorded during the migration season VP surveys. Hobby flights were recorded during the year-round PC surveys in May 2017 and April and September 2018. These flights involved nine birds, with none of these birds crossing the site at collision risk height. Hobby are an uncommon passage migrant. The population migrating over Lebanon is approximately **137 birds**[141]. These birds are not a significant part of the estimated European population of 184,000-295,000[142]. The hobbies using the Project site are considered to be of regional importance.
Common Name: Red-footed falcon **Scientific Name:** *Falco vespertinus* **IUCN Status:** Near Threatened **Seasonality on Site:** Passage Migrant **Assessment Importance:** National	Red-footed falcon flights were recorded during the migration season VP surveys in April 2014 and September and October 2017. These three flights involved six birds, a flight of four birds and two flights of one bird. Of these six birds, one bird was recorded flying at collision risk height and not crossing the site. A red-footed falcon flight was recorded in June 2014 and April 2019. The two flights involved three birds with neither crossing the site at collision risk height. Red-footed falcons are a common passage migrant in Lebanon. The population migrating over Lebanon is approximately **1,470 birds**[143]. This is not a significant part of the estimated world population of 300,000-800,000[144]. The red-footed falcons using the Project site are considered to be of national importance. Red-footed falcon are listed on Annex 1 of the Birds' Directive as a European threatened species.

[141] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[142] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.
[143] Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
[144] BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Species	Species Account
Common Name: Common crane **Scientific Name:** *Grus grus* **IUCN Status:** Least Concern **Seasonality on Site:** Passage Migrant, Winter Visitor **Assessment Importance:** National	Common crane flights were recorded during the migration season VP surveys in May 2014, November 2016, October 2017 and March, September and November 2018. The six flights recorded involved 55 birds, with no group of more than 13 birds. Of the 55 birds recorded, 15 were recorded crossing the site at collision risk height. Common crane flights were recorded during the year-round PC surveys in November 2017, February, March and August 2018 and February and March 2019. These six records involved 44 birds, with seven of these birds crossing the site at collision risk height. Common cranes are a common summer migrant species in Lebanon and recorded in large numbers. The population migrating over Lebanon is approximately **3,600 birds**[145]. These birds are not a significant part of the estimated world population of 490,000–504,999[146]. The common cranes using the Project site are considered to be of national importance. Common crane are listed on Annex 1 of the Birds' Directive as a European threatened species.

14.2.4.3 General Flight Patterns

The flight patterns recorded from vantage points indicates that during the spring migration, the migrating birds fly from south to north. During the autumn migration, the migrating birds fly from north to south. The highest level of flight activity was recorded from the PC locations to the west of the site, closest to the Oudine Valley. This confirms the assertion of the importance of the Oudine Valley to migrating birds.

Within the envelop of the wind turbines, the observer noted that 93% of the raptor species fly at altitudes above 200m over the Project area. The kestrel, short-toed snake eagle and long-legged buzzard fly at various levels but mainly at the level of the Rotor Swept Area. This is due to the fact that these species are foraging within the project site and commuting to their nest sites outside the study area.

14.2.5 Hawa Akkar Survey Results

The results of the Hawa Akkar VP and PC surveys are summarized in **Table 14-7**.

145 Serhal, A.A. & Khatib, B.C. (2014) The State of Lebanon's Birds and IBAs. Ministry of Environment.
146 BirdLife International (2019) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 10/07/2019.

Table 14-7 Results of Hawa Akkar Bird Surveys

Species	Total VP Records	VP Records at CRH and Crossing Site	Total PC Records	PC Records at CRH and Crossing Site
Black Kite	4	0	9	2
Booted Eagle	8	1	23	1
Common Buzzard	8	1	17	9
Common Crane	0	0	37	37
Eurasian Sparrowhawk	1	0	4	0
Greater Spotted Eagle	1	0	1	0
Hen Harrier	0	0	1	1
Honey Buzzard	41	6	108	56
Kestrel	19	12	48	29
Lesser Spotted Eagle	12	3	15	5
Levant Sparrowhawk	23	0	50	0
Long-legged Buzzard	13	1	27	12
Northern Goshawk	0	0	1	0
Peregrine Falcon	0	0	1	0
Short-toed Eagle	10	4	24	9
Steppe Buzzard	3	0	8	3
White Pelican	0	0	10	0
White Stork	21	0	58	15

14.2.6 Summary

The baseline assessment has identified a number of key biodiversity features which require further consideration within the assessment. These are summarized in **Table 14-8**. Potential impacts on the features are detailed in **Section 14.3**.

Table 14-8 Summary of Importance of Biodiversity Features

Feature	Importance	Justification
Upper Mountains of Akkar Donnieh IBA	International	The IBA contains an assemblage of upland woodland birds as well as listing upwards of 50,000 migratory soaring birds passing through the area each year.
Breeding Passerines	Regional	The suite of passerine species breeding within the site are considered to be of regional value. They include species which are locally rare and species for which the Upper Mountains of Akkar Donnieh IBA is designated.
White Stork	International	Baseline population of 14,300 is a significant proportion of European population of 447,000–495,000.
Black Stork	International	Baseline population of 1,300 is not a significant proportion of European population of 19,500–27,800.
White Pelican	International	Baseline population of 2,366 is a significant proportion of the European population of 9,700–11,100.
Honey Buzzard	International	Baseline population of 4,685 is a significant proportion of world population of 280,000–420,000.
Black Kite	Regional	Baseline population of 222 is a significant proportion of European population of 162,000–218,000.
Egyptian Vulture	Regional	Baseline population of 143 is not a significant proportion of European population of 6,000–9,400.
Cinereous Vulture	Regional	Baseline population of one is not a significant part of European population of 4,600–5,000.
Levant Sparrowhawk	International	Baseline population of 3,210 is a significant proportion of world population of 10,000–19,999.
Eurasian sparrowhawk	Regional	Baseline population of 124 is not a significant part of European population of 805,000–1,160,000.
Steppe Buzzard	Regional	Baseline population of 1,591 is not a significant proportion of world population of 540,000–920,000.
Long-legged Buzzard	Regional	Baseline population of 117 is not a significant part of world population of 139,000–226,000.
Lesser Spotted Eagle	International	Baseline population of 5,234 is a significant part of the estimated world population of 44,900–60,500.
Greater Spotted Eagle	Regional	Baseline population of ten is not a significant part of the world population of 5,000–13,200.
Eastern Imperial Eagle	Regional	Baseline population of 14 is not a significant part of the world population of 3,750–14,999.
Steppe Eagle	Regional	Baseline population of 16 is not a significant part of the world population of 62,744.
Booted Eagle	Regional	Baseline population of 56 is not a significant part of the world population of 149,000–188,000.

Feature	Importance	Justification
Short-toed Snake Eagle	Regional	Baseline population of 488 is not a significant part of the world population of 35,100–41,800.
Common kestrel	Local	Common kestrels are common and widespread in Lebanon. The population of common kestrels using the site (4 birds) are considered to be of local importance.
Hobby	Regional	Baseline population of 137 is not a significant part of the European population of 184,000–295,000.
Red-footed Falcon	National	Baseline population of 1,470 is not a significant part of the world population of 300,000-800,000.
Common Crane	National	Baseline population of 3,600 is not a significant part of the world population of 490,000–504,999.

14.3 Assessment of Potential Impacts

14.3.1 During Construction

14.3.1.1 Impacts on Designated Sites

Two species listed as qualifying species for Mountain of Akkar-Donnieh IBA were recorded during field surveys for the proposed development. Pale rockfinch was recorded in the middle zone and western rock nuthatch was recorded in the far zone. As neither species was recorded in the immediate zone, within the footprint of the proposed development, then no impacts are predicted on either species.

The IBA lists soaring birds and cranes (namely white stork, white pelican, Levant sparrowhawk and common crane) as another key feature. These species have not been recorded on the ground within the Project site during field surveys, they pass through the area on migration. As such, potential construction impacts would be limited to disturbance such as noise and light, from construction activities. Disturbance such as that would be a temporary, low magnitude indirect impact and would attenuate to levels unlikely to disturb species migrating through and over the area. The species listed were typically recorded flying high through the area. As such no ecologically significant effect is predicted.

14.3.1.2 Habitat Loss

Both temporary and permanent habitat loss are predicted as a result of the construction of the proposed development. Permanent loss would occur in the footprint of the infrastructure of the proposed development and from the construction of new permanent access tracks. Temporary, short-term habitat loss would occur at turbine bases, outside of the permanent hardstanding, and from the construction of new temporary access tracks that would be reinstated after construction. Direct habitat loss is assessed in **Section 13 Biodiversity**. Habitat loss is considered to result in an adverse, indirect, low magnitude, short-term, reversible impact on the community of birds breeding on the Project site which is considered to be of local importance. It would be a temporary impact in all locations other than the footprint of the infrastructure and new permanent access tracks. No ecologically significant effect is predicted.

14.3.1.3 Nest Destruction

During the construction of the proposed development, nests could be destroyed directly by construction activities and some may be abandoned due to disturbance from construction vehicles. Nest destruction is an adverse, low magnitude, short-term, reversible impact on the locally important community of breeding birds. The extent of the impact would be wherever construction activities are required, such as at turbine bases, construction compound and laydown areas. Bird nest conservation importance varies dependent on the species and all nests are highly sensitive. No impacts are predicted on the short-toed snake eagle or the long-legged buzzard nests identified as neither are in the footprint of the proposed development. This impact has the potential to result in a significant ecological effect.

14.3.1.4 Disturbance and Displacement

As well as the noise and visual disturbance associated with construction, birds could also be disturbed by the activities of personnel and vehicles. Disturbance of small breeding birds found on site as a result of construction activities would be an adverse, low magnitude, short-term impact on a community of birds considered to have local importance. Given the relatively small footprint of the proposed development and the number of small breeding birds found on the site, this is not considered to be an ecologically significant effect.

The only species of raptors that were regularly recorded within the immediate zone around the project site are short-toed snake eagle and common kestrel. Both of these species could be displaced from the immediate zone during the construction of the proposed development. Based on their respective population sizes and distribution, short-toed snake eagle is considered to be a species of regional importance and common kestrel a species of local importance. Disturbance from construction activities could cause both species to forage in alternative locations, either less favorable foraging areas on the margins of the Project site or locations further afield rather than the site itself. Displacement of these species would be an adverse, low magnitude, temporary, impact on both species, however this is not considered to be an ecologically significant effect.

14.3.2 During Operation

14.3.2.1 Collision Risk

Bird species using the airspace around the proposed development are vulnerable to colliding with the proposed development. Raptors and waterfowl are known to be particularly vulnerable to this collision risk[147]. A quantitative CRA has been undertaken for all vulnerable species. This has been undertaken using data collected from the migration season VP surveys and the year-round PC surveys. It has also been undertaken using flight data collected for Hawa Akkar, which were collected from a more appropriate level of survey effort.

Any predicted collision events would be adverse impacts, reversible at population scale. The likelihood of collision event, magnitude and duration of impact would vary by species.

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[147] Desholm, M. (2009). Avian sensitivity to mortality: Prioritising migratory bird species for assessment at proposed wind farms. Journal of Environmental Management. 90: 2672-2679.

Species-Specific Collision Risk

The results of the CRA undertaken on the data collected for Sustainable Akkar is provided in **Table 14-9**. The same table also provides a summary of the results of a CRA run on the data collected for Hawa Akkar and using the turbine specifications for Sustainable Akkar. These are presented as alternative values based on a different flight dataset and should not be considered as an additional collision risk. The mortality estimates for Sustainable Akkar and Hawa Akkar were compared with each other using a Welch Two Sample T-Test. This produced a p-value of >0.05[148], meaning that wind farm site is not a significant differentiating factor for mortality estimate. While this does not mean that the datasets are statistically similar between each site, it also does not point to significant differences between the two datasets.

Typically, population decreases of >1% would be considered a significant impact. However, based on feedback from the Lebanese Ministry of Environment[149], population decreases of >0.5% could be considered significant for long-lived species with lower population recruitment rates. The baseline populations used are for Lebanon as a whole but, as shown in the migration season research papers, the principal migration routes during spring and autumn both pass close to the proposed development. Thus, the population estimates for birds migrating over Lebanon are considered appropriate for use in this assessment.

As collision risk estimates for common kestrel and short-toed snake eagle were calculated following a different method which accounts for those species' breeding presence in the wind farm area, calculations of "Bird Records per Hour" were not made and are not shown in **Table 14-9**. Of the 22 species of bird recorded during the Sustainable Akkar field surveys and considered vulnerable to collision with a wind turbine, ten species were recorded flying at collision risk height within or across the site:

- Common crane.
- Eurasian sparrowhawk.
- Honey buzzard.
- Kestrel.
- Lesser spotted eagle.
- Long-legged buzzard.
- Short-toed snake eagle.
- Steppe buzzard.
- White Pelican.
- White stork.

Another further species, hen harrier, was recorded flying at collision risk height within or across the Hawa Akkar site.

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[148] R Core Team (2012). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0

[149] Feedback provided by The Netherlands Commission of Environmental Assessment, on behalf of the Ministry of Environment.

Table 14-9 Collision Risk Assessment Results per Species

Species	Sustainable Akkar Bird Records per Hour	Sustainable Akkar Bird Through Rotors in a Year	Sustainable Akkar Chance of Collision with Blade	Avoidance Factor	Population Estimate	Sustainable Akkar Mortality Estimate	Sustainable Akkar % Loss	Hawa Akkar Mortality Estimate	Hawa Akkar % Loss
Black Kite	0	0	0	0	222	0	0	0.05	0.0210
Black Stork	0	0	0	0	1,300	0	0	0	0
Booted Eagle	0	0	0	0	56	0	0	0.09	0.1545
Cinereous Vulture	0	0	0	0	1	0	0	0	0
Common Buzzard	0	0	0	0	922	0	0	0.46	0.0500
Common Crane	0.33	366.07	15.6	98	3,600	1.14	0.0317	1.80	0.0499
Egyptian Vulture	0	0	0	0	143	0	0	0	0
Eurasian Sparrowhawk	0.03	33.28	13.3	98	124	0.09	0.0714	0	0
Greater Spotted Eagle	0	0	0	0	10	0	0	0	0
Hen Harrier	0	0	0	0	23	0	0	0.03	0.1225
Hobby	0	0	0	0	137	0	0	0	0
Honey Buzzard	0.08	83.20	13.9	98	4,685	0.23	0.0049	2.68	0.0573
Imperial Eagle	0	0	0	0	14	0	0	0	0
Kestrel	N/A	200.85	14.9	95	4	1.50	37.4078	7.99	200
Lesser Spotted Eagle	0.39	432.63	12.3	98	5,234	1.06	0.0203	0.31	0.0059
Levant Sparrowhawk	0	0	0	0	3,210	0	0	0	0
Long-legged Buzzard	0.03	33.28	12.8	98	117	0.09	0.0728	0.52	0.4427
Northern Goshawk	0	0	0	0	18	0	0	0	0
Peregrine	0	0	0	0	55	0	0	0	0
Red-footed Falcon	0	0	0	0	1,470	0	0	0	0
Short-toed Eagle	N/A	290.14	13.7	98	488	0.79	0.1629	1.19	0.2443
Steppe Buzzard	0.02	16.64	12.0	98	1,591	0.04	0.0025	0.11	0.0070
Steppe Eagle	0	0	0	0	16	0	0	0	0
White Pelican	0.17	183.03	19	98	2,366	0.70	0.0297	0	0
White Stork	0.06	66.56	14.2	98	14,300	0.19	0.0013	0.66	0.0046

Black Kite

Black kites were not recorded crossing the site at collision risk height during the Sustainable Akkar bird surveys. The CRA using Hawa Akkar data produced a mortality estimate for black kite of 0.05 birds per year, a decrease of 0.02% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project, based on the Hawa Akkar data, is 1.25 birds. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with black kite collision risk.

Booted Eagle

Booted eagles were not recorded crossing the site at collision risk height during the Sustainable Akkar bird surveys. The CRA using Hawa Akkar data produced a mortality estimate for booted eagle of 0.09 birds per year, a decrease of 0.15% on the baseline population.

The mortality estimate over the 25 year lifespan of the Project, based on the Hawa Akkar data, is 2.25 birds. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with booted eagle collision risk.

Common Buzzard

Common buzzards were not recorded crossing the site at collision risk height during the Sustainable Akkar bird surveys. The CRA using Hawa Akkar data produced a mortality estimate for common buzzard of 0.46 birds per year, a decrease of 0.05% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project, based on the Hawa Akkar data, is 11.5 birds. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with common buzzard collision risk.

Common Crane

During the ornithological field surveys for the proposed development, 15 common crane flights were recorded crossing the proposed development at collision risk height during the migration season VP surveys and 7 were recorded during the year-round PC surveys. This is considered to represent a moderate level of flight activity. The mortality estimate of 1.14 birds per year is moderate and represents a 0.03% decrease to the common crane baseline population of 3,600. The CRA using Hawa Akkar data produced a mortality estimate for common crane of 1.8 birds per year, a decrease of 0.05% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 28.5 birds per year, based on Sustainable Akkar data and is 45 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with common crane collision risk.

Eurasian Sparrowhawk

Two Eurasian sparrowhawks were recorded crossing the site at collision risk height, one during the migration season VP surveys and one during the year-round PC surveys. This is considered to represent a low level of flight activity. The mortality estimate of 0.09 birds per year is low and represents a 0.07% decrease to the baseline migratory population of 124 birds. Eurasian sparrowhawks were not recorded crossing the site at collision risk height during the Hawa Akkar surveys.

The mortality estimate over the 25 year lifespan of the Project, based on the Sustainable Akkar data, is 2.25 birds. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with Eurasian sparrowhawk collision risk.

Hen Harrier

Hen Harriers were not recorded crossing the site at collision risk height during the Sustainable Akkar bird surveys. The CRA using Hawa Akkar data produced a mortality estimate for hen harrier of 0.03 birds per year, a decrease of 0.12% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project, based on the Hawa Akkar data, is 0.75 birds. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with hen harrier collision risk.

Honey Buzzard

Honey buzzard were recorded crossing the site at collision risk height during both surveys, with one bird recorded during the VP surveys and four birds recorded during the PC surveys. This is considered a low level of flight activity. The mortality estimate of 0.23 birds per year is low and represents a decrease of 0.005% to the baseline migratory population of 4,685 birds. The CRA using Hawa Akkar data produced a mortality estimate for honey buzzard of 2.68 birds per year, a decrease of 0.057% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 5.75 birds per year, based on Sustainable Akkar data and is 67 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with honey buzzard collision risk.

Common Kestrel

Common kestrel were recorded crossing the site at collision risk height during the VP surveys and during the PC surveys, with four birds recorded during the migration season VP surveys and nine birds recorded during the year-round PC surveys. This is considered a moderate level of flight activity. The mortality estimate of 1.5 birds per year is moderate and would represent a 37.41% reduction in the baseline population of four birds. This would represent a major impact on a feature of local importance. It is likely that collision risk would be reduced by the effect of displacement on common kestrel. The CRA using Hawa Akkar data produced a mortality estimate for common kestrel of 7.99 birds per year, a decrease of almost 200% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 37.5 birds per year, based on Sustainable Akkar data, and 199.75 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation.

It is considered unlikely that this collision risk would occur, and more likely that the birds would be displaced by the wind farm (refer to **Section 14.3.3.2)**. As common kestrel are only considered to be a feature of local importance, this impact is not considered to represent an ecologically significant effect.

Lesser Spotted Eagle

Twenty-two lesser spotted eagle flights were recorded crossing the site at collision risk height during the migration season VP surveys and four lesser spotted eagle flights were recorded crossing the site at collision risk height during the year-round PC surveys. This is considered a moderate level of flight activity. The mortality estimate of 1.06 birds per year is considered moderate and represents a decrease of 0.02% to the baseline population of 5,234 birds. The CRA using Hawa Akkar data produced a mortality estimate for lesser-spotted eagle of 0.31 birds per year, a decrease of 0.006% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 26.5 birds per year, based on Sustainable Akkar data and is 7.75 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with lesser spotted eagle collision risk.

Long-legged Buzzard

Long-legged buzzards were recorded crossing the site at collision risk height twice, once during the migration season VP surveys and once during the year-round PC surveys. This is considered a low level of flight activity. The mortality estimate of 0.09 birds per year is considered low and represents a decrease of 0.07% on the baseline population of 117 birds. The CRA using Hawa Akkar data produced a mortality estimate for long-legged buzzard of 0.52 birds per year, a decrease of 0.44% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 2.25 birds per year, based on Sustainable Akkar data and is 13 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with long-legged buzzard collision risk.

Short-toed Snake Eagle

Short-toed snake eagle were recorded crossing the site at collision risk height nine times during the VP surveys and four times during the PC surveys. This is considered a moderate level of flight activity. The mortality estimate of 0.79 birds per year is considered low and represents a 0.16% decrease to the baseline population of 488 birds. The CRA using Hawa Akkar data produced a mortality estimate for short-toed snake eagle of 1.19 birds per year, a decrease of 0.24% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 19.75 birds per year, based on Sustainable Akkar data and is 29.75 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect is predicted associated with short-toed snake eagle collision risk.

Steppe Buzzard

Steppe buzzards[150] were recorded crossing the site at collision risk height once during the year-round PC surveys. This is considered a low level of flight activity. The mortality estimate of 0.04 birds per year is considered low and represents a 0.003% decrease to the baseline population of common and steppe buzzard of 1,591 birds. The CRA using Hawa Akkar data produced a mortality estimate for steppe buzzard of 0.11 birds per year, a decrease of 0.007% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 1 bird per year, based on Sustainable Akkar data and is 2.75 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect has been predicted associated with Steppe buzzard collision risk.

White Pelican

White pelicans were recorded crossing the site at collision risk height 11 times during the year-round PC surveys. This is considered a moderate level of flight activity. The mortality estimate of 0.7 birds

[150] Steppe buzzard is a race of Common buzzard with extremely similar morphology. It is possible that birds recorded as Steppe buzzards could be common buzzards and vice versa. Regardless, it is clear that buzzard activity was low on the Project site and considerably lower than on the LWP site.

per year is low and represents a 0.03% decrease to the baseline population of 2,366 birds. White pelican were not recorded crossing the site at collision risk height during the Hawa Akkar surveys.

The mortality estimate over the 25 year lifespan of the Project, based on the Sustainable Akkar data, is 17.5 birds. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect has been predicted associated with white pelican collision risk.

White Stork

White storks were recorded crossing the site at collision risk height once during the migration season VP surveys and three times during the year-round PC surveys. This is considered to be a low level of flight activity. The mortality estimate of 0.19 birds per year is considered low and represents a 0.001% decrease to the baseline population of 14,300 birds. The CRA using Hawa Akkar data produced a mortality estimate for white stork of 0.66 birds per year, a decrease of 0.005% to the baseline population.

The mortality estimate over the 25 year lifespan of the Project is 4.75 birds per year, based on Sustainable Akkar data and is 16.5 birds per year, based on Hawa Akkar data. This is considered to be a conservative estimate as it does not account for birds habituating to the presence of the wind farm and also does not account for any proposed mitigation. Even accounting for likely population decreases over the lifespan of the Project, significant impacts are not considered to exist.

No ecologically significant effect has been predicted associated with white stork collision risk.

14.3.2.2 Disturbance and Displacement

Disturbance associated with the operation of the proposed development has the potential to cause an adverse, low magnitude, long-term, impact on the locally important community of bird species occupying the proposed development and the surrounding area. Birds can be disturbed by the activities of personnel and vehicles during the operation of the proposed development and also by visual and noise disturbance from the turbines themselves. However, those disturbance sources are likely to be limited and resident birds are likely to habituate to them. No ecologically significant effect is predicted.

The only species of raptor that were regularly recorded within the Project site/immediate zone were common kestrel and short-toed snake eagle. Both of these species could be displaced from the immediate zone during the operation of the proposed development. Disturbance from the presence of construction workers and vehicles and from visual and noise disturbance from the turbines could cause both species to forage away from the site. This would result in an adverse, low magnitude, long-term, impact on both species. Short-toed snake eagle is a species of Regional importance and common kestrel are of site importance. However, based on the location of the territories which lie approximately 2.5km from the Project site, operational disturbance impacts on these features are not considered to result in ecologically significant effects.

14.3.2.3 Barrier Effects

The proposed development may result in a barrier effect on the movement of bird species with the vertical configuration of turbines creating an actual or perceived barrier which bird species may not cross or would need to habituate to crossing. Such adverse impacts would be of low magnitude to the species inhabiting the immediate zone but potentially of moderate magnitude to any species that might use the area around the Project site for migration.

Field surveys have not recorded high levels of migratory bird activity within the wind farm footprint at collision risk height. Importantly, the migratory corridors run in a largely north-south alignment similar to that along which the proposed development would be constructed. As such, the proposed development would not create a barrier perpendicular to the direction of most flights. The impact would be of limited extent but permanent for the life of the proposed development.

No ecologically significant effects are predicted.

14.3.3 During Decommissioning

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

14.3.4 Cumulative Impacts

Cumulative impacts have been assessed in **Section 20 Cumulative Impact Assessment**, using an additive approach to assess collision risk from the Project alongside the planned Lebanon Wind Power and Hawa Akkar wind farms.

14.3.5 Critical and Natural Habitats Assessment

A Critical and Natural Habitats Assessment for the Project is currently being undertaken for the Project. The findings will be used to inform the mitigation. The CHA can be found in **Appendix L.**

14.4 Mitigation

Due to the large number of ecological and ornithological mitigation proposed for the Project, it is recommended that a suitable qualified Ecological Clerk of Works (ECOW) be employed for the Project to ensure the appropriate implementation of the Biodiversity Action and Management Plan (BAMP) to be developed by others. All of the mitigation listed below is detailed in the framework BAMP.

14.4.1 Construction and Decommissioning

<u>Nest Destruction</u>

Where required, vegetation would be removed outside of the bird breeding season (March-August). The following vegetation removal deterrence methods would also be used to ensure ground nesting birds do not nest on the site following vegetation clearance:

- Iridescent tape across the construction areas prior to construction activities;
- Bird deterring machines which produce intermittent loud noises; and
- Walking of the cleared area by individuals on a regular basis to prevent birds settling and to monitor if any birds are settling to nests on areas close to the planned construction activity.

Where vegetation has not been removed outside of the breeding bird season and must be removed during the breeding bird season, then pre-clearance surveys must be undertaken by a suitably experienced ornithologist. These surveys would identify any potential nests in the vegetation to be removed and then establish suitable "no go" buffers around these nests, to prevent the nest being destroyed or disturbed. Buffers would be species specific and determined by the ECOW.

In addition to the above, prior to commencement of decommissioning activities, walkover surveys would be completed in habitats suitable for and known to be used by breeding bird species as to identify any previously unknown nest sites.

14.4.2 Operation

Collision Risk

The results of the CRA suggest that significant collision risk impacts not predicted. However, it is acknowledged that the CRA is based on assumptions and incomplete datasets and a significant collision risk impact for species could still occur. The bird migration route through the north-east of Lebanon is an internationally important route for many species and so it is recommended that additional safeguards are implemented to prevent significant collision risk events.

This mitigation would rely heavily on the further monitoring work proposed (refer to **Section 14.4**), including continuing the migration season VP surveys, undertaking carcass searches beneath the constructed turbines and the installation of a bird detecting radar system.

It is proposed that mitigation would involve the shutdown of the turbines during periods of peak collision risk potential, such as periods of peak bird migration movement or poor weather. Shutdown would be achieved by adjusting the blade angle to be perpendicular to the wind and applying the brake to prevent any blade rotation. Further information on this process, and potential compensation, will be provided in the Bird Monitoring Protocol being produced by the MOE.

It should be noted that, based on the results of the surveys previously undertaken on the site, mitigation for collision risk impacts is not currently considered to be required.

14.5 Monitoring/Additional Good Practice Measures

14.5.1 Construction/Decommissioning

Vantage Point Surveys

It is recommended that the program of VP surveys is continued, but with a greater survey effort. Surveys should be undertaken between August 2019 and November 2020, with six hours of survey undertaken at each VP location during the months of January, February, June, July and December. During the other months, when birds are migrating, this survey effort should be doubled to 12 hours of survey effort per VP location. It is recommended that more VP locations are used, with at least five locations recommended to cover the site. These should be chosen with the help of a viewshed analysis to ensure that all turbine locations can be observed from a survey location. All surveys must be undertaken by surveyors who are experienced in the identification and recording of Lebanese birds. Where required, these surveyors should also be trained in how to survey as per the SNH guidance[151].

Data should be recorded as per SNH Guidance (2017)[152], with flight paths mapped into GIS and these reproduced on figures. This data can then be analyzed in GIS. Instead of undertaking a full CRA on the results, the analysis should consider the total number of birds per hour that are passing within the footprint of the wind farm at collision risk height. This should be calculated for each species and, if it is significantly greater than the numbers previously recorded (see **Table 14-9: Collision Risk Assessment by Species**), further assessment of collision risk impacts may be required.

<u>Hunting Ban</u>

A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year[153] impacting populations in their breeding grounds in Europe and Asia. It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4**, at the end of this report. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves.

The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site.

Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders. Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway.

<u>Artificial Light</u>

The use of artificial light should be avoided where possible as steady white lights can attract prey, such as moths, and the prey can attract predators, such as moth eating birds like hobbies and red-footed falcons. Instead, it is proposed that red lights or pulsing/blinking lights are used instead.

<u>Waste Disposal</u>

To prevent attracting scavenging bird species to the site, any waste produce by the workers on the site would need to be disposed of following a detailed plan. Waste should not be stored or deposited where it is open to the air, as this would attract birds to the site. This could, inadvertently, lead to the creation of a de-facto feeding station for scavenging birds such as corvids, kites and vultures.

[151] SNH (2017) Recommended bird survey methods to inform impact assessment of onshore wind farms, version 2. SNH Guidance.
[152] *Ibid*
[153] Committee Against Bird Slaughter (CABS) (2013) Report on the hunting of migrant birds in the Lebanon - affected species and their conservation status in the EU.

Disturbance and Displacement

Identified nests of birds of prey, such as common kestrel and short-toed snake eagle, are considered far enough away from any construction area and disturbance impacts are unlikely. However, the ECOW would be responsible for monitoring both nest sites and ensuring that they remain productive through the construction/decommissioning works.

14.5.2 Operation

Migration VP Surveys

It is recommended to continue the migratory season VPs during the start of the operational phase of the proposed development. These would commence as soon as the project is operational and would be undertaken following the methods described in this chapter, although with an increased survey effort to meet the 36 hours per migration season as suggested by SNH Guidance.

During each VP watch, flight activity by target species[154] will be recorded using the same details collected before:

- Flight Number.
- Time.
- Date.
- Species.
- Number of Birds.
- Flight height.
- Total time of flight including time spent at each height.

In addition to this information, surveyors will record if any birds display any flight behavior apparently associated with the presence of the turbines (avoidance) or if any were seen to collide with a turbine (collision). Observations would use the following terminology after Meredith (2002)[155]:

- Weave - Weaving flight line up to maximum height of turbine.
- Direct - A direct flight line, within the turbine envelope but clearly in a line up to maximum turbine blade height, avoiding turbines.
- Horizontal - A bird flying towards a wind farm site, which takes avoiding action by a horizontal movement (i.e. no change in height) so as to take it around the edge of the turbines.
- Vertical - As for horizontal, but this time, the bird gains altitude to take it over the top of the wind farm site.
- Bullet - Flight behavior with no avoiding action with regards to turbines (or other infrastructure).
- Hit - A recorded collision between a bird and a turbine (or other infrastructure).
- Avoid - Avoidance behavior near a turbine, generally taken at short notice and likely to appear as a sudden change in direction and/or height.
- Other – Any other behavior not easily classifiable into any of the above categories.

[154] Target species include all species of raptor, cranes, storks and pelicans.
[155] Meredith, C., Venosta, M., & Ressom, R. (2002) *Cordington Wind Farm Avian Avoidance Behaviour Report*, 2002. Biosis Research Report.

Carcass Searches

As well as the VP surveys, searches for collision victims will be completed under the turbines. Visual searches within an area at least five meters greater than the length of each turbine blade will be undertaken. The surveys would be stratified, with a third of the turbines survey during each visit. It would also be randomized, with a different set of turbines chosen to be surveyed on each visit. These surveys would be undertaken ten times per month during the migration period (mid-February to mid-May and mid-August to mid-November) and three times per month during the rest of the year. The amount of time spent searching will be standardized to allow comparability between turbines and visits.

Prior to starting the surveys, both scavenger and surveyor bias will be calibrated. This will be completed by leaving proxy carcasses[156] under turbines in locations where they can be seen by static trail cameras to record how much time passes before a carcass is removed by scavenging animals.

A similar process will be used to calibrate how successful surveyors are at locating carcasses. One surveyor will place a number of carcasses, ideally of differing sizes randomly under turbines and a different surveyor would search as described above. This process will be repeated across a number of turbine locations and for all surveyors involved in the searching. How many of the placed carcasses which are found can then be used to identify how effective the surveyors are at finding carcasses.

A project specific monitoring protocol would be developed. This will need to be adapted following the publication of the Bird Monitoring Protocol by the MOE.

Radar Bird Monitoring Equipment

Radar equipment to monitor volumes of migrating birds approaching the proposed development would be considered. The requirement for this would be based on the expectations of the Bird Monitoring Protocol currently being prepared by the MOE. It is anticipated that this would involve guidance on the specifications of system appropriate and how it should be utilized.

The radar system would have a more direct feedback into the shutdown mitigation of the proposed development, as it would detect large volumes of birds approaching so large collision risk events can be avoided. The other monitoring methods would have an indirect feedback into the shutdown mitigation.

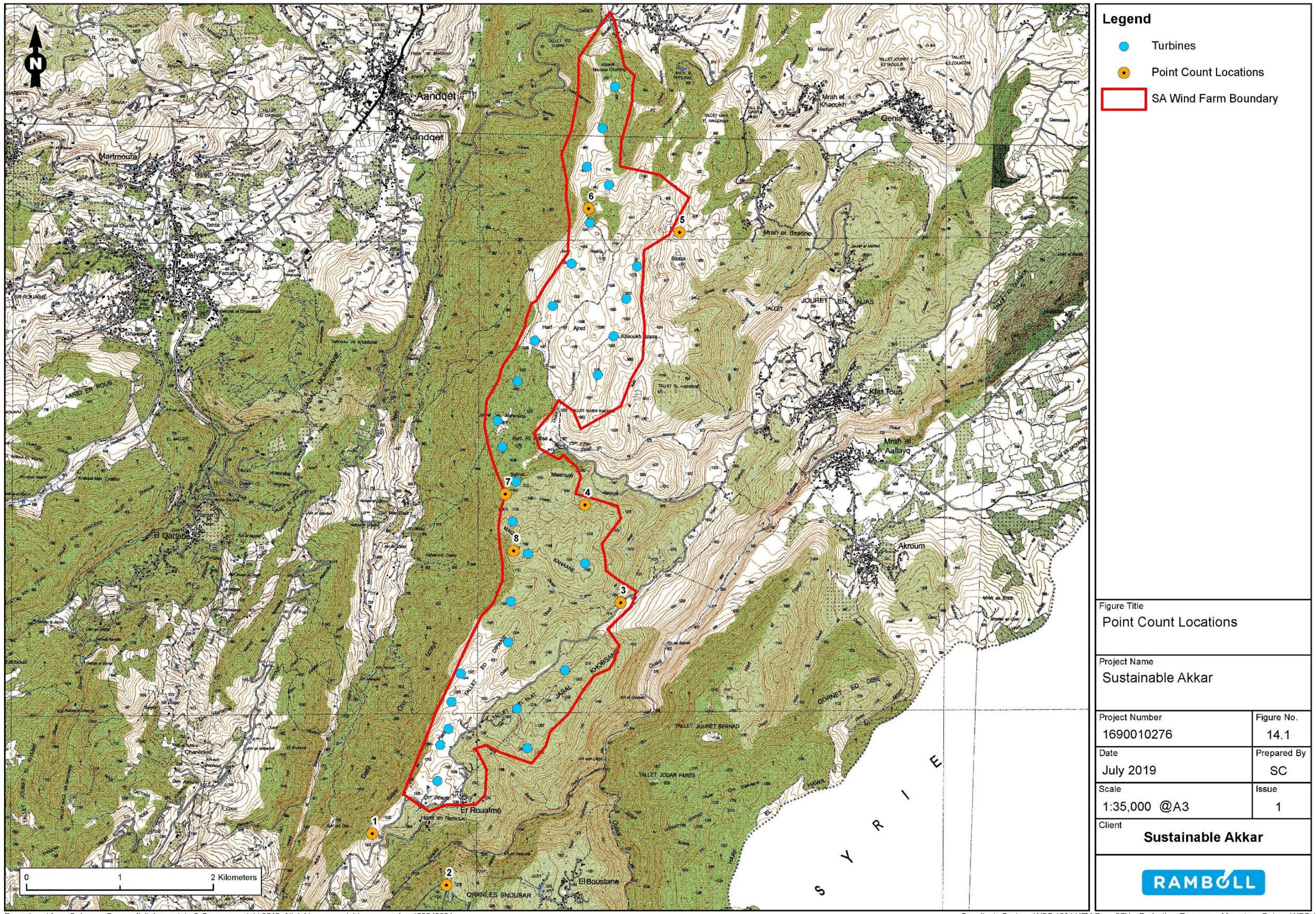
14.6 Residual Effects

Following the successful implementation of the proposed mitigation, no further, residual effects are predicted from the construction, operation or decommissioning of the proposed development.

[156] Proxies required as its unlikely that access to any hooded vulture carcasses will be possible. A bird of similar size and coloration should be used. It will be acceptable to use man-made dummies in the surveyor bias trials as that is a test of the surveyors' visual abilities. However, for the scavenger bias trials, real carcasses should ideally be used.

14.7 Section 14 Figures

Figure 14-1 Location of Point Counts



Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 14-2 Location of Vantage Points

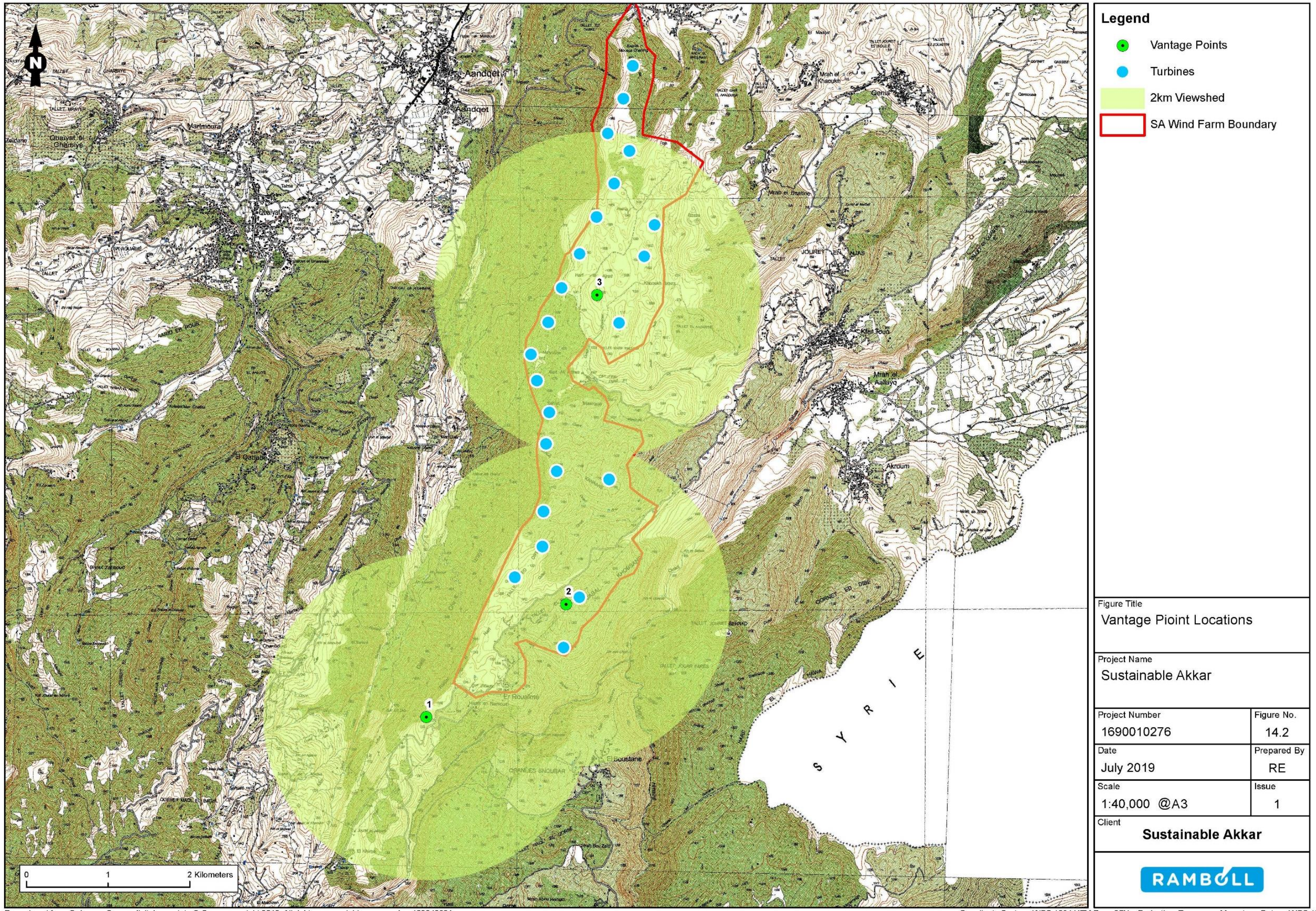
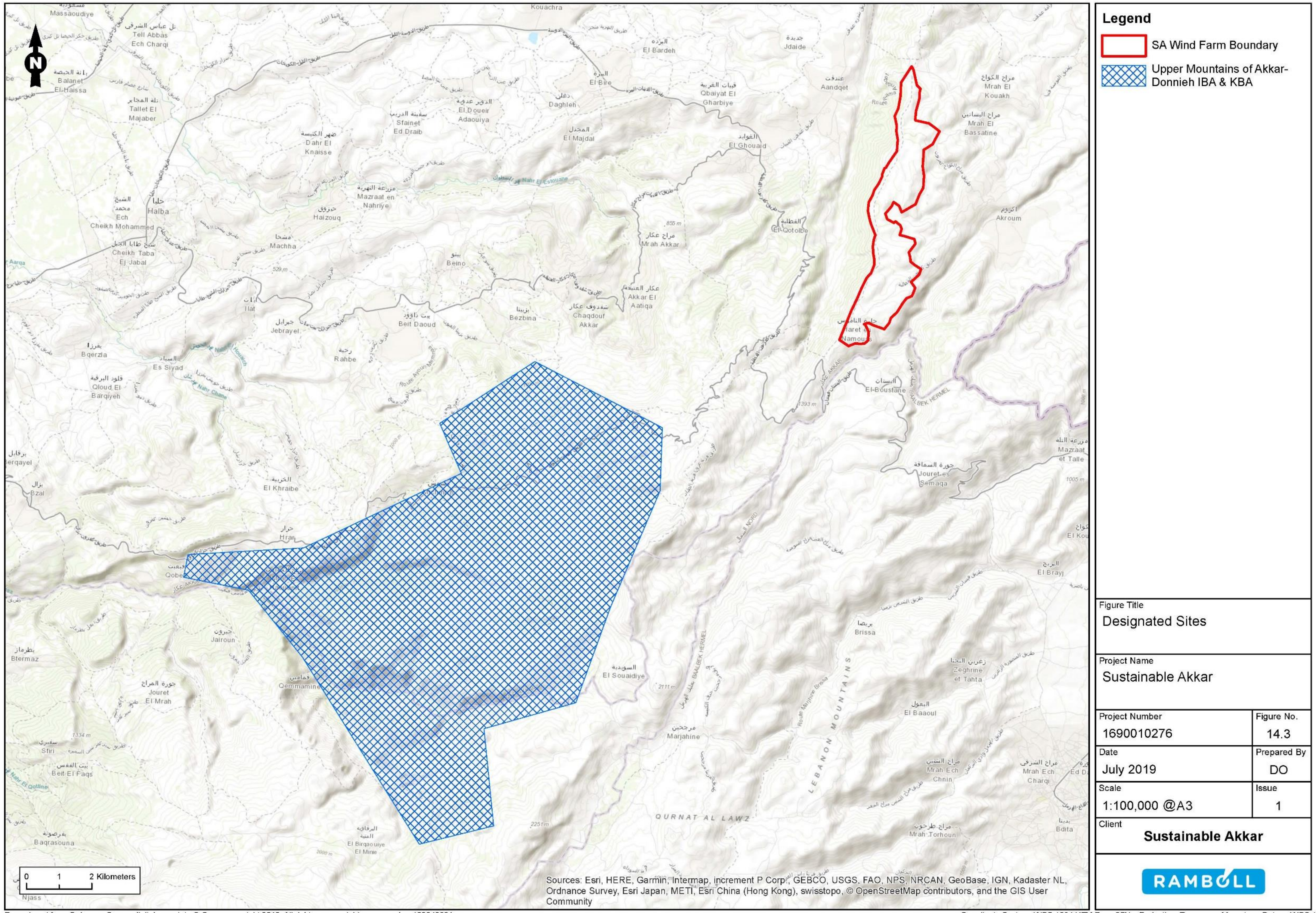
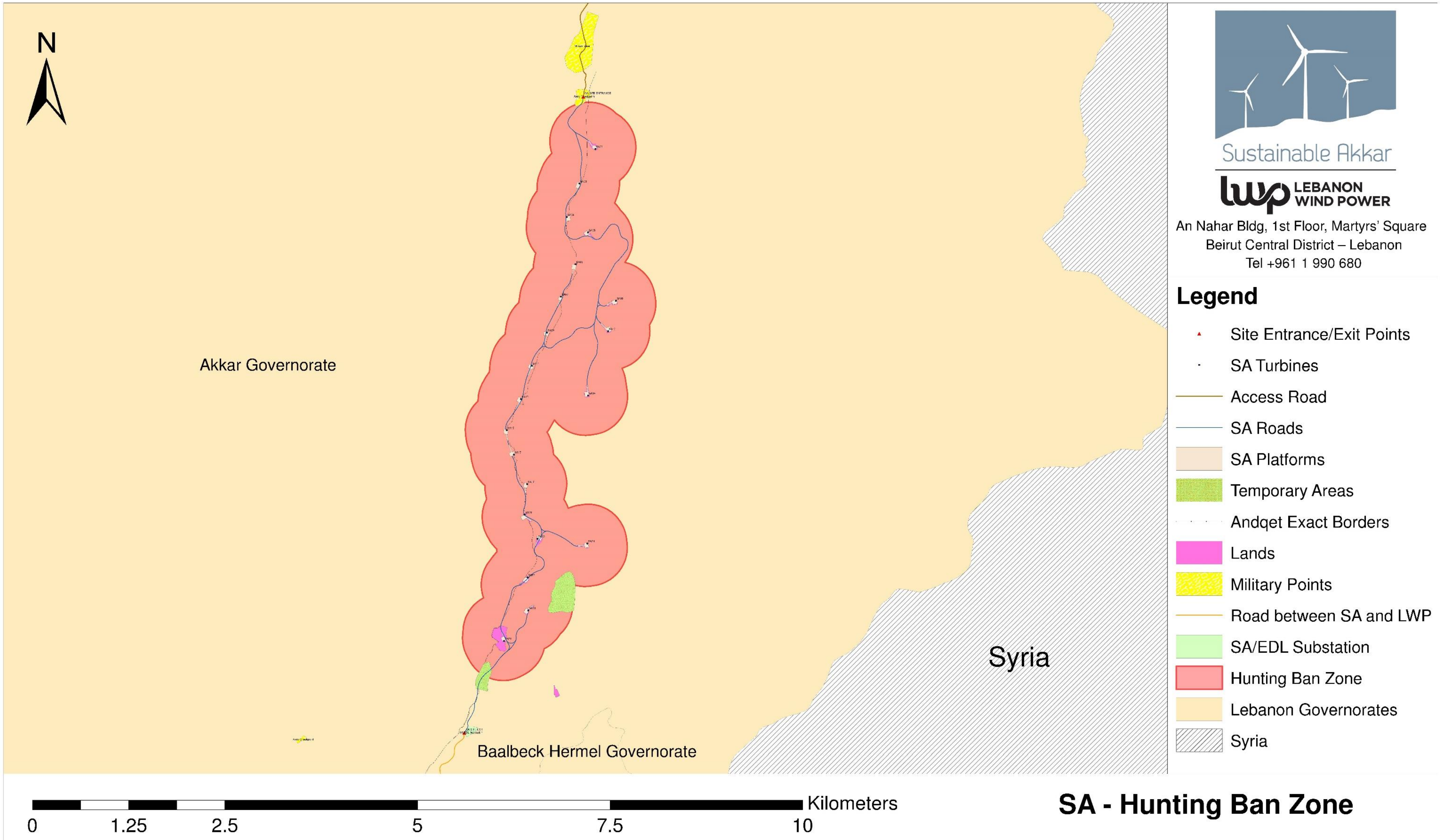


Figure 14-3 Designated Sites



Coordinate System: WGS 1984 UTM Zone 37N. Projection: Transverse Mercator. Datum: WGS 1984.

Figure 14-4 Hunting Ban Area



15. SOCIOECONOMIC CONDITIONS

15.1 Baseline Methodology

Literature review was undertaken to provide country level information and regional data for northern Lebanon and the Akkar Governorate. Socioeconomic baseline data for villages in the DAOI and IAOI was obtained from the following sources:

- Information as provided by Statistics Lebanon for villages in the DAOI and IAOI, as provided in **Appendix R**. Note: this information was supplemented by interview with the focal point for Rweimeh Village.
- Interviews and meetings with leaders and local authorities (Heads of Municipalities) in Aandqet, Chadra, Machta Hassan, Machta Hammoud and Mqaible, using a tailor-made Local Community Checklist, in order to obtain information on current socioeconomic conditions of the towns/villages.
- Survey of sample households in Fnaidek. A sample household survey is provided in **Appendix S**.
- Interviews with heads of households in Chadra, Machta Hammoud and Mqaible.
- Socioeconomic data collected through survey of sample landowners in Jabal-Akroum Kfartoun and random residents in Machta Hassan, Machta Hammoud, Mqaible, Chadra, Akroum and Sahle.
- Land use by hunters and shepherds.
- Mapping of informal settlements within 1km of the existing transport corridor.

It is noted that the socioeconomic data collection effort was undertaken by separate field teams to support the ESIAs for the Project and the planned Lebanon Wind Power and Hawa Akkar wind farms. As such, the data collection methods were not coordinated in advance or applied uniformly. In addition, in some instances, data requested from Statistics Lebanon was not available (as noted in the text). Nonetheless, the independent interviews and surveys serve to provide a profile of the area to be developed when viewed collectively and have therefore been provided herein. Further it is recognized that previous versions of this document contained information for villages that are not within the DAOI and/or IAOI, as well as information regarding SMEs; this information was deemed not relevant by reviewers and has been removed from this version of the document.

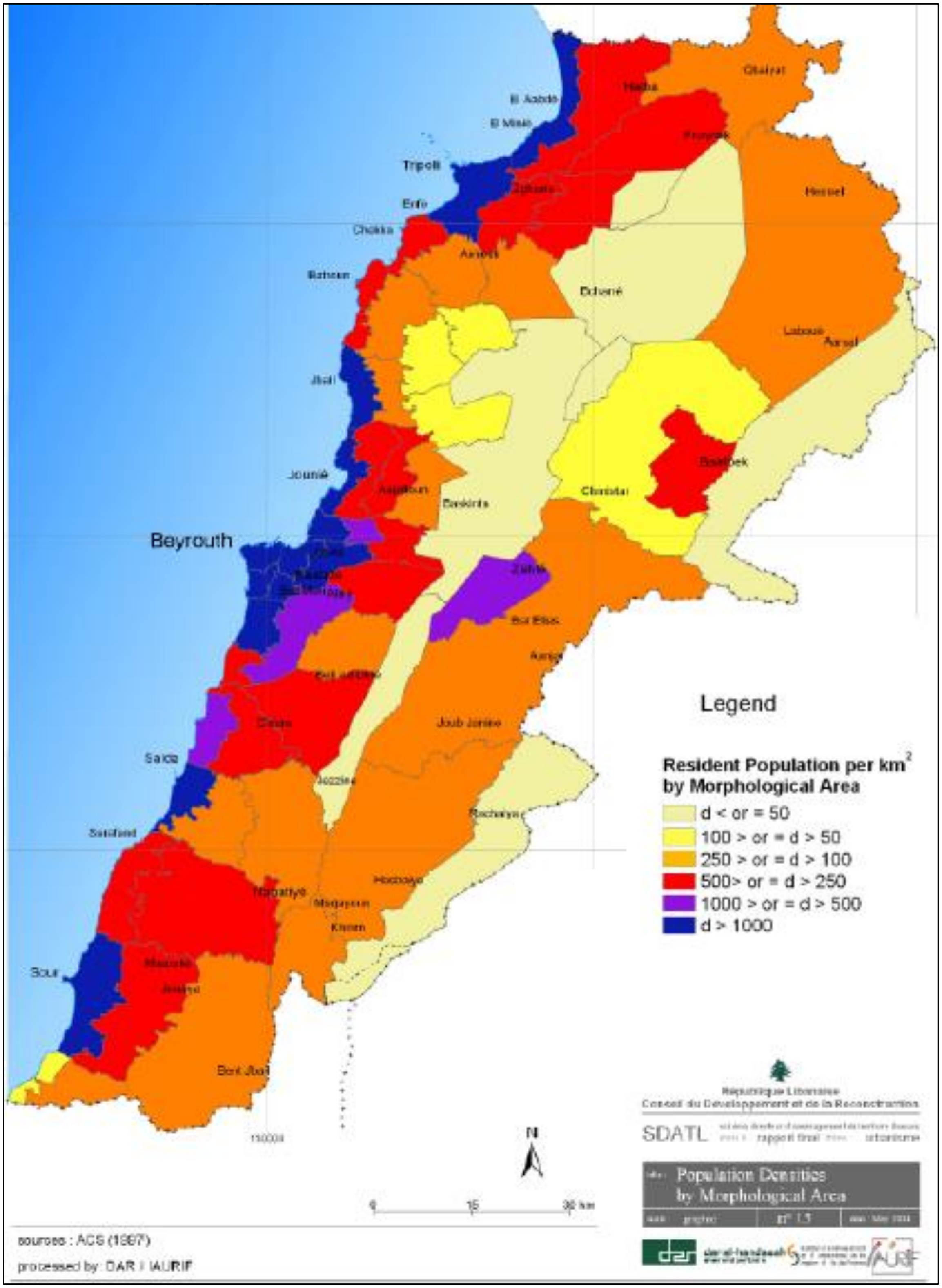
15.2 Findings

15.2.1 Lebanon

The population of Lebanon is estimated at 6.86 million in 2019, up from the 4.43 million estimated in 2013, which makes it the 108th most populated country in the world. No official census has taken place in Lebanon since 1932 due to the sensitive balance between the country's religious groups. The population density of Lebanon is shown in **Figure 15-1.**

Lebanon occupies approximately 10,452km^2 of area, ranked 168th in the world for area. With an estimated population at over 6 million as of the year 2018, the population density is approaching 583 people residing per km^2 overall, ranked the 19th most densely populated country in the world.

Figure 15-1 Population Densities of Lebanon



Evidence of civilization in the area predates recorded history, and Lebanon was once home to the maritime Phoenicians, a culture that existed for over 1,000 years. The region came under Roman Empire rule and eventually turned into the Empire's largest center of Christianity before it was conquered by the Arab Muslims and then the Ottoman Empire. While nearly all Lebanese are identified as ethnically Arab, this is an example of pan ethnicity, or grouping self-identified ethnicities into a single group, as the Lebanese people are descended from many groups and it's today a blend of a dozen closely related groups. In terms of religion among the population, we can see a breakdown of 54% Muslim following, 40.5% Christian following, and small percentages of a variety of other religions - including Buddhists, Mormons, and more.

The median age of the Lebanese population is at 30.5 years in 2018, with a total life expectancy of approximately 77.8 years of age.

There have been many migration waves in the country, as more than 1.5 million people emigrated from Lebanon between 1975 and 2011. Lebanon also hosts close to 1 million refugees and asylum seekers, most notably those from Palestine, Iraq and Syria. It's estimated that there are over 600,000 Syrian refugees (with recent sources now estimating 1 million refugees) in Lebanon escaping violence in their own country.

Before the establishment of a democracy in Lebanon under the French mandate, feudal and tribal systems were prevailing in Lebanon. For example, under the ottoman empire, and in the frame of “mellah” system, each confessional community used to nominate a representative to negotiate with prevailing power structures. Remains of these 2 dep-rooted systems persist in Lebanon, as underlying social organization, more particularly in remote regions, that have been long overlooked by the government, such as Akkar. One of the forms of this residuals systems are the big families’ structures (such as the Gemayel, the Frangieh, that have important political positions, but also the Jaafar). In this organization, one representative of the community is designated as a referent by the community members, based on different criteria (oldest or wisest of the group, etc.) to resolve matters related to the community such as money, weddings, territories, conflicts, and others.[157]

Most relationships in Lebanon are monogamous, meaning there is one husband and one wife, and are centered around nuclear households (PDS Lebanon, Ferrante 307). Though polygamy is "permitted under Muslim law... [it is] generally regarded as both impractical and undesirable" due to the extra financial burden it places on the household (Ghazi, Ferrante 307). Authority is patriarchal, meaning the male is dominant in the household. Descent is patrilineal and is "traced through the father's lineage" (Ghazi, Ferrnate 307). It can be assumed that family residence is patrilocal, since all other aspects of the family are male-dominated.

The only group that could potentially be viewed as indigenous are the Druze, a small Middle Eastern religious sect characterized by an eclectic system of doctrines and by a cohesion and loyalty among its members that have enabled them to maintain for centuries their close-knit identity and distinctive faith. The Druze numbered more than 1,000,000 in the early 21st century and live mostly in Lebanon, Syria, and Israel, with smaller communities in other countries.

[157] Dr. Roula Talhouk, PhD in Anthropology - Cultures and societies of the Arab and Islamic world, from Université Michel de Montaigne Bordeaux 3, Director of the Center for Muslim-Christian Documentation and Research (CEDRIC), Saint Joseph University of Beirut.

The largest concentration of Druze in the present day is in Lebanon. The communities are located along the western edges of the Lebanon Mountains as well as in the southeastern portion of the country as shown in **Figure 15-2**, and the total Druze population numbers well over 300,000.[158] There are no Druze communities within or near the Project, the DAOI or IAOI (or along the transport corridor).

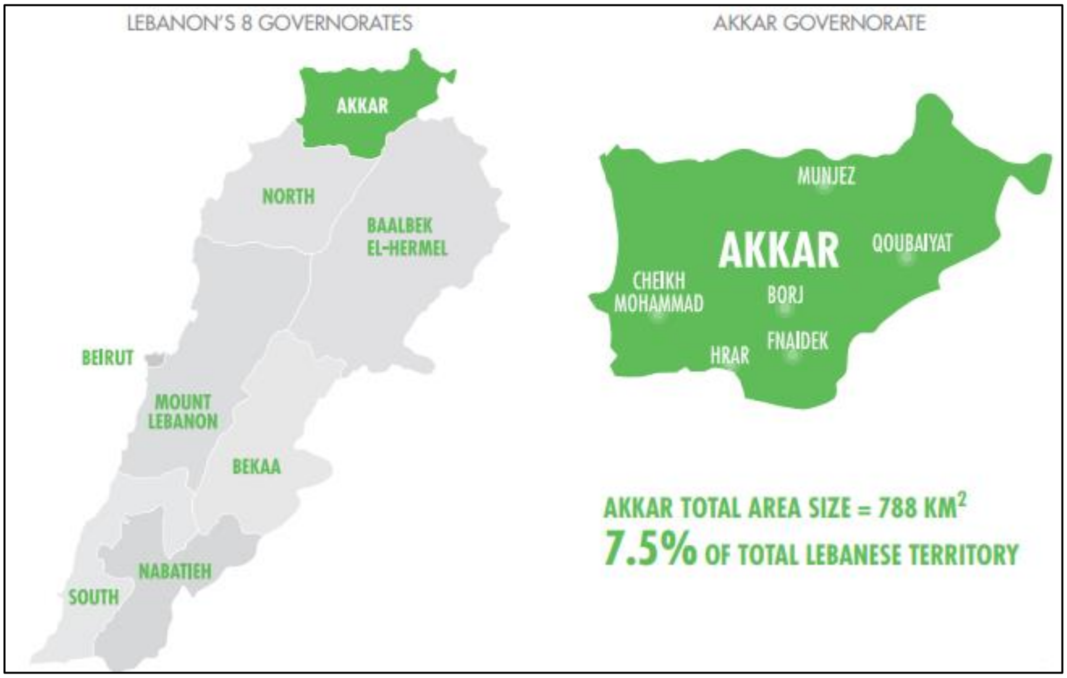
Figure 15-2 Druze Communities

[158] https://joshuaproject.net/people_groups/11620/LE

15.2.2 Akkar Region

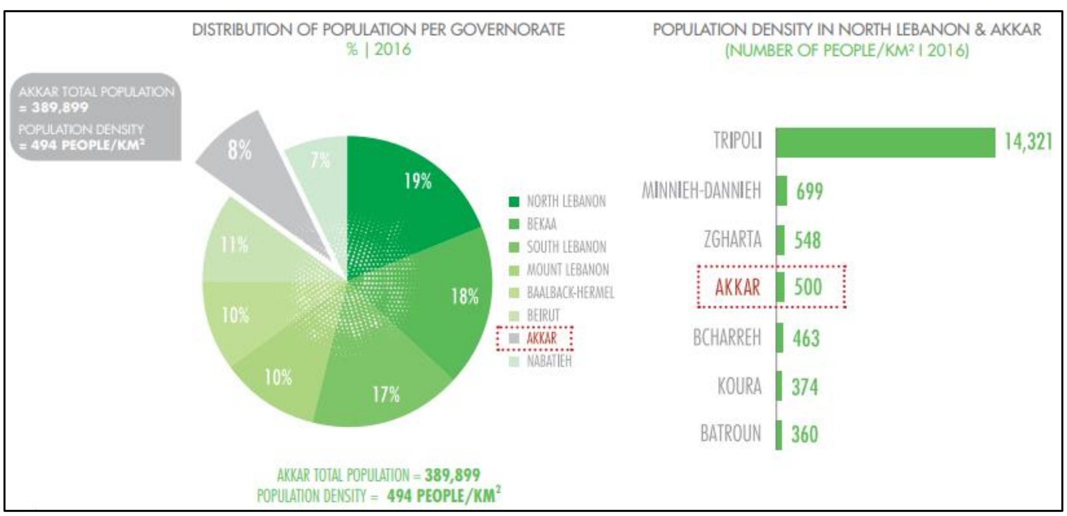
The Akkar Governorate is located in the far north of Lebanon, covering an area of 788km^2 or 7.5% of the total Lebanese territory, as shown in **Figure 15-3**.

Figure 15-3 Location of Akkar Governorate[159]



It has a population of around 400,000 inhabitants with a population density of around 500 people/km^2, one of the lowest among all the Governorates in Lebanon, as shown in **Figure 15-4**.

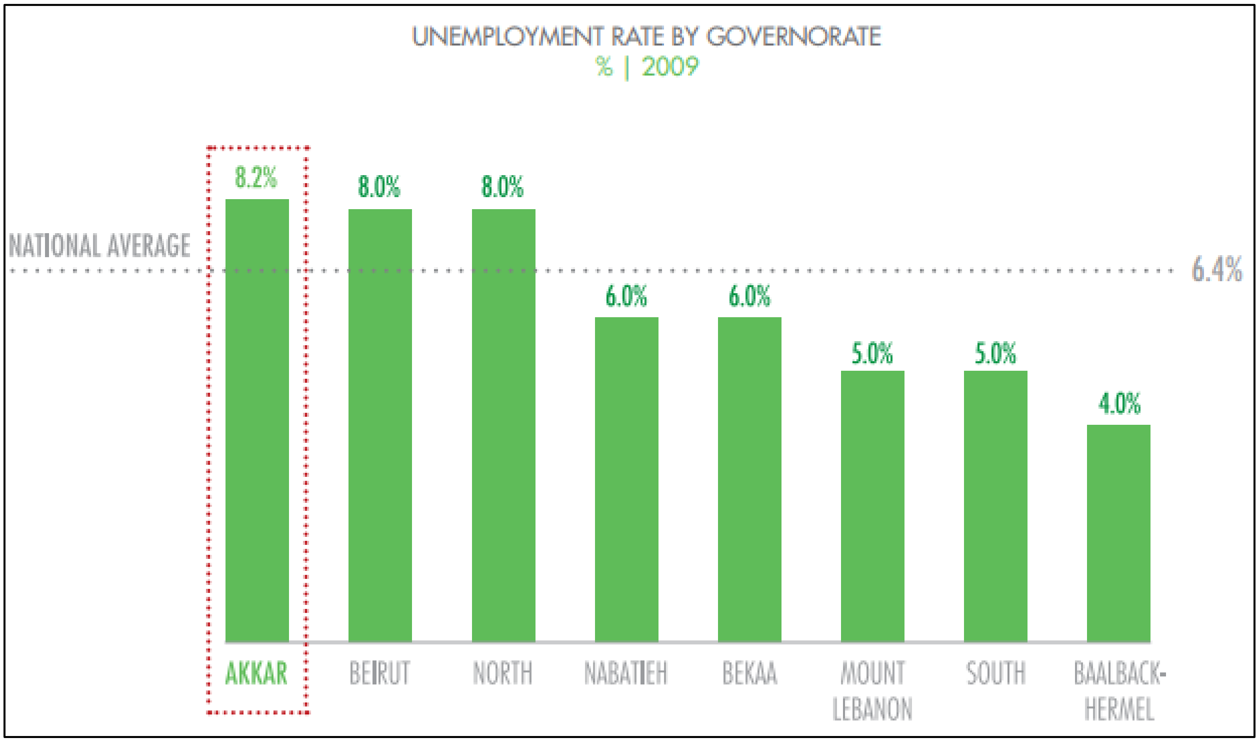
Figure 15-4 Population in the Akkar Governorate[160]



[159] UNHCR, 2018.
[160] UNHCR, 2018.

It is recognized as one of the most deprived regions in the country with a high unemployment rate, poor infrastructure, and limited access to basic public services such as electricity. In fact, a majority of Lebanese in the region are facing deterioration in livelihoods, and the business climate and job market are negatively affected by the crisis where local skills have been substituted by Syrian labor. In 2009, the estimated unemployment rate is 8.2% compared to a national average of 6.4%, as shown in **Figure 15-5**.

Figure 15-5 Akkar Governorate Unemployment Rate in 2009[161]



The labor participation rate in the labor force in Akkar is low mainly due to the weak female participation rate as well as the high age-dependency rate, as shown in **Figure 15-6**.

It is estimated that 18% of the total Lebanese labor force come from North Lebanon and Akkar, the second highest share in the country after Mount Lebanon. The Akkar labor force has been dominated by males due to gender disparity.

Males from the Akkar region account for an estimated 26.2% of the national labor force. Females account for just 5.2%, which is well below the national average of 14.8%.

Agriculture and fishing are the main sources of employment, employing 29.6% of the labor force on a full time or part time basis, in addition to public administration and armed forces (17.6%), trade, industry and construction, as shown in **Figure 15-7**.

[161] The Labour Market in Lebanon, Najwa Yacoub, Lara Bdre, 2011.

Figure 15-6 Akkar Governorate Unemployment Rate in 2009[162]

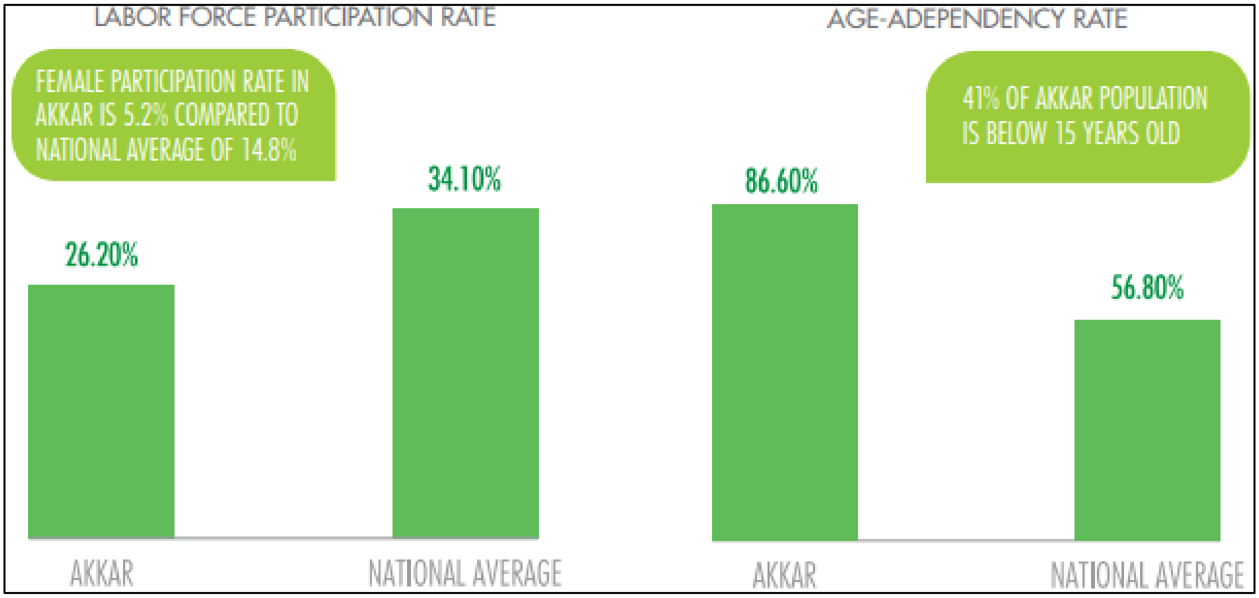
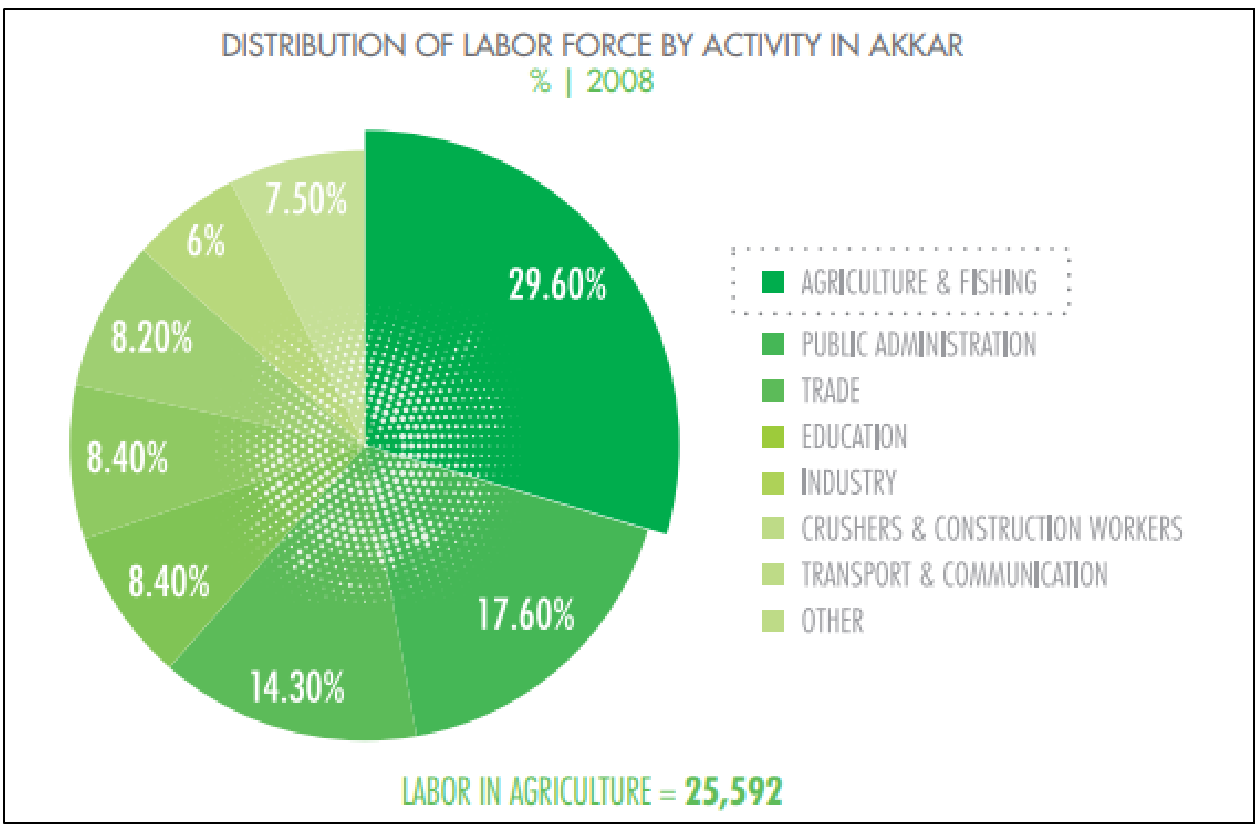


Figure 15-7 Distribution of Labor Force by Activity in Akkar in 2008

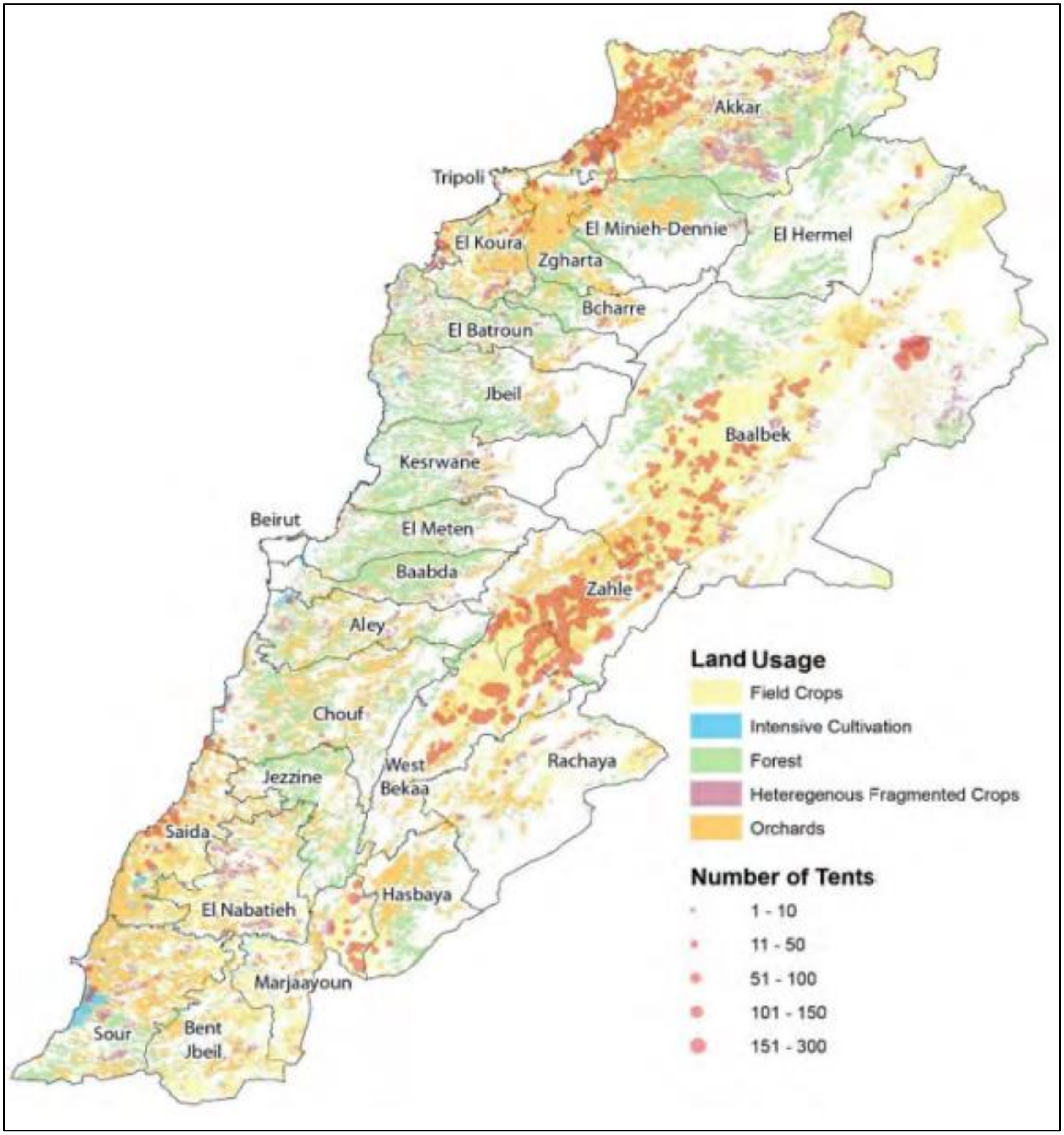


[162] Mada Association The Forgotten Akkar, 2008.

The agricultural sector in the Akkar Governorate is underdeveloped, with the main crops planted being wheat, barley, soya, corn, apples and olives. Rain fed cultivation is often practiced due to lack of irrigation networks, government supply network and water harvesting or collection systems.

However, as can be seen in **Figure 15-8**, the Project area is not used for crops, intensive cultivation or orchards and is dominated by forest bordering the Jroud Akkar ridgeline.

Figure 15-8 Agricultural Domains in Lebanon



In terms of education, there are numerous schools in the Akkar region as well as 18 universities offering degrees of business, law and engineering programs. Schools and other support infrastructure are summarized in **Table 15-1**.

Table 15-1 Social Infrastructure of the North Lebanon Region

Infrastructure	North Region	Akkar Region
Public Schools	265	163
Public Hospitals	32	21
Social Development Centers	23	19
Municipalities	140	121
Unions of Municipalities	7	6
Informal Settlements	145 hosting 10,888 of registered Syrian refugees	439 hosting 28,162 of registered Syrian refugees

The presence of refugees places a burden on Akkar governorate particularly on the sectors of education, healthcare, housing, household assets, energy, water supply, sanitation, roads and transport. Living conditions of Syrian refugees are summarized in **Table 15-2**.

Table 15-2 Living Conditions of Syrian Refugees

	Substandard Shelters	Informal Settlements	Collective Shelters
Syrian Refugees	54.5%	39.8%	2.5%

15.2.3 Literature Review - Socioeconomic Data for Villages in the DAOI

As previously presented in **Section 2 Project Description**, , the DAOI comprises the following (refer to **Table 2-9**):

- Villages where land to be leased or purchased from landowners for the installation of Project turbines, internal roads, substation and transmission line, i.e. Rweimeh Village and Aandqet.
- Villages where land will be leased and purchased for the installation of wind turbines, internal roads, substation and transmission line at the planned Lebanon Wind Power and Hawa Akkar wind farms, i.e. Fnaidek, Rweimeh Village, Karm Chbat Cadastral Area, Chadra, Machta Hammoud and Mqaible.
- Areas of the new segments of road:
  - The new 0.65km section of asphalt road to avoid impacts to Chadra, Machta Hassan and Machta Hammoud to be constructed through currently vacant land purchased from private land owners (shown as #1 in **Figure 2-7**).
  - The new 0.15km section of asphalt road to be constructed between two existing sections of asphalt road in order to avoid hairpin turns near homes (shown as #2 in **Figure 2-7**).
  - The new 3.0km section of gravel road to be constructed within the existing railroad ROW managed by Machta Hammoud Village (shown as #3 in **Figure 2-7**).
- Jabal-Akroum Kfartoun, where land is to be leased for the CRO Office.

- A 3km radius around the Project boundary to encompasses the noise, shadow flicker and visual receptors (as shown in Figure 2-14; note: red dots are uninhabited houses).
- Villages within sightline of the wind turbines and potentially affected by the Project's visual impact (refer to Section 17 Landscape), i.e. Jour El Hachich, Rweimeh Village, Quobaiyat, Akkar El-Atiqa'a, Es Sayeh and Fnaidek. As noted in Section 2 Project Description, there are other villages within the sightline of the turbines, and therefore in the DAOI; however, these villages were not included in the detailed assessment of visual impacts because of low visibility and/or because they were located at a greater distance than those villages modeled for visual impacts.
- Extends up to 15km from the Project footprint, limited to sites and monuments of national importance located within the 15km and potentially affected by the Project's visual impact (refer to Section 17 Landscape), i.e. Sahle (Hill), Al-Saifa Fortress in Akkar El-Atiqa'a and the Qammouaah Plain.

15.2.3.1 Fnaidek

The population of Fnaidek is approximately 20,000 (3,000 families in Summer) and 18,561 (1,100 families) in Winter. There are a total of 4,961 households with an average of 7 family members per household.

The ethnic composition of Fnaidek is 100% Sunna.

There is a 48.9% female and 51.1% male gender split, represented by the age breakdown shown in **Table 15-3**.

Table 15-3 Age Breakdown in Fnaidek

<22	22-39	40-59	≥60	Total
23.69%	41.67%	23.84%	10.80%	100%

39.0% of the community have a secondary education level or higher, with 6.6% with no education.

68.1% of the community is employed or freelances, 8.3% are unemployed, with the balance identifying as a student, housewife or retired. Nearly 57.0% of the community has a monthly income between 500 and 1,000 LBP, with 24% generating less than 500 LBP per month. Agriculture and Armed Forces are the most frequent occupation listed.

The percentages of the community that use natural resources are shown in **Table 15-4**.

Table 15-4 Use of Natural Resources by Fnaidek

River	Spring	Water Well	Pond	Forest	Agricultural Land
10%	70%	15%	0%	50%	80%

15.2.3.2 Rweimeh Village

Statistics Lebanon reports the population of Rweimeh Village is approximately 550 (50 families in Summer) and 120 (30 families) in Winter. There are a total of 55 households with an average of 5 family members per household. However, the focal point for Rweimeh Village (Mr. Abdo Jaafar) indicates a total of 120 households (120 in Summer and 12 households in Winter).

The ethnic composition of Rweimeh Village is 100.0% Chiaa. However, the focal point for Rweimeh Village indicates that the ethnic composition is 98.0% Chiaa and 2.0% Sunna.

No gender of age breakdown information was provided by Statistics Lebanon. However, the focal point for Rweimeh Village indicates the age breakdown shown in **Table 15-5**.

Table 15-5 Age Breakdown in Rweimeh Village

0-18	18-40	40-59	≥60	Total
240 (50%)	144 (30%)	23.84%	10.80%	100%

The number of education facilities or current students was not reported. 31.0% of the community have a secondary education level or higher, with 8.0% with no education.

69.0% of the community is employed or freelances, 6.0% are unemployed, with the balance identifying as a student, housewife or retired. 57.0% of the community has a monthly income between 500 and 1,000 LBP, with 27.0% generating less than 500 LBP per month. Agriculture and Commerce are the most frequent occupation listed.

The percentages of the community that use natural resources are shown in **Table 16-6**.

Table 15-6 Use of Natural Resources by Rweimeh Village

River	Spring	Water Well	Pond	Forest	Agricultural Land
0%	80%	0%	0%	20%	0%

Land use divisions, agricultural crops, livestock, building numbers, water supply, wastewater and paved road, or power outage information was not reported.

15.2.3.3 Jabal-Akroum Kfartoun

Akroum

The population of Akroum is approximately 4,500 (750 families in Summer) and 3,500 (500 families) in Winter. There are a total of 700 households with an average of 5 family members per household.

The ethnic composition of Akroum is 99.14% Sunna and 0.86% Chiaa.

There is a 50.1% female and 59.9% male gender split, represented by the age breakdown shown in **Table 15-7**.

Table 15-7 Age Breakdown in Akroum

<22	22-39	40-59	≥60	Total
24.10%	38.52%	25.70%	11.68%	100%

The number of education facilities or current students was not reported. 52.0% of the community have a secondary education level or higher, with 1.0% with no education.

59.0% of the community is employed or freelances, 8.6% are unemployed, with the balance identifying as a student, housewife or retired. 50.0% of the community has a monthly income between 500 and 1,000 LBP, with 28.0% generating less than 500 LBP per month. Agriculture and Armed Forces are the most frequent occupation listed.

The percentages of the community that use natural resources are shown in **Table 15-8**.

Table 15-8 Use of Natural Resources by Akroum

River	Spring	Water Well	Pond	Forest	Agricultural Land
20%	40%	20%	0%	20%	80%

Land use divisions, agricultural crops, livestock, building numbers, water supply, wastewater and paved road, or power outage information was not reported.

Kfartoun

The population of Kfartoun is approximately 5,500 (800 families in Summer) and 4,500 (650 families) in Winter. There are a total of 750 households with an average of 6 family members per household.

The ethnic composition of Kfartoun is 100.0% Sunna.

There is a 50.1% female and 59.9% male gender split, represented by the age breakdown shown in **Table 15-9**.

Table 15-9 Age Breakdown in Kfartoun

<22	22-39	40-59	≥60	Total
24.36%	37.47%	26.21%	11.97	100%

The number of education facilities or current students was not reported. 44.0% of the community have a secondary education level or higher, with 3.0% with no education.

59.0% of the community is employed or freelances, 9.0% are unemployed, with the balance identifying as a student, housewife or retired. 47.0% of the community has a monthly income between 500 and 1,000 LBP, with 31.0% generating less than 500 LBP per month. Agriculture and Armed Forces are the most frequent occupation listed.

The percentages of the community that use natural resources is shown in **Table 15-10**.

Table 15-10 Natural Resource Uses by Kfartoun

River	Spring	Water Well	Pond	Forest	Agricultural Land
5%	40%	20%	0%	30%	65%

Land use divisions, agricultural crops, livestock, building numbers, water supply, wastewater and paved road, or power outage information was not reported.

15.2.3.4 Karm Chbat Cadastral Area

The majority of the Karm Chbat Cadastral Area is designated as a Forest Reserve. However, it is noted that leased lands within the borders of the Karm Chbat Nature Reserve, directly leased from the locality of Fnaidek (2 real estate parcels) and from individual owners (4 real estate) are outside the mentioned borders of Karm Chbat as designated by Decision 14. The socioeconomic conditions for the total of six real estate parcels are as provided under Fnaidek and Rweimeh Village.

15.2.3.5 Aandqet

Aandqet has a surface area of 27.16km^2. Statistics Lebanon reports that the population of Aandqet is approximately 3,000 (300 families in Summer) and 1,200 (200 families) in Winter. There are a total of 1,253 households with an average of 3.5 family members per household. However, interviews with Aandqet municipal officials indicates a registered population of 6,500 (4,000 residents in Summer and 2,000 residents in Winter), with 4,000 constituents and 500 Syrian refugees.

The ethnic composition of Aandqet is 100.0% Christian.

There is a 51.1% female and 48.9% male gender split, represented by the age breakdown shown in **Table 15-11**.

Table 15-11 Age Breakdown of Aandqet

<22	22-39	40-59	≥60	Total
25.10%	21.02%	32.07%	21.81%	100%

The average household size is 5.

There are 2 education facilities in Aandqet with 750 current students. 46.1% of the community have a secondary education level or higher, with 5.9% with no education.

58.7% of the community is employed or freelances, 10.3% are unemployed, with the balance identifying as a student, housewife or retired. 50.5% of the community has a monthly income between 500 and 1,000 LBP, with 14.3% generating less than 500 LBP per month. Agriculture and Armed Forces are the most frequent occupation listed.

The percentages of the community that use natural resources is shown in **Table 15-12**.

Table 15-12 Use of Natural Resources by Aandqet

River	Spring	Water Well	Pond	Forest	Agricultural Land
0%	50%	0%	0%	60%	50%

Land use divisions are shown in **Table 15-13**.

Table 15-13 Aandqet Land Use Divisions

Urban Area	Agricultural Land	Forest	Grazing Area	Other
10%	20%	60%	10%	0%

Agricultural crops include vegetables in Summer, wheat in Winter, and permanent crops of almonds, olives and walnuts.

Livestock include 100 cattle, 250 sheep and 500 goats. Aandqet also has poultry farms with a significant stake of 400,000 chickens. In addition, it maintains 200 beehives.

Aandqet has approximately 900 buildings, with 1,200 residential units and 300 commercial units. It is 100% covered by a public water supply network. Public wastewater networks cover 75% of the village. Solid waste collection is provided.

Paved road networks connect all of the buildings in Aandqet, a total of 53km of paved roads.

Aandqet reports power outages at a minimum of 12 hours/day and maximum of 18 hours/day.

15.2.3.6 Chadra

Chadra has a surface area of 6.01km^2. Statistics Lebanon reports that the population of Chadra is approximately 600, with a total of 850 households. However, interviews with Chadra municipal officials indicates a registered population of 8,000 (4,500 residents in Summer and 300 residents in Winter), with 3,548 constituents and 30 Syrian refugees.

The ethnic composition of Chadra is 97.89% Christian, 0.59% Sunna and 1.52% Chiaa.

There is a 49.2% female and 50.8% male gender split, represented by the age breakdown shown in **Table 15-14**.

Table 15-14 Age Breakdown in Chadra

<22	22-39	40-59	≥60	Total
21.32%	24.73%	31.69%	22.25%	100%

The average household size is 5.

There is one educational institution in Chadra with 280 current students. 41.6% of the community have a secondary education level or higher, with 4.2% with no education.

66.8% of the community is employed or freelances, 10.3% are unemployed, with the balance identifying as a student, housewife or retired. 48.6% of the community has a monthly income between 500 and 1,000 LBP, with 14.6% generating less than 500 LBP per month. Agriculture and Armed Forces are the most frequent occupation listed.

Community use of natural resources was not reported.

Land use divisions are shown in **Table 15-15**.

Table 15-15 Chadra Land Use Divisions

Urban Area	Agricultural Land	Forest	Grazing Area	Other
37%	8%	29%	25%	0%

Agricultural crops include peanuts and vegetables in Summer, cabbage, cauliflower, shard and lettuce in Winter, and permanent crops of almonds, olives and grapes.

Livestock include 120 cattle, 700 sheep and 300 goats. Chadra also has poultry farms with 3,000 chickens. In addition, it maintains 350 beehives.

Chadra has approximately 575 buildings, with 675 residential units and 42 commercial units. It is 100% covered by a public water supply network. Public wastewater networks cover 35% of the village. Solid waste collection is provided.

Paved road networks connect 95% of Chadra, a total of 7km of paved roads.

Chadra reports power outages at a minimum of 10 hours/day and maximum of 15 hours/day.

15.2.3.7 Machta Hammoud

Machta Hammoud has a surface area of 12.41km^2. Statistics Lebanon reported that the population of is approximately 700, with a total of 1,244 households. However, interviews with Machta Hammoud municipal officials indicates a registered population of 7,000 (500 residents in Summer and 5,000 residents in Winter), with 3,272 constituents and 900 Syrian refugees.

The ethnic composition of Machta Hammoud is 100.0% Sunna.

There is a 47.4% female and 52.6% male gender split, represented by the age breakdown shown in **Table 15-16**.

Table 15-16 Age Breakdown in Machta Hammoud

<22	22-39	40-59	≥60	Total
24.56%	38.83%	25.42%	11.19%	100%

The average household size is 5.

There are 4 educational institutions in Machta Hammoud with 2,000 current students. 41.6% of the community have a secondary education level or higher, with 4.2% with no education.

66.8% of the community is employed or freelances, 10.3% are unemployed, with the balance identifying as a student, housewife or retired. 48.6% of the community has a monthly income between 500 and 1,000 LBP, with 14.6% generating less than 500 LBP per month. Agriculture and Armed Forces are the most frequent occupation listed.

Community use of natural resources was not reported.

Land use divisions are shown in **Table 15-17**.

Table 15-17 Machta Hammoud Land Use Divisions

Urban Area	Agricultural Land	Forest	Grazing Area	Other
40%	50%	5%	5%	0%

Agricultural crops include peanuts and vegetables in Summer, wheat and chickpea in Winter, permanent crops of leafy vegetables, and greenhouse crops of strawberries, tomatoes and cucumbers.

Livestock include 60 cattle, 500 sheep and 200 goats. Machta Hammoud also has poultry farms with 200 chickens and 10 ducks. In addition, it maintains 200 beehives.

Chadra has approximately 1,100 buildings, with 1,100 residential units and 175 commercial units. It is 70% covered by a public water supply network. Public wastewater networks cover 100% of the village. Solid waste collection is provided.

Paved road networks connect 80% of Machta Hammoud, a total of 6km of paved roads.

Machta Hammoud reports power outages at a minimum of 12 hours/day and maximum of 15 hours/day.

15.2.3.8 Mqaible

Mqaible has a surface area of 16.0km^2. Statistics Lebanon reports the population of Mqaible as 2,000. However, interviews with Mqaible municipal officials indicates a registered population of 5,800 (4,800 residents in Summer and 4,800 residents in Winter), with 2,600 constituents and 3,000 Syrian refugees.

The ethnic composition of Mqaible is 89.92% Sunna, 9.20% Christian and 0.88 Chiaa.

There is a 48.9% female and 51.1% male gender split, represented by the age breakdown shown in **Table 15-18**.

Table 15-18 Age Breakdown in Mqaible

<22	22-39	40-59	≥60	Total
25.32%	43.11%	21.90%	9.67%	100%

The average household size is 7.

There are 3 educational institutions in Mqaible with 1,300 current students. 41.6% of the community have a secondary education level or higher, with 4.2% with no education.

6.0% of the community is employed in public administration or defense, with 48.0% engaged in the agricultural sector. Monthly income was not reported.

Community use of natural resources was not reported.

Land use divisions are shown in **Table 15-19**.

Table 15-19 Mqaible Land Use Divisions

Urban Area	Agricultural Land	Forest	Grazing Area	Other
7%	5%	15%	68%	5%

Agricultural crops include corn, potatoes and vegetables in Summer, wheat, barley and chickpea in Winter, and permanent crops of olives, walnuts, almonds and grapes.

Livestock include 300 cattle, 600 sheep and 1,200 goats. Mqaible also has poultry farms with 1,500 chickens.

Mqaible has approximately 600 buildings, with 1,000 residential units and 50 commercial units. None of Mqaible is covered by a public water supply network. Public wastewater networks cover 90% of the village. Solid waste collection is provided.

Paved road networks connect 70% of Mqaible, a total of 15.2km of paved roads.

Mqaible reports power outages at a minimum and maximum of 17 hours/day.

15.2.4 Quantitative Research - Socioeconomic Data for Villages in the DAOI

15.2.4.1 Household Survey in Fnaidek

A household survey campaign was implemented in Fnaidek to: 1) support the collection of social demographic data; 2) understand access to energy, consumption, and how the lack of a reliable energy supply may affect livelihoods; 3) attitudes of the local households toward the Project and expectations around better energy supply. Quantitative and qualitative information was collated through primary data collection and analysis and reflection on the perceptions conveyed by the various residents pertaining to the Project and the current energy situation. Specifically, the survey focused on the following three information categories:

1. Social: The collection of social demographic data, including population, age, size of household, number of children, social composition, unemployment, employment by sector, distribution of labor force, income levels, house ownership, seasonal residency, population health profile and access to basic services.
2. Economics: The collection of data to assess household and SME energy consumption and expenditure, the background of each active business operating in each village, the nature of the supply of energy and current challenges associated with purchase and distribution of energy by subscribing to generators, the costs and burdens of energy and how it impacts the region and livelihoods, and how the economic situation in the villages will be affected by better energy supply, i.e. stimulation of the micro economy.
   The survey was designed to reflect the actual energy supply situation through a series of qualitative and quantitative questions covering many areas of the village and its socioeconomic situation. Due to lack of knowledge, certain technical questions were left unanswered by the respondents.
3. Technical and Energy Indicators: The collection of data to assess sources of energy and electricity, duration of electrification, the willingness of residents to connect and pay for electricity, household knowledge and the expectations from the Project and wind turbine technology, acceptance of this

new source of energy or their indifferent feeling towards it, and lastly, what they anticipate as Project challenges.

The research team conducted a total of 176 surveys in Fnaidek (88 households out of a total of around 1,100 households in the village and 88 active SMEs).

It is noted that Rweimeh Village was not surveyed as planned, as the Project Team was advised by the local mayors and the focal point of Rweimeh Village (Mr. Abdo Jaafar) that they must be accompanied by village leaders who were not available at the time of the visit. In addition, Rweimeh Village does not have a permanent resident population and its houses are occupied on a seasonal basis by members of the Jaafar Family, with winter occupancy reduced to just approximately 10% of the households.

Mr. Jaafar has advised the Project Proponent that there are no objections to the Project by Rweimeh Village members, the construction of the substation in Rweimeh Village, and/or the construction of the buried transmission line along the existing asphalt road and the existing track through Karm Chbat Nature Reserve.

Income Level

The baseline assessment of both villages revealed that Fnaidek enjoys a more permanent residency. Many of the Fnaidek residents have government jobs and earn 800USD to 1,500USD per month (23 out of 88 surveyed households in Fnaidek, or 26%), an income that can allow a decent livelihood in their village.

Income level and the number of household members play a major socioeconomic factor in the burden of living expenses, which reflects on the cost of electricity and how it consumes a significant percentage of their income. The survey revealed that a family earning between 800USD and 1,200USD per month spends around 200USD on electricity, which is considered a high expense as it represents a 25% at the lower end and 17% at the higher end of income level.

Age distribution for working people varies significantly indicating the difference between household age and active working individuals in businesses in the villages. Of those surveyed in Fnaidek, the minimum active age was 22 years old and the maximum was 90 years old. The most frequent age reported was 45 years old.

Of the 88 households interviewed, 32 only stay in Fnaidek seasonally (i.e., from the end of June, July, August and/or to the beginning of September). 100% of those surveyed owned their home. Despite the support some households get from working females, mainly married, the main income responsibility towards the household remains on the male. This reflects the culture of the region and the lack of opportunities for women to be actively engaged in employment.

Of the 88 households surveyed, 68% of the females were unemployed, compared to a national average of 14.8%.

Over one third of the Akkar population is engaged in agricultural activities, either as a primary or secondary job or to support their livelihoods. However, the survey revealed that less than 50% surveyed own agricultural land, investing in land to provide a secondary income but not working as farmers.

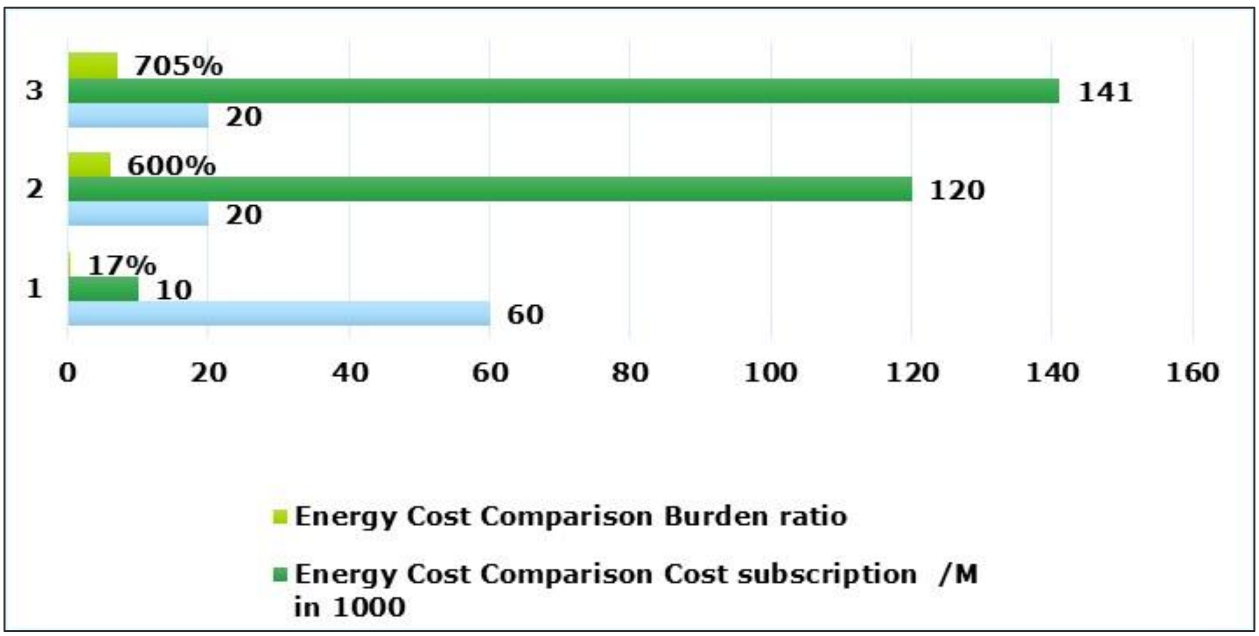
Electricity Cost as a Percentage of Income

Securing enough income to pay for the cost of electricity is a struggle for many households in the Akkar region. Power cuts are relatively common in the Akkar region. Surveyed households revealed power cuts in Fnaidek up to 14 hours. Such long power outage hours indicate that the cost of subscription to alternative energy supply sources is impacting the livelihood of individuals and the economy of the region especially since the average cost of such alternative sources is 750 LBP/KW. In addition, the margin of cost variation depends on the level of consumption.

A comparison of energy consumption costs from EDL versus privately-owned generators shows the latter is much higher due to the long hours of power cuts and the high cost per unit of electricity supplied, as shown in **Figure 15-9**.

In Fnaidek, only 7% of persons surveyed are satisfied with the current energy supply. 93% of Fnaidek residents think that they do not have enough energy supplied to them, but they are unable to consume more due to the cost burden. The common use of energy is lighting and powering appliances. Of the 88 households surveyed in Fnaidek, 0% use energy in households for heating and cooling across all four seasons.

Figure 15-9 Energy Cost Comparison



15.2.4.2 Household Survey in Chadra, Machta Hammoud and Mqaible

<u>Sample Size and Distribution</u>

The quantitative research covered a sample of 203 head of households, evenly distributed among the villages of Chadra, Machta Hammoud and Mqaible, as shown in **Table 15-20**.

Table 15-20 Sample Distribution According to Region

Sample Distribution	#	%
Chadra	70	34.5%
Machta Hammoud	69	34.0%
Mqaible	64	31.5%
Total	**203**	**100%**

Sample Distribution by Gender

Assessing the environmental and social impact of the wind farm project on local communities, the quantitative interviews focused on questioning the decision makers within the households. Therefore, it is normal – within rural and traditional communities – that the grand majority of the sample constituted of male respondents (88%), in comparison to almost 12% share only of female participants in the face-to-face interviews.

It should be noted, that Machta Hammoud interviewees were all male respondents, whereas, the highest share of female respondents was found in Chadra (27%), as shown in **Table 15-21**.

Table 15-21 Sample Distribution, According to Gender

Gender	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Female	5	7.8%	19	27.1%			24	11.8%
Male	59	92.2%	51	72.9%	69	100.0%	179	88.2%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

Sample Distribution by Age

The respondents, being head of households, were found to be mostly middle-aged people, as more than two-thirds of the sample fall within the age group that ranges between 35 and 64 years (68%). This age group constituted the majority of respondents in all three villages: almost three-quarters of Chadra respondents (74%), and two-third of Machta Hammoud and Mqaible (65% and 64% respectively). Again, Machta Hammoud revealed an exceptional case with the other one-third of the respondents being young and those who represent the age group between 18 and 34 years (35%), as shown in **Table 15-22**.

Table 15-22 Sample Distribution, According to Age Group

Age Group	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
18-34	18	28.1%	8	11.4%	24	34.8%	50	24.6%
35-64	41	64.1%	52	74.3%	45	65.2%	138	68.0%
65+	5	7.8%	10	14.3%			15	7.4%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

Sample Distribution by Marital Status and HH Size

It was found that 88% of the sample was married (or previously married), while almost a 12% was still single. Only 6% of Mqaible and Chadra respondents were single, in comparison to 23% of Machta Hammoud (due to the higher share of young respondents), as shown in **Table 15-23**.

Table 15-23 Sample Distribution, According to Marital Status

Marital Status	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Single	4	6.3%	4	5.7%	16	23.2%	24	11.8%
Married	58	90.6%	65	92.9%	52	75.4%	175	86.2%
Divorced/Separated			1	1.4%	1	1.4%	2	1.0%
Widowed	2	3.1%					2	1.0%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

The survey revealed that the targeted communities consist of big household sizes (5.9 members per HH), which is significantly higher than the national average. This is especially the case of Mqaible with an average household (HH) size of 7.5 members, in addition to Machta Hammoud (5.7 members) and Chadra (4.7 members).

In fact, some 60% of the total sample consisted of households that comprise 5 to 8 members. On the other hand, it is noteworthy that one-third of Mqaible respondents belong to HH that consist of more than 8 members (almost 33%), as shown in **Table 15-24**.

Table 15-24 Sample Distribution, According to Household Size Category

HH Size	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Less than 5	5	7.8%	33	47.1%	17	24.6%	55	27.1%
Between 5 and 8	38	59.4%	36	51.4%	48	69.6%	122	60.1%
More than 8	21	32.8%	1	1.4%	4	5.8%	26	12.8%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

Education Level

Even though the sample constitutes respondents that are 18 years of age and above, it was found that only 11% of the total sample have accomplished their university studies (out of which there are 2% with higher education degrees), as shown in **Table 15-25**.

Table 15-25 Level of Education, According to Region

Education Level	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Pre-School	28	43.8%	4	5.7%	27	39.1%	59	29.1%
Elementary	22	34.4%	9	12.9%	16	23.2%	47	23.2%
Intermediate	8	12.5%	38	54.3%	9	13.0%	55	27.1%
Secondary			13	18.6%	5	7.2%	18	8.9%
University	6	9.4%	5	7.1%	9	13.0%	20	9.9%
Higher Education			1	1.4%	3	4.3%	4	2.0%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

Further, those who did not have the chance to enroll in schools constitute 29% of the total sample. The situation is highly aggravated in Mqaible, as the share of illiterate respondents reached some 44%. This might be due to the fact that the region was deprived from educational institutions for a long period, and until recent times. The low levels of education persisting in this region affect the capabilities of finding job opportunities and advancement in future careers and impede employment of locals in high added-value economic activity sectors.

Work Status

Work status by region is shown in **Table 15-26**.

Around 34% of total sample are self-employed, which is equivalent to 49% share of total workforce within this sample. This is extremely higher than the national average (31%). The share of self-employed reaches its highest levels among the respondents from Mqaible (69%). The latter figure might be contributed to the nature of economic activities, whereby, the trade and transportation activities are predominant; in addition to the fact that Mqaible respondents registered the highest shares – by far – of engagement in agricultural sector activities (21%). Such economic activities in rural communities usually comprises of small and family businesses and small land appropriation.

On the other hand, employees recorded a very modest share concerning the work status (21% of total sample), which is equivalent to 31% of total workforce in the three villages (this is much lower than the national average at 60%). The highest share of employees was found in Machta Hammoud (28%), mostly because of higher shares of recruitment in the army and other official security forces.

Table 15-26 Work Status According to Region

Work Status	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Employer			9	12.9%	19	27.5%	28	13.8%
Employee	9	14.1%	15	21.4%	19	27.5%	43	21.2%
Self-Employed	44	68.8%	12	17.1%	13	18.8%	69	34.0%
Unemployed	3	4.7%	3	4.3%	4	5.8%	10	4.9%
Retired	4	6.3%	24	34.3%	9	13.0%	37	18.2%
Occupied with Housework	3	4.7%	7	10.0%			10	4.9%
Student	1	1.6%			5	7.2%	6	3.0%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

The unemployment rate (5%) seems to be extremely lower in such rural communities that still spare its agricultural activities. Whereas, high shares of retired respondents is mainly due to the early age of retirement in the defense sector (after 20 years of service in the military). Moreover, a high share of workforce is engaged in secondary economic activities (70%).

The highest shares of workforce distribution among all economic activities were registered by those who work in the trade sector (27%), followed by those working in the transport, storage and communication sector (18%), as shown in **Table 15-27**.

Table 15-27 Distribution of Workforce, According to Economic Activity Sector and Region

Economic Sector	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Trade	18	34.0%	9	25.0%	11	21.6%	38	27.1%
Transportation, Storage and Communication	15	28.3%	1	2.8%	9	17.6%	25	17.9%
Public Administration and Defense	4	7.5%	4	11.1%	8	15.7%	16	11.4%
Education	1	1.9%	9	25.0%	4	7.8%	14	10.0%
Agriculture	11	20.8%	2	5.6%			13	9.3%
Construction	3	5.7%	3	8.3%	2	3.9%	8	5.7%
Manufacturing			2	5.6%	4	7.8%	6	4.3%
Accommodation and Food Service Activities					6	11.8%	6	4.3%
Social Services	1	1.9%	2	5.6%	3	5.9%	6	4.3%
Health			2	5.6%	1	2.0%	3	2.1%
Real estate					1	2.0%	1	0.7%
Mining and Quarrying			1	2.8%			1	0.7%
Financial Services					1	2.0%	1	0.7%
Electricity, Gas and Water Supply					1	2.0%	1	0.7%
Other			1	2.8%			1	0.7%
Total	**53**	**100%**	**36**	**100%**	**51**	**100%**	**140**	**100%**

The great majority of those who are working do work on permanent basis (80%), as shown in **Table 15-28**. Around 11% share of total workforce is working on circumstantial basis, the condition that 28% share of Machta Hammoud workforce suffers from. Finally, some 9% share of total workforce - in the sample – is engaged in on seasonal work (this is mainly observed in Chadra and Machta Hammoud).

Table 15-28 Type of Work Permanence

Work Permanence	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Permanent	53	100.0%	29	80.6%	29	58.0%	111	79.9%
Circumstantial			1	2.8%	14	28.0%	15	10.8%
Seasonal			6	16.7%	7	14.0%	13	9.4%
Total	**53**	**100%**	**36**	**100%**	**50**	**100%**	**139**	**100%**

<u>Income</u>

While 8% of the total sample belongs to the social segment whose household monthly income is less than 675,000 LBP (less than the minimum wage threshold in Lebanon); another 9% share of total households obtains more than 2.5 million LBP per month, as shown in **Table 15-29**.

Table 15-29 Average Monthly Household Income

Household Income	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Less than 675 thousand LL	7	10.9%	1	1.4%	8	11.6%	16	7.9%
Between 675 thousand and 1 million LL	13	20.3%	3	4.3%	10	14.5%	26	12.8%
Between 1 and 1.5 million LL	21	32.8%	39	55.7%	31	44.9%	91	44.8%
Between 1.5 and 2.5 million LL	15	23.4%	24	34.3%	13	18.8%	52	25.6%
Between 2.5 and 4 million LL	8	12.5%	3	4.3%	6	8.7%	17	8.4%
More than 4 million LL					1	1.4%	1	0.5%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

Actually, almost two-third of the total sample does not exceed 1.5 million LBP in HH income/month (less than one thousand USD). Chadra is the better-off village, which recorded a 1.4% share only within the lowest segment of monthly HH income. Of course, many households receive different types of income from several sources. The most common sources of household income are obtained from private business returns (54% of HH) and salaries (53%), as shown in **Table 15-30**.

Table 15-30 All Sources of Household Income

Sources of Household Income	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Private Business	59	92.2%	20	28.6%	31	44.9%	110	54.2%
Salary	25	39.1%	46	65.7%	37	53.6%	108	53.2%
Self Consumption	21	32.8%	4	5.7%			25	12.3%
Retirement Pensions			4	5.7%	10	14.5%	14	6.9%
Profits on Capital	5	7.8%			3	4.3%	8	3.9%
Remittances	2	3.1%					2	1.0%
Social Assistance					1	1.4%	1	0.5%

Retirement pensions constitute an important source of income (in some 7% of total HH). It should be noted that remittances are minimal in this region (1%), due to negligible engagement in migration.

Public Awareness of the Project

The results of the quantitative research revealed that the majority of the sample is totally aware of planned Hawa Akkar Wind Farm project (60% of total respondents). The degree of project awareness differs from one village to another, as it recorded extremely high share of knowledgeable residents in Machta Hammoud (91%); whereas, the shares dropped significantly in Chadra (47%) and Mqaible (39%), as shown in **Table 15-31**.

Table 15-31 Level of Project Awareness

Project Awareness	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
No, never heard of the project	34	53.1%	23	32.9%	1	1.4%	58	28.6%
Not sure, probably		0.0%	20	28.6%	5	7.2%	25	12.3%
Yes, definitely heard of the project	30	46.9%	27	38.6%	63	91.3%	120	59.1%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

In fact, public awareness of the project is higher and widely spread among the residents of those villages that are directly involved in the project, and within those villages that acquire a significant amount of private land property owners inside the project site.

It should be taken into consideration that the available studies show that the directly impacted areas are those within a 500m distance from the project site. This involves issues such as noise pollution, flickering effect, shards scattering, electromagnetic fields, etc.; therefore, the farther the urban structures are from the project, the more indifferent and neutral are the local inhabitants.

When those respondents who are aware of planned Hawa Akkar wind farm were asked about the source of their information, it was found that almost half of them have heard of through word of mouth, which means that it is subject to conversations and discussions among wide array of local communities, such as the case of Mqaible and Machta Hammoud, as shown in **Table 15-32**.

Table 15-32 Sources of Information Concerning the Project

Sources of Information on the Project	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Word of Mouth	30	100.0%	2	7.4%	63	100.0%	95	47.7%
Internet and Social Media	5	16.7%	2	7.4%	44	69.8%	51	25.6%
Municipality	15	50.0%	23	85.2%	6	9.5%	44	22.1%
Participatory Sessions	2	6.7%	4	14.8%			6	3.0%
Project Launching Event			2	7.4%			2	1.0%
Radio			1	3.7%			1	0.5%
Total	**52**	**173.3%**	**34**	**125.9%**	**113**	**179.4%**	**199**	**100.0%**

A quarter of those who are aware of the project have been exposed to it through social media and other internet sources (26%). This is especially the case in Machta Hammoud (70%). The municipalities were the source of information in 22% of the cases of those who are aware of the project. However, in Chadra some 85% of the aware respondents know about the project from the municipality; and half of those from Mqaible (50%).

<u>General Awareness of Wind Farms</u>

The planned Hawa Akkar wind farm, being one of the first wind farm projects to be established in Lebanon, people seem unacquainted yet with the idea of producing electricity from wind energy. The results showed that almost half of the respondents are not generally knowledgeable of wind farms in general (48%). Only one-quarter of respondents clearly comprehend the process (26%), and another quarter slightly understand wind farms' work (27%), as shown in **Table 15-33**. Mqaible recorded the highest share of respondents who are totally not aware of generating electricity through wind farms (92%); and half of Chadra respondents are also not aware of this process.

Table 15-33 Level of Knowledge about Wind Farms

Knowledge about Wind Farms	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Yes, very well	4	6.3%	12	17.1%	36	52.2%	52	25.6%
Yes, slightly	1	1.6%	23	32.9%	30	43.5%	54	26.6%
Not at all	59	92.2%	35	50.0%	3	4.3%	97	47.8%
Total	**64**	**100%**	**70**	**100%**	**69**	**100%**	**203**	**100%**

Those who are either very well or even slightly aware of wind farms were asked about their source of information on wind farms; and the results revealed that this was to a large extent through word of mouth (68%); only 15% of total respondents mentioned that participation in municipal gatherings is their source of information about wind farms; while 11% had searched for such information through internet, as shown in **Table 15-34**.

Table 15-34 Sources of Knowledge about Wind Farms

Source of Knowledge about Wind Farms	Mqaible		Chadra		Machta Hammoud		Total Sample	
	#	%	#	%	#	%	#	%
Word of Mouth	1	20.0%	13	37.1%	58	87.9%	72	67.9%
Municipality Gatherings			14	40.0%	2	3.0%	16	15.1%
Internet	2	40.0%	5	14.3%	5	7.6%	12	11.3%
Education Curricula	2	40.0%			1	1.5%	3	2.8%
Media			3	8.6%			3	2.8%
Total	**5**	**100%**	**35**	**100%**	**66**	**100%**	**106**	**100%**

Assessment of the Project Objectives

Based on a set of questions concerning the planned Hawa Akkar wind farm objectives, the respondents were asked to rate on a scale from 1 to 4, their projection of the success level of Hawa Akkar in reaching these aims. The quantitative research revealed the following:

- The total sample appeared very optimistic and registered very high rates of expectations with regards to achieving all the project's goals (a range of medium to large levels of success).
- The assessment varied according to different villages: the respondents of Machta Hammoud were found the most enthusiastic and recorded the highest rates of positive expectations (large possibility of success); the respondents of Mqaible seemed the least assured of the project's success to reach its objectives (a range of small to medium levels of success). Chadra respondents stood in between, rating slightly below the total sample means.
- The total sample averages scored the highest results (on a scale of 1 to 4) for the following outcomes:
  - The wind farm would improve the environment and reduce emissions (a score of 3.33).
  - It would reduce electricity cuts in their region (3.31).
  - And on the national level, the project would enhance the reliance on RE (3.27).

It should be taken into consideration that the results, shown in **Table 15-35**, are of subjective nature, and only indicate the public opinion and expectations concerning the success of reaching the project aims.

Table 15-35 Assessment of Expected Success Level in Achieving Project Objectives

Assessment of Success Level in Reaching Project Objectives	Mqaible	Chadra	Machta Hammoud	Total Sample
Improve the Environmental Conditions in Akkar, and Reduce the Omissions	2.81	3.21	3.94	3.33
Reduce Electricity Cuts in the Village	2.70	3.24	3.94	3.31
Enhance the reliance on Renewable Energy in Producing Electricity in Lebanon	2.67	3.14	3.94	3.27
Improve the Quality of Electricity in the Village	2.67	3.13	3.94	3.26
Strengthen the Local Economic Activity and Job Creation in the Village	2.58	3.21	3.93	3.26
Decrease the Cost of Electricity Consumption	2.53	3.19	3.94	3.24
Enhance the Living Conditions in the Village	2.52	3.20	3.93	3.23
Boost the State Budget through Reducing Fuel Oil Imports for Production of Electricity	2.39	3.21	3.94	3.20
Easing of Electricity Crisis in Lebanon	2.44	3.11	3.94	3.18
Decrease State Expenditure through Private Sector Participation in Electricity Production	2.36	3.14	3.94	3.17

15.2.4.3 Survey of Sample Landowners in Jabal-Akroum Kfartoun and Random Residents in Machta Hammoud, Mqaible, Chadra, Akroum and Sahle

As described in **Section 6.6.3.6**, survey of sample landowners in Jabal-Akroum Kfartoun and random stakeholders in Machta Hammoud and Mqaible was undertaken as part of ongoing stakeholder consultation and engagement. Socioeconomic data collected during the surveys is summarized below.

Sample Landowners in Jabal-Akroum Kfartoun

Twenty-two (22) landowners who will be leasing parcels for the development of the planned Sustainable Akkar wind farm were engaged, specifically landowners for the parcels associated with WTG 02 (6 landowners), WTG 08 (1 landowners), WTG 10 (2 landowners), WTG 14 (1 landowner), WTG 19 (1 landowner), WTG 20 (1 landowner), WTG 21 (1 landowner), WTG 22 (1 landowner), WTG 23 (4 landowners), WTG 25 (1 landowner) and WTG 27 (2 landowners). The landowners surveyed are all male ranging in age from 21-74, with the youngest being the only unmarried individual. Household size ranged from 2 to 9. Thirteen (13) of the 22 have a secondary level of education. All are Sunna. Only 1 of the landowners is unemployed, with income ranging between 0 LBP and 2,26M LBP annually. None of the landowners surveyed rely on land/natural resources for subsistence or livelihood activities.

Residents of Machta Hammoud

Twenty (20) residents of Machta Hammoud were engaged. Machta Hammoud is located due west of the planned Hawa Akkar wind farm, and land lease/acquisition is needed for construction of the planned Hawa Akkar wind farm. The residents surveyed are male, except two, ranging in age from 32-70. All are married. Household size ranged from 2 to 10. Nine (9) of the 20 have a secondary level of education. All are Sunna. The two females list their occupation as housewife, with the balance employed or retired. Income ranges between 0 LBP and 750,000 LBP annually. None of the residents surveyed rely on land/natural resources for subsistence or livelihood activities. Two (2) of the residents surveyed rely on land/natural resources for subsistence and 1 of the residents rely on land for livelihood activities.

Residents of Mqaible

Thirty-six (36) residents of Mqaible were engaged. Mqaible is located due east of the planned Hawa Akkar wind farm, and land lease/acquisition is needed for construction of the planned Hawa Akkar wind farm. The residents surveyed are male ranging in age from 22-64. Seven (7) of the residents are single. Household size ranged from 0 (assumed to be an unoccupied residence) to 13. Twenty-nine (29) of the 36 have a secondary level of education. All are Sunna. All are employed, with one individual listing his occupation as farmer. Income ranges between 0 LBP and 1M LBP annually. None of the residents surveyed rely on land/natural resources for subsistence or livelihood activities. Three (3) of the residents surveyed rely on land/natural resources for subsistence and 1 of the residents (the farmer) rely on land for livelihood activities.

Residents of Chadra

Twenty-two (22) residents of Chadra were engaged. Chadra is located due west of the planned Hawa Akkar wind farm. Twelve (12) of the residents surveyed are male ranging in age from 28-60, with 4 of them single. Ten (10) female residents were surveyed ranging in age from 21-70, with 3 of them married. Household size ranged from NA (assumed to be an unoccupied residence) to 12. Eleven (11) of the 22 have a University level of education. All but one are Christian. Thirteen (13) are employed, with one individual listing his occupation as farmer. Four (4) are unemployed and 3 are retired.

Income ranges between NA (assumed to be 0 LBP) and 3.8M LBP annually. None of the respondents surveyed rely on land/natural resources and/or livelihood activities.

Residents of Akroum

Sixteen (16) residents of Akroum were engaged. Akroum is located due east of the planned Hawa Akkar wind farm. Six (6) of the residents surveyed are male ranging in age from 33-55, with all of them married. Ten (10) female residents were surveyed ranging in age from 35-65, with all of them married. Household size ranged from 2 to 8. Twelve (12) of the 16 have a secondary level of education or higher. All are Muslim-Sunni. All of the males are employed or retired. All but one of the women list their occupation as a housewife, with one listed as a teacher. Income ranges between NA (assumed to be 0 LBP) and 900K LBP annually. None of the respondents surveyed rely on land/natural resources and 1 of the residents rely on land for livelihood activities (farming).

Residents of Sahle

Thirty-six (36) residents of Sahle were engaged. Sahle is located on the south end of the planned Hawa Akkar wind farm. All but one of the residents surveyed are male ranging in age from 22-64, with 28 of them married. One (1) female resident was surveyed and was 35 years old and married. Household size ranged from NA (assumed to be an unoccupied residence) to 13 (two households). Thirty (30) of the 36 have a secondary level of education. All are Muslim-Sunni. All of the males are employed or work as a farmer (2 respondents). The female respondent list their occupation as a housewife. Income ranges between NA (assumed to be 0 LBP) and 1M LBP annually. Three of the respondents surveyed rely on land/natural resources and 1 of the residents rely on land for livelihood activities (farming).

15.2.5 Other Groups Potentially Impacted in the DAOI

15.2.5.1 Landowners for Land Lease and Acquisition

As presented in **Section 2 Project Description**, land issues are one of the most important considerations during Project development and implementation. Land parcels needed for the Project are owned by the Municipality of Aandqet to the west, to the Jaafar Family to the south (i.e. Rweimeh Village), and the Kanaan, Daher, Salah, Houda, Adraa, Aamche, Khoder, Melhem and Hussein Families. Following cadastral survey in 2018, land agreements have been executed as follows:

- Land tenure has been secured for a period of 28 years at an agreed price of US$34,000 / year during Phase 1 Technical Studies and Installation, US$7,000 /MW / year during Phase 2 Operations and Maintenance, and US$583.33 / MW / month during Phase 3 Decommissioning. Land owned by the Owner as per the Acknowledgment Certificate to be issued - Land to be leased by Owner to Sustainable Akkar.
- Paperwork was issued by the Ministry of Finance General Directorate of Land Registry and Cadastre to lease land parcels in Aandqet Municipality and signed by a judge in Tripoli.
- The plots subject of the abovementioned lease agreements are free from any occupant, liabilities, rights, liens, or encumbrances. The Project land take will not result in resettlement/economic displacement (loss of livelihoods).
- Nonetheless, 1,481,868m^2 will be leased for the Project for 28 years, and +3,500m^2 will be acquired permanently. This represents a loss of access to land by the Municipality of Aandqet, Rweimeh Village and Jabal-Akroum Kfartoun.

15.2.5.2 Vulnerable Groups

Vulnerable groups considered during the development of the ESIA include the following:

- Women: due to cultural norms in Lebanon (and specifically within the context and setting of the Project area), the participation of women in the decision-making process is limited which could result in overlooking any specific concerns they might have.
- Elderly: due to civil status and potential decline, this could limit their participation in the decision-making process which could result in overlooking any specific concerns they might have.
- Informal Settlements: There are numerous informal settlements and Syrian and Palestinian refugees in Lebanon in general, and in Akkar in particular. This includes people that have fled from their home to seek safety in Lebanon, many of whom are excluded from key facets of social, political and economic life. As they face restrictions on legal status and human rights, this could limit their participation in the decision-making process which could result in overlooking any specific concerns they might have.

In addition, it is noted that the presence of Palestinian and Syrian refugees and members of the Dom People (gypsies) in Fnaidek, and a few Syrian refugees in Rweimeh Village, was identified by the Developer in July 2019. The Developer did not specifically identify these vulnerable stakeholders and/or consult or engage with them separately regarding the Project; however, it is noted that all Rweimeh Village and Fnaidek community members were invited to the Initial and Final Disclosure Meetings (refer to **Section 6 Stakeholder Consultation and Engagement**).

The gender and age breakdowns in villages in the DAOI and previously presented in **Section 15.2.3**. Specific measures to address these members of the community will be included in the SEP. The location of informal settlements are presented in **Figure 15-10**. As noted previously, and as can be seen in **Figure 15-10**, there are no informal settlements within or near the Project.

In addition to informal settlements, UNHCR has developed a map of vulnerable population groups throughout Lebanon, as shown in **Figure 15-11**.

15.2.5.3 Shepherds Using the Project Area for Grazing

Information regarding shepherds grazing animals in areas near the Project was acquired from the Department of Grazing at the Ministry of Agriculture (Ms. Zeina Tamim). Mr. George Roustom (Head of Department of Aandqet Forests visited the Project site on 22 February 2019, and Mr. Mohammad Mostapha (Head of Department of the Qammouaa Forest) visited on 25 February 2019, who stated that they maintain grazing information covering the Project area.

Nine (9) of the 26 shepherds are from Jabal-Akroum Kfartoun, the closest village to the Project, and represent 35% of the shepherds. The grazing areas near the Project are shown in green in **Figure 15-12**. Five (5) of the smaller grazing areas are located within the immediate study zone, and as such, grazing at this location will be prohibited during the construction phase, i.e. 18 months.

Restriction to Grazing Areas 1 through 5 result in a temporary loss of access to 0.43km2. The grazing areas that will remain accessible are Grazing Areas 6 and 7, and represent 0.96km2, and are nearer to Jabal-Akroum Kfartoun. Therefore, there is temporary loss of access of land for grazing of 45% of the total available in the Project area.

Figure 15-10 Informal Settlements in Lebanon

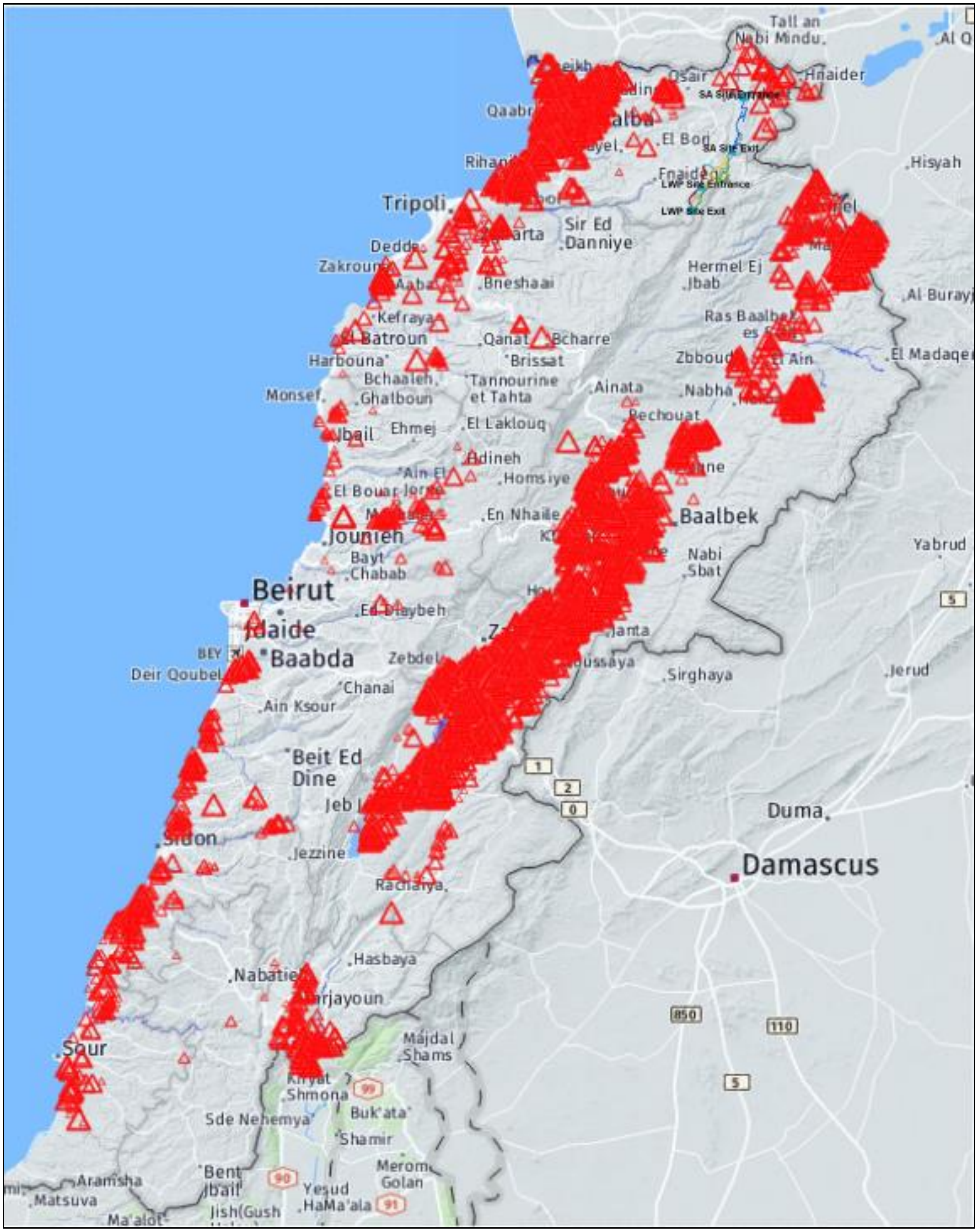


Figure 15-11 UNHCR Map of Vulnerable Population Groups in Lebanon

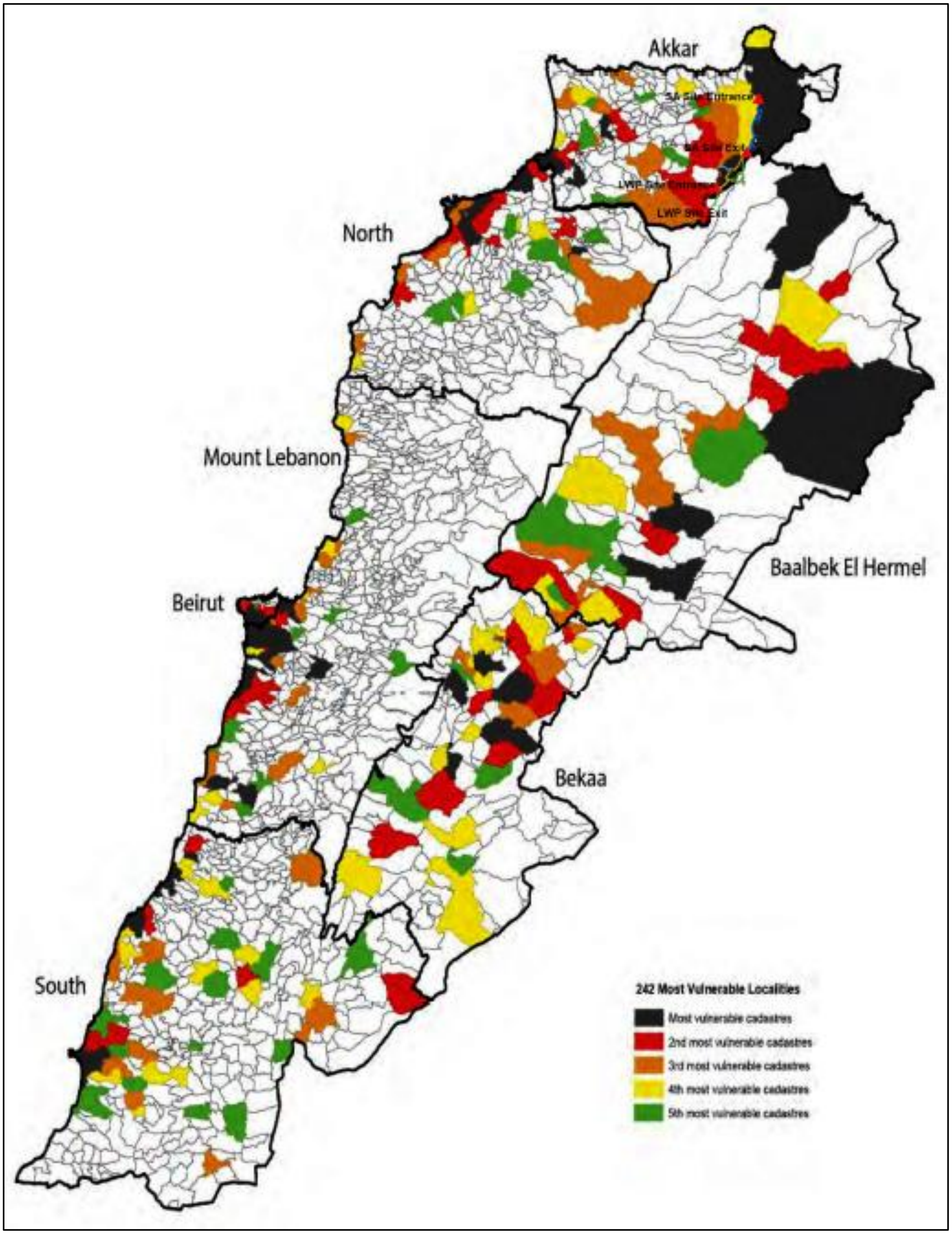


Figure 15-12 Grazing Areas Used by Shepherds Within or Near the Project

In July 2019, the CRO discussed the loss of access to grazing areas for a period of 18 months during the construction phase with the livestock owners the shepherds using the Project area. From this engagement, it was determined that the shepherd grazing in the above areas are Syrians employed by local livestock owners. Based on the discussions, the livestock owners expressed the following concerns:

1. Livestock owners rely on livestock for livelihood.
2. Access to alternative grazing areas will not be allowed by:
    a. Owners of the alternative grazing lands.
    b. Owners of the lands they need to cross to be able to access alternative grazing areas.

The loss of livelihood is passed on from the livestock owners to the Syrian shepherds.

15.2.5.4 Hunters Using Tracks Within or Near the Project

As discussed in **Section 6 Stakeholder Engagement and Consultation**, Key Informant Meetings were held with bird hunters using tracks within and near the Project, as shown in **Figure 15-13**. During these meetings, the hunters were advised that access to tracks within the Project area would be temporarily prohibited during the construction phase for a period of 90 days, indicating:

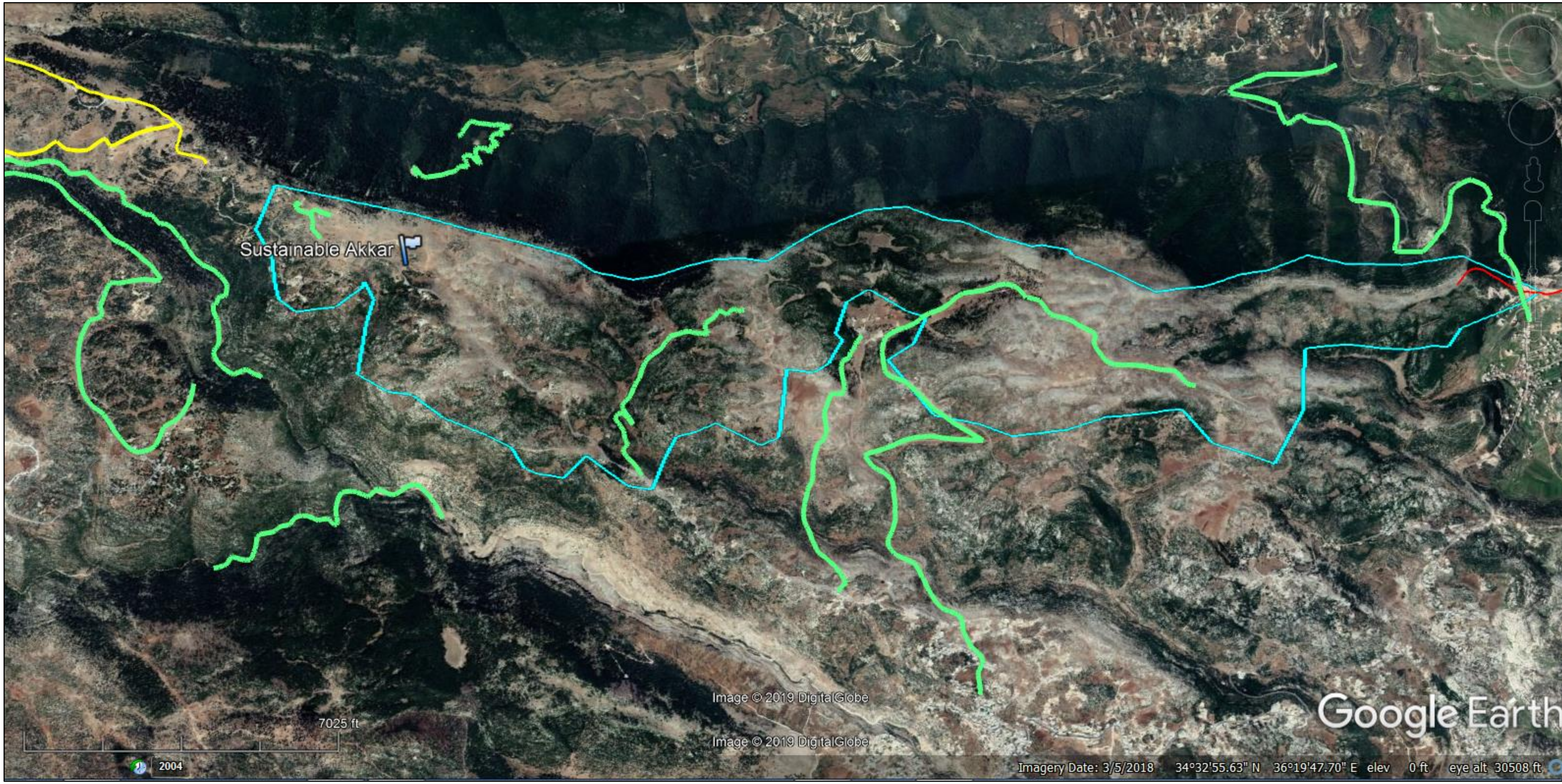
- Birds seems to avoid the installed masts and are not flying around them.
- No one in the area makes a living from hunting, it is a hobby only.
- The hunters confirmed that they can find another place to hunt.
- Hunting as a hobby usually comprises hunting at a diversity of sites.
- There were different opinions about the Project; while some of the hunters believe that the Project is beneficial for the area and therefore it is ok if they change the place of their hobby; others think that the Project is not beneficial for them as their hobby will be affected.
- Some hunters were concerned about nature more than hunting, mentioning that migratory birds are part of the equilibrium of the ecosystem and should neither be hunted/harmed by turbine blades as they are responsible of reducing the number of snakes, rats and animal corpses.
- The hunters mentioned that shops selling equipment/bullets may be affected by the Project.
- A lot of local businesses benefit from hunting season especially bungalows, cafés and restaurants. Their income may be affected if hunting activities are decreased.

15.2.5.5 Businesses Near the Project/Influx of Workers

While the hunters mentioned that the income of local businesses including accommodation and restaurants may be affected by the Project, the Project is expected to contribute positively as construction workers may need accommodation, dine at restaurants, and make purchases in the area. The availability of accommodation sufficient for the ~250 construction workers (for both the Project and the planned Lebanon Wind Power wind farm), if necessary, is currently being investigated.

Depending on the OEM/EPC Contractor selected, a worker camp may be constructed; alternatively, workers may drive or be transported by bus to and from nearby villages, depending upon where workers reside. The findings will be incorporated into the mitigation.

Figure 15-13 Hunting Tracks Near and Within the Project Area



The potential for influx by workers during the construction phase is possible, though the commitment to employ workers in the immediate area, from the northern region, from Lebanon, and lastly internationally, limit the potential impact. The potential for influx is currently being explored by the Developer. Findings will be incorporated into mitigation.

15.2.6 Literature Review - Villages in the IAOI

As previously presented in **Section 2 Project Description**, the IAOI comprises the village along the existing transport corridor between the Tripoli Seaport and the Project, including informal settlements within 1km of the existing transport corridor, and extends up to 15km from the Project footprint (limited to sites and monuments of national importance potentially affected by the Project's visual impact), as presented here again in **Table 15-36**.

Table 15-36 Villages in the IAOI

Element	Village	
Along the Transport Corridor	• Tripoli. • Beddaoui. • Deir Amar. • Borj El-Yahoudiyé. • Nabi Youcheaa. • Minie. • Zouq Bhannine. • Al Mhamra. • Bebnine. • Qoubber Chamra • Mqaiteaa • Borj El-Yahoudiyé • Kfar Melki Aakkar. • Rmoul. • Qaabrine. • Sammouniyé. • Tall Aabbas El-Gharbi. • Hissa. • Tall Aabbas Ech-Charqi.	• Tall Hmaire. • Chir Hmairine. • Hokr Jouret Srar. • Iitige. • Barcha. • Kharmoubet Akkar. • Janine • Qachlaq. • Aamaret El-Baykat. • Noura Et-Tahta. • Kouachra. • Dibbabiye. • Fraidis. • Qsair Akkar. • Menjez. • Rmah. • Chikhlar • Aaouaainat Aakkar. • Machta Hassan.
Sites and Monuments	• Sahle (Hill). • Al Saifa Fortress - Akkar el-Atiqa'a. • Qammouaah Plain.	

Further, the visual impacts from areas of influence were considered within the IAOI (refer to **Section 17 Landscape**) as follows:

- Agricultural Areas.
- Dense Abies Forests.
- Dense Pinus Forests.
- Dense Quercus Forests.
- Mixed Forests.
- Other Dense Leafy Forests.
- Rocky Land.
- Shrublands.
- Sparse Coniferous.
- Sparse Leafy Forests.
- Swamps.
- Urban Artificial.
- Urban Expansion.

15.2.6.1 Villages Along the Transport Corridor

High level information regarding villages along the existing transport corridor was provided by Statistics Lebanon. Where available, total population, number of households, ethnic composition and age breakdown was provided as presented in **Appendix R**.

15.2.6.2 Informal Settlements in IAOI

Informal settlements located immediately adjacent to the WTG transport corridor are summarized in **Table 15-37** and shown in the series of maps provided in **Appendix F**.

Table 15-37 Informal Settlements Immediately Adjacent to the WTG Transport Corridor

Settlement Code	Code Name	Number of Tents	Number of Individuals
37271-01-010	Minie 010	2	13
37271-01-063	Minie 063	3	14
37271-01-032	Minie 032	1	5
37271-01-065	Minie 065	3	18
37271-01-019	Minie 019	4	13
37271-01-058	Minie 058	2	20
37271-01-021	Minie 021	3	11
37291-01-009	Zoug Bhannine 009	83	392
37291-01-003	Zoug Bhannine 003	36	438
35277-01-018	Mhammaret 018	13	45
35269-01-037	Qoubber Chamra 037	2	9
35269-01-016	Qoubber Chamra 016	1	10
35261-01-066	Mqaiteaa 066	1	3
35234-01-046	Kfar Melki Aakkar 046	2	20
35233-01-049	Qaabrine 049	4	15
35227-01-107	Sammouniye 107	5	22
35277-01-108	Sammouniye 108	4	31
35224-01-004	Chir Hmairine 004	1	11
35224-01-007	Chir Hmairine 007	4	18
35224-01-028	Chir Hmairine 028	11	82
35224-01-021	Chir Hmairine 021	2	9
35498-01-002	Aandqet 002	8	36
Totals	**22 Settlements**	**195**	**1,235**

15.3 Impact Assessment

15.3.1 During Construction

During the construction phase, the impact of the Project on socioeconomic conditions is expected to be primarily positive given:

- The potential for the consistent provision of electricity to meet demand.
- The expected sourcing of construction materials (concrete, steel, aggregates, etc.) from the Akkar region.
- The sourcing of Project personnel (construction workers) from the northeastern part of Akkar.
- The potential income that may be generated by nearby businesses including hotels and restaurants.

The negative impacts experienced by villages and informal settlements along the transport route are temporary and expected to result in a Moderate impact. The negative impacts experienced by Rweimeh Village during the transport of construction materials are temporary and expected to result in a Minor impact (refer to **Section 16 Community Health, Safety and Security** for the assessment of transport and traffic impacts to communities).

Land Lease/Acquisition

Impacts to landowners is anticipated to be Low:

- The Project represents a loss of access to 1,481,868m^2 will be leased for the Project for 23 years (with a possible extension to 28 years), and +3,500m^2 will be acquired permanently.
- However, landowners have agreed that the compensation provided is appropriate and fair.

Access to Grazing Areas by Shepherds

Given the loss of access to nearly half of the total, the impact severity is anticipated to be High:

- A total of 45% of the area currently used for grazing will be unavailable for a period of 18 months.
- Additional consultation will be undertaken with livestock owners and shepherds to explain the areas they cannot access for the duration of the construction.
- Shepherds will be consulted to find out whether goat grazing is a subsistence activity and whether there are adequate alternative grounds that can be used during the construction period. If there's impact or loss of livelihoods, a Livelihood Restoration and Compensation Plan will be developed.
- Shepherds grazing near the Project will be advised of exclusion zones in advance, noting that other grazing areas are available. Alternative areas for grazing will be researched and secured by the Developer for alternative use during construction. If the Developer cannot arrange an alternative area because of landowners' objection, financial compensation will take place.
- All grazing areas will again be accessible at the end of construction.

Access to Tracks by Hunters

The impact severity to hunters is anticipated to be Slight:

- Access to tracks within the Project area would be temporarily prohibited during the construction phase for a period of 18 months.
- Recreational hunters near the Project will be advised of exclusion zones in advance, noting that other tracks are available, and hunting is for recreational purposes, i.e. not subsistence.
- There are other tracks available for hunters, who only hunt recreationally.

- A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year impacting populations in their breeding grounds in Europe and Asia.
- It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4** in **Section 14 Ornithology**. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves.
- The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site.
- Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders.
- Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway.

Businesses Near the Project/Influx of Workers

The impact severity is anticipated to be Low and largely Positive:

- The Project is expected to contribute positively as some construction workers may need accommodation, dine at restaurants, and make purchases in the area.
- The influx of workers has the potential to overwhelm businesses in the Project area, particularly housing. However, workers are expected to drive or be transported to and from nearby villages, depending on their village of residence. Therefore, it is not anticipated that accommodation providers will be impacted negatively.

Vulnerable Groups

Impacts to vulnerable groups, including women, the elderly and Palestinian and Syrian refugees, are not expected to be disproportionately different than other community members. The impact severity is anticipated to be Low (to be confirmed):

- The Developer will collect additional data, identify all Project stakeholders and engage with them, as necessary, including directly-affected people and vulnerable groups.
- These exercises will help clarify and confirm the DAOI and focus the assessment of project impacts and inform mitigation, as well as inform management plans.
- The Developer will identify and map all of the Project stakeholders and engage with them as necessary. This will help ensure that all Project stakeholders are consulted and there are no hidden pockets of opposition.
- Other potential use of natural resources on the Project site will be investigated.
- Additional measures to communicate the Project information, including provision of schedules, health, safety and security measures are necessary (refer to **Section 16 Community Health, Safety and Security** and the stand-alone SEP).

Workers to be Employed by the Project

- Up to 125 workers will be employed by the Project.
- Workers will be sourced from the Project area first, regionally second, nationally third and internationally last.
- Employment will supply income for a period of up to 18 months.

- Pre-recruitment skills training will be provided.
- A job skills assessment will be undertaken to provide transparency in hiring practices.
- The impact to workers is expected to be positive.

General Impacts to Communities

General impacts to communities are expected to be Positive:

- Establishment of the CRO Office in Jabal-Akroum Kfartoun.
- Community development projects as agreed between Municipalities and the Developer.

As such, the overall impact severity is expected to be Medium, with a sensitivity of Medium-High, resulting in a Moderate impact, as shown in **Table 15-38**.

Table 15-38 Assessment of Impacts During Construction

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High √**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	**Minor**	Moderate
	Medium √	Negligible	Minor	Moderate	**Moderate √**	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

15.3.2 During Operation

The overall impact severity is expected to be Slight, with a sensitivity of Medium-High, resulting in a Minor impact, as shown in **Table 15-39**.

Table 15-39 Assessment of Impacts During Operation

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High √**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	Negligible	**Minor √**	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

The major socioeconomic impact of the operational phase of the Project is expected to be Positive, with the provision of affordable electricity to the local community and to the broader Lebanese electrical consumers:

- The Project is expected to provide 22KV of supply bulk power to be distributed to the residents of neighboring villages.
- Electrification is expected to boost the local economy by stimulating productivity and enterprise efficiency, while enhancing complementary infrastructure such as roads and transportation (Plan Blue, 2010).
- Additionally, energy, at the industry level is directly linked to development, and is a catalyst for production and economic growth.
- With cheaper electricity provided by the Project, economic growth is expected in all sectors that benefit from sufficient energy supply, from basic lighting needs for backyard laying hens, to the powering of large-scale industrial activities.
- The current additional expenses paid to acquire electricity would then be allocated to improving livelihoods and business growth.
- Other local socioeconomic factors expected to significantly improve with the provision of low-cost energy are health and education. Economic benefits include those from the expected:
  - Sourcing of construction materials from the Akkar region.
  - Sourcing of Project personnel from the northeastern part of Akkar.
  - Income that may be generated by nearby businesses including hotels and restaurants.
- In terms of economic growth and livelihoods' development, electricity positively impacts quality of life both directly and indirectly. Better energy supply means more hours of lower cost/efficient energy, longer operating business hours generating more income from work, and economic savings in comparison to the high cost of generator use. This is especially relevant given that power cuts as long as 17 hours were noted in the socioeconomic surveys.
- Land lease / acquisition for 23 years with a possible extension to 28 years.
- In general, surveyed individuals support the Project and anticipate that it will reduce their energy costs, reducing their financial burdens and increasing their production and savings. All individuals

surveyed anticipated that the new network would improve power distribution and reach more houses and businesses across their villages.

- An additional perceived benefit of the Project is the provision of green energy and its impact on health and the environment.
- 75% of surveyed businesses were completely aware of the environmental benefits of the project and indicated that they are looking forward to the Project's completion and the increased energy supply to their villages.

The Developer and Bank Audi will offer financial management training/classes to encourage appropriate savings and expenditure practices within the communities.

15.3.3 During Decommissioning

Decommissioning impacts on socio-economics is expected to be similar to those noted for project construction, particularly with regards to sourcing of local labor and equipment. These impacts are expected to be moderate and positive.

16. COMMUNITY HEALTH, SAFETY AND SECURITY

This section presents the baseline and impact assessment for community health, safety and security including noise, shadow flicker, visual and traffic.

16.1 Noise

16.1.1 Baseline Methodology

There are no existing wind turbines in the area at present. However, there are two other planned wind energy projects (Lebanon Wind Power and Hawa Akkar) which will be considered in the cumulative calculation.

Two background measurement campaign were conducted for the Sustainable Akkar Wind Farm. The first one was conducted in September 2018. At this measurement ten locations on the site were considered and the noise measurements were taken for time period of 15 minutes. The second measurement was performed in February 2019. At this measurement two locations were considered, and the measurement was conducted for 48hours with a concurrent wind measurement.

A site visit in which the relevant receptors where identified and documented was conducted on 12th September 2018 by SES. In advance of the site visit potential noise receptors were identified in a desktop study using topographical maps and aerial photographs. The EHS Guidelines for Wind Energy (2015) recommends focusing on receptors within 2,000m of any of the turbines. As a worst-case approach the closest occupied dwellings in the surrounding of the wind farm were considered as receptors.

Due to the fact that the noise levels of the turbines will decrease with an increased distance to the wind farm potential receptors which are located in a greater distance will also have lower noise emissions. Therefore, this study focuses on the closest receptors to the wind farm site. However, the noise isolines will also provide information about the calculated noise levels in areas with a greater distance to the site.

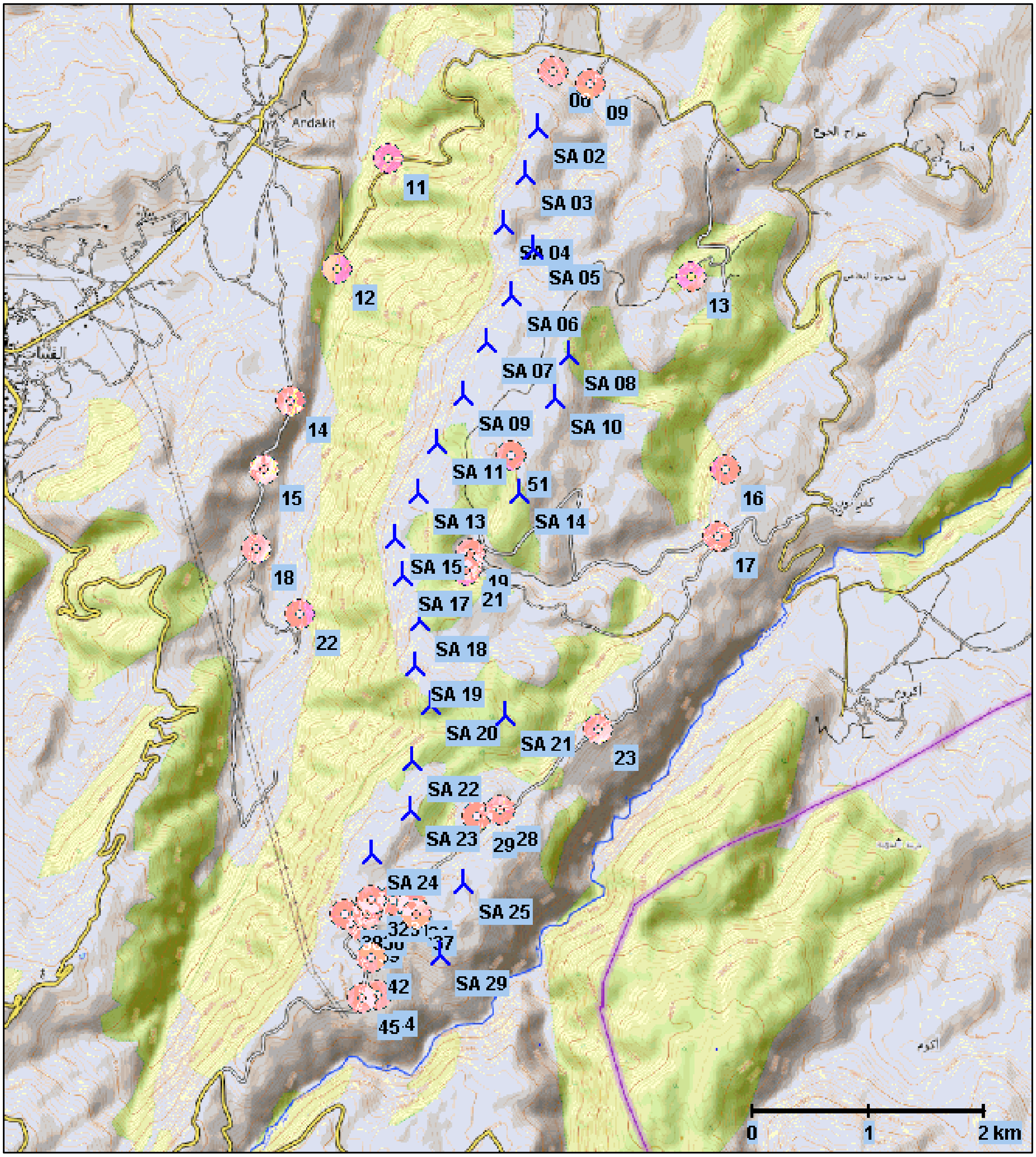
The noise receptors are displayed in **Figure 16-1.**

16.1.2 Background Noise Measurements

16.1.2.1 15-Minute Background Measurements

Background noise measurements were undertaken at the Project site by the noise consultant Dr. Charbel Afif between 23rd September and 1st October 2018. In compliance with the latest IEC standards and American National Standards Institute (ANSI), all noise measurements were made using a Class 1 Sound Level Meter, calibrated before and after each measurement according to the manufacturer's guidelines. As per WHO guidelines, measurements of environmental noise are best made close to the point of reception therefore the ten locations chosen are found near a mosque, restaurant, residential units and clinic. Each measurement period was 15 minutes at each location.

Figure 16-1 Sustainable Akkar Noise Receptor Locations



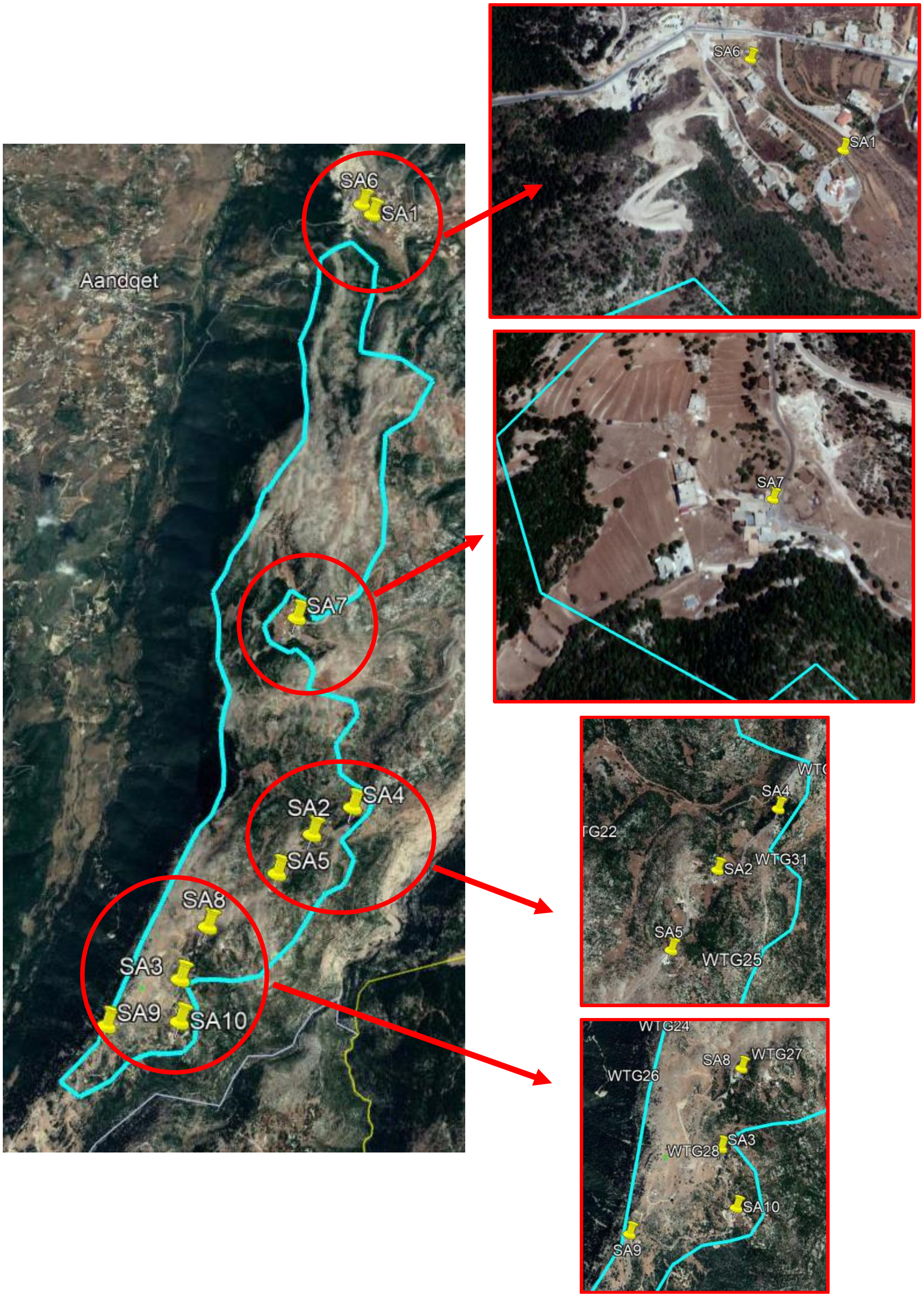
The IFC Guideline for wind energy recommends 10min measurement intervals rather then 15-minute periods. Therefore, a second measurement at Receptor 34 was conducted taking 10-minute intervals for 48 hours as recommended in IFC Guideline 1.7 Noise. Nevertheless, the 15-minute measurement provides a good overview about the background noise situation in the area as measurements were taken at 10 different locations.

Noise level measurements were carried out over 3 days at each of the overall ten locations (SAN1 to SAN10). Each measurement lasted for 15 minutes. Sound levels were recorded during the day and again during the night in order to provide a representative baseline noise level for each period. Each measurement period lasted 15 minutes [i.e. 3 days x 2 measurements (day + night) x 15 minutes/each]. Noise measurements were conducted during the day and night. The locations chosen are presented in **Table 16-1** and shown in **Figure 16-2**.

Table 16-1 Description of Sustainable Akkar Noise Monitoring Locations

Monitoring Location	Coordinates	Description
SAN1	N 34.592912° E 736.332869°	Near a few residential units and a clinic.
SAN2	N 34.534884° E 36.329091°	Near a residential unit and road leading to the WFPP.
SAN3	N 34.522998° E 36.316504°	Residential unit located around 5m from a road.
SAN4	N 34.537162° E 36.333136°	Near a road leading to the WFPP/picnic area.
SAN5	N 34.531622° E 36.325671°	Near a warehouse/storage area selling gravel.
SAN6	34.593886°N, 36.331583°E	Near few residential units and Army checkpoint.
SAN7	N 34.553742° E 36.326421°	Near few residential units and small farm.
SAN8	N 34.527236° E 36.318940°	Near residential units with an internal road leading to them.
SAN9	N 34.519296° E 36.309467°	Near a restaurant and a residential unit. Internal road leading to the restaurant.
SAN10	N 34.519597° E 36.316714°	Near a mosque and few residential units. 20 m away from the road.

Figure 16-2 Sustainable Akkar Noise Monitoring Locations



The noise metric LA90 was used to characterize the baseline noise as it is thought to be more representative of existing conditions than the equivalent sound level or LAeq because of the nature of the noise (WHO, 1999).[163] The LA90 is the measured sound pressure level (in A-weighted decibels or dB(A)) that is exceeded 90% of the time during a monitoring event. High noise events (such as a large transport truck passing nearby) tend to be excluded in the L90 metric. The noise metric L90 is generally considered representative of the ambient level of a noise environment (WHO, 1999).

16.1.2.2 48-Hour Background Noise Measurement

The baseline noise measurements were conducted by the noise consultant Dr. Charbel Afif between 12th and 25th February 2019. Two (2) locations were chosen for the measurement campaign: one at the Project site (Receptor 34) and the other at the planned Lebanon Wind Power (Receptor 73). The coordinates, photographs and details of the monitoring locations/campaign are presented in **Table 16-2** and shown in **Figure 16-3**. Noise was measured for an interrupted period of 48 hours at each location as per the IFC guidelines.

The noise measurements were made by a Class 1 Sound Level Meter. The Type 1 sound level meter used complies with the latest IEC standards and American National Standards Institute (ANSI). It was factory-calibrated in 2018. It was also calibrated before and after each measurement according to the manufacturer's guidelines.

Meteorological data was acquired from the nearest meteorological station operated by SA. Wind speed was measured at 40.4m height. The following formula was used to calculate the wind speed to 10m height (Institute of Acoustics. 2014) with 0.05 being the standard ground roughness length.

$$WS_{10m} = WS_{40.4m} \times \frac{\ln(10/0.05)}{\ln(40.4/0.05)}$$

Baseline noise levels measured at the Project at 15-minute intervals are presented in **Table 16-3**. Baseline noise levels measured at the Project for 48 hours at 10-minute intervals are provided in **Table 16-4.**

Higher noise levels were noted only once during day time at SAN9 at a residential unit near to a restaurant which was busy on Sunday 23rd September 2018.

The available noise data indicate that the noise levels during the night time range between 25-37 dB(A). This low background noise level is typical for such a remote and mountainous area. The measurements during the day indicates a noise level of 29-40 dB(A), while one 15-minute interval was measured at 48 dB(A) where the noise meter was located close to a busy restaurant. There is no relevant technical noise preload that need to be considered in the calculation in addition to the planned wind turbines.

[163] WHO (1999) Guidelines for Community Noise, page 23 World Health Organization, Geneva (1999).

Table 16-2 Noise Monitoring Locations

Monitoring Location	Coordinates	Details of The Monitoring Campaign	Photographs
NM SA - IP34	Zone 37S/ 34.527319°N, 36.321035°E	Start date: 2/12/2019 8h40 End date: 2/14/2019 8h50 Period 48.16 hours Height: 1.5 m above ground	
NM LWP - IP73	Zone 37S/ 34.473917°N, 36.268675°E	Start date: 2/23/2019 16h50 End date: 2/25/2019 17h50 Period 49 hours Height: 1.5 m above ground	

Figure 16-3 Lebanon Wind Power Noise Monitoring Locations (Google Earth®, 2018)

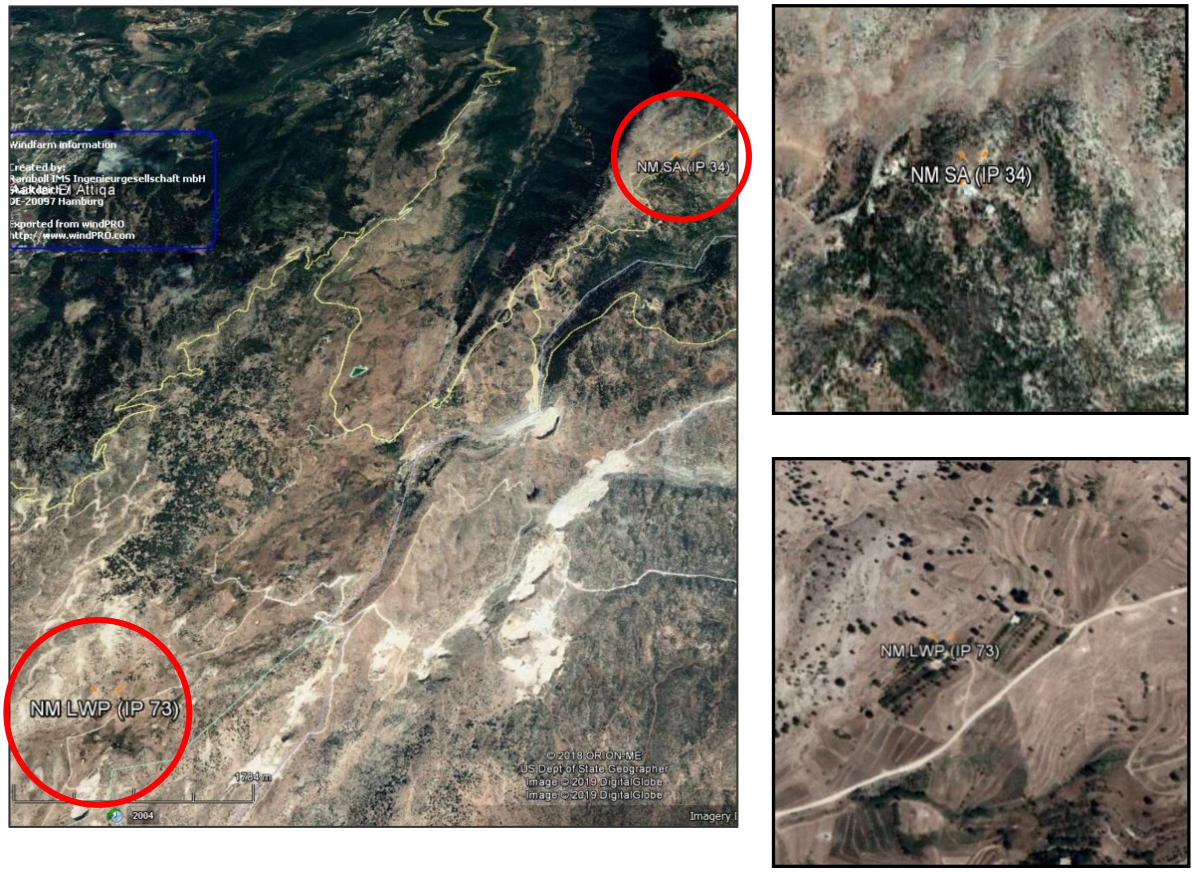


Table 16-3 Noise Measurements at Sustainable Akkar During Day and Night

Day 1	**Day time: Sunday 23/9/2018**		**Night time: Sunday 23/9/2018**	
Location	*Time*	*Noise Levels in dB(A)*	*Time*	*Noise Levels in dB(A)*
		L90		*L90*
SAN1	11:40 am	35.2	1:55 am	28.8
SAN6	12:10 pm	34.6	1:36 am	26.4
SAN7	1:17 pm	29.1	12:39 am	24.9
SAN4	2:10 pm	38.2	11:57 pm	29.8
SAN2	2:45 pm	31.0	11:38 pm	27.6
SAN5	3:12 pm	31.8	11:20 pm	26.7
SAN8	3:46 pm	37.7	10:59 pm	26.5
SAN3	4:06 pm	34.4	10:37 pm	24.6
SAN9	4:48 pm	47.6	10:18 pm	26.3
SAN10	5:17 pm	34.5	10:00 pm	28.8
Day 2	**Day time: Friday 28/9/2018**		**Night time: Wednesday 26/9/2018**	
Location	*Time/Period*	*Noise Levels in dB(A)*	*Time/Period*	*Noise Levels in dB(A)*
		L90		*L90*
SAN1	1:40 pm	38.7	2:00 am	25.8
SAN6	2:00 pm	39.8	2:22 am	28.4
SAN7	2:47 pm	32.2	3:12 am	25.9
SAN4	3:22 pm	34.9	4:12 am	35.8
SAN2	3:45 pm	32.6	4:36 am	27.8
SAN5	4:04 pm	36.1	4:57 am	25.8
SAN8	4:26 pm	35.0	5:21 am	26.9
SAN3	4:51 pm	30.3	5:43 am	25.6
SAN9	5:10 pm	33.0	6:02 am	24.3
SAN10	5:27 pm	38.0	6:24 am	31.8
Day 3	**Day time: Monday 1/10/2018**		**Night time: Monday 1/10/2018**	
Location	*Time/Period*	*Noise Levels in dB(A)*	*Time/Period*	*Noise Levels in dB(A)*
		L90		*L90*
SAN1	10:40 am	33.2	2:00 am	26.9
SAN6	10:22 am	35.6	2:26 am	27.2
SAN7	9:47 am	31.5	3:13 am	25.6
SAN4	9:03 am	35.8	4:17 am	36.9
SAN2	8:38 am	31.6	4:39 am	26.8
SAN5	8:17 am	31.8	5:02 am	26.8
SAN8	7:55 am	34.6	5:22 am	33.9
SAN3	7:36 am	31.2	5:46 am	25.6
SAN9	7:18 am	30.6	6:03 am	24.2
SAN10	7:00 am	31.5	6:24 am	33.8

Table 16-4 Noise Measurements for 48 Hours During Day and Night

IP 34 (SA) – Wind Speed Corrected to 10m									
	0<WS<1	**1<WS<2**	**2<WS<3**	**3<WS<4**	**4<WS<5**	**5<WS<6**	**6<WS<7**	**7<WS<8**	**8<WS<9**
Count	6	34	56	77	43	34	27	10	2
Wind speed (m/s)	0.85	1.58	2.49	3.46	4.45	5.49	6.42	7.19	8.43
Temperature (°C)	5.41	5.51	5.72	5.96	6.78	7.64	7.50	8.18	7.88
Wind direction (°)	150.80	122.20	107.04	132.27	130.58	133.17	147.00	151.40	140.25
Humidity (%)	59.32	64.78	68.62	79.18	73.27	63.79	60.25	52.39	56.32
Air pressure (mbar)	628.64	629.62	631.34	634.84	633.29	634.30	631.80	632.23	631.83
Leq - 10 min daytime	36.78	36.67	35.83	36.94	36.97	39.02	43.22	47.07	-
LA90 - 10 min daytime	34.68	34.03	33.28	34.31	34.12	36.32	39.85	43.52	-
Leq - 10 min nighttime	31.46	30.97	31.72	32.61	35.37	43.81	46.75	47.94	48.94
LA90 - 10 min nighttime	29.22	29.05	29.70	30.16	32.92	40.57	42.88	43.83	45.21
IP 73 (LWP) – Wind Speed Corrected to 10m									
	0<WS<1	**1<WS<2**	**2<WS<3**	**3<WS<4**	**4<WS<5**	**5<WS<6**	**6<WS<7**	**7<WS<8**	**8<WS<9**
Count	77	98	42	17	10	12	21	12	5
Wind speed (m/s)	0.63	1.47	2.39	3.33	4.47	5.63	6.47	7.31	8.26
Temperature (°C)	5.24	4.52	5.01	4.81	4.09	4.17	3.86	3.03	2.16
Wind direction (°)	314.93	310.88	270.45	193.35	158.10	162.29	152.91	144.61	144.13
Humidity (%)	59.29	75.03	69.86	63.04	76.46	73.42	87.36	96.03	99.99
Air pressure (mbar)	848.40	848.09	848.71	848.69	849.06	848.81	848.97	848.88	848.59
Leq - 10 min daytime	33.07	33.21	33.22	37	32.62	45.33	40.71	44.6	49.75
LA90 - 10 min daytime	31.23	31.01	31.16	34.22	30.95	42.27	37.65	42.25	46.68
Leq - 10 min nighttime	31.16	33.23	32.99	34.45	34.4	35.7	39.64	41.8	40
LA90 - 10 min nighttime	29.55	31.33	31.26	32.59	32.15	32.90	36.59	38.96	37.8

The available noise background data at the Sustainable Akkar site (Receptor 34) shows that the noise levels during the night time range between 29-45 dB(A) while there is an increase of the noise levels at higher wind speeds. LA90 noise levels over 36 dB(A) were only measured at wind speeds over 5m/s. This quiet background noise level is typical for such a remote and mountainous area. The measurements during the day indicates a noise level of 33-44 dB(A). While noise levels over 40 dB(A) were only observed at wind speeds over 7 m/s. These measurements underline the quiet and rural background of the area.

These measurements underline the quiet and rural background of the area. The background noise monitoring also confirms that there is no significant technical preload by other commercial or industrial activities which need to be considered in the calculation in addition to the planned wind turbines. While noise levels increase with higher wind speeds, the effect of masking the wind turbine noise by the wind itself is not considered in this assessment.

16.1.3 Assessment of Potential Noise Impacts

16.1.3.1 Noise Impacts During the Construction

A full construction noise assessment was not undertaken as the exact construction methodology is not known so far. The EPC Contractor has not been selected and the machinery composition and working methods/areas are yet to be defined. Therefore, a construction noise assessment was conducted that comprised a qualitative assessment with a supporting example based on quantitative calculations. The prediction of construction noise levels was undertaken using the calculation methodology presented in ISO 9613-2:1996. Noise generated by the transport of the WTG components was not considered in the assessment as a total of 22 trucks roundtrip will be added to the existing traffic per week. Further, the existing road segments already carry a significant amount of traffic. The Noise Assessment Report is provided in **Appendix T**.

During the construction phase potential noise emissions are expected from the activities associated with the installation of turbines, transmission lines and substation as well as the development of access roads and road widening activities. The main sources of noise are associated with transportation activities and the delivery of raw materials and turbines and furthermore with the operation of excavation, leveling and construction equipment. The following major activities will be conducted during the construction phase:

- Construction noise (breaker, excavator, dump truck etc.).
- Construction of access roads.
- Construction of electrical substation and associated structures.
- Erection of turbines.

Each of the construction activities includes working with heavy “balance-of-plant” machines with noise levels (LWA) up to 120 dB(A), as shown in **Table 16-5**.

The construction work is usually carried out one after the other at each turbine location, up to a maximum of two turbines per week. However, for the noise assessment, it was assumed that the work will occur concurrently at two turbine locations (i.e. at turbines WTG 24 and WTG 25). This scenario represents a worst case which might not be expected, or even if so, might occur for only a period of a few weeks, Turbines 24 and 25 were selected since the nearby noise receptors in Rweimeh Village are considered to be the receptors with the highest noise impact.

Table 16-5 Balance-of-Plant Machines

Activity	Balance-of-Plant Machines
Laying of access roads	1 x excavator (107 dB(A)), 1 x roller (107 dB(A)), 1 x bulldozer (109 dB(A)), 2 x dump truck (115 dB(A))
Excavation of foundations	1 x breaker (mounted on wheeled backhoe – 120 dB(A)), 1 x excavator (107 dB(A)), 2 x dump truck (115 dB(A))
Concreting of foundations	2 x concrete mixer (108 dB(A)), pumping (106 dB(A), or idling (99 dB(A))
Erection or dismantling of turbines	2 x mobile crane (106 dB(A)), 3 x flatbed truck (108 dB(A))

The construction noise was calculated for 28 locations around the wind farm, at the same noise sensitive areas that were used for the operational noise prediction. The equivalent continuous noise levels L_{Aeq} were calculated, as presented in **Table 16-6**.

If the construction works were to occur simultaneously at two nearby turbine locations (worst case scenario), the noise levels will be will exceed at six receptors the long-term noise limit according to the EHS Guideline Noise 1.7 (2007) during day time of 55 dB(A). The noise levels will be also below the local noise limit of 60 dB(A) for residential areas near construction sites derived from the governmental Decision No. 52/1 of July 1996.

In summary, the potential construction noise impacts on nearby residents are limited to a short time of the construction phase. The impacts will be of a negative nature and medium likelihood since it is rather unlikely that all the considered machinery will operate on full capacity at two turbine locations at the same time. Due to the distance to the closest dwellings the impact will be of medium magnitude.

Mitigation

- In order to organize the construction works with as little nuisance as possible, it is recommended to limit the working hours from Monday to Friday 7 am to 7 pm. if possible. Some flexibility in working hours may be required during the delivery and erection of turbines and depending on weather conditions.
- The final time schedule of the transport movements should be clarified with the authorities and communities.
- Only well-maintained equipment should be operated on-site.
- Generators to be housed in acoustic enclosures. Stationary noise generating equipment should be sited away from sensitive receptors.
- Minimize drop height during loading and unloading of excavated materials from haulage vehicles to minimize noise generation.
- Avoid vehicle and machinery idling and shut down machines in intermittent use.

Table 16-6 Noise Assessment - Construction Phase

IP	IP Name	Longitude	Latitude	Laying of Access Roads [dB(A) L_{Aeq}]	Excavation of Foundations [dB(A) L_{Aeq}]	Concreting of Foundations [dB(A) L_{Aeq}]	Erection of Turbine [dB(A) L_{Aeq}]	EHS Noise Level/Daytime [dB(A) L_{Aeq}]	Local Noise Level/Daytime [dB(A) L_{Aeq}]
06	SA 06: house	36.332278°	34.592306°	19	22	12	14	55	60
09	SA 09: house	36.335836°	34.591482°	19	22	13	14	55	60
11	SA 11: house	36.316885°	34.585207°	22	25	15	17	55	60
12	SA 12: house	36.312379°	34.576544°	25	28	18	20	55	60
13	SA 13: house	36.345692°	34.576697°	24	27	17	19	55	60
14	SA 14: house	36.308375°	34.566215°	29	32	22	24	55	60
15	SA 15: house	36.305997°	34.560880°	31	34	24	26	55	60
16	SA 16: house	36.349478°	34.561788°	28	32	22	24	55	60
17	SA 17: house	36.348794°	34.556554°	30	33	23	25	55	60
18	SA 18: house	36.305468°	34.554667°	34	37	27	29	55	60
19	SA 19: house	36.325610°	34.554785°	35	38	28	30	55	60
20	SA 20: house	36.325412°	34.553826°	36	39	29	31	55	60
21	SA 21: house	36.325264°	34.553336°	36	39	29	31	55	60

IP	IP Name	Longitude	Latitude	Laying of Access Roads [dB(A) L_{Aeq}]	Excavation of Foundations [dB(A) L_{Aeq}]	Concreting of Foundations [dB(A) L_{Aeq}]	Erection of Turbine [dB(A) L_{Aeq}]	EHS Noise Level/Daytime [dB(A) L_{Aeq}]	Local Noise Level/Daytime [dB(A) L_{Aeq}]
22	SA 22: house	36.309792°	34.549615°	37	40	30	32	55	60
23	SA 23: house	36.338111°	34.541330°	40	43	33	35	55	60
28	SA 28: summer house	36.329101°	34.534886°	49	52	42	44	55	60
29	SA 29: house	36.326909°	34.534279°	51	54	44	46	55	60
31	SA 31: summer house	36.319257°	34.527638°	56	59	49	51	55	60
32	SA 32: summer house (beekeeper)	36.317191°	34.527530°	55	58	48	50	55	60
34	SA 34: house	36.321032°	34.527326°	55	58	48	50	55	60
36	SA 36: house	36.316861°	34.526472°	53	56	46	48	55	60
37	SA 37: house	36.321536°	34.526544°	53	57	47	49	55	60

IP	IP Name	Longitude	Latitude	Laying of Access Roads [dB(A) L_{Aeq}]	Excavation of Foundations [dB(A) L_{Aeq}]	Concreting of Foundations [dB(A) L_{Aeq}]	Erection of Turbine [dB(A) L_{Aeq}]	EHS Noise Level/Daytime [dB(A) L_{Aeq}]	Local Noise Level/Daytime [dB(A) L_{Aeq}]
38	SA 38: restaurant in construction	36.314741°	34.526375°	52	55	45	47	55	60
39	SA 39: house	36.316340°	34.525495°	51	54	44	46	55	60
42	SA 42: summer house	36.317378°	34.523063°	48	51	42	44	55	60
44	SA 44: house	36.317980°	34.520157°	45	49	39	41	55	60
45	SA 45: house	36.316535°	34.519998°	45	48	38	40	55	60
51	SA 51: summer house	36.329166°	34.562378°	32	35	25	27	55	60

Following the implementation of this mitigation measure, the significance of the residual impact can be reduced to low and therefore to minor significant. The dwellings affected by the construction noise are houses located in a rural environment, most of the houses are only occupied a few months during the year and are considered of medium sensitivity. Given all of the above, the impact is considered to be of moderate significance, as shown in **Table 16-7**.

Table 16-7 Noise Assessment for Construction Phase (Worst-Case Scenario)

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium √	Negligible	Minor	**Moderate √**	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

16.1.3.2 Noise Impacts During Operations

Wind turbines produce noise caused by several different mechanisms which can be roughly grouped into mechanical and aerodynamic sources. The major mechanical components include gearbox, generator and yaw motors in addition to fans and hydraulic motors. Mechanical noise is radiated by the surface of the turbine and by openings in the nacelle housing. The interaction of air flow and the turbine blades produces aerodynamic noise caused by a variety of processes as air passes over and past the blades (IFC, 2015).

The noise generated by the wind turbines at nearby residences was calculated using WindPRO 3.2 (DECIBEL module), produced by Energi- og Miljødata (DK). WindPRO is a commercial software program that enables noise modeling of wind farms using sound propagation factors as adopted by ISO 9613-2. The modeling process included the following steps: (1) characterizing the noise sources, (2) creating a digital terrain model (DTM) of the site and vicinity to enable the model to evaluate effects of distance and topography on noise attenuation, and (3) assigning the equipment sound levels to appropriate locations on the site. WindPRO then calculates sound levels in the vicinity of the project site. For the modeling, numerous modeling receptor locations representing the residences nearest the proposed wind turbine locations were used.

National Noise Limits

The noise limits in Lebanon depend on the land use and the period of the day and are derived from the governmental the Decision No. 52/1 of July 1996. The limits are listed in **Table 16-8.**

Table 16-8 Limits for Noise Levels per Decision No. 52/1 of July 1996 [dB(A)]

Region Type	Limit for Noise Level		
	Daytime 7 am-6 pm	Evening time 6 pm-10 pm	NightTime 10 pm–7 am
Downtown/ Administrative and comercial areas	55-65	50-60	45-55
Residential areas having some construction sites or commercial activities/are located near a road	50-60	45-55	40-50
Urban resiential areas	45-55	40-50	35-45
Suburban residential areas with low activity	40-50	35-45	30-40
Industrial areas	60-70	55-65	50-60
Rural residential areas	35-45	30-40	25-35

In July 2019, the MOE confirmed the noise limit of 55 dB(A) during the day and 45 dB(A) during night time for residential houses set by the EHS Guideline. Therefore, the noise assessment will consider the 45 dB(A) [L_{Aeq}] nighttime noise limit. Since IFC (2007) and the MOE state absolute noise limits rather than relative noise limits, a background noise measurement is not necessary for the noise assessment.

International Noise Limits

The EHS Guidelines for Wind Energy (2015) sets the following screening criteria for wind farms:

> *"Preliminary modeling should be carried out to determine whether more detailed investigation is warranted. The preliminary modeling can be as simple as assuming hemispherical propagation (i.e., the radiation of sound, in all directions, from a source point). Preliminary modeling should focus on sensitive receptors within 2,000 meters (m) of any of the turbines in a wind energy facility."*
>
> *"If the preliminary model suggests that turbine noise at all sensitive receptors is likely to be below an LA90 of 35 decibels (dB) (A) at a wind speed of 10 meters/second (m/s) at 10 m height during day and night times, then this preliminary modeling is likely to be sufficient to assess noise impact; otherwise it is recommended that more detailed modeling be carried out, which may include background ambient noise measurements."*

A preliminary modelling exercise (conducted with the candidate turbine with the lowest noise level, V150) has indicated that turbine noise at some sensitive receptors is likely to be above an L_{A90} of 35 dB at a wind speed of 10m/s at a 10m height during the day and night times (refer to **Appendix T**). Since the screening noise limit of 35 dB is exceeded, more detailed modelling was conducted and included:

- A background ambient noise measurement to establish that there is no significant technical noise preload.
- A concurrent measurement of the prevailing wind speeds using the meteorological mast located on the mountain ridge close to the future turbine locations.
- Consideration of the cumulative noise effects of the three planned wind farms, Lebanon Wind Power, Sustainable Akkar and Hawa Akkar.
- Conducting a noise modelling based on worst case assumptions (see propagation model and assumptions), including calculation of the noise impact using the maximum sound power level of the turbines as LAeq value rather than the L_{A90} value. The L_{A90} value is a less stringent measure since it is 1.5 to 2 dB below the L_{Aeq} value. Consequently, considering using the LAeq value for the assessment follows the worst-case approach.
- The noise output of a turbine varies with the wind speed. Therefore, as part of our worst-case approach the wind speed with a maximum noise output of the turbines is considered. Since the calculation considers the loudest noise output of the turbines, it is not necessary assessing wind speeds, which are associated with lower noise outputs.

The EHS Guidelines for Wind Energy (2015) do not provide a noise limit other than the screening limit. EHS Guidelines for Wind Energy (2015) is designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. Therefore, the IFC / World Bank Environmental, Health, and Safety General Guideline 1.7 Noise (2007) was consulted for the noise limits, as shown in **Table 16-9**.

Table 16-9 Noise Level Guidelines per IFC General EHS Guidelines (2007)

Receptor	Daytime (07:00-22:00) [dB(A) L_{Aeq}]	Nighttime (22:00-07:00) [dB(A) L_{Aeq}]
Residential, institutional, educational	55	45
Industrial, commercial	70	70

For the evaluation of the noise level at the receptors the lower noise limit for the night time of 45 dB(A) will be applied in this analysis. The guidelines value of 45 dB(A) applies for a noise level measured out of doors.

Propagation Model and Assumptions

The calculation model of the International Standard ISO 9613-2 '*Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation*' is used to predict the levels of noise generated by the wind farm. This model predicts the sound pressure level by taking the source sound power level for each WTG and subtracting a number of attenuation factors:

Predicted Noise Level = Law + D – Ageo – Aatm – Agr – Abar – Amisc, with:

Law = sound power level of each turbine.
D = directivity correction factor (not used for worst case downwind propagation).
Ageo = losses due to geometrical divergence.
Aatm = losses due to atmospheric absorption.
Agr = losses due to the ground effect.
Abar = barrier losses where the turbine hub is unsighted.
Amisc = miscellaneous effects (vegetation, buildings).

When calculating predicted noise levels with ISO 9613-2, it is assumed that the noise sensitive area (receptor) is located downwind of the noise source (turbine). For upwind situations, lower noise levels can be expected. When noise propagation for multiple sources in different directions is calculated, the results are always worst-case assumptions. In addition, it should be noted that one receptor cannot be downwind of all noise sources at the same time. The meteorological coefficient C0 was set to 0 dB. The applied method does not use Abar and the Amisc attenuation factors, and therefore deliver more conservative results. There is sufficient buffer to the noise limits since the modelling was carried out under the following worst-case assumptions:

- Downwind noise propagation conditions for each turbine location and for each receptor.
- 70% humidity and 10°C air temperature.
- The maximum sound power level [in dB(A)] (covering all wind speeds) of the turbine was used (to be expected only under high wind conditions).
- Masking of the turbine noise by the noise of the wind itself was not considered.
- Meteorological coefficient C0 was set to 0dB.
- Abar and the Amisc attenuation factors were not considered in the calculation.
- A security surcharge of 1 dB(A) is applied on the maximum sound power level of the turbines. (Note: since noise guarantees are stipulated in confidential turbine supply agreements, a noise guarantee was not available to Ramboll. Therefore, the value of 1 dB(A) is based on experience and provides an additional security for the calculation.)

Therefore, the detailed modelling provides a sufficient degree of conservatism in the modelling assumptions to make any under-prediction unlikely. The model predictions are based on a widely validated prediction algorithm and manufacturer’s technical data.

Noise Sources

The primary noise sources associated with the Project would be a maximum of 21 wind turbines. However, the noise impact was undertaken assuming full operation of 23 wind turbines as a worst-case scenario, with all wind turbines operating simultaneously and continuously. Generally, the operational noise of a wind turbine has two sources: 1) the aerodynamic noise produced by the rotating blades; and 2) the mechanical noise produced by the turbine’s gearbox and generator. The intensity of the WTG noise depends on the wind speed. At very low wind speeds, no relevant noise emission is produced, WTGs become louder with increasing wind speed and power production.

The wind farm will be equipped with one turbine type from the following OEM: Nordex, GE, Vestas or Siemens. Since the OEM has not yet been selected, the calculation was based on the highest possible number of turbine locations as a worst-case approach.

The final wind turbine model has not yet been selected. Therefore, in this noise assessment three different turbine models listed in **Table 16-10** are considered. The specifications of the noise power levels of the OEMs (Vestas and GE) are provided in **Appendix T**.

Table 16-10 Technical WTG Data for Three Scenarios

	Planned WTG Scenario A	Planned WTG Scenario B	Planned WTG Scenario C
Name(s) on Print Out	7-23	7-23	7-23
Number **of Turbines (Worst-Case)**	23	23	23
Manufacturer	Nordex	Vestas	GE
WTG-Type	N149	V150	5.3-158
Rotor Diameter [m]	149	150	158
Hub Height [m]	105	105	121
Rated Power [MW]	4.5	4.2	5.3
Operating Mode, **Nighttime**	Mode 0	P01	Normal Operation
Serrations	No	Yes	Yes
Source of Sound Power Level	F008_271_A12_DE	0067-7067 V08	-NO_5.3-158-50Hz_IEC_EN_r03
L_{WA} [dB(A)], Nighttime	108.1	104.9	106.0
L_{WA} [dB(A)], Daytime	108.1	104.9	106.0
Surcharge*) [dB(A)]	1.0	1.0	1.0
LWA Total [dB(A)], Nighttime	**109.1**	**105.9**	**107.0**

Some of the turbines need to be operated in a noise reduced mode, the different selected modes are presented in **Table 16-11** through **Table 16-13**.

Table 16-11 Technical WTG Data for Vestas Scenario

	Planned WTG	Planned WTG	Planned WTG	Planned WTG
Name(s) on Print Out	02-08, 13, 15, 17-23	09-11, 29	24, 25	14
Number	16	4	2	1
Manufacturer	Vestas	Vestas	Vestas	Vestas
WTG-Type	V150	V150	V150	V150
Rotor Diameter [m]	150	150	150	150
Hub Height [m]	105	105	105	105
Rated Power [MW]	4.2	4.2	4.2	4.2
Operating Mode, Nighttime	P01	S02	S03	S13
Rated Power [MW], Nighttime	4.2	3.5	1.5	1.5
Serrations	Yes	Yes	Yes	Yes
Source of Sound Power Level	0067-7067 V08	0067-7067 V08	0067-7067 V08	0067-7067 V08
L_{WA} [dB(A)], Nighttime	104.9	102.0	99.5	97.0
L_{WA} [dB(A)], Daytime	104.9	104.9	104.9	104.9
Surcharge*) [dB(A)]	1	1	1	1
L_{WA} Total [dB(A)], Nighttime	105.9	103.0	100.5	98.0

Table 16-12 Technical WTG Data for Nordex Scenario

	Planned WTG	Planned WTG	Planned WTG	Planned WTG	Planned WTG	Planned WTG
Name(s) on Print Out	02-08, 18-22	13, 15, 17, 23	09-11, 29	24	25	14
Number	12	4	4	1	1	1
Manufacturer	Nordex	Nordex	Nordex	Nordex	Nordex	Nordex
WTG-Type	N149	N149	N149	N149	N149	N149
Rotor Diameter [m]	149	149	149	149	149	149
Hub Height [m]	105	105	105	105	105	105
Rated Power [MW]	4.5	4.5	4.5	4.5	4.5	4.5
Operating Mode, Nighttime	Mode 0	Mode 4	Mode 8	Mode 10	Mode 11	Mode 16
Rated Power [MW], Nighttime	4.500	4.100	3.720	3.370	3.300	2.940
Serrations	Yes	Yes	Yes	Yes	Yes	Yes
Source of Sound Power Level	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE
L_{WA} [dB(A)], Nighttime	106.1	104.1	102.0	100.0	99.5	97.0
L_{WA} [dB(A)], Daytime	106.1	106.1	106.1	106.1	106.1	106.1
Surcharge*) [dB(A)]	1	1	1	1	1	1
L_{WA} Total [dB(A)], Nighttime	107.1	105.1	103.0	101.0	100.5	98.0

Table 16-13 Technical WTG Data for GE Scenario

	Planned WTG	Planned WTG	Planned WTG	Planned WTG	Planned WTG	Planned WTG
Name(s) on Print Out	02-08, 18-22	17	9, 10, 15, 23, 24, 29	11, 13	25	14
Number	12	1	6	2	1	1
Manufacturer	GE	GE	GE	GE	GE	GE
WTG-Type	5.3-158	5.3-158	5.3-158	5.3-158	5.3-158	5.3-158
Rotor Diameter [m]	158	158	158	158	158	158
Hub Height [m]	121	121	121	121	121	121
Rated Power [MW]	5.3	5.3	5.3	5.3	5.3	5.3
Operating Mode, Nighttime	Normal Operation	NRO104	NRO 102	NRO 101	NRO 99	NRO 98
Rated Power [MW], Nighttime	5.300	4.800	4.470	4.498	3.948	3.517
Serrations	Yes	Yes	Yes	Yes	Yes	Yes
Source of Sound Power Level	-NO_5.3-158-50Hz_IEC_EN_r03	-NO_5.3-158-50Hz_IEC_EN_r03	-NO_5.3-158-50Hz_IEC_EN_r03	-NO_5.3-158-50Hz_IEC_EN_r03	-NO_5.3-158-50Hz_IEC_EN_r03	-NO_5.3-158-50Hz_IEC_EN_r03
L_{WA} [dB(A)], Nighttime	106.0	104.0	102.0	101.0	99.0	98.0
L_{WA} [dB(A)], Daytime	106.0	106.0	106.0	106.0	106.0	106.0
Surcharge*) [dB(A)]	1	1	1	1	1	1
L_{WA} Total [dB(A)], Nighttime	107.0	105.0	103.0	102.0	100.0	99.0

The sound power level of proposed Siemens turbine and its reduced noise modes are in the range of the three considered scenarios, therefore no additional calculation was conducted for the Siemens turbine type.

The 48 hour background noise monitoring at Receptor 34 shows that the noise levels are between 29-45 dB(A) during the nighttime, and below 34 dB(A) at wind speeds below 5m/s. Consequently, the measured noise levels are typical for such remote and mountainous area. While background noise levels increase with higher wind speeds, the effect of masking the wind turbine noise by the wind itself was not considered in this assessment. The background noise monitoring also confirms that there is no significant technical preload by any other commercial or industrial activities which needs to be added to the noise levels at the receptors.

The sound power level information refers to the maximum sound power level of the wind turbine types. The individual sound sources of all wind turbines overlap to a resulting sound pressure level, which is to be evaluated for the relevant receptor.

The sound power levels of the turbines were taken from the manufacturer specifications. In addition, a security surcharge of 1 dB(A) was applied.

Noise Modelling Results

The additional and cumulative load of the planned wind turbines at the surveyed receptors were calculated according to the ISO 9613-2:1996. Noise levels were calculated for the following at a maximum of 23 locations:

- Vestas 4.2MW turbine.
- Nordex 4.5MW turbine.
- GE 5.3MW turbine.

The modeled results for the Vestas V150, Nordex N-149 and GE 5.3-158 are summarized in **Table 16-14** to **Table 16-16**. The isophones are shown in **Figure 16-4** to **Figure 16-6.**

For all three scenarios, the modeled sound levels are within IFC's nighttime noise limit guideline of 45 dB(A). The potential noise impacts on nearby residents affect a few dwellings in the vicinity of the project site. The potential noise impacts are negative in nature and of high likelihood since the turbines will be operating constantly apart from times with low wind speeds.

The operational noise can cause annoyance and sleep disturbance for nearby residents in case (unmitigated) all turbines are operated on full capacity during the night time.

In case reduced noise modes are applied the noise IFC limit of 45dB (A) is met and consequently the magnitude of the impact is assessed to be low. The dwellings affected by noise impacts are houses located in a rural environment and are considered of medium to high sensitivity. Given the distance of the Hawa Akkar wind farm, and the even greater distance to the Lebanon Wind Power project, there are negligible cumulative noise impacts. Given all of the above, the noise impact during the operation is considered to be of minor significance, as shown in **Table 16-17.**

Table 16-14 Calculated Noise Levels for Scenario A: Vestas V150

Receptor	Longitude	Latitude	Daytime Noise Levels		Nighttime Noise Levels		IFC Noise Level Guideline Daytime/Nighttime [dB(A)]
			Noise Levels SA Wind Farm [dB(A)]	Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	Noise Levels SA Wind Farm [dB(A)]	Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	
SA 06: house	36.332278°	34.592306°	41.0	41.8	41.0	41.7	55/45
SA 09: house	36.335836°	34.591482°	39.9	40.7	39.8	40.7	55/45
SA 11: house	36.316885°	34.585207°	37.3	37.6	37.1	37.4	55/45
SA 12: house	36.312379°	34.576544°	36.7	36.9	36.2	36.3	55/45
SA 13: house	36.345692°	34.576697°	36.9	37.1	36.4	36.6	55/45
SA 14: house	36.308375°	34.566215°	38.4	38.5	37.5	37.6	55/45
SA 15: house	36.305997°	34.560880°	38.3	38.3	37.7	37.7	55/45
SA 16: house	36.349478°	34.561788°	35.2	35.3	33.9	34.0	55/45
SA 17: house	36.348794°	34.556554°	34.4	34.4	33.0	33.1	55/45
SA 18: house	36.305468°	34.554667°	38.5	38.5	38.1	38.1	55/45
SA 19: house	36.325610°	34.554785°	45.0	45.0	44.0	44.0	55/45
SA 20: house	36.325412°	34.553826°	45.3	45.3	44.7	44.7	55/45
SA 21: house	36.325264°	34.553336°	45.2	45.2	44.7	44.7	55/45
SA 22: house	36.309792°	34.549615°	39.1	39.1	38.8	38.8	55/45
SA 23: house	36.338111°	34.541330°	37.3	37.4	36.7	36.8	55/45
SA 28: summer house	36.329101°	34.534886°	43.4	43.4	42.2	42.2	55/45
SA 29: house	36.326909°	34.534279°	45.8	45.8	44.6	44.6	55/45
SA 31: summer house	36.319257°	34.527638°	46.7	46.7	43.1	43.2	55/45
SA 32: summer house	36.317191°	34.527530°	46.3	46.3	42.3	42.4	55/45
SA 34: house	36.321032°	34.527326°	47.5	47.5	44.0	44.0	55/45
SA 36: house	36.316861°	34.526472°	44.5	44.5	40.9	40.9	55/45
SA 37: house	36.321536°	34.526544°	48.0	48.0	44.7	44.7	55/45
SA 38: restaurant in construction	36.314741°	34.526375°	43.1	43.1	39.6	39.6	55/45
SA 39: house	36.316340°	34.525495°	43.2	43.2	39.9	39.9	55/45
SA 42: summer house	36.317378°	34.523063°	43.1	43.1	40.2	40.2	55/45
SA 44: house	36.317980°	34.520157°	41.7	41.7	38.8	38.9	55/45
SA 45: house	36.316535°	34.519998°	39.6	39.6	36.8	36.8	55/45
SA 51: summer house	36.329166°	34.562378°	48.8	48.8	44.7	44.7	55/45

Figure 16-4 Calculated Noise Levels for Scenario A: Vestas V150 night time

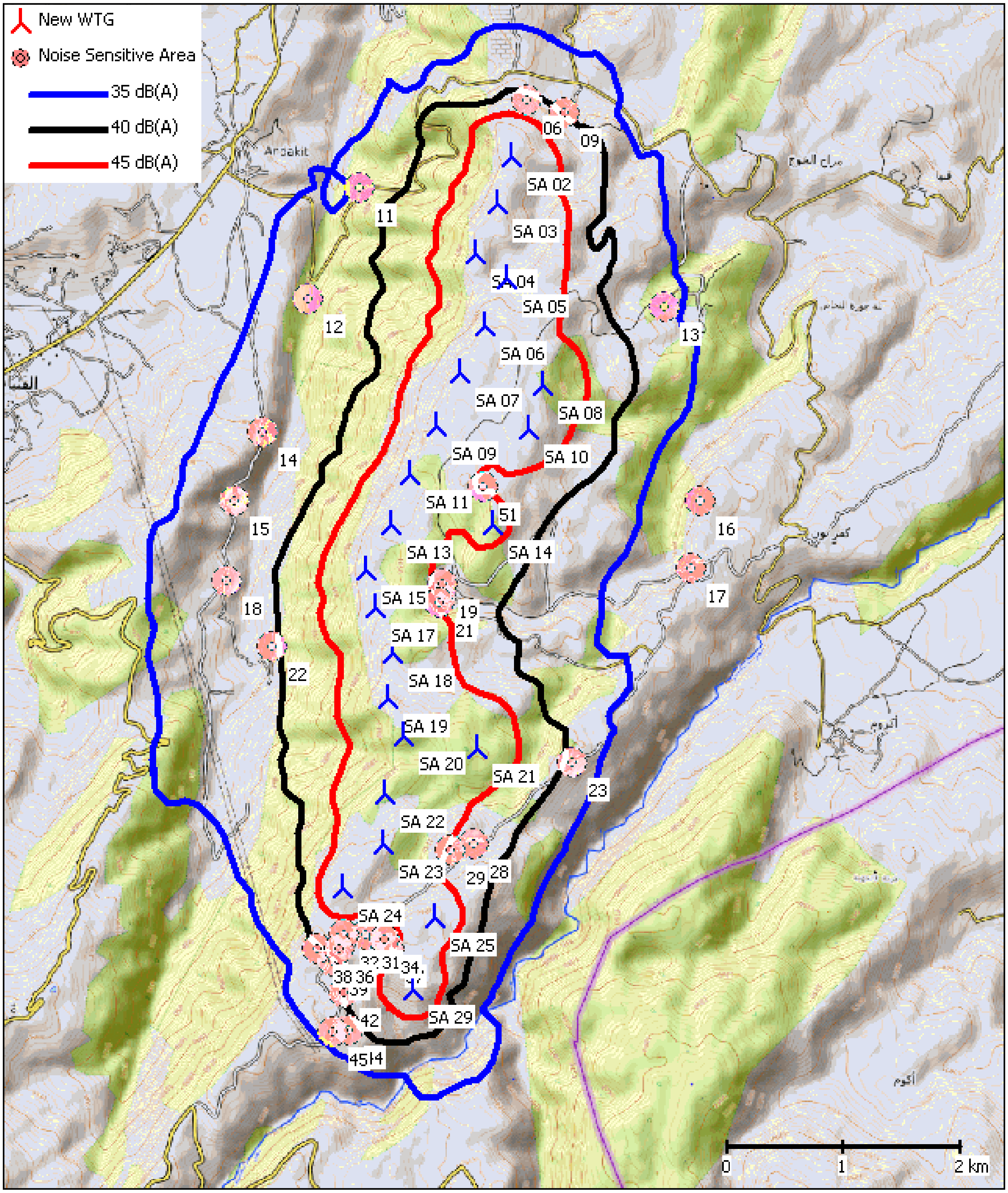


Table 16-15 Calculated Noise Levels for Scenario B: Nordex N149

Receptor	Longitude	Latitude	Daytime Noise Levels		Nighttime Noise Levels		IFC Noise Level Guideline Daytime/Nighttime [dB(A)]
			Noise Levels SA Wind Farm [dB(A)]	Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	Noise Levels SA Wind Farm [dB(A)]	Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	
SA 06: house	36.332278°	34.592306°	42.2	42.8	42.2	42.7	55/45
SA 09: house	36.335836°	34.591482°	41.1	41.7	41.0	41.7	55/45
SA 11: house	36.316885°	34.585207°	38.5	38.7	38.2	38.4	55/45
SA 12: house	36.312379°	34.576544°	37.9	38.0	37.0	37.1	55/45
SA 13: house	36.345692°	34.576697°	38.1	38.2	37.4	37.6	55/45
SA 14: house	36.308375°	34.566215°	39.6	39.7	37.7	37.7	55/45
SA 15: house	36.305997°	34.560880°	39.5	39.5	37.6	37.7	55/45
SA 16: house	36.349478°	34.561788°	36.4	36.4	34.7	34.7	55/45
SA 17: house	36.348794°	34.556554°	35.6	35.6	33.7	33.7	55/45
SA 18: house	36.305468°	34.554667°	39.7	39.7	38.2	38.2	55/45
SA 19: house	36.325610°	34.554785°	46.2	46.2	44.1	44.1	55/45
SA 20: house	36.325412°	34.553826°	46.5	46.5	44.8	44.8	55/45
SA 21: house	36.325264°	34.553336°	46.4	46.4	44.8	44.9	55/45
SA 22: house	36.309792°	34.549615°	40.3	40.3	39.3	39.3	55/45
SA 23: house	36.338111°	34.541330°	38.5	38.5	37.6	37.6	55/45
SA 28: summer house	36.329101°	34.534886°	44.6	44.6	42.8	42.8	55/45
SA 29: house	36.326909°	34.534279°	47.0	47.0	44.9	44.9	55/45
SA 31: summer house	36.319257°	34.527638°	47.9	47.9	43.3	43.3	55/45
SA 32: summer house	36.317191°	34.527530°	47.5	47.5	42.6	42.6	55/45
SA 34: house	36.321032°	34.527326°	48.7	48.7	44.1	44.1	55/45
SA 36: house	36.316861°	34.526472°	45.7	45.7	41.2	41.2	55/45
SA 37: house	36.321536°	34.526544°	49.2	49.2	44.7	44.7	55/45
SA 38: restaurant in construction	36.314741°	34.526375°	44.3	44.3	39.9	39.9	55/45
SA 39: house	36.316340°	34.525495°	44.4	44.4	40.1	40.1	55/45
SA 42: summer house	36.317378°	34.523063°	44.3	44.3	40.3	40.3	55/45
SA 44: house	36.317980°	34.520157°	42.9	42.9	38.9	39.0	55/45
SA 45: house	36.316535°	34.519998°	40.8	40.8	36.9	37.0	55/45
SA 51: summer house	36.329166°	34.562378°	50.0	50.0	44.9	44.9	55/45

Figure 16-5 Calculated Noise Levels for Scenario B: Nordex N149

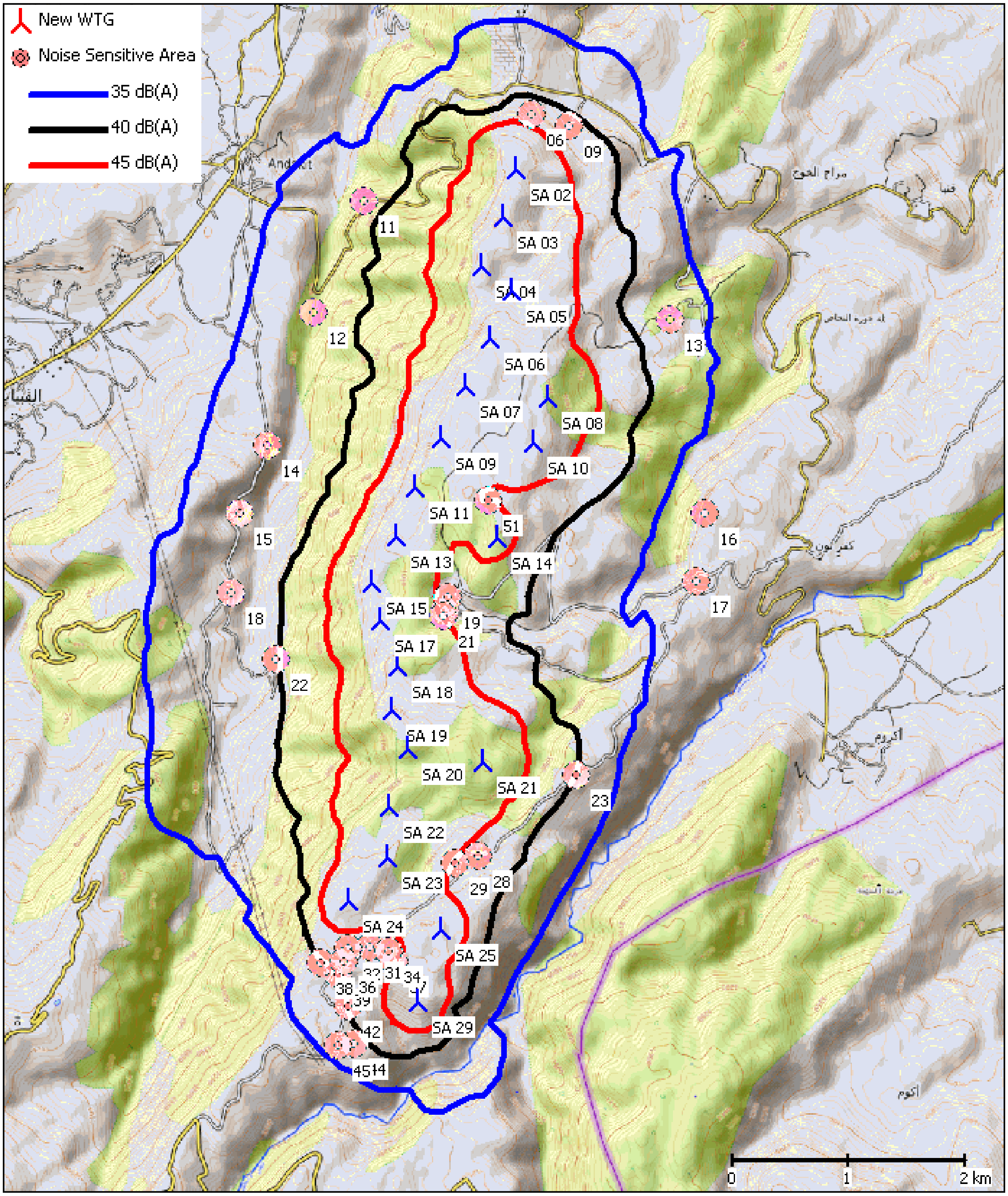


Table 16-16 Calculated Noise Levels for Scenario C: GE 5.3-158

Receptor	Longitude	Latitude	Daytime Noise Levels		Nighttime Noise Levels		IFC Noise Level Guideline Daytime/Nighttime [dB(A)]
			Noise Levels SA Wind Farm [dB(A)]	Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	Noise Levels SA Wind Farm [dB(A)]	Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	
SA 06: house	36.332278°	34.592306°	42.4	43.0	42.3	42.9	55/45
SA 09: house	36.335836°	34.591482°	41.2	41.8	41.2	41.8	55/45
SA 11: house	36.316885°	34.585207°	38.5	38.7	38.2	38.4	55/45
SA 12: house	36.312379°	34.576544°	38.0	38.0	36.9	37.0	55/45
SA 13: house	36.345692°	34.576697°	38.2	38.3	37.6	37.7	55/45
SA 14: house	36.308375°	34.566215°	39.7	39.7	37.0	37.0	55/45
SA 15: house	36.305997°	34.560880°	39.5	39.5	36.8	36.9	55/45
SA 16: house	36.349478°	34.561788°	36.4	36.5	34.7	34.7	55/45
SA 17: house	36.348794°	34.556554°	35.6	35.7	33.6	33.7	55/45
SA 18: house	36.305468°	34.554667°	39.7	39.7	37.5	37.6	55/45
SA 19: house	36.325610°	34.554785°	46.6	46.6	43.9	43.9	55/45
SA 20: house	36.325412°	34.553826°	46.7	46.7	44.5	44.5	55/45
SA 21: house	36.325264°	34.553336°	46.9	46.9	44.8	44.8	55/45
SA 22: house	36.309792°	34.549615°	40.8	40.8	39.3	39.3	55/45
SA 23: house	36.338111°	34.541330°	40.0	40.0	39.3	39.3	55/45
SA 28: summer house	36.329101°	34.534886°	44.9	44.9	42.9	42.9	55/45
SA 29: house	36.326909°	34.534279°	47.2	47.2	44.5	44.5	55/45
SA 31: summer house	36.319257°	34.527638°	48.0	48.0	44.0	44.0	55/45
SA 32: summer house	36.317191°	34.527530°	47.4	47.4	43.6	43.6	55/45
SA 34: house	36.321032°	34.527326°	48.9	48.9	44.5	44.5	55/45
SA 36: house	36.316861°	34.526472°	46.0	46.0	42.1	42.2	55/45
SA 37: house	36.321536°	34.526544°	49.4	49.4	44.9	45.0	55/45
SA 38: restaurant in construction	36.314741°	34.526375°	44.5	44.5	40.8	40.9	55/45
SA 39: house	36.316340°	34.525495°	44.6	44.6	40.8	40.8	55/45
SA 42: summer house	36.317378°	34.523063°	44.4	44.4	40.5	40.5	55/45
SA 44: house	36.317980°	34.520157°	42.8	42.9	38.9	39.0	55/45
SA 45: house	36.316535°	34.519998°	41.0	41.0	37.2	37.2	55/45
SA 51: summer house	36.329166°	34.562378°	50.0	50.0	45.0	45.0	55/45

Figure 16-6 Calculated Noise Levels for Scenario C: GE 5.3-158

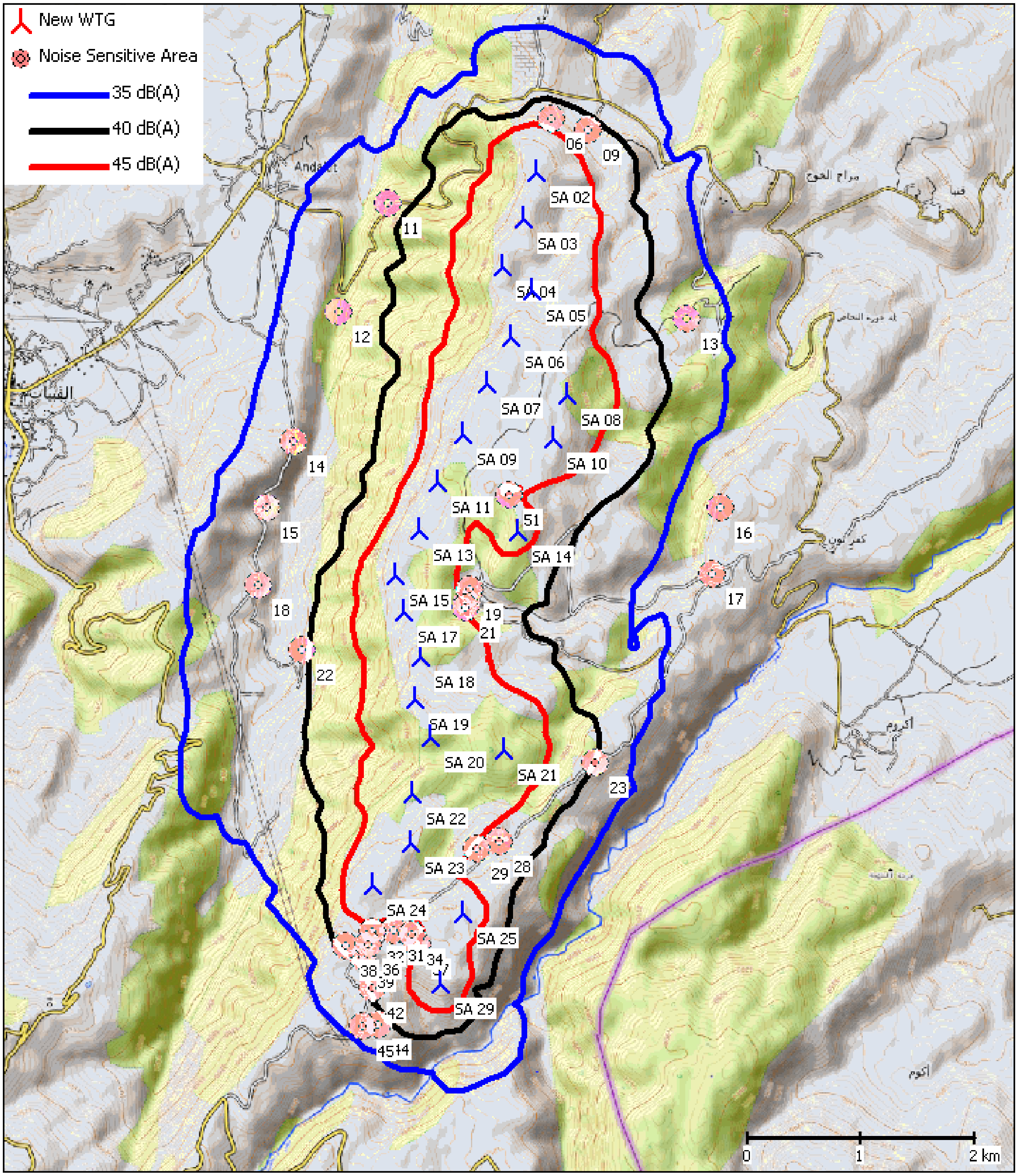


Table 16-17 Noise Assessment for Operations and Maintenance Phase (Worst-Case Scenario), with Mitigation

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High √**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	Minor	**Minor √**	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Mitigation Measures

The turbine locations were optimized to minimize the impact of noise by keeping a sufficient distance to the surrounding properties. This has been one of the key factors during the design process. The distance of the WTGs to nearby receptors was increased by eliminating the originally planned WTGs 12, 27 and 28. In addition, WTG 25 was shifted to increase the distance to nearby receptors.

In order to comply with the IFC noise limit of 45 dB(A) some turbines need to be operated in noise reduced modes. Using the noise reduced modes which are available for all considered turbine types, the IFC noise limit of 45 dB(A) can be complied with. Due to the fact, that the calculation was based on a worst-case assumption of 23 turbine locations, the noise assessment should be redone when the final and reduced turbine layout is available. At the time the final number of turbines is available, the noise reduction modes for the corresponding turbine type can be stipulated.

The WTGs will be maintained regularly to ensure that the turbines do not become louder over time.

16.1.3.3 Noise Impacts During Decommissioning

During decommissioning, the main sources of noise are associated with the dismantling and removal of the wind turbines and associated infrastructure. Given the temporary nature of these activities and the remote location of the project site, these impacts were considered to be of minor significance, like during the construction phase.

16.2 Shadow Flicker

16.2.1 Baseline Methodology

The project area is mountainous and rocky, with sparse vegetation. The 23 potential WTGs locations are on a ridge, oriented north to south. The elevation of the project area varies from 914m to 1,257m. Site visits in which the relevant receptors where identified and documented were conducted in December 2018 and January 2019 by SES. Before the site visit, potential shadow receptors were identified using topographical maps and aerial photographs.

There are no existing wind turbines in the area. However, there are two other wind energy projects ("Lebanon Wind Power" and "Hawa Akkar") planned nearby. In advance of the site visit potential shadow flicker receptors were identified in a desktop study using topographical maps and aerial photographs. Since residential houses were identified as shadow flicker receptors their sensitivity is assessed to be "high".

The shadow flicker impact of a wind energy project is limited to the moving blade of the turbines. Since there are no existing wind turbines in the planning area, a detailed study about the shadow flicker baseline is not necessary. However, there are two other wind farms in the area (the planned Sustainable Akkar and Hawa Akkar wind farms) which need to be considered in the assessment.

Shadow flicker occurs when the sun passes behind the wind turbine and the turbine casts a shadow. At times when the blades are turning areas of moving shadow occur and a flickering affect is caused when these shadows fall on the ground, structures or other objects. Shadow flicker may become a problem if potentially sensitive receptors (e.g. residential properties, health care facilities, schools, etc.) are located nearby and have a specific orientation to the wind energy facility (IFC, 2015). The objectives of the shadow flicker assessment, as presented in **Appendix U**, are as follows:

- To identify the areas that are affected by the shadow flicker of the WTGs.
- To assess impacts of the Project on residential and/or other sensitive receptors like hospitals or schools.

The methodology of the shadow flicker assessment is based on the Environmental, Health, and Safety Guidelines Wind Energy (IFC, 2015). The probability of shadow flicker occurrence and the extent of its effects on the residents depend on a number of factors such as the direction of windows relative to the turbine, the distance from the turbine, the turbine hub height and the rotor diameter, the width of the blades, the time of year and the time of day. Exposure to shadow flicker decreases with increasing distance from the wind farm.

The final wind turbine model has not yet been selected. Therefore, three different turbine models that may be selected for Sustainable Akkar wind farm were assessed, i.e. the Vestas, Nordex, and GE Wind turbines, as shown in **Table 16-18**.

Table 16-18 WTG Input Data

	Planned WTG Scenario A	Planned WTG Scenario B	Planned WTG Scenario C
Number in reports	02-11, 13-15, 17-25, 29	02-11, 13-15, 17-25, 29	02-11, 13-15, 17-25, 29
Count	23	23	23
Manufacturer	Vestas	Nordex	GE Wind
WTG type	V150	N149	5.3-158
Rotor diameter/m	150	149	158
Hub height/m	105	105	121
Rated power/MW	4.2	4.5	5.3
Mean blade width/m	2.8	2.7	2.7
Shadow length/m	1,905	1,809	1,819

With a mean blade width of 2.8m, the Vestas V150 has the broadest blade, and therefore casts the largest shadow area (1,905 m). Consequently, the Vestas V150 model was considered as worst-case scenario for identifying the potential receptors. While the Vestas V150 has the largest area in which shadow flicker can occur, the shadow flicker times generated by the GE 5.3-158 for individual receptors within its shadow area can be higher due to the larger rotor. The shadow flicker area of proposed Siemens turbine is in the range of the three considered scenarios, therefore no additional calculation was conducted for the Siemens turbine type.

To assess the compliance with the recommended limits, shadow flicker was modeled and predicted based on an astronomical worst-case scenario, which is defined in the EHS Guideline for Wind Energy (2015) as follows:

- There is continual sunshine and permanently cloudless sky from sunrise to sunset.
- There is sufficient wind for continually rotating turbine blades.
- Rotor is perpendicular to the incident direction of the sunlight.
- Sun angles less than 3 degrees above the horizon level are disregarded.
- Distances between the rotor plane and the tower axis are negligible.
- Light refraction in the atmosphere is not considered.

The affected houses will not suffer from shadow flicker if:

- The weather is overcast.
- The rotor plane of the turbine is parallel with the imaginary line between the location of the sun and the respective IP.
- There is an obstacle between the respective building and the sun in the direction of the wind turbine.
- The wind turbines are not under operation.
- There is poor visibility due to fog.

The calculations were conducted using WindPRO 3.2 software (SHADOW Module), produced by Energi- og Miljødata (DK). The model considers the movement of the sun relative to the time of day and time of year predicting the time and duration of expected shadow flicker at the window of an affected receptor. The input parameters used in the model are as follows:

- The turbine locations.
- The turbine dimensions.
- The locations of the receptors (IPs) to be assessed.

To support the calculation, a digital terrain model (DTM) was developed using SRTM (Shuttle Radar Topography Mission) data with a resolution of 30m.

A review of International Legislation and Regulations for Wind Turbine Shadow Flicker (International Conference May 2017) identified that the majority of countries, that have regulations or guidelines for the impacts of shadow flicker and their assessment, have based their regulations on the German Guidelines 'Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergieanlagen' (2002). The guidance identifies a shadow flicker limit at dwellings of 30 hours a year and 30 minutes a day for the worst case (astronomical maximum possible shadow). Since the 30 hours a year and 30 minutes a day limit is widely accepted and it is also referenced in the IFC guideline (2015), this limit was considered for the assessment.

Consequently, the threshold for the predicted shadow flicker duration is:

- Accumulated exposure on residential properties should not exceed a total of 30 hours per year.
- Exposure on residential properties should not be longer than 30 minutes per day.

If one of these thresholds is exceeded, mitigation methods such as turning off turbines during critical times must be considered, e.g. the turbines which cause the exceedance should be equipped with a shadow flicker shut down module.

16.2.1.1 Receptors

A site visit in which the relevant receptors where identified and documented was conducted in September 2018 by SES. In advance of the site visit potential shadow flicker receptors were identified in a desktop study using topographical maps and aerial photographs. Since residential houses were identified as shadow flicker receptors their sensitivity is assessed to be medium-high.

The area of potential shadow flicker receptors was selected based on the "20% criteria". If less than 20% of the sun is being covered by the passing rotor blade, the resulting shadow intensity at a neighboring property will not be strong enough to account for a nuisance. For the Vestas V150, which has the largest shadow area of the considered turbines, this corresponds to a theoretical maximum distance of 1,905m from the wind turbine.

This study focuses on the closest receptors to the wind farm site. However, the shadow flicker maps will also provide an indication about the shadow flicker times of the potential effected area around the wind farm site. The shadow flicker receptors are displayed in **Figure 16-7.** The astronomically maximum shadowing (hours/year) based on the Vestas turbine is shown in **Figure 16-8.**

Figure 16-7 Sustainable Akkar Shadow Flicker Receptors

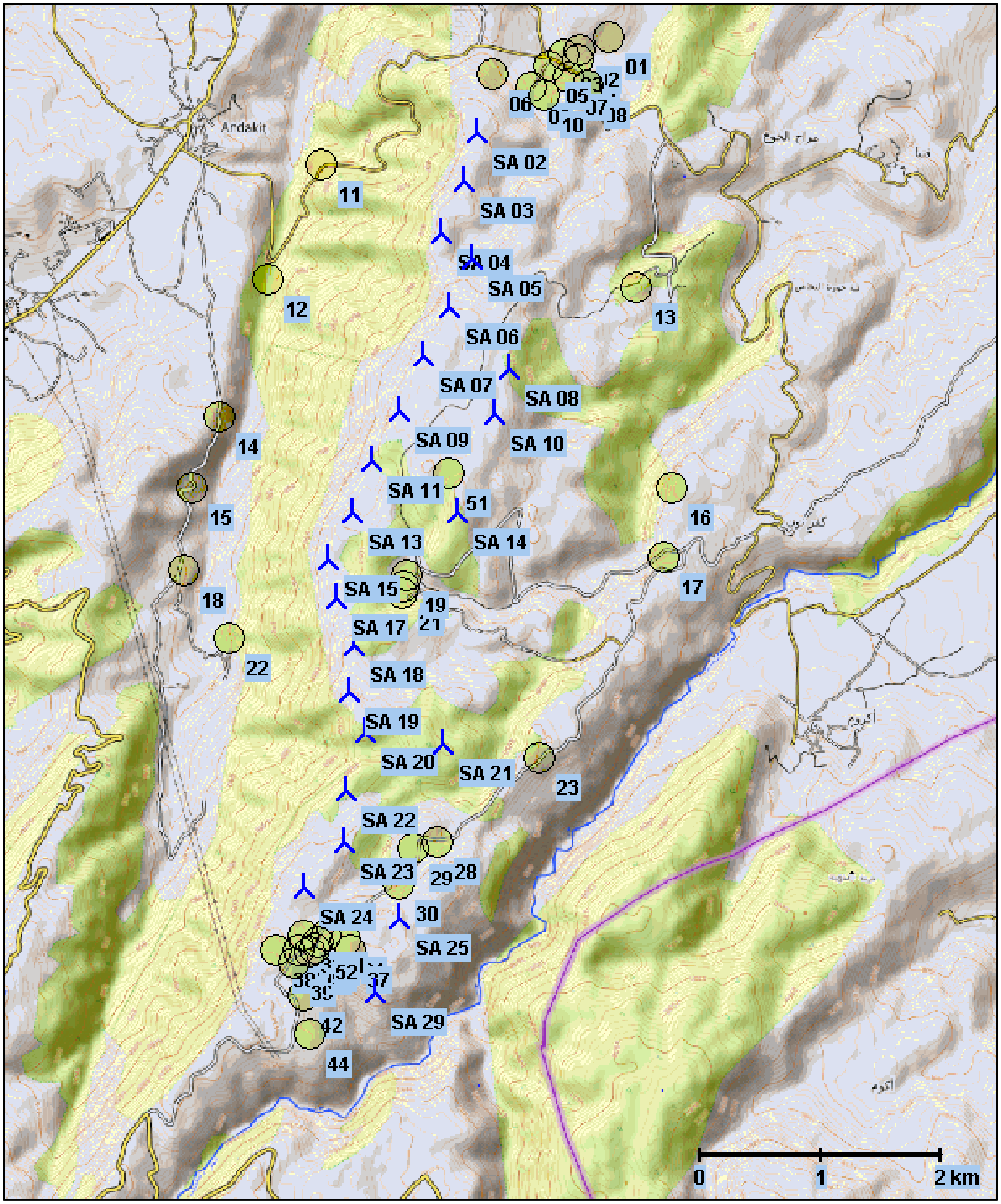
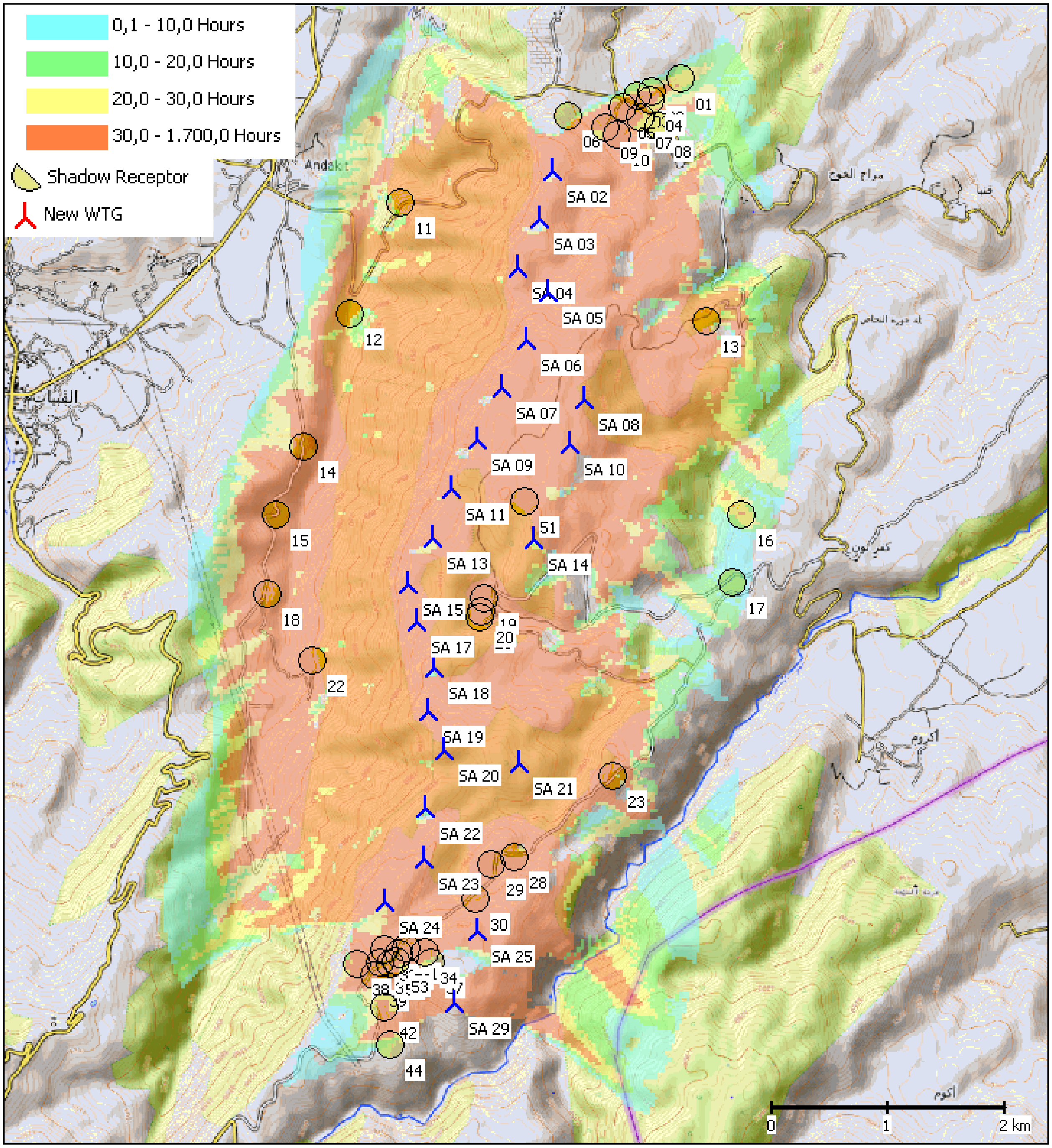


Figure 16-8 Astronomically Maximum Shadowing (h/year), Vestas V150 Scenario



16.2.2 Shadow Flicker Impact Assessment

16.2.2.1 Shadow Flicker Impacts During Construction

The shadow flicker impact of a wind energy project is limited to the moving blade of the turbines therefore, there will be no impacts in terms of shadow flicker during the construction phase.

16.2.2.2 Shadow Flicker Impact During Operation

Shadow Flicker Modelling Results

The calculations were conducted according to the recommendations of the IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015). The technical data for the calculations was provided by the turbine manufacturer. Shadow flicker exposure naturally decreases with an increase in distance from the wind farm. Predicted exposure of a receptor to the shadow flicker effect is measured in minutes per day and cumulative yearly hours.

The results show the hours of shadow flicker which accumulate at locations near the wind farm during a year, as presented in **Table 16-19** through **Table 16-21**.

Table 16-19 Duration of Shadow Flicker at Emission Points, Scenario A Vestas V150

Receptor	Longitude	Latitude	Accumulated Astronomical Maximum Possible Shadow Flicker [Hours per Year]	Astronomical Maximum Possible Shadow Flicker* [Minutes per Day]
01 house	36.342664°	34.595375°	26:45	0:27
02 house	36.340089°	34.594336°	**34:28**	**0:33**
03 house	36.338629°	34.593927°	**38:10**	**0:37**
04 house	36.339883°	34.593601°	**36:55**	**0:34**
05 house	36.337333°	34.593057°	**52:38**	**0:43**
06 house	36.332278°	34.592306°	0:00	0:00
07 house	36.339041°	34.592315°	**33:07**	**0:38**
08 house	36.340853°	34.591672°	20:18	**0:34**
09 house	36.335836°	34.591482°	**72:18**	**0:55**
10 house	36.336913°	34.590857°	**61:16**	**0:50**
11 house	36.316885°	34.585207°	**51:33**	0:27
12 house	36.312379°	34.576544°	**46:15**	0:21
13 house	36.345692°	34.576697°	**54:21**	**0:33**
14 house	36.308375°	34.566215°	**44:09**	0:24
15 house	36.305997°	34.560880°	**44:20**	0:25
16 house	36.349478°	34.561788°	28:10	0:23
17 house	36.348794°	34.556554°	7:58	0:20

Receptor	Longitude	Latitude	Accumulated Astronomical Maximum Possible Shadow Flicker [Hours per Year]	Astronomical Maximum Possible Shadow Flicker* [Minutes per Day]
18 house	36.305468°	34.554667°	**41:49**	0:27
19 house	36.325610°	34.554785°	**108:00**	**0:55**
20 house	36.325412°	34.553826°	**190:53**	**0:58**
21 house	36.325264°	34.553336°	**198:10**	**1:01**
22 house	36.309792°	34.549615°	**51:27**	0:28
23 house	36.338111°	34.541330°	**33:57**	**0:42**
28 summer house	36.329101°	34.534886°	**64:10**	**0:43**
29 house	36.326909°	34.534279°	**86:23**	**0:58**
30 brick factory	36.325632°	34.531636°	**201:59**	**1:57**
31 summer house	36.319257°	34.527638°	**97:49**	**0:57**
32 summer house	36.317191°	34.527530°	**89:31**	**0:49**
34 house	36.321032°	34.527326°	**79:12**	**1:07**
36 house	36.316861°	34.526472°	**113:35**	**0:47**
37 house	36.321536°	34.526544°	0:00	0:00
38 house	36.314741°	34.526375°	**40:19**	0:30
39 house	36.316340°	34.525495°	**60:10**	**0:39**
42 summer house	36.317378°	34.523063°	**42:40**	**0:46**
44 house	36.317980°	34.520157°	0:00	0:00
51 small summer house	36.329170°	34.562376°	**67:41**	**0:41**
52 house	36.318558°	34.527166°	**120:11**	**0:52**
53 house	36.318311°	34.526671°	**139:50**	**0:59**
54 house	36.317796°	34.526388°	**132:16**	**0:55**

* Highest value which can occur astronomically within one year.

Table 16-20 Duration of Shadow Flicker at Emission Points, Scenario B Nordex N149

Receptor	Longitude	Latitude	Accumulated Astronomical Maximum Possible Shadow Flicker [Hours per Year]	Astronomical Maximum Possible Shadow Flicker* [Minutes per Day]
01 house	36.342664°	34.595375°	26:35	0:27
02 house	36.340089°	34.594336°	**34:18**	**0:33**
03 house	36.338629°	34.593927°	**37:41**	**0:37**
04 house	36.339883°	34.593601°	**36:11**	**0:34**
05 house	36.337333°	34.593057°	**52:11**	**0:43**
06 house	36.332278°	34.592306°	0:00	0:00
07 house	36.339041°	34.592315°	**32:31**	**0:38**
08 house	36.340853°	34.591672°	20:02	**0:33**
09 house	36.335836°	34.591482°	**71:07**	**0:54**
10 house	36.336913°	34.590857°	**60:19**	**0:50**
11 house	36.316885°	34.585207°	**51:00**	0:27
12 house	36.312379°	34.576544°	**45:36**	0:21
13 house	36.345692°	34.576697°	**47:54**	**0:33**
14 house	36.308375°	34.566215°	29:56	0:24
15 house	36.305997°	34.560880°	**43:39**	0:25
16 house	36.349478°	34.561788°	22:06	0:23
17 house	36.348794°	34.556554°	7:54	0:20
18 house	36.305468°	34.554667°	**41:23**	0:27
19 house	36.325610°	34.554785°	**106:48**	**0:55**
20 house	36.325412°	34.553826°	**188:45**	**0:58**
21 house	36.325264°	34.553336°	**196:12**	**1:00**
22 house	36.309792°	34.549615°	**50:50**	0:28
23 house	36.338111°	34.541330°	**33:26**	**0:42**
28 summer house	36.329101°	34.534886°	**63:25**	**0:43**
29 house	36.326909°	34.534279°	**85:20**	**0:58**
30 brick factory	36.325632°	34.531636°	**200:08**	**1:56**
31 summer house	36.319257°	34.527638°	**96:41**	**0:57**
32 summer house	36.317191°	34.527530°	**88:30**	**0:48**
34 house	36.321032°	34.527326°	**78:32**	**1:07**
36 house	36.316861°	34.526472°	**112:51**	**0:46**

Receptor	Longitude	Latitude	Accumulated Astronomical Maximum Possible Shadow Flicker [Hours per Year]	Astronomical Maximum Possible Shadow Flicker* [Minutes per Day]
37 house	36.321536°	34.526544°	0:00	0:00
38 house	36.314741°	34.526375°	**39:49**	0:30
39 house	36.316340°	34.525495°	**59:42**	**0:39**
42 summer house	36.317378°	34.523063°	**42:17**	**0:46**
44 house	36.317980°	34.520157°	0:00	0:00
51 small summer house	36.329170°	34.562376°	**65:42**	**0:41**
52 house	36.318558°	34.527166°	**119:01**	**0:52**
53 house	36.318311°	34.526671°	**138:32**	**0:59**
54 house	36.317796°	34.526388°	**131:21**	**0:54**

* Highest value which can occur astronomically within one year.

Table 16-21 Duration of Shadow Flicker at Emission Points, Scenario C GE Wind 5.3-158

Receptor	Longitude	Latitude	Accumulated Astronomical Maximum Possible Shadow Flicker [Hours per Year]	Astronomical Maximum Possible Shadow Flicker* [Minutes per Day]
01 house	36.342664°	34.595375°	29:33	0:28
02 house	36.340089°	34.594336°	**38:53**	**0:34**
03 house	36.338629°	34.593927°	**43:56**	**0:39**
04 house	36.339883°	34.593601°	**34:51**	**0:35**
05 house	36.337333°	34.593057°	**58:45**	**0:45**
06 house	36.332278°	34.592306°	6:38	0:25
07 house	36.339041°	34.592315°	**41:11**	**0:40**
08 house	36.340853°	34.591672°	21:57	**0:35**
09 house	36.335836°	34.591482°	**70:32**	**0:56**
10 house	36.336913°	34.590857°	**72:07**	**0:52**
11 house	36.316885°	34.585207°	**57:08**	0:28
12 house	36.312379°	34.576544°	**48:57**	0:22
13 house	36.345692°	34.576697°	**54:49**	**0:35**
14 house	36.308375°	34.566215°	**33:35**	0:25
15 house	36.305997°	34.560880°	**48:28**	0:26

Receptor	Longitude	Latitude	Accumulated Astronomical Maximum Possible Shadow Flicker [Hours per Year]	Astronomical Maximum Possible Shadow Flicker* [Minutes per Day]
16 house	36.349478°	34.561788°	22:51	0:24
17 house	36.348794°	34.556554°	8:55	0:21
18 house	36.305468°	34.554667°	**46:03**	0:29
19 house	36.325610°	34.554785°	**133:47**	**0:57**
20 house	36.325412°	34.553826°	**211:47**	**1:01**
21 house	36.325264°	34.553336°	**215:21**	**1:03**
22 house	36.309792°	34.549615°	**58:40**	0:30
23 house	36.338111°	34.541330°	**38:04**	**0:43**
28 summer house	36.329101°	34.534886°	**65:30**	**0:45**
29 house	36.326909°	34.534279°	**95:54**	**1:00**
30 brick factory	36.325632°	34.531636°	**237:11**	**1:58**
31 summer house	36.319257°	34.527638°	**105:10**	**1:00**
32 summer house	36.317191°	34.527530°	**106:03**	**0:52**
34 house	36.321032°	34.527326°	**84:10**	**1:15**
36 house	36.316861°	34.526472°	**128:32**	**0:52**
37 house	36.321536°	34.526544°	0:00	0:00
38 house	36.314741°	34.526375°	**52:04**	**0:35**
39 house	36.316340°	34.525495°	**71:21**	**0:46**
42 summer house	36.317378°	34.523063°	**54:56**	**0:55**
44 house	36.317980°	34.520157°	0:00	0:00
51 small summer house	36.329170°	34.562376°	**136:45**	**1:20**
52 house	36.318558°	34.527166°	**139:21**	**0:58**
53 house	36.318311°	34.526671°	**154:00**	**1:03**
54 house	36.317796°	34.526388°	**145:58**	**0:59**

* Highest value which can occur astronomically within one year.

Mitigation Measures

The installation of shadow flicker shutdown modules in the turbines is a very common and an often-applied mitigation measure. Shutdown modules will eliminate the possibility for exceedances of annual and day limits. An automatic shadow flicker shutdown system shuts down the WTG when the sun is shining (direct sunshine on a horizontal area > 120 W/m²). These systems shut down a turbine when one of two conditions are reached:

- 30 minutes of shadow-flicker occur on one day at a receptor.
- The maximum annual quota of shadow flicker at a receptor is reached.

When shutdown systems feature a radiation sensor, the turbines only shut down when the sun is shining. If the shadow-flicker shutdown system does not include a radiation detector, the WTG will shut down at all times when the shadow-flicker assessment indicates shadow-flicker at a receptor (i.e. also in cases of overcast sky or fog when there is actually no shadow flicker). The use of shadow flicker shutdown modules will have a (small) negative effect on the energy yield of the wind farm.

The shadow flicker impacts will be of a negative nature and high likelihood. The calculated shadow flicker times show that the maximum astronomical possible shadow flicker times will be above the recommended limits of 30 hours per year and 30 minutes per day. This can cause annoyance for residents; however, the maximum astronomical possible shadow flicker times will about 1 hour per day apart from one building, which is not a residential building. The potential shadow flicker impacts on nearby residents is limited to individual dwellings in the vicinity of the Project site. There are no villages or bigger settlements located in the shadow area of the turbines.

Following the implementation of this mitigation measure, the significance of the residual impact can be reduced to Minor as shown in **Table 16-22**.

Table 16-22 Shadow Flicker Assessment for Operation Phase (Worst-Case Scenario), With Mitigation

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High √**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	Negligible	Minor	**Minor √**
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Therefore, if shadow flicker shut down modules are not installed, the magnitude of the impact is assessed to be Medium. The dwellings affected by shadow flicker are houses located in a rural environment and are considered of high sensitivity, resulting in a Major impact significance if not mitigated.

16.2.2.3 Shadow Flicker Impacts During Decommissioning

The shadow flicker impact of a wind energy project is limited to the moving blade of the turbines therefore, there will be no impacts in terms of shadow flicker during the decommissioning phase.

16.3 Visual Amenity

The aim of the visual amenity assessment is to assess the potential effects of the Project on views available to people.

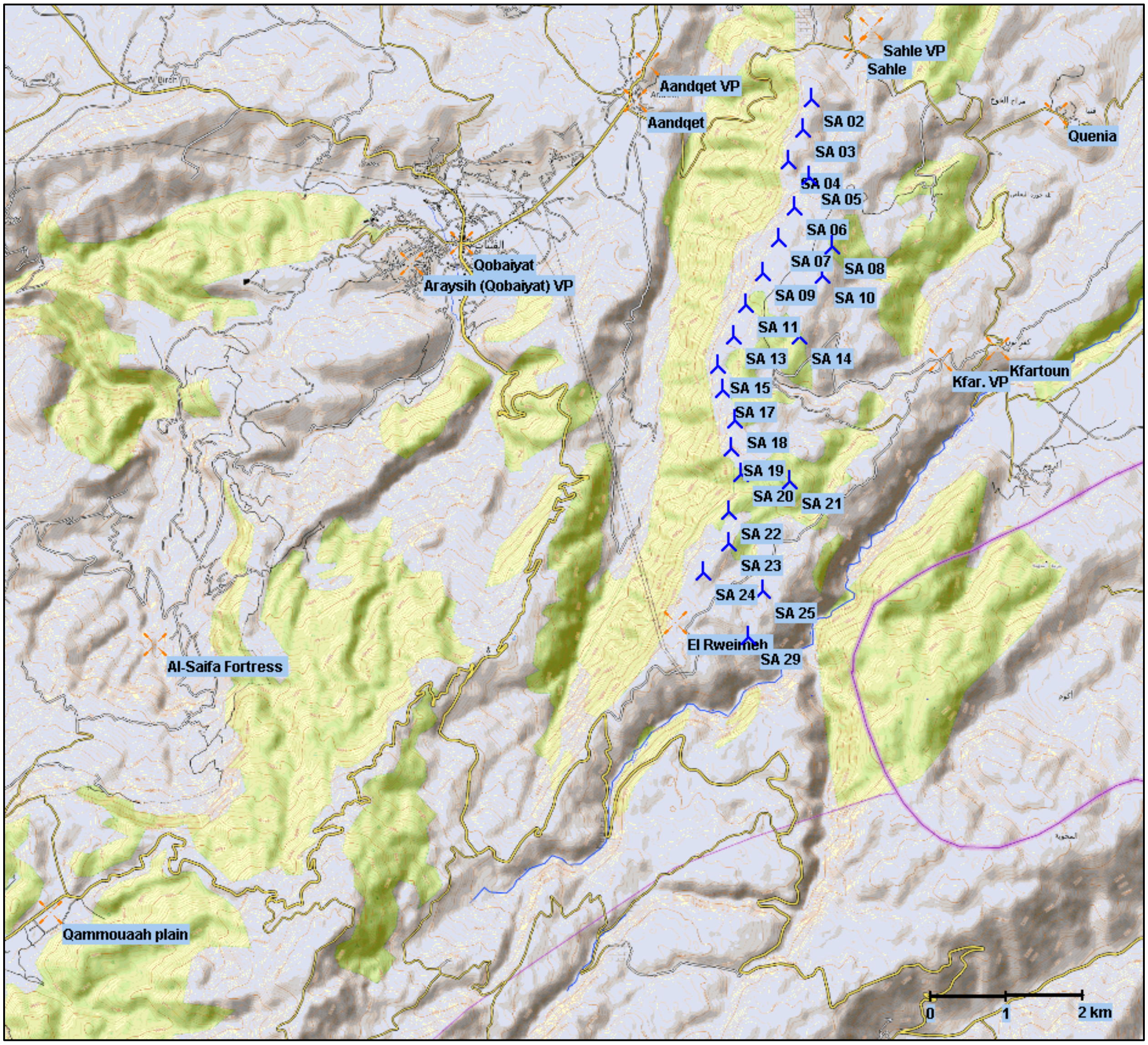
16.3.1 Visual Amenity Baseline Methodology

Information regarding the existing visual conditions in the Project Area was obtained through physical survey of the area. Photographs were taken to support the assessment by SES during a site visits conducted between September to December 2018 from the perspective of identified receptors, as shown in **Figure 16-9**. To ensure that the site visit was conducted to Ramboll standards, SES was prepared for the site visit by training videos and comprehensive site visit instructions as well as telephone conferences.

The ridge on which the wind farm is located is divided in two: a wetter and greener western part with more vegetation; and a drier eastern part of the site which is located in the shadow of the mountain ridge. The area in the west of the planned wind farm is an important forest and has, therefore, ecological and recreational importance. The area west of the wind farm is also characterized by more human activity including scattered settlements, roads, small fields and olive plants plantations. The study area has one of the lowest population densities in Lebanon (see also **Section 15 Socioeconomic Conditions**). A high voltage power line runs overhead south of the Project site, passing the settlement of Rweimeh Village.

The climate is characterized by long cold winters with snow, and a moderate climate during the three remaining seasons. Jabal Akroum is also characterized by the predominance of the Foehn effect. Incoming air masses moving in from the West and WSW pass through Wadi Oudine and meet the mountains perpendicularly; they follow the terrain heated by sunlight and rise. If the humidity is quite high initially in the air masses, the water vapor condenses to form clouds (see also **Section 8 Climate and Climate Change**). Condensation is usually followed by precipitation on the top and windward sides of the mountain (Wadi Oudine side). If the air is stable over the mountain, air masses cannot continue to rise once passing the top and descend on the leeward side. Consequently, the local climate condition cause that there is often no visibility of the mountain ridges where the WTGs will be installed since the area is covered in clouds.

Figure 16-9 Visual Receptors



16.3.1.1 Receptors

IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015) were used for the assessment of the visual impacts by the development, since there is no Lebanese guidance on how to assess visual impacts of wind turbines. The IFC guideline (2015) recommends assessing key viewpoints (receptors) by using zones of theoretical visibility (ZTVs), wire grids and photomontages. Viewpoints should include nearby settlements. However, IFC Guideline does not require a detailed assessment of all settlements in the sightline of the project.

According to the IFC (2015) visual receptors could be residential properties or users of recreational areas/routes. In the following assessments visual receptors were divided in settlement receptors and other visual receptors which include recreational receptors.

Settlements

In the 15km study area 80 settlements were identified and then screened if a more detailed assessment of these potential receptors is necessary (refer to **Table 16-23**). During the selection of the key viewpoints the distance of the receptors to the development is an important criterion. Turbines viewed at a distance farther than 5km are generally visible but become insignificant in the vertical field of view (CEDRO, 2012) . The reasons why settlements were scoped out for a more detailed assessment are also stated in **Table 16-23**.

Based on the screening of the 80 settlements in the 15km study area, the following settlements were selected as main receptors for the assessment:

- Sahle.
- Qenia.
- Quobaiyat.
- Aandqet.
- Kfartoun.
- Rweimeh Village.

All settlements are displayed in the ZTV (see **Appendix V**). The characteristics of the visual receptors at settlements are presented in **Table 16-24.** The assessment of the views from settlements was based on the viewpoints and also on the ZTVs.

Viewpoints (Visual Receptors which include Photomontages)

Viewpoints were selected from those places which are potentially most sensitive to the anticipated change arising from the development. Initially, five viewpoints were selected in the study area in cooperation with Ramboll landscape experts and Dr. Layale Abi-Esber, a local environmental expert. The viewpoints were checked against the ZTV in order to ensure that there is actually visibility of the turbines from the proposed locations. The viewpoints include important recreational site as well as local settlements in the surrounding of the wind farm.

In a second step, the selected viewpoints were discussed with and confirmed by the Ministry of Environment to ensure that there is a representative coverage of the potential effects in the study area. Due to the very low population density and the reduced visibility caused by the topography there is no visual receptor in the south of the development. The characteristics of the visual receptors are presented in **Table 16-25.**

For the viewpoints, photomontages were made which predict the visual change taking place once the wind turbines are erected. By using the realistic positions in the landscape and the correct scale of the wind turbines, visualizations provide a good impression on how the landscape will look like after the wind farm construction.

Table 16-23 Scoping of Settlements within the 15km Study Area

Settlement	Detailed Assessment	Reason for Inclusion/Exclusion
Hadidah (Syria)	No	Similar direction as receptor Sahle but located in a larger distance to the closest WTG (11km). If not blocked by local structures like buildings the WTGs will visible in the foreground of higher mountains in the south-south-west of the town. Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a very small scale. (see wire grids in **Appendix V**).
Tell Kalach (Syria)	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (11km). If not blocked by local structures like buildings the WTGs will visible on the ridgeline in the south-south-east of the town. Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a very small scale. (see wire grids in **Appendix V**).
Aridah (Syria)	No	Similar direction as receptor Sahle but located in a larger distance to the closest WTG (9km). If not blocked by local structures like buildings the WTGs will visible on the ridgeline in the south-south-east of the settlement. Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a small scale. (see wire grids in **Appendix V**).
Na`isiyah (Syria)	No	Similar direction as receptor Sahle but located in a larger distance to the closest WTG (9.5km). Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a small scale.
Bqaiaa	No	Similar direction as receptor Sahle but located in a larger distance to the closest WTG (8.3km). Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a small scale.
Ash Shayk Ibrahim (Syria)	No	Similar direction as receptor Sahle but located in a larger distance to the closest WTG (8.8km). Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a small scale.

Settlement	Detailed Assessment	Reason for Inclusion/Exclusion
Halat	No	No visibility of turbines, see ZTV.
Mqaible	No	No visibility of turbines, see ZTV.
Al Bahluniyah	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (9.2km). Due to the distance the turbines will appear at a small scale.
Al Qurayyat	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (8.1km). Due to the distance the turbines will appear at a small scale.
Machta Hammoud	No	No visibility of turbines, see ZTV.
Al Farid	No	Similar direction as receptor Sahle/ Qenia but located in a larger distance to the closest WTG (6.3km). Due to the wind park array stretching from north to south the turbines will also only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a small scale.
Debbabiyeh	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (12.1km). Due to the distance the turbines will appear at a very small scale.
Kafr Nun	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (8.2km). Due to the distance the turbines will appear at a small scale.
Aaouiaanat	No	Low visibility of turbines, see ZTV. The village is located on a slope facing west, while the turbines are located in the east.
Rimah	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (7.2km). Due to the distance the turbines will appear at a small scale.
Chiklar	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (6.4km). Due to the distance the turbines will appear at a small scale.
Chadra	No	Low visibility of turbines, see ZTV
Rajem Khalak	No	Similar direction as receptor Sahle/Qenia but located in a larger distance to the closest WTG (6.5km). Due to the distance the turbines will appear at a small scale.
Menjez	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (8.1km). Due to the distance the turbines will appear at a small scale.
Hnaider	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (9.3km). Due to the distance the turbines will appear at a small scale.
Fraidis	No	No visibility of turbines, see ZTV.

Settlement	Detailed Assessment	Reason for Inclusion/Exclusion
Dbadeb	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (5.6km). Due to the distance the turbines will appear at a small scale.
Kouachra	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (11.5km). Due to the distance the turbines will appear at a very small scale. (see wiregrids in **Appendix V**).
Arab Jernaya	No	Similar direction as receptor Sahle but located in a larger distance to the closest WTG (3.7km). Only a low number of turbines will be visible due to its topographical location (see ZTV).
Rajem Beit Hussein	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (5.3km). Due to the distance the turbines will appear at a small scale.
Sahle	yes	Considered as receptor north of the wind farm.
Daoussa w Baghdadi	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (13.0km). Due to the distance the turbines will appear at a very small scale.
Kanisa	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (9.9km). Due to the distance the turbines will appear at a very small scale.
Al Buwayt	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (8.2km). Due to the distance the turbines will appear at a small scale.
Aydamun	No	Similar direction as receptor Aandqet but located in a larger distance to the closest WTG (4.0km). The settlement is much smaller than Aandqet and located on a slope facing south towards a small valley. Consequently, views from houses of the settlement will rather be facing south than east, which is the direction of the SA turbines. Due to the distance the turbines will appear at a small to medium scale.
Manseh	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (5.5km). Due to the distance the turbines will appear at a small scale.
An Na`im (Syria)	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (13.7km). Due to the distance the turbines will appear at a very small scale.
Ain El Zeit	No	Low visibility of turbines, see ZTV.
Al Birah	No	Low visibility of turbines, see ZTV.
Kherbet Daoud	No	Low visibility of turbines, see ZTV.
Aandqet	Yes	Considered as receptor northwest of the wind farm.
Mrah El Kouakh	No	The small settlement comprises only a couple of houses along a road and is located in a distance of approx. 2km to the

Settlement	Detailed Assessment	Reason for Inclusion/Exclusion
		closest WTG. The settlement has a similar direction as receptor Qenia, however Mrah El Kouakh will have reduced visibility of the turbines due to the local topography (see ZTV).
Qenia	Yes	Considered as receptor northeast of the wind farm. In addition, the settlement is located on a ridge and has therefore an increased visibility for the local area.
Al Hit (Syria)	No	Similar direction as receptor Qenia but located in a larger distance to the closest WTG (8.3km). If not blocked by local structures like buildings the WTGs will be visible on the ridgeline in the west of the small settlement. Due to the distance the turbines will appear at a small scale. (see wire grids in **Appendix V**).
Sindianet Zeidane	No	Similar direction as receptor Quobaiyat but located in a larger distance to the closest WTG (7.3km). Due to the distance the turbines will appear at a small scale.
Majdal	No	Similar direction as receptor Quobaiyat but located in a larger distance to the closest WTG (9.6km). Due to the distance the turbines will appear at a small scale.
Kfartoun	Yes	Considered as receptor east of the wind farm.
Quobaiyat	Yes	Considered as receptor west of the wind farm
Qatlabah	No	Low visibility of turbines, see ZTV.
Huwayk (Syria)	No	Similar direction as receptor Kfartoun but located in a larger distance to the closest WTG (8.8km). Due to the distance the turbines will appear at a small scale.
Daoura	No	No visibility of turbines, see ZTV.
Akroum	No	Similar direction as receptor Kfartoun but has a lower visibility of the turbines due to the local topography (see ZTV).
Aqrabiyah (Syria)	No	Similar direction as receptor Kfartoun but located in a much larger distance to the closest WTG (12.2km). If not blocked by local structures like buildings the WTGs will be visible on the ridgeline in the west of the settlement. Due to the distance the turbines will appear at a very small scale. (see wire grids in **Appendix V**).
Beino	No	No visibility of turbines, see ZTV.
Beit El Khalil	No	Similar direction as receptor Quobaiyat but located in a larger distance to the closest WTG (8.7km). If not blocked by local structures like buildings the WTGs will be visible in the west of the small scattered settlement. Some of the southern WTGs will be blocked by the topography. Due to the distance the turbines will appear at a small scale. (see wire grids in **Appendix V**).

Settlement	Detailed Assessment	Reason for Inclusion/Exclusion
Aaiyat	No	No visibility of turbines, see ZTV.
Bluzah (Syria)	No	No visibility of turbines, see ZTV.
Chettaha	No	No visibility of turbines, see ZTV.
Qboula	No	No visibility of turbines, see ZTV.
Bayt `Ali (Syria)	No	No visibility of turbines, see ZTV.
Chaqdouf	No	No visibility of turbines, see ZTV.
Aakkar El Aatiqa`a	No	No visibility of turbines, see ZTV.
Rweimeh Village	Yes	Considered as receptor south of the wind farm.
Aayoun	No	No visibility of turbines, see ZTV.
Ain Yaaqoub	No	No visibility of turbines, see ZTV.
Tikrit	No	No visibility of turbines, see ZTV.
Bezbina	No	No visibility of turbines, see ZTV.
Es Sayen	No	No visibility of turbines, see ZTV.
Boustane	No	Similar direction as receptor Rweimeh Village but located in a larger distance to the closest WTG (1.5km). Reduced visibility of the turbines due to the topography and vegetation (trees).
Memneh	No	No visibility of turbines, see ZTV.
Hmaireh	No	No visibility of turbines, see ZTV.
Mazraat El Talleh	No	No visibility of turbines, see ZTV.
Mrah El Zakbeh	No	No visibility of turbines, see ZTV.
Jouar El Hachich	No	No visibility of turbines see ZTV.
Qasr	No	No visibility of turbines see ZTV.
Qornet Aakkar	No	No visibility of turbines see ZTV.
Fnaidek	No	No visibility of turbines see ZTV.
Fissane	No	No visibility of turbines see ZTV.
Mrah Ras El Ain	No	No visibility of turbines see ZTV.
Kouakh	No	No visibility of turbines see ZTV.
Souaiseh	No	No visibility of turbines see ZTV.
Charbine	No	No visibility of turbines see ZTV.
Brissa	No	No visibility of turbines see ZTV.
Hermel	No	No visibility of turbines see ZTV.

Table 16-24 Visual Receptor Sensitivity Assessment – Settlements-

Receptor	Key Characteristics	Sensitivity
Sahle	Located approx. 800m northeast of the wind farm at an altitude of 750m. The scattered settlement northeast of the wind farm comprises mostly multi-story buildings. The area is already influenced by technical structures including telecommunication towers, a quarry and an army base. The area has a low population density and is not frequently visited by recreational users or holidaymakers.	Medium
Qenia	Located approx. 3.3km northeast of the wind farm at an altitude of 670m. Qenia is a small village in which most of the houses are located just by the main street. The eastern part of the village is located on higher ground and has therefore also more views over the area. The area has a low population density and is not frequently visited by recreational users or holidaymakers.	Medium-High
Aandqet	Located approx. 2.1km northwest of the wind farm at an altitude of 620m. The area is already influenced by technical structures including medium voltage overhead power lines, a quarry and telecommunication towers. The viewpoint for the visualization located in the north of the village Aandqet on a main road. Due to its exposed location it represents a worst-case view of the village. The area has a low population density and is not frequently visited by recreational users or holidaymakers.	Medium-High
Araysih (Quobaiyat)	Located approx. 5.5km west of the wind farm at an altitude of 550m. The center of the village Quobaiyat is located in a distance of approx. 3.8km to the closest turbine. The area is already influenced by technical structures like telecommunication towers. The viewpoint for the visualization is located in the upper parts of the village Quobaiyat. Due to its elevated and exposed location it represents a worst-case view of the village. The village has a higher population density than the surrounding area and has an increased summer population.	Medium-High
Kfartoun	Located approx. 2.5km east of the wind farm at an altitude of 880m. The viewpoint for the visualization is located in the west of the village Kfartoun and in a distance of 1.8km of the wind farm. Due to its exposed location and its open view on the wind farm site it represents a worst-case view of the village. The center of the village is located at a lower elevation and is therefore less exposed for views on the wind farmThe area has already some technical structures including medium voltage overhead power lines and concert buildings. The area has a low population density and is not frequently visited by recreational users or holidaymakers.	Medium-High
Rweimeh Village	Located approximately 750m south of the wind farm. The scattered small settlement northeast of the wind farm comprises a couple of detached houses. The majority of the dwellings are only occupied a couple of months during the summer season (see **Section 15.2.3.2**). The area is already influenced by technical structures including two large overhead power lines and telecommunication masts. Views in the valley and towards the wind farm area are partly blocked by the existing trees. The area has a spare population density and is usually not visited by recreational users or holidaymakers.	Low-medium

Table 16-25 Visual Receptor Sensitivity Assessment

Receptor	Key Characteristics	Sensitivity
Sahle (Hill)	Located approx. 1.2km northeast of the wind farm. The visual receptor was selected because of its potential to have cumulative views of the SA and the HA wind farm projects and due to its exposed location. The viewpoint represents a worst-case view from an exposed hilltop close to the village Sahle. The village Sahle is located in the valley and therefore will experience a much lower visibility of the proposed turbines. There are no dwellings on the hilltop. There are only very few individual house in vicinity of the hilltop which will therefore have less open views over the area. The area is already influenced by technical structures including telecommunication towers, a quarry and an army base. The area has a low population density and is not frequently visited by recreational users or holidaymakers.	Low
Al-Saifa Fortress Akkar El-Atiqa'a	Located approximately 7.3km southwest of the wind farm. The fortress is in a state of ruin, with only a part of the northern tower remaining. The ruin of the fortress can be regarded as national important historic site. The site is mentioned on the website http://www.discoverlebanon.com. However, the ruin is not a frequently visited site by recreational users or holidaymakers as there is no supporting infrastructure such as designated parking lots, picnic tables or information boards.	High
Qammouaah Plain	Located approximately 9.7km southwest of the wind farm. The plain is the starting point for tourists visiting the ancient woodlands and the nature reserve in the area. Therefore, it is frequently used by holidaymakers. The Plain has touristic infrastructure such as restaurants, accommodations and inflatable castles for children.	High

16.3.2 Visual Impact Assessment

16.3.2.1 Visual Impacts During Construction

During construction, the main visual impacts come from land clearing and excavation, stockpiling of equipment and materials, the use of large construction equipment such as cranes, and the construction of the turbines and transmission towers themselves. While the construction phase is anticipated to last about one year, the use of large construction equipment like cranes, which has the largest visual impact is limited to several weeks.

At the individual turbine locations, the cranes will be placed only for a couple of days. Due to the temporary nature of the construction process and the remote location of the project the visual construction impacts will be low in significance. Therefore, this section will focus on the operational phase of the project.

16.3.2.2 Visual Impacts During Operations

During operation, the predominant visual impact will be the 21 wind turbines (worst-case 23 turbines used for visual assessment), adding man-made elements of considerable scale. The assessment of visual effects will consider the effects of change on the views available to people outside of the immediate site boundary of the project.

IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015) were used for the assessment of the visual impacts by the development, since there is no guidance how to assess visual impacts of wind turbines in Lebanon. The IFC guideline (2015) recommends assessing key viewpoints (receptors) by using zones of theoretical visibility (ZTVs), wire grids and photomontages. In addition, the CEDRO Guideline Report was used.

To judge the visual consequences on people, zones of theoretical visibility (ZTV) of the proposed development and visualizations were generated. While the ZTVs give an estimation of which areas are affected by the wind farm, the use of key viewpoints and visualizations give a realistic impression on how views in the area will look like after the wind farm construction.

Using this methodology visual impact assessment consists of predicting and evaluating the impact of the project settlement patterns and cultural heritage features. The above-mentioned tools and methodology are recommended in IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015).

Zones of Theoretical Visibility (ZTVs)

Zones of theoretical visibility (ZTV) are used to describe the area over which a development can theoretically be seen and is based on a digital terrain model (DTM) created by using SRTM (Shuttle Radar Topography Mission) data with a resolution of 30m.

Wind turbines can be clearly visible in a distance from 15km at good weather conditions, however beyond that distance they are not likely to modify the landscape composition[164]. Therefore, the study area and the distances of the ZTV was defined as 15km from the outer limit of the wind farm. The radius is based on the EIA guideline report for Lebanon1[165] and frequently applied German guideline[166] for landscape assessment.

In the study area, the character of most of the forest is rather open with space and visibility between the individual trees. Therefore, forest cover was not included in the ZTV to reduce the visibility of the turbines. The same was observed for the settlements nearby the wind farm. Most of the houses are individual detached houses where visibility can be found between the dwellings. Therefore, settlements were also not considered as land cover in the calculations. By taking out the forest and the settlements as land cover, which usually blocks the visibility of the turbines, a worst-case approach was applied for calculating the ZTV. The ZTVs are presented in **Appendix V**.

The ZTV calculation of the area around the wind farm shows how many turbines are visible for the entire study area.

[164] Environmental Impact Assessment, CEDRO, Guideline Report, 2012.
[165] Environmental Impact Assessment, CEDRO, Guideline Report, 2012.
[166] Nohl; Beeinträchtigungen des Landschaftsbildes durch mastartige Eingriffe, Kirchheim bei München 1993/2001.

Visualizations (Photomontage)

To prepare visualizations, photographs of the landscape were taken, and 3D models of the proposed turbines were projected into the photographs. These renderings are produced with the software WindPRO by the Danish company EMD. For the visualizations the focal length of the photos, the coordinates of the photo location, a digital terrain model, the coordinates of the planned turbines and 3D models of the wind turbines are considered.

As a worst-case approach, the photographs for the visualizations were taken during clear weather conditions and the rotors are set to face towards the observer. Rather than providing the most realistic visualizations, the turbines were displayed dark when the background was bright and white when the background was rather dark in order to provide a worst-case photograph. The photomontages are presented in **Appendix V**. The receptors and their sensitivity are described in the following section.

A viewing distance is provided under the visualizations based on the focal length of the photograph (in case of a panoramic picture, it is based on the opening angle). The visualizations give a realistic picture of the proposed development, when they are looked at with the provided viewing distance.

Methodology for Assessing Visual Receptors

The assessment of the significance of effects is derived from a comparison of the nature of the effects (magnitude), as well as the nature of the receptors (sensitivity). The visual impact evaluation is based on the sensitivity degrees presented in **Table 16-26**.

The sensitivity of visual receptors is defined as very high, high, medium and low based on professional interpretation, combining judgements of their susceptibility to the type of change or development proposed and the value attached to the particular views. Visual receptors consist of the particular person or group of people likely to be affected at a specific viewpoint and are assessed in terms of both their susceptibility to change in views and visual amenity and also the value attached to particular views. The susceptibility of different visual receptors mainly depends on:

- The occupation or activity of people experiencing the view at particular locations.
- The extent to which their attention or interest may therefore be focused on the views and the visual amenity they experience at that particular location.

The magnitude of change can be described as very large, large, medium, small and very small, as shown in **Table 16-27**.

Table 16-26 Receptor Sensitivity Criteria

Sensitivity Level	Characteristics
Very High	Receptor is highly sensitive to changes due to the following factors: • Receptor type is nationally valued, designated and or unique • Receptor type is of cultural value with strong historical or topical cultural associations e.g. important with tourists. • Views are almost free from existing distracting manmade structures like power lines, roads, large buildings etc. • Receptor is frequently visited by recreational users or holidaymakers.
High	Receptor is highly sensitive to changes due to the following factors: • Receptor type is of cultural value with historical or topical cultural associations e.g. important with tourists. • Receptor has a nature-related recreational feature • Low level of existing distracting manmade structures like power line, roads, large buildings, etc. • Receptor is visited by recreational users or holidaymakers.
Medium	Receptor is sensitive to changes due to the following factors: • Receptor type has some cultural value with historical or topical cultural associations • Receptor has some extant nature-related recreational feature • Receptor or views are locally valued but regionally or nationally common • Medium level of existing distracting manmade structures like power line, roads, large buildings etc. • Receptor is occasionally visited by recreational users or holidaymakers.
Low	Receptor is less sensitive to changes due to the following factors: • Receptor type has low or none cultural value with historical or topical cultural associations • Receptor has no or very little nature-related recreational features • Considerable existing distracting manmade structures like power line, roads, large buildings etc. • Receptor is hardly visited by recreational users or holidaymakers.

Table 16-27 Criteria for Magnitude of Visual Amenity Change

Magnitude	Characteristics
Very Large	Very large changes in visual characteristics, wind turbines controlling the view.
Large	Range from notable changes in visual characteristics, wind turbines can be easily and unmistakable seen.
Medium	Moderate changes in visual characteristics in a local area, wind turbines clearly visible.
Small	Minor change in visual characteristics, wind turbines are visible.
Very Small	Very minor change in visual characteristics, wind turbines not clearly visible or not obvious visible.
No Change	Wind turbines are not visible.

The Cedro Guideline Report (2012) was established for Environmental Impact Assessments for Wind Farm developments in Lebanon. The guideline provided an indication of the visual impact on potential viewers depending on the distance of the turbines, which is the most important factor for the visual impact. According to the guideline at distances less than 1,000m, wind turbines excess "human scale" and can be overpowering and therefore could lead to a large impact. Turbines viewed from 1 to 5km have a visual impact, but these impacts are considered to be minor. Turbines viewed at a distance of farther than 5km are generally visible but become insignificant in the vertical field of view.

The magnitude depends on the following:

- The distance of the receptor to the proposed development.
- The extent of adding new elements to views
- The geographic area over which the intervention will be perceived.
- The alteration of the skyline/altering the vertical scale in relation to the existing landscape features.
- The duration of the change.
- The reversibility of the change.

To assess the project's impact on visual receptors, the magnitude of change and visual sensitivity must be considered. By combining these two aspects the matrix presented in **Table 16-28** is derived.

Assessment of Effects on Visual Receptors

Roads and Craned Pads

New roads connecting the proposed turbine locations to the existing road network will be required. The material used for the tracks and crane pads will be similar to the existing bedrock. Therefore, the new tracks and crane pads will not stand out visually from the surrounding. New road sections will be on the rocky ridge of the site, consequently the new roads made of gravel will not visual attract attention due to the similar visual appearance. Since the project area is mountainous, the visibility of the new tracks will be limited and partly blocked by the topography.

The magnitude of change is considered to be low given that the tracks fit themselves into the surrounding and that most tracks are hidden in the landscape. The new tracks will not be adding a new element to this landscape. Therefore, the effect of new tracks on the landscape and visual resource is considered to be minor and not significant.

Cabling

Due to visual concerns it was decided that the power lines which collects the energy from the wind farm site will be executed by underground cables, routed along the line of new tracks. Therefore, there will be no additional overhead powerlines necessary for the Project. Consequently, this study will rather focus on the new wind turbines.

Wind Turbines

The 23 turbines of the Sustainable Akkar wind farm will add man-made elements of considerable scale to views establishing a new landmark feature and a point of reference in views from the wider area.

Table 16-28 Significance Matrix

Impact Magnitude \ Receptor Sensitivity	Low	Medium	High	Very High
Very Small	Negligible	Slight to negligible	Slight	Slight
Small	Slight to negligible	Slight to moderate	Slight to moderate	Moderate to substantial
Medium	Slight to moderate	Moderate	Moderate to substantial	Substantial
Large	Moderate	Moderate to substantial	Substantial	Substantial
Very Large	Moderate	Substantial	Substantial	Critical

Large, multimegawatt turbines with rotor diameters of up to 158m are considered for the project. Using such large turbines reduces the number of turbines necessary per generation capacity and therefore the footprint of the project. In addition, turbines with large rotor diameters have reduced rotor speeds in comparison with smaller turbines, which also reduces the visual impact.

At the time Ramboll was contracted to undertake the landscape and visual assessment, the final wind turbine model had not yet been selected. Therefore, four different turbine models that may be selected for Sustainable Akkar wind farm were assessed, as listed in **Table 16-29** (it is noted that Scenario A representing Nordex has been removed).

Table 16-29 WTG Scenarios

	Planned WTG Scenario B	Planned WTG Scenario C	Planned WTG Scenario D
Number in Reports	02-11, 13-15, 17-25, 29	02-11, 13-15, 17-25, 29	02-11, 13-15, 17-25, 29
Count	23	23	23
Manufacturer	Vestas	GE Wind	Siemens
WTG type	V150	5.3-158	SG145-4.5
Rotor Diameter/m	150	158	145
Tip Height/m	180	200	180
Hub Height/m	105	121	107.5
Rated Power/kW	4.2	5.3	4.5
Rotor Speed/rpm	4.9 -12.0	5.2 - 9.7	up to 10.8

For the assessment including the ZTVs, as well as the visualizations, the turbine type GE Wind 5.3-158 with a tip height of 200m was considered as a worst-case approach due to its large rotor and its larger total height compared to the Nordex, Siemens and Vestas models.

The key visual receptors were assessed based on criteria provided in the methodology, as shown in **Table 16-27 and 16-28** and its sensitivity classified accordingly. In a second step the significance of the impact was established by considering the magnitude of impact as well the sensitivity of receptor. The visual effects on key receptors are summarized in **Table 16-30** and on settlement receptors in **Table 16-31**.

Due to the remote location of the wind farm there are only a limited number of villages, individual houses and cultural features visually effected by the planned wind turbines. From the most frequently tourist spot in the area, the Qammouaah Plain, no turbines will be visible.

Mitigation Measures

The following mitigation measures have been addressed within the design to mitigate elements of potential visual impacts:

- A remote area with one of the lowest population densities in Lebanon was chosen to reduce visual impact on residential areas.
- Large, multi-MW turbines with large rotor diameters are being considered.
- Turbines with large rotor diameters have a reduced rotor speed in comparison with smaller turbines, which also reduces the visual impact.
- The turbines SA 01, SA 26, SA 27 and SA 28 were eliminated.
- The wind farm layout was designed so that the array follows the existing landform of the mountain ridges.
- Tracks will be designed to follow and fit with contours in the land as far as possible.
- The turbines and all the other aboveground structures will be removed at the end of the operational lifetime.
- The internal cabling will be underground cabling.

Effects of the Mitigation Measures

- By choosing a remote area with a low population density for the project site the number of effected residential areas and sensitive receptors was reduced at a very early project stage.
- By Large, multi-MW turbines with large rotor diameters the number of turbines per generation capacity and the footprint of the project was reduced. In addition, large rotors have a reduced rotor speed compared to smaller turbines which will also reduce the visual impact of the project.
- The turbines SA 26, SA 27 and SA 28 were eliminated to reduce visual impacts to the receptors in Rweimeh Village. The turbine SA 01 in the very north of the site was also erased. In altering the wind farm array this way, the distance to potential visual receptors was increased. In addition, the distance of the turbines to the wind energy projects Lebanon Wind Power and Hawa Akkar was also increased so that cumulative impacts could be reduced.
- By considering the landform of the mountain ridges at the wind fam design, the wind farm layout follows the existing morphology of the mountain. Consequently, the typological appearance of the ridge remains largely recognizable. In addition, the overlapping of rotors of views from the east and the west are unlikely which can be perceived as visually restless.

Table 16-30 Assessment of Visual Effects on Key Receptors

Receptor	Sensitivity	Magnitude of change	Significance
Sahle (Hill)	Low	-Large- (viewpoint) The turbines are clearly visible due to the distance of approx. 1.2km to the project site and the exposed location of the viewpoint. The Village Sahle is located in the valley and therefore will experience a much lower visibility of the proposed turbines due to the topography. (see also the visualization in **Appendix V**)	Slight to Moderate
Al-Saifa Fortress Akkar el-Atiqa'a	High	-None- The ZTV demonstrates that the area around the Fortress will have no visibility of the wind farm due to the existing orography which blocks the view towards the wind farm.	Negligible
Qammouaah Plain	High	-None- The ZTV demonstrates that the plain will have no visibility of the development due to the existing orography which blocks the view towards the wind farm.	Negligible
Sahle Village	Medium	-Medium to Large- The northern turbines of the project will appear at a large scale due to a distance of less than 1km to the village. However, due to the local topography only a limited number of the turbines will be visible (see ZTV map) and the rotors of the turbines will not be facing to the village most the time due to the prevailing wind directions. The wind turbines of the Project will add further large-scale man-made structures to the existing views of the village which is already influenced by technical structures including telecommunication towers, a quarry, an army base and many multi-story bare-concrete buildings in construction. Although the wind turbines will be added to the view of the village as new and large technical element the magnitude of change is limited to the existing visual preload. The visual intervention by the project will therefore result in a moderate significance. (see also the visualization in **Appendix V** of Sahle Hill).	Moderate

Table 16-31 Assessment of Visual Effects on Settlements

Receptor	Sensitivity	Magnitude of change	Significance
Qenia	Medium-High	-Medium- The ZTV indicates that about half the turbines of the project will be visible. In the lower parts of the village the number of visible turbines will be reduced due to the local topography. Due to the distance of more than 3km the WTGs will not appear in a large scale. In addition, the houses itself will reduce the visibility of the turbines. Consequently, in total the visual intervention by the project will result in a moderate significance.	Moderate
Aandqet	Medium	-Medium to Large- The turbines will be clearly visible from the worst-case viewpoint north of the village due to the distance of approx. 2.2km to the planned wind farm. In addition, the turbines are located on an elevated ridge which runs in parallel to the ridge of the Viewpoint. The WTGs are located in a height of approx. 300 m above the viewpoint which increases the visibility of the turbines. In the center of the village the houses itself will reduce the visibility of the turbines. Consequently, in total the visual intervention by the project will result in a moderate to substantial significance. (see also the visualization in the **Appendix V**)	Moderate to Substantial
Araysih (Quobaiyat)	Medium-High	-Medium to Large- The ZTV indicates that from the center of the village a reduced number of turbines of the project will be visible, the rest (the southern turbines) will be blocked by the local topography. From exposed locations in Quobaiyat (like the considered viewpoint) the turbines will be clearly visible. The turbines will be equally distributed on the ridge of the wind farm and follow the topography of the mountain. Although the project will be clearly visible on the horizon from exposed places in the village, and the WTGs would occur as new elements, the magnitude of change is restricted, and the turbines will not be dominate features in the landscape. This is due to the distance of about 3.8km, therefore the WTGs will not rather appear in a large scale. In addition, the buildings itself will partly block the views on the turbines, particularly in the more densely	Moderate to Substantial

		developed areas of the village (see also the visualization in the **Appendix V**) Consequently, in total the visual intervention by the project will result in a moderate to substantial significance.	
Kfartoun Medium-High	Medium-High	-Medium to Large- From exposed locations in the village (like the considered viewpoint which is located in the western part of the village) the turbines will be clearly visible. However, the ZTV indicates that from the center of the village a reduced number of turbines of the project will be visible, the rest will be blocked by the local topography. In addition, in the center of the village the houses itself will reduce the visibility of the turbines. The visualization in **Appendix V** from the edge of the village Kfartoun represents a worst-case view due to its exposed location and smaller distance to the project. Consequently, in total the visual intervention by the project will result in a moderate to substantial significance.	Moderate to Substantial
Rweimeh Village	Low-medium	-Large- The turbines will be clearly visible and appear to be large features in the landscape due to the distance of less than 1km to the planned WTGs. The WTGs of the northern part of the wind farm will appear smaller due to the larger distance to the viewpoint. The wind turbines of the Project will add further large-scale man-made structures to the existing views of the village which is already influenced by technical structures including telecommunication towers and the overhead power lines. Although the wind turbines will be added to views available to people from the village as new and large technical elements, the magnitude of change is limited due to the existing visual preload. In addition, the sensitivity of the of the village is rather low, due to the very low permanent population. Therefore, in total the visual intervention by the project will result in a moderate to substantial significance. It needs to be noted that the village Rweimeh Village is inhabited by Jaafar Family, who is in strong favor of the project. According to the head of the Jaafar Family, the Restaurant in the foreground of the visualization was constructed because of anticipated business opportunists caused by the Project.	Moderate to Substantial

- By following the existing tracks and fitting the location of the tracks with the contours lines the visual impact of the tracks can be reduced.
- By removing the turbines and all the other aboveground structures at the end of the operational lifetime, the visual impact of the project will be entirely revisable and limited to the operation phase of the project.

The assessment of visual impacts of the Project are Moderate, as shown in **Table 16-32**.

Table 16-32 Visual Impact Assessment for Operation Phase

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium √	Negligible	Minor	Moderate	**Moderate √**	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

16.3.2.3 Visual Impacts During Decommissioning

Decommissioning impacts are similar to construction impacts: the stockpiling of equipment and materials, the use of large construction equipment such as cranes, and the decommissioning process itself. Given the temporary nature of the decommissioning process, visual impacts are expected to be of negligible significance.

16.4 Transport and Traffic Impacts to Communities

16.4.1 Baseline Methodology

As presented in **Section 12 Transport and Traffic**, two route surveys and a Traffic Impact Study were undertaken to assess the conditions for the practical and safe transport of WTG components to the Project. The methodology was to assess potential routes, identify obstacles along those routes and to survey peak hour traffic volumes at key road links and junctions. Based on these studies, the preferred transport route for the Project was selected, as described in **Section 2 Project Description**. This section presents the impacts of transport and traffic to community health, safety and security, elaborating the difference between physical impacts and those to pedestrians, drivers and communities.

16.4.2 Baseline Findings

16.4.2.1 Obstacle Removal

The transport and traffic studies identified obstacles along the route that will need to be removed entirely or modified to provide the vertical and lateral clearance needed to transport the WTG components, as was summarized in **Table 12-9**. The obstacle removal works are generally as follows:

- Temporary concrete bund, curb, electric pole and overhead removal.
- Removal of curbs, electric poles, trees, lamp posts, and fencing along ramps, roundabouts and curves, as well as prohibition of car parking during transport.
- Raising of the pedestrian bridges to provide a vertical clearance of 570cm.
- Ground leveling and compaction at significant curves to facilitate maneuverability.

16.4.2.2 Construction of New Road Segments

New sections of road will be constructed as follows:

- In order to avoid impacts to Chadra, Machta Hassan and Machta Hammoud, a new 0.65km section of asphalt road will be constructed through currently vacant land purchased from private land owners (shown as #1 in **Figure 2-8**). The new road section will connect with the existing asphalt road outside of Machta Hammoud.
- A new 0.15km section of asphalt road will be constructed (shown as #2 in **Figure 2-8**) between two existing sections of asphalt road in order to avoid hairpin turns near homes.
- A new 3.0km section of gravel road will be constructed within the existing railroad right of way (ROW) managed by Machta Hammoud Village (shown as #3 in **Figure 2-8**), traveling east before connecting to an existing asphalt road to enter the Hawa Akkar Wind Farm.

16.4.2.3 Addition to Traffic Volume

Capacity analysis was undertaken for the 5 road segments to be used, Road Segments A, B, C, D, and E, under three scenarios:

1. The existing traffic conditions (year 2018); This scenario uses the existing traffic volumes collected through automatic and manual counts.
2. Future background traffic conditions (year 2020) without the Project; this projection applied a conservative traffic growth rate of 3%.
3. Future traffic conditions (year 2020) with the Project; the projection was derived after assigning the generated trips for the transport of the WTG components in combination with the projection generated under Item 2.

The resulting LOS was then calculated for the selected road segments under the three scenarios to illustrate the impact of the additional traffic. As an extra measure of conservatism, the LOS was calculated between 10pm and 11pm (a period of higher traffic volume), whilst the WTG component transport will be undertaken between 11pm and 4am.

During the WTG transport, the LOS of Road Segment A will be reduced from A to B, Road Segment B will be reduced from A to C, Road Segment C will be reduced from A to B, and Road Segment D will be reduced from A to B. For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road. For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic.

16.4.3 Transport and Traffic Impact Assessment

16.4.3.1 Transport and Traffic Impacts During Construction

Obstacle Removal

Obstacle removal activities will be undertaken by the Developer in close coordination with the concerned local authorities. Obstacles will be removed either temporarily (concrete blocks, selected poles) or permanently before being moved to another location (selected poles) or reinstated with an improved design (roundabout islands).

Removal of obstacles will cause a temporary impact to pedestrians, drivers, and communities along small sections of the roadway, creating delays or detours.

Mitigation

- The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition of the 45m of concrete wall be coordinated with the Port Authority.
- Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport.
- Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass.
- Any modification required for the Al Abdeh roundabout will be discussed with the municipality as it is under their authority.
- Such works will be coordinated and permitted by the Developer and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest.

As such, the impact severity is considered Low and the receptor sensitivity considered Medium, resulting in a Minor Impact as shown in **Table 16-33**.

Table 16-33 Assessment of Impacts from Obstacle Removal

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Construction of New Road Segments

New 0.65km Asphalt Road

Land purchase from private land owners is necessary for the construction of the new 0.65km section of asphalt road through a ~12.5ha parcel of land outside of Machta Hassan and Machta Hammoud, as shown in **Figure 16-10**. This segment of road is being constructed to avoid travel along existing roads that traverse Chadra, Machta Hassan and Machta Hammoud.

The land is currently vacant, and there will be approximately 120m distance between the existing houses and the new segment of road. Compensation will be provided at a cost to be agreed with the landowner(s). As such, the impact to the landowner(s) is considered minor when compared to the alternative of traffic and transport impacts to the densely developed city centers.

New 0.15km Asphalt Road

Land purchase from private land owners is necessary for the construction of the new 0.15km section of asphalt road between two existing sections of asphalt road, as shown in **Figure 16-11**. The purpose of the road segment is two-fold: 1) to avoid hairpin turns near homes; and 2) to create greater buffer distances (i.e. 21m to 60m) between the transport route and the homes. Compensation will be provided at a cost to be agreed with the landowner(s). As such, the impact to the landowner(s) is considered minor when compared to the alternative of traffic and transport impacts to the densely developed city centers.

New 3.1km Gravel Road within Existing Railroad ROW

Land purchase from the Municipality of Machta Hammoud is necessary for the construction of the new 3.1km section of gravel road within an existing railroad ROW, as shown in **Figure 16-10** and **Figure 16-11**. It is noted that a 0.11km segment of asphalt road will also be constructed to join the existing asphalt road to enter the Hawa Akkar wind farm site.

Compensation will be provided for construction within the railroad ROW at a cost to be agreed with the Municipality of Machta Hammoud. It is noted that the existing railroad ROW is currently used as a road by vehicles, as shown in **Figure 16-13**. As such, the new segment of gravel road is considered a roadway improvement that will enhance driving conditions.

In addition, compensation will be provided at a cost to be agreed with the landowner to join the gravel road with the existing asphalt road. This land that will be acquired is currently mowed lawn that fronts the intersection of the railroad ROW and the existing asphalt road, as shown in **Figure 16-14**. Therefore, the acquisition does not represent a loss of agricultural land and/or source of subsistence.

Mitigation

The construction of asphalt and gravel roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. The construction would be performed under the supervision and conditions of the relevant municipality. The improved road network will have a positive impact on the health and safety in the area by providing safer roads, minimizing impacts to city centers, providing greater buffer distances between houses and the road and eliminating dangerous curves/turns. As such, the impact severity is considered Low and the receptor sensitivity considered Medium. resulting in a Minor Impact as shown in **Table 16-34**.

Figure 16-10 New 0.65km Asphalt Road Segment to Avoid Chadra, Machta Hassan and Machta Hammoud

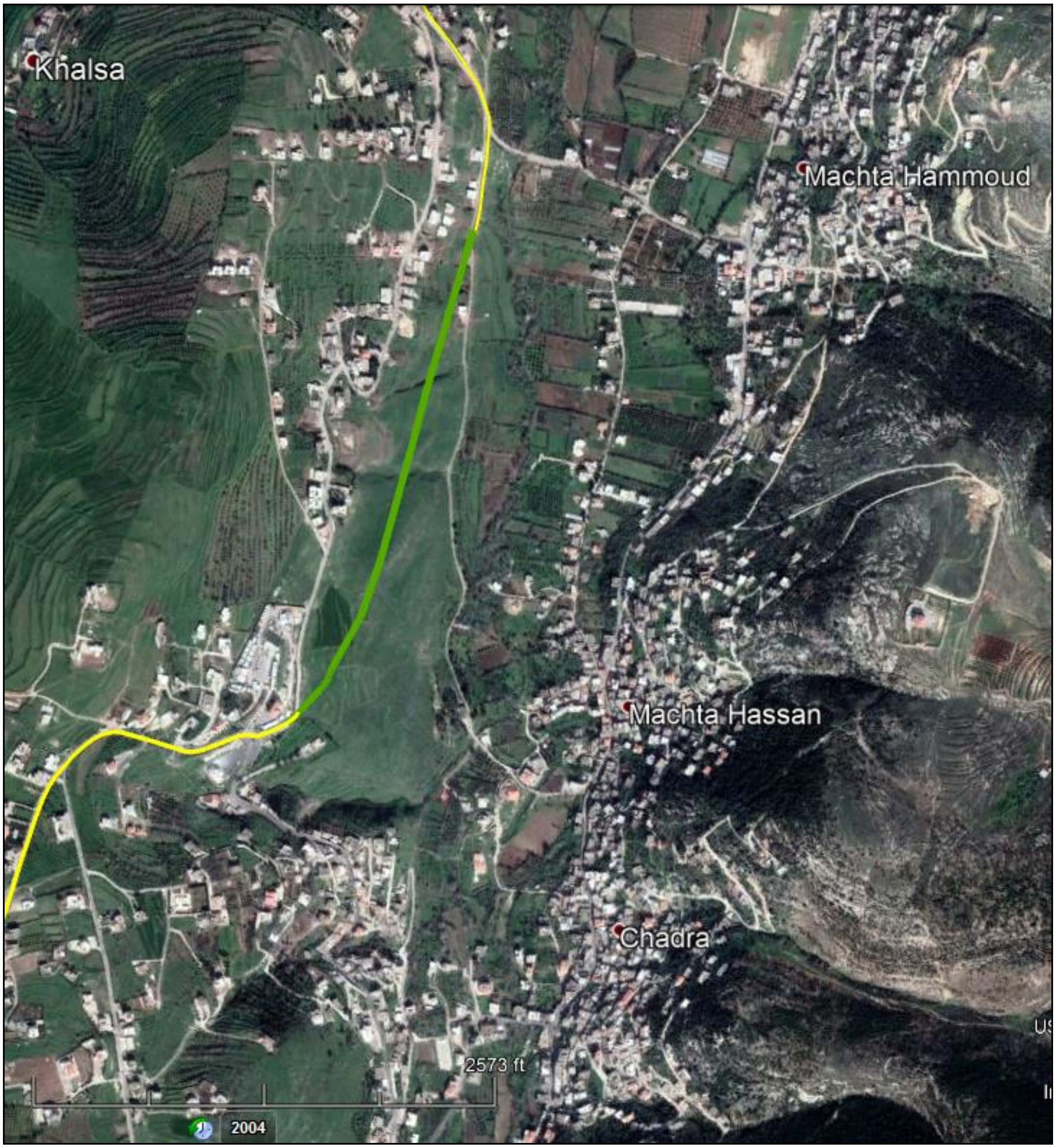


Figure 16-11 New 0.15km Segment of Asphalt Road

Figure 16-12 New 3.1km Gravel Road within Railroad ROW

Figure 16-13 Existing Railroad ROW Used by Vehicles

Figure 16-14 Land Acquisition for 0.11km Asphalt Road Segment

Table 16-34 Assessment of Impacts from New Road Segments

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	BHigh	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Construction of Internal Track

Land will be leased from the following villages for the construction of internal track (and other Project components):

- Project: Fnaidek, Rweimeh Village and Karm Chbat Cadastral Area.
- Hawa Akkar Wind Farm: Chadra, Aandqet and Mqaible.
- Sustainable Akkar Wind Farm: Aandqet, Jabal-Akroum Kfartoun and Rweimeh Village.

Track work will also occur near the Lebanese Army Military base in Sahle.

However, it is considered that the construction of the internal tracks will have no impact on access to homes and businesses by residents of the surrounding villages and/or access to and operations at the Lebanese Army Military base. While access to certain areas will be prohibited during internal track construction (and the Construction phase in general), this measure is being taken to ensure the health, safety and security of community members. No negative impacts on health and safety are anticipated from internal track construction, particularly if the proper procedures and measures will be followed to ensure public wellbeing.

<u>Mitigation</u>

- Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army.
- Occupational health and safety rules, codes and regulations will be followed during works.
- The OEM/EPC Contractor will be supervised by and accountable to the Developer.

Therefore, the impact severity is considered Slight and the receptor sensitivity considered Medium, resulting in a Negligible Impact as shown in **Table 16-35**.

Table 16-35 Assessment of Internal Track Development

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	**Negligible √**	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Transport of WTG Components

Villages Along the Transport Route

The transport of WTG components will add a roundtrip convoy of 12 oversized trucks twice per week (a total of 24 trucks roundtrip per week) to the existing road network for a period of 13 weeks. Based on the traffic counts carried out during baseline studies, communities along these roads currently experience the passage of nearly 57,000 heavy vehicles per week. During transport, the LOS will not decrease below LOS C, and the calculated decrease in LOS will only occur temporarily, two times per week over a total period of 13 weeks.

Informal Settlements

As shown in **Figure 15-10**, there are no informal settlements within or near the Project's immediate study area. Informal settlements located immediately adjacent to the WTG transport corridor are as summarized in **Table 15-37**. Twenty-two (22) informal settlements, comprised of 195 individual tents and 1,235 people, are currently located adjacent to existing Road Segments B, C, D, and E, and experience average daily traffic totals of 36,392, 20,580, 16,007 and 12,070, respectively. As above, transport of WTG components will add a roundtrip convoy of 12 oversized trucks twice per week (a total of 24 trucks roundtrip per week) to the existing traffic volume experienced by the informal settlements for a period of 13 weeks. It is noted that informal settlements may not have access to traditional forms of notification, i.e. radio, television, newsletters or postings at village municipal buildings. Therefore, this has been incorporated into the planned mitigation planning.

Mitigation

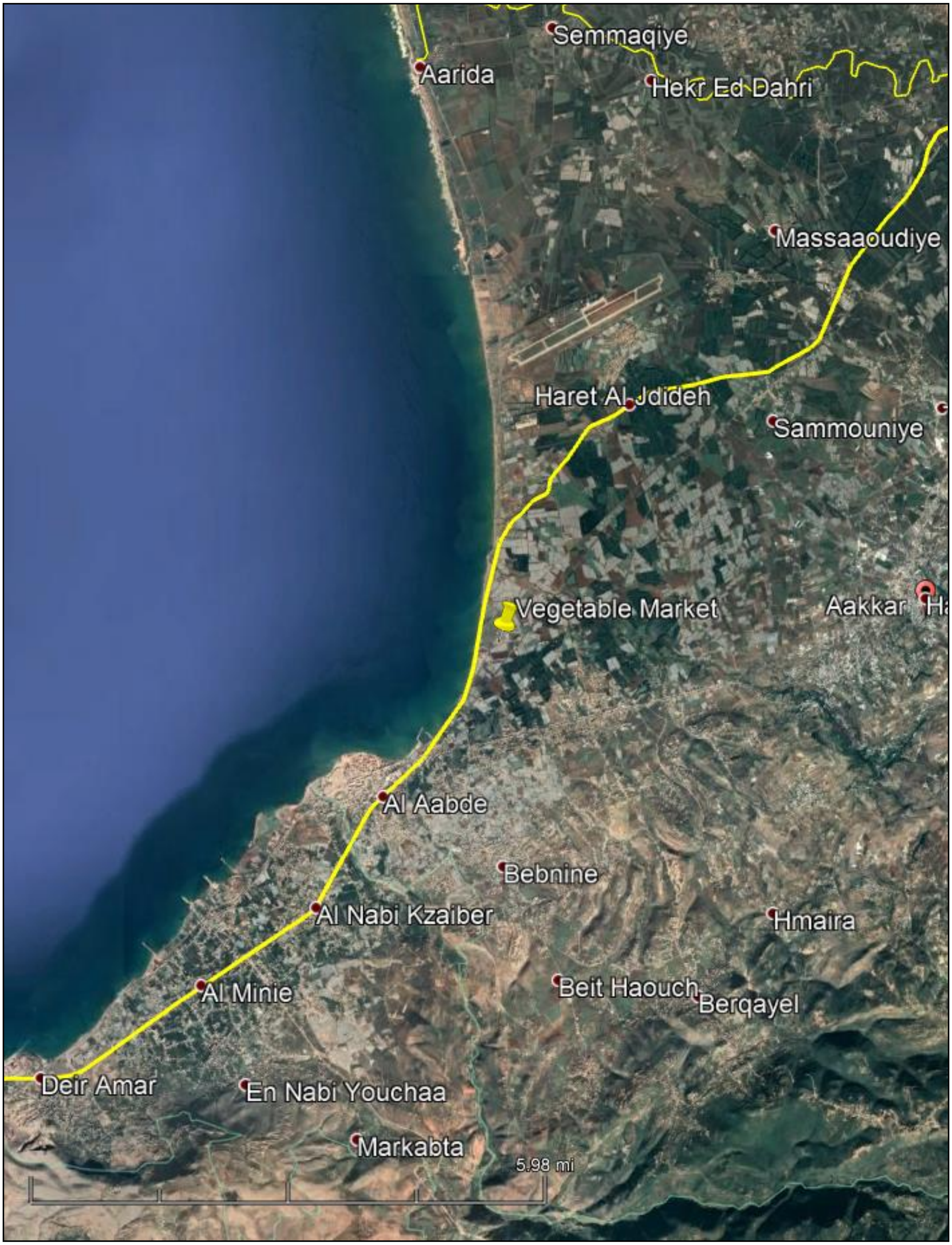
- A communications protocol under development for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport.
- A separate communications protocol under development for the transport of WTG components will be distributed to all informal settlements within 1km of the transport route two to three months prior to the start of transport.
- Access to the grievance mechanism will be shared with all villages and informal settlements.

- A final transport route map will be provided to all villages and informal settlements.
- Advance notification of the scheduled transport will be provided to all communities along the route through radio, television, newsletters or postings at village municipal buildings.
- Informal settlements within 1km of the transport route will be notified in person in advance by the CRO and the Developer.
- The transport of WTG components will occur between 11pm and 4am to avoid impacts to communities traveling to work and school.
- Municipal police will provide end-to-end escort for the transport convoy.
- The truck convoy will travel at a low speed to lessen the generation of noise, vibration and dust.
- Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market, as shown in **Figure 16-15**.
- For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road.
- For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic.
- The mitigation measures will minimize the potential for transport of WTG components to impact community health. safety and security. As such, the impact severity of traffic and transport from transport of WTG components is considered Low, and the receptor sensitivity considered Medium, resulting in a Minor Impact as shown in **Table 16-36**.

Table 16-36 Assessment of WTG Component Transport during Construction

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium √**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Figure 16-15 Akkar Vegetable Market



Transport of Construction Materials

The transport of construction materials will be limited to the following, as shown in **Figure 16-16**:

- The destination of all surplus excavated earth material will be the 6 quarries, using tracks internal to the Project site, the existing asphalt road (in red) and the existing quarry tracks (in green).
- The highest traffic volumes by the project are anticipated between the quarry and the wind farm site (yellow route near the Project entrance).
- All ready-mix concrete will be sourced from the Batch Plant to be constructed in Rweimeh Village and will be transported to the Project site using the existing asphalt road (in yellow).
- Sand and gravel will be sourced from the 6 quarries using the existing quarry tracks (in yellow), the existing asphalt road (in red), and tracks internal to the Project site.
- All cement will be sourced from Chekkah, south of Tripoli and the location of two large cement plants.

The impact of the transport of cement from Chekkah is considered to be minimal, i.e. the addition of 1 truck per day along a route that carries nearly 57,000 heavy vehicles per week.

Given the presence of existing tracks and asphalt roads, and close proximity of the quarries, the batching plant and the Project site, the movement of construction materials will be limited to a 12.5km^2 area in Rweimeh Village, and therefore will likely not impact the wider community. It is noted that 50+ houses are located along the quarry tracks and existing asphalt roads, as shown in **Figure 16-17** (Note: the houses highlighted in red are vacant).

It is noted that the members of Rweimeh Village are supportive of the location of both the Substation and the Batching Plant within the village, and they are accustomed to transport of quarry materials along the existing asphalt roads to supply the north Akkar region with sand and gravel. Further, over 90% of Rweimeh Village members are only present 3 months of the year. Whilst the residents of these houses are likely accustomed to quarry activities, including the movement of trucks, the construction will take place in summer and it is anticipated that the Project represents a significant increase in the volume of heavy vehicles to the quarry roads.

Mitigation

- The Developer will meet with Rweimeh Village residents of the houses located along the quarry tracks and existing asphalt roads to discuss the Project and nature and timing of the transport of construction materials.
- Advance notification of the start of construction will be provided.
- The trucks will travel at a low speed to lessen the generation of noise, vibration and dust.
- Occupational health and safety rules, codes and regulations will be followed during works.
- Negotiation of entry to quarry roads by resident vehicles will follow standard traffic safety/traffic control protocols. i.e. Stop/Go signage, flagman, etc.
- The OEM/EPC Contractor will be supervised by and accountable to the Developer.

The mitigation measures will minimize the potential for health, safety and security impacts related to the transport of construction materials. The impact severity is considered Medium and the receptor sensitivity considered Medium-High, resulting in a Moderate Impact as shown in **Table 16-37**.

Figure 16-16 Quarries and Existing Tracks (Green) Joining Existing Road (Yellow)

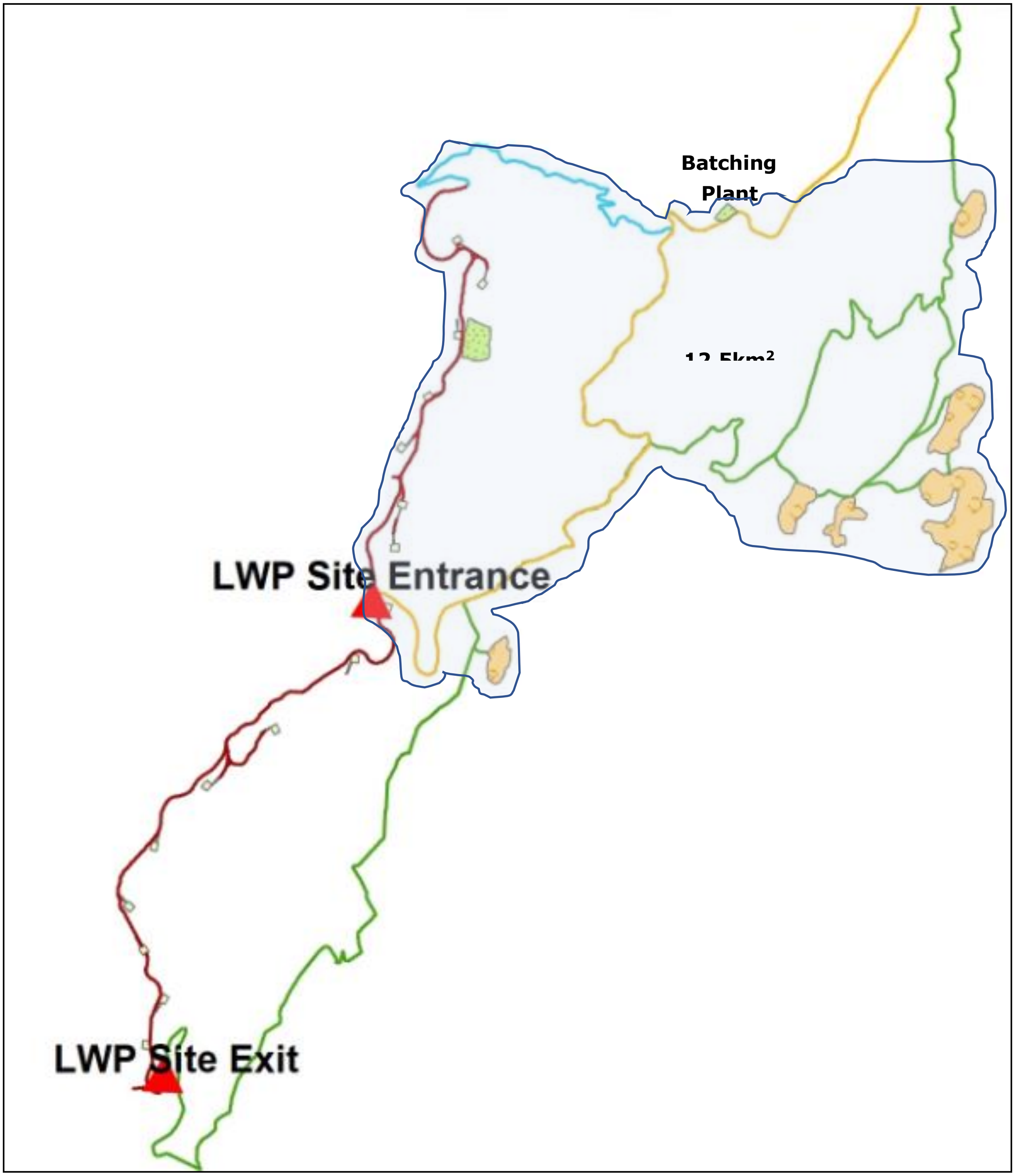


Figure 16-17 Houses Near Transport Routes for Construction Materials

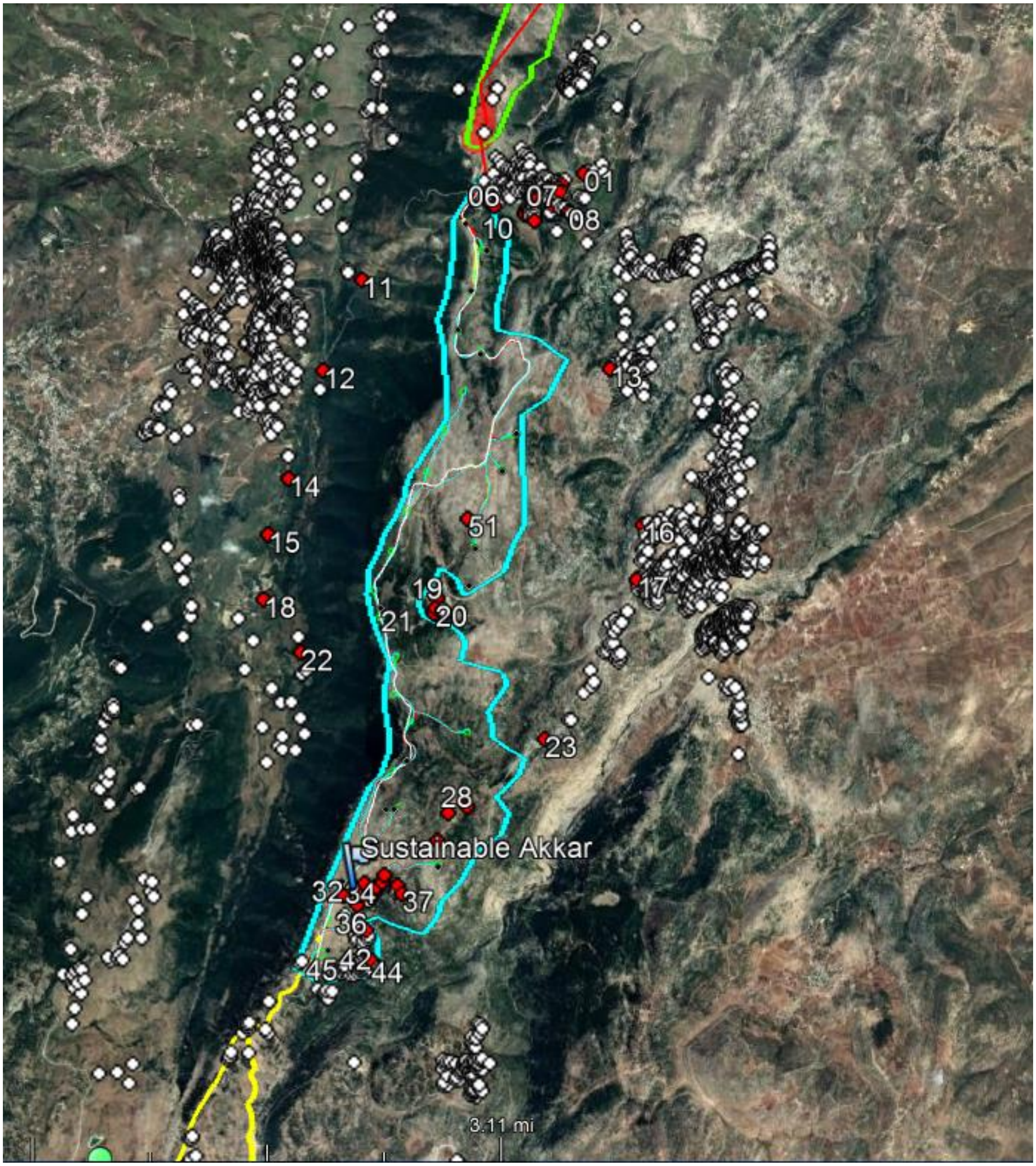


Table 16-37 Assessment of Construction Material Transport during Construction

		Sensitivity of Receptor				
		Low	Low-Medium	Medium	Medium-High √	High
364B364BImpact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium √	Negligible	Minor	Moderate	**Moderate √**	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

16.4.3.2 Transport and Traffic Impacts During Operation

Traffic impacts during the operational phase are expected to be low to negligible and relate only to travel to the Project site by the EPC Contractor for periodic maintenance activities at the Project site.

16.4.3.3 Transport and Traffic Impacts During Decommissioning

During the decommissioning phase, the wind turbines will need to be dismantled and removed from the Project site. Traffic impacts are expected to be similar to that of the construction phase but will require assessment at the time to capture the most up-to-date traffic conditions along the expected disposal route.

17. LANDSCAPE

This section presents an assessment of the landscape effects, i.e. change on the landscape as a resource resulting from the Project.

17.1 Baseline Methodology

Information regarding the existing landscape elements in the Project area was obtained through physical survey of the area. Photographs were taken to support the assessment by SES during site visits conducted between September to December 2018.

The study area is located at an altitude between 300m and 2,200m, encompassing different ecosystems and habitats. The surveyed area extends between the upper middle mountain zone (Eu-Mediterranean) and the high mountain zone (Supra-Mediterranean) as indicated by the tree species observed onsite.

The study area (i.e. Project plots and surrounding area) encompasses the following habitats: Calabrian pine forests, evergreen oak woods, juniper woodland, mixed forests, grassland, cliffs and rocky habitats. This zone is part of Akkar-Donnieh-Hermel Important Plant Area (IUCN Important Plant Areas of the south and east Mediterranean region, 2011), and close to the proposed Akkar Heights National Park (SDATL, 2009).

The study area has been subject to major changes since antiquity[167]. Former dense forestation was displaced by human activities through housing, agriculture and forestry. However, still existing forests are subjected to managed forestry. Natural forests or forests containing the former existing potential vegetation are only present at small or medium sizes (forests with oak and pine).

The result is a large landscape mosaic, which can be summarized in landscape units as described below (refer to the landscape mosaic map in **Appendix V**).

The climate in the area is characterized by long cold winters with snow, and a moderate climate during the three remaining seasons. Jabal Akroum is also characterized by the predominance of the Foehn effect. Incoming air masses moving in from the West and WSW pass through Wadi Oudine and meet the mountains perpendicularly; they follow the terrain heated by sunlight and rise. If the humidity is quite high initially in the air masses, the water vapor condenses to form clouds (see also **Section 8 Climate and Climate Change**). Condensation is usually followed by precipitation on the top and windward sides of the mountain (Wadi Oudine side). If the air is stable over the mountain, air masses cannot continue to rise once passing the top and descend on the leeward side. Consequently, the local climate condition cause that there is often no visibility of the mountain ridges where the WTGs will be installed since the area is covered in clouds.

[167] Marvin W. Mikesell: The Deforestation of Mount Lebanon. In: Geographical Review, Vol. 59, No. 1, Januar 1969, S. 1–28.

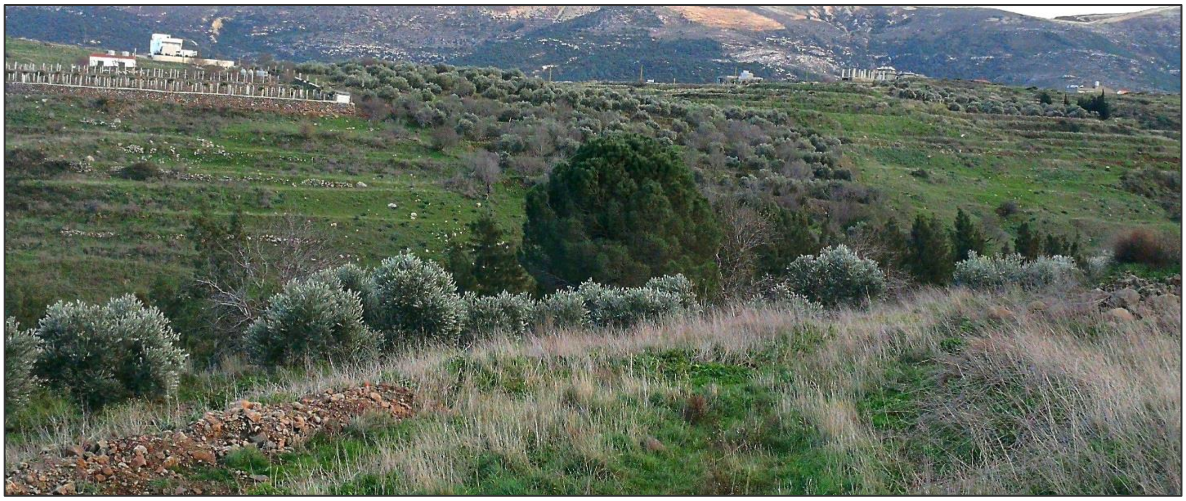
17.1.1 Landscape Units

The classification of the landscape units is based on the latest official Lebanese land use cover survey.

Agricultural Areas

The agricultural units often have a clearly recognizable culture-historical landscape character. For example, from old stone walls bordered olive groves, terracing as shown in **Figure 17-1**.

Figure 17-1 Agriculture Area (here Olive Plantations)



However, the tertiary development with modern influences is clearly recognizable, where historical elements are only recognizable on a small scale as a relic. In particular, high voltage power lines, quarries, semi-finished buildings, etc., have a strong influence on the historical agricultural shaped landscape. The Sustainable Akkar and the Hawa Akkar project sites do not have any agricultural areas, while agricultural areas near the planned Lebanon Wind Power project are mainly constituted of terraces planted with apple and cherry trees.

Dense Pinus and Quercus Forests

This forestry units consists of native forests, as shown in **Figure 17-2**; however, they are subjected to intensive use. These woods are the main source of wood-fuel for heating in winter season. The wood extracted from these forests is used for cooking and charcoal production. This applies in particular to the areas in the northern part of the study[168]. Accordingly, the units are not classified in the highest value rating grade.

[168] Lebanon's National Blueprint for a Sustainable Forest Biomass: promoting renewable energy and forest stewardship, Developed by: Biodiversity Program - Institute of the Environment – University of Balamand – Lebanon, 2016.

Figure 17-2 Example of a Dense Pinus Forest

Dense Cedrus Forests

This forest type is the original forest-vegetation unit of the Lebanon Mountains. However, the cedar forests have been subjected to a strong utilization since 5,000 years BC. Consequently, only very small patches of the old cedar forest are still present. Since the ecological conditions have changed over time, the natural regeneration and survival of the last relicts of this forest form is endangered.[169] In the study area there are no cedar forests. There are only a few individual trees in the area. These individual stocks do not form a spatial unit in the sense of a landscape image and are accordingly not subject for the evaluation. The remaining Cedrus trees are part of the mixed woods in the area. These woods are a mixture of Cedrus, Abies, Juniperus Excelsa and Drupacea.

Abies Forests

The quality for Abies forest is classified as a lower medium grade since it is managed in a monoculture.

Mixed Forests

These areas are classified as having medium quality because they consist of large contiguous areas and also due to the variety of species within the unit, as shown in **Figure 17-3**. The present mixed Forests are a mixture of Cedrus, Abies cilicica, and Juniperus species, with Abies dominating on northwest and north slopes, and Cedrus on northeast and east slopes. Goat grazing areas and summer farms are present in this landscape unit.

[169] Der Zustand der Zedernwälder Libanons [The state of the cedar forests in Lebanon]; Ladislav Paule, Archiv für Naturschutz und Landschaftsforschung, Heft 4, 1975, Band 15.

Figure 17-3 Example of a Mixed Forest Area Consisting of Conifer and Broadleaf Trees

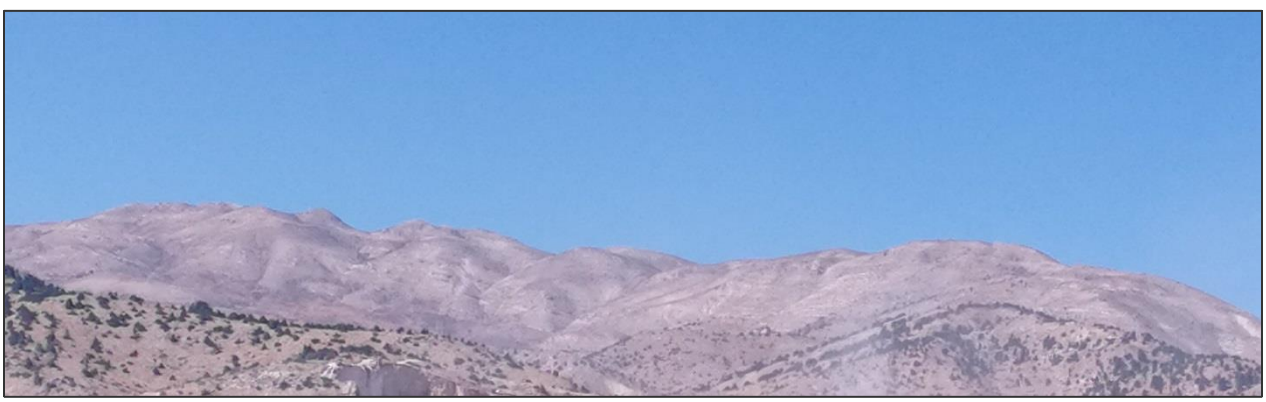
Other Dense Leafy Forests

This unit is present only with very small proportions in the southwest of the study area. Special qualitative characteristics cannot be awarded to the unit.

Rocky Land

The vegetation-free areas of the ridges have a certain natural character, as shown in **Figure 17-4**. There is hardly any human activity in this area. However, it is to be assumed that in former times these were covered at least in the middle altitudes with vegetation/forest. Accordingly, the unit is classified with a medium to high scenic quality.

Figure 17-4 Rocky Areas on the High Ridges of the Project Site



Shrublands

This unit is represented on a large scale in the study area, as shown in **Figure 17-5**. These are secondary structures of anthropogenic origin. This unit is comparable to the macchie vegetation of the Mediterranean region in Europe. The existing shrublands are the result of human interventions such as cutting trees and grazing. Shrubland areas were formerly dominated by trees before the alteration made by human activity such as grazing and repetitive burnings. Due to the diverse structures and peculiarities, the unit is rated medium-high in terms of quality.

Figure 17-51 Example of Shrublands

Sparse Coniferous and Sparse Leafy Forests

Due to the rather degenerated nature and the partial occurrence of this atypically vegetation in terms of the local spatial context, the quality of the unit is classified with a rather low importance, as shown in **Figure 17-6**.

Figure 17-6 Example of Sparse Coniferous Area

Swamps

This unit is located in the south of the study area. Due to the rarity, the particular biotope type and naturalness, the unit is qualitatively rated high.

Urban Artificial and Urban Expansion

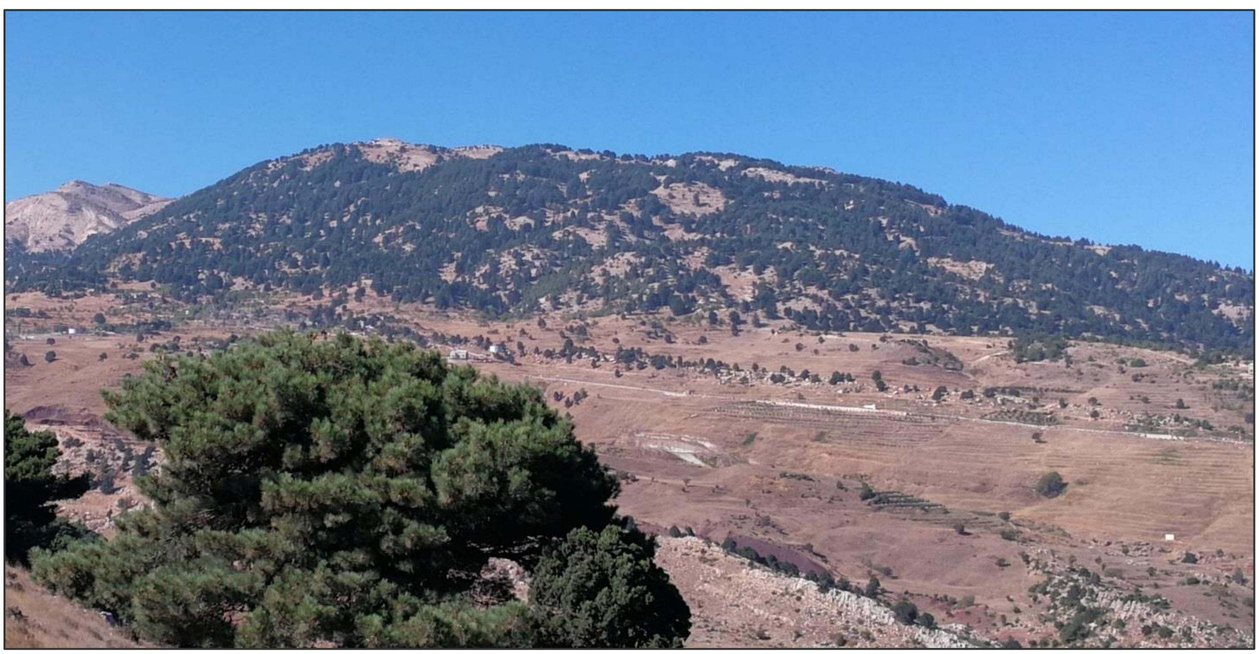
The urban areas, as part of the landscape, have hardly cultural-historical features that could justify a special qualitative claim. Most of them are modern buildings and local structures, as shown in **Figure 17-7**.

Figure 17-7 Example for Urban Area (Quobaiyat)

Protected Areas and Cultural-Historical Elements

There is a protected forest area in the immediate vicinity of the planned WTG (see landscape unit map in **Appendix V**). The Karm Chbat Nature Reserve is shown in **Figure 17-8**. However, there is no information available that this area is protected in terms of landscape or scenic value. The majority of the area is the unit Sparse Coniferous. Accordingly, there is no particular scenic quality. In the study area, there are no significant cultural-historical elements that could be affected by the planned WTGs.

Figure 17-8 Karm Chbat Nature Reserve



17.2 Assessment of Potential Landscape Impacts

17.2.1 Landscape Impacts During Construction

During construction, the main visual impacts come from land clearing and excavation, stockpiling of equipment and materials, the use of large construction equipment such as cranes, and the construction of the turbines and transmission towers themselves. While the construction phase is anticipated to last about one year, the use of large construction equipment like cranes, which has the largest visual impact is limited to several weeks. At the individual turbine locations, the cranes will be placed only for a couple of days. Due to the temporary nature of the construction process and the remote location of the Project the visual construction impacts will be low in significance. Therefore, this section will focus on the operational phase of the Project.

17.2.2 Landscape Impacts During Operation

The aim of the landscape impact assessment is to assess the potential effects of the proposed wind farm on the landscape in the study area.

17.2.2.1 Methodology

IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015) were used for the assessment of the visual impacts by the development, since there is no guidance how to landscape impacts of wind turbines in Lebanon. The IFC guideline (2015) recommends assessing key viewpoints (receptors) by using zones of theoretical visibility (ZTVs), wire grids and photomontages. In addition, the CEDRO Guideline Report (2012) and the Nohl Guidance (1993) was used.

To judge the visual consequences for the landscape, zones of Theoretical Visibility (ZTV) of the proposed development and visualizations were generated. While the ZTVs give an estimation of which areas are affected by the wind farm, the use of key viewpoints and visualizations give a realistic impression on how views in the area will look like after the wind farm construction. Using this methodology landscape assessment consists of predicting and evaluating the impact of the Project on landscape units. The above-mentioned tools and methodology are recommended in IFC Environmental, Health, and Safety Guidelines for Wind Energy (2015).

The CEDRO Guideline sets main objectives for the landscape study.

- Highlight the landscape qualities of the territory in the different study areas;
- Identify and prioritize the cultural heritage and landscape issues at stake regarding the wind turbines;
- Determine whether the landscape is able to accommodate wind turbines and how;
- Compose a landscaping integration project; and
- Measure the visual effects produced and the effects on perception of the territory by the population.

Based on the objectives stated in the CEDRO Guideline the German NOHL methodology was used to assess the impact on the landscape in detail in combination with the use of ZTVs, visualizations and wire grids (as recommended in the IFC EHS Guideline, 2015).

The NOHL methodology provides a comprehensive tool for evaluating the quality of the landscape and in a second step to judge in a very objective way the intervention of the planned turbines in the landscape. This methodology is very commonly applied in the German planning process.

Ideally the landscape assessment is based on existing Landscape Character Areas defined by local authorities. However, such studies were not available for the Akkar region. Since there is only limited information on existing landscape units (for instance by the authorities) the Nohl methodology is regarded as very suitable to establish the landscape impact of the Project. The landscape assessment is based on the regional structure of land use and landcover, the impressions gained during the site inspection and the review of literature. The landscape areas were evaluated in terms of their landscape aesthetic intrinsic value, their historical continuity and the existing technical overprinting of the cultural landscape. The landscape assessment considers a study area of 15km which is recommended by the CEDRO Guideline for wind energy project in Lebanon . For the landscape assessment different spatial units within the study area are determined. The details of the landscape units are described in the assessment section of the report. For each of the landscape units the relevance of the landscape change is examined.

NOHL

The assessment of the potential change of the landscape is based on the guideline by NOHL (1993/2001)[170]. The landscape assessment based on NOHL methodology is conducted in seven steps which will be described below.In the first step, the three aspects nature quality, diversity and characteristic are rated on a scale from 1 to 10. Ten (1) points represent a very large and 1 point represents a very low expression of the respective criteria. Afterwards, the sum (characteristic double weighted) of the three aspects is the basis for the total value of the aesthetic value of the landscape unit, as shown in **Table 17-1**.

Table 17-1 Aesthetic Value

Points	Total Value	Verbal Expression
4 - 9	1	Very Low
10 - 13	2	
14 - 17	3	
18 - 20	4	
21 - 22	5	
23 - 24	6	
25 - 27	7	
28 - 31	8	
32 - 35	9	
36 – 40	10	Very High

In the second step, the three aspects (nature quality, diversity and characteristic) after the intervention on the landscape are assessed and lead to the prospective aesthetic value for each

[170] Nohl; Beeinträchtigungen des Landschaftsbildes durch mastartige Eingriffe, Kirchheim bei München 1993/2001.

landscape unit. This is done on the basis of the visibility analysis and visualizations. Furthermore, the spatial characteristics (hub height, rotor diameter, rotor speed) of the planned wind turbines are considered in the assessment.

In the third step, the difference of the sum of the three aspects of the aesthetic value before and after the intervention is calculated. The result is the aesthetic intensity of the intervention and its expression is defined in **Table 17-2.**

Table 17-2 Aesthetic Intensity of the Intervention

Points	Total Value	Verbal Expression
0	1	Very Low
1 - 2	2	
3 - 4	3	
5 - 6	4	
7 - 9	5	
10 - 12	6	
13 - 16	7	
17 - 21	8	
22 - 37	9	
28 – 36	10	Very High

In the fourth step, the visual vulnerability of the landscape is determined. The three aspects relief, diversity of elements and vegetation density are consulted. These aspects are assessed on a scale from 1 to 10 based on the impressions of the terrain survey, the available photographs of the site, the digital terrain model and map material for each landscape unit. The sum of the three aspects is the basis for the total value of the visual vulnerability of the landscape unit, as shown in **Table 17-3**.

Table 17-3 Aesthetic Visual Vulnerability

Points	Total Value	Verbal Expression
3 - 6	1	Very Low
7 - 9	2	
10 - 12	3	
13 - 14	4	
15 - 16	5	
17 - 18	6	
19 - 20	7	
21 - 23	8	
24 - 26	9	
27 - 30	10	Very High

The grade rating ranges from very high (10 points: "flat terrain, monotonous structure, hardly any trees and shrubs") to very low (1 point: "mountainous terrain; diverse structure; dense woodland").

In the fifth step, the worthiness of protection is considered. According to NOHL (1993), factors such as uniqueness, irreplaceability, rarity and representativeness are decisive for determining the worthiness of protection. The evaluation bases on a scale from 1 to 10 and ranges from "Very High" (10 points: "nature reserves, natural monuments, protected landscape features, monuments [castles, palaces] and unique geomorphic landscape components") to "Very Low" (1 point: "low-structure, intensively used arable land, atypical housing estates, commercial areas").

In the sixth step, the aesthetic sensitivity of the landscape is determined for each unit. It results from the above-mentioned aesthetic value, visual vulnerability and worthiness of protection. The sum (aesthetic value double weighted) of these three aspects is the basis for the total value of the aesthetic sensitivity of the landscape, which is rated on a scale from 1 to 10, as shown in **Table 17-4**.

Table 17-4 Aesthetic Sensitivity of the Landscape

Points	Total Value	Verbal Expression
4 - 9	1	Very Low
10 - 13	2	
14 - 17	3	
18 - 20	4	
21 - 22	5	
23 - 24	6	
25 - 27	7	
28 - 31	8	
32 - 35	9	
36 - 40	10	Very High

In the final seventh step, the aesthetic relevance of the intervention is determined as a result of the intensity of the intervention and the sensitivity of the landscape. Both are equal weighted and according to their sum the total value of the relevance of the intervention is calculated, rated on a scale from 1 to 10, as shown in **Table 17-5**.

Table 17-5 Aesthetic Relevance of the Intervention

Points	Total Value	Verbal Expression
2 - 4	1	Very Low
5 - 6	2	
7 - 8	3	
9 - 10	4	
11	5	
12	6	
13	7	
14 - 15	8	
16 - 17	9	
18 - 20	10	Very High

The results of the respective evaluations for each landscape unit are presented in **Table 17-6.**

Table 17-6 Identification and Aesthetic Value of the Landscape Units

Unit	Natural Quality	Diversity	Characteristic
Agricultural Areas	Low-Medium	Low-Medium	Low-Medium
Dense Abies Forests	Low	Low	Low
Dense Pinus Forests	Medium-High	Medium-High	High
Dense Quercus Forests	Medium-High	Medium-High	High
Mixed Forests	Medium	Medium	Medium
Other Dense Leafy Forests	Medium-High	Medium	Low-Medium
Rocky Land	Medium	Low-Medium	Medium-High
Shrublands	Medium	Medium-High	Medium-High
Sparse Coniferous	Low	Low-Medium	Low
Sparse Leafy Forests	Low	Low-Medium	Low
Swamps	High	High	High
Urban Artificial	Low	Low	Low
Urban Expansion	Low	Low	Low

For a better understanding an example for the derivation of the relevance of the intervention is given.

Example:

1. First step: evaluation of the natural quality, diversity and characteristic before the intervention.

   Natural Quality: 4, Diversity: 5, Characteristic (double weighted): 4+4=8 → Sum: 17.

   14-17 points match value 3 according to the value table of the aesthetic intrinsic value.

   Resulting aesthetic intrinsic value: Low (3).

2. Second step: same evaluation of the natural quality, diversity and characteristic after the intervention.

   Natural Quality: 3, Diversity: 4; Characteristic (double weighted): 3+3=6 → Sum: 13.

   10-13 points match value 2 according to the value table of the aesthetic intrinsic value.

   Resulting aesthetic intrinsic value: Very Low (2).

3. Third step: evaluation of the intensity of the intervention.

   Difference of the aesthetic intrinsic value before (17) and after (13) the intervention → 4.

   3-4 points match value 3 according to the value table of the intensity of the intervention.

   Resulting aesthetic intensity of the intervention: Low (3).

4. Fourth step: evaluation of the visual vulnerability.

   Relief: 6, Diversity of elements: 5, vegetation density: 5 → Sum: 16.

   15-16 points match value 5 according to the value table of the visual vulnerability.

   Resulting visual vulnerability: Middle (5).

5. Fifth step: determination of the worthiness of protection.

   Worthiness of protection: 2.

   Resulting worthiness of protection: Very Low (2).

6. Sixth step: evaluation of the sensitivity of the landscape unit.

   Visual vulnerability: 5, worthiness of protection: 2, Aesthetic intrinsic value (double weighted):4+4=8 → Sum: 15.

   14-17 points match value 3 according to the value table of the sensitivity of the landscape.

   Resulting aesthetic sensitivity of the landscape: Low (3).

7. Seventh step: evaluation of the relevance of the intervention.

   Intensity of the intervention: 3, Sensitivity of the landscape: 3 → Sum: 6.

   5-6 points match value 2 according to the value table of the relevance of the intervention.

   Resulting aesthetic relevance of the intervention: Very Low (2).

17.2.2.2 Landscape Assessment

Zone of Theoretical Visibility (ZTV)

The ZTV calculation of the area around the wind farm shows how many turbines are visible for the entire study area (see **Appendix V**). **Table 17-7** lists result of the ZTV calculations and shows the size of area, where turbines are visible. A turbine is considered as visible when parts of the turbine are visible. This is referred as "tip ZTV".

Table 17-7 Sum of Visibility of the Turbines in 15km Radius

WTG Visibility	Area (ha)	Area (%)
0	42,581	45.6
1-7	7,035	7.5
8-13	6,140	6.6
14-18	4,133	4.4
19-22	7,262	7.8
23	26,317	28.2

The ZTV maps are presented in **Appendix V** which are used for the magnitude analysis of the landscape units.

Sensitivity and Magnitude Analysis of the Landscape Units

For evaluation of the landscape units, the overall consideration takes place within the respective units. Therefore, an averaging is carried out with regard to the impairments. The general rule is, if the quality of the unit is high, the intensity of the impairment is also high. This depends on whether areas of the respective units are affected at all or the size and the proportions of the landscape units are within the 15km radius.

For assessing the sensitivity and magnitude of change for the landscape units the following tools were used: the landscape units map, the ZTV maps, visualizations from key viewpoints.

<u>Agricultural Areas:</u>

The agricultural area features a low level of biodiversity since the major part of the area is covered by crops, so that the natural quality is rated as Low to Medium.

Scenic diversity is rated as Low to Medium due to the homogeneous vegetation cover and the lack of structuring landscape features such as waterbodies or rugged terrain.

Although agricultural areas throughout the area of interest show clear characteristics of organically grown, cultural landscape (i.e. terraced olive and cherry plantations), the influence of technical development is obvious. Thus, high-voltage power lines, quarries and (semi-finished) modern buildings have a strong visual impact on the historic, cultural landscape. Therefore, the characteristic was rated as Low to Medium.

The agricultural units do not feature major obstacles (i.e. big trees) that could limit the visibility of the turbines. On the other hand, the major part of agricultural areas is located distant (approximately 10km) to the WTGs in the northwestern and southern part of the area of interest (see landscape map). Further, very few or no WTGs are visible in major areas of the landscape unit due to the mountainous topography which acts as a visual barrier (see ZTV map).

Accordingly, the intensity of intervention and visual vulnerability are rather low, so that the overall impact of the Project on the aesthetic relevance of the unit can be rated as Low (see details in **Table 17-8**).

Dense Abies Forests: The natural quality of the Abies forests is rated as Low as they are characterized by forestry with *Abies* monoculture and low biodiversity.

Scenic diversity is rated as low because of the uniform vegetation cover consisting of tree plantations.

Since the Abies plantations are strongly influenced by human activities – not only functionally, but also in their appearance – they do not provide an image of untouched or wild nature. Hence, characteristic is rated as Low for this landscape unit.

The major part of the Abies forests is located southwest (approx. 5 to 8km) of the planned WTGs. Smaller areas are scattered in more distant southwestern direction (approx. 10 to 15km) (see landscape map). Due to their alignment from north to south, up to 23 WTGs are visible from the larger connected Abies forests, while no WTGs are visible from the smaller scattered forests (see ZTV map in **Appendix V**). However, visual vulnerability is rated as medium because Abies plantations with their dense and high tree vegetation act as a visual barrier for viewpoints within the forests. Accordingly, the intensity of intervention and visual vulnerability are rather low, so that the overall impact of the Project on the aesthetic relevance of the unit can be rated as Low.

Dense Pinus Forests and Dense Quercus Forests:

These forests, although managed by forestry and used intensively for fuelwood production, are characterized by a diverse vegetation cover and a high biodiversity. Thus, natural quality is rated as Medium to High.

The Pinus and Quercus forests are partially located in the south to southwest in a 10km radius around the WTGs. Large connected areas are situated adjacent to the WTGs in western direction (see landscape map in **Appendix V**). These landscape units feature a rocky, mountainous topography characterized by steep slopes and deep valleys. Therefore, scenic diversity is rated as Medium to High.

Although Pinus and Quercus forests are intensively used as a source of fuelwood, they still provide the impression of a near-natural landscape with little visible signs of man-made structures such as roads or buildings. Since traditional land use and appearance of the forests have not changed within the last decades, characteristic of these landscape units is rated as Medium to High.

Table 17-8 Evaluation of the Relevance of the Intervention for the Individual Landscape Units

Landscape Unit	Before the Intervention			Aesthetic Intrinsic Value	After the Intervention			Aesthetic Intensity of the Intervention	Relief	Diversity of Elements	Vegetation Density	Visual Vulnerability	Worthiness of Protection	Aesthetic Sensitivity of the Landscape	Aesthetic Relevance of the Intervention
	Natural Quality (1x)	Diversity (1x)	Characteristic (2x)		Natural Quality (1x)	Diversity (1x)	Characteristic (2x)								
Agricultural Areas	4	4	8	**3**	4	4	6	**2**	7	4	4	**5**	**4**	**3**	**2**
Dense Abies Forests	3	3	6	**2**	3	3	6	**1**	7	4	7	**6**	**4**	**3**	**1**
Dense Pinus Forests	7	7	16	**8**	6	6	14	**3**	9	6	7	**8**	**8**	**9**	**6**
Dense Quercus Forests	7	7	16	**8**	7	6	14	**3**	8	6	7	**8**	**8**	**9**	**6**
Mixed Forests	6	6	12	**6**	5	6	10	**3**	8	7	7	**8**	**7**	**7**	**4**
Other Dense Leafy Forests	7	5	8	**4**	7	5	8	**0**	7	5	7	**7**	**4**	**3**	**1**
Rocky Land	5	4	14	**6**	3	2	10	**5**	8	4	1	**4**	**4**	**4**	**4**
Shrublands	6	7	14	**7**	6	5	12	**3**	7	7	3	**6**	**4**	**6**	**4**
Sparse Coniferous	3	4	6	**2**	2	3	4	**3**	7	4	3	**4**	**4**	**2**	**2**
Sparse Leafy Forests	3	4	6	**2**	2	3	4	**3**	7	4	3	**4**	**4**	**2**	**2**
Swamps	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	**-**	**-**	**-**
Urban Artificial	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	**-**	**-**	**-**
Urban Expansion	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	**-**	**-**	**-**

Note: No negative effects are expected for the units Swamps, Urban Artificial and Expansion. Therefore, they are not subject to the numerical rating. The same applies to the individual cedar trees (see above).

Accordingly, the intensity of intervention and visual vulnerability is higher than the Dense Abies Forest unit so that the overall impact of the Project on the aesthetic relevance of the unit can be rated as medium (see details **Table 17-8)**. In addition, large connected areas of the units are located close to the planned WTGs, these units are perceptible in the context of the wind farm (see ZTV map in **Appendix V**). Due to the high quality of the landscape unit, a medium to high impairment is to be expected.

<u>Mixed Forests:</u> Mixed forests are intensively used as a source of timber and fuelwood. Extensive silvopasture is a common management system in these forests. Biodiversity is higher than in the dense Abies forests with a mixture of Cedrus, Abies cilicica and Juniperus species, with Abies dominating on northwest and north slopes, and Cedrus on northeast and east slopes. Hence, natural quality is rated as Medium.

With diverse vegetation and numerous glades on wavy topography, scenic diversity of mixed forests is rated as Medium.

Although characterized by intense human activity, the mixed forests offer an image of intact nature on mountain sides without man-made structures such as roads or major modern buildings. Further, they feature a near natural traditional management (silvopasture), that has not changed in the last decades. Thus, characteristic is rated as Medium.

Adjacent to the Pinus and Quercus forests, the mixed forests are partially located around the WTGs. The major part of the forests are situated up to 10km south of the planned wind farm and more than 10km in the southwestern part of the area of interest (see landscape map in **Appendix V**).

Accordingly, the intensity of intervention and visual vulnerability are very equal to Dense Pinus Forest and Dense Quercus Forest, so that the overall impact of the Project on the aesthetic relevance of the unit can be rated as medium. In addition, large areas of this unit are not located in the direct vicinity of the wind farm, therefore the visual impairments will be very limited (see ZTV map **Appendix V**).

<u>Other Dense Leafy Forests:</u> The natural quality is rated as medium to high, because the leafy forests represent a near natural intact type of forests

Their scenic diversity was rated as medium, since the forests are situated in the valley bottoms amidst a mountainous scenery.

Leafy forests' characteristic is rated as low, due to their small extent.

Small areas of this unit exist at the north-south edge of the study area. Visual impairment can be ruled out due to the large distances and due to the relief, which will block the visibility of the wind farm as the dense leafy forests are situated at the valley bottoms (see landscape map and ZTV map) As WTGs are not visible throughout the leafy forests, a more detailed analysis was not done for this landscape unit. Consequently, the overall aesthetic relevance of the WTGs is rated as Low (see details **Table 17-8**).

<u>Rocky Land:</u> This landscape unit features a sparse scrub vegetation in the middle altitudes, while the ridges are mostly vegetation-free. Due to the native character of the vegetation, although sparsely scattered, the natural character is rated as Medium.

Bare rock is predominant in this landscape unit accompanied by a sparse vegetation cover in the middle altitude. Regarding also the rugged topography, the quality of scenic diversity sums up to a rating of Low to Medium.

These rocky lands give an impression of a rocky scenery, unaffected by human activities. But, however, they provide also the impression of an inanimate nature, especially on the ridges. This leads to the medium to high characteristic ranking of the rocky land. Due to the special nature there is a medium impairment after the intervention. The medium rating is due to the fact, that the large areas can still be perceived from the valley without disturbance and that the arrangement of the wind turbines results in a reduction of the interference (see ZTV map **in Appendix V**). Accordingly, the intervention intensity and visual vulnerability are medium rated, so that the overall impact of the Project on the aesthetic relevance of the unit is to be assessed as Medium.

Shrublands: Shrublands are the most frequent landscape unit in the area of interest. They are present throughout the whole region, but the major part is located southeast of the planned WTGs (see landscape map in **Appendix V**). These secondary structures are the result of centenaries of human land management, similar to the macchia vegetation in the western Mediterranean. Typically, this biome features a high biodiversity, conserving also relics of the plant species from the former woody biome. Thus, natural quality is rated as Medium.

Scenic diversity is rated as medium to high because they are found on a wide range of land forms. Thus, shrublands exist on higher and lower slopes, on lowlands as well as on wavy to mountainous topography.

The special land management (i.e. logging and grazing) that results in this shrubland biome is practiced for millennia in the Mediterranean. The shrubland preserves therefore a typical Mediterranean cultural landscape. Hence, characteristic is rated as Medium to High.

Due to the special nature, diversity and, in some cases, immediate proximity to the wind farm, there is a medium degree of impairment after the intervention. The low vegetation does not act as a visual barrier. The classification is intermediate due to the fact, that many large areas are located in a large distance from the planning area (see landscape map). Accordingly, the intensity of intervention is low to medium and the visual vulnerability is rather medium, so that the overall impact of the Project on the aesthetic relevance of the unit is to be assessed as Medium.

Sparse Coniferous and Sparse Leafy Forests: Sparse coniferous and sparse leafy forests are the results of intensive land use. Due to the degraded nature of these landscape unit, natural quality is rated as Low.

Major parts of these forests are located within a 5 to 15km radius south of the WTGs (see landscape map in **Appendix V**). These homogenous woodlands exist mainly on mountainous topography, so that scenic diversity is rated as Low to Medium.

Due to the degraded nature of these landscape units, characteristic is rated as Low.

Although, planned WTGs are visible from major parts of the landscape units (see ZTV map) visual vulnerability is low due to the low aesthetical relevance. The overall rating is very similar to the *Dense Abies Forests unit*, so that the overall impact of the Project on the aesthetic relevance of the unit can be rated as Low.

Judging the Overall Significance of the Landscape Impact

In general, the study area is characterized by forest and agricultural use. It does not include any wild and protected landscape areas. While some natural forest areas with a higher landscape value exists, in total the Project hardly leads to significant changes within the 15km radius. This can be deduced from the results of the evaluation of the individual landscape units and the results of the visualizations as well as from the ZTV.

In the immediate area of the wind farm views are often blocked due to the mountainous topography. In particular, the more sensitive forest units with oak and pine are barely visually impaired by the Project. Experiencing and perceiving the mentioned units will remain largely unobstructed (see visualizations and ZTV).

As shown in **Table 17-8**, some landscape units are affected up to the medium range, namely the dense Pinus and the dense Quercus forest which have the highest aesthetic relevance of the intervention. In addition, the impact on the landscape was reduced by the careful design of the turbine array (see Araysih -Quobaiyat Viewpoint). This is due to the fact, that the layout of the turbines follows the topography of the existing ridge. Moreover, the ridge is emphasized in the sense of a landscape arrangement in the aesthetic sense.[171] An overprint, effect of dominance or blocking effect (phalanx) does not arise. This is due to the ordered juxtaposition of the WEA and the geomorphological arrangement on the ridge. Although the proposed wind turbines will introduce new technical elements in the landscape and certainly affect the perception of the landscape, the typological appearance of the ridge remains largely recognizable. In addition, the visual effects of turbines are entirely reversible at the end of the operational life of the wind farm.

The largest impact on a single landscape unit is assessed to be Medium. This is due to the low sensitivity of the units and the reduced visibility caused by the topography. The likelihood of the impact is assessed to be High. The overall visual impact of the turbines during the operational phase is considered of Minor significance.

Other expected landscape impacts of the Project during the operational phase include power transmission lines, access roads and crane pads. The transmission lines will be buried and therefore are expected to have a negligible impact on the landscape. New roads and crane pads are expected to be of materials similar to existing bedrock and will therefore also not stand out from the surrounding landscape.

<u>Mitigation Measures</u>

The following mitigation measures have been addressed within the design to mitigate elements of potential landscape impacts:

- Large, multi-MW turbines with large rotor diameters are being considered reduce the number of turbines per generation capacity and the footprint of the Project.
- Turbines with large rotor diameters have reduced rotor speeds in comparison with smaller turbines, which also reduces the visual impact.
- The turbines SA 01, SA 26, SA 27 and SA 28 were eliminated.
- The wind farm layout was designed so that the array follows the existing landform of the mountain ridges. Tracks will be designed to follow and fit with contours in the land as far as possible.
- The turbines and all the other aboveground structures will be removed at the end of the operational lifetime.
- The internal cabling will be underground cabling.

[171] Schöbel, Windenergie und Ästhetik [wind energy and aesthetic]; Berlin, 2012.

Effects of the Mitigation Measures

- By Large, multi-MW turbines with large rotor diameters the number of turbines per generation capacity and the footprint of the Project was reduced. In addition, large rotors have a reduced rotor speed compared to smaller turbines which will also reduce the landscape impact of the Project.
- The turbines SA 01, SA 26, SA 27 and SA 28 were eliminated which will reduce landscape impacts. In addition, the distance of the turbines to the wind energy projects Lebanon Wind Power and Hawa Akkar were also increased so that cumulative impacts could be reduced.
- By considering the landform of the mountain ridges at the wind farm design, the wind farm layout follows the existing morphology of the mountain. Consequently, the typological appearance of the ridge remains largely recognizable. In addition, the overlapping of rotors of views from the east and the west are unlikely which can be perceived as visually restless.
- By following the existing tracks and fitting the location of the tracks with the contours lines the visual impact of the tracks can be reduced.
- By removing the turbines and all the other aboveground structures at the end of the operational lifetime, the landscape impact of the Project will be entirely revisable and limited to the operation phase of the Project.

Since the Project area is mountainous, the visibility of the new tracks will be limited and partly blocked by the topography. Therefore, the landscape impact is expected to be of minor significance, as shown in **Table 17-9**.

Table 17-9 Landscape Assessment for Operation Phase

		Sensitivity of Receptor				
		Low	**Low-Medium √**	**Medium**	**Medium-High**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium √	Negligible	**Minor √**	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

17.2.3 Landscape Impacts During Decommissioning

Decommissioning impacts are similar to construction impacts: the stockpiling of equipment and materials, the use of large construction equipment such as cranes, and the decommissioning process itself. Given the temporary nature of the decommissioning process, landscape impacts are expected to be of negligible significance.

18. ARCHAEOLOGY AND CULTURAL HERITAGE

18.1 Baseline Methodology

Baseline information regarding archaeology and cultural heritage was undertaken through literature review.

18.2 Baseline Findings

18.2.1 Archaeological Sites

The archaeological history of Lebanon is one of thousands of years ranging from the Lower Paleolithic, Phoenician, Jewish, Roman, Muslim, Christian, Ottoman, and Crusades history, including 460 World Heritage (including UNESCO), Archaeological and Historic Site Locations. Lebanon features several important Paleolithic sites associated with Neanderthals. These include Adloun, Chekka Jdidé, El-Masloukh, Ksar Akil, Nahr Ibrahim and Naame. Jbail is a well-known archaeological site, also known as ancient Byblos, a Phoenician seaport, where the tomb of Ahiram and the other Byblian royal inscriptions were found. Byblos, as well as archaeological sites in Baalbek, Tyre, Sidon, and Tripoli, contain artifacts indicating the presence of libraries dating back to the period of Classical antiquity.

The archaeological site mapped near the Project are shown as Sites 1 through 11 in **Figure 18-1** and described below. It is noted that detailed information regarding the sites is limited.

Site 1 – Khorab Beit Daher

Khorabe Beit Daher is an archaeological remains/ancient site located at decimal latitude 34.60889 and longitude 36.27194 at an elevation of 462 asl. It is listed as Site 423 by the ARCHI Worldwide Database.[172] An aerial map of the site is presented in **Figure 18-2**.

Site 2 – Obour el Bid

Khorabe Beit Daher is an archaeological remains/ancient site located at decimal latitude 34.61528, and longitude 36.29639. No elevation information is available. It is listed as Site 55 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-3**.

Site 3 - Khirbet Hbanjar

Khirbet Hbanjar is an archaeological remains/ancient site located at decimal latitude 34.63694 and longitude 36.29806 at an elevation of 248 asl. It is listed as Site 418 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-4**.

Site 4 – Khirbet Arhsar

Khirbet Hbanjar is an archaeological remains/ancient site located at decimal latitude 34.63278 and longitude 36.30417 at an elevation of 340 asl. It is listed as Site 421 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-5**.

[172] https://www.archiuk.com/worldwide

Figure 18-1 Archaeological Sites Near the Project

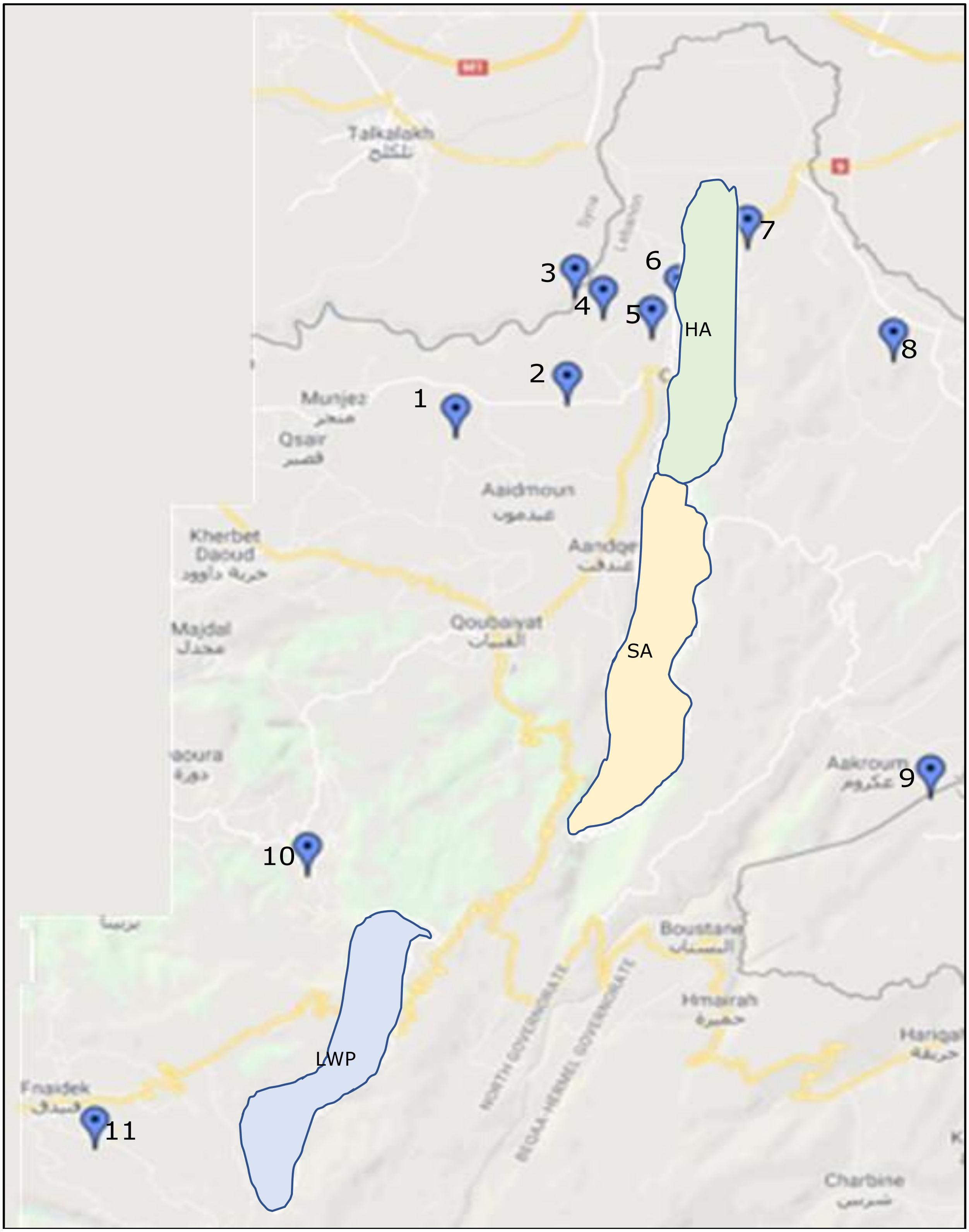


Figure 18-2 Khorab Beit Daher Site

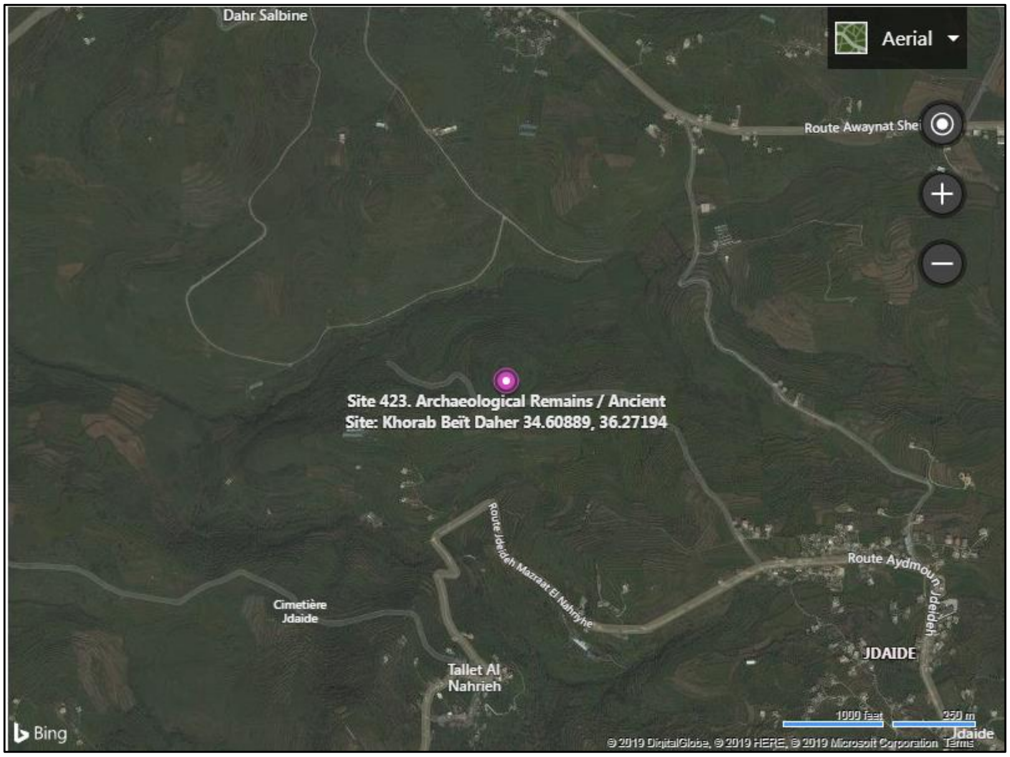


Figure 18-3 Obour el Bid

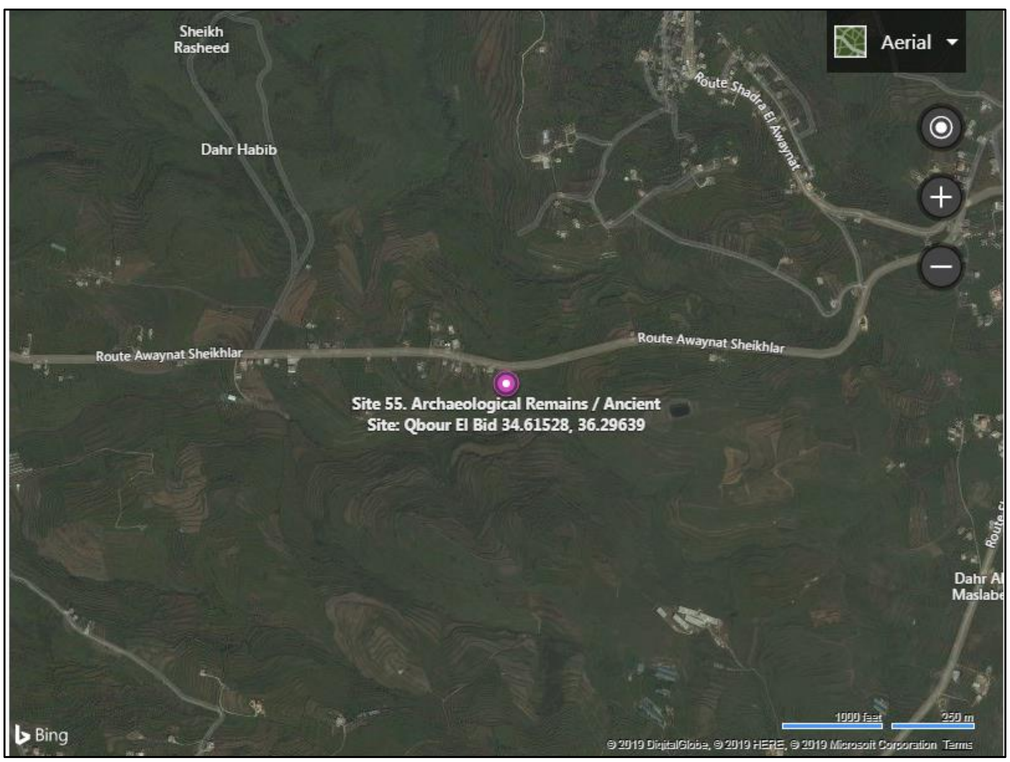


Figure 18-4 Khirbet Hbanjar

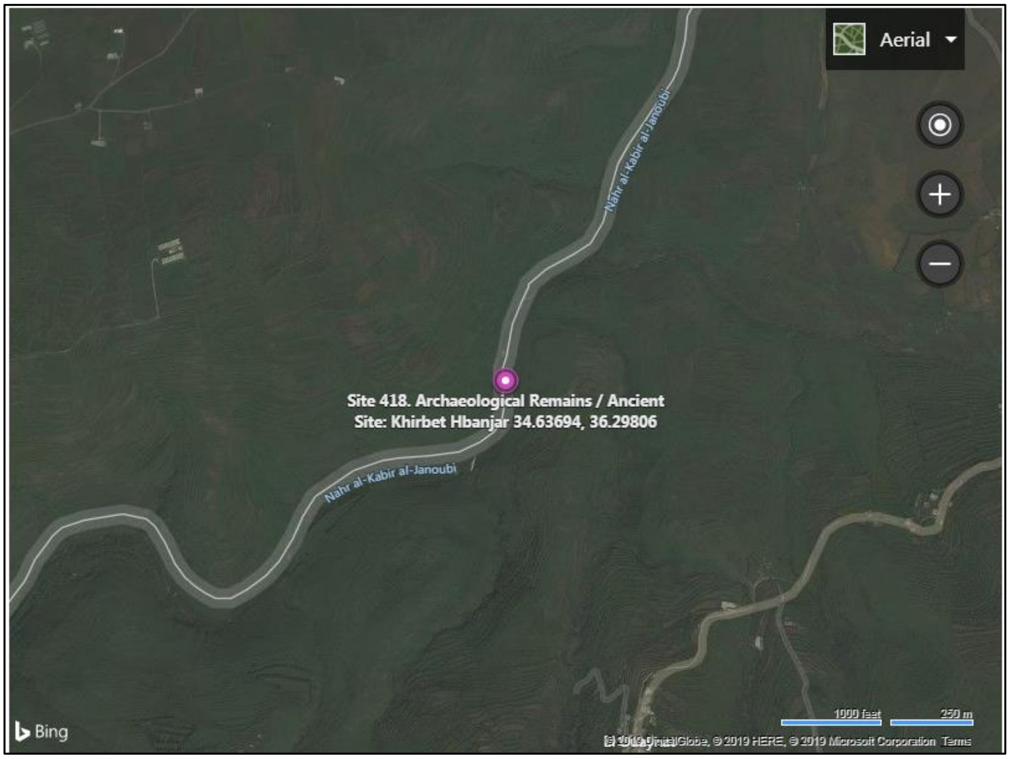
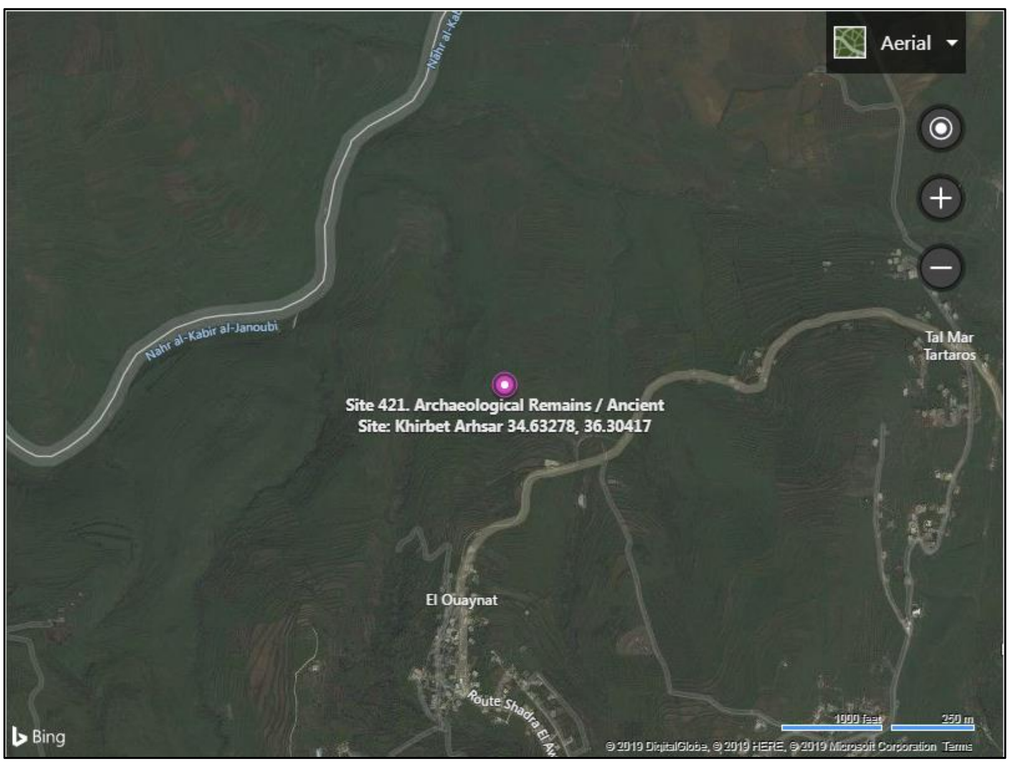


Figure 18-5 Khirbet Arhsar



Site 5 - El Mansoura

El Mansoura is an archaeological remains/ancient site located at decimal latitude 34.62861 and longitude 36.315. There is no elevation information. It is listed as Site 421 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-6**.

Site 6 – Tahoun Ksar

El Mansoura is an archaeological remains/ancient site located at decimal latitude 34.635 and longitude 36.32083. There is no elevation information. It is listed as Site 419 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-7**.

Site 7 - Khorab el Haïyat

Khorab el Haïyat is an archaeological remains/ancient site located at decimal latitude 34.64667 and longitude 36.33583 at an elevation of 558 asl. It is listed as Site 417 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 19-8**.

Site 8 – Qalaat Deïr Chir

Qalaat Deïr Chir is an archaeological remains/ancient site located at decimal latitude 34.62417 and longitude 36.36778 at an elevation of 508 asl. It is listed as Site 422 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-8**.

Site 9 – Khribet el Qasr

Khribtet el Qasr is an archaeological remains/ancient site located at decimal latitude 34.53778 and longitude 36.37667. There is no elevation information. It is listed as Site 413 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-9**.

Site 10 – Qalaat Aakkar (Citadel of Hosn Akkar)

Qalaat Aakkar is a 13th century fortified building/earthwork site located at decimal latitude 34.52222 and longitude 36.24. It is listed as Site 430 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-10**, with a photograph presented in **Figure 18-11**.

Elevated on a rocky mountain between the two valleys of Akkar, the citadel of Hosn Akkar is only reachable by goat path. It is said that the citadel was built by Mohrez Bin Akkar, who was killed in 864 A.D., and was later seized by the Seljuks, the Crusaders and the Mamluks. This site was included in the choice of viewpoints for visual impact assessment.

Site 11 – En Nabi Ayoûb

En Nabi Ayoûb is a tomb/shrine located in Mont-Liban at decimal latitude 34.46583 and longitude 36.19167 at an elevation of 1,308m. It is listed as Site 287 by the ARCHI Worldwide Database. An aerial map of the site is presented in **Figure 18-12**, with a photograph presented in **Figure 18-13**.

Figure 18-6 El Mansoura

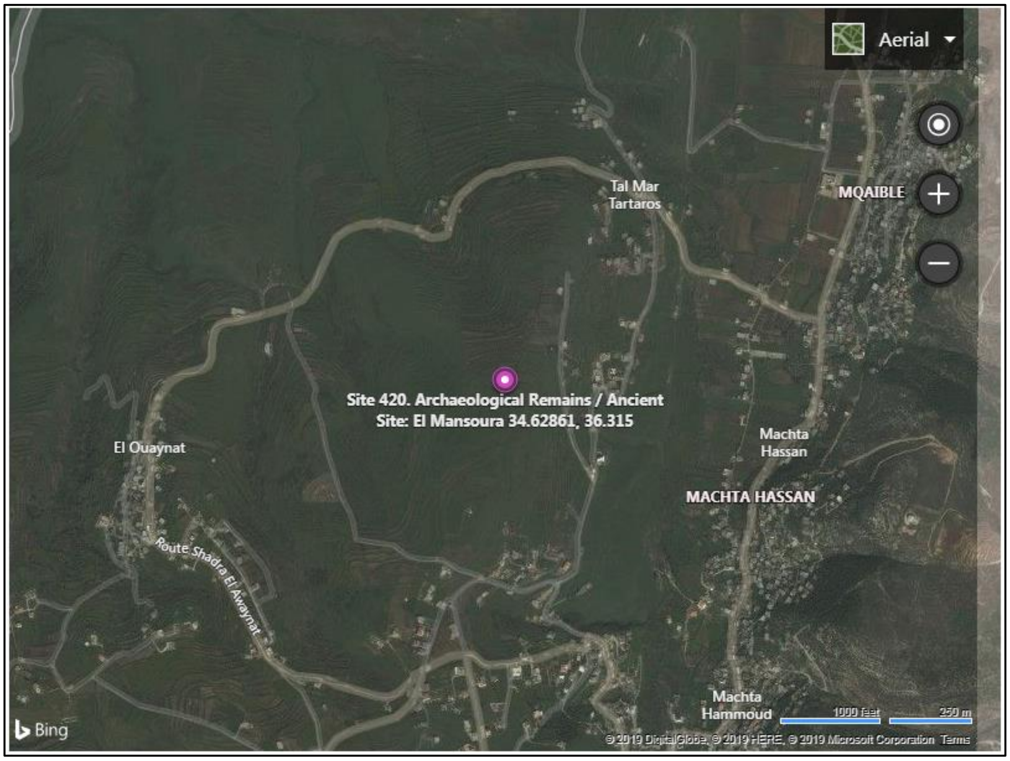


Figure 18-7 Tahoun Ksar

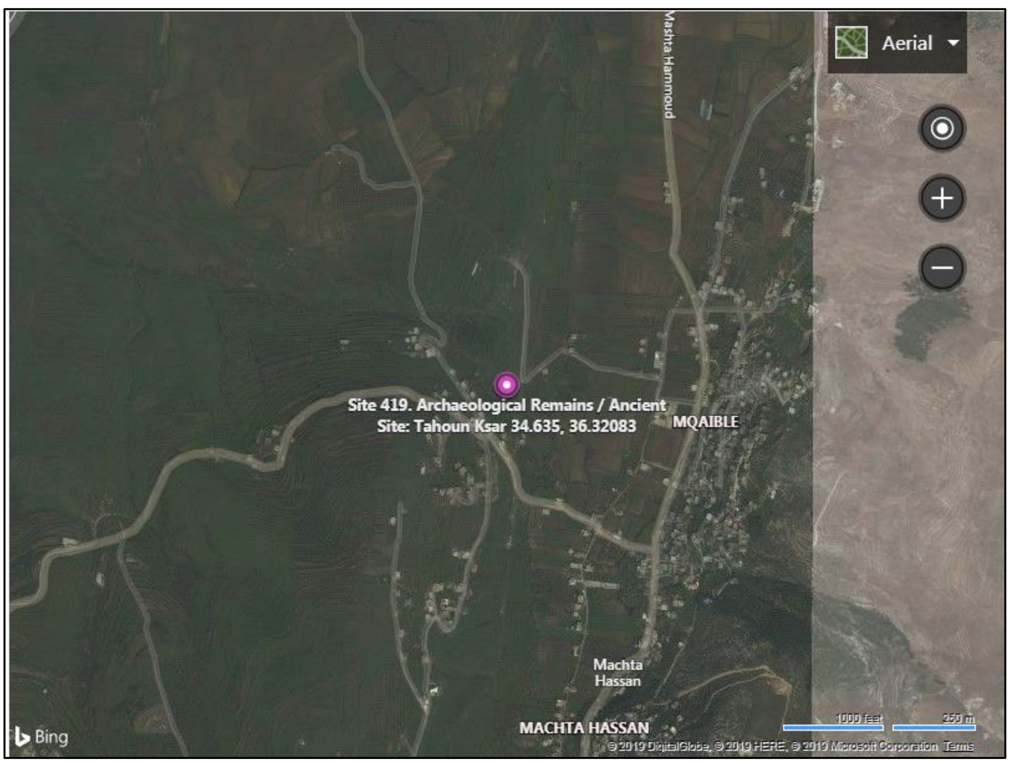


Figure 18-8 Khorab el Haïyat

Figure 18-9 Qalaat Deïr Chir

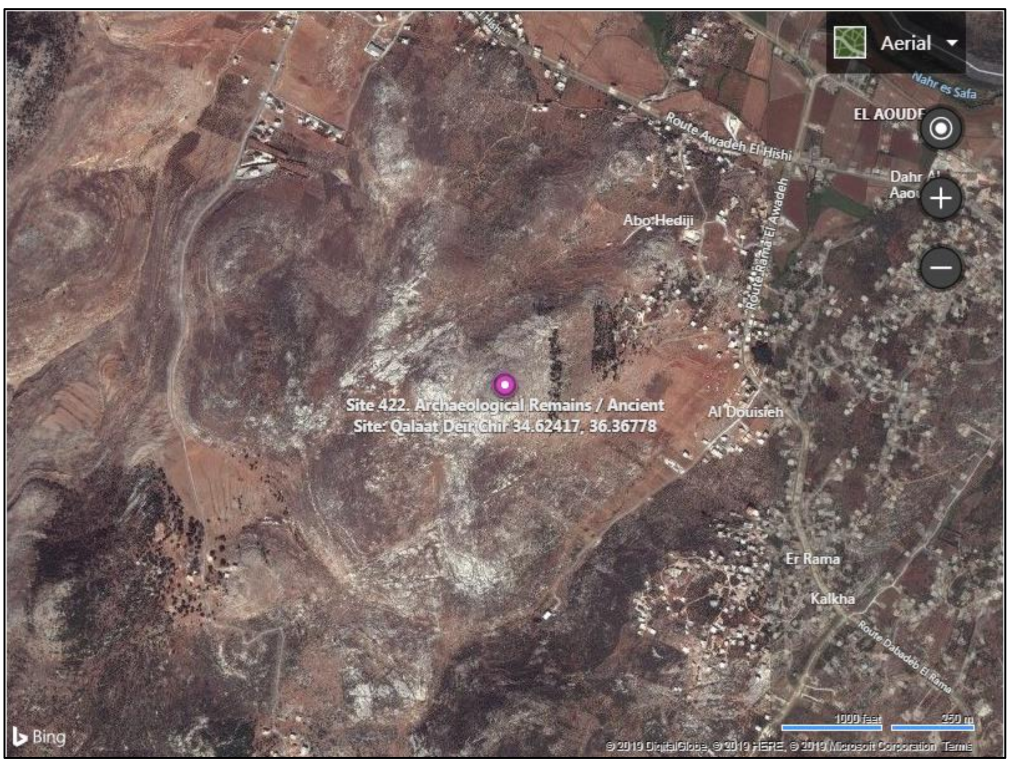


Figure 18-10 Qalaat Akkar

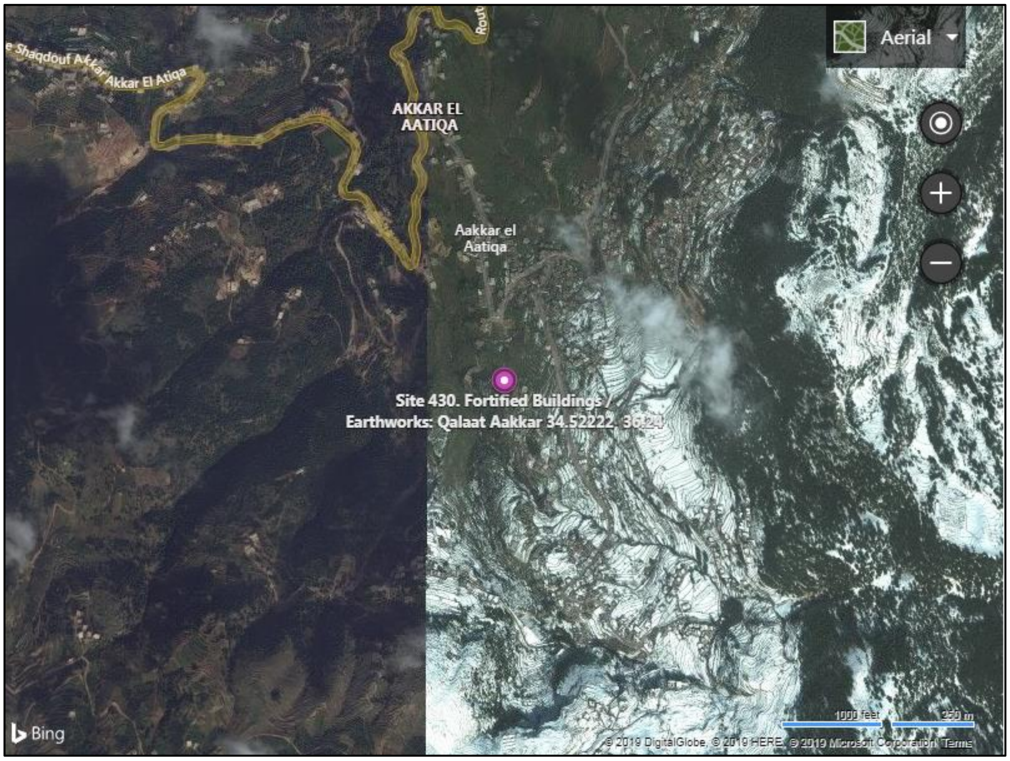


Figure 18-11 Qalaat Akkar Fortress

Figure 18-12 En Nabi Ayoûb

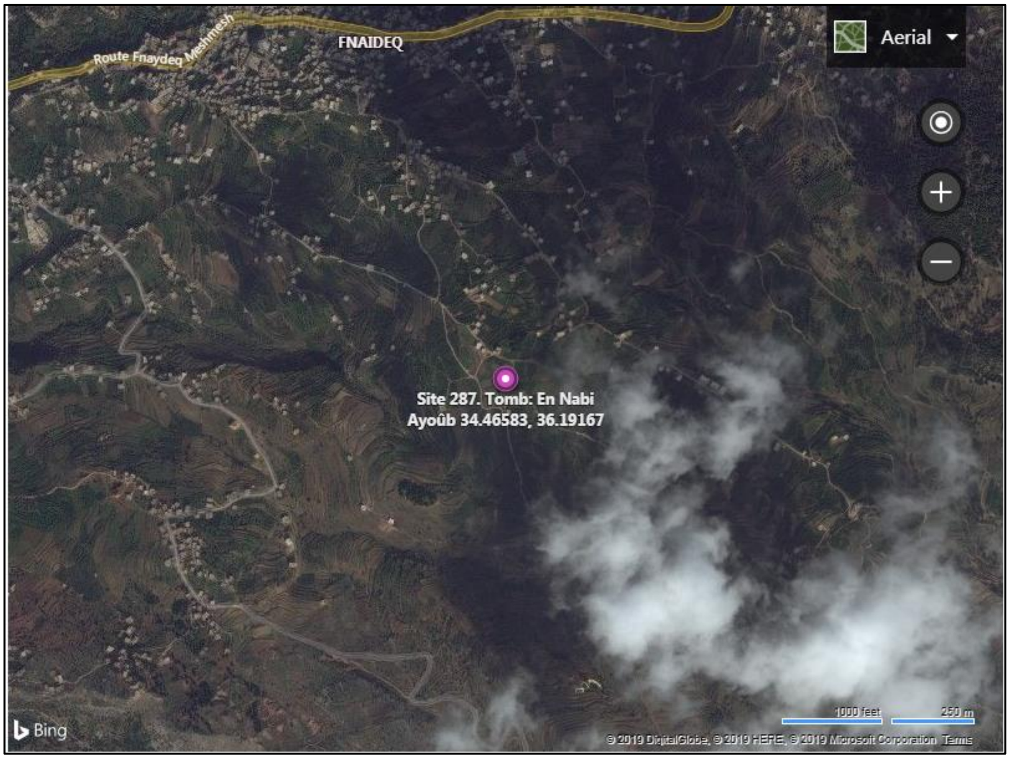


Figure 18-13 En Nabi Ayoûb

18.2.2 Cultural Resources and Attractions

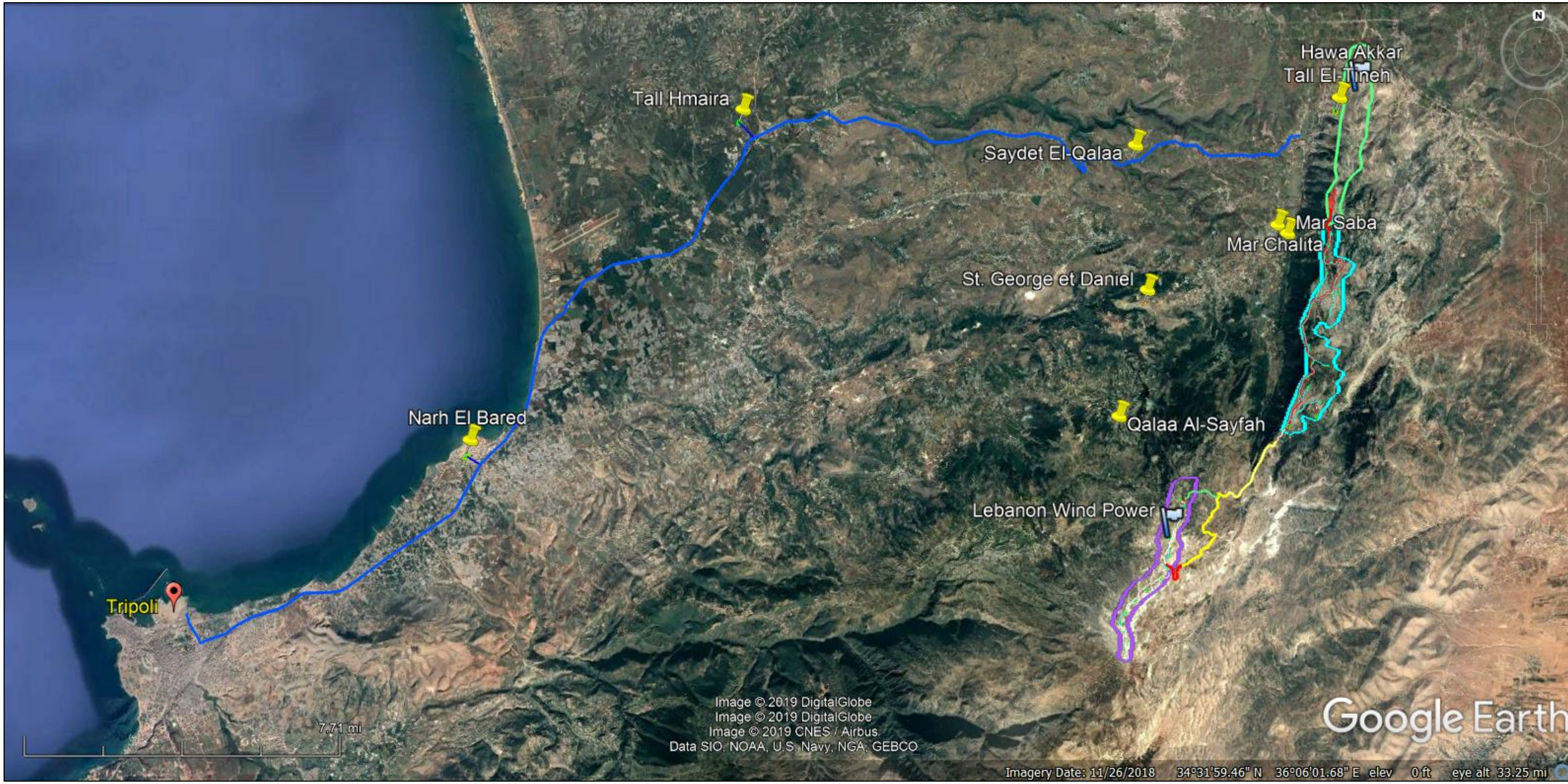
Based on the literature review, the Akkar region has several cultural resources and attractions, as follows:

- St. George et Daniel (included in the choice of viewpoints for visual impact assessment, as shown in **Figure 18-14**; refer to **Section 16 Community Health, Safety and Security**).
- Qalaa Al Sayfah Fortress (included in the choice of viewpoints for visual impact assessment, as shown in **Figure 18-14**; refer to **Section 16 Community Health, Safety and Security**).
- Silk plant and remains of old mills (also found in nearby Aandqet).
- Old olive press with caves and engraved rocks in Akroum.
- Citadels and mosques dating from the 19^{th} century in Al Bireh and Bourj villages.
- Roman temples in Akroum.
- Cemeteries of Al Salha, Akroum.
- Tall Hmaira.
- Naher El Bared Camp.
- Saydet (Our Lady) Al-Ghisseleh Ancient Church.
- Mar Doumit Ancient Monastery for Carmelite Fathers.
- Mar Challita Ancient Monastery (Aandqet).
- Saint Joseph and Mar Saba Ancient Monasteries (Aandqet).
- Mar Gerges (Saint Georges) Ancient Monastery and Church, near an old well.
- Saydet Ghezrata Ancient Church.
- Old Church in Al-Chanbouq Area.
- Saydet Chahlo Church.
- Mar Eliane Monastery within Al-Bat'aneh Valley buried underground (Aandqet).
- Our Lady of the Fort (Saydet el Qalaa) in Menjez.
- Mar Elias in Oudine.

In addition, the Akkar region offers numerous eco-tourism attractions as follows:

- Quobaiyat's Scientific Permanent Museum for Animals, Birds & Butterflies.
- The Lebanon Mountain Trail.
- Karm Chbat Nature Reserve; refer to **Section 13 Biodiversity**.
- Qammouaah Forest.
- The Al Atiqa'a Waterfalls.
- The Ouyoun el Samak Cascade in Safinet el Qaytaah.

Figure 18-14 Cultural Resources and Attractions



18.3 Impact Assessment

18.3.1 During Construction

18.3.1.1 Archaeology

No cultural heritage resources were found during the field work campaigns implemented in the immediate project zone. In addition, the elevation of the Project site lessens the likelihood of cultural resources and artifacts to be present. However, it is recognized that the Akkar region (and Lebanon in genera) is rich in archaeological, cultural and religious artifacts and sites.

During the construction phase, excavation and earth moving for the construction of roads, wind turbines, transmission lines, substations and buildings may uncover heritage resources.

Though the potential for impact is considered low, a Chance Finds Procedure has been developed (in accordance with guidance provided by the Ministry of Culture and the General Directorate of Antiquities) to appropriately respond to cultural resources encountered during construction, as follows:

Where historical remains, antiquity or any other object of cultural or archaeological importance are unexpectedly discovered during construction in an area not previously known for its archaeological interest, the following procedures should be applied:

1. Stop construction activities.
2. Delineate the discovered site area.
3. Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a night guard should be present until the Responsible Authorities takes over.
4. Notify the responsible foreman/archaeologist, who in turn shall notify the Responsible Authorities, the General Directorate of Antiquities and local authorities (within less than 24 hours).
5. The Responsible Authorities will be in control of protecting and preserving the site before deciding on the proper procedures to be carried out.
6. An evaluation of the finding will be performed by the General Directorate of Antiquities. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, scientific or research, social and economic values.
7. The decision on how to handle the finding will be reached based on the above assessment and could include changes in the Project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage.
8. The Responsible Authorities' decision concerning the management of the finding shall be implemented fully.
9. Construction work could resume only when permission is given from the Responsible Authorities after the decision concerning the safeguard of the heritage is fully executed.

The Chance Finds Procedure has been included in the stand-alone ESMP.

Based on the low likelihood of a discovery, and the implementation of the Chance Find Procedure, the impact severity is considered Slight, while the sensitivity is considered High given the value of the receptor. This results in a Minor impact, as shown in **Table 18-1**.

Table 18-1 Assessment of Potential Impact to Archaeology During Construction

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High √**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	Negligible	Minor	**Minor √**
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

18.3.1.2 Eco Tourism Sites

During the construction phase, access to certain portions of the 5.13M m^2 Karm Chbat Nature Reserve will be limited to ensure the health and safety of visitors. As shown in **Figure 18-15**, approximately 10-20% of the Karm Chbat Nature Reserve will involve construction activities at different times across the entire construction phase. Given that other eco-tourism attractions in the area will not be affected, i.e. Quobaiyat's Scientific Permanent Museum for Animals, Birds & Butterflies, the Lebanon Mountain Trail, the Qammouaah Forest, the Al Atika Waterfalls and the Ouyoun el Samak Cascade in Safinet el Qaytaah, the impact severity of the temporary lack of access to the Karm Chbat Forest Reserve is considered Low. The sensitivity of the receptor (i.e. eco tourists) is considered Medium, resulting in a Minor impact, as shown in **Table 18-2**.

18.3.2 During Operation

18.3.2.1 Cultural Heritage

During the operation phase, impacts to cultural heritage are not considered significant.

18.3.2.2 Eco Tourism

As a green energy project, the Project is expected to become a tourist attraction, drawing citizens from other regions of Lebanon (particularly students) to visit the Project site and enjoy the remote setting. This tourism is considered to have a positive impact on the local economy and enhance opportunities to visit other nearby eco tourisms sites in the area.

Figure 18-15 Karm Chbat Nature Reserve

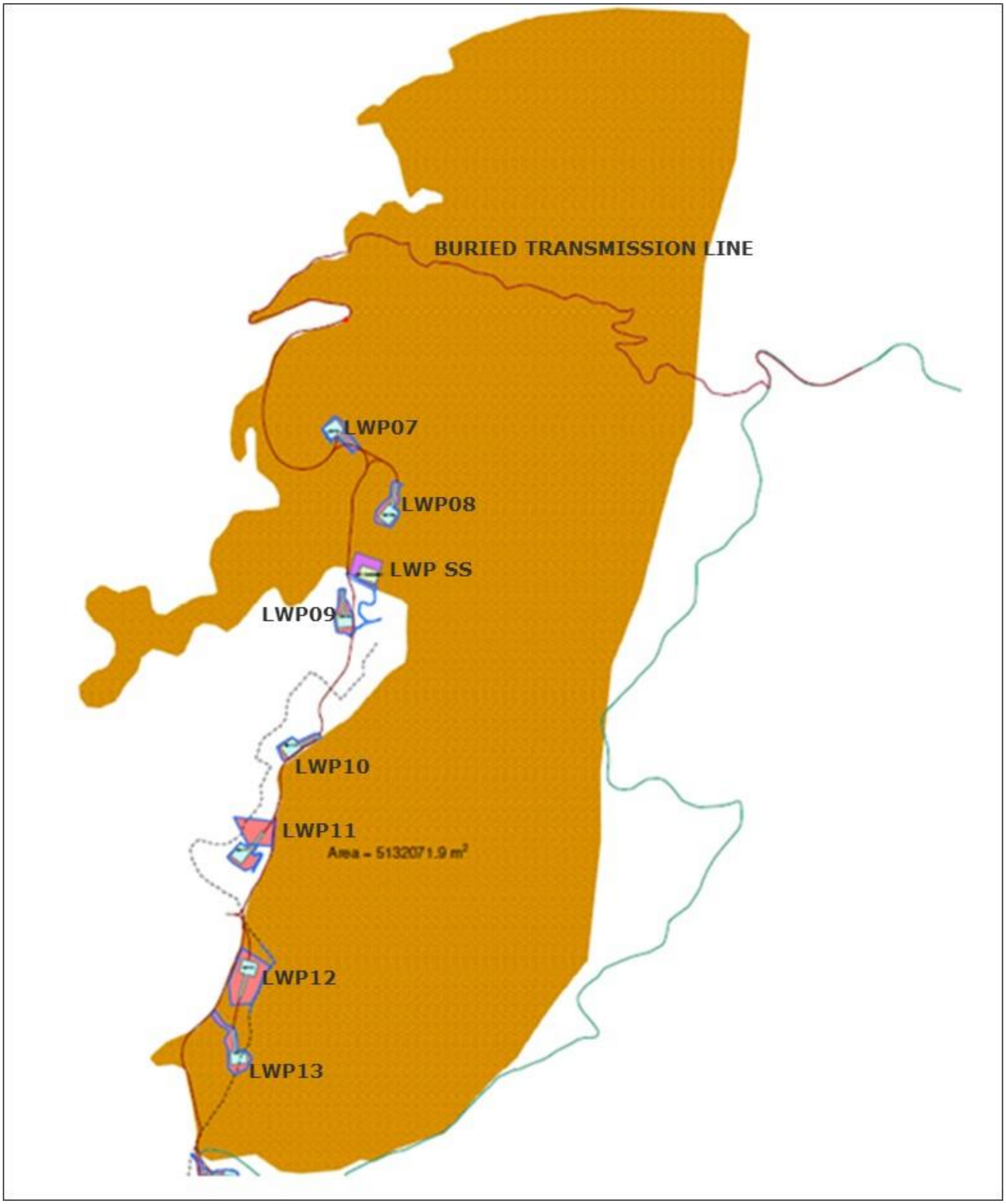


Table 18-2 Assessment of Access to Karm Chbat Nature Reserve During Operation

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

18.3.3 During Decommissioning

18.3.3.1 Cultural Heritage

During the decommissioning phase, impacts to cultural heritage are considered to be similar to the construction phase. Again, the low likelihood of encountering cultural resources and artifacts is low, and the implementation of the Chance Find Procedure reduces the potential for impact even further.

18.3.3.2 Eco Tourism

During the decommissioning phase, the impacts to eco-tourism are considered to be similar to the construction phase. Again, access to certain portions of the Karm Chbat Nature Reserve will be limited to ensure the health and safety of visitors. Approximately 10-15% of the Karm Chbat Nature Reserve will involve decommissioning activities at different times across the entire decommissioning phase.

19. OCCUPATIONAL HEALTH AND SAFETY

This section presents an assessment of health and safety hazards and sources and their potential impacts to workers. It is noted that the regulation of occupational health and safety in Lebanon is shared by the Ministry of Public Health and the Ministry of Labor, which includes the conduct of inspections to ensure adherence to public health and safety, project and site inspection and documentation of occupational health and safety conditions and a focus on local community health and safety expectations and needs.

The selected OEM/EPC Contractor will implement a Health, Safety and Security (HSS) Management System appropriate to control the risks identified for the construction and operations and maintenance phases of the Project. The system will include development of appropriate policies and objectives, responsibilities and authorities of personnel, ensuring that appropriate and competent resources are available, arrangements for reporting, monitoring, review and corrective actions.

Arrangements are expected to include manual handling/ergonomics, control use of hazardous substances, covering training, application, storage, work at height, excavation safety, confined space safety, use of pressurized systems, equipment guarding, use of personal protective equipment (PPE), use of lifting equipment (including requirements for equipment certification and use of lift plans where appropriate, risk from falling objects), hot work, work with electricity, control of exposure to noise/radiation (including electric and magnetic fields), use of vehicles, security, adverse weather conditions, provision of welfare amenities, etc.

19.1 Baseline Methodology

Occupational health and safety information was based on the activities to be undertaken by workers during the pre-construction, construction, operations and decommissioning phases of the Project.

19.2 Baseline Findings

Anticipated work activities are summarized in the following sections, as described in **Section 2 Project Description**.

Occupational health and safety are considered primarily in terms of potential exposure to pollutants from various media (air, water, soil, other) and accident occurrence (direct and indirect) in relation to on-site workers and/or operators during both the construction and operation phases.

In this respect, site health, safety and environmental regulations will be compiled for adoption by the OEM/EPC Contractor involved in construction. These guidelines will be part of the contractual obligations for the selected OEM/EPC Contractor who will be responsible for ensuring the implementation of such guidelines as well as training employees for the use of correct tools and procedures.

19.2.1 Pre-Construction Phase

Surveys and Studies

A final transport route review once the specific model of wind turbine has been selected and dimensions of the components are understood. This will ensure that any changes to the likely impacts along the route are identified. Additional topographical surveys as required to serve as a solid basis for the specification of the works. Geotechnical investigations on all proposed sites for wind turbines, substations, transformers and related structures and buildings, for structures of transmission lines, along all site road routes for the purpose of construction and further public use and at other sites. planned survey / monitoring (i.e. surveying of major karstic features, groundwater mapping, water quality monitoring of groundwater, local springs, etc.) to inform detailed design and address adverse impacts during construction.

Employment and Workforce Training

After contract award, the successful OEM/EPC Contractor will be asked to present a hiring plan, including both local and international workforce. The OEM/EPC Contractor shall provide comprehensive training to Employer's designated personnel covering all aspects of the Facility and the technical operation of the wind farm, safety at work, equipment and system for operations and maintenance. The training shall at least include the following:

- On the job training.
- Factory training.
- Wind Turbine maintenance and associated planning.
- Supervisory control and data acquisition (SCADA) software and hardware training.
- Operations and maintenance staff training.

Preparatory Works

Preparator works will include the following:

- Site preparation including compaction of soil, filling of low areas with imported fill and grading of the entire area of the site to the required lines levels and slopes, as required.
- Provision of temporary laydown areas, warehouses, workshops, vehicles, equipment etc. all as necessary for the construction phase.
- Provision of temporary firefighting and alarm system.
- Provision of temporary site drainage, storm water and sanitary drainage as necessary for the site, site facilities, temporary laydown areas, warehouses, workshops, as required.
- Disposal of sewage, as necessary.
- Provision of temporary site fencing including gates, as necessary.
- Provision of first aid, site safety and security system for the construction phase.
- Provision of temporary offices for the Employer and their representative.
- Provision of temporary offices for the Contractor

Procurement

The procurement and delivery of equipment and parts will be undertaken by the selected OEM/EPC Contractor. Shipping and clearance will be conducted in compliance with customs and other involved authorities' regulations.

19.2.2 Construction Phase

Obstacle Removal and Road Development

- The Port: Temporary concrete bund, curb, electric pole and overhead removal, will be necessary for trucks to navigate the Port. At the Port exit, 45m of concrete wall will need to be demolished to facilitate exit by trucks carrying the WTG components.
- Ramps, roundabouts and curves: Car parking will be prohibited during transport and removal of curbs, electric poles, trees, lamp posts, and fencing will be necessary.
- Pedestrian bridges: Raising of the bridges to provide a vertical clearance of 570cm will be required.
- At significant curves: Ground leveling and compaction to facilitate maneuverability.

Excavation, Land Clearing, Internal Road Network and Foundation Construction

- Platforms consisting of leveled areas adjacent to the turbines and their bases.
- Leveling and large rock removal would be undertaken within the surrounding areas within the Project site boundaries.
- The platforms will be used for installation and maintenance, to accommodate large vehicles and equipment.

Transportation of Wind Turbine Components to the Project Site

The transport of wind turbine components will include one turbine assembly, comprised of 5 tower sections, 2 nacelle sections, 1 hub and 3 blades per turbine, 2 times per week. The transport will require an escorted convoy of 11 oversized trucks traveling roundtrip from the Tripoli Seaport and Project site between 11pm and 4am. Transport of the substation and associated switchgear will be undertaken separately, requiring 1 truck each.

Transportation of Construction Materials

- Sand and gravel sourced from the 6 quarries will require 86 trucks per day for a period of 90 days.
- Transport of surplus excavated material will require approximately 86 trucks per day for a period of 90 days.
- Ready-mix concrete sourced from the Batching Plant to be constructed in Rweimeh Village will require approximately 13 trucks per day for a period of 90 days.
- Cement sourced from Chekkah will require approximately 1 truck per day for a period of 90 days.

Installation of WTG Components through Onsite Mobile Cranes

On-site installation, civil and electrical works by the selected OEM/EPC Contractor, as well as the Developer.

Other Construction Works

Excavation, ground leveling, concrete works, foundation establishment, and structure erection for building infrastructure.

Excavation, Land Clearing and Electrical Work to connect each turbine to the power grid

These activities will be required to connect each turbine to the power grid. It includes excavation and the installation and laying of transmission and communication cables, the installation of the substation and installation of the buried transmission line along Quobaiyat-Qasr Road and the existing hunter's track to the Project to connect the Project substation with the substation at the Sustainable Akkar wind farm.

Commissioning

Comprises the transfer of the plant from the state of mechanical completion into the state of continuous operation and includes mechanical tests will be performed to ensure compliance with manufacturer specifications, and the proper functioning of electrical and communication systems.

19.2.3 Operations and Maintenance Phase

The operations and maintenance phase will involve 3 full-time workers to undertake the following:

- Management and administration of the facility.
- Environmental, health and safety management.
- Spare parts management including delivery, shipping and logistics for components and parts.
- Remote monitoring 24 hours a day, 7 days a week.
- Planning and supervision of the maintenance and repair activities.
- Communication with grid operator as well as operating the wind farm to satisfy EDL requirements.
- OEM/EPC Contractor's home office technical support.

19.2.4 Decommissioning Phase

The decommissioning and restoration process comprises removal of aboveground structures, below ground structures to a depth of 1m or greater, removal of access roads if required by the land owners (or local authorities), restoration of topsoil, re-planting and re-vegetation, seeding and implementation of a two-year monitoring and remediation period, in a manner aimed at reducing the damage that may affect the land.

19.3 Impact Analysis

19.3.1 Pre-Construction Phase

The pre-construction phase activities are not expected to pose occupational health and safety impacts that cannot be managed by standard field survey management plans.

19.3.2 Construction and Operations and Maintenance Phases

During both the construction and operations phases, occupational health and safety impacts are potentially posed by: work on active roads; the handling of hazardous materials; pressurized equipment hazards; working above and below grade and confine spaces; operation of lifting equipment (i.e. cranes, gantry and tuggers); transport of equipment and construction materials by heavy vehicles; electrical hazards; exposure to noise, vibration, air emissions, radiation and electromagnetic fields; adverse weather, ground stability and visibility; structural collapse and mechanical failure; manual handing; security; remote working conditions; and other issues including language differences.

The risk register is presented in **Table 19-1**.

Mitigation

Construction

During construction, it is important to plan and coordinate the efforts and on-site equipment use amongst the OEM/EPC Contractor, delivery/shipping company, and supervision and support team from the technology providers. As such, preparatory work for construction would entail the preparation of infrastructure for construction and maintenance, performance of civil engineering works, installation of machinery and installation and connection of electrical equipment.

Mitigation measures include, but are not limited to the following:

Air Quality

- Covering loads of dusty or excavated materials on a vehicle entering or leaving the construction site with impervious sheeting (such as nylon canvas).
- Undertaking proper enclosure and guarding to limit public access to the site.
- Drivers and workers in the vicinity of earth moving equipment would be supplied with ear mufflers, as well as goggles and nose masks, if necessary, in order to protect them from dust impacts.
- Water spraying at the excavation sites prior to, during and after excavation to limit airborne particles.
- Proper unloading of materials on-site to minimize dust.
- Limiting the use of heavy equipment during periods of high winds.
- Forbidding construction vehicles from keeping engines running (waiting to enter site or on-site).
- Adopting weight limits for trucks and not exceeding vehicle loading capacity.
- Ensuring adequate maintenance and repair of construction machinery.
- Maintaining good housekeeping practices; and effective operational and waste management practices.
- Implementing H&S measures (masks, work gloves, proper clothing, H&S rules) as needed.
- Providing suitable rehabilitation and maintenance of road network surfaces to ease traffic flow.
- Using environmentally friendly equipment with higher fuel efficiency or air pollution control.
- Maintaining and operating equipment using appropriate fuel mixtures.
- Enforcing speed limits for vehicles and maintaining normal traffic speed on-site and recommended traffic speed and driving time on the roads.
- Applying dust suppression methods such as watering at access and internal roads.
- Adopting good house-keeping measures to reduce dust build-up.
- Maintaining stockpiles at minimum heights and forming long-term stockpiles into the optimum shape (i.e. stabilization) to reduce wind erosion.
- Avoiding open burning of solid waste.
- Enclosing the construction site with a dust mesh, as applicable.
- Carrying out loading and unloading of material without scattering.
- Covering access roads and internal roads with plant mix.
- Washing construction vehicles leaving site to prevent transmission of soil.
- Keeping drop height of materials that have potential to generate dust at a minimum.
- Using well-maintained vehicles and ensuring regular maintenance of these vehicles.
- Collecting and addressing complaints and suggestions through grievance mechanism.

Table 19-1 Occupational Health and Safety Risk Register – Construction and Operations Phase

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
Hazardous Materials (e.g. toxic, flammable, asphyxiant, explosive)	Hazardous substances used/stored (e.g. paint, solvents, hydraulic fluids, diesel, herbicides, etc.)	X	X	Exposure to substance hazardous to health	Injury/illness	M/L	• Hazardous substance use, storage, handling arrangements, • Control of work (e.g. Permit to Work, Job Hazard Assessment) • Pesticide Management Plans • Use of PPE • Subcontractor/supplier/equipment selection and management • Health risk assessment and monitoring • HSE auditing • Emergency response
	Flammable/ explosive gas (e.g. welding gases)	X	X	Loss of containment, ignition, fire/explosion/ missiles	Injury/fatality	M	• Hazardous substance use, storage, handling arrangements • Control of ignition sources • Control of work (e.g. Permit to Work, Job Hazard Assessment) • Subcontractor/supplier/equipment selection and management • HSE auditing • Emergency response
	Bulk storage of flammable gas/liquid (e.g. propane for cooking, heating, diesel for vehicle fuel)	X	X	Loss of containment, ignition, fire, BLEVE	Injury/fatality	M/L	• Design basis of diesel storage (bunding, ignition control, safeguarding systems) • Hazardous substance use, storage, handling arrangements • Control of ignition sources • Control of work (e.g. Permit to Work, Job Hazard Assessment) • Subcontractor/supplier/equipment selection and management • HSE auditing • Emergency response
	Cellulosic material (combustibles such as wood, paper, etc.)	X		Fire in construction camp accommodation area (accumulation, ignition of flammable materials)	Injury/fatality	M	• Induction briefing • Subcontractor/supplier/equipment selection and management • No smoking, housekeeping policies • Fire protection: building fire detection/alarm/protection • HSE auditing • Emergency response
	Cellulosic material (combustibles)	X	X	Fire in operational building (accumulation, ignition of flammable materials)	Injury/fatality	M/L	• Induction briefing • Subcontractor/supplier/equipment selection and management • No smoking, housekeeping policies • Fire protection: building fire detection/alarm/protection • HSE auditing • Emergency response
	Cellulosic material	X	X	Fire in wind turbine nacelle (e.g. due to ignition of insulation, lubricants construction, materials)	Injury/fatality	M	• Design basis of wind turbine, active, passive fire protection arrangements, escape/evacuation/rescue arrangements • Hazardous substance use, storage, handling arrangements • Control of ignition sources • Control of work (e.g. Permit to Work, Job Hazard Assessment) • Subcontractor/supplier/equipment selection and management • HSE auditing • Emergency response

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
	Transformer Insulating Fluid (SF6)	X	X	Loss of containment, e.g., during commissioning	Injury	L	• Hazardous substance use, storage, handling arrangements • Control of work (e.g. Permit to Work, Job Hazard Assessment) • Subcontractor/supplier/equipment selection and management • Alarm warning systems • HSE auditing • Emergency response
Pressure Hazards	High pressure systems used to support construction phase (e.g. hydraulic, compressed air, bottled gases, HP water jetting)	X		Loss of integrity/ catastrophic failure, sudden, explosive release of pressure	Injury/fatality	L	• Control of work (e.g. Permit to Work, Job Hazard Assessment) • Use of PPE • Subcontractor/supplier/equipment selection and management • HSE auditing • Emergency response
	Pressure systems in buildings and used for maintenance (e.g. compressed air, bottled gases)		X	Loss of integrity/ catastrophic failure, sudden, explosive release of pressure	Injury/fatality	L	• Control of work (e.g. Permit to Work, Job Hazard Assessment) • Use of PPE • Subcontractor/supplier/equipment selection and management • HSE auditing • Emergency response
Differences in Height (e.g. working above grade, below grade)	Work at height during the construction phase (e.g. foundation construction, pylon, mast installation, scaffolding)	X		Fall from height	Injury/fatality	H	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment, Use of appropriate work procedures/standards) • Appropriate training of personnel • HSE auditing • Use of PPE, safe working platforms • Emergency response
	Work at height during the operations (e.g. maintenance in the nacelle, scaffolding)		X	Fall from height	Injury/fatality	H	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment) • Appropriate training of personnel • HSE auditing • Use of PPE, safe working platforms • Emergency response
	Objects at height (tools, equipment)	X	X	Dropped object	Injury/fatality	M	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment) • HSE auditing • Use of PPE, safe working platforms • Emergency response
	Work below grade (e.g. excavation, foundation construction	X		Excavation collapse, trapped personnel, exposure to asphyxiating environment	Injury/fatality	H/M	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment, Use of appropriate work procedures/standards) • HSE auditing • Use of PPE • Emergency response

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
Lifting (e.g. cranes, gantry and tuggers)	Cranes, mechanical lifting arrangements deployed during construction/ commissioning phase	X		Mechanical failure of lifting arrangements, loss of control of lift, leading to dropped object/impact.	Injury/fatality	H	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Lift Plans, Permit to Work, Job Hazard Assessment) • Certification, verification of lifting arrangements • HSE auditing • Use of PPE • Emergency response
	Cranes, mechanical lifting arrangements deployed during operation/ maintenance phase		X	Mechanical failure of lifting arrangements, loss of control of lift, leading to dropped object/impact.	Injury/fatality	M	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Lift Plans, Permit to Work, Job Hazard Assessment) • Certification, verification of lifting arrangements • HSE auditing • Use of PPE • Emergency response
Transport (e.g. land, marine, air)	Vehicle, plant, equipment movement – during construction/ commissioning phase	X		Road traffic accident: loss of control during land transport operations	Injury/fatality	H	• Design basis of road infrastructure • Vehicle land logistics/subcontractor/supplier/equipment selection and management • Road/land logistics HSE management arrangements (e.g. driver training and competence, safety briefings, journey management, auditing) • Emergency response
	Vehicle, plant, equipment movement – during construction/ commissioning phase	X		Vehicle impact with personnel	Injury/fatality	H	• Design basis of road infrastructure (segregation of roads, paths) • Control of work activities • Vehicle land logistics/subcontractor/supplier/equipment selection and management • Road/land logistics HSE management arrangements (e.g. driver training and competence, safety briefings, journey management, auditing) • Emergency response
	Vehicle, plant, equipment movement – during operation/ maintenance phase		X	Road traffic accident: loss of control during land transport operations	Injury/fatality	H/M	• Design basis of road infrastructure • Vehicle land logistics/subcontractor/supplier/equipment selection and management • Road/land logistics HSE management arrangements (e.g. driver training and competence, safety briefings, journey management, auditing) • Emergency response
	Vehicle, plant, equipment movement – during operation/ maintenance phase		X	Vehicle impact with personnel	Injury/fatality	H/M	• Design basis of road infrastructure (segregation of roads, paths) • Control of work activities • Vehicle land logistics/subcontractor/supplier/equipment selection and management • Road/land logistics HSE management arrangements (e.g. driver training and competence, safety briefings, journey management, auditing) • Emergency response
	Wind turbine structures, meteorological masts	X	X	Fixed/rotary wing aircraft impact with elevated structure	Injury/fatality	L	• Design basis of wind turbines, masts (location away from flight paths, equipped with beacons/lights/warning)

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
Electricity	High Voltage and Low voltage power generation systems and distribution infrastructure	X		Loss of control/ separation, personnel exposure to live electrical system	Injury/fatality	H	• Design basis of all electrical systems, in accordance with relevant safety/engineering codes, standards and legislation • Control of work (e.g. Permit to Work, Job Hazard Assessment). Appropriate procedures for electrical work, Lock-out and Tag-out procedures) • Subcontractor/supplier/equipment selection and management • HSE auditing • Use of PPE • Emergency response
	High Voltage and Low voltage power generation systems and distribution infrastructure		X	Loss of control/ separation, personnel exposure to live electrical system	Injury/fatality	M	• Design basis of all electrical systems, in accordance with relevant safety/engineering codes, standards and legislation • Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment). Appropriate procedures for electrical work, Lock-out and Tag-out procedures) • HSE auditing • Use of PPE • Emergency response
	Electrical distribution system/ transmission line - overhead		X	3rd party, uncontrolled access to pylons, loss of separation with transmission lines	Injury/fatality	L	• Design basis of pylons and overhead transmission lines, in accordance with relevant safety/engineering codes, standards and legislation • Control of work (e.g. Permit to Work, Job Hazard Assessment). • Asset security arrangements, access control • Community engagement • Warning signs
	Electrical distribution system/ transmission line - underground		X	3rd party, uncontrolled access to underground transmission lines	Injury/fatality	L	• Design basis of buried transmission lines in accordance with relevant safety/engineering codes, standards and legislation • Asset security arrangements, access control • Community engagement • Warning signs
	Electrical distribution system/ transmission line - underground		X	Excavation of/impact on underground transmission line	Injury/fatality	L	• Design basis of buried transmission lines in accordance with relevant safety/engineering codes, standards and legislation • Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment), Appropriate procedures for electrical work, Lock-out and Tag-out procedures) • Use of PPE • Emergency response

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
	Energized electrical systems	X	X	Fire/explosion, from short circuit or fault	Injury/fatality	M	• Design basis of electrical systems in accordance with relevant safety/engineering codes, standards and legislation. • Subcontractor/supplier/equipment selection and management • Protection systems, active passive fire protection • Asset integrity (maintenance, inspection, verification) • Control of work (e.g. Permit to Work, Job Hazard Assessment). Appropriate procedures for electrical work, Lock-out and Tag-out procedures. • Use of PPE • Emergency response
Noise	Construction, commissioning plant and equipment (e.g. generators)	X		Exposure to high, damaging noise levels	Injury	M/L	• Design basis of plant and equipment to minimize noise • Subcontractor/supplier/equipment selection and management • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Use of PPE • HSE auditing, noise monitoring, health risk assessment
	Noise sources present during the operational phase (e.g. turbine machinery, blade/air movement)		X	Exposure to high, damaging noise levels	Injury	L	• Design basis of plant and equipment to minimize noise • Subcontractor/supplier/equipment selection and management • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Use of PPE • HSE auditing, noise monitoring, health risk assessment
Emissions	Fumes, dusts during construction/ commissioning phase	X		Exposure to fumes, dusts , reduced ambient air quality	Injury	L	• Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Subcontractor/supplier/equipment selection and management • Use of PPE • HSE auditing, air quality monitoring, health risk assessment
Radiation	Construction integrity assurance/ verification activities (e.g. weld radiography)	X		Exposure to radioactive source	Injury	L	• Subcontractor/supplier/equipment selection and management • Control of work (e.g. Permit to Work, Job Hazard Assessment, appropriate work procedures) • HSE auditing • Use of PPE • Emergency response
	Microwaves associated with Line of Sight (LOS) comms systems	X	X	Loss of separation, exposure to microwaves	Injury	L	• Design basis of communications equipment, location, shielding • Access control • Control of work (e.g. Permit to Work, Job Hazard Assessment) • HSE auditing, health risk assessment

Hazard Category	Hazard Source	Project Phase: Construction/ Commissioning	Project Phase: Operation/ Maintenance	Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
Electromagnetic Fields	Electrical equipment, generation and distribution infrastructure (e.g. transformers, generators, turbines etc.)	X	X	Exposure to Electromagnetic Fields	Injury	L	• Design basis of electrical systems in accordance with relevant safety/engineering codes, standards and legislation • Control of work (e.g. Permit to Work, Job Hazard Assessment) • HSE auditing, health risk assessment
Vibration (e.g. use of tools, equipment)	Equipment, plant used during the construction phase (e.g. heavy machinery, jackhammer, piling)	X		Frequent exposure to vibration from equipment – Whole body vibration, hand arm vibration	Injury	M/L	• Design basis of plant and equipment to minimize vibration • Subcontractor/supplier/equipment selection and management • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Use of PPE • HSE auditing, health risk assessment
	Equipment, plant used during the operations/ maintenance phase (e.g. hand tools)		X	Frequent exposure to vibration from equipment – hand arm vibration	Injury	L	• Design basis of equipment, tools to minimize vibration • Subcontractor/supplier/equipment selection and management • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Use of PPE • HSE auditing, health risk assessment
Confined Space	Below grade excavation, construction, commissioning phase	X		Exposure to oxygen deficient/ asphyxiating atmosphere/restricted access	Injury/fatality	H/M	• Subcontractor/supplier/equipment selection and management • Control of work activities (e.g. Permit to Work, Job Hazard Assessment, Appropriate work procedures)
	Turbine nacelle and shaft, inspection rooms/hatches	X	X	Exposure to oxygen deficient/ asphyxiating atmosphere/restricted access	Injury/fatality	M	• Design basis of wind turbine, ventilation arrangements • Subcontractor/supplier/equipment selection and management • Control of work activities (e.g. Permit to Work, Job Hazard Assessment, Appropriate work procedures) • HSE auditing, health risk assessment
Environment/ Weather (adverse weather, ground stability, visibility)	Reduced visibility (e.g. Fog)	X	X	Reduced worksite visibility, increased likelihood of incident (e.g. slips, trips, falls, impacts, collisions)	Injury/fatality	L	• Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures
	High ambient temperature	X	X	Working in high heat environment, heat stress, sunstroke, sunburn, dehydration	Injury/fatality	M/L	• Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures • HSE auditing, health risk assessment • Use of PPE

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
	Low ambient temperature (ice, snow)	X	X	Working in low temperature environment/ increased likelihood of incident (e.g. slips, trips, falls, impacts, collisions)	Injury/fatality	M/L	• Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures • HSE auditing, health risk assessment • Use of PPE • Asset maintenance (de-icing, gritting roads)
	Low ambient temperature (ice, snow)		X	Ice accumulation and shedding, projectiles (ice throw)	Injury/fatality	L	• Design basis of wind turbines; designed to accommodate expected loads • Location of wind turbines (nearest significant community 2km away) • Adverse weather policy and procedures • Ice detection warning systems • Wind turbine operational control • Emergency response
	High wind	X	X	Working in high wind environment, increased likelihood of incident (e.g. slips, trips, falls, impacts, projectiles)	Injury/fatality	M	• Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures • HSE auditing, health risk assessment • Use of PPE
	High Wind	X	X	Turbine overspeed, catastrophic blade failure, projectiles	Injury/fatality	L	• Design basis of wind turbine, overspeed protection systems • Wind turbine operational control • Emergency response
	High precipitation	X	X	Working in high precipitation environment, increased likelihood of incident (e.g. slips, trips, falls, impacts, collision)	Injury/fatality	M/L	• Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures • HSE auditing, health risk assessment • Use of PPE
	Flooding – construction/ commissioning phase	X		Working in waterlogged environment, increased likelihood of incident (e.g. slips, trips, falls, impacts, collision)	Injury/fatality	L	• Temporary worksite, access roads, camp flood protection, drainage arrangements • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures
	Flooding – operation/ maintenance phase		X	Working in waterlogged environment, increased likelihood of incident (e.g. slips, trips, falls, impacts, collision)	Injury/fatality	L	• Site flood protection, drainage arrangements • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures
	Ground stability	X		Ground instability, structural failures, collapse	Injury/fatality	M	• Geotechnical design basis for all structures, roads • Siting of equipment

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
	Ground stability		X	Ground instability, structural failures, collapse	Injury/fatality	L	• Geotechnical design basis for all structures
	Lightning	X	X	Lightning strike	Injury/fatality	L	• Structure lightning protection arrangements • Control of work activities (e.g. Permit to Work, Job Hazard Assessment) • Adverse weather policy and procedures
	Earthquake	X	X	Earthquake, ground instability, structural failures, collapse	Injury/fatality	L	• Site selection • Design basis of all facilities and structures
Biological (e.g. health, hygiene)	Illness, disease, bacteria, virus	X	X	Disease spread among workforce, contamination, illness	Injury/fatality	H	• Design basis of all facilities • Welfare arrangements • Health risk policies, management and assessment • Medical screening, treatment and arrangements
Biological (e.g. health, hygiene)	Illness, disease, bacteria, virus	X	X	Disease spread among workforce, contamination, illness	Injury/fatality	L	• Design basis of all facilities • Welfare arrangements • Health risk policies, management and assessment • Medical screening, treatment and arrangements
Mechanical (e.g. structural collapse, mechanical failure)	Turbine pylon	X	X	Catastrophic structural failure	Injury/fatality	L	• Design basis of wind turbines; designed to accommodate expected static and dynamic loads. • Manufacturing, installation, commissioning QA arrangements • Asset integrity (maintenance, inspection, verification) • Emergency response
	Turbine blade	X	X	Catastrophic failure, blade throw, projectiles	Injury/fatality	L	• Design basis of wind turbines; designed to accommodate expected loads • Location of wind turbines (nearest significant community 2km away) • Manufacturing, installation, commissioning QA arrangements • Wind turbine operational control • Asset integrity (maintenance, inspection, verification) • Emergency response
Impact	Moving machinery, equipment	X	X	Impact with machinery, equipment (crushing, piercing, trapping etc.)	Injury/fatality	M/L	• Design basis of wind turbine equipment; • Asset integrity (maintenance, inspection, verification) • Control of work activities (e.g. Permit to Work, Job Hazard Assessment, Lock-out and tag-out) • HSE auditing, Risk assessment • Emergency response
Manual handling	Lifting/moving of loads	X		Injury through unsuitable manual handling of equipment	Injury/fatality	H	• Subcontractor/supplier/equipment selection and management • Appropriate training and work procedures • Health risk assessment and monitoring • HSE auditing

Hazard Category	Hazard Source	Project Phase		Scenario	Consequences (to People)	Risk (H/M/L)	Key Control Arrangements (Prevention/Mitigation)
		Construction/ Commissioning	Operation/ Maintenance				
	Lifting/moving of loads		X	Injury through unsuitable manual handling of equipment	Injury/fatality	M	• Subcontractor/supplier/equipment selection and management • Health risk assessment and monitoring • HSE auditing
Security	3rd Parties	X	X	Unauthorized access to assets, security/terrorism incident, sabotage	Injury/fatality	H	• Appropriate secure design of facilities/assets • Security arrangements
Remote Working (including lone working)	Various	X	X	Incidents/injuries during remote or lone working	Injury/fatality	M	• Remote and lone working management arrangements • Subcontractor/supplier/equipment selection and management • HSE auditing • Emergency response
Other	External vegetation	X	X	Ignition of vegetation external to assets, bush fire.	Injury/fatality	L	• Vegetation management, clearance
	Workforce language barrier issues	X		Communication problems, leading to the increased likelihood of accidents/incidents	Injury/fatality	M	• Communication and training arrangements • Multi-lingual safety representatives

Water and Soil Resources Protection

- Implementation of the Construction Health and Safety Plan.
- Staging of work areas.
- Provision of washout/washdown facilities with filter/neutralization prior to discharge.
- Installation of silt fencing.
- Erosion and sediment control.
- Excavation and grading containment.
- Awareness on the efficient use of water.
- Minimizing water and soil exposure.
- Minimizing and if possible, eliminating chemical usage (oil, lubricants and fuel) onsite.
- Using as much as possible non-toxic and biodegradable chemicals to be stored on-site.
- Reporting in case of spills from generator or disposed waste on-site in order to seek immediate remedial measures.
- Routine inspection and maintenance of equipment to ensure that risk of leak/spill is minimized.
- Promotion of general best practice housekeeping during construction.
- Control and supervision of refueling at all times by appropriate personnel.
- Development and implementation of training program for management of hazardous substances.
- Temporarily store hazardous waste on-site in a designated and enclosed area.
- Forbidding hazardous waste storage outside designated area.
- Ensuring that oil changes, refueling, or lubrication of vehicles will be conducted offsite or in a dedicated area.
- Equipping fuel storage tanks with drip trays and spill control equipment.
- In case of spills, hazardous materials would be controlled via absorbents, and contaminated soil would be removed and disposed of in compliance with applicable legislation.

Topsoil Management

- Strip topsoil from project footprint (turbine bases and platform) at suitable depths and store separately at specialized areas.
- Minimize topsoil losses via use of suitable equipment, procedures and construction work schedule - avoid soil disturbance during heavy windy and rainy periods.
- Identify topsoil storage areas at relatively low slope areas.
- Ensure that top soil stockpiles do not exceed 2m in height.
- Ensure that only soil material will be stored at topsoil storage areas.
- Maintain slope stability and a safe working environment for heavy construction vehicles.
- Ensure that surface grading is done with appropriate vehicles to avoid soil compaction.
- Enclose topsoil storage area(s) with fencing and place explanatory signboards
- Ensure drainage of temporary topsoil site(s).
- Within completed construction areas (turbine bases and platforms), reuse stored top soil for rehabilitation and landscaping.
- Do not use vegetative soil or topsoil as fill material under any circumstances.
- Ensure unnecessary soil stripping to minimize disturbance to vegetation, ecosystems and soils.

Noise and Vibration

- Choosing equipment with lower sound power levels when possible.
- Using noise mufflers, and minimizing machinery or equipment idling conditions.
- Optimizing internal-traffic routing to minimize vehicle reversing needs and maximize distances from closest sensitive receptors.
- Keeping the main access road in well-maintained condition.
- Ensuring mobile vehicles use only designated roads to reduce traffic through community areas
- Proper site logistics and planning.
- Performing proper maintenance on construction vehicles and equipment.
- Limiting site working hours if possible.
- Conducting construction activities closest to noise sensitive receptors during day time only.
- Informing local municipalities and residents of the construction schedule and time of planned noisy activities.
- Informing noise sensitive receptors about construction schedule in their proximity in advance.
- Scheduling potentially noisier activities during daytime and/or less intrusive times.
- Conducting noise monitoring during construction to verify compliance with regulatory limits.
- Keeping equipment speed as low as feasibly possible without compromising performance.
- Collecting and addressing complaints and suggestions through grievance mechanism.

Solid Waste Management

- Proper site clearing.
- General cleanliness and organization of the site.
- Use of excavated material as fill material, e.g. topsoil.
- Segregation and proper disposal waste oils, paint barrels, lubricants, etc. from other wastes.

Traffic and Transport

- Planning, development and implementation of traffic management
- Maintaining minimal traffic speed on-site and recommended traffic speed and driving time off-site
- Implementing working hour limits for drivers and inform drivers periodically on working schedule
- Implementing restrictions for night time driving
- Adopting proper weight guidelines for trucks and not exceeding vehicle loading capacity
- Providing alternate routing plans during all phases of construction
- Restricting operation of heavy vehicles to those who are trained, competent and licensed
- Providing traffic trainings to all relevant personnel and specialized trainings to personnel who will operate industrial, heavier or critical vehicles.
- Including traffic issues in the scope of the trainings and instructions for site visitors.
- Limiting visitor mobility in the construction area.
- Installing and maintaining signage and other traffic visuals.
- Implementing right of way practices.
- Implementing proper vehicle maintenance at all times.
- Conducting or enforcing periodic medical examinations for drivers.
- Conducting awareness raising activities for affected communities through established mechanism.
- Collecting and addressing complaints and suggestions through the grievance mechanism.

Health and Safety

- Restriction of access to project construction areas by patrolling and guarding.
- Provision of training on the fundamentals of occupational Health and Safety procedures.
- Developing an Emergency Response Plan and training personnel on the actions to be taken in risk situations.
- Installation of warning signs at the entrance to the site to inform people about the Project and risks associated with entry.
- Availability of PPE such as protective clothing, goggles, gloves, boots, masks, rubber boots, brightly colored working overalls equipped with light reflecting stripes, safety helmets, rubber or plastic type of equipment (broom, shovel, other) for personnel as needed.
- Covering excavated ground (e.g. anchorage pits for turbines before filling) to prevent fall-in accidents for people and animals alike.
- Provision of on-site medical facility/first aid and medical insurance for the workers/construction site.
- Installing retaining nets to hold falling debris during site clearing and construction.
- Prevention of stagnation of exposed water volumes to hamper insect and vector breeding.
- Implementation of speed limits for trucks entering and exiting the site.
- Installing proper signage to avoid accidental injury.
- Implementing good housekeeping practices.
- Ensuring that the project elements (turbines, bases, offices, substation, etc.) are designed incompliance with applicable legislations related to natural hazards, especially seismic safety
- Conducting regular maintenance of equipment.

Following the implementation of these mitigation measures, the impact severity is considered Low, and the sensitivity of the receptor as High, resulting in a residual impact categorized as Moderate as shown in **Table 19-2**.

Table 19-2 Construction Phase Assessment

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High**	**High √**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	Minor	Minor	**Moderate √**
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Operations and Maintenance Phase

Air Quality

For generators and other equipment:

- Using good quality fuel (from reputable sources).
- Performing regular and preventive routine maintenance according to manufacturer recommendations.
- Looking out for and fixing potential leakage and spillage of any kind at an early stage.
- Outfitting of the generators with an effluent filter for Particulate Matter (PM).

Water and Soil Management

- Collecting domestic wastewater from toilets and sinks and conveying to public sewer network.
- Ensuring that no sanitary wastewater is discharged onto the land.
- Identify high risk spill areas, e.g. fuel tanks and generator – and have impervious surfaces and capture facilities in place.
- Limit activities during adverse weather conditions to reduce potential wind and water erosion.

Noise and Vibration

- Adopting proper scheduling for noisy wind turbine/substation maintenance activities.
- Selecting adequate noise muffling equipment and minimizing machinery idling.
- Ensuring good maintenance and repair of equipment.
- Optimizing turbine operation as per wind speed to minimize noise generation.
- Keeping turbines in good working order throughout the operational life of the project via routine maintenance, inspection and operational diagnostics.
- Limiting the cutting/clearing of vegetation.
- Planting trees near sensitive receptors to act as a noise barrier.
- Ensuring equipment that may be intermittent in use is shut down between work periods or throttled down to a minimum.
- Implementing a rigorous inspection and maintenance program applicable to equipment on-site.
- Providing adequate Personnel Protective Equipment (PPE) to workers at noisy activities/locations that exceed permissible occupational noise level limits.
- Conducting noise monitoring (1st year of operation, continuous at local municipalities, and in case of complaints) to verify compliance with regulatory limits and take corrective action.

Solid Waste Management

- Storage of SW in a pre-determined area in covered drums for collection and disposal.
- Keeping the site free of litter.

Health and Safety

- Restricting access to project elements (turbines, substation) by patrolling and guarding areas around the site – noting that local residents, shepherds/herders, herb gatherers, and land users will not be subject to area access restrictions, rather restrictions to accessing Project elements.
- Installation of warning signs at site entrances to warn people about the Project and associated risks.
- Provision of appropriate monitoring instruments
- Conducting regular maintenance of equipment.

- Enforcing on-site transportation regulations.
- Covering excavated ground (e.g. anchorage pits for turbines before filling) to prevent fall-in accidents for people and animals alike.
- Prevention of stagnation of exposed water volumes to hamper insects and vector breeding.
- If needed, employees should be provided with PPE such as hand gloves, helmets, safety shoes, goggles, aprons etc. and ear protecting devices like earplugs/earmuffs and breathing masks.
- Prohibition of dirt accumulation, dampness, water, oil, and other substances which may adversely affect electrical safety within electrical areas or the substation.
- Training of workers and staff for fire-fighting, work permit system, first aid, safe handling of chemicals and integrating safety during operation.
- Provision of safety and warning signs where needed (displayed in Arabic and English).
- An accident / incident reporting and information system for employees for good awareness levels.
- Provision of first aid boxes at key points at the project facilities with prominent marking.
- Regulations prohibiting smoking in potentially fire prone or sensitive areas and all indoor areas.
- Provision of fire-fighting equipment and/or system if/where needed within site facilities; and regular testing of fire extinguishers.
- Ensuring electrical switchboards are not accessible to the public and related cautionary signs are in place.
- Ensuring access to turbine ladders is closed off and related cautionary signs are in place.
- Grounding installed conducting objects, as applicable.
- Ensuring maintenance schedule for turbines is strictly followed.

Specific to hazards due to accidents and/or incidents and lifting objects to heights can be applicable during construction and operation:

- Ensuring use of applicable PPEs and other protective means.
- Installing guard rails and signs.
- Ensuring sufficient overall illumination during working hours and special illumination on hazard areas during nighttime.
- Conducting regular visual checks and clean-up of excavation debris.
- Restricting operation of heavy machinery to those who are trained, competent and licensed.
- Providing regular H&S trainings.
- Conducting labor audits to contractors' work force by an external third party.
- Limiting manual lifting/handling needs by providing mechanical alternatives.
- Ensuring personnel who conduct lifting operations receive special training.
- Ensuring lifting operations are well planned and risks discussed in advance.
- Ensuring lifting equipment is properly maintained and has sufficient capacity to support the weight.
- Setting exclusion zones below any activities working at height, to account for falling objects.
- Abiding by weather condition limits set by the lifting equipment manufacturer.
- Implementing the worker internal occupational grievance mechanism.
- Conducting regular labor audits to contractors' workforce (by independent third-party auditors).

Mitigation measures specific to blade and ice throw, and lightning applicable during operation:

- Installing, maintaining and updating lightning protection systems for turbines and other elements.
- Installing and maintaining vibration sensors reacting to imbalance and shut down turbines.
- Using de-icing mechanism, especially during fall and winter seasons.
- Carrying out periodic blade inspections and repairing defects that could affect blade integrity.
- Ensure heat control mechanism is maintained properly.
- Ensure static and illuminated warning signs are used to inform/warn receptors.

Following the implementation of these mitigation measures, the impact severity is considered Low, and the sensitivity of the receptor as Medium-High, resulting in a residual impact categorized as Minor as shown in **Table 19-3**.

Table 19-3 Operations and Maintenance Phase Assessment

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High √**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	Minor	**Minor √**	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

20. CUMULATIVE IMPACT ASSESSMENT

This section presents the Cumulative Impact Assessment (CIA) for the construction and operation of the Project. Cumulative impacts are contextual and encompass a broad spectrum of impacts at different spatial and temporal scales. In this instance, cumulative impacts may occur because the series of three wind farms, Sustainable Akkar, Lebanon Wind Power and Hawa Akkar, will be constructed in close proximity, and will used the same transport route from Tripoli. Therefore, this ESIA must take into consideration the cumulative impacts of the three wind farms.

20.1 Wind Farm Descriptions

Three wind farms are to be developed in the Akkar region, the Project and the planned Lebanon Wind Power and Hawa Akkar wind farms, as shown in **Figure 20-1**.

20.1.1 Sustainable Akkar

The Project is as described in the previous sections of this ESIA Report. As previously detailed, a buried transmission line will be established underground between the Project's substation and that of the planned Lebanon Wind Power wind farm to the south, which will run 7km through Rweimeh Village along the existing road corridor (Quobaiyat-Qasr Road). Project land will be secured through long term lease agreements with the land owners.

Project land for the wind turbines and associated components will be secured through long term lease agreements with the land owners, while land for the substation will be purchased. Land preparation and road widening works are expected to start in July 2019 and turbine mounting in March 2020. The start of operation is expected in June 2020.

20.1.2 Hawa Akkar

The Hawa Akkar wind farm comprises the construction and operation of wind turbines to provide a maximum licensed capacity of 68.3MW (62.1MW + 10% potential for expansion = 68.3MW)as stipulated in the PPA arranged between Hawa Akkar and the GOL, which will be delivered to the public grid. Hawa Akkar is considering installation of Vestas 4.2MW wind turbines at up to 16 locations, for a total power generation of 67.2MW.

The wind turbine layout is shown in **Figure 20-2**.

20.1.3 Lebanon Wind Power

The Lebanon Wind Power wind farm comprises the construction and operation of wind turbines to provide a maximum licensed capacity of 68.3MW (62.1MW + 10% potential for expansion = 68.3MW) as stipulated in the PPA arranged between Lebanon Wind Power and the GOL, which will be delivered to the public grid. Depending on the OEM/EPC Contractor selected, the following scenarios are considered.

Figure 20-1 Proximity of the 3 Wind Farms

Figure 20-2 Hawa Akkar Turbine Layout

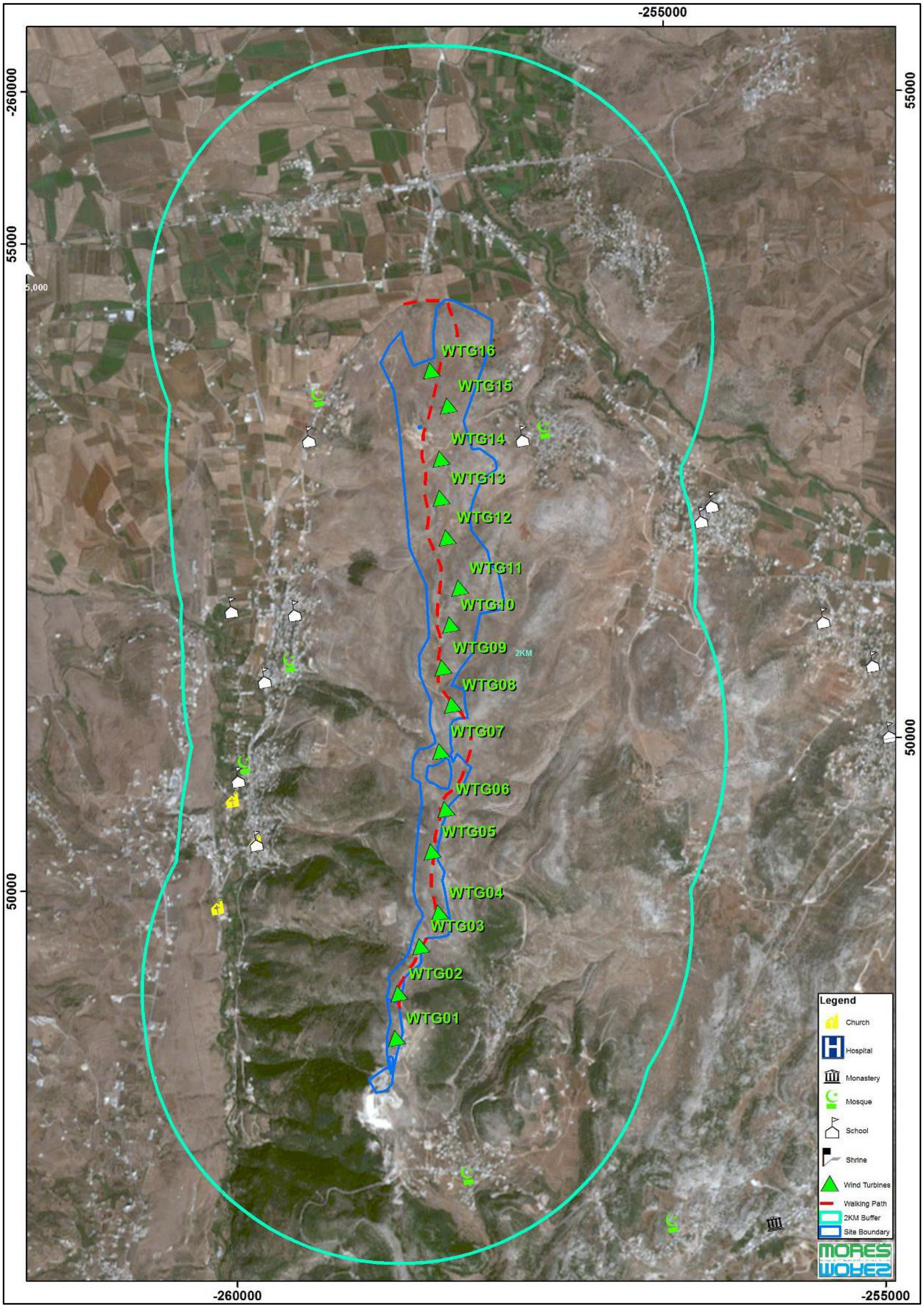


Table 20-1 Potential OEMs, Turbine Power Ratings and Turbine Locations

OEM/EPC Contractor	Turbine Power Rating	No. of Turbines	WTG Locations Selected	Power Generated by Turbines	Total Power Generated
VESTAS	4.2MW	16	WTG 07-WTG 13 and WTG 15-WTG 23	67.2MW	67.2MW
GE	4.8MW	6	WTG 11 and WTG 18-WTG 22	28.8MW	65.9MW
	5.3MW	7	WTG 10, WTG 13-WTG 17 and WTG 23	37.1MW	

The ESIA for Sustainable Akkar addressed the worst case-scenario, i.e. installation of 5.3MW wind turbines at a maximum of 16 locations, as in **Table 20-1**.

The Lebanon Wind Power wind turbine layout is shown in **Figure 20-3**.

20.2 Cumulative Impact Assessment Methodology

CIA is an evidence-based procedure which sets out the likely combined, significant effects of the proposed developments on social and environmental resources, so they can be considered in the planning process.

Specifically, IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts recognizes that because of the increasing significance of system-wide risk factors such as climate change, water availability, decline of species biodiversity, degradation of ecosystem services, and modification of socioeconomic and population dynamics, among others, cumulative impact assessment and management is an essential framework for risk management.

In addition, an assessment of the cumulative impacts from all three proposed wind farms was undertaken per the request of the MOE stipulated in Minister's Letter #14175 dated 19/12/2017.

The objective of the CIA is to consider factors that contribute to the cumulative impact of wind turbine developments to avoid, manage or mitigate cumulative impacts to physical features, ecosystems services, natural processes, social conditions and cultural assets.

In undertaking the CIA, the six-step approach presented in **Figure 20-4** was applied.

In a first step, the compiled dataset for Lebanon Wind Power, Sustainable Akkar and Hawa Akkar were reviewed to identify the potential for additive and/or synergistic impacts to Valued Environmental Components (VECs) that could be generated over time by the 3 wind farms.

VECs are the environmental and social attributes that are considered important in assessing cumulative risks and can include:

- Physical features.
- Natural processes, habitats, wildlife populations.
- Social conditions.
- Cultural aspects.

Figure 20-3 Lebanon Wind Power Turbine Layout

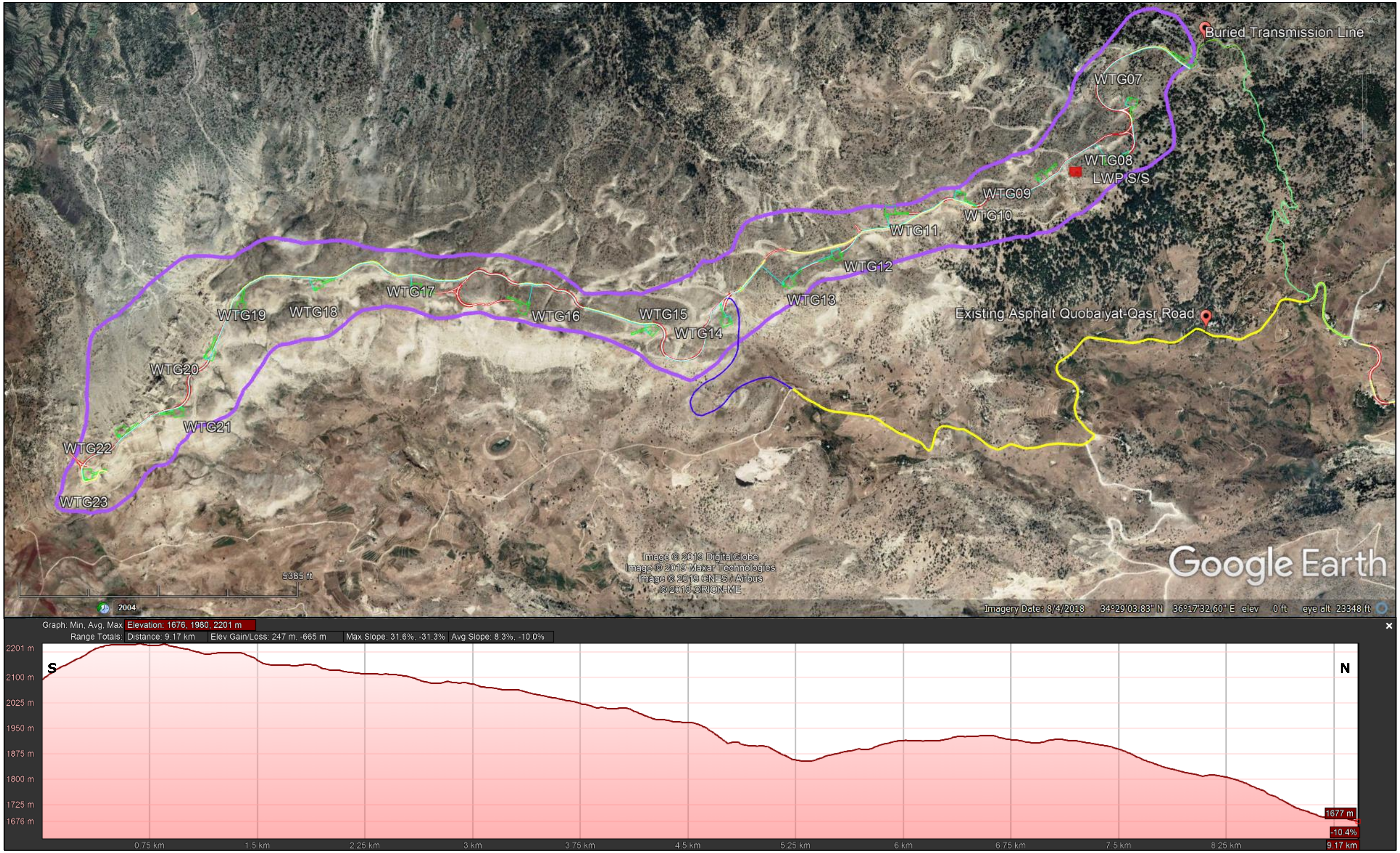
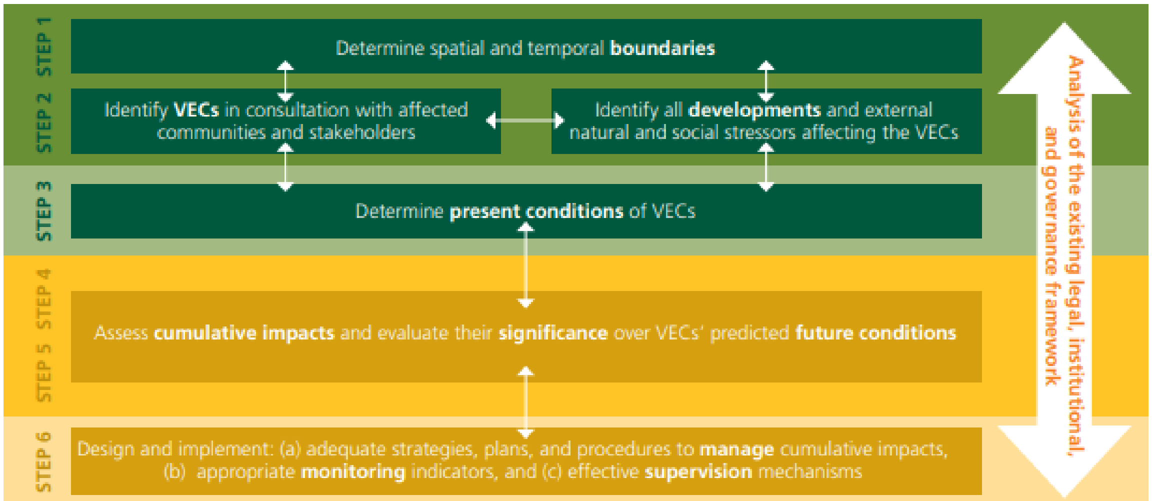


Figure 20-4 Cumulative Impact Assessment Approach[173]



Following review of the data set, it was considered that VECs to be considered in the assessment of cumulative impacts comprise the following:

- Air Quality.
- Transport and Traffic
- Biodiversity:
  - Habitats and Flora.
  - Terrestrial Fauna.
  - Bats.
  - Ornithology.
- Socioeconomic Conditions
- Noise.
- Shadow Flicker.
- Visual Amenity.
- Landscape.

In the second step the key potential impacts and risks that could affect the long-term sustainability and/or viability of the VEC were identified. The potential for additive and/or synergistic impacts to VECs, including known or predictable cause-effect relationships, was considered.

A third step comprised the assessment of the significance of potential cumulative impacts and the need for mitigation.

[173] International Finance Corporation, Good Practice Handbook, Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, 2013.

20.3 Cumulative Impact Assessment

20.3.1 Air Quality

Impacts to air quality are presented in **Section 11 Air Quality**. The total emissions originating from the three wind farms are presented in **Table 20-2**.

Table 20-2 Cumulative Emissions from the Three Wind Farms During Phases

Emissions in kg	NOx	PM10	PM2.5	SO2	CO
Construction	45,105	2,007,619	403,815	349	11,632
Operation (1yr)	671	81,083	12,138	58	4,905
Decommissioning	4361	71,249	13,866	3	1,558
Total	**50,137**	**2,159,951**	**429,819**	**410**	**18,095**

The construction phase will emit the most emissions but is also of a short duration when compared to the projects' lifetime.

When compared to the emissions of Waked et al. (2012) for the Akkar area (i.e. emissions of Cells 6, 7, and 10 for Lebanon Wind Power, Cells 4 and 5 for Sustainable Akkar, and Cells 1 and 2 for Hawa Akkar), the incremental contribution of the emissions are as follows:

- NOx is less than 20%.
- CO is less than 2%.
- SO2 is less than 1%.

On the other hand, the PM emissions are more than an order of magnitude higher than those calculated by Waked et al. (2012). That means that the CO, NOx, and SO2 incremental emissions are not expected to breach the air quality standards in any of the phases, while PM (which originates mainly from fugitive emissions) shall be mitigated during construction. It is noted that most public receptors are located more than 350m from the construction site; therefore, the receptor considered in this assessment is the construction worker.

Mitigation

The main concern in the mitigation measures to implement is due to PM emissions and specifically fugitive PM. IAQM (2016) and Mojave Desert (2013) suggest the following mitigation measures, which will be implemented at the three wind farms individually:

- Use of wind screens or enclosures around dusty activities or the site boundary. Mojave Desert Air Quality Management District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75%.
- Water spray is also used to reduce fugitive dust as it increases the moisture content of the material. Therefore, and according to Mojave Desert, water spray (application point) will ensure a control efficiency of 75%.
- For unpaved roads, water flushing is the essential with 0.48 gallons per square yard twice per day to maintain a control efficiency above 50%.
- For paved roads, water flushing with 0.48 gallons per square yard followed by sweeping is very effective and can reach 96%. If conducted directly before the passage of the turbines convoy or

the morning and evening passages of the project vehicles to and from the site, a consequent decrease will occur.

- A combination of the different above-mentioned measures will give a higher control efficiency that when applied individually.

Practically, it is considered that fugitive PM can easily be decreased by 75%. As such, with the application of the above mitigation measures, the severity of the impact from PM is considered Low, with the receptor sensitivity (the construction worker) considered Medium-High, resulting in a Minor impact as shown in **Table 20-3.**

Table 20-3 Cumulative Impact of PM During Construction

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High √**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	Minor	**Minor √**	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

20.3.2 Transport and Traffic

The transport route for the WTG components will begin at the Tripoli Seaport and proceed to the Project site using existing roads and new road or links, as was previously shown in **Figure 2-7** through **Figure 2-11**. All three wind farms will use a common transport route for the WTG components, involving the following:

- Road Obstacle Removal.
- New Road Development.
- Transport of the WTG Components, Construction Materials and Workers.

Road Obstacle Removal

Minor civil works will be necessary for trucks carrying the WTG components to navigate from the Tripoli Port to the three wind farms as follows:

- The Port: Temporary concrete bund, curb, electric pole and overhead removal, will be necessary for trucks to navigate the Port. At the Port exit, 45m of concrete wall will need to be demolished to facilitate exit by trucks carrying the WTG components.
- Ramps, roundabouts and curves: Car parking will be prohibited during transport and removal of curbs, electric poles, trees, lamp posts, and fencing will be necessary.

- Pedestrian bridges: Raising of the bridges to provide a vertical clearance of 570cm will be required.
- At significant curves: Ground leveling and compaction to facilitate maneuverability.

Such works will be coordinated and permitted by the Project Proponent and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest.

Mitigation

- The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition of the 45m of concrete wall be coordinated with the Port Authority.
- Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport.
- Any modification required for the Al Abdeh roundabout will be discussed with the municipality as it is under their authority.
- Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass.
- Such works will be coordinated and permitted by the Developer and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest.

Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass.

New Road Development

Construction of new segments of road will occur at the following locations:

- In order to avoid impacts to Chadra, Machta Hassan and Machta Hammoud, a new 0.65km section of asphalt road will be constructed through currently vacant land purchased from private land owners (shown as #1 in **Figure 2-7**). The new road section will connect with the existing asphalt road outside of Machta Hammoud.
- A new 0.15km section of asphalt road will be constructed (shown as #2 in **Figure 2-7**) between two existing sections of asphalt road in order to avoid hairpin turns near homes.
- A new 3.0km section of gravel road will be constructed within the existing railroad right of way (ROW) managed by Machta Hammoud Village (shown as #3 in **Figure 2-7**), traveling east before connecting to an existing asphalt road to enter the Hawa Akkar Wind Farm.

Mitigation

The construction of asphalt roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army. It is considered that construction of the internal tracks will have no impact on access to and operations at the Lebanese Army Military base and/or external receptors.

Transport of WTG Components, Construction Materials and Workers

The construction of the three wind farms will be staggered such that the quantities of WTG components and transport of construction materials can be assumed in succession, as shown in **Table 20-4** and **Table 20-5.**

Table 20-4 Vehicle Trips Required for Transport of WTG Components, Construction Materials and Workers

Component	Quantity	Maximum Turbines	Total Units	Vehicle Type	Estimated Roundtrips From Tripoli Port to Project Site		
					Maximum Turbine Transport/Week	Maximum Truck Trips/Week	Duration =
Lebanon Wind Power							
Tower	5 sections/ tower/turbine	16	80	5 oversize trucks/ tower/turbine		10	
Nacelles	2 sections/ nacelle/turbine	16	32	2 oversize trucks/ nacelle/turbine	2	4	
Hub	1 hub/turbine	16	16	1 oversize truck/ hub/turbine		2	
Blades	3 blades/turbine	16	48	3 oversize trucks/ 3 blades/turbine		6	8 weeks
		Totals	**176**	**12 oversize trucks/turbine**	**2**	**24**	
Substation	1 substation/17 turbines	NA	1	1 oversize truck/substation	1	NA	
Switchgear	1 substation/17 turbines	NA	1	1 semi-trailer (20-ton)/ switchgear	1	NA	
Sustainable Akkar							
Tower	5 sections/ tower/turbine	27	135	5 oversize trucks/ tower/turbine		10	
Nacelles	2 sections/ nacelle/turbine	27	54	2 oversize trucks/ nacelle/turbine	2	4	
Hub	1 hub/turbine	27	27	1 oversize truck/ hub/turbine		2	
Blades	3 blades/turbine	27	81	3 oversize trucks/ 3 blades/turbine		6	13 weeks
		Totals	**297**	**12 oversize trucks/turbine**	**2**	**24**	
Substation	1 substation/27 turbines	27	1	1 oversize truck/substation	1	NA	
Switchgear	1 substation/27 turbines	27	1	1 semi-trailer (20-ton)/ switchgear	1	NA	
Hawa Akkar							
Tower	5 sections/ tower/turbine	16	80	5 oversize trucks/ tower/turbine		10	
Nacelles	2 sections/ nacelle/turbine	16	32	2 oversize trucks/ nacelle/turbine	2	4	
Hub	1 hub/turbine	16	16	1 oversize truck/ hub/turbine		2	
Blades	3 blades/turbine	16	48	3 oversize trucks/ 3 blades/turbine		6	8 weeks
		Totals	**176**	**12 oversize trucks/turbine**	**2**	**24**	
Substation	1 substation/17 turbines	16	1	1 oversize truck/substation	1	NA	
Switchgear	1 substation/17 turbines	16	1	1 semi-trailer (20-ton)/ switchgear	1	NA	

Table 20-5 Vehicle Trips Required for Transport of Construction Materials

Lebanon Wind Power	Quantities		Transport		Total Number of Trips		No. of Working Days	Total Number of Trips/Day		
	Low Range	High Range	Description	Capacity	Low Range	High Range		Low Range	High Range	Average
Surplus from excavation managed in m³	137,427	171,784	Semi-Trailer (m³)	20	6,871	8,589	90	76.35	95.44	85.89
Ready-mixed concrete in m³ sourced from Batching Plant in Rweimeh Village	10,737	12,884	Concrete Mixer Truck (m³)	10	1,074	1,288	90	11.93	14.32	13.12
Cement in tonnes sourced from Chekkah	4,295	5,154	Powder Cement Tank Trailer (tonnes)	45	95	115	80	1.19	1.43	1.31
Sand in m³ from 6 Quarries	4,295	5,154	Semi-Trailer (m³)	20	215	258	80	2.68	3.22	2.95
Gravel in m³ from 6 Quarries	8,589	10,307	Semi-Trailer (m³)	20	429	515	80	5.37	6.44	5.91
Construction steel in tonnes	1,074	1,503	Semi-Trailer (m3)	20	54	75	80	0.67	0.94	0.81
Sustainable Akkar	**Quantities**		**Transport**		**Total number of Trips**		**No. of working days**	**Total No. of Trips/day**		
	Low Range	**High Range**	**Description**	**Capacity**	**Low Range**	**High Range**		**Low Range**	**High Range**	**Average**
Surplus from excavation managed in m³	182,573	228,216	Semi-Trailer (m³)	20	9,129	11,411	90	101.43	126.79	114.11
Ready-mixed concrete in m³ sourced from Batching Plant in Rweimeh Village	14,263	17,116	Concrete Mixer Truck (m³)	10	1,426	1,712	90	15.85	19.02	17.43
Cement in tonnes sourced from Chekkah	5,705	6,846	Powder Cement Tank Trailer (tonnes)	45	127	152	80	1.58	1.90	1.74
Sand in m³ from 6 Quarries	5,705	6,846	Semi-Trailer (m³)	20	285	342	80	3.57	4.28	3.92
Gravel in m³ from 6 Quarries	11,411	13,693	Semi-Trailer (m3)	20	571	685	80	7.13	8.56	7.84
Construction steel in tonnes	1,426	1,997	Semi-Trailer (m3)	20	71	100	80	0.89	1.25	1.07
Hawa Akkar	**Quantities**		**Transport**		**Total Number of Trips**		**No. of Working Days**	**Total Number of Trips/Day**		
	Low Range	**High Range**	**Description**	**Capacity**	**Low Range**	**High Range**		**Low Range**	**High Range**	**Average**
Surplus from excavation managed in m³	137,427	171,784	Semi-Trailer (m³)	20	6,871	8,589	90	76.35	95.44	85.89
Ready-mixed concrete in m³ sourced from Batching Plant in Rweimeh Village	10,737	12,884	Concrete Mixer Truck (m³)	10	1,074	1,288	90	11.93	14.32	13.12
Cement in tonnes sourced from Chekkah	4,295	5,154	Powder Cement Tank Trailer (tonnes)	45	95	115	80	1.19	1.43	1.31
Sand in m³ from 6 Quarries	4,295	5,154	Semi-Trailer (m³)	20	215	258	80	2.68	3.22	2.95
Gravel in m³ from 6 Quarries	8,589	10,307	Semi-Trailer (m³)	20	429	515	80	5.37	6.44	5.91
Construction steel in tonnes	1,074	1,503	Semi-Trailer (m3)	20	54	75	80	0.67	0.94	0.81

The construction phase may require a worst-case scenario of up to 250 staff working in a single day for both Lebanon Wind Power and Sustainable Akkar together). The OEM/EPC Contractors for the three wind farms have not yet been selected; however, approximately 25% of the workers (up to 50) will be hired from the local communities in the northeastern part of Akkar, including Wadi Khaled. The OEM/EPC Contractor will be required to transport local workers from local villages through carpooling and/or van transport to minimize traffic impacts to rural roads.

The balance of the workforce (up to 150) will be accommodated in nearby villages in hotels and/or apartments. Again, the OEM/EPC Contractor will be required to provide carpooling and/or van transport of workers to reduce traffic impacts to rural roads. The exact details are to be determined following selection of the OEM/EPC Contractor and the location of hired construction workers.

- A communications protocol being developed for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport. A final transport route map will be provided to all municipalities.
- All three wind farms will use the same traffic access plan.
- Announcements will be made to all villages along the WTG transport route from the Tripoli Seaport to the entrance of the Project site).
- WTG components will be transported 2 days per week, a total of 24 trucks roundtrip per week.
- Municipal police will provide an escort for the WTG transport convoy.
- Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market.
- The road that passes through Rweimeh Village is the main access of the trucks transporting rocks and gravel, and maintenance activities will be undertaken by the Developer.
- For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road.
- For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic.
- Once the OEM/EPC Contractor has been selected, and the number and location of construction numbers are known, measures will be put in place to maximize mitigation of traffic impacts through carpooling and group transport by van.

Given the above, the cumulative impacts of traffic and transport for the three wind farms is not considered to be much greater than for the individual Project. Collectively, therefore, the impact severity is considered Low, with the sensitivity of the receptor considered Medium, resulting in a Minor impact as shown in **Table 20-6**.

Table 20-6 Cumulative Impact of Traffic and Transport During Construction

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low √	Negligible	Negligible	**Minor √**	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

20.3.3 Biodiversity

20.3.3.1 Habitats and Flora

Habitat loss impacts from Sustainable Akkar are predicted to be negligible. Impacts associated with Hawa Akkar and Lebanon Wind Power wind farms are also predicted to be negligible based on the similar requirement for infrastructure and on the lower importance of the habitats around both Hawa Akkar and Lebanon Wind Power. The appropriate implementation of the mitigation will result in non-significant impacts at all wind farm sites. No cumulative impacts are predicted from the three wind farms in combination on habitats and flora.

Potential Impacts at Sustainable Akkar

<u>During Construction</u>

As described in **Section 13.2.1**, taxa with high ecological value are considered to be sensitive features for the Project. These are: *Fraxinus ornus, Juniperus drupacea, Juniperus excelsa, Juniperus oxycedrus, Origanum libanoticum, Ostrya carpinifolia, Phillyrea media, Ranunculus cuneatus,* and *Rhamnus cathartica*. No IPA or other threatened species were recorded on the Project site, although three vulnerable species are expected to be present (Ehernberg's marjoram *Origanum ehrenbergii,* snow romulea *Romulea nivalis and R. phoenicia*). Including *Origanum libanoticum*, six endemic species also occur on the Project site.

Construction activities have the potential to degrade or destroy terrestrial habitat either directly through excavation, compaction, or modification (e.g. vegetation removal) or indirectly as a result of dewatering or from the accidental release of fuels, lubricants or other chemicals. The construction of turbine foundations, new access tracks and the substation would cause permanent habitat loss. Habitat loss and modification includes all areas replaced and potentially modified by project infrastructure, e.g. turbine foundations and permanent hardstanding, access tracks and the substation site.

Direct loss and indirect modification from the proposed development could total up to 75.47ha out of 943.72ha (8%) in the Project site, i.e. the overall habitat loss as a result of the proposed development would be low and in itself is not considered to constitute an ecologically significant effect. However, the following sections consider the importance of certain habitat types and sensitive features and the potential significance of any effects resulting from habitat loss impacts. A minor adverse impact is considered to occur if the habitat loss involves less than 10% of the habitat present in the Project site and a moderate adverse impact if the habitat loss involves 10-20% of the habitat present in the Project site. A major adverse impact is considered to occur if the habitat loss involves greater than 20% of the habitat present in the Project site. The significance of the effect is considered in relation to the magnitude of the impact, the habitat present in the wider region (where information is available) and the ecological importance of the habitat. A significant effect is considered to occur where the impact would lead to an adverse effect on the function or status of a habitat (including the extent, abundance and distribution of flora species).

Sensitive Features

Nine (9) sensitive features were recorded on the Project site. The sensitive features were recorded in the *Juniperus excelsa* dominance (*Juniperus excelsa*), mixed oak woodland, including the oak/*J. excelsa* mix (*Fraxinus ornus*, *Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Phillyrea media*, *Ranunculus cuneatus* and *Rhamnus cathartica*), oak woodland (*Juniperus excelsa* and *Phillyrea media*) and oak/pine habitat types (*Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Ostrya carpinifolia*, *Phillyrea media* and *Rhamnus cathartica*).

The total area of *Juniperus excelsa* dominance likely to be lost or modified as a result of the proposed development is 2.69ha (19.55%). This is considered to be a **Moderate** adverse impact on *Juniperus excelsa* in a habitat of regional importance. The total area of mixed oak woodland and oak/*J. excelsa* mix habitat types likely to be lost or modified as a result of the proposed development is 49.98 ha (6.59%). This is considered to be a **Minor** adverse impact on *Fraxinus ornus*, *Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Phillyrea media*, *Ranunculus cuneatus* and *Rhamnus cathartica* in a habitat of national importance. The total area of oak woodland likely to be lost or modified as a result of the proposed development is 1.65ha (12.39%). This is considered to be a **Moderate** adverse impact on *Juniperus excelsa* and *Phillyrea media* in a habitat of regional importance. The total area of oak/pine habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). This is considered to be a **Moderate** adverse impact on *Juniperus excelsa*, *Juniperus oxycedrus*, *Juniperus drupacea*, *Origanum libanoticum*, *Ostrya carpinifolia*, *Phillyrea media* and *Rhamnus cathartica*in a habitat of national importance. However, as only a very small part of these habitat types is likely to contain these species, the loss or modification is not considered to lead to an ecologically significant effect. The impacts are minor in habitats of national importance apart from the oak/pine habitat type, which has a moderate impact in a habitat of national importance. However, the oak/pine habitat type is well-distributed in the region, with better quality habitat than is represented on the Project site, particularly in the Aandqet Forest, therefore this effect is also considered to be not significant.

However, as the species are sensitive features, as detailed in **Section 13.2.1**, measures will be taken to offset any losses of the species as a result of the proposed development.

Vulnerable Species

Three vulnerable species are expected to be present (Ehernberg's marjoram, snow romulea and *Romulea phoenicia*). Ehernberg's marjoram is likely to occur in coniferous woodland. Snow romulea and *Romulea phornicia* are likely to occur in coniferous woodland, mixed oak woodland and oak woodland.

The total area of pine forest dominance 2 habitat type likely to be lost or modified as a result of the proposed development is 7.16ha (16.93%). The total area of oak/pine habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). The total area of mixed oak woodland and oak/*J. excelsa* mix habitat types likely to be lost or modified as a result of the proposed development is 49.98ha (6.59%). The total area of oak woodland likely to be lost or modified as a result of the proposed development is 1.65ha (12.39%). These are considered to be **Moderate** adverse impacts that would not result in ecologically significant effects.

However, as the species are vulnerable, as detailed in **Section 13.2.1**,measures will be taken to offset any losses of the species as a result of the proposed development.

Endemic Species

Six endemic species were recorded on the Project site, with two further endemic species not recorded on the site but expected to be present (*Silene reuteriana* and *Salvia peyronii*). The endemic species were recorded in the mixed oak woodland (*Phlomis chrysophylla*, *Salvia hierosolymitana, Origanum libanoticum*, *Ballota antilibanotica* and *Micromeria graeca*) and oak/pine habitat types (*Phlomis chrysophylla*, *Origanum libanoticum* and *Pyrus syriaca*).

The total area of mixed oak woodland and oak/*J. excelsa* mix habitat types likely to be lost or modified as a result of the proposed development is 49.98ha (6.59%). This is considered to be a **Minor** adverse impact on *Phlomis chrysophylla*, *Salvia hierosolymitana, Origanum libanoticum*, *Ballota antilibanotica* and *Micromeria graeca* in a habitat of national importance. The total area of oak/pine habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). This is considered to be a **Moderate** adverse impact on *Phlomis chrysophylla*, *Origanum libanoticum* and *Pyrus syriaca* in a habitat of national importance. However, as only a very small part of the habitat types are likely to contain these species, the loss or modification is not considered to lead to an ecologically significant effect. Although a moderate impact is considered to occur in a habitat of national importance, the oak/pine habitat type is well-distributed in the region, with better quality habitat than is represented on the Project site, particularly in the Aandqet Forest, therefore this effect is also considered to be not significant.

However, as the species are endemic, as detailed in **Section 13.2.1**, measures will be taken to offset any losses of the species as a result of the proposed development.

Natural Habitats

The areas of oak woodland and mixed woodland habitat (oak-pine mix) in good condition around Turbines 22-18 and Turbines 13, 15, and 17 are considered to be natural habitats in the CHA, as detailed in **Appendix L**. The total area of oak woodland likely to be lost or modified as a result of the proposed development is 1.65ha (12.39%). The total area of oak-pine mix habitat type likely to be lost or modified as a result of the proposed development is 13.97ha (12.05%). These are considered to be **Moderate** adverse impacts that would not result in ecologically significant effects but as these habitats are considered to be natural habitats, mitigation would need to provide a no net loss of biodiversity for these areas.

<u>During Operations and Maintenance</u>

Improved access to forested areas via the newly constructed wind farm tracks could lead to an increase in tree felling activities undertaken by local people, leading to a further loss of oak, *Juniperus excelsa* and pine habitat types. However, as unpaved tracks already occur in the Project site and some areas show signs of being previously felled, this is considered to be a **Minor** adverse impact and is not considered to lead to an ecologically significant effect.

Improved access could also lead to an increase in the burning of vegetation for warmth or cooking. Due to the dry nature of the landscape, if fires were allowed to get out of control, this could have a **Major** adverse impact on the habitats and potentially lead to an ecologically significant effect.

<u>During Decommissioning</u>

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

Potential Impacts at Hawa Akkar

The Hawa Akkar ESIA Report by MORES S.A.R.L. indicates the following:

The impacts of wind farms on floral diversity and vegetation cover is not given special attentions during the construction phase where the road systems are installed. It is acknowledged that road systems often result in habitat fragmentation which will affect both quality and quantity of the habitats. These would have a direct impact on the wildlife as well.

In principle, road constructions favor the introduction of exotic species. Thus, it reduces native biodiversity (Rentch et al. 2005, Hill et al. 2005). It can destroy plant populations and communities as well. Roads serve as barriers to dispersal for some animals, by disrupting behavior and increased noise levels can reduce bird densities (Reijnen et al. 1997, Brotons and Herrando 2001, St. Clair 2003, Bautista et al. 2004). Wind or animal vehicle seed dispersal is affected as well in certain circumstances.

Potential Impacts at Lebanon Wind Power

<u>During Construction</u>

Cilician fir, a near threatened species occurs in the Project site. Two of the threatened species that led to the classification of the area as an IPA, *Cousinia libanotica* and *Astragalus angulosus*, occur in the Project site. Three further IPA species were not observed during surveys but are expected to be present (Schweinfurth's buttercup *Ranunculus schweinfurthii, Erophila gilgiana* and *Silene grisea*). Lebanon violet, an endangered, endemic species, was observed in the Project site, as was Lebanon cedar, a vulnerable, although not endemic species. Two other vulnerable, endemic species were not observed during surveys but are expected to be present (Ehrenberg's marjoram *Origanum ehrenbergii* and snow romulea *Romulea nivalis*). Twelve (12) endemic species also occur in the Project site, with two further endemic species expected to be present.

Construction activities have the potential to degrade or destroy terrestrial habitat either directly, through excavation, compaction or modification (e.g. vegetation removal), or indirectly as a result of dewatering or from the accidental release of fuels, lubricants or other chemicals. The construction of turbine foundations, access tracks and the substation would cause permanent habitat loss. Habitat loss and modification includes all areas replaced and potentially modified by project infrastructure, e.g. turbine foundations and permanent hardstanding, access tracks and the substation site.

Direct loss and indirect modification from the proposed development could total 32.16ha out of 724.02 ha (4.44%) within the site boundary (including the proposed new road between LWP and SA outwith the site boundary), i.e. the overall loss as a result of the proposed development is likely to be low and in itself is not likely to constitute an ecologically significant effect. However, the following sections consider the importance of certain habitat types, zones and sensitive features and the potential significance of any effects resulting from loss impacts. A minor adverse impact is considered to occur if the habitat loss involves less than 10% of the habitat present in the Project site and a moderate adverse impact if the habitat loss involves 10-20% of the habitat present in the Project site. A major adverse impact is considered to occur if the habitat loss involves greater than 20% of the habitat present in the Project site. The significance of the effect is considered in relation to the magnitude of the impact, the habitat present in the wider region (where information is available) and the ecological importance of the habitat. A significant effect is considered to occur where the impact would lead to an adverse effect on the function or status of a habitat (including the extent, abundance and distribution of flora species).

Karm Chbat Nature Reserve

Total losses or modifications from the proposed development potentially total 8.31ha out of 118.77ha (7.01%) within the Karm Chbat Nature Reserve, i.e. the overall loss or modification as a result of the proposed development is likely to be negligible and in itself does not constitute an ecologically significant effect on this feature of national importance. However, important plant species are believed to occur in the degraded coniferous forest and coniferous forest 3 habitats. At present, it is considered that 5.87% and 15.58% of these habitat types, respectively, could be affected as a result of the proposed development. The loss of over 15% of the coniferous forest 3 habitat could lead to an ecologically significant effect as this habitat type only occurs in Karm Chbat and is not present elsewhere in the Project site. Furthermore, better quality/less degraded coniferous forest habitat is present in the region, particularly in the Aandqet Forest. As only a small part of the degraded coniferous forest habitat would be lost, it is not considered likely to lead to an ecologically significant effect.

These habitats occur within private or barren land and, typically, no ecologically significant effects would be considered to occur. However, as Karm Chbat is considered to be a critical habitat as part of the Lebanon Wind Power CHA, further mitigation is required to ensure there is a net biodiversity gain for the habitats within Karm Chbat.

Cilician Fir Supporting Habitat

The degraded coniferous forest and coniferous forest 3 habitats support Cilician fir, the endemic tree species for which the large Western Akroum KBA was established. The total area of habitat likely to be lost or modified as a result of the proposed development is 9.41ha (5.59%). This is considered to be a **Minor** adverse impact on Cilician fir. This loss/modification is not likely to lead to an ecologically significant effect, not least as there are large areas of degraded coniferous forest elsewhere in the Project site that are not impacted in any way by the development and better quality/less degraded coniferous forest in the wider region, particularly in the Aandqet Forest and Oudine Valley. However, only one area of coniferous forest 3 habitat occurs in the Project site and the loss of this could lead to an ecologically significant effect.

As the species is the named feature of a KBA, measures will be taken to offset any losses of the species as a result of the proposed development. The degraded coniferous forest and coniferous forest habitats are considered to be critical habitat as part of the Lebanon Wind Power CHA and further mitigation is required to ensure there is a net biodiversity gain for this habitat and the habitats that fall within the KBA.

IPA Species

Cousinia libanotica occurs in the degraded coniferous forest habitat, subalpine zone 1 and subalpine zone 2. *Astragalus angulosus* occurs in the ecotone subalpine/high mountain zone. Three further IPA species were not observed during surveys but are expected to be present:

- Ranunculus schweinfurthii.
- Erophila gilgiana.
- Silene grisea.

The total area of degraded coniferous forest habitat likely be lost or modified as a result of the proposed development is 7.9ha (6.07%). This is considered to be a **Minor** adverse impact on *Cousinia libanotica* in a habitat of national importance. The total area of subalpine zone likely to be lost or modified as a result of the proposed development is 15.28ha (4.34%). This is considered to be a **Minor** adverse impact on *Cousinia libanotica* in a habitat of national importance. The total area of ecotone subalpine/high mountain zone likely to be lost or modified as a result of the proposed development is 5.69ha (7.54%). This is considered to be a **Minor** adverse impact on *Cousinia libanotica* and *Astragalus angulosus* in a habitat of national importance. Notwithstanding the fact that only a very small part of these habitat types and zones will contain the IPA species, the potential loss or modification of 5.18% of the total area within the Project site is not likely to lead to an ecologically significant effect. The impacts are minor on features of national importance and there are large areas of degraded coniferous forest, subalpine zone and ecotone subalpine/high mountain zone elsewhere in the Project site that are not impacted in any way by the development and better quality/less degraded habitat in the wider region.

Endangered and Vulnerable Species

An endangered species, Lebanon violet, and a vulnerable species, Lebanon cedar, were recorded in the degraded coniferous forest habitat. Three other vulnerable species, Schweinfurth's buttercup, Ehrenberg's marjoram and snow romulea, were not observed during surveys but are expected to be present. They occur on sandstone and in areas of melting snow in mountainous regions. The majority of the site is unlikely to be suitable for such snow areas to persist, however, it is considered possible that areas within the degraded coniferous forest habitat in the northern part of the Project site might provide such conditions.

The total area of degraded coniferous forest habitat likely to be lost or modified as a result of the proposed development is 7.9ha (6.07%). This is considered to be a **Minor** adverse impact on Lebanon violet and Lebanon cedar in a habitat of national importance. Notwithstanding the fact that only a very small part of this habitat type will contain the vulnerable species, the potential loss or modification of 6.07% of the total area within the Project site is not likely to lead to an ecologically significant effect. This loss/modification is not likely to lead to an ecologically significant effect as there are large areas of degraded coniferous forest elsewhere in the Project site that are not impacted in any way by the development and better quality/less degraded coniferous forest in the wider region, particularly in the Aanqet Forest and Oudine Valley. However, as the species are endangered and vulnerable, measures will be taken to offset any potential losses of the species as a result of the proposed development. Critical habitat for Lebanon violet is not considered to be present on the Project site. Critical habitat is present for Lebanon cedar and further mitigation is required to ensure there is a net biodiversity gain for this habitat. The presence of critical habitat could not be confirmed for Scweinfurth's buttercup, Ehrenberg's marjoram and snow romulea. Full details are provided in the Lebanon Wind Power CHA.

Endemic Species

Twelve endemic species were recorded on the site, with two further endemic species not observed during surveys but expected to be there (*Alchemilla diademata* and *Campanula trichopoda*). The endemic species were recorded in the degraded coniferous forest habitat (*Astragalus cruentiflorus, Acantholimon libanoticum, Centaurea hololeuca* and *Berberis libanotica*), ecotone subalpine/high mountain zone (*Hypericum libanoticum, Asperula glareosa, Berberis libanotica* and *Campanula stricta*), subalpine zone 1 (*Astragalus kurnet-es-saudae* and *Campanula stricta*) and subalpine zone 2 (*Astragalus cruentiflorus, Astragalus hermoneus, Acantholimon libanoticum, Asynema rigidum, Daphne libanotica, Berberis libanotica, Astragalus kurnet-es-saudae* and *Astragalus dictyocarpus*).

The total area of degraded coniferous forest habitat likely to be lost or modified as a result of the proposed development is 7.9ha (6.07%). This is considered to be a **Minor** adverse impact on *Astragalus cruentiflorus, Acantholimon libanoticum, Centaurea hololeuca* and *Berberis libanotica* in a habitat of national importance. The total area of ecotone subalpine/high mountain zone likely to be lost or modified as a result of the proposed development is 5.69ha (7.54%). This is considered to be a **Minor** adverse impact on *Hypericum libanoticum, Asperula glareosa, Berberis libanotica* and *Campanula stricta* in a habitat of national importance. The total area of subalpine zone likely to be lost or modified as a result of the proposed development is 15.28ha (4.34%). This is considered to be a **Minor** adverse impact on *Astragalus cruentiflorus, Astragalus hermoneus, Acantholimon libanoticum, Asynema rigidum, Daphne libanotica, Berberis libanotica, Astragalus kurnet-es-saudae*, *Astragalus dictyocarpus* and *Campanula stricta* in a habitat of national importance. Notwithstanding the fact that only a very small part of these habitat types and zones will contain the endemic species, the loss of 5.18% of the total area within the Project site is not likely to lead to an ecologically significant effect. The impacts are minor on features of national importance and there are large areas of degraded coniferous forest, subalpine zone and ecotone subalpine/high mountain zone elsewhere in the Project site that are not impacted in any way by the development and better quality/less degraded habitat in the wider region.

However, as the species are endemic, measures will be taken to offset any losses of the species as a result of the proposed development. It cannot be confirmed if critical habitat is present for any individual endemic species. However, it is possible that the assemblage of endemic species might be sufficient to trigger critical habitat status, as detailed in the Lebanon Wind Power CHA.

Natural Habitats

The subalpine zone, ecotone subalpine/high mountain zone and coniferous forest habitat type are considered to be natural habitats in the Lebanon Wind Power CHA. The total area of subalpine zone likely to be lost or modified as a result of the proposed development is 15.28ha (4.34%). The total area of ecotone subalpine/high mountain zone likely to be lost or modified as a result of the proposed development is 5.69ha (7.54%). The total area of coniferous forest habitat likely to be lost or modified as a result of the proposed development is 1.51ha (3.94%). These are considered to be **Minor** adverse impacts that would not result in ecologically significant effects but as these habitats are considered to be natural habitats, mitigation would need to provide a no net loss of biodiversity for these areas.

During Operations and Maintenance

Improved access to forested areas via the newly constructed wind farm tracks could lead to an increase in tree felling activities undertaken by local people, leading to a further loss of degraded coniferous forest and coniferous forest. However, as unpaved tracks already occur in the Project site and some areas show signs of being previously felled, this is considered to be a **Minor** adverse impact and is not considered to lead to an ecologically significant effect.

Improved access could also lead to an increase in the burning of vegetation for warmth or cooking. Due to the dry nature of the landscape, if fires were allowed to get out of control, this could have a **Major** adverse impact on the habitats and potentially lead to an ecologically significant effect.

During Decommissioning

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

Mitigation

While ecologically significant impacts on habitats and flora are possible, they can be effectively reduced to an insignificant level through the effective implementation of the proposed mitigation at the Project. The same methods of mitigation would be utilized at both Sustainable Akkar and Hawa Akkar, as applicable and include:

During Pre-Construction

- Completion of a pre-construction flora survey to identify habitats and key flora species as identified in the baseline section.
- Completion of pre-construction survey to identify all Cilician firs and Lebanon cedars on site and subsequent micrositing of infrastructure to avoid or reduce their removal. Where this is not possible, appropriate offsetting of the loss of Cilician firs and Lebanon cedars within those areas will be completed.
- Preparation of a final BAMP outlining the measures required to deliver a net gain for areas of critical habitat, such as the degraded coniferous forest and coniferous forest habitat types where Lebanon cedar and Cilician fir are known to occur, and no net loss for areas of natural habitat, such as the subalpine zone and ecotone subalpine/high mountain zone.

During Construction

- A net gain of critical habitat will be achieved through the translocation of Lebanon cedar and Cilician fir and the creation of new woodland, particularly in Karm Chbat and in the degraded coniferous forest habitat type. Translocations would follow IUCN guidelines[174]. The developer would identify suitable receptor sites to replicate conditions found on the donor site and the receptor sites would be as close to the Project site as possible in areas not earmarked for future

[174] https://portals.iucn.org/library/sites/library/files/documents/2013-009.pdf, Accessed on 7th August 2019.

development. The receptor site must be the same size or bigger to ensure no biodiversity loss. Monitoring of the success of translocation and the creation of new woodland will be undertaken for the duration of the development i.e. 25 years. Full details of the measures to achieve a net gain for critical habitat will be provided in the final BAMP.

- Offsetting for the loss of natural habitats will be required to deliver no net loss of biodiversity in these areas. Full details of the measures to achieve no net loss will be provided in the final BAMP.
- Preparation and provision of workforce toolbox talks and monitoring to ensure all staff understand the importance of the biodiversity controls in place, what they entail and how these controls should be followed. Particular key early tasks in workforce education will include implementation of a hunting ban on the Project site and prohibition of burning of vegetation for warmth or cooking.
- Minimization of the project footprint within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure construction.
- If any key flora species are identified during the pre-construction survey, areas of habitat inhabited by the plants would be avoided. If it is not possible to avoid examples or areas of the species listed in the baseline, every effort would be made to reduce the impact and further offsetting would be required.
- Avoidance of gullies and snow cones to minimize disturbance with the snow melt water system.
- Implementation of rehabilitation measures to mitigate the loss of habitat, such as vegetation remediation, translocation or creation of new habitat areas. Full details of these measures will be provided in the final BAMP to be developed by others.
- Proper management of excavation materials. Rubble from site excavations should not be allowed to spread down slopes. Clear working procedures should be defined, implemented and supervised.
- Separation and storage of top soil for use in restoration of all temporary project infrastructure and areas of temporary disturbance, e.g. track margins. Segregation of the topsoil of different habitat types will be required.
- Soil management would also include observance of appropriate biosecurity controls to prevent the spread of invasive plants or floral diseases. This would involve washing vehicles and equipment to remove particles of vegetation and loose soil, with this done in specific “wash down” areas. Any invasive plants that are removed during vegetation clearance would need to be disposed of appropriately, in a safe way that does not allow it to spread.
- Good construction environmental management on site based on good practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents.

<u>During Operation and Maintenance</u>

- Monitoring of all habitat reinstatement, translocation, recreation, offsetting or enhancement as identified and implemented as required following pre-construction surveys.
- Remove invasive plant species during routine vegetation maintenance.
- Monitor power-line right-of-way vegetation to avoid fire risk. Remove blowdown and other high-hazard fuel accumulations.

<u>During Decommissioning</u>

Typically, the same controls set out for construction would apply:

- Minimization of activities within Karm Chbat Nature Reserve. Footprint minimization will include measures such adherence to strict working boundaries for all infrastructure decommissioning.
- Good construction environmental management on site based on good practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents.
- Preparation and provision of workforce toolbox talks to ensure all staff understand the importance of the biodiversity controls in place and exactly what they entail.

20.3.3.2 Terrestrial Fauna

While ecologically significant impacts on terrestrial faunal species and their resting places are possible, they can be effectively reduced to an insignificant level through the effective implementation of the proposed mitigation, e.g. pre-construction surveys and subsequent temporal or seasonal avoidance of impacts. The same methods of mitigation would be utilized at both Sustainable Akkar and Hawa Akkar, resulting in non-significant impacts at all wind farm sites. It is considered that the cumulative impact on terrestrial fauna is not significant.

Potential Impacts at Sustainable Akkar

<u>During Construction</u>

Loss or Disturbance of Resting Places

Faunal species typically inhabit locations for sleeping, breeding and/or hibernating (hereafter "resting places") either underground or within vegetation, e.g. in a tree. The construction of the proposed development has the potential to damage or destroy resting places within vegetation and underground.

The loss (destruction) of a resting place would be an adverse one-time, high magnitude permanent direct impact upon the individual or population of a species inhabiting the resting place and cause them to seek shelter elsewhere, in possibly less favourable locations where it would be necessary to find or construct a new resting place. Without detailed survey data, it is difficult to establish the sensitivity of the faunal species as that would depend on factors such as the species present, the numbers of individuals using the resting place and the type of resting place being lost, e.g. breeding or hibernation. The impact would be limited in extent to the individual or population using the resting place.

Assuming a likely worst-case scenario based on the species identified in the mammal desk study, that the species impacted is of regional importance and the resting place forms a key part of the species' life cycle, the impact would result in a significant ecological effect.

For reptiles, were any of the three endangered reptile species to be impacted by the loss of a resting place, those species are of international importance and as any resting place likely forms a key part of the species' life cycle, given how mobile reptiles are but how dependent they are on breeding (egg laying) locations or hibernation locations, the impact would result in a significant ecological effect.

For *Callidium libani*, if its presence is confirmed on the Project site, the coniferous forest containing Cilician fir and Lebanon cedar will be considered as critical habitat and loss of this would result in an ecologically significant effect and require mitigation to deliver a net gain.

<u>During Operations and Maintenance</u>

No impacts leading to significant ecological effects are considered to exist. No impact from traffic movements during operation are predicted.

<u>During Decommissioning</u>

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase.

Potential Impacts at Hawa Akkar

The Hawa Akkar ESIA Report prepared by MORES S.A.R.L. indicates the following:

Eleven mammal species were identified. Even though, some mammals might adjust their behaviour accordingly, but habitat fragmentation, human activity, and opening of roads will expose these species to more threats and lack of resources (food and home range); hence, affecting their population size.

Potential Impacts at Lebanon Wind Power

The potential impacts to terrestrial fauna at the Lebanon Wind Power project are the same as provided for the Sustainable Akkar project.

Mitigation

<u>During Pre-Construction</u>

- Completion of pre-construction fauna walkover survey to identify potential habitat for key mammal, reptile and invertebrate species, followed by camera trapping to confirm mammal species considered to be present/status of any dens found. Further surveys are required to determine if *Callidium libani* is present. If this species is present, the coniferous forest containing Cilician fir and Lebanon cedar would be considered to be critical habitat for *C. libani.*
- Preparation of a final BAMP (to be developed by others) setting out the measures required based upon the findings of the further surveys. A framework BAMP has been included with the ESIA for Lebanon Wind Power and Sustainable Akkar, as an appendix of the stand-alone ESMP.

<u>During Construction</u>

- If any mammal or reptile species are encountered during works, they would be allowed to disperse or would be translocated outwith the construction area.

<u>During Operation and Maintenance</u>

- If found to be present during pre-construction surveys, monitoring of populations of endangered reptiles and/or endangered invertebrates (*Callidium libani*) as appropriate, including monitoring of any offsets or enhancements for those species.

20.3.3.3 Bats

Bats can be vulnerable to collision risk or disturbance from wind turbines when foraging and migrating. There is potential for ecologically significant impacts on bats resulting from Lebanon Wind Power, with this also being the case for Sustainable Akkar and Hawa Akkar. Overall, significant impacts are predicted on common pipistrelle, Kuhl's pipistrelle and serotine based on the species vulnerability to collision risk and their recorded usage of the site. Ecologically significant effects are still possible for the other species recorded during the bat surveys. However, it is considered that the impact of collision risk is reversible, i.e. mitigation measures are possible which would avoid or reduce the impacts and ensure that even if any residual effects occur, they would not be significant.

Potential Impacts at Sustainable Akkar

<u>During Construction</u>

Mammals can be affected by wind power projects in various ways: habitat fragmentation and destruction, noise effects, visual impacts, vibration and shadow flicker effects, increase of direct mortality on wind farm roads, among others (de Lucas et al. 2005; Santos et al. 2010; Lovich and Ennen 2013). Impacts vary according to the nature of the site, and lifecycle stage of the installation.

Bats are the mammals that are most vulnerable to wind farms. Many international studies have demonstrated the effect of wind turbines and the prevailing environmental conditions on some bat species. For example, Rydell et al. (2014) reported the negative effect of wind turbines in Northwestern Europe on certain bat species, and Arnett et al. (2008) described bat fatalities from 21 post-construction sites in the USA and Canada. Kunz et al. (2007) estimated that bats are killed at the rate of 30-40 bats per turbine per year in the Appalachian Mountains in eastern United States.

Bats are highly sensitive by nature. Even though they live the longest relative to their size (typically up to 30 years), but they are characterized by very special niche requirements and slow reproduction rates. Bats give birth to a single "baby" (or pup) per year, which makes them among the slowest reproducers with respect to their size.

These characteristics put the bats among the most threatened species of mammals in the world. In Lebanon all bat species are at risk from habitat destruction, putting fire in caves, hunting, drying of wetlands, elimination of their feeding sites, and excessive use of pesticide (Horáček et al. 2008, 2009, Benda et al. 2016).

Wind turbines can induce bat mortality either through 1) collision; or 2) barotrauma (Arnett et al. 2008, Baerwald et al. 2008, Grodsky et al. 2011). Several hypotheses propose that bats are killed by barotrauma caused by rapid air pressure reduction near the moving blades (Arnett et al 2008, Kunz et al. 2007). However recent research into the likelihood of barotrauma impacts has concluded that for an impact to occur, bats would have to be so close to a turbine blade as to be more at risk from collision (Rollins et al, 2012, Lawson et al 2018).

In recent years, many studies were conducted on bat fatalities in connection to wind projects. Bats have different behaviors and flight styles, which is why they are affected to varying degrees by wind turbines (Rydell et al. 2010, Camina 2012, Amorim et al. 2012). Bat species that fly and forage in open space like the *Pipistrellus spp*. and those that migrate long distances at high altitude like the *Nyctalus spp*. are more at risk of collision with the wind turbines. On the other hand, gleaning bats that fly close to vegetation like the *Rhinolophus spp*. face less risk of collision with wind turbines.

Some animals might adjust their behavior, but habitat fragmentation and destruction, human activity, sound pollution and opening of roads will expose these species to more threats. In addition, lack of resources including feeding, roosting and hibernating sites will affect their population size.

Loss or Disturbance of Roosts

Bat species typically roost in one of three main roost types, trees, natural features such as caves or features constructed by humans, such as houses, bridges or mines. The construction of the proposed development has potential to damage or destroy just one of those potential roost features on the Project site, namely caves. The loss (destruction) of an active roost feature would be an adverse one-time, high magnitude, permanent, direct, impact upon the population(s) of bats using the roost feature and cause them to forage elsewhere, in possibly less favourable habitats[175].

The impact would be limited in extent to the roost feature being lost. Without a full year of survey data, it is difficult to establish the sensitivity of the bat population(s) as that would depend on factors such as the species present, the numbers of bats using the roost and the type of roost being lost, e.g. maternity or hibernation. None of the species present are endangered or endemic, however, other surveys in the area have identified large roosts of some species, potentially some of the largest in Lebanon.

Assuming a likely worst-case scenario that the roost present is of national importance, the impact would be near certain to result in a significant ecological effect. Impacts associated with disturbance of a roost rather than loss of the roost would be similar but likely to be of moderate or low magnitude depending on the type of impact. A disturbance impact would occur as a result of construction noise, construction light or habitat alteration in the vicinity of the roost and could result in an ecologically significant effect.

Loss of Foraging Habitat

Both permanent and temporary loss of bat foraging habitat during construction is possible. It is likely to be limited to the extreme northern part of the Project site where construction activities could result in changes in vegetation cover and any associated flying invertebrate resource. On the majority of the Project site, as it is situated on higher ground along the mountain ridge, the predominantly westerly winds can reach up to 35 m/s and typically exceed the 7 m/s speed above which bat activity has been found to reduce greatly. The permanent loss of foraging areas, e.g. felling of areas of forest or clearance of shrubland, would be an adverse one-time, high magnitude, permanent, direct impact upon the population(s) of bats feeding in the area of lost habitat and would cause them to seek alternative foraging locations. Without detailed survey data, it is difficult to establish the sensitivity of the bat population as that would depend on factors such as the species present, the numbers of bats using the foraging area and for how much of the year and whether that is during particularly sensitive periods, e.g. the breeding season when female bats need to gather sufficient prey to be of sufficient health to feed dependent young. The impact would extend to all populations of bats which use the foraging resource.

Assuming a worst-case scenario that the population(s) of bats using the foraging habitat is (are) of national importance, the impact would result in a significant ecological effect. Impacts associated with temporary loss of a foraging area, e.g. temporary construction infrastructure upon areas of sparse herbaceous vegetation, rather than the permanent loss of the foraging area would be similar but likely to be of moderate or low magnitude. It is considered possible that it could result in an ecologically significant effect.

<u>During Operations and Maintenance</u>

Bat species that occupy higher altitudes and species that tend to fly at greater heights whilst foraging or migrating, such as *Pipistrellus* or *Nyctalus* species, are at greater risk of turbine collision during

[175] Bach, L. and Rahmel, U., 2004. Summary of wind turbine impacts on bats—assessment of a conflict. Bremer Beiträge für Naturkunde und Naturschutz, 7, pp.245-252.

operation than low flying species that tend to remain at lower altitudes, such as horseshoe and *Myotis* species. **Table 13-20** summarises the level of collision risk with turbines of the bat species considered likely to occur within the Sustainable Akkar site.

Commonly recorded throughout Lebanon, greater and lesser horseshoe bats tend to forage close to the ground, therefore collision risk is considered to be low for these species. However, as this species tends to move to higher altitudes to roost during winter months, the risk of collision could be greater as colonies undertake this migration. Data on bat migrations in Lebanon are limited therefore this cannot be confirmed. Greater and lesser horseshoe bat activity was recorded at low levels during the passive surveys (1.69% and 0.17% of total activity recorded).

The typical activity of all Myotis species (long fingered, whiskered and greater mouse-eared bats), makes these species low risk for collision. All species have narrow altitudinal ranges and these species typically forage below typical collision heights. Low levels of activity of greater mouse-eared bats was recorded during passive surveys (4.16%) also accounting for a small proportion of activity recorded during transect surveys (2.58%). Activity from long fingered bats recorded during passive surveys was low (0.03%) and was not recorded during transect surveys. Similarly, low levels of whiskered bat activity was recorded during passive surveys (0.19%).

Both serotine and bent-winged bat are considered to be of a medium collision risk as these species are known to reach collision height when foraging. These species prefer to forage over woodland and open habitats at mid-range altitudes. During passive surveys, serotine were recorded at all detector locations with moderate levels of activity overall (9.22%). Low levels of activity were recorded for this species during transect surveys (2.24%). Bent winged bats were recorded at all but one detector location (LWP19) with low levels of activity overall (0.16%) with no records made during transect surveys.

Common, Kuhl's and Savi's pipistrelle species are considered to be at high risk of collision, with wide altitudinal ranges, typically reaching collision height whilst foraging. European free-tailed bat has a high collision risk and this species typically forages at height (10-300m) and can reach altitudes of 3,000m[176] when migrating between summer and winter roosts. High activity from Kuhl's and common pipistrelle was recorded during passive surveys (34.69% and 28.91% respectively) and were recorded across all survey locations. Savi's pipistrelle was less commonly recorded (9.89%) but also present across all sites. Common and Kuhl's pipistrelle were also the most commonly recorded species during active transect surveys, constituting 41.93% and 45.85% of all activity recorded, respectively, where as Savi's pipistrelle was less commonly recorded during transects (2.80%). European free-tailed bat was recorded across the entire site, at all survey locations during passive surveys with relatively low levels of activity (6.23%). Low levels of activity from this species was also recorded as part of the active transect surveys (2.80%).

Common noctules are also at a high risk of collision as their typical activity patterns coincides with typical collision zones for turbines. This species covers large distances whilst foraging (up to 26km) above 100m and are commonly reported to be the most frequently recorded fatality at wind farm

[176] Williams, T. C., Ireland, L. C. & Janet M. Williams, J. M. 1973. High Altitude Flights of the Free-Tailed Bat, *Tadarida brasiliensis*, Observed with Radar. Journal of Mammalogy, 54:807-821.

sites[177]. As such, collision risk for bats has the potential to be an adverse, high-magnitude long term impact for many of the bat species likely to be present at the Project site, populations of which are considered to be potentially up to national importance. Noctule was recorded at all detector sites with the exception of LWP16. The level of recorded noctule activity on site, as per spring activity surveys, is low (1.30%) according to passive detector results.

Activity data used in this assessment is based on spring activity of bats across the SA project site. Good practice guidance[178][179] requires that a full year of assessment is completed in effectively inform impact assessment. As only spring activity has been collected and analyses thus far, it is no possible to determine an accurate collision rate prediction per species. Once a full year of survey is completed a revised assessment can be undertaken, thus able to consider significant variables such as summer and winter migration/hibernation movements. As such, it is only possible to estimate if, based on a temporally limited dataset, a predicted collision risk for each species would result in an ecologically significant effect or whether any fatalities might not result in significant effects on those populations.

<u>During Decommissioning</u>

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

Potential Impacts at Hawa Akkar

The Hawa Akkar ESIA Report prepared by MORES S.A.R.L. indicates the following:

Bat species are endangered due to habitat destruction and excessive use of pesticide. Moreover, the greater mouse-eared bat was reported for the first time from that area, it is highly endangered and not well distributed in Lebanon. Wind turbines can affect bats in several ways:

- Disturbance or destruction of foraging habitats.
- Destruction of commuting corridors.
- Disturbance and destruction of roosts.
- Increased collision risk for bats in flight.
- Disorientation of bats in flight due to the emission of ultrasound noise.

Due to the reasons mentioned above, there was a lack in identifying all the bat species present. However, of the four species encountered, two bat species the Greater horseshoe bat (*Rhinolophus ferrumequinum*) and Lesser horseshoe bat (*Rhinolophus hipposideros*) they practice low flight and hunt close to habitat structure. However, Greater Mouse-eared Bat (*Myotis myotis*) and pipistrellus practice high flight above 40m and migrates or moves long distances which implies they are at more risk due to these turbines.

Potential Impacts at Lebanon Wind Power

The potential impacts to bats at the Lebanon Wind Power project are the same as provided for the Lebanon Wind Power project. Without more detailed survey data, it is difficult to establish the

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[177] Rodrigues, L., L. Bach, M.J. Dubourg-Savage, B. Karapandza, D. Kovac, T. Kervyn, J.Dekker, A. Kepel, P. Bach, J. Collins, C. Harbusch, K. Park, B. Micevski, J. Minderman.2015. Guidelines for consideration of bats wind farm projects – Revision 2014.
[178]. https://www.nature.scot/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation, Accessed on 5th July 2019
[179] EUROBATS Publication Series No. 6 (English version). UNEP/EUROBATS Secretariat,Bonn, Germany, 133pp http://www.eurobats.org/publications/eurobats_publication_series, Accessed on 5th July 2019.

sensitivity of the bat population as that would depend on factors such as the species present, the numbers of bats using the foraging area and for how much of the year and whether that is during particularly sensitive periods, e.g. the breeding season when female bats need to gather sufficient prey to be of sufficient health to feed dependent young. The impact would extend to all populations of bats which use the foraging resource.

Mitigation

During Pre-Construction

- A full year of activity surveys will be competed pre-construction, adding to the information gathered from the spring activity surveys used to inform this assessment. As per best guidance, a full year of survey data will allow for a more accurate understanding of bat activity across the Project site, temporally and spatially, which will enable a more accurate and informed impact assessment which in turn will determine the most effective mitigation required.

During Construction

- A presumption for avoidance of all artificial light as far as possible. All lights should be cowled and downward facing and avoid light spill onto surrounding non-construction areas.

During Operations and Maintenance

- Once the pre-construction survey results have been analyzed, it will be possible to develop an appropriately focused scope of operational period bat surveys. Surveys would cover up to three years' activity periods.
- Given the high levels of activity recorded at LWP6, LWP19 and LWP21, and at SA2, SA6, SA9 and SA20, predominately from species identified as high or medium risk in terms of collision (common pipistrelle, Kuhl's pipistrelle and serotine), it is recommended that turbines situated at these locations are subject to operational adjustments. Raising the cut-in speed at which the turbine begins to generate electricity, thus preventing movement in low winds, notably decreases bat mortality rates[180] along with feathering of blades i.e. adjusting the angle of the blade parallel to the wind or turning the unit away from the wind[181]. In addition, operational times could be altered – stopping the turbines at these locations between the most active periods i.e. 20:00-05:00.
- Monitoring of bat collision fatalities under and around each turbine following a standardized methodology potentially using trained dogs. Monitoring to be completed monthly and concurrently with bird collision monitoring.
- Preparation and subsequent implementation of plan to identify and protect key bat roost caves in the area on and around the Project site from human persecution, such as identified elsewhere in the area.

Additional Good Practice

- To prevent persecution and destruction of bat roost caves, protective metal grates should be installed across the entrances of all bat roost caves identified during the course of pre-construction

[180] Horn J.W., Arnett E.B. & Kunz T.H. (2008) Behavioral responses of bats to operating wind turbines. *The Journal of Wildlife Management,* 72, 123–132.
[181] Hein, C, D and Schirnacher, M, R. (2016). Impact of Wind Energy on bats: A Summary of our Current Knowledge. Human-Wildlife Interactions 10 (1), Pp 19-27.

surveys. These would prevent members of the public from accessing the caves and disturbing or damaging the roosts, as is known to occur in the region.

- A survey protocol during the construction and operation phase of the proposed development has been recommended as mitigation along with the protection of bat roosts caves that have been identified. This provides a conservation benefit for bats by providing safe locations for them to breed and roost.
- The monitoring protocol would be the first of its kind in Lebanon and would lead the way in monitoring wind farm impacts on bats within the Middle East. It is considered that the implementation of this mitigation strategy would prevent any cumulative impacts on bats from the three wind farm developments.

20.3.3.4 Ornithology

All three wind farm developments sit near bottle necks for migrating birds, with these migration flyways being of international importance. Collision Risk Assessments were undertaken by Ramboll for each development based on VP and PC survey data. The outputs of these assessments are summarized in **Table 20-7**, along with a cumulative estimate of collision mortality for each species where a collision risk above zero is predicted.

The only species for which a significant risk of collision mortality (greater than 1%) is predicted is kestrel, although this is due to the population being of site importance and therefore only considering the resident birds present on each site (approximately 12 birds). As discussed in the main development chapters this risk is more likely to take the form of displacement away from the operational wind farm. The next highest predicted collision risk is for long-legged buzzard and then for short-toed snake eagle, which would also be subject to more displacement impacts. However, the collision risk for long-legged buzzard is in excess of the 0.5% threshold set out by the Ministry of Environment and could therefore be considered significant.

Due to the importance of the flyway and level of uncertainty associated with collision risk estimates mitigation is still proposed. This has been detailed in the mitigation section and would include turbine shutdown periods to be informed by migration season VP surveys, carcass searches below turbines and the potential implementation of bird monitoring radar systems.

Following the successful implementation of the mitigation proposals for Sustainable Akkar, which would be undertaken concurrently at Lebanon Wind Power and Hawa Akkar, no significant cumulative impacts are predicted.

Potential Impacts at Sustainable Akkar

<u>During Construction</u>

Impacts on Designated Sites

Two species listed as qualifying species for Mountain of Akkar-Donnieh IBA were recorded during field surveys for the proposed development. Pale rockfinch was recorded in the middle zone and western rock nuthatch was recorded in the far zone. As neither species was recorded in the immediate zone, within the footprint of the proposed development, then no impacts are predicted on either species.

Table 20-7 Cumulative Collision Risk

Species	LWP Mortality Estimate	SA Mortality Estimate	HA Mortality Estimate	Cumulative Mortality Estimate	Population Estimate	% Loss
Black Kite	0	0	0.04669	0.04669	222	0.02103
Booted Eagle	0	0	0.08653	0.08653	56	0.15451
Common Buzzard	0.19839	0	0.46065	0.65904	922	0.07148
Common Crane	0	1.14213	1.79654	2.93867	3,600	0.08163
Eurasian Sparrowhawk	0.08914	0.08852	0	0.17766	124	0.14328
Hen Harrier	0	0	0.02817	0.02817	23	0.12247
Honey Buzzard	4.84456	0.23129	2.68235	7.75820	4,685	0.16560
Kestrel	0.70946	1.49631	7.98825	10.19402	12	84.95013
Lesser Spotted Eagle	0.16488	1.06426	0.30627	1.53541	5,234	0.02934
Levant Sparrowhawk	0.86261	0	0	0.86261	3,210	0.02687
Long-legged Buzzard	0	0.08519	0.51792	0.60311	117	0.51548
Short-toed Eagle	0.03730	0.79499	1.19215	2.02444	488	0.41484
Steppe Buzzard	0.48258	0.03993	0.11205	0.63456	1,591	0.03988
White Pelican	0	0.70285	0	0.70285	2,366	0.02971
White Stork	0	0.18902	0.66296	0.85199	14,300	0.00596

The IBA lists soaring birds and cranes (namely white stork, white pelican, Levant sparrowhawk and common crane) as another key feature. These species have not been recorded on the ground within the Project site during field surveys, they pass through the area on migration. As such, potential construction impacts would be limited to disturbance such as noise and light, from construction activities. Disturbance such as that would be a temporary, low magnitude indirect impact and would attenuate to levels unlikely to disturb species migrating through and over the area. The species listed were typically recorded flying high through the area. As such no ecologically significant effect is predicted.

Habitat Loss

Both temporary and permanent habitat loss are predicted as a result of the construction of the proposed development. Permanent loss would occur in the footprint of the infrastructure of the proposed development and from the construction of new permanent access tracks. Temporary, short-term habitat loss would occur at turbine bases, outside of the permanent hardstanding, and from the construction of new temporary access tracks that would be reinstated after construction. Habitat loss is considered to result in an adverse, indirect, low magnitude, short-term, reversible impact on the community of birds breeding on the Project site which is considered to be of local importance. It would be a temporary impact in all locations other than the footprint of the infrastructure and new permanent access tracks. No ecologically significant effect is predicted.

Nest Destruction

During the construction of the proposed development, nests could be destroyed directly by construction activities and some may be abandoned due to disturbance from construction vehicles. Nest destruction is an adverse, low magnitude, short-term, reversible impact on the locally important community of breeding birds. The extent of the impact would be wherever construction activities are required, such as at turbine bases, construction compound and laydown areas. Bird nest conservation importance varies dependent on the species and all nests are highly sensitive. No impacts are predicted on the short-toed snake eagle or the long-legged buzzard nests identified as neither are in the footprint of the proposed development. This impact has the potential to result in a significant ecological effect.

Disturbance and Displacement

As well as the noise and visual disturbance associated with construction, birds could also be disturbed by the activities of personnel and vehicles. Disturbance of small breeding birds found on site as a result of construction activities would be an adverse, low magnitude, short-term impact on a community of birds considered to have local importance. Given the relatively small footprint of the proposed development and the number of small breeding birds found on the site, this is not considered to be an ecologically significant effect.

The only species of raptors that were regularly recorded within the immediate zone around the project site are short-toed snake eagle and common kestrel. Both of these species could be displaced from the immediate zone during the construction of the proposed development. Based on their respective population sizes and distribution, short-toed snake eagle is considered to be a species of regional importance and common kestrel a species of local importance. Disturbance from construction activities could cause both species to forage in alternative locations, either less favorable foraging areas on the margins of the Project site or locations further afield rather than the site itself. Displacement of these species would be an adverse, low magnitude, temporary, impact on both species, however this is not considered to be an ecologically significant effect.

During Operation

Collision Risk

Bird species using the airspace around the proposed development are vulnerable to colliding with the proposed development. Raptors and waterfowl are known to be particularly vulnerable to this collision risk[182]. A quantitative CRA has been undertaken for all vulnerable species. This has been undertaken using data collected from the migration season VP surveys and the year-round PC surveys. It has also been undertaken using flight data collected for Hawa Akkar, which were collected from a more appropriate level of survey effort.

Any predicted collision events would be adverse impacts, reversible at population scale. The likelihood of collision event, magnitude and duration of impact would vary by species.

Species-Specific Collision Risk

The mortality estimates for Sustainable Akkar and Hawa Akkar were compared with each other using a Welch Two Sample T-Test. This produced a p-value of >0.05[183], meaning that wind farm site is not a significant differentiating factor for mortality estimate. While this does not mean that the datasets are statistically similar between each site, it also does not point to significant differences between the two datasets.

Typically, population decreases of >1% would be considered a significant impact. However, based on feedback from the Lebanese Ministry of Environment[184], population decreases of >0.5% could be considered significant for long-lived species with lower population recruitment rates. The baseline populations used are for Lebanon as a whole but, as shown in the migration season research papers, the principal migration routes during spring and autumn both pass close to the proposed development. Thus, the population estimates for birds migrating over Lebanon are considered appropriate for use in this assessment.

As collision risk estimates for common kestrel and short-toed snake eagle were calculated following a different method which accounts for those species' breeding presence in the wind farm area, calculations of "Bird Records per Hour" were not made. Of the 22 species of bird recorded during the Sustainable Akkar field surveys and considered vulnerable to collision with a wind turbine, ten species were recorded flying at collision risk height within or across the site:

- Common crane.
- Eurasian sparrowhawk.
- Honey buzzard.
- Kestrel.
- Lesser spotted eagle.
- Long-legged buzzard.

[182] Desholm, M. (2009). Avian sensitivity to mortality: Prioritizing migratory bird species for assessment at proposed wind farms. Journal of Environmental Management. 90: 2672-2679.
[183] R Core Team (2012). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0
[184] Feedback provided by The Netherlands Commission of Environmental Assessment, on behalf of the Ministry of Environment.

- Short-toed snake eagle.
- Steppe buzzard.
- White Pelican.
- White stork.

Another further species, hen harrier, was recorded flying at collision risk height within or across the Hawa Akkar site.

Disturbance and Displacement

Disturbance associated with the operation of the proposed development has the potential to cause an adverse, low magnitude, long-term, impact on the locally important community of bird species occupying the proposed development and the surrounding area. Birds can be disturbed by the activities of personnel and vehicles during the operation of the proposed development and also by visual and noise disturbance from the turbines themselves. However, those disturbance sources are likely to be limited and resident birds are likely to habituate to them. No ecologically significant effect is predicted.

The only species of raptor that were regularly recorded within the Project site/immediate zone were common kestrel and short-toed snake eagle. Both of these species could be displaced from the immediate zone during the operation of the proposed development. Disturbance from the presence of construction workers and vehicles and from visual and noise disturbance from the turbines could cause both species to forage away from the site. This would result in an adverse, low magnitude, long-term, impact on both species. Short-toed snake eagle is a species of Regional importance and common kestrel are of site importance. However, based on the location of the territories which lie approximately 2.5km from the Project site, operational disturbance impacts on these features are not considered to result in ecologically significant effects.

Barrier Effects

The proposed development may result in a barrier effect on the movement of bird species with the vertical configuration of turbines creating an actual or perceived barrier which bird species may not cross or would need to habituate to crossing. Such adverse impacts would be of low magnitude to the species inhabiting the immediate zone but potentially of moderate magnitude to any species that might use the area around the Project site for migration.

Field surveys have not recorded high levels of migratory bird activity within the wind farm footprint at collision risk height. Importantly, the migratory corridors run in a largely north-south alignment similar to that along which the proposed development would be constructed. As such, the proposed development would not create a barrier perpendicular to the direction of most flights. The impact would be of limited extent but permanent for the life of the proposed development.

No ecologically significant effects are predicted.

<u>During Decommissioning</u>

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

Potential Impacts at Hawa Akkar

The Hawa Akkar ESIA Report prepared by MORES S.A.R.L. indicates the following:

<u>During Construction</u>

Breeding Birds

Following is a review of the impacts of wind farms on the various relevant groups of birds, largely in relation to the season (status) they occur in the habitat Hawa Akkar Wind Farm is planned to occupy, namely, breeding; comprised of resident and summer breeding visitors, migrants and winter visitors. Results from other countries are related back to the Lebanese situation, particularly where relevant to this country's species.

It appears from the various studies cited above, that the Hawa Akkar Wind Farm should have a restricted collision fatalities effect on the breeding avifauna of the Study Area and limited concern regarding habitat loss and disturbance in view of the large area of the site relative to the number (16) of turbines planned.

Migrating Birds

Generally, the Hawa Akkar Wind Farm site does not seem to present major hazards to birds migrating through it, most notably because the wind turbines are aligned in the same direction as the flow of the migrating birds, namely north-south direction with minimal barrier effect. Also, there are a number of other reasons most important of which are the following:

- It is not bounded by any restricting land formations; ridges of significance rise further south of the Study Area location.
- Observations, since 2007, from different locations over the Aanqet Valley have shown that the migrants fly over the valley avoiding the crest, mostly at an appreciable altitude allowing them to pass over the gorge.
- The site, being of a simple ecological nature, mostly a barren landscape, should not be inviting for most of the migrating birds, since passerines, the majority of the expected bird movement, search for a perch to alight on, apart from the wheatears. Wheatears are nocturnal migrants who typically seek higher elevations as a staging area, and consequently, are expected to prefer the upper slopes further south. Therefore, there should be little probability of birds colliding with the wind turbines as they take off or decent.
- The fact that the Study Area lies on one of the main migration flyways of the country should be a cause of serious concern, particularly in autumn for the migrating raptors, when birds are expected to gain altitude to pass over the higher grounds further south. This is an area requiring investigation to monitor at what level the birds start to soar. This condition is not as pronounced for the passerines and spring migrants since they have already gained height or are flying from high grounds, and therefore have adjusted their flight altitude accordingly, so it is expected that the flow should be well beyond rotor height.
- This situation is deeply aggravated by the effect of inclement weather on migrants' flight altitude, as presented above, and best managed with detection and mitigation.
- It is expected that the disturbance level and degradation of the habitat used by the birds as a staging post should be minimal in view of the area of the site and the limited planned developments (16 turbines and an office), in particular if related to the nature of the grounds.

Wintering Birds

It appears from the available information that it is not anticipated this wind farm will have any adverse effect on the likely wintering birds populations, since mostly are sulking, ground hugging species or are present in very low numbers, such as the raptors. However, the Lapwing (*Vanellus vanellus*) does fly in relatively large flocks and at rotor height levels, but typically it is classified as a farmland species, so it can be categorized here as an occasional visitor, also, as yet, it has not been recorded as affected by wind farm structures in any of the literature reviewed; a notable fact worth consideration.

Local Birds

The location of Hawa Akkar Wind Farm, in agreement with the information presented by Hassan (2011), lays in one of the most favorable locations for wind farms installations in the country. The most suitable region for wind turbines coincides with the flight path of migrating soaring birds during both seasons. Indeed, a predicament requiring a very careful and thorough assessment, in particular if it is compounded by poor metrological conditions. However, this situation although challenging, is not as problematic as it may seem since we have the instruments and knowledge to address these threats.

Potential Impacts at Lebanon Wind Power

<u>During Construction</u>

Impacts on Designated Sites

The proposed development overlaps slightly with the Mountains of Akkar-Donnieh IBA. The only potential construction work to be undertaken within the boundary of the IBA is the potential upgrade of the access track. This would not result in any habitat loss and would be undertaken following best practice construction methods to ensure that no indirect impacts occur. No ecologically significant effects are predicted on the IBA.

One of the Mountains of Akkar-Donnieh IBA breeding species was recorded during the field surveys on the Project site, namely western rock nuthatch. These birds were recorded in all zones around the proposed development up to 1,500m. The main infrastructure at the site is located at 1,800m at its lowest point so the only construction that could impact upon western rock nuthatch is the construction of the access road and underground cable.

Both of these developments would involve a limited footprint and as they avoid the removal of any trees likely to be used by most of the IBA breeding bird species, the activities would not result in any impacts on the named IBA species and therefore there would not be an ecologically significant effect. Western rock nuthatch primarily feed on the ground on rocky habitats and nest in rocky crevices, caves or on cliff faces. The construction work undertaken within the boundary of the IBA is at a height greater than 2,150m, significantly higher than where western rock nuthatch were recorded as being active.

The IBA lists soaring birds and cranes (namely white stork, white pelican, Levant sparrowhawk and common crane) as another key feature. Those species have not been recorded utilizing the Project site as they pass through the area on migration. As such, potential construction impacts would be limited to disturbance such as noise and light, from construction activities.

Disturbance such as that would be a temporary, low magnitude indirect impact. The extent of light disturbance would be far greater than that of noise as it would attenuate to levels unlikely to disturb species migrating through and over the area. The species listed were typically recorded flying high through the area. As such no ecologically significant effect is predicted.

Habitat Loss

Both temporary and permanent habitat loss are predicted as a result of the construction of the proposed development. Permanent loss would occur in the footprint of the infrastructure of the proposed development and from the construction of new permanent access tracks. Temporary, short-term habitat loss would occur at turbine bases, outside of the permanent hardstanding, and from the construction of new temporary access tracks that would be reinstated after construction.

Habitat loss is considered to result in an adverse indirect, low magnitude, short-term, reversible impact on the community of birds breeding on the Project site which is considered to be of local importance. It would be a temporary impact in all locations other than the footprint of the infrastructure and new permanent access tracks. No ecologically significant effect is predicted.

Nest Destruction

During the construction of the proposed development, nests could be destroyed directly by construction activities and some may be abandoned due to disturbance from construction vehicles. Nest destruction is an adverse, low magnitude, short-term, reversible impact on the locally important community of breeding birds. The extent of the impact would be wherever construction activities are required, such as at turbine bases, construction compound and laydown areas. Bird nest conservation importance varies dependent on the species and all nests are highly sensitive. This impact has the potential to result in a significant ecological effect.

However, it is considered that the impact is reversible, i.e. mitigation measures are possible which would avoid the impact and avoid any residual effects.

Disturbance and Displacement

As well as the noise and sights associated with construction, birds could also be disturbed by the activities of personnel and vehicles. Disturbance of small breeding birds found on site as a result of construction activities would be an adverse, low magnitude, short-term impact on a community of birds considered to have regional importance.

Given the relatively small footprint of the proposed development and the number of small breeding birds found on the site, this is not considered to be an ecologically significant effect.

The only species of raptors that were regularly recorded within the immediate zone around the project site are short-toed snake eagle and common kestrel. Both of these species could be displaced from the immediate zone during the construction of the proposed development. Based on their respective population sizes and distribution, short-toed snake eagle is considered to be a species of regional importance and common kestrel a species of local importance.

Disturbance from construction activities could cause both species to forage in alternative locations, either less favorable foraging areas on the margins of the Project site or locations further afield rather than the site itself. Displacement of these species would be an adverse, low magnitude, temporary, impact on both species, however this is not considered to be an ecologically significant effect.

<u>During Operation</u>

Collision Risk

Bird species using the airspace around the proposed development are vulnerable to colliding with the proposed development. Raptors and waterfowl are known to be particularly vulnerable to this collision risk[185]. A quantitative CRA has been undertaken for all vulnerable species. This has been undertaken using data collected from the migration season VP surveys and the year-round PC surveys. Any predicted collision events would be adverse impacts, reversible at population scale. The likelihood of collision event, magnitude and duration of impact would vary by species.

Species-Specific Collision Risk

As collision risk estimates for common kestrel and short-toed snake eagle were calculated following a different method which accounts for those species' breeding presence in the wind farm area, estimates of "Bird Records per Hour" were not made. Typically, population decreases of >1% would be considered a significant impact. However, based on feedback from the MOE[186], population decreases of >0.5% could be considered significant for long-lived species with lower population recruitment rates. The baseline populations used are for Lebanon as a whole but, as shown in the migration season research papers, the principal migration routes during spring and autumn both pass close to the proposed development. Thus, the population estimates for birds migrating over Lebanon are considered appropriate for use in this assessment. Of the 18 species of bird recorded during the field surveys and considered vulnerable to collision with a wind turbine, only eight species were recorded flying at collision risk height within or across the site:

- Common buzzard.
- Eurasian sparrowhawk.
- Honey buzzard.
- Common kestrel.
- Lesser Spotted Eagle.
- Levant Sparrowhawk.
- Short-toed snake eagle.
- Steppe buzzard.

Disturbance and Displacement

Disturbance associated with the operation of the proposed development has the potential to cause an adverse, low magnitude, long-term impact on the regionally important community of bird species occupying the proposed development and the surrounding area. Birds can be disturbed by the activities of personnel and vehicles during the operation of the proposed development and also by visual and noise disturbance from the turbines themselves. However, those disturbance sources are likely to be limited and resident birds are likely to habituate to them. No ecologically significant effect is predicted.

The only species of raptor that were regularly recorded within the immediate zone were common kestrel and short-toed snake eagle. Both of these species could be displaced from the immediate zone

[185] Desholm, M. (2009). Avian sensitivity to mortality: Prioritising migratory bird species for assessment at proposed wind farms. Journal of Environmental Management. 90: 2672-2679.
[186] Feedback provided by The Netherlands Commission of Environmental Assessment, on behalf of the Ministry of Environment.

during the operation of the proposed development. Disturbance from the presence of construction workers and vehicles and from visual and noise disturbance from the turbines could cause both species to forage away from the site. This would result in an adverse, low magnitude, long-term, impact on both species. Short-toed snake eagle is a species of Regional importance and common kestrel are of site importance. However, based on the location of the territories which lie a number of kilometers from the Project site, operational disturbance impacts on these features are not considered to result in ecologically significant effects.

Barrier Effects

The proposed development may result in a barrier effect on the movement of bird species with the vertical configuration of turbines creating an actual or perceived barrier which bird species may not cross or would need to habituate to crossing.

Such adverse impacts would be of low magnitude to the species inhabiting the immediate zone but potentially of moderate magnitude to any species that might use the area around the Project site for migration.

Field surveys have not recorded high levels of migratory bird activity within the wind farm footprint at collision risk height. Importantly, the migratory corridors run in a largely north-south alignment similar to that along which the proposed development would be constructed. As such, the proposed development would not create a barrier perpendicular to the direction of most flights. The impact would be of limited extent but permanent for the life of the proposed development.

No ecologically significant effects are predicted.

<u>During Decommissioning</u>

Decommissioning impacts are considered to be similar to, but less than, those described for the construction phase. No ecologically significant effects are predicted.

Mitigation

<u>Construction and Decommissioning</u>

Nest Destruction

Where required, vegetation would be removed outside of the bird breeding season (March-August). The following vegetation removal deterrence methods would also be used to ensure ground nesting birds do not nest on the site following vegetation clearance:

- Iridescent tape across the construction areas prior to construction activities.
- Bird deterring machines which produce intermittent loud noises.
- Walking of the cleared area by individuals on a regular basis to prevent birds settling and to monitor if any birds are settling to nests on areas close to the planned construction activity.

Where vegetation has not been removed outside of the breeding bird season and must be removed during the breeding bird season, then pre-clearance surveys must be undertaken by a suitably experienced ornithologist. These surveys would identify any potential nests in the vegetation to be removed and then establish suitable “no go” buffers around these nests, to prevent the nest being destroyed or disturbed. Buffers would be species specific and determined by the ECOW.

In addition to the above, prior to commencement of decommissioning activities, walkover surveys would be completed in habitats suitable for and known to be used by breeding bird species as to identify any previously unknown nest sites.

Operations and Maintenance

Collision Risk

The results of the CRA suggest that significant collision risk impacts are not predicted. However, it is acknowledged that the CRA is based on assumptions and incomplete datasets and a significant collision risk impact for species could still occur. The bird migration route through the north-east of Lebanon is an internationally important route for many species and so it is recommended that additional safeguards are implemented to prevent significant collision risk events.

This mitigation would rely heavily on the further monitoring work proposed (refer to **Section 14.5)**, including continuing the migration season VP surveys, undertaking carcass searches beneath the constructed turbines and the installation of a bird detecting radar system.

It is proposed that mitigation would involve the shutdown of the turbines during periods of peak collision risk potential, such as periods of peak bird migration movement or poor weather. Shutdown would be achieved by adjusting the blade angle to be perpendicular to the wind and applying the brake to prevent any blade rotation. Further information on this process, and potential compensation, will be provided in the Bird Monitoring Protocol being produced by the MOE.

It should be noted that, based on the results of the surveys previously undertaken on the site, mitigation for collision risk impacts is not currently considered to be required.

Migration VP Surveys

It is recommended to continue the migratory season VPs during the start of the operational phase of the proposed development. These would commence as soon as the Project is operational and would be undertaken following the methods described in this section, although with an increased survey effort to meet the 36 hours per migration season as suggested by SNH Guidance. During each VP watch, flight activity by target species[187] will be recorded using the same details collected before:

- Flight Number.
- Time.
- Date.
- Species.
- Number of Birds.
- Flight height.
- Total time of flight including time spent at each height.

In addition to this information, surveyors will record if any birds display any flight behavior apparently associated with the presence of the turbines (avoidance) or if any were seen to collide with a turbine (collision). Observations would use the following terminology after Meredith (2002)[188]:

[187] Target species include all species of raptor, cranes, storks and pelicans.
[188] Meredith, C., Venosta, M., & Ressom, R. (2002) *Cordington Wind Farm Avian Avoidance Behaviour Report*, 2002. Biosis Research Report.

- Weave - Weaving flight line up to maximum height of turbine.
- Direct - A direct flight line, within the turbine envelope but clearly in a line up to maximum turbine blade height, avoiding turbines.
- Horizontal - A bird flying towards a wind farm site, which takes avoiding action by a horizontal movement (i.e. no change in height) so as to take it around the edge of the turbines.
- Vertical - As for horizontal, but this time, the bird gains altitude to take it over the top of the wind farm site.
- Bullet - Flight behavior with no avoiding action with regards to turbines (or other infrastructure).
- Hit - A recorded collision between a bird and a turbine (or other infrastructure).
- Avoid - Avoidance behavior near a turbine, generally taken at short notice and likely to appear as a sudden change in direction and/or height.
- Other – Any other behavior not easily classifiable into any of the above categories.

Carcass Searches

As well as the VP surveys, searches for collision victims will be completed under the turbines. Visual searches within an area at least five meters greater than the length of each turbine blade will be undertaken. The surveys would be stratified, with a third of the turbines survey during each visit. It would also be randomized, with a different set of turbines chosen to be surveyed on each visit. These surveys would be undertaken ten times per month during the migration period (mid-February to mid-May and mid-August to mid-November) and three times per month during the rest of the year. The amount of time spent searching will be standardized to allow comparability between turbines and visits.

Prior to starting the surveys, both scavenger and surveyor bias will be calibrated. This will be completed by leaving proxy carcasses[189] under turbines in locations where they can be seen by static trail cameras to record how much time passes before a carcass is removed by scavenging animals.

A similar process will be used to calibrate how successful surveyors are at locating carcasses. One surveyor will place a number of carcasses, ideally of differing sizes randomly under turbines and a different surveyor would search as described above. This process will be repeated across a number of turbine locations and for all surveyors involved in the searching. How many of the placed carcasses which are found can then be used to identify how effective the surveyors are at finding carcasses.

A project specific monitoring protocol would be developed. This will need to be adapted following the publication of the Bird Monitoring Protocol by the MOE.

Radar Bird Monitoring Equipment

Radar equipment to monitor volumes of migrating birds approaching the proposed development would be considered. The requirement for this would be based on the expectations of the Bird Monitoring Protocol currently being prepared by the MOE. It is anticipated that this would involve guidance on the specifications of system appropriate and how it should be utilized.

The radar system would have a more direct feedback into the shutdown mitigation of the proposed development, as it would detect large volumes of birds approaching so large collision risk events can

[189] Proxies required as its unlikely that access to any hooded vulture carcasses will be possible. A bird of similar size and coloration should be used. It will be acceptable to use man-made dummies in the surveyor bias trials as that is a test of the surveyors' visual abilities. However, for the scavenger bias trials, real carcasses should ideally be used.

be avoided. The other monitoring methods would have an indirect feedback into the shutdown mitigation.

Monitoring/Additional Good Practice Measures

Hunting Ban

A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year[190] impacting populations in their breeding grounds in Europe and Asia. It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4**. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves.

The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site.

Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders. Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway.

Artificial Light

The use of artificial light should be avoided where possible as steady white lights on the nacelle can attract prey, such as moths, and the prey can attract predators, such as moth eating birds like hobbies and red-footed falcons. Instead, it is proposed that red lights or pulsing/blinking lights are used on the nacelle instead.

Waste Disposal

To prevent attracting scavenging bird species to the site, any waste produce by the workers on the site would need to be disposed of following a detailed plan. Waste should not be stored or deposited where it is open to the air, as this would attract birds to the site. This could, inadvertently, lead to the creation of a de-facto feeding station for scavenging birds such as corvids, kites and vultures.

Disturbance and Displacement

Identified nests of birds of prey, such as common kestrel and short-toed snake eagle, are considered far enough away from any construction area and disturbance impacts are unlikely. However, the ECoW would be responsible for monitoring both nest sites and ensuring that they remain productive through the construction/decommissioning works.

20.3.4 Socio-Economic Environment

On a cumulative basis, the Lebanon Wind Power, Sustainable Akkar and Hawa Akkar wind farm projects will have a positive and very significant impact on the Akkar Region. The three projects together will:

[190] Committee Against Bird Slaughter (CABS) (2013) Report on the hunting of migrant birds in the Lebanon - affected species and their conservation status in the EU.

- Generate a significant amount of new renewable energy to the local villages, the Akkar region and the other regions in Lebanon.
- Require the purchasing locally of a large amount of construction materials and other goods and services.
- Will provide approximately 250 jobs to local workers (for both the Lebanon Wind Power and Sustainable Akkar projects).
- Require upgrades to several local roads in order to accommodate the heavy trucks during the construction phase and local community members will also benefit from improved travel to work and/or school on these upgraded roads.
- The potential income that may be generated by nearby businesses including hotels and restaurants.
- Also, once in operation, the three projects together may be considered new tourist attractions. Tourists, while in the area viewing the wind turbines, will spend money in shops and restaurants, thereby generating additional revenue for the local SMEs.

Potential Impacts from Sustainable Akkar Wind Farm

During Construction

Villages and Informal Settlements

The negative impacts experienced by villages and informal settlements along the transport route are temporary and expected to result in a Moderate impact. The negative impacts experienced by Rweimeh Village during the transport of construction materials are temporary and expected to result in a Minor impact.

Land Lease/Acquisition

Impacts to landowners is anticipated to be Low:

- The Project represents a loss of access to 747,589m^2 will be leased for the Project for 28 years, and +3,500m^2 will be acquired permanently.
- However, landowners have agreed that the compensation provided is appropriate and fair.

Access to Grazing Areas by Shepherds

Given the loss of access to nearly half of the total, the impact severity is anticipated to be High:

- A total of 45% of the area currently used for grazing will be unavailable for a period of 18 months.
- All grazing areas will again be accessible at the end of construction.

Access to Tracks by Hunters

The impact severity to hunters is anticipated to be Slight:

- Access to tracks within the Project area would be temporarily prohibited during the construction phase for a period of 18 months.
- Recreational hunters near the Project will be advised of exclusion zones in advance, noting that other tracks are available, and hunting is for recreational purposes, i.e. not subsistence.
- There are other tracks available for hunters, who only hunt recreationally.

Businesses Near the Project/Influx of Workers

The impact severity is anticipated to be Low and largely Positive:

- The Project is expected to contribute positively as some construction workers may need accommodation, dine at restaurants, and make purchases in the area.
- The influx of workers has the potential to overwhelm businesses in the Project area, particularly housing. However, workers are expected to drive or be transported to and from nearby villages, depending on their village of residence. Therefore, it is not anticipated that accommodation providers will be impacted negatively.

Vulnerable Groups

Impacts to vulnerable groups, including women, the elderly and Palestinian and Syrian refugees, are not expected to be disproportionately different than other community members. The impact severity is anticipated to be Low (to be confirmed):

Workers to be Employed by the Project

- Up to 125 workers will be employed by the Project.
- The impact to workers is expected to be positive.

General Impacts to Communities

General impacts to communities are expected to be positive with the establishment of the CRO Office in Jabal-Akroum Kfartoun and community development projects as agreed between Municipalities and the Developer. As such, the overall impact severity is expected to be Medium, with a sensitivity of Medium-High, resulting in a Moderate impact.

<u>During Operations and Maintenance</u>

As with the Lebanon Wind Power project, major socioeconomic impact of the operational phase of the Project is expected to be Positive, with the provision of affordable electricity to the local community and to the broader Lebanese electrical consumers:

<u>During Decommissioning</u>

Decommissioning impacts on socioeconomics is expected to be similar to those noted for project construction, particularly with regards to sourcing of local labor and equipment. These impacts are expected to be moderate and positive.

Potential Impacts from Hawa Akkar

The Hawa Akkar ESIA Report prepared by MORES S.A.R.L. indicates the following:

<u>During Construction</u>

The construction phase of the project would employ a total of 300 persons, and thus have a positive economic impact on the project area, especially considering that priority will be given to local residents. The Hawa Akkar contract has a pledge to employ local residents and give them priority in its part-time and full-time positions.

The improvement in the state of the road network in the area would increase its appeal and overall land value. An increase in land prices would generate potential profit for local landowners. This improvement will also stimulate the local economy indirectly and encourage further infrastructure improvements in the project area.

Ready mix cement would be supplied by the Lebanese cement industry, thus generating work opportunities and helping keep jobs in a key national industry. Trucks and supplies of other material for construction would also be procured locally and would have positive socioeconomic impacts.

Operations and Maintenance

The operation phase of the project would employ between 20 and 30 persons, creating a positive economic impact in the project area, noting that (as mentioned) priority will be given to local residents.

The project will also generate educational and recreational tourism and site seeing activities in the area. These would bring revenue to local residents, both directly via entry fees and indirectly via secondary recreational activities and purchasing. Overall, the project will stimulate the growth of the local economy.

The Hawa Akkar lease agreements will bring direct financial benefits to the community with remuneration estimated at 7,400 USD per turbine per year, paid directly to the 3 municipalities. This sum alone would amount to an annual sum of 118,400 USD over 25 years.

The municipalities of Chadra, Machta Hammoud and Mqaibleh would also receive other financial payments that would greatly improve living conditions in the area. This represents a dramatic improvement in finances for these poor municipalities, and direct access to funds, since typically such municipal funding is received indirectly via governmental procedures with bureaucratic complications.

HA management has also openly stated that it will compensate owners of electricity generators in order to lessen their losses, since HA appreciated their role in society and infrastructure support in the absence of governmental capacities in that regard.

In addition, HA is considering a donation and investment of up to 3 Million USD to improve the Quobaiyat substation belonging to the government, in order to upgrade it and support the Akkar area and residents in terms of electricity supply quality and quantity. This would also allow for less electrical losses and provision of 24 hours of electricity in the project area and neighboring villages/areas.

In addition, the use of local resources (renewable wind energy) would decrease dependence on foreign fossil fuel imports, thus strengthening the local economy and increasing economic independence and circulation of resources within the country.

Potential Impacts from Lebanon Wind Power

<u>During Construction</u>

Villages and Informal Settlements

The negative impacts experienced by villages and informal settlements along the transport route are temporary and expected to result in a Moderate impact. The negative impacts experienced by Rweimeh Village during the transport of construction materials are temporary and expected to result in a Minor impact (refer to **Section 16 Community Health, Safety and Security** for the assessment of transport and traffic impacts to communities).

Land Lease/Acquisition

Impacts to landowners is anticipated to be Low:

- The Project represents a loss of access to 155,611m^2 that will be leased for the Project for 23 years (with a possible extension to 28 years), and +3,500m^2 that will be acquired permanently.
- However, landowners have agreed that the compensation provided is appropriate and fair.

Access to Grazing Areas by Shepherds

Given the loss of access to such a small percentage of the total, the impact severity is anticipated to be Medium:

- A total of 8.6% of the area currently used for grazing will be unavailable for a period of 18 months.
- All grazing areas will again be accessible at the end of construction.

Access to Tracks by Hunters

The impact severity to hunters is anticipated to be Slight:

- Access to tracks within the Project area would be temporarily prohibited during the construction phase for a period of 18 months.
- There are other tracks available for hunters, who only hunt recreationally.

Businesses Near the Project/Influx of Workers

The impact severity is anticipated to be Low and largely Positive:

- The Project is expected to contribute positively as some construction workers may need accommodation, dine at restaurants, and make purchases in the area.
- The influx of workers has the potential to overwhelm businesses in the Project area, particularly housing. However, workers are expected to drive or be transported to and from nearby villages, depending on their village of residence. Therefore, it is not anticipated that accommodation providers will be impacted negatively.

Vulnerable Groups

Impacts to vulnerable groups, including women, the elderly and Palestinian and Syrian refugees, are not expected to be disproportionately different than other community members. The impact severity is anticipated to be Low (to be confirmed):

Workers to be Employed by the Project

- Up to 125 workers will be employed by the Project.
- The impact to workers is expected to be positive.

General Impacts to Communities

General impacts to communities are expected to be positive and include the establishment of the CRO Office in Jabal-Akroum Kfartoun and community development projects as agreed between Municipalities and the Developer. As such, the overall impact severity is expected to be Medium, with a sensitivity of Medium-High, resulting in a Moderate impact.

During Operations and Maintenance

The overall impact severity is expected to be Slight, with a sensitivity of Medium-High, resulting in a Minor impact. The major socioeconomic impact of the operational phase of the Project is expected to be Positive, with the provision of affordable electricity to the local community and to the broader Lebanese electrical consumers:

- The Project is expected to provide 22KV of supply bulk power to be distributed to the residents of neighboring villages.
- Electrification is expected to boost the local economy by stimulating productivity and enterprise efficiency, while enhancing complementary infrastructure such as roads and transportation (Plan Blue, 2010).
- Additionally, energy, at the industry level is directly linked to development, and is a catalyst for production and economic growth.
- With cheaper electricity provided by the Project, economic growth is expected in all sectors that benefit from sufficient energy supply, from basic lighting needs for backyard laying hens, to the powering of large-scale industrial activities.
- The current additional expenses paid to acquire electricity would then be allocated to improving livelihoods and business growth.
- Other local socioeconomic factors expected to significantly improve with the provision of low-cost energy are health and education. Economic benefits include those from the expected:
  - Sourcing of construction materials from the Akkar region.
  - Sourcing of Project personnel from the northeastern part of Akkar.
  - Income that may be generated by nearby businesses including hotels and restaurants.
- In terms of economic growth and livelihoods' development, electricity positively impacts quality of life both directly and indirectly. Better energy supply means more hours of lower cost/efficient energy, longer operating business hours generating more income from work, and economic savings in comparison to the high cost of generator use. This is especially relevant given that power cuts as long as 17 hours were noted in the socioeconomic surveys.
- Land lease / acquisition for 23 years with a possible extension to 28 years.
- In general, surveyed individuals support the Project and anticipate that it will reduce their energy costs, reducing their financial burdens and increasing their production and savings. All individuals surveyed anticipated that the new network would improve power distribution and reach more houses and businesses across their villages.
- An additional perceived benefit of the Project is the provision of green energy and its impact on health and the environment.
- 75% of surveyed businesses were completely aware of the environmental benefits of the project and indicated that they are looking forward to the Project's completion and the increased energy supply to their villages.
- The Developer and Bank Audi will offer financial management training/classes to encourage appropriate savings and expenditure practices within the communities.

During Decommissioning

Decommissioning impacts on socioeconomics is expected to be similar to those noted for project construction, particularly with regards to sourcing of local labor and equipment. These impacts are expected to be Moderate and Positive.

Mitigation

- Additional consultation will be undertaken with livestock owners and shepherds to explain the areas they cannot access for the duration of the construction.
- Shepherds will be consulted to find out whether goat grazing is a subsistence activity and whether there are adequate alternative grounds that can be used during the construction period. If there's impact or loss of livelihoods, a Livelihood Restoration and Compensation Plan will be developed.
- Shepherds grazing near the Project will be advised of exclusion zones in advance, noting that other grazing areas are available. Alternative areas for grazing will be researched and secured by the Developer for alternative use during construction. If the Developer cannot arrange an alternative area because of landowners' objection, financial compensation will take place.
- Recreational hunters near the Project will be advised of exclusion zones in advance, noting that other tracks are available, and hunting is for recreational purposes, i.e. not subsistence.
- A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year impacting populations in their breeding grounds in Europe and Asia.
- It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4** in **Section 14 Ornithology**. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves.
- The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site.
- Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders.
- Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway.
- The Developer will collect additional data, identify all Project stakeholders and engage with them, as necessary, including directly-affected people and vulnerable groups.
- These exercises will help clarify and confirm the DAOI and focus the assessment of project impacts and inform mitigation, as well as inform management plans.
- The Developer will identify and map all of the Project stakeholders and engage with them as necessary. This will help ensure that all Project stakeholders are consulted and there are no hidden pockets of opposition.
- Other potential use of natural resources on the Project site will be investigated.
- Additional measures to communicate the Project information, including provision of schedules, health, safety and security measures are necessary (refer to **Section 16 Community Health, Safety and Security** and the stand-alone SEP).
- Workers will be sourced from the Project area first, regionally second, nationally third and internationally last.
- Employment will supply income for a period of up to 18 months.
- Pre-recruitment skills training will be provided.
- A job skills assessment will be undertaken to provide transparency in hiring practices.
- Establishment of the CRO Office in Jabal-Akroum Kfartoun.
- Community development projects as agreed between Municipalities and the Developer.

20.3.5 Noise

The primary noise sources associated with the three proposed projects would be a maximum of 56 wind turbines. The final wind turbine model has not yet been selected for the Lebanon Wind Power and for the Sustainable Akkar Project. Therefore, for these sites the cumulative noise assessment was based on the Nordex turbine as a worst-case approach since this turbine has the highest noise levels of the considered turbines. The considered turbine data is presented in **Table 20-8** through **Table 20-10.** The noise assessment also considers a worst-case number of WTG locations, i.e. 17 for Lebanon Wind Power, 23 for Sustainable Akkar and 16 for Hawa Akkar.

Table 20-8 Technical WTG Data LWP Site (Worst Case Assumption)

Lebanon Wind Power	Planned WTG
Name(s) on Print Out	7-23
Number	17
Manufacturer	Nordex
WTG-Type	N149 Without serrations
Rotor Diameter [m]	149
Hub Height [m]	105
Rated Power [MW]	4.5
Operating Mode, Nighttime	Mode 0
Serrations	No
Source of Sound Power Level	F008_271_A12_DE
LWA [dB(A)], Nighttime	108.1
LWA [dB(A)], Daytime	108.1
Surcharge*) [dB(A)]	1
LWA Total [dB(A)], Nighttime	**109.1**

Table 20-9 Technical WTG Data SA Site (Worst Case Assumption)

Sustainable Akkar	Planned WTG	Planned WTG	Planned WTG	Planned WTG	Planned WTG	Planned WTG
Name(s) on Print Out	02-08, 18-22	13, 15, 17, 23	09-11, 29	24	25	14
Number	12	4	4	1	1	1
Manufacturer	Nordex	Nordex	Nordex	Nordex	Nordex	Nordex
WTG-Type	N149 With serrations	N149 With serrations	N149 With serrations	N149 With serrations	N149 With serrations	N149 With serrations
Rotor Diameter [m]	149	149	149	149	149	149
Hub Height [m]	105	105	105	105	105	105
Rated Power [MW]	4.5	4.5	4.5	4.5	4.5	4.5
Operating Mode, Nighttime	Mode 0	Mode 4	Mode 8	Mode 10	Mode 11	Mode 16
Serrations	Yes	Yes	Yes	Yes	Yes	Yes
Source of Sound Power Level	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE	F008_271_A12_DE
LWA [dB(A)], Nighttime	106.1	104.1	102.0	100.0	99.5	97.0
LWA [dB(A)], Daytime	106.1	106.1	106.1	106.1	106.1	106.1
Surcharge*) [dB(A)]	1	1	1	1	1	1
LWA Total [dB(A)], Nighttime	107.1	105.1	103.0	101.0	100.5	98.0

Table 20-10 Technical WTG Data HA Site

Hawa Akkar	Planned WTG	Planned WTG
Name(s) on Print Out	01-13	14-16
Number	13	3
Manufacturer	Vestas	Vestas
WTG-Type	V150	V150
Rotor Diameter [m]	150	150
Hub Height [m]	105	105
Rated Power [MW]	4.2	4.2
Operating Mode, Nighttime	P01	SO3
Serrations	Yes	Yes
Source of Sound Power Level	0067-7067 V08	0067-7067 V08
LWA [dB(A)], Nighttime	104.9	99.5
LWA [dB(A)], Daytime	104.9	104.9
Surcharge*) [dB(A)]	1	1
LWA Total [dB(A)], Nighttime	**105.9**	**100.5**

In July 2019, the Ministry of Environment confirmed the noise limit of 55 dB(A) during the day and 45 dB(A) during night time for residential houses set by the EHS Guideline. Therefore, the noise assessment will consider the 45 dB(A) [L_{Aeq}] nighttime noise limit. Since the IFC (2007) and the MOE state absolute noise limits rather than relative noise limits, a background noise measurement is not necessary for the noise assessment. The noise output of a turbine varies with the wind speed. Therefore, as part of the worst-case approach the wind speed with a maximum noise output of the turbines is considered. Since the calculation considers the loudest noise output of the turbines, it is not necessary assessing wind speeds which are associated with lower noise outputs.The cumulative load of the planned wind turbines at the surveyed noise sensitive areas was calculated according to the ISO 9613-2:1996. Noise levels were calculated at a maximum of 56 WTG locations, as shown in **Table 20-11**. However, since the number of turbines will be reduced once the OEM is selected, the noise levels will be lower as indicated in the calculations.

Due to the array of the three wind farms which stretch from north to south, there are very limited cumulative noise impacts. The only place which will experience a small amount of cumulative impacts is the area between the Sustainable Akkar and Hawa Akkar site (see **Figure 20-5**). However, these small cumulative impacts will not cause an exceedance of the IFC limit of 45 dB(A).

Therefore, there are negligible cumulative noise impacts, as shown in **Table 20-12**.

Table 20-11 Cumulative Noise Calculation based on Nordex N-149 (Worst-Case)

Receptor	Nighttime Noise Levels Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	Daytime Noise Levels Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	IFC Noise Level Guideline Daytime/Nighttime [dB(A)]
LWP: 30 house under construction	32.4	32.5	55/45
LWP: 33 house	30.5	30.5	55/45
LWP: 46 occupied house in summer	33.9	34.0	55/45
LWP: 53 house	37.3	37.3	55/45
LWP: 55 villa	39.1	39.1	55/45
LWP: 57 house	40.5	40.5	55/45
LWP: 61 house	41.2	41.2	55/45
LWP: 68 house	43.5	43.5	55/45
LWP: 73 house	44.5	44.5	55/45
LWP: 78 house	39.6	39.6	55/45
LWP: 82 house	37.5	37.5	55/45
LWP: 85 house	41.5	41.5	55/45
LWP: 89 house	40.6	40.6	55/45
LWP: 94 house	43.3	43.3	55/45
LWP: 97 house	44.4	44.4	55/45
LWP: 98 house	41.5	41.5	55/45
SA 34: house	44.1	48.7	55/45
SA 42: summer house	40.3	44.3	55/45
SA 31: summer house	43.3	47.9	55/45
SA 06: house	42.7	42.8	55/45
SA 09: house	41.7	41.7	55/45
SA 13: house	37.6	38.2	55/45
SA 17: house	33.7	35.6	55/45
SA 16: house	34.7	36.4	55/45
SA 37: house	44.7	49.2	55/45

Receptor	Nighttime Noise Levels Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	Daytime Noise Levels Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	IFC Noise Level Guideline Daytime/Nighttime [dB(A)]
SA 20: house	44.8	46.5	55/45
SA 19: house	44.1	46.2	55/45
SA 21: house	44.9	46.4	55/45
SA 29: house	44.9	47.0	55/45
SA 28: summer house	42.8	44.6	55/45
SA 23: house	37.6	38.5	55/45
SA 32: summer house	42.6	47.5	55/45
SA 11: house	38.4	38.7	55/45
SA 12: house	37.1	38.0	55/45
SA 14: house	37.7	39.7	55/45
SA 15: house	37.7	39.5	55/45
SA 18: house	38.2	39.7	55/45
SA 22: house	39.3	40.3	55/45
SA 38: restaurant in construction	39.9	44.3	55/45
SA 36: house	41.2	45.7	55/45
SA 39: house	40.1	44.4	55/45
SA 44: house	39.0	42.9	55/45
SA 45: house	37.0	40.8	55/45
HA: 10 house	43.5	48.1	55/45
HA: 12a house	44.6	49.3	55/45
HA: 15 house	42.5	46.6	55/45
HA: 17 house	41.2	44.7	55/45
HA: 23 house	42.9	44.0	55/45
HA: 29 house	37.1	37.4	55/45
HA: 35 house	34.7	34.8	55/45
HA: 39 house	42.6	42.6	55/45

Receptor	Nighttime Noise Levels Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	Daytime Noise Levels Cumulative Noise Level LWP + HA + SA Wind Farm [dB(A)]	IFC Noise Level Guideline Daytime/Nighttime [dB(A)]
HA: 40 house	41.5	41.5	55/45
HA: 46 house	40.4	40.4	55/45
HA: 45 army base / quarry	43.8	43.8	55 (no residential receptor)
HA: 44 house	35.6	35.7	55/45
HA: 37 house	37.2	37.3	55/45
HA: 38 house	35.3	35.4	55/45
HA: 34 house	37.3	37.4	55/45
HA: 33 house	37.9	38.0	55/45
HA: 32 house	40.5	40.5	55/45
HA: 26 house	39.5	39.7	55/45
HA: 25 house	39.4	39.7	55/45
HA: 24 house	39.2	39.6	55/45
HA: 19 house	37.0	38.3	55/45
HA: 14 house	38.0	40.3	55/45
HA: 11 house	38.1	40.8	55/45
HA: 09 house	38.1	41.4	55/45
HA: 04 house	37.8	41.9	55/45
HA: 01 house	37.7	42.4	55/45
HA: 02 house	36.7	41.2	55/45
HA: 43 temporary army base	54.4	54.4	55 (no residential receptor)
HA: 12b house	44.0	48.5	55/45
SA 51: summer house	44.9	50.0	55/45

Figure 20-5 Cumulative Noise Isolines for the 3 Wind Farm Projects

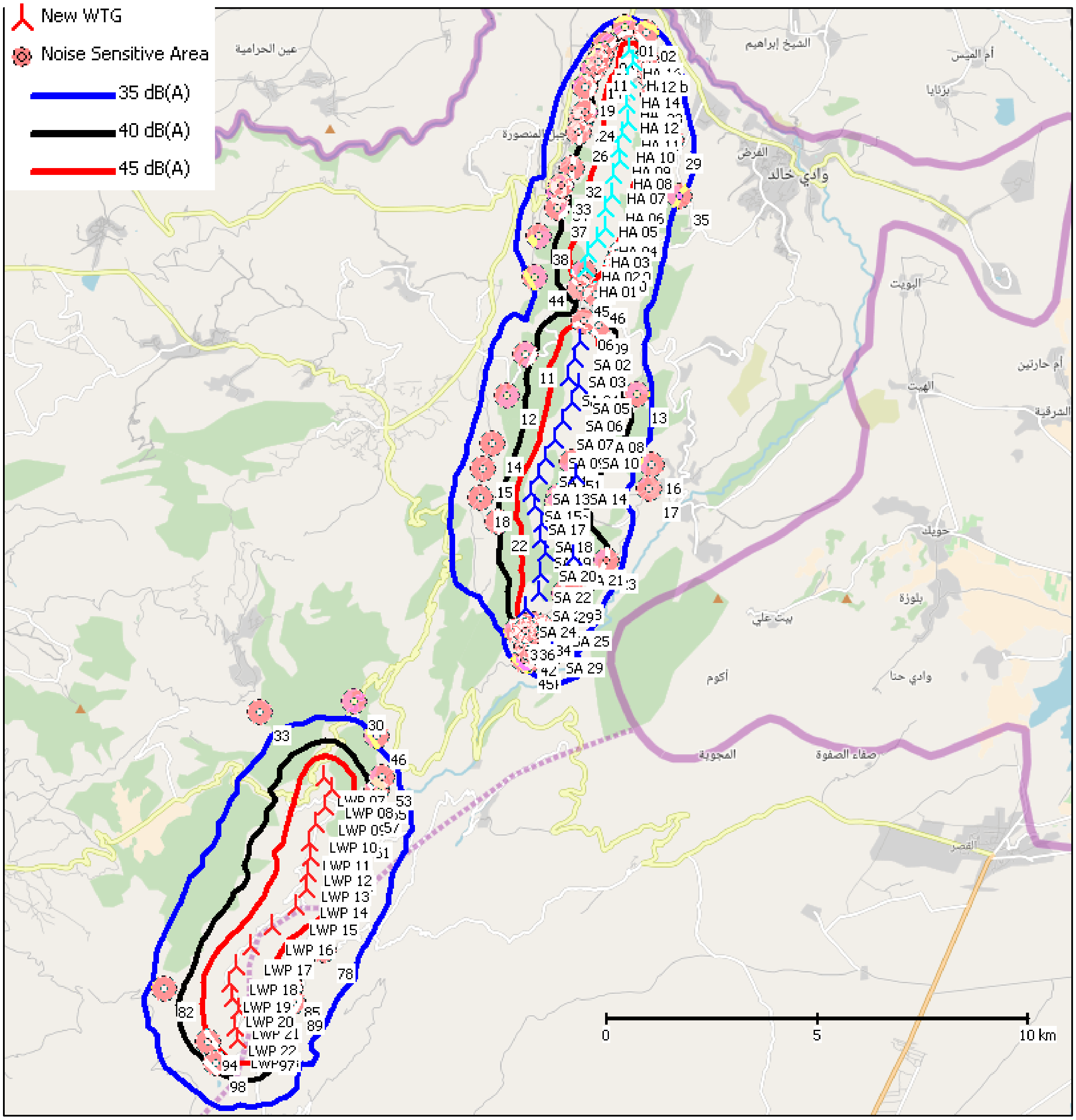

Table 20-12 Cumulative Noise Impact

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight √	Negligible	Negligible	**Negligible √**	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

20.3.6 Shadow Flicker

Based on the worst-case assumptions derived from the EHS Guideline (2015) and the turbine locations of the three projects a shadow flicker map was calculated to show potential overlapping shadow areas of the three projects which could cause cumulative impacts.

Due to the distance of more than 5,000m between the Lebanon Wind Power project and the Sustainable Akkar project, there will be no overlapping shadow flicker areas (see **Figure 20-6**), and consequently no cumulative impacts arising from these projects in terms of shadow flicker.

In the north of the Sustainable Akkar project there is a very small area which overlaps with the shadow area of the Hawa Akkar project (see **Figure 20-7**). Since there are no sensitive receptors like dwellings for instance in the overlapping area, there is also no cumulative impact from shadow flicker for the Hawa Akkar and the Sustainable Akkar project.

In summary, there will be no cumulative shadow flicker impacts due to the distance between the parallelly planned wind farms, as shown in **Table 20-13**.

Figure 20-6 Shadow Flicker Area (HA+SA+LWP)

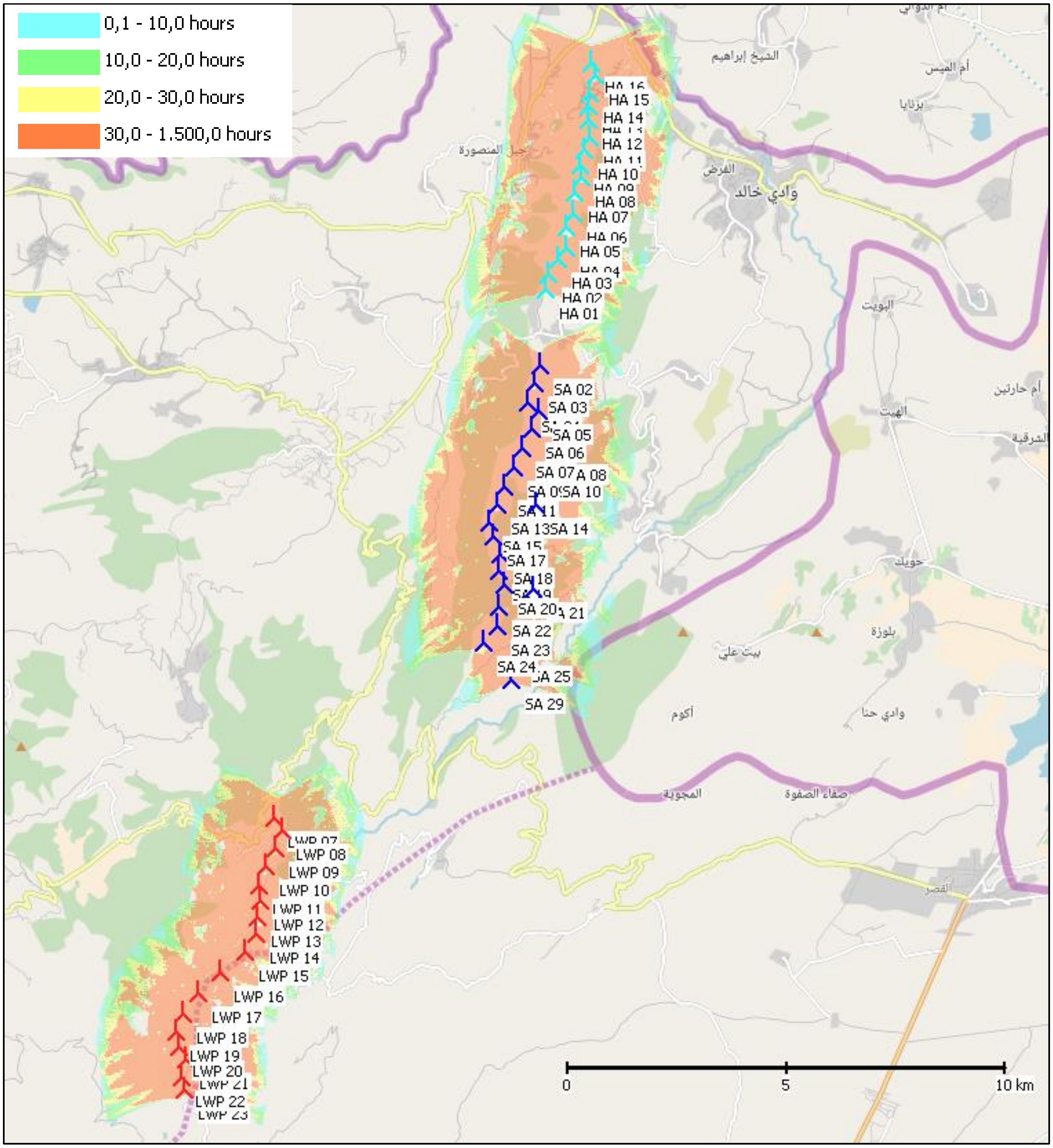

Figure 20-7 Shadow Flicker Areas between the SA and the HA Projects

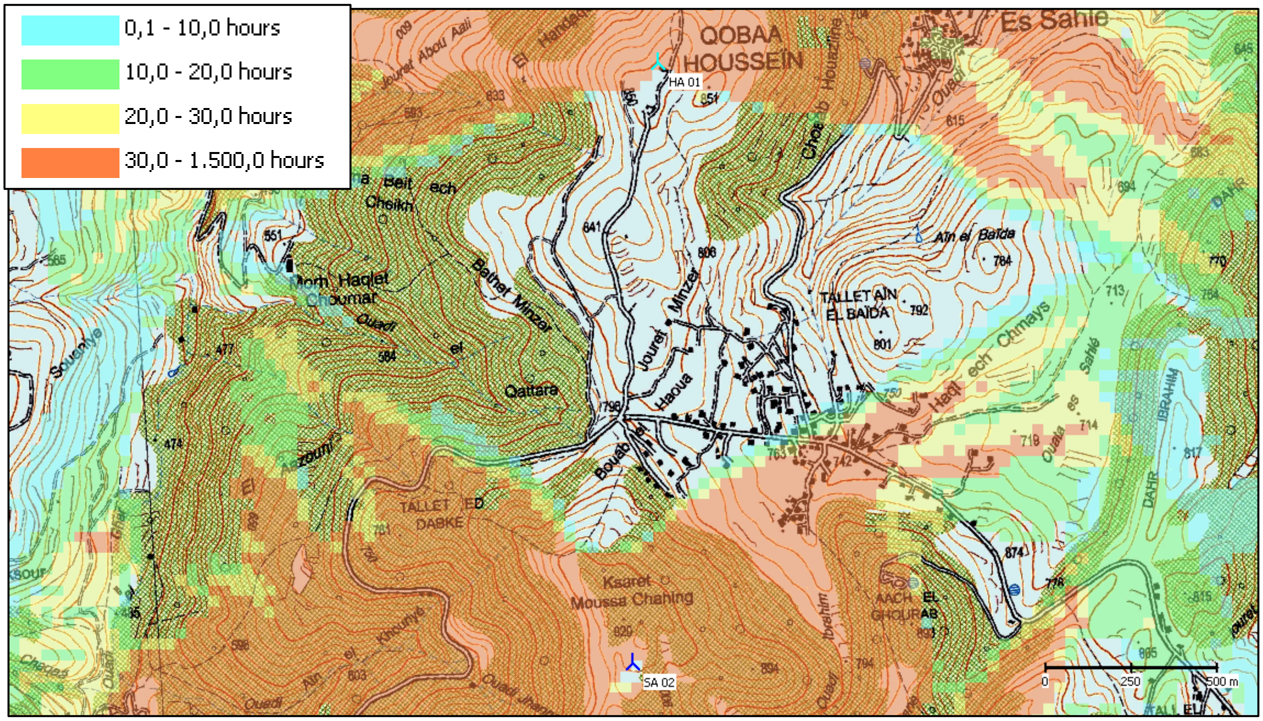

Table 20-13 Cumulative Impact Shadow Flicker

		Sensitivity of Receptor				
		Low	Low-Medium	Medium √	Medium-High	High
Impact Severity	No Change √	Negligible	Negligible	**Negligible √**	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

20.3.7 Visual and Landscape

Inter-visibility between wind farms is normally found to be highest in those areas located between the developments. However, the actual pattern of cumulative inter-visibility (CIV) dependent on the land-cover, land-use and landform of the area is subjected to combined visibility. Since there is only little vegetation, which usually reduces the visibility, the landcover and land use was not considered in the calculation. Due to the large height differences in the area, the local topography is the most important factor which determines the visibility of the wind farm.

The cumulative ZTV (provided in **Appendix V**) demonstrates that the individual visibility of the Sustainable Akkar wind farm development will mostly occur in the eastern and southern part of the 15km study area, as shown in **Table 20-14**. The cumulative ZTV also clearly shows that the most sensitive receptor in the area, the Qammouaah Plain and its surrounding, does not have any visibility from the Sustainable Akkar and the Hawa Akkar wind farms (see visualization of all three wind farms).

Table 20--14 Cumulative Visibility for Wind Farm Projects in 15km Radius of the SA Project

WF Visibility	Area [ha]	Area [%]
Sustainable Akkar only	3,387	3.6
Hawa Akkar only	3,725	4.0
Lebanon Wind Power only	16,289	17.4
LWP + SA + HA	33,587	35.9
LWP + HA	1,080	1.2
LWP +SA	6,838	7.3
SA + HA	7,075	7.6

Cumulative Effects on Visual Amenity

The cumulative effects on the visual amenity were considered for each receptor in **Table 20-15** and **Table 20-16.**

By erasing the turbines SA 26, SA 27 and SA 28 of the project the cumulative impact between the two wind farms Sustainable Akkar and Lebanon Wind Power was reduced. In addition, by eliminating the most northern turbine (SA 01) of the Project, the distance between the wind farms Hawa Akkar and Sustainable Akkar was increased, so that the two projects appear more as individual projects rather than one large wind farm.

In total, the cumulative impacts of the Sustainable Akkar project in combination with the neighboring Hawa Akkar and Lebanon Wind Power Project on the relevant receptors are considered of slight to moderate significance.

Table 20-15 Cumulative Assessment of Visual Effects on Key Receptors and Settlements

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
Sahle (Hill)	Low	-Very Large- (viewpoint) The turbines of the SA and of the Hawa Akkar project will be clearly visible and appear at a large scale due to the distance of approximately 1km to the project site and the exposed location of the viewpoint. The Village Sahle is located in the valley and therefore will experience a much lower visibility of the proposed turbines due to the topography. In summary, cumulative magnitude of change will be very large due to the unimpeded visibility of both projects from the Hill. However, the viewpoint located at an uninhabited hilltop which has a low sensitivity resulting a moderate significance. (see also the visualization in **Appendix V**)	Moderate
Al-Saifa Fortress Akkar el-Atiqa'a	High	-None- The ZTV demonstrates that the area around the Fortress will have no cumulative visibility of the wind farm due to the existing orography which blocks the view towards the SA wind farm.	Negligible
Qammouaah Plain	High	-None- The ZTV demonstrates that the plain will have no cumulative visibility of the development due to the existing orography which blocks the view towards the SA wind farm.	Negligible
Sahle Village	Medium	-Medium to Large- The northern turbines of the project SA will appear at a large scale due to a distance of less than 1km to the village. In addition, the southern turbines of the Hawa Akkar will appear in the north of the village at a large scale due to the distance of approximately 1km. However, due to the local topography only a limited number of the turbines will be visible (see ZTV map) and the rotors of the turbines of both projects will not be facing to the village most the time due to the prevailing wind directions. Due to its different locations the Hawa Akkar	Moderate to Substantial

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
		wind farm (in the north) cannot be seen from Village in the same field of view together with the SA wind farm (in the south). The village is already influenced by technical structures including telecommunication towers, a quarry, an army base and many multi-story bare-concrete buildings in construction. The wind turbines of both projects will add further large-scale man-made structures in the north and the south of the village to the existing views. Although the wind turbines will be added to the view of the village as new and large technical element the magnitude of change is limited to the existing visual preload. The visual intervention by the projects will therefore result in a moderate to substantial significance. (see also the visualization in the **Appendix V** of Sahle Hill)	
Qenia	Medium-High	-Medium- The ZTV indicates that about half the SA turbines of the project will be visible in the southwest of the village. The turbines of the Hawa Akkar project will appear on the horizon in the northwest of the project resulting that a larger area of views towards the west will be influenced by wind turbines. In the lower parts of the village the number of visible turbines will be reduced due to the local topography. Due to the distance of more than 3km the WTGs of the SA project will not appear in a large scale. In addition, the houses itself will reduce the visibility of the turbines. Unimpeded visibility of both projects in the west of the village is possible. However, only some exposed areas of the village will have these unimpeded views of both projects. Consequently, the cumulative magnitude of change is medium resulting in a moderate significance.	Moderate
Aandqet	Medium	-Small to Medium - The SA turbines will be clearly visible from the worst-case viewpoint north of the village due to the distance of approximately 2.2km to the planned wind farm.	Moderate

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
		The closest planned turbine of the Hawa Akkar project is located northeast of the village in a distance of approximately 3km. Due to its location and its array (stretching from north to south) the Hawa Akkar project will only take a small percentage of the horizontal view from an observer in Aandqet. In addition, the majority of the turbines will be located in a distance of more than 5km from the village. Therefore, the cumulative effects are limited for views from Aandqet. In the center of the village the houses itself will reduce the visibility of the turbines. Consequently, the cumulative magnitude of change is small to medium resulting in a moderate significance. (see also the cumulative visualization in **Appendix V**)	
Araysih (Quobaiyat)	Medium-High	-Low to Medium- The cumulative ZTV indicates that turbines of all three projects will be visible from views in Quobaiyat. While from exposed locations in Quobaiyat (like the considered viewpoint) the SA turbines will be clearly visible, the turbines of the HA project are located in a distance of 6km northeast of Quobaiyat and the turbines of the LWP project are located south in distance of 8km. In addition, the HA and the LWP will only cover a small presentence of the horizontal field of view considering views from Quobaiyat. Consequently, the SA turbines will have the by far the largest impact on views from Quobaiyat. The HA and the LWP projects are contributing very little to the overall cumulative impact resulting that cumulative impacts in Quobaiyat have a low to medium magnitude. Consequently, the cumulative visual intervention by the three projects is assessed to be of moderate significance.	Moderate
Kfartoun Medium-High	Medium-High	-Small to Medium - The SA turbines will clearly visible from the worst-case viewpoint on the eastern edge of the village due to the distance of approximately 2km to the planned wind farm.	Moderate

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
		The closest planned turbine of the Hawa Akkar project is located northwest of the village in a distance of approximately 5.5km. Due to its location and its array (stretching from north to south) the Hawa Akkar project will only take a small percentage of the horizontal view from an observer in Kfartoun. The cumulative impact with the LWP project southwest is even smaller due to the local topography and a distance of more than 11km to the closest planned LWP turbine. Therefore, the cumulative effects are limited for views from Kfartoun. In the center of the village the houses itself will reduce the visibility of the turbines. Consequently, the cumulative magnitude of change is small to medium resulting in a moderate significance. (see also the cumulative visualization in **Appendix V**)	
Rweimeh Village	Low-medium	-Low to Medium - While for views from Rweimeh Village the SA turbines will appear to be large features and be clearly visible, the turbines of the HA project are located in a distance of 9km in the north of Rweimeh Village and the closest turbines of the LWP project is located southwest in distance of 5.5km. The viewpoint Rweimeh Village is located on an imaginary line between the two projects. Therefore, in the field of view of a potential observer only one of the two projects or even only one part of one project is visible at once. This also limits the cumulative impacts. In addition, trees and buildings will further reduce the cumulative visibility in the Rweimeh Village settlement. Therefore, the SA turbines will have the by far the largest impact on views from Rweimeh Village. The HA and the LWP project are contributing very little to the overall cumulative impact, resulting that the cumulative visual impacts in Rweimeh Village have a low to medium magnitude. Consequently, the cumulative visual intervention by the three projects is assessed to be of moderate significance.	Slight to Moderate

Table 20-16 Cumulative Assessment of Visual Effects on Scoped Out Settlements

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
Halat, Mqaible, Machta Hammoud, Aaouiaanat, Shadra, Furaydis, Ain El Zeit, Al Birah, Kherbet Daoud, Qatlabah, Daoura, Beino, Aaiyat, Bluzah (Syria), Chettaha, Qboula, Bayt `Ali (Syria), Chaqdouf, Aakkar El Aatiqa'a, Aayoun, Ain Yaaqoub, Tikrit, Bezbina, Es Sayen, Memneh, Hmaireh, Mazraat El Talleh, Mrah El Zakbeh, Jouar El Hachich, Qasr, Qornet Aakkar, Fnaidek, Fissane, Mrah Ras El Ain, Kouakh, Souaiseh, Charbine, Brissa, Hermel	Medium-High	-Very Low to None - No or low visibility of SA turbines see ZTV.	Negligible
Hadidah (Syria), Tell Kalach (Syria), Aridah (Syria), Na`isiyah (Syria), Bqaiaa, Ash Shayk Ibrahim (Syria), Al Farid	Medium-High	- Low - Due to the wind park array stretching from north to south the SA turbines will only cover a small percentage of the field of view from a potential observer located in the north of the project. In addition, due to the distance the turbines will appear at a small scale. Consequently, the SA turbines do not contribute significantly to the cumulative level of change. In this area the turbines of the HA project will be the relevant component of visual change due to its closer distance.	Slight to Negligible
Al Bahluniyah, Al Qurayyat, Kafr Nun, Rimah, Chiklar, Menjez, Aydamun, Sindianet Zeidane, Majdal, Beit El Khalil	Medium-High	- Low to Medium – All settlements are located west of the project with visibility of the SA and HA project at views towards the east. The LWP turbines are located south and cannot be perceived in the same field of view. In addition, due	Moderate

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
		to the wind park array stretching from north to south the LWP turbines will also only cover a small percentage of the field view. Since the turbines of the SA and the HA project are located in the same viewing direction, the area on the horizon in which turbines are visible is increased this leads to a cumulative impact. However, due to the distance of the settlements, the SA turbines will appear at a small scale and therefore the cumulative magnitude of change is limited.	
Debbabiyeh, Kouachra, Daoussa w Baghdadi	Medium-High	- Very Low – All settlements are located west of the project with visibility of the SA and HA project. Due to the distance of more than 10km the SA turbines will appear at a very small scale.	Slight to Negligible
Al Farid, Rajem Khalak, Hnaider, Dbadeb, Arab Jernaya, Rajem Beit Hussein, Kanisa, Al Buwayt, Manseh, Al Hit (Syria), Huwayk (Syria),	Medium-High	- Low to Medium – All settlements are located east of the project with visibility of the SA and HA project at views towards the west. The LWP turbines are located in a distance greater than 10km and are partly blocked by the topography. Therefore, they do not contribute or only to a very low extend to the visual change. Since the turbines of the SA and the HA project are located in the same viewing direction, the area on the horizon in which turbines are visible is increased this leads to a cumulative impact. However, due to the distance of the settlements, the SA turbines will appear at a small scale and therefore the cumulative magnitude of change is limited.	Moderate
An Na`im (Syria), Aqrabiyah (Syria)	Medium-High	- Very Low – The two settlements are located east of the project with visibility of the SA and HA project at views towards the west. The LWP turbines are located in a distance greater than 19km and therefore do not contribute or only to a very low extend to the visual	Slight to Negligible

Receptor	Sensitivity	Magnitude of Cumulative Change	Cumulative Significance
		change. Since the turbines of the SA and the HA project are located in the same viewing direction, the area on the horizon in which turbines are visible, is increased. This leads to a cumulative impact. However, due to the distance of the settlements, the SA turbines will appear at a very small scale and therefore the cumulative magnitude of change is very limited.	
Akroum	Medium-High	- Very Low - The settlement has low to no visibility of the HA and the LWP turbines, therefore the cumulative magnitude of change is low to none.	Slight to Negligible
Mrah El Kouakh	Medium	- Very Low - The settlement has low to no visibility of the HA and LWP turbines therefore the cumulative magnitude of change is very low.	Slight to Negligible
Boustane	Medium	- Low to Medium - The SA turbines will be the dominant component of change (if visible due to the vegetation). The closest LWP turbines are located in a distance of approx. 6km to the west, while the SA turbines are located in the north. Consequently, the WTGs of both projects will not appear in the same field of view. The HA WTGs will not be visible from the very small settlement. The LWP project is contributing little to the overall cumulative impact, resulting that the cumulative visual impacts in Boustane have a low to medium magnitude.	Slight to Moderate

Table 20-17 Cumulative Visual Impact Assessment for Operation Phase

		Sensitivity of Receptor				
		Low	**Low-Medium**	**Medium**	**Medium-High √**	**High**
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium √	Negligible	Minor	Moderate	**Moderate √**	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

Cumulative Effects on Landscape Units

Due to the mountainous topography there is hardly cumulative visibility in the southern part of the study area. Consequently, the northern part of the study area is assessed in detail in terms of cumulative impact.

The cumulative ZTV shows that the northern and the eastern part of the study area experience most of the cumulative impact. The contribution of the visual impact by Sustainable Akkar wind farm and Lebanon Wind Power is relatively low in this area due to the large distance of the turbines. Consequently, these turbines will only appear at a small scale. From some elevated and exposed areas in the northern part of the study area, the ZTV shows that turbines of all three projects can be seen. However, the largest areas of cumulative visibility in which all three projects will be seen together, will occur mostly in the lower elevated areas in Syria.

Effected by the visibility of the three wind farms are in particular the large landscape units; namely the forests, the scrublands, the agricultural areas as well as the urban areas. The visibility of the SA and LWP turbines in the northern part of the study area will be very limited due to the large distance of the turbines, so that they appear in a small scale. In addition, due to the wind park array, which is oriented from north to south, the SA and LWP turbines only take a very small percentage of the horizontal field of view (from the agriculture areas in the north of the study area for instance). Consequently, at the plain in the northern part of the study area the turbines of the Hawa Akkar project will have the main visual effect on the landscape. There are no significant cumulative impacts caused by the SA and the LWP project although the turbines will be only visible at good weather conditions and on a small scale. Therefore, there are no significant cumulative impacts within the northern plain of the study area, although the ZTVs indicates that a large number of turbines will be visible.

Derived from the findings of the visualizations in combination with the ZTV, a verbal, argument-based valuation of the cumulative impacts is deemed to be appropriate for assessing the cumulative impacts. This is mainly due to the distance and locations of the three wind farms. Due to the geographical situation of the three wind farms, orientated from north to south, cumulative impacts are very restricted and mainly occur in the small areas between the projects. Therefore, the impact on the landscape units is mostly caused by individual wind farms.

An exception within the study area are forest areas close to Aandqet with the landscape unit of the pine and quercus forest. With the in parallel planned wind farm Hawa Akkar in the north, visibility of wind turbines will be introduced in an additional part of the landscape unit. However, there will be very limited areas, where the two wind farms will be visible in the same sightline, due to the location of the HA turbines in the north of the SA turbines, causing a moderate cumulative effect. In addition, the forest itself will limit views from this landscape units.

The roads for the wind farm will be designed to follow and fit with contours of the topography as far as possible, so that the landscape impacts can be reduced. Roads, especially single-track roads, generally do have a relatively small impact on large landscape areas. In addition, roads have restricted visibility due to existing topography and vegetation. Furthermore, dirt roads already exist on the wind farm site. In the surrounding of the project various bituminized roads already exists, which are part of the current landscape. Consequently, there will be no significant impacts on the landscape units by the SA wind farm roads and also no cumulative impact in combination with the planned wind turbines. Due to the distance to the LWP and HA project and their internal wind farm roads, there will be no significant cumulative landscape impacts caused by the wind farm roads.

The internal cabling will be underground cabling, consequently there will be also no significant cumulative landscape impacts.

The overall magnitude of change attributable to the wind farm SA in addition to the LWP project and HA project is low to medium, resulting in a minor and not significant effects in landscape terms, as shown in **Table 20-18**.

Table 20-18 Cumulative Landscape Impact

		Sensitivity of Receptor				
		Low	**Low-Medium√**	**Medium**	**Medium-High**	**High**
Impact Severity	No Change√	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium√	Negligible	**Minor√**	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
	Very High	Moderate	Moderate	Moderate	Major	Critical

20.4 Summary

The Cumulative Impact Assessment was undertaken per the request of the MOE stipulated in Minister's Letter #14175 dated 19/12/2017 and in accordance with International Finance Corporation, Good Practice Handbook, Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, 2013.

The Proponents for Lebanon Wind Power, Sustainable Akkar and Hawa Akkar and their contractors will be responsible for the implementation of the ESMP across all project phases to mitigate identified impacts. The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental, social and health and safety impacts of the Project during construction and operation phase in accordance with the applicable national legislation and regulations and lender standards. The health, safety and security aspects are included as a separate section of the ESMP. The specific objectives of this ESMP are as follows:

- Provide an institutional mechanism with well-defined roles and responsibilities for ensuring that measures identified in ESIA are implemented.
- Minimizing any adverse environmental, social and health and safety impacts resulting from the Project activities by implementing all suggested mitigation measures and control technologies, safeguards identified through the ESIA process.
- Prevent or compensate for any loss of the affected persons.
- Conducting all project activities in accordance with the relevant Lebanese Laws and the international guidelines.
- Prevent environmental degradation as a result of either individual subprojects or their cumulative effects.
- Enhance positive environmental and social outcomes.
- Ensure that the ESMP is feasible and cost-efficient.
- Provide a Project monitoring program for effective implementation of the mitigation measures and ascertain efficacy of the environmental management and risk control systems in place.
- Ensure that all stakeholders concerns are addressed.

To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment, and manage health and safety risks. It provides an overview of the environmental and social baseline conditions of the Project's Area of Influence, summarizes the potential impacts associated with the proposed development works and sets out the management measures required to mitigate any potential impacts in a series of discipline specific ESMP sections. In the risk register completed for the Project, the potential health, safety and security risks for the project have been assessed and control measures identified.

This ESMP is to be implemented by the OEM/EPC Contractor to be commissioned by Sustainable Akkar sal for the Project. Implementation and management of certain plans, i.e. the SEP and Grievance Mechanism, will remain the responsibility of LWP. In addition, a Committee responsible for the follow up on environmental and social management at wind farms is proposed to be formed at the MOE. Finally, a grievance record and redress mechanism will be developed and implemented throughout all project phases.

21. SUMMARY OF ANTICIPATED IMPACTS

The Project will result in significant and positive environmental and economic impacts on the strategic and national level and are crucial given the current challenges the energy sector in Lebanon is facing. The Project will offer energy security as well as alleviate a source of major economic burden to the Lebanese economy.

Compared with the current conventional way of producing electricity in Lebanon through thermal power plants using heavy fuel oil and/or natural gas, generating electricity through wind power is expected to reduce consumption of fossil fuels, and will thus help in reducing GHG emissions, as well as air pollutant emissions. The Project will:

- Assist in solving the problem of electricity shortage on the local and national scales.
- Assist in achieving the commitment to 12% supply of energy through RE.
- Reduce GHG emissions since it will be displacing a largely fossil fuel-based electricity generating system.
- Save millions of cubic meters of water per year in comparison to an oil-burning power plant which utilizes water for cooling.

Anticipated environmental and social impacts on various receptors throughout the Project phases are summarized in **Table 21-1**.

Table 21-1 Summary of Anticipated Impacts

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
Climate and Climate Change	Construction	GHG Emissions	• The GHG emissions are considered offset by the beneficial impact of generating clean energy through the operation of the wind farm. • The expected energy output from SA is 315.75GWh/yr resulting in 6,315GWh over 20 years. • The total emissions from the LCA (lifespan 20 years) results in 61179.31 tons of CO2eq. • Since the EDL emission rate is 630 t CO2eq/GWh, the carbon payback period is 83 days.	Low	Medium	**Minor**
	Operations and Maintenance	Flood Risk	• The selected OEM/EPC Contractor, as part of the detailed design prepared for the Project, avoid locating any of the Project components within the buffer distances developed under the flood risk assessment to eliminate any risks for flood. • A detailed hydrological study must be undertaken to identify and determine the required engineering structures to be considered as part of the detailed design for new asphalt and gravel road segment and internal tracks (e.g. drainage structures, culverts).	Slight	Medium	**Negligible**
	Operations and Maintenance	Wildfire	• It is recommended that the selected OEM/EPC Contractor, as part of the detailed design prepared for the Project, avoid locating any of the Project components within the buffer distances (if any) developed for the Karm Chbat Nature Reserve. • The selected OEM/EPC Contractor must identify and determine the required fire detection and protection equipment to be considered as part of the detailed design.	Low	High	**Moderate**
Geology and Hydrology	Construction, Operations and Maintenance	Potential Impacts to Soil and Groundwater	While typically not a groundwater issue, control of these pollution sources in a karstic environment is necessary to preclude impacts to groundwater. Control impacts to soil and groundwater through: • Implementation of general best practice housekeeping measures. • Following the Construction Health and Safety Plan. • Staging of work areas. • Provision of washout/washdown facilities with filter/neutralization prior to discharge. • Installation of silt fencing. • Erosion and sediment control. • Excavation and grading containment. • Provision of spill response equipment. • Additional protection shall be afforded by scheduling major activities with high potential for the generation of water pollution away from the snow melt season when the large majority of recharge is believed to occur.	Low	High	**Moderate**
	Construction, Operations and Maintenance	Impacts from Improper Management of Waste Streams	*Solid Waste Generation* • Coordinate with the appropriate Municipality or hire a competent private contractor for the collection of solid waste from the site to the municipal approved disposal area. • Prohibit fly-dumping of any solid waste to the land. • Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". • During construction, distribute a sufficient number of properly contained containers clearly marked as "Construction Waste" for the dumping and disposal of construction waste. Where possible, the OEM/EPC Contractor must seek ways to reduce construction waste by reusing materials (for example			

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			through recycling of concrete for road base course). • Implement proper housekeeping practices on the construction site at all times. • Maintain records and manifests that indicate volume of waste generated onsite, collected by contractor, and disposed of at the landfill. The numbers within the records are to be consistent to ensure no illegal dumping at the site or other areas. *Wastewater Generation* • Coordinate with Akkar Water Directorate to hire a private contractor for the collection of wastewater from the site to the appropriate WWTP. • Prohibit illegal disposal of wastewater to the land. • Maintain records and manifests that indicate volume of wastewater generated onsite, collected by contractor, and disposed of at the WWTP. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas. • Ensure that constructed septic tanks during construction and those to be used during operation are well contained and impermeable to prevent leakage of wastewater into soil. • Ensure that septic tanks are emptied and collected by wastewater contractor at appropriate intervals to avoid overflowing. *Hazardous Waste Generation* • Coordinate with the MOE and hire a private contractor for the collection of hazardous waste from the site to an appropriate Hazardous Waste Treatment Facility. • Follow the requirements for management and storage as per hazardous waste management and handling of the MOE. • Prohibit illegal disposal of hazardous waste to the land. • Ensure that containers are emptied and collected by the contractor at appropriate intervals to prevent overflowing. • Maintain records and manifests that indicate volume of hazardous waste generated onsite, collected by contractor, and disposed of at an appropriate Hazardous Waste Treatment Facility. The numbers within the records are to be consistent to ensure no illegal discharge at the site or other areas. *Hazardous Materials* • Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another. • Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must present at all times. Spilled material should be tracked and accounted for. • Incorporate dripping pans at machinery, equipment, and areas that are prone to contamination by leakage of hazardous materials (such as oil, fuel, etc.). • Regular maintenance of all equipment and machinery used onsite. Maintenance activities and other activities that pose a risk for hazardous material spillage (such as refuelling) must take place at a suitable location (hard surface) with appropriate measures for trapping spilled material. • Ensure that a minimum of 1,000 litres of general-purpose spill absorbent is available at hazardous material storage facility. Appropriate absorbents include elite, clay, peat and other products			

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			manufactured for this purpose. • If spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste.			
		Impacts on Water Resources	• The anticipated impacts on the local water resources and utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operation phase. Such impacts are expected to be of low magnitude and of low sensitivity given the minimal water requirements of the Project. • The selected OEM/EPC Contractor should coordinate with the Akkar Water Directorate to secure the water requirements of the Project.			
		Impacts on Wastewater Disposal Utilities	• The anticipated impacts on wastewater utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operation phase. Such impacts are expected to be of low magnitude given the minimal wastewater quantities generated, and of low sensitivity as they will be easily handled. • There are no mitigation measures to be applied. However, the selected OEM/EPC Contractor must coordinate with the Akkar Water Directorate to obtain list of authorized contractors for disposal of wastewater.			
		Impacts on Solid Waste Disposal Utilities	• The anticipated impacts on solid waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operations and maintenance phase. Such impacts are expected to be of low magnitude given the minimal solid waste quantities generated, and of low sensitivity as they will be easily handled by the landfill. • Given the above impact is considered not significant. As such, there are no mitigation measures to be applied. However, the selected OEM/EPC Contractor must: - Undertake discussions with the appropriate municipal landfills to determine where there is sufficient capacity to easily handle construction debris generated from the Project. - Coordinate with the appropriate municipality or hire a competent private contractor for the collection of construction waste from the site to the approved landfill. - Coordinate with the appropriate municipality or hire a competent private contractor for the collection of solid waste from the site to the approved landfill.			
		Impacts on Hazardous Waste Disposal Utilities	• The anticipated impacts on hazardous waste utilities are considered of short-term duration during the Project construction phase and of long-term duration during the operations and maintenance phase. Such impacts are expected to be of low magnitude given the minimal hazardous waste quantities generated, and of low sensitivity as they will be easily handled appropriately by an appropriate Hazardous Waste Treatment Facility. • The impact is considered not significant. As such, there are no mitigation measures to be applied. However, the selected OEM/EPC Contractor must coordinate with the MOE to hire a competent private contractor for the collection of hazardous waste from the site and disposal at an appropriate Hazardous Waste Treatment Facility.			
Geophysical Ground and Seismicity	Construction, Operations and Maintenance	Landslide, Slope Stability, Earthquake	• Ground stability problems are not expected due to high resistance values and safe carrying power values evidenced by the seismic measurements. • During detailed design, the OEM/EPC Contractor will incorporate the recommendations of the seismic study for excavation at the platform foundation locations to a depth where stable soils are encountered.	Slight	Medium	**Negligible**
Air Quality	Construction and	Impact of Particulate	• Use of wind screens or enclosures around dusty activities or the site boundary. Mojave Desert Air	Low	Medium	**Minor**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
	Decommissioning	Matter	Quality Management District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75%. • Water spray is also used to reduce fugitive dust as it increases the moisture content of the material. Therefore, and according to Mojave Desert too, Water spray (Application point) will ensure a control efficiency of 75%. This is very useful for exaction for example. • For unpaved roads, water flushing is the essential with 0.48 gallons per square yard twice per day to maintain a control efficiency above 50%. • For paved roads, water flushing with 0.48 gallons per square yard followed by sweeping is very effective and can reach 96%. If conducted directly before the passage of the turbines convoy or the morning and evening passages of the project vehicles to and from the site, a consequent decrease will occur. • A combination of the different above-mentioned measures will give a higher control efficiency that when applied individually.			
Transport and Traffic	Construction	Obstacle Removal	• An additional route survey will be undertaken once the OEM/EPC Contractor is selected. • The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition of the 45m of concrete wall be coordinated with the Port Authority. • Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport. • Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. • Any modification required for the Al Abdeh roundabout will be discussed with the municipality as it is under their authority. • Such works will be coordinated and permitted by the Developer and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest.	Slight	Medium	**Negligible**
	Construction	New Road Development	• The construction of asphalt roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. • Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army.	Low	Medium	**Minor**
	Construction	Transport of WTG Components, Construction Materials and Workers	• A communications protocol being developed for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport. A final transport route map will be provided to all municipalities. • All three wind farms will use the same traffic access plan. • Announcements will be made to all villages along the WTG transport route from the Tripoli Port to the entrance of the Project site). • WTG components will be transported 2 days per week, a total of 24 trucks roundtrip per week. • Municipal police will provide an escort for the WTG transport convoy. • Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market. • The road that passes through Rweimeh Village is the main access of the trucks transporting rocks and gravel, and maintenance activities will be undertaken by the Developer.	Low	Medium	**Minor**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			• For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road. • For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic. • Once the OEM/EPC Contractor has been selected, and the number and location of construction numbers are known, measures will be put in place to maximize mitigation of traffic impacts through carpooling and group transport by van.			
Biodiversity	Construction, Operations and Maintenance, Decommissioning (Habitats)	Total Habitat Loss: • Approximately 75.47 ha out of 948.72 ha (8%). Sensitive Features Loss: • *Juniperus excelsa* dominance: 2,69ha (19.55%) lost or modified (moderate adverse impact) • Mixed oak woodland: 49.89ha (6.59%) lost or modified (moderate adverse impact) • Oak woodland: 165ha (12.39%) lost or modified (moderate adverse impact) • Oak/pine woodland: 13.97ha (12.05%) lost or modified (moderate adverse impact) Habitats Including Vulnerable Plant Species: • Pine forest dominance 2: 7.16ha (16.93%)	Pre-Construction: • Completion of a pre-construction flora survey to identify habitats and key flora species as identified in the baseline section. • Micrositing of infrastructure to avoid or reduce oak woodland and mixed woodland removal. • Preparation of a final BAMP outlining the measures required to deliver no net loss for areas of natural habitat, such as oak woodland and mixed woodland. A framework BAMP has been provided with the ESIA, as an appendix to the stand-alone ESMP. Construction: • Offsetting for the loss of natural habitats will be required to deliver no net loss of biodiversity in these areas. Full details of the measures to achieve no net loss will be provided in the final BAMP. Measures would include additional tree planting to produce new areas or improve degraded areas of oak-dominated woodland and mixed woodland. The translocation of tree species would also be considered. • Preparation and provision of workforce toolbox talks and monitoring to ensure all staff understand the importance of the biodiversity controls in place, what they entail and how these controls should be followed. Particular key early tasks in workforce education will include implementation of a hunting ban on the Project site and prohibition of burning of vegetation for warmth or cooking. • Minimization of the project footprint within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure construction. • If any key flora species are identified during the pre-construction survey, areas of habitat inhabited by the plants should be avoided. If it is not possible to avoid examples or areas of the species detailed in the baseline, every effort should be made to reduce the impact and further offsetting would be required. • Implementation of rehabilitation measures to mitigate the loss of habitat, such as vegetation remediation, translocation or creation of new habitat areas. • Proper management of excavation materials. Rubble from site excavations should not be allowed to spread down slopes. Clear working procedures should be defined, implemented and supervised. • Separation and storage of top soil for use in restoration of all temporary project infrastructure and areas of temporary disturbance, e.g. track margins. Segregation of the topsoil of different habitat types will be required.			**Not Ecologically Significant**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
		lost or modified (moderate adverse impact) • Oak/pine habitat: 13.97ha (12.05%) lost or modified (moderate adverse impact) • Mixed oak woodland: 49.98ha (6.59%) lost or modified (moderate adverse impact) • Oak woodland: 1.65ha (12.39%) lost or modified (moderate adverse impact)	• Soil management would also include observance of appropriate biosecurity controls to prevent the spread of invasive plants or floral diseases. This would involve washing vehicles and equipment to remove particles of vegetation and loose soil, with this done in specific "wash down" areas. Any invasive plants that are removed during vegetation clearance would need to be disposed of appropriately, in a safe way that does not allow it to spread. • Good construction environmental management on site based on best practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents. During Operations and Maintenance: • Monitoring of all habitat reinstatement, translocation, recreation, offsetting or enhancement as identified and implemented as required following pre-construction surveys. • Remove invasive plant species during routine vegetation maintenance. • Monitor power-line right-of-way vegetation to avoid fire risk. Remove blowdown and other high-hazard fuel accumulations. During Decommissioning: • Typically, the same controls set out for construction will apply. • Minimization of activities within Karm Chbat Nature Reserve. Footprint minimization will include measures such as adherence to strict working boundaries for all infrastructure decommissioning. • Good construction environmental management on site based on best practice guidance to avoid spillage of fuels, other pollutants or excavated materials and provision of sufficient spill kits and similar to deal with any incidents. • Preparation and provision of workforce toolbox talks to ensure all staff understand the importance of the biodiversity controls in place and exactly what they entail.			
	Pre-Construction, Construction, During Operation and Maintenance (Terrestrial Fauna)	Terrestrial Fauna: Loss or Disturbance of Resting Places	During Pre-Construction: • Completion of pre-construction fauna walkover survey to identify potential habitat for key mammal and reptile species, followed by camera trapping to confirm species considered to be present/status of any dens found. • Preparation of a final BAMP setting out the measures required based upon the findings of the further surveys. A framework BAMP will be included with the ESIA. During Construction: • If any mammal or reptile species are encountered during works, they would be allowed to disperse or would be translocated outwith the construction area. During Operation and Maintenance: • If found to be present during pre-construction surveys, monitoring of populations of endangered reptiles as appropriate, including monitoring of any offsets or enhancements for those species.			**Not Ecologically Significant**
	Pre-construction, Construction, During Operation	Bats: Loss or Disturbance of Roosts and Foraging Habitat	Assuming a likely worst-case scenario that the roost present is of national importance, the impact would be near certain to result in a significant ecological effect. Impacts associated with disturbance of a roost rather than loss of the roost would be similar but likely to be of moderate or low magnitude			**Not Ecologically Significant**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
	and Maintenance, Decommissioning (Bats)	and Collision Risk	depending on the type of impact. A disturbance impact would occur as a result of construction noise, construction light or habitat alteration in the vicinity of the roost and could result in an ecologically significant effect. During Pre-Construction: • A full year of activity surveys will be competed pre-construction, adding to the information gathered from the spring activity surveys used to inform this assessment. As per best guidance, a full year of survey data will allow for a more accurate understanding of bat activity across the site, temporally and spatially, which will enable a more accurate and informed impact assessment which in turn will determine the most effective mitigation required. During Construction: • A presumption for avoidance of all artificial light as far as possible. All lights should be cowled and downward facing and avoid light spill onto surrounding non-construction areas. Operation and Maintenance: • Assuming a worst-case scenario that the population(s) of bats using the foraging habitat is (are) of national importance, the impact would result in a significant ecological effect. Impacts associated with temporary loss of a foraging area, e.g. temporary construction infrastructure upon areas of sparse herbaceous vegetation, rather than the permanent loss of the foraging area would be similar but likely to be of moderate or low magnitude. It is considered possible that it could result in an ecologically significant effect. • Once the pre-construction survey results have been analyzed, it will be possible to develop an appropriately focused scope of operational period bat surveys. Surveys would cover up to three years' activity periods. • Given the high levels of activity recorded at SA2, SA6, SA9 and SA20 and predominately from species identified as high or medium risk in terms of collision (common pipistrelle, Kuhl's pipistrelle and serotine) it is recommended that turbines situated at these locations are subject to operational adjustments. Raising the cut-in speed at which the turbine begins to generate electricity, thus preventing movement in low winds, notably decreases bat mortality rates[26] along with feathering of blades i.e. adjusting the angle of the blade parallel to the wind or turning the unit away from the wind[27]. In addition, operational times could be altered – stopping turbines at these locations between the most active periods i.e. 20:00-05:00. • Monitoring of bat collision fatalities under and around each turbine following a standardized methodology potentially using trained dogs. Monitoring to be completed monthly and concurrently with bird collision monitoring. • Preparation and subsequent implementation of plan to identify and protect key bat roost caves in the area on and around the Project site from human persecution, such as identified elsewhere in the area.			
Ornithology	Construction, Decommissioning	Designated Sites	• The IBA lists soaring birds and cranes (namely white stork, white pelican, Levant sparrowhawk and common crane) as another key feature. Those species have not been recorded on the Project site during field surveys, they pass through the area on migration. As such, potential construction impacts would be limited to disturbance such as noise and light, from construction activities. • Repetition of the migratory period VPs ensuring that the 36 hours per season standard is met. To be completed for three years after the start of operation and commence at the first migratory period after start of operation, regardless of whether it is the spring or autumn period. • Monitoring of bird collision fatalities under and around each turbine following a standardized			**Not Ecologically Significant**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			methodology potentially using trained dogs. Monitoring to be completed monthly between November and February and in June and July, i.e. outside of the migration periods. Completed weekly during spring migration period of March to May and August to October. Project specific monitoring protocol to be prepared based on best practice guidance. • This study has not identified a need to shut down turbines on site during the bird migration seasons. However, if it were identified to be necessary based on the results of collision fatality monitoring or as a requirement of the as yet unpublished Lebanese Ministry of the Environment guidance on wind turbine shut down to avoid bird collisions, some or all turbines will be shut down as appropriate and proportionate to identified confirmed or potential impacts. • Related to the previous action, the project will consider the installation of bird monitoring radar to inform all shutdown related activities. • Strict enforcement of hunting ban on Project site. • Avoid artificial light where possible. White steady lights attract prey and their predators. Use red or white blinking or pulsing lights instead. • Enclosed, segregated waste disposal to avoid attracting birds to predictable food sources.			
		Habitat Loss	• Both temporary and permanent habitat loss are predicted as a result of the construction of the proposed development. Permanent loss would occur in the footprint of the infrastructure of the proposed development and from the construction of new permanent access tracks. Temporary, short-term habitat loss would occur at turbine bases, outside of the permanent hard-standing and from the construction of new temporary access tracks that would be reinstated after construction. • Mitigation for habitat loss is as presented above for Biodiversity.			
		Nest Destruction	Where required, vegetation would be removed outside of the bird breeding season (March-August). The following vegetation removal deterrence methods would also be used to ensure ground nesting birds do not nest on the site following vegetation clearance: • Iridescent tape across the construction areas prior to construction activities. • Bird deterring machines which produce intermittent loud noises. • Walking of the cleared area by individuals on a regular basis to prevent birds settling and to monitor if any birds are settling to nests on areas close to the planned construction activity. Where vegetation has not been removed outside of the breeding bird season and must be removed during the breeding bird season, then pre-clearance surveys must be undertaken by a suitably experienced ornithologist. These surveys would identify any potential nests in the vegetation to be removed and then establish suitable “no go” buffers around these nests, to prevent the nest being destroyed or disturbed. Buffers would be species specific and determined by the ECOW. In addition to the above, prior to commencement of decommissioning activities, walkover surveys would be completed in habitats suitable for and known to be used by breeding bird species as to identify any previously unknown nest sites.			
		Disturbance and Displacement	• Disturbance of small breeding birds found on site as a result of construction activities would be an adverse, low magnitude, short-term impact on a community of birds considered to have local importance.			
	Operations and Maintenance	Collision Risk to birds flying at collision risk height: • Common buzzard. • Eurasian	• It is recommended that the program of VP surveys is continued, but with a greater survey effort. Surveys should be undertaken between August 2019 and November 2020, with six hours of survey undertaken at each VP location during the months of January, February, June, July and December. During the other months, when birds are migrating, this survey effort should be doubled to 12 hours of survey effort per VP location. It is recommended that more VP locations are used, with at			

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
		sparrowhawk. • Honey buzzard. • Common kestrel. • Lesser Spotted Eagle. • Levant Sparrowhawk. • Short-toed snake eagle. • Steppe buzzard.	least five locations recommended to cover the site. These should be chosen with the help of a viewshed analysis to ensure that all turbine locations can be observed from a survey location. All surveys must be undertaken by surveyors who are experienced in the identification and recording of Lebanese birds. Where required, these surveyors should also be trained in how to survey as per the SNH guidance . • The results of the CRA suggest that significant collision risk impacts not predicted. However, it is acknowledged that the CRA is based on assumptions and incomplete datasets and a significant collision risk impact for species could still occur. The bird migration route through the north-east of Lebanon is an internationally important route for many species and so it is recommended that additional safeguards are implemented to prevent significant collision risk events. • This mitigation would rely heavily on the further monitoring work proposed, including continuing the migration season VP surveys, undertaking carcass searches beneath the constructed turbines and the installation of a bird detecting radar system. • It is thus proposed that mitigation would involve the shutdown of the turbines during periods of peak collision risk potential, such as periods of peak bird migration movement or poor weather. Shutdown would be achieved by adjusting the blade angle to be perpendicular to the wind and applying the brake to prevent any blade rotation. Further information on this process, and potential compensation, will be provided in the Bird Monitoring Protocol being produced by the Lebanese Ministry of Environment			
		Disturbance and Displacement: • Common kestrel • Short-toed snake eagle	• Both species could be displaced from the immediate zone during the operation of the proposed development. • Disturbance from the presence of construction workers and vehicles and from visual and noise disturbance from the turbines could cause both species to forage away from the site. • This would result in an adverse, low magnitude, long-term, impact on both species.			
		Barrier Effects	• The proposed development may result in a barrier effect on the movement of bird species with the vertical configuration of turbines creating an actual or perceived barrier which bird species may not cross or would need to habituate to crossing. • Such adverse impacts would be of low magnitude to the species inhabiting the immediate zone but potentially of moderate magnitude to any species that might use the area around the Project site for migration.			
Socioeconomic Conditions	Construction, Decommissioning	Positive Impacts: • The potential for the consistent provision of electricity to meet demand. • Economic benefits from the expected sourcing of construction materials from the Akkar region. • Economic benefits from the sourcing of Project	• Landowners have agreed that the compensation provided is appropriate and fair, though the Project represents a loss of access to 747,589m^2 will be leased for the Project for 28 years, and +3,500m^2 will be acquired permanently. • A total of 45% of the area currently used for grazing will be unavailable for a period of 18 months. Given the loss of access to nearly half of the total, the impact severity is anticipated to be High. Additional consultation will be undertaken with livestock owners and shepherds to explain the areas they cannot access for the duration of the construction. Shepherds will be consulted to find out whether goat grazing is a subsistence activity and whether there are adequate alternative grounds that can be used during the construction period. If there's impact or loss of livelihoods, a Livelihood Restoration and Compensation Plan will be developed. Shepherds grazing near the Project will be advised of exclusion zones in advance, noting that other grazing areas are available. Alternative areas for grazing will be researched and secured by the Developer for alternative use during construction. If the Developer cannot arrange an alternative area because of landowners' objection, financial compensation will take place. All grazing areas will again be accessible at the end of construction.	Medium	Medium-High	**Moderate**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
		personnel from the northeastern part of Akkar. • Economic benefit from income that may be generated by nearby businesses including hotels and restaurants. • Land lease / acquisition for 28 years. Negative Impacts: • Land lease / acquisition for 28 years. • Temporary loss of access by shepherds to 0.43km^{2}of grazing areas. • Temporary loss of access to tracks by recreational bird hunters. • Potential impacts to vulnerable groups, including women, the elderly and informal settlements. • The potential to overwhelm businesses in the Project area by the influx of workers.	• Access to tracks within the Project area would be temporarily prohibited during the construction phase for a period of 18 months. Recreational hunters near the Project will be advised of exclusion zones in advance, noting that other tracks are available, and hunting is for recreational purposes, i.e. not subsistence. There are other tracks available for hunters, who only hunt recreationally. A significant impact on birds migrating through Lebanon is the culture of hunting that exists. In spite of laws that make the killing of migrating birds illegal, thousands are still killed each year impacting populations in their breeding grounds in Europe and Asia. It is proposed that all hunting within the wind farm area is banned, this area is shown in **Figure 14-4** in **Section 14 Ornithology**. This would not only protect the birds using the wind farm area but would also prevent damage to the turbines themselves. The site would be secured during construction, preventing public access to the area. It is proposed to maintain this during the operation phase, with security staff responsible for preventing members of the public accessing the wind farm site. Efforts should be made to invest in public awareness and support for the hunting ban among local residents. This would take the form of increased nature education and training of local bird recorders. Surveyors from the project surveys would be a good resource to educate locals of the species of birds and why Lebanon is an Internationally important bird flyway. • Impacts to vulnerable groups, including women, the elderly and Palestinian and Syrian refugees, are not expected to be disproportionately different than other community members. The impact severity is anticipated to be Low (to be confirmed). The Developer will collect additional data, identify all Project stakeholders and engage with them, as necessary, including directly-affected people and vulnerable groups. These exercises will help clarify and confirm the DAOI and focus the assessment of project impacts and inform mitigation, as well as inform management plans. The Developer will identify and map all of the Project stakeholders and engage with them as necessary. This will help ensure that all Project stakeholders are consulted and there are no hidden pockets of opposition. Other potential use of natural resources on the Project site will be investigated. Additional measures to communicate the Project information, including provision of schedules, health, safety and security measures are necessary (refer to **Section 16 Community Health, Safety and Security** and the stand-alone SEP). • Up to 125 workers will be employed by the Project. Workers will be sourced from the Project area first, regionally second, nationally third and internationally last. Employment will supply income for a period of up to 18 months. Pre-recruitment skills training will be provided. A job skills assessment will be undertaken to provide transparency in hiring practices. The impact to workers is expected to be positive. • General impacts to communities are expected to be Positive based on establishment of the CRO Office in Jabal-Akroum Kfartoun and community development projects as agreed between Municipalities and the Developer.			
	Operations and Maintenance	• Reduced cost of provision of power to residents. • Boosting of the local economy. • Enhancing infrastructure such as roads and	• The Developer and Bank Audi will offer financial management training/classes to encourage appropriate savings and expenditure practices within the communities.	Slight	Medium-High	**Minor**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
		transportation. • Cleaner environment. • Improved quality of life. • Economic growth.				
Community Health, Safety and Security	Construction, Decommissioning	Noise	• Limit the working hours from Monday to Friday 7 a.m. to 7 p.m., if possible. Some flexibility in working hours may be required during the delivery and erection of turbines and depending on weather conditions. • The final time schedule of the transport movements should be clarified with the authorities and communities. Only well-maintained equipment should be operated on-site.	Slight	Medium-High	**Negligible**
	Operations and Maintenance		• The distance of the WTGs to nearby receptors was increased by eliminating the originally planned WTGs 26, 27 and 28. In addition, WTG 25 was shifted to increase the distance to nearby receptors. • In order to comply with the IFC noise limit of 45 dB(A) some turbines need to be operated in noise reduced modes. Using the noise reduced modes which are available for all considered turbine types, the IFC noise limit of 45 dB(A) can be complied with. Due to the fact, that the calculation was based on a worst-case assumption of 23 turbine locations, the noise assessment should be redone when the final and reduced turbine layout is available. At the time the final number of turbines is available, the noise reduction modes for the corresponding turbine type can be stipulated. • The WTGs will be maintained regularly to ensure that the turbines do not become louder over time.	Low	Medium-High	**Minor**
	Operations and Maintenance	Shadow Flicker	• The installation of shadow flicker shutdown modules in the turbines is a very common and an often-applied mitigation measure. Shutdown modules will eliminate the possibility for exceedances of annual and day limits. An automatic shadow-flicker shutdown system shuts down the WTG when the sun is shining (direct sunshine on a horizontal area > 120 W/m²). These systems shut down a turbine when one of two conditions are reached: - More than 30 minutes of shadow-flicker occur on one day at a receptor. - The maximum annual quota of shadow-flicker at a receptor is exceeded. • When shutdown systems feature a radiation sensor, the turbines only shut down when the sun is shining. If the shadow-flicker shutdown system does not include a radiation detector, the WTG will shut down at all times when the shadow-flicker assessment indicates shadow-flicker at a receptor (i.e. also in cases of overcast sky or fog when there is actually no shadow flicker). • The use of shadow flicker shutdown modules will have a (small) negative effect on the energy yield of the wind farm.	Slight	High	**Minor**
	Operations and Maintenance	Visual Amenity in Settlements	• Sahle – no mitigation (mitigation was considered in the design phase).	Medium to Large	Medium-High	**Moderate**
			• Qenia– no mitigation (mitigation was considered in the design phase).	Medium	Medium-High	**Moderate**
			• Aandqet Village – no mitigation (mitigation was considered in the design phase).	Medium to Large	Medium-High	**Moderate-Substantial**
			• Quobaiyat– no mitigation (mitigation was considered in the design phase).	Medium to Large	Medium-High	**Moderate-Substantial**
			• Kfartoun – no mitigation (mitigation was considered in the design phase).	Medium to Large	Medium-High	**Moderate-Substantial**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			• Rweimeh – no mitigation (mitigation was considered in the design phase).	Large	Low-medium	**Moderate-Substantial**
		Visual Amenity from Key Viewpoints	• Sahle Hill – no mitigation (mitigation was considered in the design phase).	Large	Low	**Slight-Moderate**
			• Al-Saifa Fortress Akkar el-Atiqa'a – no mitigation (mitigation was considered in the design phase).	None	High	**Negligible**
			• Qammouaah Plain – no mitigation (mitigation was considered in the design phase).	None	High	**Negligible**
	Construction, Decommissioning	Transport and Traffic: Obstacle Removal	• The temporary removal of concrete bund, curb, electric pole and overhead cable, and demolition of the 45m of concrete wall be coordinated with the Port Authority. • Raising of pedestrian bridges, prohibition of car parking, removal of curbs, electric poles, trees, lamp posts, and fencing at ramps and roundabouts and ground leveling and compaction of significant curves will be coordinated with the Ministry of Transport. • Asphalt speed bumps will be replaced with rubber ones, which we can easily be removed during the transportation of the WTG components and reinstalled immediately after the trucks pass. • Any modification required for the Al Abdeh roundabout will be discussed with the municipality as it is under their authority. • Such works will be coordinated and permitted by the Developer and the Ministry of Transport and scheduled for time periods when traffic levels and/or pedestrian use are lowest.	Low	Medium	**Minor**
		Transport and Traffic: Construction of New Road Segments	• The construction of asphalt and gravel roads will occur for a period of 6 months and will be coordinated and permitted by Ministry of Transport and scheduled for time periods when traffic levels are lowest. The construction would be performed under the supervision and conditions of the relevant municipality. • The improved road network will have a positive impact on the health and safety in the area by providing safer roads, minimizing impacts to city centers, providing greater buffer distances between houses and the road and eliminating dangerous curves/turns.	Low	Medium	**Minor**
		Transport and Traffic: Construction of Internal Track	• Construction of internal track will occur for a period of 3 months and will be coordinated with the Ministry of Transport and the Lebanese Army. • Occupational health and safety rules, codes and regulations will be followed during works. • The OEM/EPC Contractor will be supervised by and accountable to the Developer.	Slight	Medium	**Negligible**
		Transport and Traffic: Transport of WTG Components	• The transport of WTG components will occur between 11pm and 4am to avoid impacts to communities traveling to work and school. • Municipal police will provide end-to-end escort for the transport convoy. • Advance notification of the scheduled transport will be provided to all communities along the route. • The trucks will travel at a low speed to lessen the generation of noise, vibration and dust. • A communications protocol being developed for the transport of WTG components will be distributed to all Mayors two to three months prior to the start of transport. A final transport route map will be provided to all municipalities. • Transport will be timed before and after farmers take their crops to the Akkar Vegetable Market. • For Road Segments A, B, C and D, which are 4 lanes with a median, a conservative approach to traffic management will dedicate the northbound direction for transport and divert all other background traffic to the other direction making a two-lane road.	Low	Medium	**Minor**
		Transport and Traffic: Impacts to Communities Along the Transport Corridor		Low	Medium	**Minor**
		Transport and Traffic: Impacts to Informal Settlements Along the Transport Corridor		Slight	Medium-High	**Minor**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			• For Road Segment E, which is a two-lane road, the transport vehicles will have to utilize the road along with the background traffic.			
		Transport and Traffic: Transport of Construction Materials	• The Developer will meet with Rweimeh Village residents of the houses located along the quarry tracks and existing asphalt roads to discuss the Project and nature and timing of the transport of construction materials. • Advance notification of the start of construction will be provided. • The trucks will travel at a low speed to lessen the generation of noise, vibration and dust. • Occupational health and safety rules, codes and regulations will be followed during works. • Negotiation of entry to quarry roads by resident vehicles will follow standard traffic safety/traffic control protocols, i.e. Stop/Go signage, flagman, etc. • The OEM/EPC Contractor will be supervised by and accountable to the Developer.	Medium	Medium-High	**Moderate**
	Operations	Transport of Workers	• None	Slight	Medium-High	**Negligible**
Landscape	Operations	Visual Impacts to Landscape	• Large, multi-MW turbines with large rotor diameters are considered. By using large, multi-MW turbines with large rotor diameters the number of turbines per generation capacity and the footprint of the Project will be reduced. In addition, large rotors have a reduced rotor speed compared to smaller turbines which will also reduce the visual impact of the Project. • The distance of the WTGs to nearby receptors was increased by eliminating the originally planned WTGs 26, 27 and 28. In addition, WTG 25 was shifted to increase the distance to nearby receptors. The wind farm layout was designed so that the array follows the existing landform of the mountain ridges. By considering the landform of the mountain ridges at the wind fam design, the wind farm layout follows the existing morphology of the mountain. Consequently, the typological appearance of the ridge remains largely recognizable. In addition, the overlapping of rotors of views from the east and the west are unlikely which can be perceived as visually restless. • Tracks will be designed to follow the existing tracks and fit with contours as far as possible. By following the existing tracks and fitting the location of the tracks with the contours lines the landscape impact of the tracks can be reduced. • The turbines and all the other aboveground structures will be removed at the end of the operational lifetime. By removing the turbines and all the other aboveground structures at the end of the operational lifetime, the landscape impact of the project will be entirely revisable and limited to the operation phase of the project. • The internal cabling should be underground cabling. By designing the internal cabling as underground cabling the landscape impact in the immediate surrounding was reduced.	Medium	Low-Medium	**Minor**
Archaeology and Cultural Heritage	Construction, Decommissioning	Buried Artifacts	Though the potential for impact is considered low, a Chance Finds Procedure has been developed (in accordance with guidance provided by the Ministry of Culture and the General Directorate of Antiquities) to appropriately respond to cultural resources encountered during construction, as follows: Where historical remains, antiquity or any other object of cultural or archaeological importance are unexpectedly discovered during construction in an area not previously known for its archaeological interest, the following procedures should be applied: 1. Stop construction activities. 2. Delineate the discovered site area. 3. Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a night guard should be present until the Responsible Authorities takes over.	Slight	High	**Minor**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			4. Notify the responsible foreman/archaeologist, who in turn shall notify the Responsible Authorities, the General Directorate of Antiquities and local authorities (within less than 24 hours). 5. The Responsible Authorities will be in control of protecting and preserving the site before deciding on the proper procedures to be carried out. 6. An evaluation of the finding will be performed by the General Directorate of Antiquities. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, scientific or research, social and economic values. 7. The decision on how to handle the finding will be reached based on the above assessment and could include changes in the Project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage. 8. The Responsible Authorities' decision concerning the management of the finding shall be implemented fully. 9. Construction work could resume only when permission is given from the Responsible Authorities after the decision concerning the safeguard of the heritage is fully executed. The Chance Finds Procedure has been included in the stand-alone ESMP.			
		Eco-Tourism at Karm Chbat Nature Reserve	• During the construction phase, access to certain portions of the 5.13M m^2 Karm Chbat Nature Reserve will be limited to ensure the health and safety of visitors.	Low	Medium	**Minor**
Occupational Health & Safety	Construction, Decommissioning	Impacts to Workers	*Air Quality* • Covering loads of dusty or excavated materials on a vehicle entering or leaving the construction site with impervious sheeting (such as nylon canvas). • Undertaking proper enclosure and guarding to limit public access to the site. • Drivers and workers in the vicinity of earth moving equipment would be supplied with ear mufflers, as well as goggles and nose masks, if necessary, in order to protect them from dust impacts. • Water spraying at the excavation sites prior to, during and after excavation to limit airborne particles. • Proper unloading of materials on-site to minimize dust. • Limiting the use of heavy equipment during periods of high winds. • Forbidding construction vehicles from keeping engines running (waiting to enter site or on-site). • Adopting weight limits for trucks and not exceeding vehicle loading capacity. • Ensuring adequate maintenance and repair of construction machinery. • Maintaining good housekeeping practices; and effective operational and waste management practices. • Implementing H&S measures (masks, work gloves, proper clothing, H&S rules) as needed. • Providing suitable rehabilitation and maintenance of road network surfaces to ease traffic flow. • Using environmentally friendly equipment with higher fuel efficiency or air pollution control. • Maintaining and operating equipment using appropriate fuel mixtures. • Enforcing speed limits for vehicles and maintaining normal traffic speed on-site and recommended traffic speed and driving time on the roads. • Applying dust suppression methods such as watering at access and internal roads. • Adopting good house-keeping measures to reduce dust build-up. • Maintaining stockpiles at minimum heights and forming long-term stockpiles into the optimum shape (i.e. stabilization) to reduce wind erosion. • Avoiding open burning of solid waste. • Enclosing the construction site with a dust mesh, as applicable.	Low	High	**Moderate**

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			• Carrying out loading and unloading of material without scattering. • Covering access roads and internal roads with plant mix. • Washing construction vehicles leaving site to prevent transmission of soil. • Keeping drop height of materials that have potential to generate dust at a minimum. • Using well-maintained vehicles and ensuring regular maintenance of these vehicles. • Collecting and addressing complaints and suggestions through grievance mechanism. *Water and Soil Resources Protection* • Awareness on the efficient use of water. • Minimizing water and soil exposure. • Minimizing and if possible, eliminating chemical usage (oil, lubricants and fuel) onsite. • Using as much as possible non-toxic and biodegradable chemicals to be stored on-site. • Reporting in case of spills from generator or disposed waste on-site in order to seek immediate remedial measures. • Routine inspection and maintenance of equipment to ensure that risk of leak/spill is minimized. • Promotion of good housekeeping during operation and maintenance. • Control and supervision of refueling at all times by appropriate personnel. • Development and implementation of training program for management of hazardous substances. • Temporarily store hazardous waste on-site in a designated and enclosed area. • Forbidding hazardous waste storage outside designated area. • Ensuring that oil changes, refueling, or lubrication of vehicles will be conducted offsite or in a dedicated area. • Equipping fuel storage tanks with drip trays and spill control equipment. • In case of spills, hazardous materials would be controlled via absorbents, and contaminated soil would be removed and disposed of in compliance with applicable legislation. *Topsoil Management* • Strip topsoil from project footprint (turbine bases and platform) at suitable depths and store separately at specialized areas. • Minimize topsoil losses via use of suitable equipment, procedures and construction work schedule - avoid soil disturbance during heavy windy and rainy periods. • Identify topsoil storage areas at relatively low slope areas. • Ensure that top soil stockpiles do not exceed 2m in height. • Ensure that only soil material will be stored at topsoil storage areas. • Maintain slope stability and a safe working environment for heavy construction vehicles. • Ensure that surface grading is done with appropriate vehicles to avoid soil compaction. • Enclose topsoil storage area(s) with fencing and place explanatory signboards • Ensure drainage of temporary topsoil site(s). • Within completed construction areas (turbine bases and platforms), reuse stored top soil for rehabilitation and landscaping. • Do not use vegetative soil or topsoil as fill material under any circumstances. • Ensure unnecessary soil stripping to minimize disturbance to vegetation, ecosystems and soils.			

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			Noise and Vibration • Choosing equipment with lower sound power levels when possible. • Using noise mufflers, and minimizing machinery or equipment idling conditions. • Optimizing internal-traffic routing to minimize vehicle reversing needs and maximize distances from closest sensitive receptors. • Keeping the main access road in well-maintained condition. • Ensuring mobile vehicles use only designated roads to reduce traffic through community areas • Proper site logistics and planning. • Performing proper maintenance on construction vehicles and equipment. • Limiting site working hours if possible. • Conducting construction activities closest to noise sensitive receptors during day time only. • Informing local municipalities and residents of the construction schedule and time of planned noisy activities. • Informing noise sensitive receptors about construction schedule in their proximity in advance. • Scheduling potentially noisier activities during daytime and/or less intrusive times. • Conducting noise monitoring during construction to verify compliance with regulatory limits. • Keeping equipment speed as low as feasibly possible without compromising performance. • Collecting and addressing complaints and suggestions through grievance mechanism. *Solid Waste Management* • Proper site clearing. • General cleanliness and organization of the site. • Use of excavated material as fill material, e.g. topsoil. • Segregation and proper disposal waste oils, paint barrels, lubricants, etc. from other wastes. *Traffic and Transport* • Planning, development and implementation of traffic management. • Maintaining minimal traffic speed on-site and recommended traffic speed and driving time off-site. • Implementing working hour limits for drivers and inform drivers periodically on working schedule. • Implementing restrictions for night time driving. • Adopting proper weight guidelines for trucks and not exceeding vehicle loading capacity. • Providing alternate routing plans during all phases of construction. • Restricting operation of heavy vehicles to those who are trained, competent and licensed. • Providing traffic trainings to all relevant personnel and specialized trainings to personnel who will operate industrial, heavier or critical vehicles. • Including traffic issues in the scope of the trainings and instructions for site visitors. • Limiting visitor mobility in the construction area. • Installing and maintaining signage and other traffic visuals. • Implementing right of way practices. • Implementing proper vehicle maintenance at all times. • Conducting or enforcing periodic medical examinations for drivers.			

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			• Conducting awareness raising activities for affected communities through established mechanism. • Collecting and addressing complaints and suggestions through the grievance mechanism. *Health and Safety* • Restriction of access to project construction areas by patrolling and guarding. • Provision of training on the fundamentals of occupational Health and Safety procedures. • Developing an Emergency Response Plan and training personnel on the actions to be taken in risk situations. • Installation of warning signs at the entrance to the site to inform people about the Project and risks associated with entry. • Availability of personal protective equipment (PPE) such as protective clothing, goggles, gloves, boots, masks, rubber boots, brightly colored working overalls equipped with light reflecting stripes, safety helmets, rubber or plastic type of equipment (broom, shovel, other) for personnel as needed. • Covering excavated ground (e.g. anchorage pits for turbines before filling) to prevent fall-in accidents for people and animals alike. • Provision of on-site medical facility/first aid and medical insurance for the workers/construction site. • Installing retaining nets to hold falling debris during site clearing and construction. • Prevention of stagnation of exposed water volumes to hamper insect and vector breeding. • Implementation of speed limits for trucks entering and exiting the site. • Installing proper signage to avoid accidental injury. • Implementing good housekeeping practices. • Ensuring that the project elements (turbines, bases, offices, substation, etc.) are designed incompliance with applicable legislations related to natural hazards, especially seismic safety • Conducting regular maintenance of equipment.			
	Operations	Impacts to Workers	*Air Quality* For generators and other equipment: • Using good quality fuel (from reputable sources). • Performing regular and preventive routine maintenance according to manufacturer recommendations. • Looking out for and fixing potential leakage and spillage of any kind at an early stage. • Outfitting of the generators with an effluent filter for Particulate Matter (PM). *Water and Soil Management* • Collecting domestic wastewater from toilets and sinks and conveying to public sewer network. • Ensuring that no sanitary wastewater is discharged onto the land. • Identify high risk spill areas, e.g. fuel tanks and generator – and have impervious surfaces and capture facilities in place. • Limit activities during adverse weather conditions to reduce potential wind and water erosion.	Low	Medium-High	**Minor**

			Noise and Vibration • Adopting proper scheduling for noisy wind turbine / sub-station maintenance activities. • Selecting adequate noise muffling equipment and minimizing machinery idling. • Ensuring good maintenance and repair of equipment. • Optimizing turbine operation as per wind speed to minimize noise generation. • Keeping turbines in good working order throughout the operational life of the project via routine maintenance, inspection and operational diagnostics. • Limiting the cutting/clearing of vegetation. • Planting trees near sensitive receptors to act as a noise barrier. • Ensuring equipment that may be intermittent in use is shut down between work periods or throttled down to a minimum. • Implementing a rigorous inspection and maintenance program applicable to equipment on-site. • Providing adequate Personnel Protective Equipment (PPE) to workers at noisy activities/locations that exceed permissible occupational noise level limits. • Conducting noise monitoring (1st year of operation, continuous at local municipalities, and in case of complaints) to verify compliance with regulatory limits and take corrective action. *Solid Waste Management* • Storage of SW in a pre-determined area in covered drums for collection and disposal. • Keeping the site free of litter. *Health and Safety* • Restricting access to project elements (turbines, substation) by patrolling and guarding areas around the site – noting that local residents, shepherds/herders, herb gatherers, and land users, will not be subject to area access restrictions, but rather restrictions related to accessing Project elements. • Installation of warning signs at site entrances to warn people about the Project and associated risks. • Provision of appropriate monitoring instruments • Conducting regular maintenance of equipment. • Enforcing on-site transportation regulations. • Covering excavated ground (e.g. anchorage pits for turbines before filling) to prevent fall-in accidents for people and animals alike. • Prevention of stagnation of exposed water volumes to hamper insects and vector breeding. • If needed, employees should be provided with PPE such as hand gloves, helmets, safety shoes, goggles, aprons etc. and ear protecting devices like earplugs/earmuffs and breathing masks. • Prohibition of dirt accumulation, dampness, water, oil, and other substances which may adversely affect electrical safety within electrical areas or the sub-station. • Training of workers and staff for fire-fighting, work permit system, first aid, safe handling of chemicals and integrating safety during operation. • Provision of safety and warning signs where needed (displayed in Arabic and English). • An accident / incident reporting and information system for employees for good awareness levels. • Provision of first aid boxes at key points at the project facilities with prominent marking. • Regulations prohibiting smoking in potentially fire prone or sensitive areas and all indoor areas.			

Resource	Phase	Impact	Mitigation	Impact Significance	Sensitivity of Receptor	Residual Impact Significance
			• Provision of fire-fighting equipment and/or system if/where needed within site facilities; and regular testing of fire extinguishers. • Ensuring electrical switchboards are not accessible to the public and related cautionary signs are in place. • Ensuring access to turbine ladders is closed off and related cautionary signs are in place. • Grounding installed conducting objects, as applicable. • Ensuring maintenance schedule for turbines is strictly followed. Specific to hazards due to accidents and/or incidents and lifting objects to heights can be applicable during construction and operation: • Ensuring use of applicable PPEs and other protective means. • Installing guard rails and signs. • Ensuring sufficient overall illumination during working hours and special illumination on hazard areas during nighttime. • Conducting regular visual checks and clean-up of excavation debris. • Restricting operation of heavy machinery to those who are trained, competent and licensed. • Providing regular H&S trainings. • Conducting labor audits to contractors' work force by an external third party. • Limiting manual lifting/handling needs by providing mechanical alternatives. • Ensuring personnel who conduct lifting operations receive special training. • Ensuring lifting operations are well planned and risks discussed in advance. • Ensuring lifting equipment is properly maintained and has sufficient capacity to support weight. • Setting exclusion zones below any activities working at height, to account for falling objects. • Abiding by weather condition limits set by the lifting equipment manufacturer. • Implementing the worker internal occupational grievance mechanism. • Conducting regular labor audits to contractors' workforce (by independent third-party auditors). Mitigation measures specific to blade and ice throw, and lightning applicable during operation: • Installing, maintaining and updating lightning protection systems for turbines and other elements. • Installing and maintaining vibration sensors that react to imbalance in rotor blades and shut down turbines. • Using de-icing mechanism, especially during fall and winter seasons. • Carrying out periodic blade inspections and repairing defects that could affect blade integrity. • Ensure heat control mechanism is maintained properly. • Ensure static and illuminated warning signs are used to inform/warn receptors.			

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