Vietnam Electrical Equipment Joint Stock Corporation (GELEX)

Environmental and Social Impact Assessment

GELEX 1,2,3 Wind Power Project, Quang Tri Province, Vietnam

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The business of sustainability

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GELEX 1,2,3 Wind Power Project, Quang Tri Province, Vietnam

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Acronyms and Abbreviations

Name	Description
@	at
AoI	Area of Influence
CCTV	Closed-circuit Television
CMS	Central Monitoring System
DoNRE	Department of Natural Resources and Environment
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EOR	Energy Outlook Report
EP	Equator Principle
EPC	Engineering, Procurement and Construction
EPP	Environmental Protection Plan
ERM	ERM Vietnam
ESIA	Environmental and Social Impact Assessment
EVN	Vietnam Electricty
FGD	Focus Group Discussion
FS	Feasibility Study
GIIP	Good International Industry Practice
ha	hectare
Hz	hertz
IFC	International Finance Corporation
IFC PS	International Finance Corporation – Performance Standard
IUCN	International Union for Conservation of Nature
JSC	Joint Stock Company
KII	Key Informant Interview
km	kilometre
kV	kilovolt
kW	kilowatt
LEP	Law on Environmental Protection
m	metre
m/s	metre per second
m^2	squared metre
MoNRE	Ministry of Natural Resources and Environment
MW	megawatt
NGOs	Non-Governmental Organisations
O&M	Operation and Maintenance
OECD	Organisation for Economic Cooperation and Development
RE	Renewable Energy
rpm	Round per minute

Name	Description
SCADA	Supervisory Control and Data Acquisition
SEA	Strategic Environmental Assessment
TPES	Total Primary Energy Supply
US$	United States Dollar
UXO	Unexploded Ordnance
V	volt
VND	Vietnam Dong
WGS	World Geodetic System
WPP	Wind Power Plant
WTG	Wind Turbine Generator

EXECUTIVE SUMMARY

This Environmental and Social Impact Assessment presents an assessment of the potential environment and social impacts of proposed 88MW wind power development in Huong Linh Commune, Huong Hoa District, Quang Tri Province, Vietnam.

The Project comprises of 21 wind turbine generators (WTGs) with total installed capacity of 88 MW, each with a capacity of 4.2 MW in mountainous area of central Vietnam. The Project will be divided into three separate projects GELEX 1, GELEX 2 and GELEX 3. Each project will consist of seven wind turbines which will all be connected to 5.08 km of 110kV transmission line and 10.74 km of 22kV transmission line. The Project is scheduled to generate electricity by the end of Quarter 3 of 2021.

Vietnam Electrical Equipment Joint Stock Corporation (GELEX) (hereinafter as" Client") is responsible for the Project's development and operation. The Client has completed Feasibility Study for in 2019 for 03 proposed wind power plants, which were conducted by SCI Joint Stock Company. Local Environmental Protection Plans (EPP) for GELEX 1 and 2 wind power plant have been approved by local authority. The ESIA aimed to assess Project-related impacts regarding to environmental and social aspect against International Finance Corporation Performance Standards (IFC PSs) and associated World Bank Environmental, Health and Safety (EHS) Guidelines. The ESIA is prepared based on (i) information provided by Client such as Feasibility Study, Site Investigation Report, Wind Measuring report, local EPP, (ii) desktop review of reliable sources; (iii) additional primary baseline survey to collect data from socio-economic surveys of affected communities, noise monitoring within and around the Project area and biodiversity surveys (including bird, bat, primate and terrestrial fauna and flora surveys). The outcomes of the ESIA, including mitigation measures and monitoring will be summarised in the Environmental and Social Management Plan (ESMP). The ESMP will combine together the mitigation and monitoring requirements identified in the local EPP and the ESIA to provide an overview of future environmental and social commitments of this Project.

The ESIA is comprised of three volumes (herein 14 chapters), including:

Volume 1: **Introduction** to describe the Project Description with detailed information of its component and area; Project Alternatives to discuss alternatives in term of power generation type, site selection and technology; applicable regulations and international standards, methodology used for the impact assessment and the scope of the ESIA report.

Volume 2: **Baseline Information** to provide adequate environmental and socio-economic background information to identify key issues, and to present the outcomes of the stakeholder engagement process during the initial ESIA development.

Volume 3: **Impact Assessment** to assess the potential impacts and consequences related on each of the key receptors within the area. The assessment also identifies the significance of impacts based on the existing controls in place and recommends additional mitigation measures and monitoring to satisfy IFC standards and other international guidelines.

Environmental Context

The vegetation and habitat of the Project site are dominant by shrubland, natural vegetation, agricultural land and water surface. The area within 100m buffer from transmission line is dominated by moderately dense vegetation cover, such as forest. The area within a radius of 50km includes five Key Biodiversity Areas in which three are within Vietnamese territory whilst the other two are under management of Laos, four Important Bird and Biodiversity Areas and four Protected Areas. The vegetation cover in the project area was recorded as normal based on the normalised difference vegetation index (NDVI) calculation results from flora survey indicating that the Project Area is comprised relatively high vegetation quality. The results of vegetation surveys showed that there are two species listed as Endangered species and one Near-Threatened species in IUCN Red List. As for fauna species, three species have been identified based on the screening assessment that are likely triggering Critical Habitat which are Red-shanked Douc Langur (*Pygathrix nemaeus*; IUCN CR), Southern White-cheeked

Gibbon (*Nomascus siki*; IUCN CR) and Bourret's Box Turtle (*Cuora bouretti*; IUCN CR). Avifauna species were also surveyed, notably, bats were recorded to exist partly outside the Project footprint on the eastern edge of the Project Area. Two species of bird have been found to be listed as Vulnerable in the IUCN Red List (Great Hornbill and Pale-caped Pigeon).

Baseline monitoring of physical environment condition showed that ambient environmental quality (air, noise, fresh water, soil) is moderately met the allowable permits of Vietnamese National Technical regulations.

Social Context

The total number of households that were directly affected by the Project is 94 households in three villages: Hoong Moi, Xa Bai and Cooc. No affected households were physically displaced; all affected households within the Project area were economical displaced through land acquisition process. The main livelihood of local people in the affected area were predominated (83.3%) by cultivation (rice and cassava planting are common agricultural activities) and animal husbandry. A further 10.4% work in wage-based livelihoods such as public employment, working for private companies or as hired labour. A very small proportion (5.2%) relies on enterprise-based livelihoods, particularly small businesses/services. ERM has conducted the engagement activities with key stakeholders of the Project in February 2020. At the time of survey, ethnic minority (Bru - Van Kieu) was recorded within the Project site.

Impact and Risk Assessments

A summary of the outcomes of the impact assessment for each environmental and social aspect identified in the Scoping Study are summarised in table below. A brief description of each aspect is provided hereafter.

Key Impacts	Applicable IFC PS	Phase	Significance of Impact	
			Before Mitigation	With Mitigation
Environmental Impacts				
Air Quality	IFC PS3	Construction	Negligible	Negligible
Noise Emissions	IFC PS3	Construction	Minor	Negligible
		Operation	Minor	Minor
Water Resource Quantity	IFC PS3	Construction	Moderate	Minor
Water Resource Quality	IFC PS3	Construction	Moderate	Minor
Soil Compaction and Errosion	IFC PS3	Construction	Minor	Negligible
Soil Contamination	IFC PS3	Construction	Minor	Negligible
Loss of Habitat	IFC PS6	Construction	Moderate	Minor
Disturbance and/or Displacement of Fauna	IFC PS6	Construction	Moderate	Minor
Barrier Creation, Fragmentation and Edge Effects	IFC PS6	Construction	Moderate	Minor
Degradation of Habitat	IFC PS6	Construction/Operation	Moderate	Minor
Mortality – Vehicle Strike, Hunting and Poaching	IFC PS6	Construction	Major	Moderate

Key Impacts	Applicable IFC PS	Phase	Significance of Impact	
			Before Mitigation	With Mitigation
Mortality – Turbine and Transmission Line Strike	IFC PS6	Operation	Negligible	Negligible
Shadow Flicker	IFC PS4	Operation	Major	Moderate
Landscape & Visual Amenity	IFC PS4	Construction	Minor	Negligible
		Operation		
Electromagnetic Interference	IFC PS4	Operation	Negligible	Negligible
Project Activities on Climate Change		Construction	Negligible	Negligible
		Operation	Positive	
Climate Change to the Project		Operation	Moderate	Minor
Social Impacts				
Economic displacement and livelihood impacts	IFC PS5	Construction	Major	Minor
Disturbance to agriculture production	IFC PS5	Construction	Minor	Negligible
Community health, safety and security impacts	IFC PS4	Construction	Moderate	Minor
Impacts associated with construction workers	IFC PS4	Construction	Moderate	Minor
Benefits to local communities	IFC PS4	Construction	Positive	
		Operation		
General disturbance on local community	IFC PS4	Operation	Moderate	Minor
Impacts on Indigenous People	IFC PS7	Construction	Major	Minor
		Operation		

Key Risks	Applicable IFC PS	Phase	Risk Ranking	
			Before Mitigation	With Mitigation
Unplanned Events				
Small scale leakage and spill incidents	IFC PS4 IFC PS3	Construction	Moderate/ Minor	Minor/ Minor
		Operation	Moderate	Minor
Road traffic transporting personnel or materials involved in a collision	IFC PS4	Construction	Major/ Moderate	Major/ Moderate
Fire and explosion	IFC PS4 IFC PS3	Construction	Major	Moderate
		Operation	Major/ Moderate	Moderate/ Minor

Key Risks	Applicable IFC PS	Phase	Risk Ranking	
			Before Mitigation	With Mitigation
Blade ejection failure	IFC PS4	Operation	Major/ Moderate	Major/ Minor
Accidental transmission line snapping and tower swaying/collapsing	IFC PS4	Operation	Major	Major
Natural Hazards		Operation	Major	Major

- **Ambient Air:** Air emission from land clearing and preparation, construction of substation, transmission line pylons, generator and vessel movement for material transport during construction phase have minor impact on the project area and surrounding area. With mitigation measures, air emission impacts will be reduced to Negligible.
- **Noise:** The noise impacts during the construction and operation phase is assessed to be Minor. Construction noise levels will be reduced to Negligible with the successful implementation of mitigation measures. However, the noise levels during operation phase still remain the same. Recommendations are designed to ensure that any residual impacts are minimised as far as practically achievable.
- **Avifauna:** the impacts on migratory birds during the operation phase was considered to be Major during construction phase and Negligible during operation phase due to relatively high density of species and there are two species identified as Vulnerable (VU) (Great Hornbill and Pale-caped Pigeon). Results of the dry season field surveys show that all flights were at the heights of less than 35 m, which is lower than the Rotor Swept Zone (RSZ). So the bird collision risks is considered Negligible. In terms of electrocution, power poles in flat landscapes lacking trees are particularly attractive to birds to use as perches, which creates a greater risk of electrocution. Regarding bats, no high-risk bat species was identified in the field surveys within the Project EAAA.
- **Terrestrial Habitat:** The key impacts on terrestrial habitat were associated with clearing of the site. Terrestrial biodiversity impacts were considered to Moderate and Minor after mitigation measures were applied during construction phase.
- **Land Acquisition and Economic Displacement:** With a limited number of directly affected people (94 affected households) and none of physical displacement was occurred, it was noted that there would also be substantial economic displacement and associated livelihood impacts with regards to ethnic minority (Bru- Van Kieu). In order to mitigate these impacts, the LRP has been proposed to be prepared. With the mitigation measures, the residual impacts would reduce from Major to Minor level.
- **Economic Impacts:** Economic impacts is one of the positive impact. The Project was identified to create a variety of employment, including direct and indirect that brings positive economic impacts on the local economy of Huong Linh Commune. These indirect and induced employment opportunities include employment through supply chains, development of additional business opportunities to provide services to construction works.
- **Unplanned Events:** Unplanned events will have Major/Moderate impact on the environment and community as they are unlikely to occur. While these events are infrequent, mitigation measures have been identified.
- **Cumulative Impacts:** Cumulative impacts associated with projects will likely be experienced during the construction and operation phases of the Project, including noise impacts, Bird and bat strike and habitat loss; Water quantity & quality; Economy and employment; Local Community Livelihood; Community health and safety; Infrastructure and public services; Traffic; and Shadow

flicker. Cumulative environmental impacts on migratory birds and fauna in the area will become a concern when additional wind farms are developed in the area. The cumulative impacts on shadow flicker are hihly concerned and the impact is considered Major. Cumulative social impacts are mostly considered as Moderate.

In conclusion, the construction and operation of the Project will have impacts of Minor to Moderate significance prior to mitigation. With implementation of the mitigation measures, the residual impacts are considered to be reduced Negligible to Minor.

To manage and mitigate such impacts, the ESMP has been prepared. The ESMP should be read with reference to this ESIA. As part of this report, a range of measures have been developed to reduce the overall impacts to acceptable levels and as low as reasonably practicable. The effective implementation of the ESMP and adherence with the IFC guidelines will assist in managing the environmental and social impacts to acceptable levels.

1. INTRODUCTION

1.1 Purpose

This Environmental and Social Impact Assessment (ESIA) presents an assessment of the potential environmental and social impacts of the GELEX 1,2,3 Wind Power Project in Quang Tri Province, Vietnam.

ERM Vietnam (ERM) was commissioned by Vietnam Electrical Equipment Joint Stock Corporation (GELEX) (hereinafter as" Client") to undertake an ESIA of the GELEX 1,2,3 Wind Power Project. The purpose of the ESIA is to inform GELEX and their project partners about the environmental and social impacts associated with the Project and in particular the extent to which the Project aligns with the expectations of the International Finance Corporation (IFC) Performance Standards and associated World Bank Group Environmental, Health and Safety (EHS) Guidelines.

The ESIA assesses the environmental and social impacts based on the agreed scope of baseline data collection and impact assessment and preludes the preparation of an Environmental and Management Plan (ESMP).

1.2 Project Background

With the rapid growth of energy demand and global trend of searching energy sources that reduce greenhouse gas emissions, the Government of Vietnam had reviewed, updated and approved the revised "National Power Development Master Plan (PDP) VII for the 2011- 2020 period, with a vision toward 2030" under Decision No. 428/QD-TTg, dated 18 March 2016 of Prime Minister. Specifically, the Master Plan will prioritize renewable energy (wind energy, solar energy, biomass energy), so as gradually increase the proportion of electricity generated from renewable energy sources. The targets set in PDP VII aims to increase the share of renewable energy to around 7% by 2020 and over 10% by 2030 and reduce the use of coal-fired energy source to ensure energy security, global warming reduction, environmental protection and sustainable socio-economic development.

In order to implement the national strategy of power development and provide opportunities to developers or investors to develop renewable grid-connected electricity production projects, Ministry of Industry and Trade defined priority areas in Quang Tri province for wind power development according to Decision No.6185/QD-BCT, dated 19 June 2015 on Power Development Plan of Quang Tri Province up to 2020, a vision towards to 2030. Particularly, the west mountainous region of Quang Tri Province is appreciated to have a great potential for wind power, where the average wind speed reach 6-7m/s. In addition, three (03) wind energy potential areas with the total 6,707 hectares are identified as details:

- Zone 1: including Huong Son, Huong Lap, Huong Phung Communes, Huong Hoa District with total area of 2,789 hectares.
- Zone 2: including Huong Linh, Huong Lap, Huong Hiep Communes, Huong Hoa District with total area of 2,882 hectares.
- Zone 3: including Gio Viet, Gio Hai, Gio Thanh Communes (Gio Linh District), Vinh Tan Commune and coastal area in Vinh Linh District and Con Co District with total area of 1,036 hectares.

With a purpose to ensure power security and supply electricity without generating greenhouse gas emission, GELEX 1,2,3 Wind Power Project in Quang Tri Province with a total installed capacity of 90MW expecting to generate 273,300MWh/year will be a suitable project that is in line with the Quang Tri Province Power Development Plan and Policy on socio-economic development in association with environmental protection.

In order to comply national investment approval process, the Project proponent firstly divided the Project into three separate projects, named "GELEX 1, GELEX 2 and GELEX 3 Wind Power Project". Three separate projects were proved to proceed by the Quang Tri Province People's Committee under Decision No.331/QD-UBND, dated 18 February 2019 for GELEX 1, 2 and 3 Wind Power Project. GELEX has completed a Feasibility Study in 2019 for 03 proposed wind power plants, which were conducted by SCI Joint Stock Company. Local Environmental Protection Plans (EPP) for GELEX 1 and 2 wind power plant were prepared by Centre for Natural and Environmental Montoring of Quang Tri Province and approved by Huong Hoa District People's Committee under Document No. 02/GXN-UBND, dated 12 March 2020 and Document No. 03/GXN- UBND dated 12 March 2020, respectively.

GELEX seeks international finance for these three projects therefore the ESIA is prepared for the Project named as GELEX Wind Power Project which including all project components of GELEX 1, GELEX 2 and GELEX 3 Wind Power Project.

GELEX Wind Power Project is located in Huong Linh Commune, Huong Hoa District in Quang Tri Province within an area of 26.36 ha (project's footprint) (See Figure 1.1). The key components of the GELEX Wind Power Project include:

- 21 wind turbines with installed capacity of 4.2 MW for each turbine;
- A 22/110kV – 2x63MVA substation;
- About 5.08 km 110kV transmission line that connects the 22/110kV substation of GELEX Wind Power Plant to Lao Bao 110/220kV substation;
- Approximately 10.74km overhead 22kV transmission line that connects all turbines;
- About 9.915 km internal road which will be rehabilitated and expanded.

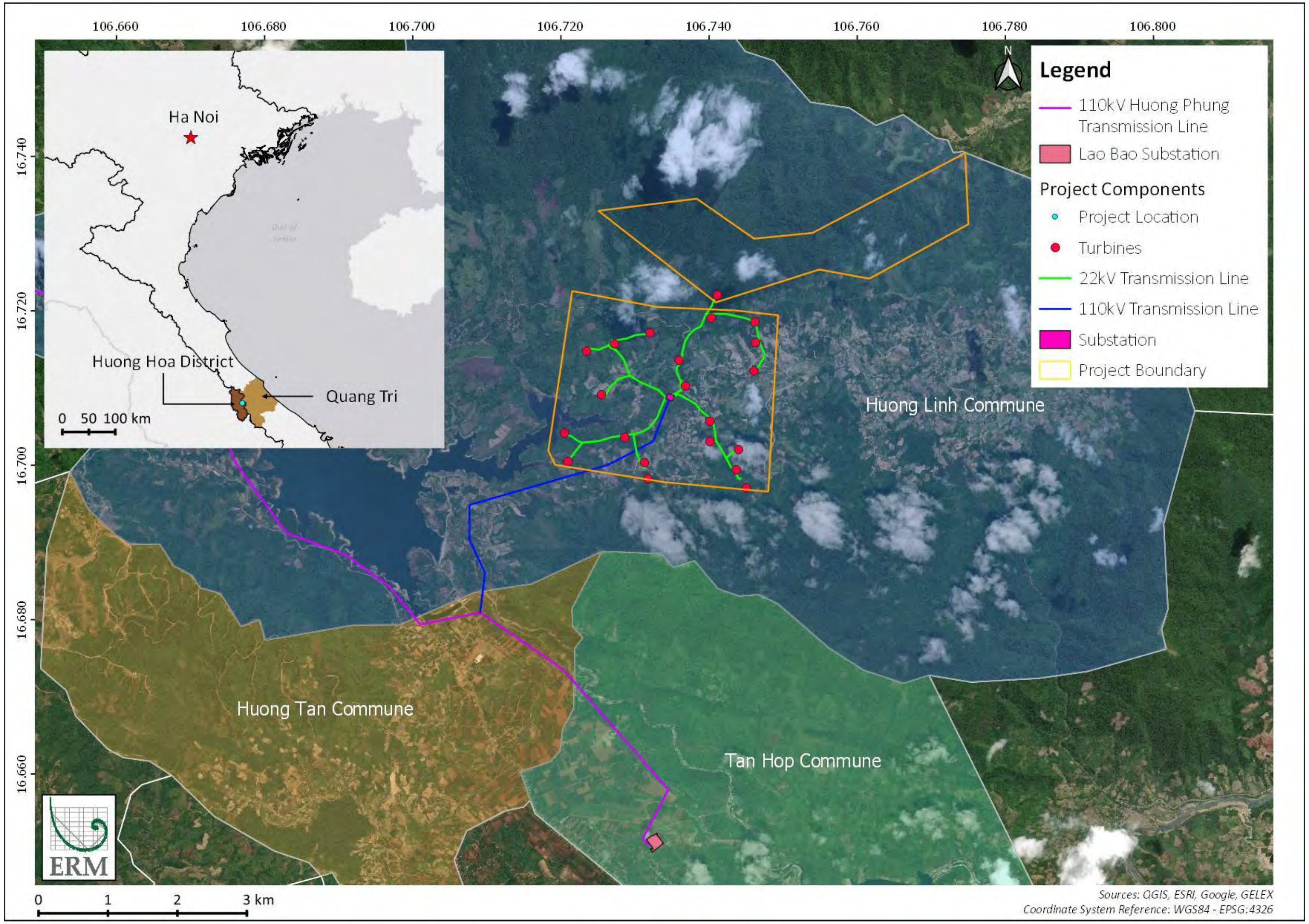


Figure 1.1 Project Location

1.3 Environmental and Social Impact Assessment Objective

The objective of this ESIA is to assess potential impacts of the wind power project on the environment, cultural heritage and socio-economic development of affected areas, and to propose measures in order to avoid, reduce or mitigate negative impacts against the applicable standards to support GELEX's application for finance from International Lenders.

1.4 Scope of Baseline survey and Impact Assessment

The Baseline studies and impact assessment for the ESIA reports is summarised in Table 1.1. The further detailes of impact assessment will be identified in Chapter 5.

Table 1.1 Scope of Baseline Survey and Impact Assessment

Topic	Scope of Work
Baseline survey	
Flora and fauna species survey	Undertake desktop assessment and onshore floral surveys to map the distribution and species composition of onshore and shoreline vegetation, particularly mangrove communities. Floral surveys will be conducted over a single season.
Seasonal vantage point survey for avifauna	Undertake two seasonal land- based vantage point bird surveys within the wind farm block.
Bat (chiropteran) screening	Undertake a comprehensive desktop study of the likely presence, abundance and distribution of bat species to systematically assess the information on chiropteran fauna in the study area.
Environmental Baseline Studies	Obtain the physical environmental baseline information (e.g. air quality, surface water quality, soil) from the regulatory EPP prepared by the Project's local consultancy; and Conduct noise baseline monitoring.
Socio-economic Baseline Studies	Undertake stakeholder engagement; and Complete a household survey, collect primary data and analyis.
Biodiversity Assessment	Determine the presence of IUCN Endangered or Critical Endangered species and endemic or restricted range species; Undertake an assessment of natural and modified habitats; Determine key biodiversity values; and Note any existing key threats to habitats and species.
Noise Screening Study and Assessment	Determine IFC operational noise thresholds and limits; Develop project-specific operational noise models to calculate ISO 9613:2 wind farm noise levels; and Compare resultant noise levels with project-specific criteria, identify any levels that exceed thresholds and limits, and qualify the magnitude and extent of any impacts.
Stakeholder Engagement Plan	Determine any stakeholder identification and mapping previously undertaken; Determine stakeholder engagement/disclosure activities to date, including the nature of information and the medium of disclosure;

Topic	Scope of Work
	Establish how findings of the stakeholder engagement have been included in the decision making process; and Establish any ongoing issues identified during stakeholder engagement that might have relevance for the Project.
Impact Assesessment	
Surface and Ground water Quality	Assess impacts on changes to physical, chemical or biological quality of surface water bodies and ground water resources and changes in habitat quality, abundance, diversity
Soil Environemnt	Assess impacts on Changes to physical and chemical soil properties
Air Quality	Emissions of NO_x, SO_x, PM, CO
EMF	Assess Impacts of potential of electromagnetic interference (EMI) which may occur from the Project development
Shadow Flicker	Potential impacts on health of project-affected people (eyes, vision) and vegetation growth
Social Impact Assessment	Assess Impacts on Physical/ Economical Displacement, Economy and Employment, Occupational and Community Health and Safety, Infrastructure and Public services, Cultural resources
Indigenous People Impact Assessment	Assess impacts on effect on customary rights of use and access to land and natural resources; socio-economic status; cultural and community integrity; livelihood and social security status; indigenous knowledge.

1.5 Structure of the ESIA

The structure and contents of the ESIA is as follows:

Table 1.2 ESIA Structure

Volume	Chapter	Chapter Title
Executive Summary		
1	1	Introduction
	2	Project Description
	3	Administrative Framework
	4	Impact Assessment Methodology
	5	ESIA Screening and Scoping
	6	Stakeholder Engagement
2	7	Environmental Baseline
	8	Biodiversity Baseline
	9	Social-economic Baseline
3	10	Environmental Impact Assessment
	11	Social Impact Assessment

Volume	Chapter	Chapter Title
	12	Unplanned Events
	13	Rapid Cumulative Impact Assessment
	14	Environmental and Social Impact Assessment
Appendices		

2. PROJECT DESCRIPTION

This chapter provides a description of the Project development, including the site selection process and alternative sites, Project status and proposed schedule and a description of the facilities, equipment and the associated activities that will be carried out during the site preparation, construction and operation phases. It also provides a description of potential unplanned events and details of employment and accommodation for workers during construction and operation.

2.1 Project Alternatives

The "IFC Performance Standard 1" (IFC, 2012) and the associated "IFC Guidance Note 1" (IFC, 2012) requires that the ESIA shall identify and analyse alternatives, including but not limited to project site location, design, technology and no project alternative (which assumes that the Project development does not happen). This section provides an analysis of certain alternatives to the Project development in relation to: (i) the "no project scenario", (ii) the Project site selection alternatives and (iiI) methods of power generation alternatives.

2.1.1 No Project Scenario

Vietnam has large reserves of primary energy resources, such as coal, oil, natural gas, and water for hydropower generation. It also has a high potential for renewable energy resources, such as biomass, solar, and wind. During the period 2007-2017, Vietnamese total primary energy supply (TPES[1]) grew at 4.7 % per annum. Hydropower experienced the highest growth at 14.5 % per annum, followed by coal at 11.3 % per annum. The share of coal increased from the third largest fuel source in 2007 to the largest in 2017. Meanwhile, the share of biomass fell from being the largest contributor in 2007 to the third largest in 2017. Oil, growing at the rate of 4.3 % per annum, is the second largest fuel source. Solar and wind have historically only contributed to a very small share in TPES. An overview of the progress of primary energy supply mix from 2007 to 2017 is presented in Figure 2.1.

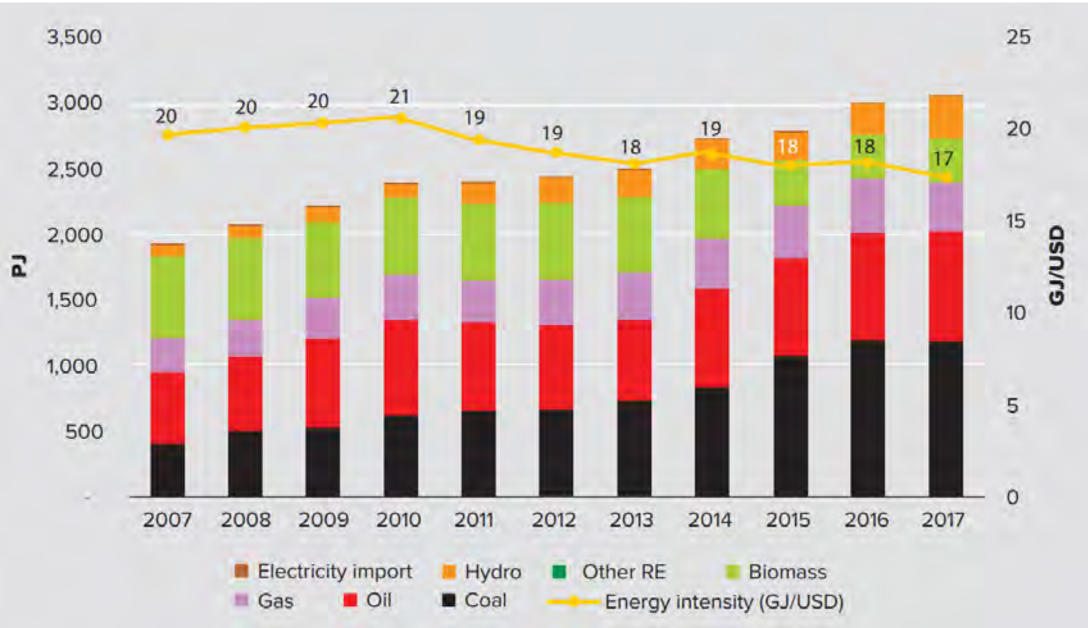
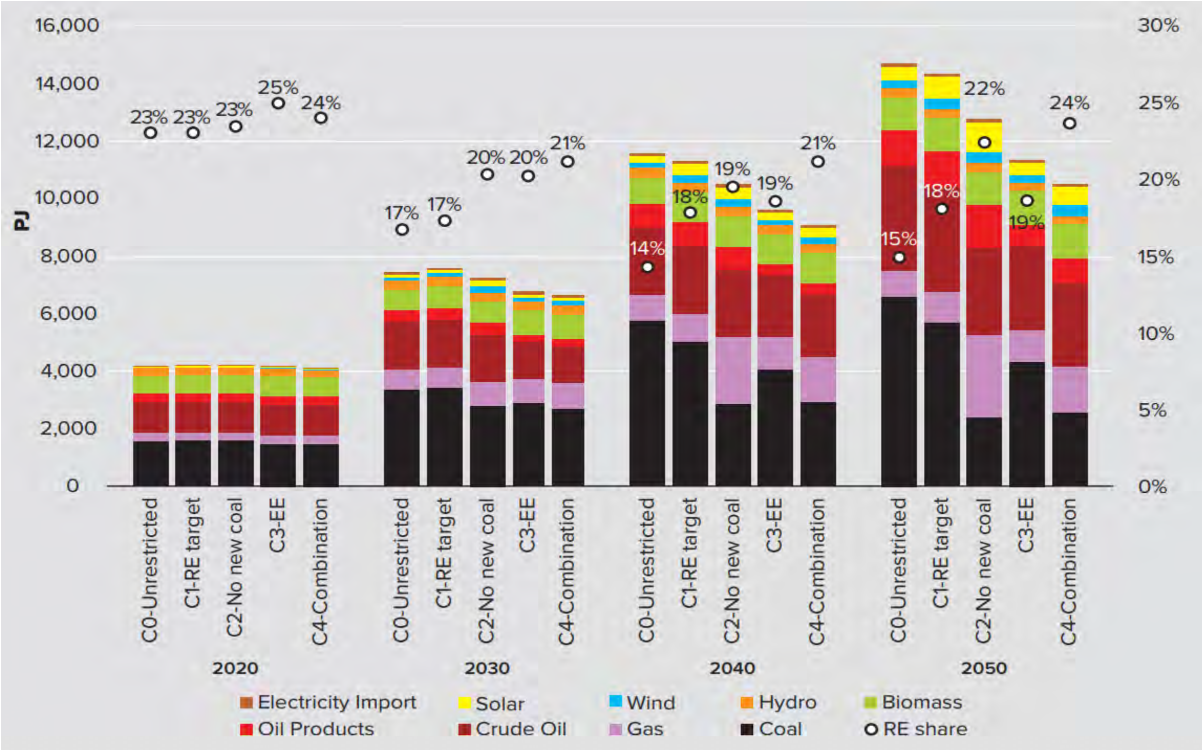


Figure 2.1 Progress of Primary Energy Supply Mix from 2007 to 2017

[1] Total primary energy supply describes the total input of primary energy to the energy system. TPES is the sum of production and imports subtracting exports and storage changes. Where primary energy is used to describe fuels, it is the energy available as thermal energy in the fuel. When solar and wind energy is converted to electricity, the electricity made from wind and solar counts as the primary energy for these sources.

Figure 2.2 shows the predicted power generation make-up of Vietnam by fuel type to 2050. While this shows a heavy reliance on coal fired power generation, it also shows the growth in supply by renewables such as hydropower to remain relatively stable over that period.

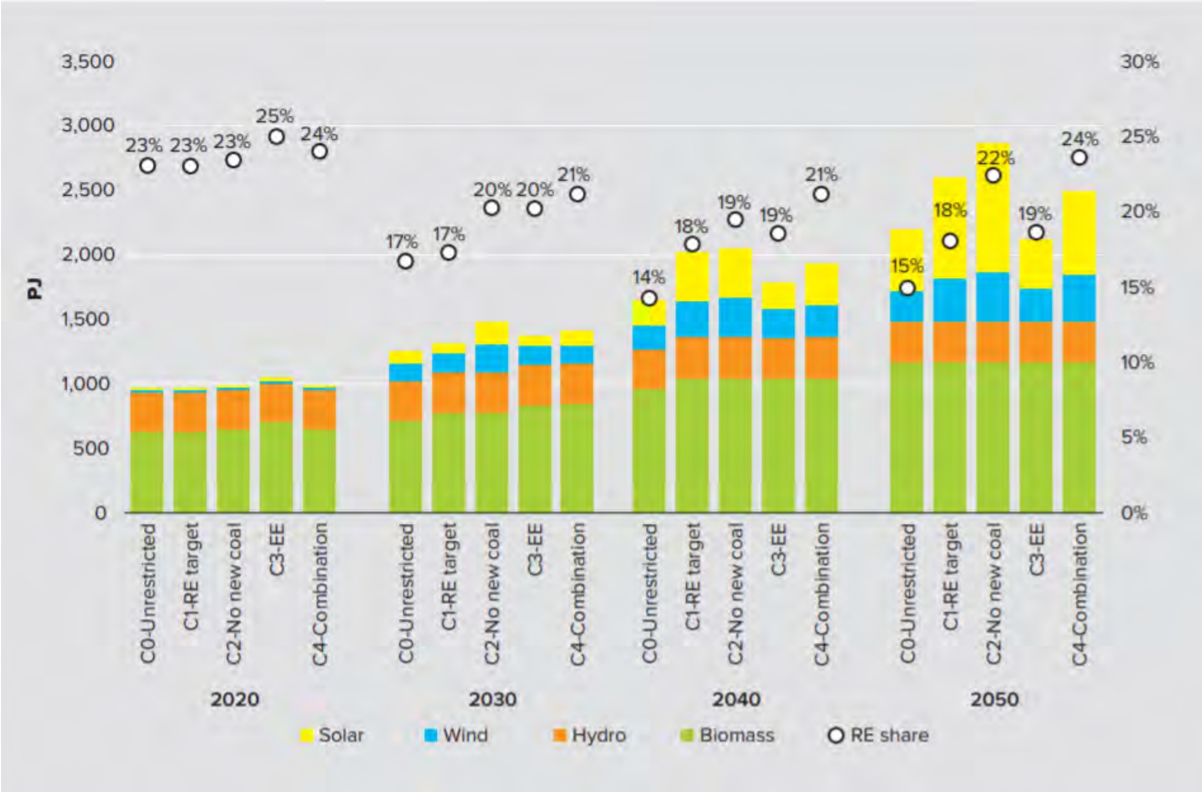


Source: Vietnam Energy Outlook Report, 2019

Figure 2.2 Total Primary Energy Supply (TPES) and RE Share in TPES across Analysed Scenarios in the Period 2020 – 2050

The revised National Power Development Plan in the period 2011-2020 with the vision to 2030 and the Renewable Energy (RE) Development Strategy together set relatively concrete directions for the development of the power sector in the coming years. Regarding the primary energy mix per fuel type, coal still covers the major part but tends to be stable in the following years of the planning period at the proportion of 37.3 % in 2025 and 38.4 % in 2035. This is a result of applying low carbon policies to promote RE development. Hydro power experiences a significant reduction while gasoline and oil products cover over 20-22 % and natural gas accounts for about 11-13 % of the total primary energy.

The Energy Outlook Report (EOR) 2019 showed that the RE shares in TPES have a slightly decreasing trend in future years, primarily due to a large increase in fossil fuel consumption. With the proposed scenarios, the share of RE in the total primary energy supply could reach 21% in 2030, then increase to 24% in 2050. This ratio is remarkably higher than the one under the Business as Usual (BaU) scenario, but still fails to meet the required target in the RE Development Strategy (32% in 2030 and 44% in 2050).



Source: Vietnam Energy Outlook Report, 2019

Figure 2.3 Renewable Energy Sources and Their Share in TPES for All Analysed Scenarios

Figure 2.3 has shown that wind and solar shares significantly increase across the scenarios, as they have low operation and maintenance costs and no fuel costs. Additional analysis in EOR2019 showed that with increasing wind and solar shares, the total energy system cost slightly increases while capital cost increases rapidly. Therefore, in the transition from conventional power production to wind and solar, it should be take consideration of access to capital cost, even considering the expectation that the investment costs of wind and solar will decrease drastically in the coming 30 years.

Financing of clean energy investments is a booming market. After 2030, with the fossil fuels' increasing price tendency, the investment cost of fossil fuel power sources will increase due to stricter environmental standards while the power production cost of RE sources will fall as a result of technology improvement. As a result, RE could be able to compete with traditional power sources.

Should the Project not proceed, power supply would continue to be met by other sources, however as noted there is clearly a current and future reliance on fossil fuel generated power, particularly coal. In addition, should the project not move forward, the significant positive economic and environmental benefits would not be realized. Some benefits would be include the following:

- Producing clean energy that contributing energy security through development of local energy resources and decreasing dependency on traditional energy sources;
- The clean energy produced from renewable energy resources contributes to decrease global warming due to the fact that it produces no greenhouse gas emission and reduces some types of air pollution.
- During the construction and operation phase, the Project is expected to generate local employment opportunities. As such, this is expected, to a certain extent, to subsequently enhance the socio-economic conditions and standards of living of local community where the project will be developed.

- In the case of this Project, it is crucial to take consideration of positive environmental and social impacts incurred from the project development, against negative impacts that anticipated at the site-specific level. However, it could be concluded that the “no project” is not a preferable option.

2.1.2 Site Selection Alternatives

According to “Wind Resource Atlas of Vietnam” prepared by AWS Truepower, LLC (March, 2011), Huong Hoa District, Quang Tri Province is considered as potential wind source area, which has average wind speed ranging from 6.75 – 7.0 m/s measured at the altitude of 80m. In addition, based on the outcomes of wind measurment stations set up in Huong Linh 1, 2 wind power plant at the height of 60m, 80m and 100m with measurement period of Jan 2019 to December 2019, it is confirmed that the Huong Linh Commune is the priority area for wind farm development in Quang Tri province. The project site was identified and approved by the Ministry of Industry and Trade in accordance with the Decision No 4797/ QĐ-BCT, dated 27 December 2018 on supplementing the Project into the“Power Development Plan of Quang Tri Province in the period of 2016 -2025, a vision towards to 2035”.

The certain project site was identified and selected by MoIT due to some main factors as follows:

- The Project location was in vacant and unused land and a part of project area was located in production forest area;
- As mentioned above, the selected site has a good meteorological conditions such as superior wind speed; and located in high potential wind resource area;
- The site is in line with local authority’s development planning for the whole area and is concurred and supported by local authority under the Decision No.331/QD-UBND, dated February 18, 2019 for GELEX Wind Power Plants;
- The site location is feasible for connecting the plant to national power system.

2.1.3 Alternative Methods of Power Generation

This section discussed several alternatives besides the development of a wind farm project. This mainly includes other renewable energy alternatives suitable in general as well as other alternatives for power generation such as conventional thermal power plants.

There are a range of power generation options potentially available and a summary of the advantages and disadvantages of these options are provided at Table 2.1.The Project is currently consistent with the Vietnamese National Power Development Plan for the period 2011 – 2020 with the vision to 2030 (under Decision No 428/QD-TTg, dated 18 March 2016), which mostly focused on the renewable power development. The revised Power Development Plan VII outlined a master plan for power source development, in which renewable energy (wind energy, solar energy, bio energy) will be prioritized, so as to gradually increase the proportion of electricity generated from Renewable energy sources. The key objective of the Project is to meet the supply-demand balance of power resource by exploiting potential wind power for producing electricity in contribution to increase environmental efficiency.

Table 2.1 Comparision of Power Generation Methods

System	Advantage	Disadvantage
Supercritical Thermal Power	■ Large-scale production potential ■ Moderate gestation period Wider distribution potential ■ Provides cheap electricity to the consumer ■ Provide stable output and reliable electricity on the grid ■ Easily accessible and well established technology ■ Requires less land per Megawatt	■ High fossil fuel consumption ■ Large quantities of water required for cooling ■ High volume of emission from operation ■ Accumulation of fly ash (in case of coal powered installations) ■ Upstream impact from mining and oil exploration
Ultra Supercritical Thermal Power	In addition to the above advantages: ■ Improved efficiency by reaching higher pressure and temperatures compared to supercritical boilers. ■ Reduced emissions, particularly of CO and mercury. ■ The general rule of thumb is that each percentage point of efficiency improvement yields 2–3% less CO. ■ Potentially lower operating costs	As above.
Hydropower	■ GHG emission estimated as low ■ Do not create any waste by-products during conversion process ■ Some hydropower facilities can quickly go from zero power to maximum output. Because hydropower plant can generate power to the grid immediately, they provide essential back-up power during major electricity outages or disruptions	■ Site specific, dependent on reservoir/ river ■ Long gestation period ■ Alteration of river flow regime ■ Adverse social and ecological impacts due to inundation and downstream effects
Solar power	■ Pollution levels are insignificant ■ Inexpensive power generation ■ Inexhaustible solar resource ■ GHG emissions estimated as low	■ Large land requirement ■ Site-specific, dependent on solar insolation ■ Expensive installation

System	Advantage	Disadvantage
Wind power	■ Pollution levels are low ■ Inexpensive power generation ■ Inexhaustible wind resource ■ GHG emissions estimated as low	■ Large land requirement ■ Site-specific, dependent on wind pattern ■ Expensive installation
Nuclear power	■ GHG emissions estimated as low ■ Low fuel cost ■ The production of electric energy is continuous. A nuclear power plant generates electricity for almost 90% of annual time. It reduces the price volatility compared to other fuels ■ Do not emit smoke particles or gases	■ Availability of fuel source ■ Hazards associated with radioactive material ■ High cost of project ■ Disposal waste is expensive, as wastes are radioactive in nature ■ Long gestation period ■ Risk of fallout and meltdown scenarios and its impacts on the local population and environment

2.2 Project Location

The Project's footprint is located within a 26.36 ha area in Huong Linh Commune, Huong Hoa District, Quang Tri Province, which is considered as the highest potential wind source area with an average wind speed of 7 -7.9 m /s. The proposed wind farm site is located in a mountainous area with an average altitude ranging from around 450m to about 540m above sea level. The project site can be accessed through the Western Ho Chi Minh Trail road, which is about 5.5 km west and southwest of the Project site and asphalt road Highway 9, which is about 10 km south of the Project site.

The physical surrounds of the Project are described below (See Figure 2.4):

- To the North: the project is adjacent to Huong Son, Huong Lap Communes, Huong Hoa District.
- To the South: the project is adjacent to Tan Hop Commune, Lao Bao Town, Huong Hoa District.
- To the West: the project is adjacent to Rao Quan Lake.
- To the East: the project is adjacent to Krong Klang Commune, Dakrong District.

Coordinates of GELEX Wind Power Project were set up in accordance to Decision No. 8228/BCT- ĐL dated 30th October, 2019 of Ministry of Industry and Trade on adjusting some turbines positions of GELEX 3 Wind Power Plant Project and Area of GELEX 1, 2 Wind Power Plant Project.

The location of the Project area studied in this ESIA, as well as the locations of its wind turbines and substation are presented in Table 2.2, Table 2.3 and Table 2.4 respectively.

Table 2.2 Locations of Project Boundary Area

Landmark	Coordinates (WGS84)	
	Latitude (m) – X(m)	Longitude (m)- Y(m)
1	16.70187068	106.718308
2	16.70005849	106.719228
3	16.697798	106.7341371
4	16.69657471	106.7480133
5	16.71943095	106.7497493
6	16.72005292	106.7436526
7	16.72050897	106.7330205
8	16.722569	106.7215341

Table 2.3 Locations of GELEX Wind Power Project's Wind Turbines

Turbines	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
GL1.1	16.70048573	106.7209533
GL1.2	16.70417596	106.7204804
GL1.3	16.71479998	106.7234777
GL1.4	16.70913502	106.7254841

Turbines	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
GL1.5	16.70363309	106.7286414
GL1.6	16.7003525	106.7312911
GL1.7	16.69826089	106.7317431
GL2.1	16.71027735	106.7368199
GL2.2	16.70572131	106.7401372
GL2.3	16.70307689	106.7401441
GL2.4	16.70204443	106.74399
GL2.5	16.6994266	106.743677
GL2.6	16.69705521	106.7450331
GL2.7	16.71576577	106.7272436
GL3.1	16.71908772	106.7403058
GL3.2	16.72204829	106.7411352
GL3.3	16.71858485	106.746205
GL3.4	16.71590731	106.7462954
GL3.5	16.71222396	106.7460798
GL3.6	16.70048573	106.7209533
GL3.7	16.70417596	106.7204804

Table 2.4 Location of 22kV/110kV Substation of GELEX Wind Power Plant

Landmark	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
TBA1	16.709199	106.732565
TBA 2	16.709474	106.733515
TBA 3	16.710389	106.733229
TBA 4	16.710128	106.732290

Source: Project Feasibility Study, 2019

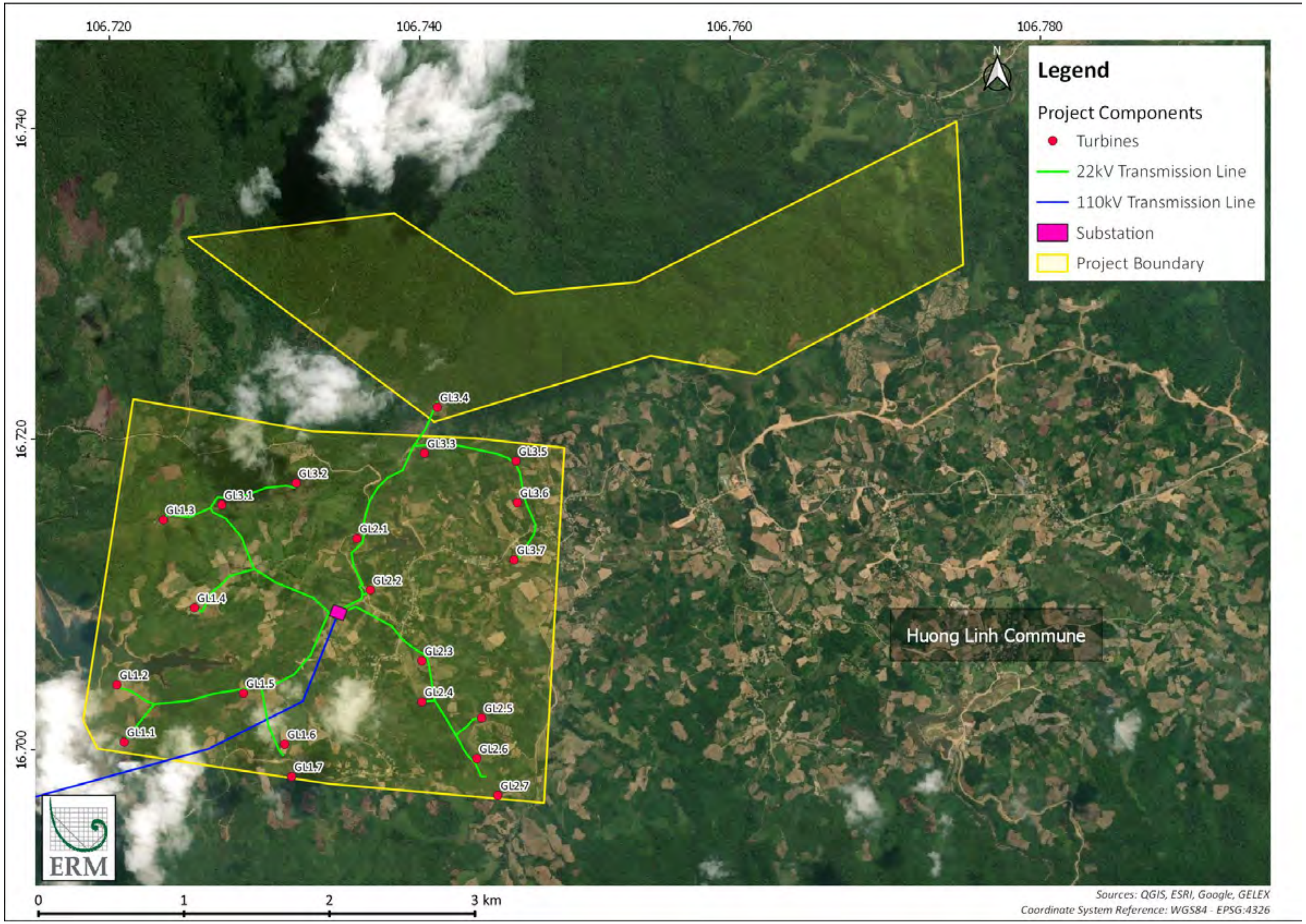


Figure 2.4 **Project Locations and Turbines Layout**

2.2.1 Wind turbine layout

The entire wind power project, including twenty-one (21) wind turbines, is expected to be built on a mountainous area. Selection of wind turbine layout and distance from one turbine to another should basically meet the following requirements:

- The turbines shall be placed in the good meteorological condition area such as superior wind speed;
- For safety, the minimum distance among wind turbines in a wind farm is generally limited ranging from three times of rotor diameters to five times of rotor diameters, which its direction is perpendicular to main wind direction. Due to the limits of the wind farm area, the proposed project suggested the turbine distance will be checked from three rotor diameters to four rotor diameters;
- Ensuring cost of electrical connection shall be reasonable due to the fact that the turbine distance is larger, the cost of connection cables is more expensive.

The Project's wind turbine layout is presented in Figure 2.4.

2.2.2 Substation and operation house

The 22/110kV substation with a capacity of 2 x 63 MVA is planned to be built in Huong Linh Commune. The substation is approximately 400m from the nearest residential area and is about 200m from the nearest wind turbine (GL2.2) The total area for substation, operation house and auxiliary works is approximately 1.897 ha, of which land currently used for forest production takes up 40% (0.757 ha) while the rest area is agricultural land accounting for 60% (1.139ha).

2.2.3 22 kV transmission line

The 10.74 km overhead 22kV transmission line that connects all turbines will pass through mainly vacant and unused land, which takes up 98.9% (0.0178 ha) of total fixed-term used land for overhead 22 kV transmission line while the rest area is agricultural land accounting for 1.1% (0.005 ha). The layout of 22kV transmission line is presented in Figure 2.4.

2.2.4 110kV transmission line

According to Power Development Master Plan of Quang Tri Province, an overhead 110kV transmission line with a length of 5.08 km will be constructed to connect 22/110kV substation to Lao Bao 110/220kV substation which is under construction. The 110kV transmission line will pass through mainly land for perennial crops and vacant and unused land, which is about 1.545 ha, accounting for 61.14% area of fixed-term used land for 110kV transmission line. The rest area is production forest and agricultural land, taking up 38.86% (0.983 ha)[2].

2.3 Project Schedule

The schedule for Project Implementation is shown in detail in the following Table 2.5.

Table 2.5 GELEX Wind Power Project Schedule

No.	Timeframe	Duration	Activity
1	October 2019 – January 2020	4 months	■ Survey, set up Feasibility Study report ■ Approve the Feasibility Study report
2	February 2020 – June 2020	5 months	Prepare Detailed Design

[2] Source: Feasibility Study Report for Gelex 3

No.	Timeframe	Duration	Activity
3	January 2020 – June 2020	5 months	■ Conduct Land Clearance and Inventory of Loss and Land Acquisition ■ Negotiate and sign EPC contract
4	June 2020 – Sep 2021	15 months	Construction phase (construction of wind turbines foundation, substation, transmission line, access road and operation house).
7	Sep 2021 – October 2021	3 months	Trial for operation, and begin operation.
Estimated project duration			32 months

The project is expected to be operational for a period of 20 years.

2.4 Project Facilities and Components

A flow diagram of the Project's power production process indicating its main components is provided in below Figure 2.5.

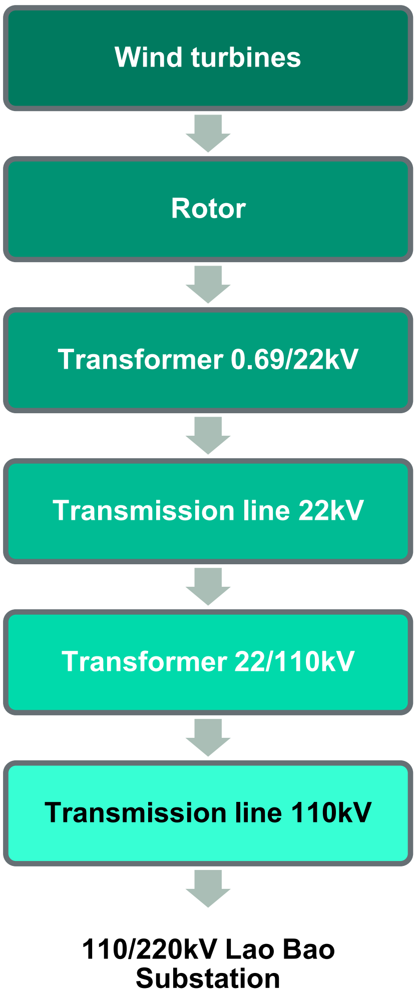


Figure 2.5 Flow Diagram of Project's Power Production Process

Wind turbine technology operates by harvesting the kinetic energy in wind and turning it into mechanical energy which in turn is used for electricity generation. The energy in the wind with a speed of 4-5 m/s turns two or three propeller-like blades around a rotor with a speed of 30 – 60 rounds/minute. The rotor is connected to the main shaft, which spins a generator that converting wind energy to electricity (3 phase, alternating current, 690V). The transformers will increase the electricity to 22kV. The transformers connect with each other through the medium voltage line 22kV and then connects to the substation 22/110kV. Electricity from substation 110kV will connect to the 110/220kV Lao Bao Substation through the dual circuit of 110kV transmission line.

2.4.1 Wind turbines

2.4.1.1 Rotor

According to the Feasibility Study Report 2019, there are twenty-one (21) wind turbines tower to be built in the Project. The key specification of chosen turbine is presented in Table 2.6 below:

Table 2.6 GELEX Wind Turbine's Specification

Specifications	
Manufacturer	ENERCON GmbH
Type designation	E-138 EP3 E2; Horizontal turbine; Gearless, Variable speed, single blade adjustment
Total capacity	4.2MW
Turbine height (hub height)	111m
Tip height	167.68m
Diameter	138.25m
Number of wings	3
Rotor starts at wind speed	2m/s
Rotor stops (after 10 minutes) when wind speed reaches	25 m/s

Source: Feasibility Study Report, 2019.

2.4.1.2 Transformer 0.69/22kV

Specifications	
The rated capacity	5000kVA
output voltage	22kV
Frequency	50Hz

Source: Feasibility Study Report, 2019.

2.4.2 110kV transmission line

The specifications of 110 kV transmission line are described as below:

Specifications	
Length	5.084 km
Type	Overhead

Specifications	
No. of circuits	2 (pre-installed 1 circuit)
Connection point (input)	110kV Gate column of 110/22kV substation
Connection point (output)	110kV dual-circuit transmission line of 220 kV Lao Bao Substation.
Cable	ACSR- 300/39
Lightning rod	01 GSW-50 lightning protection cable, 01 lightning protection cable with OPGW-57 optical cable (12 fibre-optic cables), as per ITU.T G652 standard.
Insulation	Using glass or ceramic support insulator with capacity of 70kN and 120kN, as per IEC standard.
Column	Using free-standing, dual circuit galvanised steel tower columns.
Foundation	Using cast-in-place reinforced concrete foundation
Route corridor	15 m (from the centre line to each side 7.5 m)
Earthing system	Using galvanised steel

2.4.3 22kV transmission line

The specifications of 22 kV transmission line are described as below:

Specifications	
Length	10.74 km
Type	overhead
No. of circuits	1 and 2 circuits
Cable	ACSR – 185/29mm^2
Insulation	Using 24kV porcelain support insulators and dual polymer 24kV porcelain support insulators
Column	Using centrifugal concrete piles with length of 12m, 14m and 18m.
Foundation	Using cast-in-place reinforced concrete foundation

2.4.4 Transmission parts

The transmission parts will include the following:

- Gear box;
- Coupling;
- Brake;
- Controller;
- Anemometer;
- Quick rotation axis connecting between gear and generator;
- Generator;

- High-speed shaft;
- Yaw drive; and
- Yaw motor.

2.4.5 Access Road and Internal Road System

An inter-village road of Huong Linh Commune has existed within Project site, which is 200m – 700m from wind turbines. This road is currently asphalted with a width of 6m. However, this road is only used for travel and production activities of local people. So, it is necessary to renovate, upgrade an existing access road for transporting materials, turbines, machine and equipment and serve the construction and operation activities of the Project. The access road is estimated 10 km long.

The internal road connected to turbine towers and the operation house will be built as concrete road with the width of 5.5 m; designed speed of 30km/h and the maximum slope of 8%. The entire internal road system will be constructed within the Project footprint. The length of internal road of GELEX Wind power plant will be 9.915 km.

2.4.6 Other components

- Laydown area
- Other facilities during construction phase such as cement batching plant, fuel storage area, water storage area, construction office.
- Wind monitoring system with meteorological sensors (speed, wind direction);
- Anti-lightning system;
- Communication system;
- Control system;
- Electricity metering system;
- Fire protection equipment for fire prevention;
- CMS (Conditional Monitoring System);
- Warning lights department; and
- Remote monitoring department.

2.5 Project Activities

2.5.1 Pre-construction phase

The Pre-construction phase will include two main activities:

- Land acquisition for clearance. The project developer will coordinate with local authorities to measure and conduct inventory of loss, then develop the compensation, support and resettlement plan.
- Demining and UXO clearance in the Project area, by hiring a military unit with such capabilities;
- Site preparation of the substation and other utility elements (operation house, auxiliary works, etc.) including EPC contractor mobilisation;
- Vegetation clearance includes mechanised tree chopping and root digging; and
- Site clearance and levelling ground

According to Feasibility report for the Project's design, the Site Plan of the Project is divided into several main areas, as follows:

Table 2.7 Area of Land for the Project

No.	Items	Area (ha)					Total (ha)
		Production Forest Land	Land for Perennial crops	Vacant land for forestry	Agricultural land	Land for business	
Fixed-term used land							
1	Turbine foundation and security fence	2.651	2.116	4.42	4.41	0.067	**13.664**
2	Substation 22/110 kV and control room, parking lot, warehouse and auxiliary works	0.757	-	-	1.139	-	**1.896**
3	Pylon and of 22kV transmission line	0.015	0.0149	0.0379	0.0095	-	**0.0773**
4	Pylon and 110kV transmission line	0.281	0.796	0.749	0.421	0.281	**2.528**
5	Traffic road system (Upgraded inter-village road and build new internal road)	2.027	1.938	2.44	1.868	0.234	**8.507**
Temporarily-used land							
6	Temporary excavated soil site	1.89	1.2	2.33	1.12	0.5	**7.04**
7	Laydown area	-	-	4.4	-	-	**4.4**
8	Crane Installation Site	-	-	4.3	-	-	**4.3**
9	Concrete batching plant	-	-	3.0	-	-	**3.0**
10	Construction of 110kV transmission line	0.14	0.796	0.19	0.14	0.047	**1.313**
TOTAL AREA (ha)		**7.761**	**6.86**	**21.87**	**9.11**	**1.13**	**46.73**

2.5.2 Construction Phase

Key activities of the Construction Phase will include:

- Construction/establishment of the cement batching plant;
- Construction of turbine foundations;
- Construction of a 22/110kV substation and operation house;
- Construction of 22kV overhead transmission line and 110kV overhead transmission line;
- Construction of internal road and upgrading existing access road;
- Transportation of wind turbines, construction material and machines;
- Installation of substation fence, auxiliary works;
- Installing turbines, electrical equipment, cabinets, panels;

- Installation of the communication system, fibre optic cable, and SCADA (Supervisory Control and Data Acquisition);
- Construction and installation of water supply and drainage system, power supply system and fences;
- Completion of internal electrical connections; and
- Commissioning.

2.5.2.1 Wind turbine layout construction

2.5.2.1.1 Turbine foundation

The turbine foundation will be the round shaped shallow mat type foundation. The foundation will include the basement, the mat and the central pillar, which being poured concrete M400; stones of 1x2 and bearing steels CIII type. The thickness of concrete layer that protect steel against water resistant should be 5.0cm. Round shaped turbine foundation will be built with diameter of 10m, depth of 5m. Anchor bolts are extensively used to connect the foundation and the pillar.

Formwork will be installed, braced and reinfornced prior to concrete being poured into the foundation. Formwork can be made of wooden planks, Formwork must be erected and tightened before concreting begins.

Figure 2.6 Round-Shaped Turbine Foundation

2.5.2.1.2 Turbine installation

After completing construction of the wind turbine foundation, the next steps will be to assembly the wind turbine components. Lifting works will begin with the lowest tower subsections. Complete nacelles, with gearboxes and generators already installed, will be lifted onto the tower tops. The rotor blades will be fixed to the hub before being lifted and connected to the nacelle. It is noted that installation of some components cannot occur when the wind speed is greater than 10 m/s due to safety constraints of the cranes.

The key processes required for WTG installation are presented in Figure 2.7.

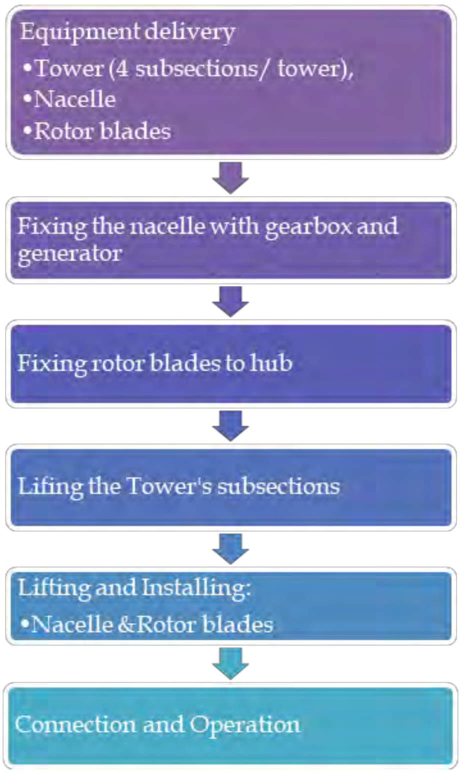


Figure 2.7 Flow Chart of Turbine Installation Process

2.5.2.2 Substation and control house

A substation 22kV/110kV will be developed with a total estimated capacity of 2x63 MVA

The construction of the substation and control house includes but is not limited to the following activities:

- Earthworks:
  - Levelling;
  - Access road;
  - Digging and covering soil
- Substation foundation construction: cast- in place reinforced concrete M200.
- Installation of electrical equipment:
  - Transformers;
  - Outdoor and indoor equipment.
- Installation of cooling system, auxiliary oil tank, pipeline system, fire protection system.

2.5.2.3 Transmission lines

- The construction of the transmission lines includes but is not limited to the following activities:
  - Building the transmission pylons foundation, including:

- Soil excavation;

- Installing the cast-in place reinforced concrete foundation by concreted stone 2x4, compression strength of B15 (M200) and precast reinforced concrete foundation concreted stone 1x2, compression strength of B15 (M200)
- Assembling the pylons: Using centrifugal concrete column of 12m; 14m and 16m of height.
- Installation of insulation and accessories;
- Straining of rope to measure deflection;
- String power lines; and
- Grounding installation work.

2.5.2.4 Power Supply

According to the regulatory EPP and FS reports, power for the Construction Phase will be taken from two sources:

- Source 1: Power supply from diesel generator
- Source 2: Power supply from the existing 110kV transmission line near the construction site.

2.5.2.5 Water Supply

According to the regulatory Environmental Protection Plan (EPP) and Feasibility Study (FS) report, water for the construction activities will be taken from natural streams within the Project footprint. However, water for domestic activities will be ground water taken from 30m-depth predefined wells. Pumping will be used to take groundwater into three (03) 1000 liters storage tanks. The ground water sources will also be used in Operation Phase of GELEX Wind power Plant for domestic usage and fire protection system.

2.5.2.6 Transportation of major equipment and material

Main major equipments (wind turbines, propeller, transformer...) are usually imported from foreign firms, as are high-strength bolts with fatigue design which are used to connect the colums. These equipment will be transported by sea and then unloaded to Hon La port, Quang Dong Commune, Quang Trach District, Quang Binh Province.

Special trailer crane will be used to unload and transport these equipment to the construction site.

Materials will be transported to the site by road from Hon La port via Quang Trach inter-district route to national road 1A, along the road Quang Binh 71 to National Road 15. Then passing National Road 9 to Khe Van Bridge. The project site can be accessed through the inter-village route Huong Linh Commune and internal road. The total length of the transported route is approximately 200km.

In term of soucing the construction material, it is understood that some materials (levelling sand, brick, stone, iron, steel materials) can be purchased directly from Quang Tri province.

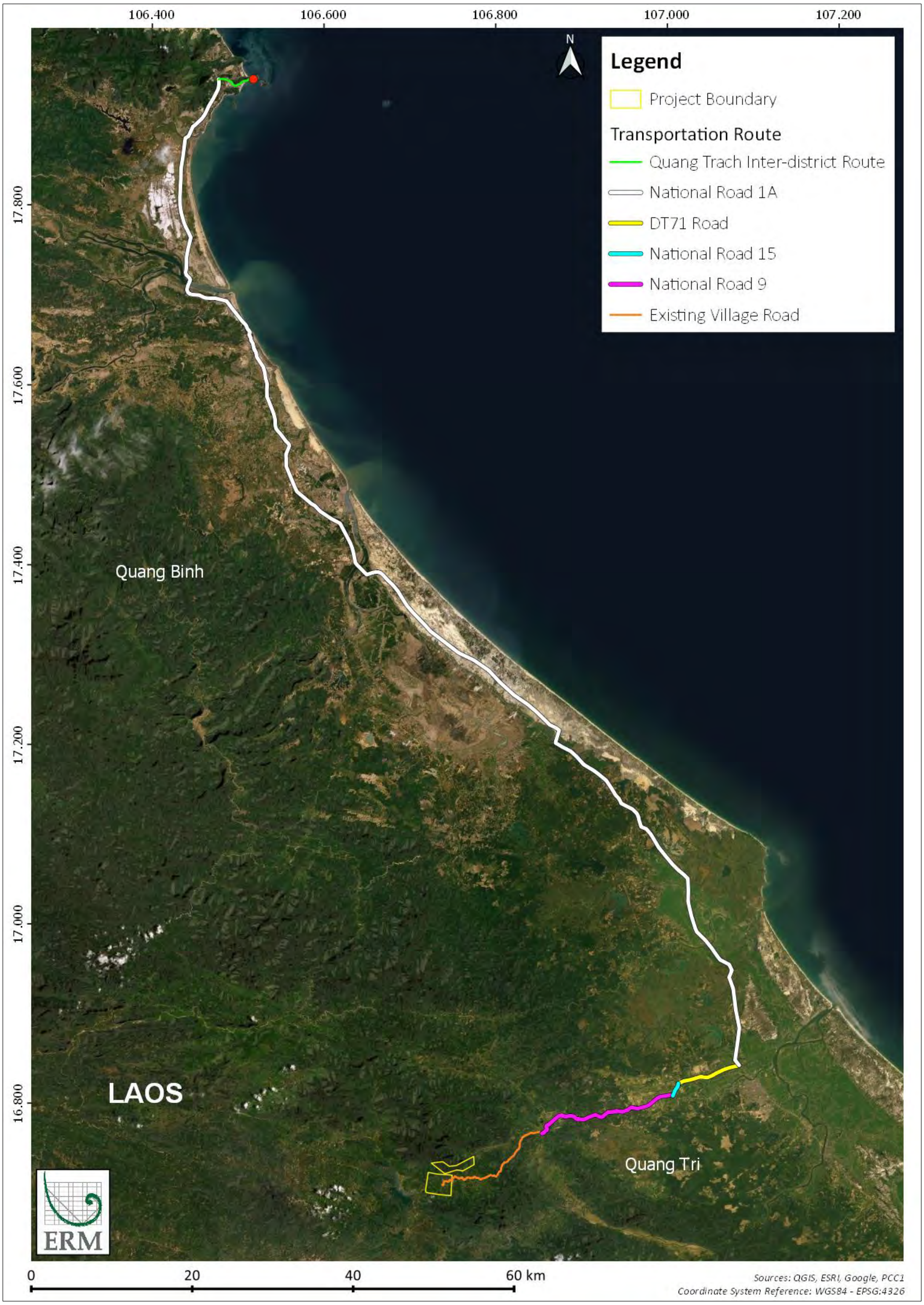


Figure 2.8 Equipment Transportation Route

2.5.3 Operational and Maintenance phase

Activities that will be carried out during the operation and maintenance phase includes:

- Commissioning tests of the wind farm which usually involves inspection of the first wind turbines' operation, standard electrical tests and civil engineering quality. Careful testing at this stage is extremely crucial to assess whether a good quality wind farm can be delivered and maintained. Generally, commissioning of an individual turbine can take more than two days with experienced staff. Some parameters need to be tested during commissioning tests including wind speed, wind direction, air density, turbine rounds per minutes, adjusted angle, turbine control system, SCADA, etc.
- Routine inspection of all WTGs as per supplier's specifications
- Scheduled maintenance activities at each WTG location as per the supplier's Guidance on Operation and Maintenance (except for the first maintenance will be conducted after 01 month operation)
- Operations and maintenance of ancillary facilities such as yards, stores, Central Monitoring System (CMS) building facilities;
- Inspection and maintenance of transmission lines; and
- Inspection and maintenance of intra-site pathways/ access roads.

The wind turbines will operate at all times, provided wind speeds are suitable, with the exception of downtime required for maintenance activities. For the most part, day-to-day facility operations will be automated through the use of computerized networking systems. A team of technical wind farm maintenance specialists will be trained by the Origin Equipment Manufacturer (OEM) during the warranty period (from 5 to 10 years). In term of Operation & Maintenance (O&M) for general maintenance of the wind farm site, it will be conducted by qualified staff and senior technicians.

2.5.4 Decommissioning phase

According to Feasibility report 2019 of GELEX 1, 2 and 3 Wind Power Project, there are two options for the decommissioning phase of the Project as follows:

- Once selected, a well-sited wind farm remains in operation. An out-of-date wind turbine is replaced with a working turbine of equivalent or even better generation capacity, which depends on Project Owner.
- If the site is to be abandoned after completion of the designed plant life, decommissioning should be initiated by dismantling the turbine components. The tower and blades of the removed wind turbine will be taken down by crane, disassembled into components and then the turbines will be refurbished at source or use elsewhere for another project. The blades of wind turbines can be recycled to make unburnt bricks or wall or embankment materials for nearby local construction works. The concrete should be broken up and removed to a landfill site. Infrastructure such as roads and transmission lines should be handed over to the government for use.
- At the time of writing this ESIA, detailed information of decommission phase is unavailable and the Client has not prepared the Plan of decommission phase. For that reason, this phase will be scoped out in this ESIA.

2.6 Unplanned event

There is the potential for unplanned events to occur during the construction, operation or decommissioning phase of the project. Examples of unplanned events include:

- Environmental incidents such as leakage and spill incident
- Vehicle, vessel accidents;

- Natural disaster such as flooding;
- Fire or explosion;
- Medical emergencies such as injury, illness, or fatalities.

2.7 Project Management

Some key agencies involve in project management, including:

- Project owner: Vietnam Electrical Equipment Joint Stock Corporation (GELEX)
- Equipment and Material Supplier: ENERCON
- Construction unit: [to be provided by Client]
- Operation and Maintenance: [to be provided by Client]

2.8 Employment and Accommodation

The Client plans to prioritise the recruitment of local workers who can take care of their own accommodation

2.8.1 Construction

The main labour source for the construction phase includes (i) local labour supplied by domestic construction company; (ii) Foreign consultant and project manager.

It is estimated that number of employees during the construction and turbine installation phase for Wind Power Plant would be 300 people totally.

2.8.2 Operation

The Project Owner will employ the operator to operate and maintain the wind farm under agreed O& M contract during the Project Life cycle (50 years). The project life cycle was identified and approved by local authority (Quang Tri People's Committee) under Decision No 331/QD – UBND, dated 18 February 2019 on Project Investment Approval.

- No. of working days/year: 365 days;
- No. of hours worked/day: 24 hours;
- No. of shifts/day: three shifts/day, each shifts last 8 hours;
- No. of employees during the operation phase: 60 persons.

3. ADMINISTRATIVE FRAMEWORK

This chapter provides legal and regulatory framework, covering national requirements as well as applicable international treaties, guidelines and standards. The intent of this Chapter is to discuss the regulatory context, which is directly related to environmental compliance, which mus be adhered to by all parties involved in the Project throughout the planning, construction and operation.

3.1 Overview

There are two levels of regulatory provisions applicable to the Project . The first is the Vietnamese assessment and approval process, which must be followed to achieve environmental approval by regulators. Secondly, as the Project proponent seeks to meet international standards, the 2012 IFC Performance Standards 1-8 (IFC PS) and the World Bank Group EHS Guidelines are also applicable. The primary means of intergrating the IFC PS and EHS expectation into the construction and operation phases of the project is through the preparation of this ESIA.

The Project obtained approval for its regulartory Environmental Protection Plan (EPP) in 2019. However, the local EPP did not address some environmental and social aspects that meet international standards and expectations. This ESIA contributes to fullfill the gaps between Vietnamese regulatory EPP and IFC PS and EHS standards.

3.2 Regulatory Framework Affecting Projects in Vietnam

3.2.1 Law on Environmental Protection

The Law on Environmental Protection (LEP) No. 55/2014/QH13 dated 23 June 2014 is the main piece of environmental legislation currently in force in Vietnam. The law assigns national responsibilities to environmental strategy, the drafting of regulations and standards and all monitoring to the Ministry of Natural Resources and Environment (MoNRE) and the Vietnam Environment Protection Agency (VEPA). Responsibility for implementation of environmental policy at the local level is assigned to the provincial assemblies through their Department of Natural Resources and Environment (DoNRE).

3.2.2 Environmental regulations/ standards

- Decree No. 38/2015/ND-CP dated 24 April 2015 on waste and scrap management;
- Decree No. 80/2014/ND-CP dated 06 August 2014 on the drainage and treatment of wastewater;
- Circular No. 36/2015/TT-BTNMT dated 30 June 2015 on hazardous waste management;
- Circular No. 04/2015/TT-BXD Providing guidance on a number of articles of the government Decree No. 80/2014/ND-CP dated 06 August 2014 on drainage and wastewater treatment;
- Circular No. 08/2017/TT-BXD dated 16 May 2017 on construction waste management;
- QCVN 03-MT:2015/BTNMT - National Technical Regulation on the allowable limits of heavy metals in the soils;
- QCVN 05:2013/BTNMT - National Technical Regulation on Ambient Air Quality;
- QCVN 06:2009/BTNMT - National Technical Regulation on Hazardous Substances in Ambient Air;
- QCVN 07:2009/BTNMT - National Technical Regulation on Hazardous Waste Thresholds;
- QCVN 08-MT:2015/BTNMT - National Technical Regulation on Surface Water Quality;
- QCVN 09-MT:2015/BTNMT - National Technical Regulation on Ground water Quality;
- QCVN 14:2008/BTNMT - National Technical Regulation on Domestic Wastewater;
- QCVN 40:2011/BTNMT - National Technical Regulation on Industrial Wastewater;

- QCVN 26:2010/BTNMT - National Technical Regulation on Noise.

3.2.3 Environmental Impact Assessment

The Law on Environmental Protection states that all enterprises, as prescribed by the Government within the law, shall conduct a Strategic Environmental Assessment (SEA), an Environmental Impact Assessment (EIA) or Environmental Protection Plan (EPP) and obtain approval prior to the development and operation of a facility. The key EIA regulations are given below:

- Law on Environmental Protection 2015 (No. 55/2014/QH13 dated 23 June 2014) ;
- Decree No. 40/2019/ND-CP dated 13 May 2019 on amending a number of articles of decrees that guiding the implementation of the Law on Environmental Protection;
- Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, SEA, EIA and EPP;
- Decree No. 19/2015/ND-CP dated 14 February 2015 detailing the implementation of a number of articles of the law on environmental protection;
- Circular No. 25/2019/TT-BTNMT dated 31 December 2019 providing detailed regulations for Decree No.40/2019/ND-CP.

Vietnam's regulatory EIA process is shown in Figure 3.1 below.

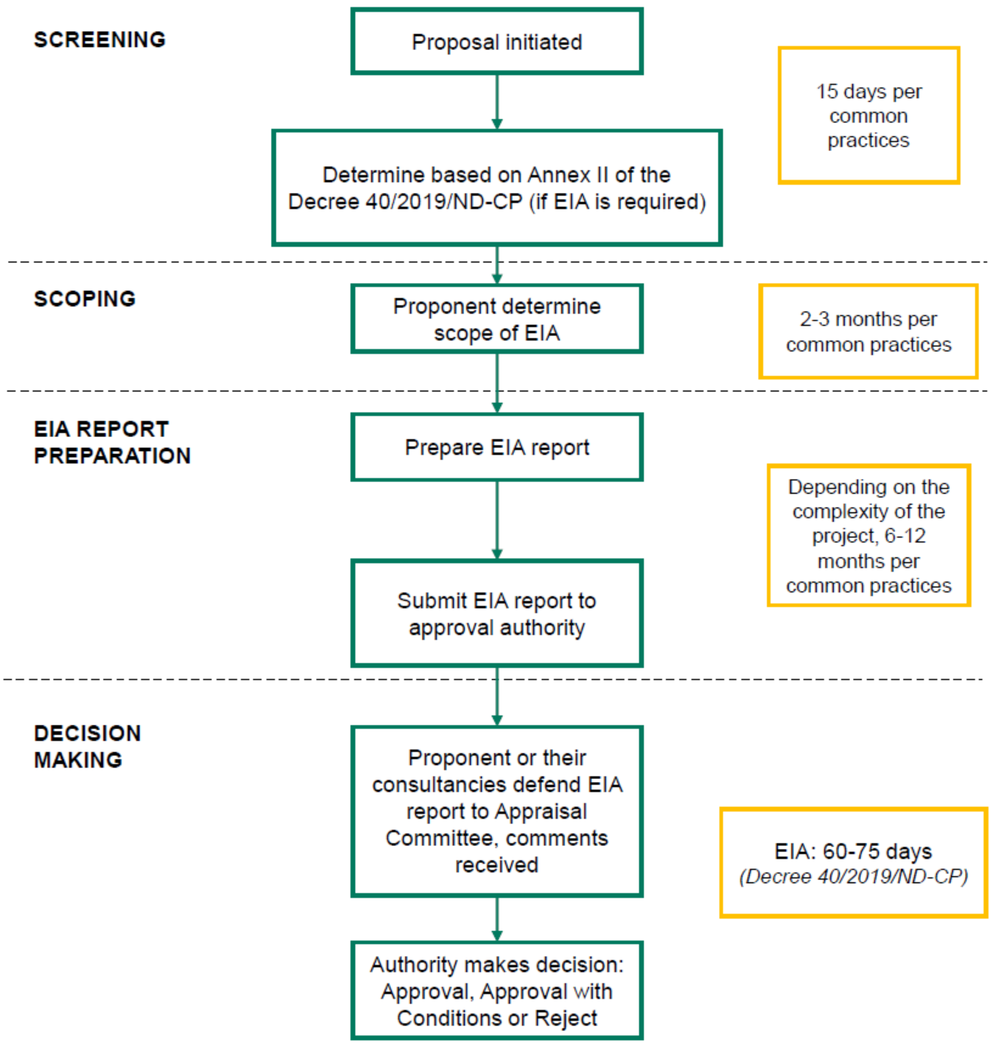


Figure 3.1 EIA Process

3.2.3.1 Public Consultation

Under Decree No. 40/2019/ND-CP dated 13th May, 2019 on amending a number of articles of decrees that guiding the implementation of the Law on Environmental Protection, public consultation is required to be conducted during EIA preparation. The Decree requires that project owners consult with People's Committees (PCs) of the communes, wards and towns located within proximity of the project area, as well as local organisations and the communities directly affected by the project. Information gleaned through research and community feedback mechanisms must be meaningfully considered in order to minimise the negative effects of the project on the natural environment, biodiversity and community health.

The PC of the commune where the project is expected to be located and organisations under direct impact of the project shall be consulted as per the following procedures:

- The project owner shall send EIA reports to the PC and organisations directly affected by the project, together with a written request for opinions;
- Within 15 working days from the date on which the EIA reports are received, the PC and organisations under the direct impact of the project shall send their response if they have concerns regarding the project.

Consultation with the community under the direct impact of the project shall be carried out in the form of community meeting co-chaired by the project owner and the relevant PC, together with the participation of representatives from the Vietnamese Fatherland Front of communes, socio-political organisations, socio-professional organisations, neighbourhoods and villages, and convened by the relevant PC. All opinions of delegates attending the meeting must be adequately and honestly recorded in the meeting minutes.

3.2.3.2 Information Disclosure

As required by the Decree No. 40/2019/ND-CP, dated 13 May 2019, the EIA shall be implemented with guidance of the Ministry of Natural Resources and Environment. The project proponent shall develop a plan to manage any environment affected by the project, based on the EIA report's recommendations, and have the plan available at the project site.

3.2.4 Law on Forestry 2017 and Law on Biodiversity 2008

The Law on Forestry 2017 regulates the rights and obligations of the forest owners'[3] organisations who are allocated forest in Vietnam for management. They must manage, protect, develop and use the forest sustainably in compliance with forest management regulations, provisions stated herein and other regulations required by relevant law. Those regulations stipulate that forest owners must:

- Comply with regulations on inspection of forest development;
- Return the forest that the State appropriates according to provisions stated herein;
- Conserve forest biodiversity, forest plants and animals;
- Ensure forest fire safety, prevent and eliminate forest pests;
- Facilitate management, inspection or actions against violations carried out by a competent state authority; and
- Fulfil financial obligations and other obligations.

3.2.5 National regulations on land acquisition, compensation, support and resettlement

The Land Law No. 45/2013/QH13, dated 29 November 2013 is the existing supreme legal regulation prescribing land use rights and land management in Vietnam, including those of land acquisition, compensation, support and resettlement.

3.2.5.1 National level regulations

- Law on Land No. 45/2013/QH13 (Land Law 2013);
- Decree No. 47/2014/ND-CP dated 15 May 2014 of the Government on regulating CSR Policies when land is acquired by the government;
- Decree No. 43/2014/ND-CP dated 15 May 2014 of the Government detailing a number of articles of the Land Law 2013;
- Decree No. 01/2017/ND-CP dated 06 January 2017 of the Government on amendments to the Decrees on the implementation of the Land Law;
- Decree No. 44/2014/ND-CP dated 15 May 2014 of the Government prescribing Land Prices;

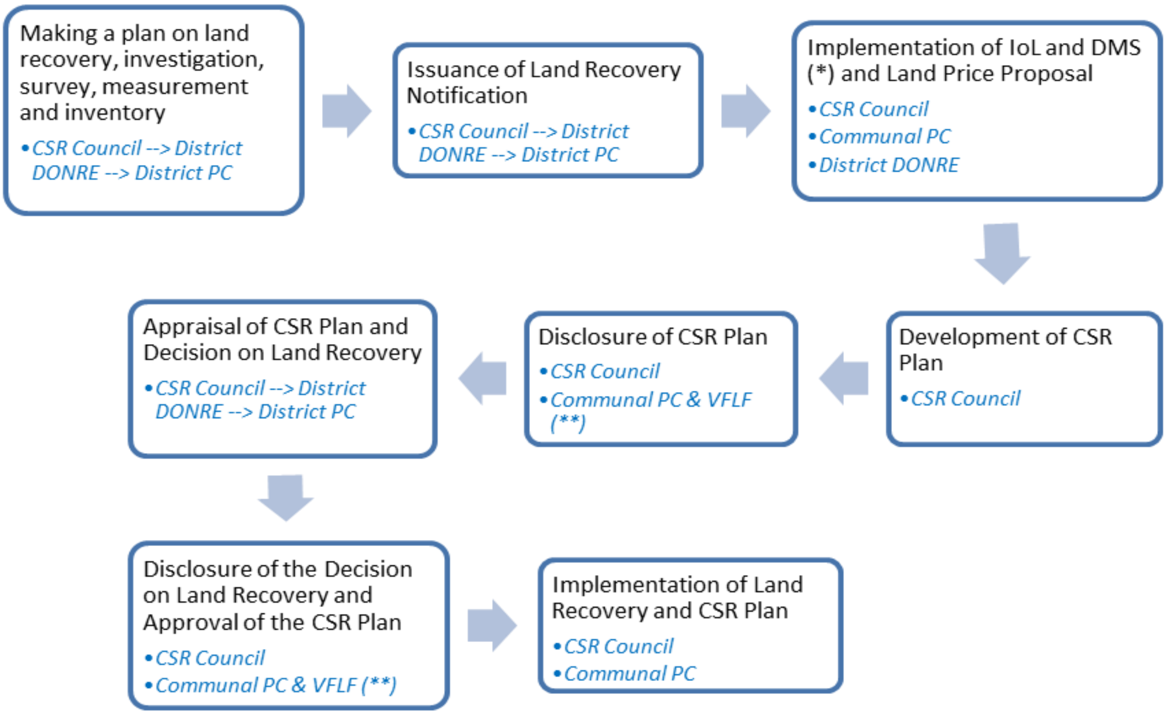
[3] "forest owner" may be an organisation, household, individual or community that is allocated or leased out a forest by the State; allocated or leased out land for afforestation, forest regeneration or development; receives transfer of the forest, receives the forest as a gift or inherits the forest according to regulations of law

- Circular No. 30/2014/TT-BTNMT dated 02 June 2014 of MoNRE regulating documents on land allocation, land lease, land use change and land acquisition; and
- Circular No. 37/2014/TT-BTNMT dated 30 June 2014 of MoNRE detailing regulations on compensation, support, and resettlement upon land expropriation by the state.

3.2.5.2 Provincial level regulations

- Decision No. 31/2017/QD-UBND dated 20 November 2017 of Quang Tri Province People's Committee on regulating Compensation, Support and Resettlement Policies upon land expropriation by the State in Quang Tri Province;
- Decision No. 49/2019/QD-UBND dated 20 December 2019 of Quang Tri Province People's Committee on issuing the list of land price in Quang Tri Province which is applied for 5 years (2020-2024);
- Decision No. 2746/QĐ-UBND, dated 11 October 2017 of Huong Hoa District People's Committee on adjusting Land Use Plan towards 2020 of Huong Hoa District.

A typical land compensation, support and resettlement process that complies with Vietnamese regulation includes the following main steps.



Note: Inventory of Loss (IOL) and Detailed Measurement Survey (DMS) are conducted under the presence of members of the CSR Council and affected household's representative(s). IoL and DMS results will be disclosed to the Project affected persons (PAPs) for review and signature. All DMS results will be collected and sent back to the PC at provincial or district level who is tasked with the CSR process for signing and stamping.

Figure 3.2 Land Compensation, Support and Resettlement Process Required in Vietnam

3.2.6 National regulations on electricity

The Law on Electricity No. 28/2004/QH11 was approved by the National Assembly of the Socialist Republic of Vietnam at its 6th session on 03 December 2004, and Decree No. 14/2014/ND-CP dated 26 February 2014 stipulates in detail the implementation of The Law on Electricity, especially regarding electricity safety. Its key regulations are as follows:

- According to Article 12, for any 110kV lines outside cities and towns the distance from the highest point of the trees vertically to the height of the lowest conducting line at the state of maximum deflection must not be less than 3m. In any case where the trees are outside the safety corridor of overhead conducting lines and outside cities, towns etc., the distance from any part of tree when the tree falls to any part of line must not be less than 1m. Rice, crops and plants must be planted at least 0.5m from the pole foundation and sleeper;

- According to Article 13, houses and constructional works are permitted to exist within the safety corridor of overhead conducting lines with voltage 110kV if they meet the following conditions: 1) Roof and walls must be made of non-combustible materials; 2) There must be no obstruction of the entry or exit of the house or works during testing, maintenance and replacement of parts of the high-voltage grid; 3) The distance from any part of the house or works to the nearest conducting line when the line is at the state of maximum deflection must not be less than 4m; 4) The electric field intensity must be less than 5kV/m at any point outside the house or works, and one meter from the ground and less than or equal to 1kV/m at any point inside the house and one meter from the ground.

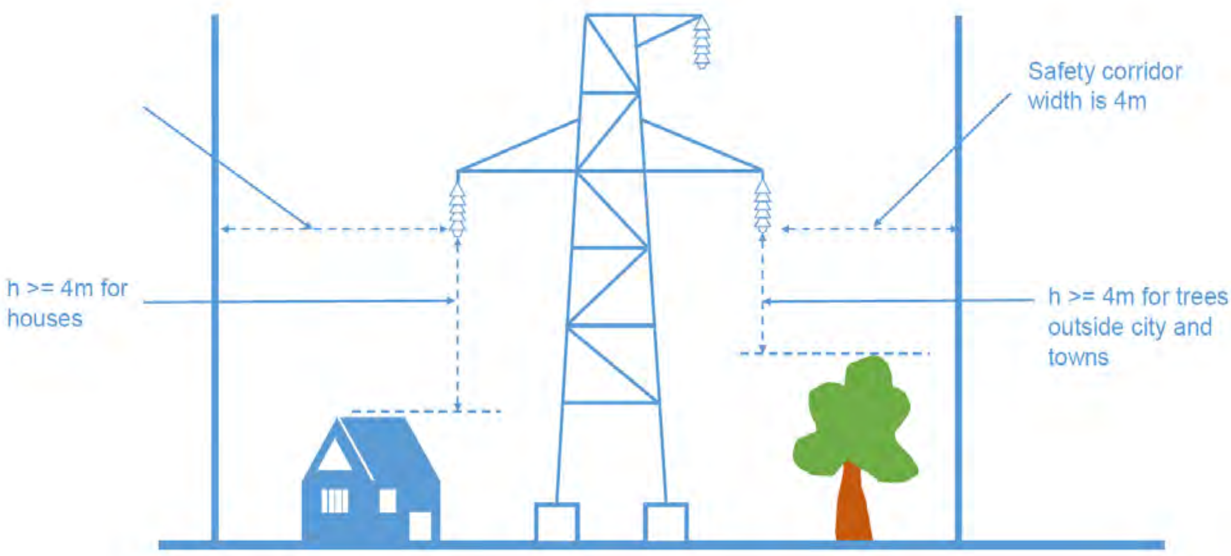


Figure 3.3 Safety Corridor Required for 110kv Transmission Lines

Other regulations on electricity in Vietnam include:

- Circular No. 31/2014/TT-BCT dated 02 October 2014 regulating details on electrical safety;
- QCVN 25/2016/BYT – National Technical Regulation on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace; and
- QCVN 21:2016/BYT - National Technical Regulation on High Frequency Electromagnetic - Permissible Exposure Level of High Frequency Electromagnetic Intensity in the Workplace.

3.2.7 National regulations on grievances

Community grievances mechanisms in Vietnam are regulated by the Law on Grievance 2011. Generally, it stipulates that if a person has a grievance they must first submit it to local authorities at the lowest level (commune PC). If their grievance cannot be solved at that level, they are entitled to a second and third submission to authorities of higher administrative levels (i.e., district PC/Court and then provincial PC/ Court).

3.2.8 National regulations on Occupational Health and Safety (OHS)

Law No. 84/2015/QH13 on occupational safety and hygiene dated 25 June 2015, deals with occupational hygiene and safety assurance, policies and benefits for victims of occupational accidents and occupational diseases (hereinafter referred to as victims), the rights and obligations of organisations or individuals relating to occupational hygiene and safety, and the roles of regulatory agencies in occupational hygiene and safety.

In addition to this law, a number of Decrees, Circulars, Decisions and Standards have been issued relating to labour rights, health and safety. Decree No. 45/2013/ND-CP, dated 10 May 2013, provides provisions on the Labour Code on OHS. The employer has the responsibility to fully provide employees with the technical equipment required for labour safety and labour sanitation and to improve their working conditions wherever possible. The employee must follow regulations on labour safety, labour sanitation and the labour regulations of the business. All organisations and individuals associated with labour and production must observe national legislations on labour safety, labour sanitation and environmental protection.

3.2.9 National regulations on chemicals

Law No. 06/2007/QH12 sets national requirements on the classification, labelling, packaging, transportation, storage and use of chemicals. For any projects where chemicals listed in Appendix IV of Decree No. 113/2017/ND-CP are used onsite, the project owners are required to i) develop and implement chemical-related incident prevention and response plans and establish safety distances; or ii) develop and implement chemical-related incident prevention and response measures. A list of chemicals subject to conditional production or trading, chemicals restricted from production or trading, as well as banned chemicals were provided in Decree No. 77/2016/ND-CP and Decree No. 113/2017/ND-CP. Several circulars under these decrees guide project owners on labelling, packaging, storage and usage of chemicals. TCVN 5507:2002 stipulates the arrangements of hazardous chemical storage.

The Stockholm Convention was signed on 22/5/2001 and entered into force on 17 May 2004 with the aim of protecting human health and the environment from the risks of Persistent Organic Pollutants (POPs). Vietnam ratified the Stockholm Convention on 22 July 2002 and was the 14th party to the Convention. To implement the Stockholm Convention, Vietnam issued the National Implementation Plan for the Stockholm Convention, under Decision No. 184/2006/QD–TTg dated 10 August 2006 pertaining to safety management, minimisation and eventual elimination of POPs in Vietnam. The Decision meets both the requirements of the Stockholm Convention and Vietnam's goal of sustainable development.

3.2.10 National regulations on fire prevention and fire fighting

Law No. 27/2001/QH10 on Fire Prevention and Fighting mandates that every entity has responsibilities in fire prevention and firefighting and that the heads of agencies, organisations and households must support the organisation and regularly inspection of fire prevention and firefighting activities, within the ambit of their respective responsibilities. Fire prevention and firefighting plans for all developments listed in Annex IV of Decree No. 79/2014/ND-CP dated 31 July 2014 of the Government must be prepared, appraised, and approved by the relevant authorities before project construction. To have a fire prevention and firefighting plan approved, a dossier must be prepared and submitted to the Fire Police for appraisal and approval, as specified in Article 15 of Decree No. 79/2014/ND-CP.

3.2.11 Regulations on labour rights, health and safety

The main legislation in Vietnam relating to labour rights, health and safety is the Labour Code No. 10/2012/QH13 which was issued on 18 June 2012 by the Vietnamese National Assembly. It stipulates that everyone has the right to work without discrimination based on sex, nationality, social background, beliefs or religion. Maltreatment of an employee and forced labour in any form are strictly forbidden.

The government protects workers through its relevant legislation on employment, apprenticeship, labour contracts, collective labour accord, salary, work and break time, labour discipline, material liability, specific provisions for female workers, minors and other types of workers (elderly workers, disabled workers, highly-skilled professionals and technically-skilled workers, employees working for foreign organisations and individuals in Vietnam, foreigners working in Vietnam and Vietnamese employees working abroad, as well as other types of labour), social insurance, trade unions, and settlement of labour disputes.

3.3 International Regulatory Framework

The Applicable International Standards that will be adopted for this Project are as follows.

3.3.1 Equator Principles III (2013)

The Equator Principles (EPs) refer to the environmental and social risk management framework voluntarily adopted by 83 member financial institutions (Equator Principle Financial Institutions (EPFIs)). They are primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. The EPs were developed by private-sector banks and launched in June 2003. They were first revised in July 2006 and new revisions, known as EP III, took effect on June 2013.

The EPs establish voluntary principles for addressing environmental and social risks and issues in global project finance transactions, including adherence to IFC PS. The EPs are designed to serve as a benchmark for the financial industry to manage social and environmental risks in project financing. They apply to all new project financings across all industry sectors. The Principles (EPs 1 to 10) are:

- Principle 1: Review and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Environmental and Social Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

The EP III can be found on the Equator Principle website[4].

Principle 1: Review and Categorisation: the Project is categorised to ensure that the required level of environmental and social due diligence is commensurate with the nature, scale and stage of the Project, and with the level of environmental and social risks and impacts. The categories are:

- Category A – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;
- Category B – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and
- Category C – Projects with minimal or no adverse environmental and social risks and/or impacts.

[4] https://equator-principles.com/wp-content/uploads/2019/11/The-Equator-Principles-November-2019.pdf

- **Principle 2: Environmental and Social Assessment**: all Category A and Category B Projects are required to conduct an assessment process to address the relevant environmental and social risks and impacts of the proposed Project.
- **Principle 3: Applicable Environmental and Social Standards:** requires that the Project comply with relevant host country laws, regulations and permits that pertain to environmental and social issues. The principle also brings into consideration compliance with the IFC PS on Environmental and Social Sustainability and the World Bank EHS Guidelines.

Principles 4 to 7 and Principles 9 and 10 apply to all Category A and, as appropriate, Category B Projects. Principle 8 applies to all Category A and Category B Projects.

3.3.2 IFC's Performance Standards on Environmental and Social Sustainability (2012)

In April 2006, the IFC, a member of the World Bank Group, released a set of Performance Standards (PS) based upon the original World Bank Group Safeguard Policies, which recognised further the specific issues associated with private sector projects. The IFC PS have been broadened to include issues such as greenhouse gases, human rights, community health, and safety and security. A revised set of PS came into force on January 1, 2012. The complete list of IFC PS is provided in Figure 3.4 and more details can be found on the IFC website[5].

Source: IFC, 2019

Figure 3.4 IFC Performance Standards

3.3.3 World Bank/ IFC General EHS Guidelines

Supplementing the IFC PS are the General EHS Guidelines that were released in April 2007. The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). They are categorised by environment, occupational and community health and safety, and construction and decommissioning. The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, which provide guidance to users on EHS issues within specific industry sectors.

[5] http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework/Sustainability+Framework+-+2012/Performance+Standards+and+Guidance+Notes+2012/

3.3.3.1 World Bank EHS Guidelines for Electric Power Transmission and Distribution (2007)

The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

The EHS Guidelines for Electric Power Transmissions and Distribution are organised in the following sections:

- Section 1.0 – Industry – Specific Impacts and Management
- Section 2.0 – Performance Indicators and Monitoring
- Section 3.0 – References and Additional Sources
- Annex A – General Description of Industry Activities

3.3.3.2 World Bank EHS Guidelines for Wind Energy

The EHS Guidelines for Wind Energy include information relevant to environmental, health, and safety aspects of onshore and offshore wind energy facilities. It should be applied to wind energy facilities from the earliest feasibility assessments, as well as from the time of the environmental impact assessment, and continue to be applied throughout the construction and operational phase.

3.4 International Conventions

3.4.1 The Kyoto Protocol on Climate Change (UNFCC)

Vietnam became a signatory to the UNFCC in 1998 with full accession in 2002. This obligates Vietnam to assure that future development in the country meets the conditions of the Convention. Relevant to this project are the requirements associated with the potential generation of greenhouse gas. Further conditions of relevance include:

- Enhancement of energy efficiency in relevant sectors;
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forest management practices, afforestation and reforestation;
- Promotion of sustainable forms of agriculture;
- Implementation of measures to limit and/ or reduce emissions of greenhouse gases; and
- Limitation and/ or reduction in methane emissions.

3.4.2 The United Nations Convention on Biodiversity 1992

This Convention seeks to conserve biodiversity and promote its sustainable use. It requires the identification and monitoring of the biodiversity in an area and adopting the necessary conservation measure. Vietnam became party to this Convention in 1994.

3.4.3 The Basel Convention 1989

This was developed under the auspices of the United Nations Environmental Programme (UNEP) in response to the growing worldwide awareness of the problem of international traffic in hazardous waste. The *Basel Convention 1989* is the first and foremost global environmental treaty that strictly regulates the trans-boundary movement of hazardous wastes. It obligates parties to ensure environmentally sound management, especially during the disposal process.

The objectives of the Convention are to:

- Ensure that waste is disposed of as near as possible to the place or source of its generation;
- Reduce trans-boundary waste and where it cannot be avoided, to be disposed of in an environmentally sound and efficient manner; and
- Provide assistance to developing countries in the management of hazardous waste and the generation.

The Convention places a ban on the export of hazardous waste from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries.

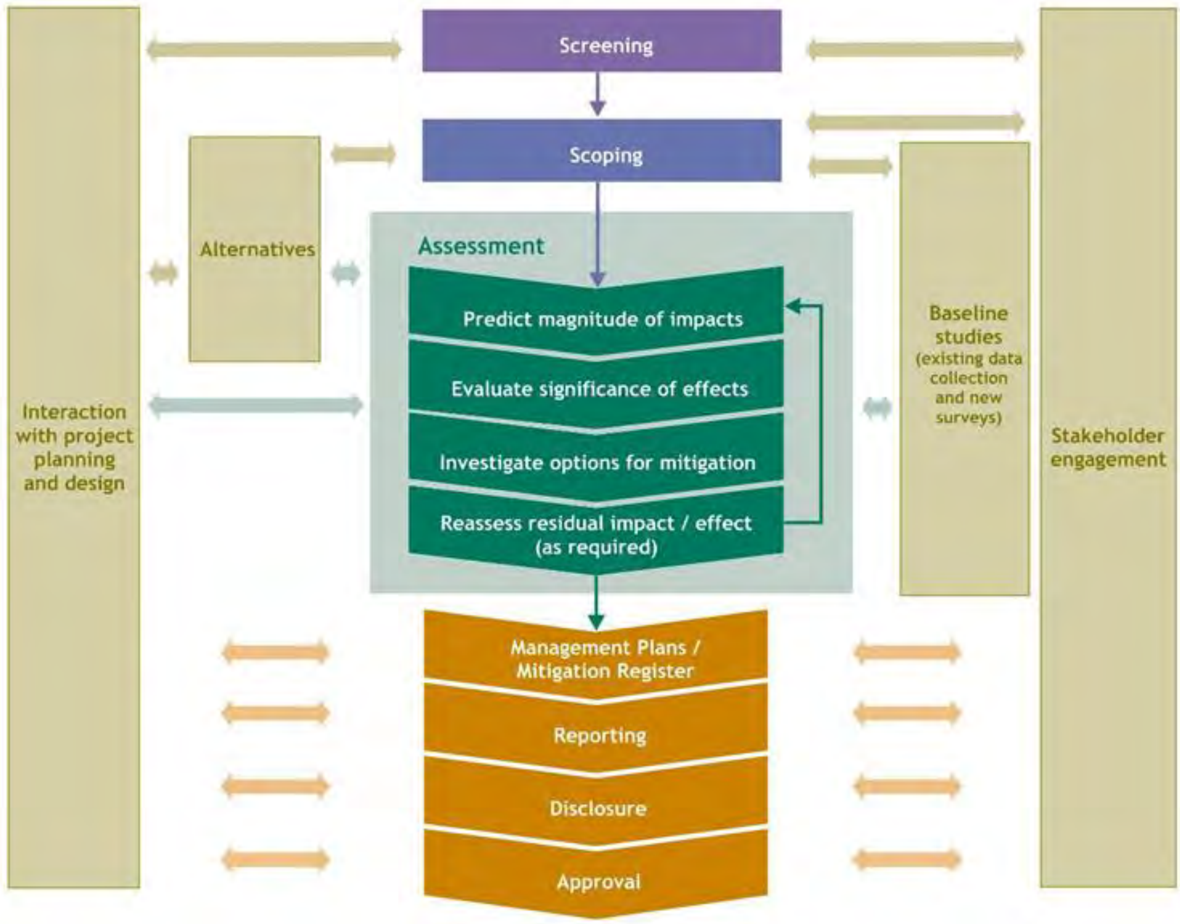
3.4.4 International Union for Conservation of Natural and Natural Resources, Red List of Threatened Species

The IUCN Red List, in 1964, was founded in order to provide a comprehensive inventory of the global conservation status of biological species, and to set of precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are applicable to all species and all regions of the world. Following the guidelines of the IUCN Red List, Vietnam's Red List was produced in 1992, updated in 2007, and has been an effective guideline for conservation of extinction species in Vietnam.

4. IMPACT ASSESSMENT METHODOLOGY

4.1 Introduction

This section presents the methodology used to conduct this ESIA, which follows the approach illustrated in Figure 4.1. This ESIA has been undertaken following a systematic process that: evaluates the potential impacts the Project could have on aspects of the physical, biological, social/socio-economic and cultural environment; identifies preliminary measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for potential adverse impacts; and identifies measures to enhance potential positive impacts where possible.



Source: ERM, 2019

Figure 4.1 Process for Producing an ESIA

This section also details the methodology used for the collection and analysis of primary and secondary data used in this report. Primary and secondary information from the Project Owner, government sources, non-governmental organisations (NGOs) and other Project-related stakeholders have been collected to support the preparation of this report.

4.2 Screening

At the initial stage of this ESIA, preliminary information was provide to aid in the determination of what legal and other requirements should be applied to the Project. This step was completed utilizing a high-level description of the Project and its associated facilities.

4.3 Scoping

Scoping has been undertaken to delineate the potential Area of Influence for the Project (and thus the appropriate Study Area) and to identify potential interactions between the Project and resources/ receptors in the Area of Influence. It also helps in developing and selecting alternatives to proposed action and in identifying the issues to be considered in this ESIA.

The content of this ESIA report has been prepared according to the output from the scoping process, which is further detailed in Chapter 5.

4.4 Project Description

In order to set out the scope of the Project features and activities, with particular reference to the aspects which have the potential to impact the environment, a Project Description has been prepared. Details of the Project facilities' design characteristics, as well as planned and possible unplanned Project activities, are provided in Chapter 2 of this ESIA Report.

4.5 Baseline Conditions

To provide the context within which the impacts of the Project can be assessed, a description of physical, biological, social/socio-economic and cultural conditions that would be expected to prevail in the absence of the Project is presented. The Baseline includes information on all resources/receptors that were identified during scoping as having the potential to be significantly affected by the Project.

The baseline characterisation is reported in Chapter 7, Chapter 8 and Chapter 9 of this ESIA Report

4.6 Stakeholder Engagement

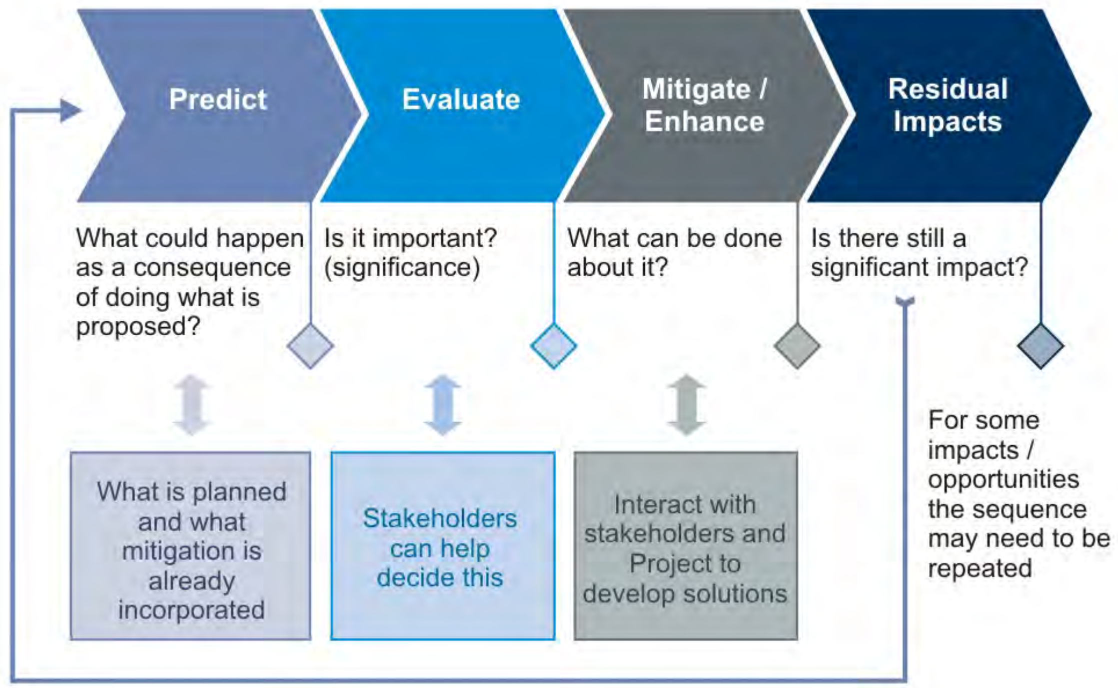
An effective ESIA Process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

Details of the Stakeholder Engagement activities undertaken for this Project to date are presented in Chapter 6 of this ESIA Report.

4.7 Impact Assessment (IA)

Impact identification and assessment starts with scoping and continues throughout the remainder of the ESIA Process. The main ESIA steps are summarised below and comprise of:

- **Potential Impact Identification:** to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities;
- **Impact Evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;
- **Management and Mitigation Enhancement Measures:** to identify appropriate and justified measures to mitigate potential negative impacts and enhance potential positive impacts; and
- **Residual Impact Evaluation:** to evaluate the significance of potential impacts assuming effective implementation of mitigation and enhancement measures.



Source: ERM, 2019

Figure 4.2 The IA Process

4.7.1 Impact Prediction

Prediction of impacts is essentially an objective exercise to determine what is likely to happen to the environment as a consequence of the Project and its associated activities. From the potentially significant interactions identified during the Scoping phase, the impacts to the various resources/receptors are elaborated and evaluated. The diverse range of potential impacts considered in the ESIA Process typically results in a wide range of prediction methods being used, including quantitative, semi-quantitative and qualitative techniques.

4.7.2 Impact Evaluation

Once the identification of potential impacts is completed, each potential impacts is described in terms of its various relevant characteristics (e.g. type, scale, duration, frequency, extent). The terminology and designations used to describe impact characteristics are shown in Table 4.1.

Table 4.1 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The “reach” of the potential impact (e.g., confined to a small area around the Project footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is potentially affected.	Temporary Short-term Long-term

Characteristic	Definition	Designations
Scale	The size of the potential impact (e.g. the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.)	[no fixed designations; intended to be a numerical value or a qualitative description of "intensity"]
Frequency	A measure of the constancy or periodicity of the potential impact.	[no fixed designations; intended to be a numerical value or a qualitative description]

The definitions for the type designations are shown in Table 4.2. Definitions for the other designations are resource/receptor-specific, and are discussed in the resource/receptor-specific IA chapters presented later in this ESIA.

Table 4.2 Impact Type Definitions

Type	Definition
Direct	Potential impacts that result from a direct interaction between the Project and a resource/receptor (e.g between occupation of a pilot of land and the habitats which are affected)
Indirect	Potential impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land)
Induced	Potential impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g influx of camp followers resulting from the importation of a large project workforce)

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is *likelihood*. The *likelihood* of an unplanned event occurring is designated using a qualitative scale, as described in Table 4.3

Table 4.3 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions
Possible	The event is likely to occur at some time during normal operating conditions
Likely	The event will occur during normal operating conditions (i.e, it is essentially inevitable)

Once impact characteristics are defined, the next step in the IA phase is to assign each potential impact a "magnitude". Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood (for unplanned event)

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the potential impact. The magnitude designations themselves are universally consistent, but the definitions for these designations vary depending on the resource/receptor. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large

In the case of a potential Positive impact, no magnitude designation (aside form "positive") is assigned. It is considered sufficient for the purpose of the ESIA to indicate that the Project is expected to result in a potential *positive* impact, without characterising the exact degree of positive change likely to occur.

In the case of potential impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is utilised. However, the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation.

In addition to characterising the magnitude of impact, the other principal impact evaluation step is definition of the sensitivity/vulnerability/importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity/vulnerability/importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors may also be considered, such as legal protection, government policy, stakeholder views and economic value. As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis. The sensitivity/vulnerability/importance designations used herein for all resources/receptors are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned to each impact. Impact significance is designated using the matrix shown in Table 4.4.

Table 4.4 Impact Significance

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/importance designations that enter into the matrix. The context for what the various impact significance ratings signify is presented in the box below.

It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the ESIA Process). This helps avoid a situation where an impact is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

Context of Impact Significance

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/vulnerability/importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its' effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of ESIA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there maybe be major residual impacts after all practicable mitigation options have been exhausted (i.e., ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholder to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

4.7.3 Mitigation and Enhancement Measures

Once the significance of a potential impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this ESIA, ERM has adopted the following Mitigation Hierarchy, which is shown in Figure 4.3.

- **Avoid at Source; Reduce at Source:** avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
- **Abate on Site:** add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping).
- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site).
- **Repair or Remedy***:* some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind; Compensate Through Other Means:** where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

Figure 4.3 Hierarchy of Mitigation Options

The priority in mitigation is to first apply mitigation measures to the source of the potential impact (i.e., to avoid or reduce the magnitude of the potential impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

4.7.4 Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the ESIA Process is to assign residual impact significance. This is essentially a repeat of the IA steps discussed above, considering the implementation of the proposed mitigation and enhancement measures.

4.7.5 Management, Monitoring and Audit

The final stage of the ESIA Process is defining the basic management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

A Register of Commitments, which is a summary of all actions the Project Proponent has committed to executing, with respect to environmental/social/health performance for the Project, is also included as part of this Report. The Register of Commitments includes mitigation measures, compensatory measures and offsets, and management and monitoring activities.

4.8 Cumulative Impact

According to IFC 2013, “Cumulative impacts (CI) are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones”. According to the IFC (IFC 2013), the assessment and management of cumulative impacts is necessary when the Project and other developments under consideration could contribute to generating cumulative impacts on valued environmental and social component.

In order to gain an understanding of the projects overall contribution to impacts, a cumulative impact assessment (CIA) was undertaken. Whilst total cumulative impacts due to multiple projects within a given area should be identified within government- led spatial planning efforts, the Project owner needs to determine the degree to which it is contributing to these overall cumulative impacts. In this regards, the objectives of the CIA are twofold:

- Determine if the cumulative impacts caused by the Project and other existing or predictable future projects would threaten the sustainability of valuable environmental component (VEC) in the area; and
- Develop mitigation measures to prevent unacceptable conditions of VECs. The measures could include additional mitigation measures for Project and also additional mitigation measures for other existing or predictable future projects in the area.

The ESIA and CIA are prepared based on similar logical framework, analytical process and tools. Unlike the ESIA that centres on the Project as a source of impacts, the CIA focuses on VECs under influence from different projects (Figure 4.4). In a CIA, the overall resulting condition of the VEC and its related viability are assessed.

This CIA closely follows the six (6) steps of the IFC Guidance (IFC 2013), as shown in Figure 4.6

IFC Guidance takes into consideration the limitations that a private developer may face carrying out a CIA as part of an ESIA, or difficulties encountered in compiling such information. The limitations applicable to this CIA include:

- Incomplete information about other projects and activities (e.g. the information is not available in the public domain);
- Uncertainty with respect to the implementation of future projects; and
- Difficulty in establishing thresholds or limits of acceptable change for VECs, and therefore the significance of cumulative impacts.
-

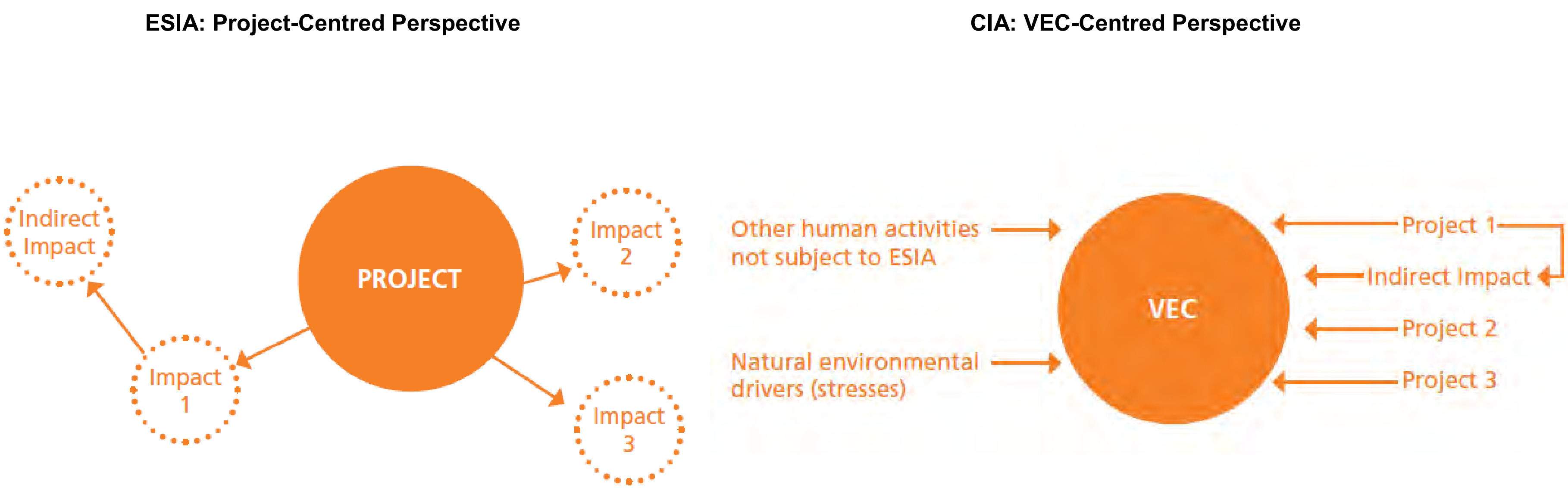


Figure 4.4 ESIA and CIA Analysis (IFC 2013)

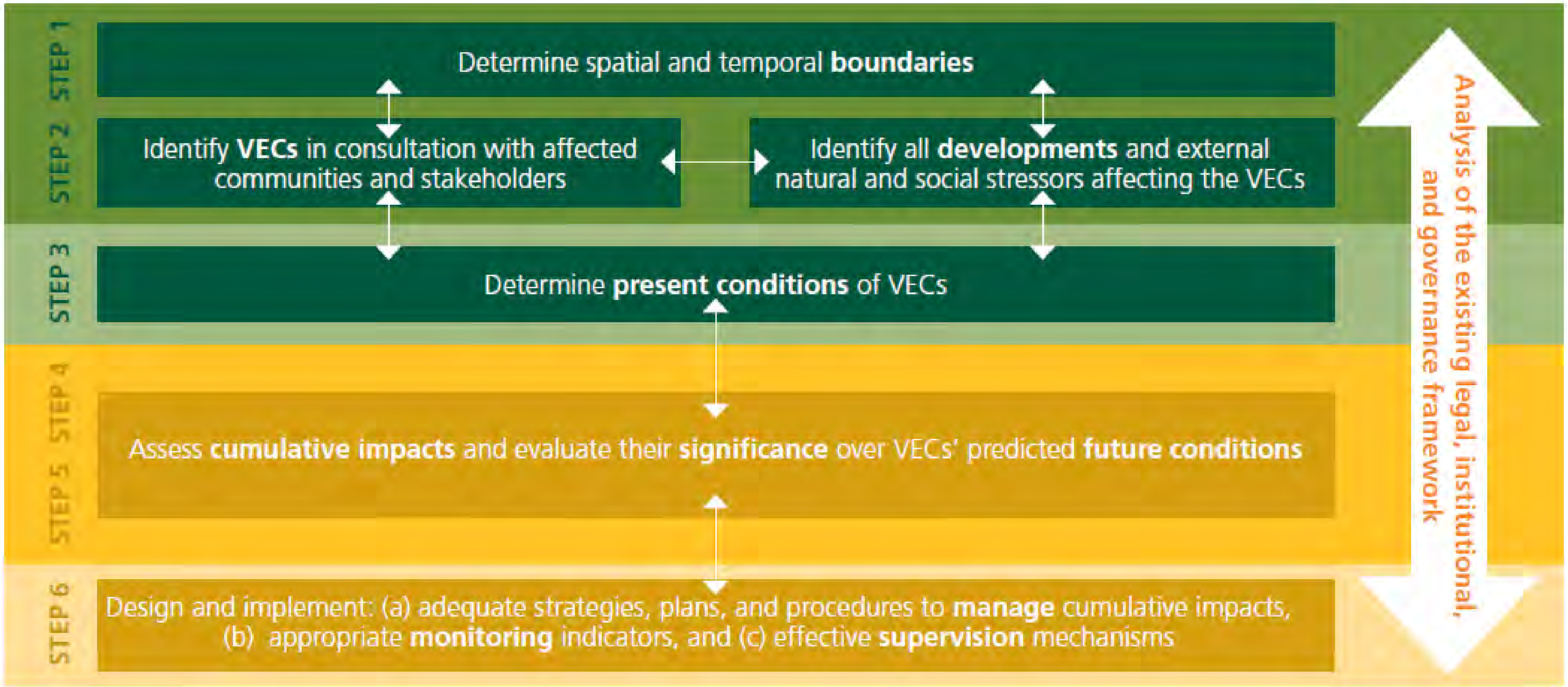


Figure 4.5 Six-Step Approach for CIA (IFC 2013)

4.9 Risk assessment for unplanned events

To evaluate potential impacts from unplanned events, a risk-based approach is used to define: 1) the most likely unplanned events leading to environmental, social and/or community health impacts; and 2) those unplanned events with the most significant potential environmental, social and/or community health impacts overall. Impact significance for unplanned events is therefore determined by evaluating the combination of likelihood and consequence.

4.9.1 Assess the Scale of Consequence

Indicative levels of consequence for potential impacts from unplanned events can be defined for the physical, biological, and social environment as provided below.

Table 4.5 Indicative Levels of Consequence for Potential Impacts from Unplanned Events

	Incidental	Minor	Moderate	Major	Severe
Physical Environment	Impacts such as localised or short term effects or environmental media, meeting all environmental standards	Impacts such as widespread, short-term impacts to environmental media, meeting all environmental standards	Impacts such as widespread, long-term effects on environmental media, meeting all environmental standards	Impacts such as significant, widespread and persistent changes in environmental media OR Exceedance of environmental standards	Exceedance of environmental standards and fine/ prosecution
Biological Environment	Impacts such as localised or short term effects on habitat or species	Impacts such as localised, long term degradation of sensitive habitat or widespread, short-term impacts to habitat or species	Impacts such as localised but irreversible habitat loss or widespread, long-term effects on habitat or species	Impacts such as significant, widespread and persistent changes in habitat or species	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
Social Environment	Slight, temporary, adverse impact on a few individuals	Temporary (<1 year), adverse impacts on community which are within international health standards	Adverse specific impacts on multiple individuals that can be restored in <1 year OR One or more injuries, not severe.	Adverse long-term, multiple impacts at a community level, but restoration possible. OR One or more severe injuries to a member of the public including permanently disabling injuries.	Adverse long-term, varied and diverse impacts at a community level or higher – restoration unlikely. OR Fatalities of public.

4.9.2 Assess the Likelihood

For the purposes of assessment, the likelihood of an unplanned event occurring can be classified as follows:

1 - Remote, not known in the industry;

2 - Very unlikely, known of in the industry;

3 - Unlikely, may occur once or more in life of the Project;

4 - Likely, may occur once or twice per year;

5 - Expected, may occur more than twice per year.

4.9.3 Assess the Significance

The consequences and likelihood of potential unplanned events are combined to determine the overall impact significance using the risk matrix shown in Table 4.6.

For potential impacts that are determined to have an impact significance of Moderate or Major, risk reduction measures are identified; these can include measures that reduce the likelihood of the event from occurring (i.e. preventive barriers), those that reduce the consequences on sensitive receptors/resources if the event were to occur (i.e. mitigation or recovery measures), and those that affect the likelihood and consequence.

Table 4.6 Risk Matrix for Potential Unplanned Events

		Likelihood of Occurrence				
		1	2	3	4	5
Con	Incidental	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor	Negligible	Minor	Minor	Minor	Moderate
	Moderate	Minor	Minor	Moderate	Moderate	Major
	Major	Moderate	Moderate	Major	Major	Major
	Severe	Major	Major	Major	Major	Major

5. ESIA SCREENING AND SCOPING

This section forms a basic of identifying important environmental and social impacts to be assessed in the ESIA and ideally, avoids detailed assessment of impacts which are deemed unlikely to be of significance or which can be easily addressed through implementation of appropriate management or mitigation measures.

5.1 Objectives

To identify environmental and social risks that are relevant to the Project, the Client completed a Feasibility Study and a local EIA in 2019. Upon checking the local EIA against international standards, multiple gaps have been identified. ERM Vietnam was commissioned to undertake the ESIA, supplementing gaps within previous studies and impact assessments to align with the expectations of various international standards.

The ESIA is prepared to target only the important environmental and social risks, and specifically targeted areas, which fall out of the scope of the regulatory EIA process, or those impacts, which are considered likely to be significant in the context of this project.

In relation to this Project, this primarily applies to the following:

- The social impact assessment conducted during the EIA did not sufficiently address livelihood restoration support and the land acquisition process has not been completed at the time of writing;
- A Critical Habitat Assessment (CHA) is required under IFC PS6 and this had not been completed at the time of writing;
- Consideration of CIs, associated facilities and non-routine events are not assessed in the EIA and previously attempted local ESIA; and
- Consideration of impacts to indigenous peoples and cultural heritage are not considered within the EIA.

Based on the level of Project description information and available desktop information, ERM has a reasonable level of confidence regarding the important environmental and social interactions that have been identified and presented within this Chapter.

5.2 Screening Results

Based on initial findings from the Scoping Site Visit in February 2020 by ERM and the IFC E&S Categorisation, the Project is categorised as Category B for the following reasons:

- The Project is expected to cause potential limited adverse environmental and social impacts/ risks during the construction phase such as increase noise level, changes in ground water resource and soil environment, impacts on terrestrial habitat, occupational and community health and safety. Most of the potential impacts from the Project are generally site-specific; and Impacts from the Project can be mitigated to ensure lower impacts to receptors through application of appropriate mitigation measures.

Additionally, IFC PS7 defines Indigenous Peoples as a distinct social and cultural group possessing the following characteristics in varying degrees:

- Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;

- Customary cultural, economic, social, or political institutions that are separate from those of the mainstream society or culture; and
- A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.

Observations from the survey and background research to date specific to these characteristics are described in the below table. The four characteristics are evaluated independently, and no characteristic weighs more than the others.

Table 5.1 Characteristics of Van Kieu People

No	Characteristics	The Van Kieu People[6]	Determined (Yes/No)
1	Self-identification	The Project is located in Huong Linh Commune, which 97% of commune population are of Van Kieu ethnic minority group. Van Kieu people have their own language, scripts and unique culture although they have integrated well to the larger Kinh community. Van Kieu ethnic group has particular ethnic features and individuals refer to themselves as belonging to the group.	Yes
2	Collective attachment	Van Kieu ethnic group is one of three indigenous ethnic minorities residing in the mountainous areas of Quang Tri and Thua Thien Hue provinces. In the past, the Bru people had settled in the Central Laos. Later, due to historical changes, they had to migrate to other places, including some to the east to settle down in the West of Quang Tri province where they set up their villages around the mountain called Van Kieu, which popularly pronounced as Van Kieu. According to the interview with local authorities at commune level, the Van Kieu people have inhabited and attached to the mountainous area of Quang Tri province for approximately 10 generations.	Yes
3	Customary institutions	Van Kieu people have distinct cultural practices such as community organization, including the patriarch system, house style, ceremony and festival, belief (Sacred Forest) and blowing rituals as described in sections above.	Yes
4	Distinct language	Van Kieu people have their own language and scripts which is different from the official language of Vietnam. Though they are also proficient in official language, they often interact with each other in their language.	Yes
Conclusion		From the above analysis, it is concluded that the Van Kieu people is considered as IPs as this ethnic minority group fulfils all four characteristics mentioned in IFC PS7	

Under social impact assessment section, the Project is likely to have limited impacts on indigenous people (Van Kieu people).As such, as required by IFC PS7, an IPP, including assessment of social impacts and resource requirements for addressing impact, is required.

Overall, based on above analysis, the Project has been categorised as Category B.

[6] Source: http://ubdt.gov.vn/gioi-thieu/cong-dong-54-dan-toc.htm and data of Van Kieu group was taken from social baseline survey by ERM.

5.3 Scope of the Assessment

The initial stage of the ESIA is the scoping assessment, which results in a scoping report that identifies a screening of potential Project impacts, using information provided by GELEX (e.g. EPP and Feasibility Study) and Project area mapping assessment. This section aims to identify and assess the key environmental and social risks and impacts of the Project through a scoping process.

- Scoping is a process by which potential interactions between the Project and resources/receptors within the Project area are examined and prioritised.
- Resources/receptors that are likely to give rise to significant environmental and/or social effects will be 'scoped in' whilst others will be 'scoped out'.

The aim is to focus the assessment on those that have a reasonable potential to experience significant impacts, which the GELEX should seek to avoid through Project design. Scoping also aims to identify key data gaps and ways to fill in those gaps.

Based on ERM's initial understanding of the site, as well as a primary and secondary baseline data review, activities (both planned and unplanned) associated with the Project and associated facilities during the construction and operation phases have been considered with respect to their potential to interact with environmental and social resources/receptors. The following section details the scoping methodology and results.

5.4 Scoping Methodology

The scoping process includes the following steps:

- Identify the Project elements and footprint;
- Gather information on activities at the Project Site and associated facilities at each phase of the Project;
- Identify and confirming the potentially relevant environmental and socio-economic resources listed in the Study Area;
- Map potential interactions between Project activities and environmental and socio-economic resources by way of a Scoping Matrix;
- Taking into consideration the information gathered on the extent and nature of Project activities, and the existing condition/ sensitivities of the resources, the potential interactions are prioritised in terms of their likelihood to cause significant impacts.

The scoping exercise is intended to ensure that the IA focuses on those issues that are most important for design, decision-making and stakeholder interests. Table 5.2 presents the resources/receptors considered during scoping.

Table 5.2 Resources/Receptors Considered During Scoping

Resources/Receptors	Impacts
Environmental	
Terrestrial vegetation	Changes to vegetation population, health, species abundance and diversity and impact on endangered and economic species, food chain effects
Avifauna species	Impacts on endangered and economic species, food chain effects
Air	Emissions of NOx, SOx, PM, CO.

Resources/Receptors	Impacts
Water resource (Surface water and Groundwater)	Changes to physical, chemical or biological quality of rivers, lakes, and other surface water bodies. Introduction of exotic species; changes in habitat quality, abundance, diversity. Effluent discharge. Contamination of shallow or deep groundwater resources. Change in groundwater resources
Soil	Changes to physical and chemical properties and soil ecology
Noise	Changes in noise level
Visual Amenity	Changes in landscape and visual amenity
EMF	Potential of electromagnetic interference (EMI) may occur from the Project development.
Shadow Flicker	Potential impacts on health of project-affected people (eyes, vision) and vegetation growth
Social / Socio-economic	
Economy and employment	Change in national/local economy, employment, standard of living, occupations
Resource ownership and use	Temporary or permanent restriction for accessing or using land, changes in livelihood activities based on land-based resources; changes in ownership of such resources.
Infrastructure and public services	Improvement or pressure on existing urban/rural infrastructure or services e.g. transportation, power, water, sanitation, waste handling facilities
Community Health	
Environmental change	Potential degradation in air quality (eg NOx, SOx, VOC, CO, PM), contamination of surface water and potable ground water, increased vibration and noise, increased night time light beyond acceptable limits, changes to the visual environment.
Communicable and non-communicable diseases	Change in incidence and /or prevalence of communicable and non-communicable diseases or disease causing factors
Vector borne diseases	Changes in the incidence and or prevalence of vector borne diseases, the density of these vectors and their breeding grounds
Sexually Transmitted Diseases (STDs)	Changes in the incidence and /or prevalence of STDs and the factors that contribute to this (e.g. external workforce, transport routes)
Health care/recreational facilities	Changes in availability of and access to health care and recreational facilities including green space
Traffic Safety	Changes in traffic volume contributes to increase risks of traveller safety, especially the Project is located in a mountainous area.
Indigenous People	
Indigenous People	Changes in cultural resources, livelihood of indigenous people, impacts on customary right of use and access to land and natural resources, socio-economic status, cultural and community integrity; health, education, social security status, indigenous knowledge.

5.5 Project Area of Influence

The Area of Influence (AoI) varies depending on the nature of Project and its receptors. Under the IFC PS1, an AoI should include the physical boundary of Project's activities as the core area, plus a wider buffer zone covering access to Project and any natural or community receptors which may be affected by Project.

- Based on available information of the Project provided by the Client, and information obtained from the site visit, the scoping opinion meeting with local authorities and good international industry practice on potential E&S impacts of a wind power project, the Project's AoI is defined as below:
- Project AoI of noise impact should be determined within 2,000m of any turbines;
- Project AoI of shadow flicker should be determined as 10 times of rotor diameters from each turbine location;
- Project AoI of blade throw should be determined as 1.5 times of turbine height (tower and rotor radius); and
- Project AoI of biodiversity is considered as Ecological Appropriate Area for Analysis (EAAA) to be assessed to define habitat values in the immediate project vicinity where species regularly dwell;
- Project AoI of Social aspect includes the region surrounding the Project where various social interactions will take place, which includes Project area and the area of potential environmental physical and biological impacts.

Area of Influence of the Project is presented in Figure 5.1 and Figure 5.2.

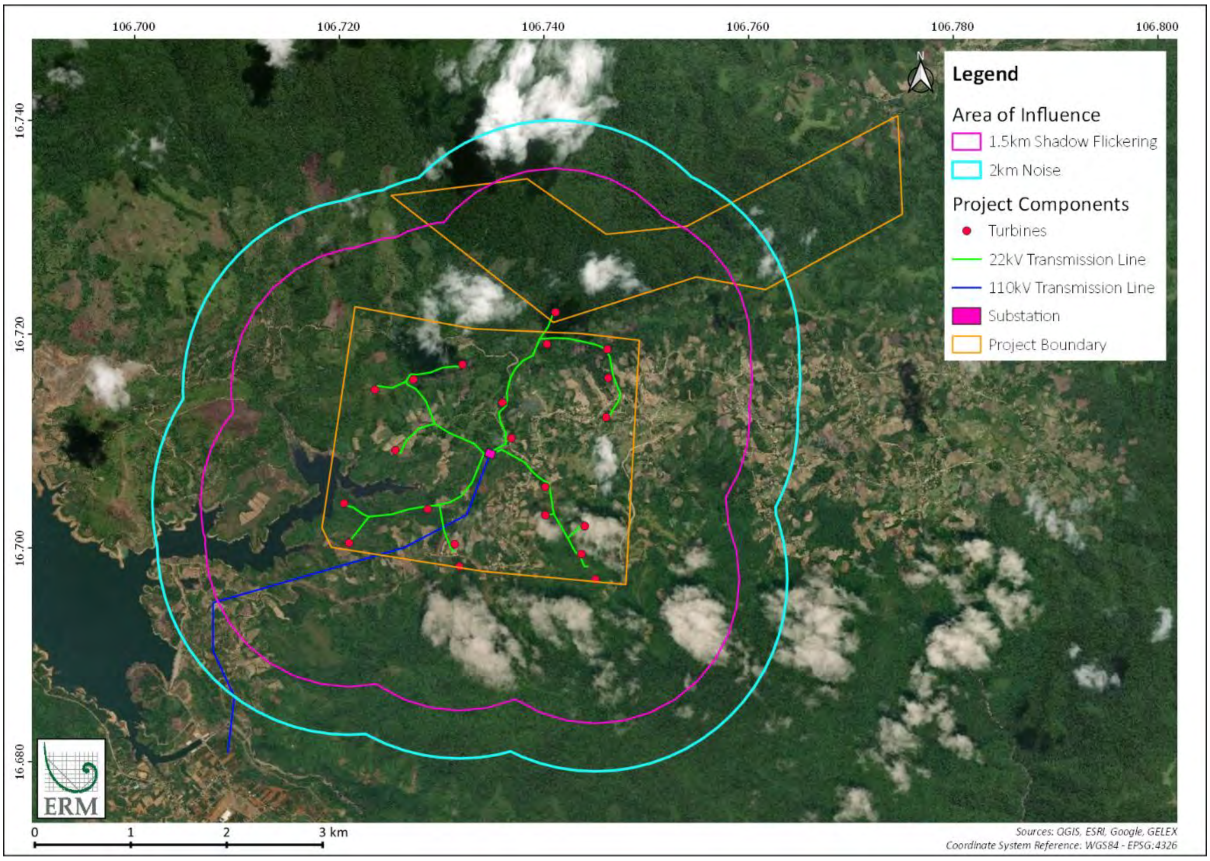


Figure 5.1 Area of Influence of Noise and Shadow Flicker

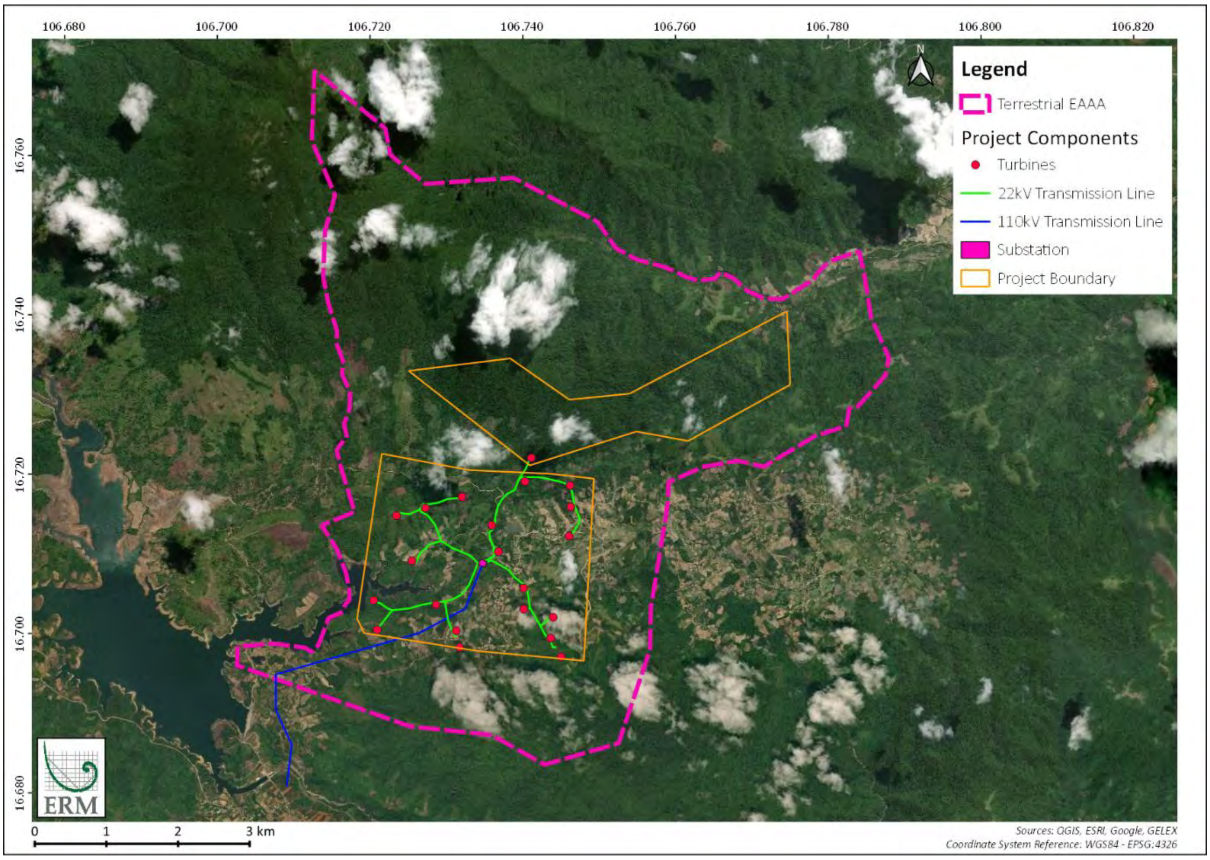


Figure 5.2 Area of Influence of Ecological Habitat

Nearby sensitive receptors have been identified at the initial site visit, including:

- Sacred sites: The so-called ghost forests where descended Van Kieu people are buried in the forests, are within 1km from the Project boundaries. These areas have a significant spiritual value for Van Kieu ethnic minorities; and
- Livelihood sites: agricultural fields, gazing areas, coffee farms and planted forests have been identified to be within and surround the Project area. GELEX Wind Project will cover an area of 7.76 ha of the planted forests and 9.11ha of agricultural land.
- Residential areas:
  - The nearest residential area which is within the Project area and approximately 100 m from the turbine GL 3.7 to the North. This residential area is Xa Bai village in Huong Linh Commune., which is resided by Van Kieu ethnic minority.
- Water bodies:
  - Many small streams and creeks under Nghi stream system (East-West direction flow) and Xa Bai stream system (West- East direction flow) pass by the Project and connect to Rao Quan Lake, which is approximately 300m from the nearest turbine to the West. Water resource from these streams is only used for irrigation.
- Production forests:
  - GELEX Wind Project will acquire 7.76 ha of the production forest permanently and temporarily, which taking up 16.69% of the Project area
- Key biodiversity and protected areas:
  - Project is within 50km from Dakrong, Dong Phou Vieng, Laving-Laveun, Truong Son and Upper Xe Bangfai Key Biodiversity Areas (IBAT, 2020); and

- The Project is also within 50km from Bac Huong Hoa, Dakrong and Dong Phou Vieng Protected Areas (IBAT, 2020).

Project's potential sensitive receptors are presented in Figure 5.3, Figure 5.4 and Figure 5.5 below.

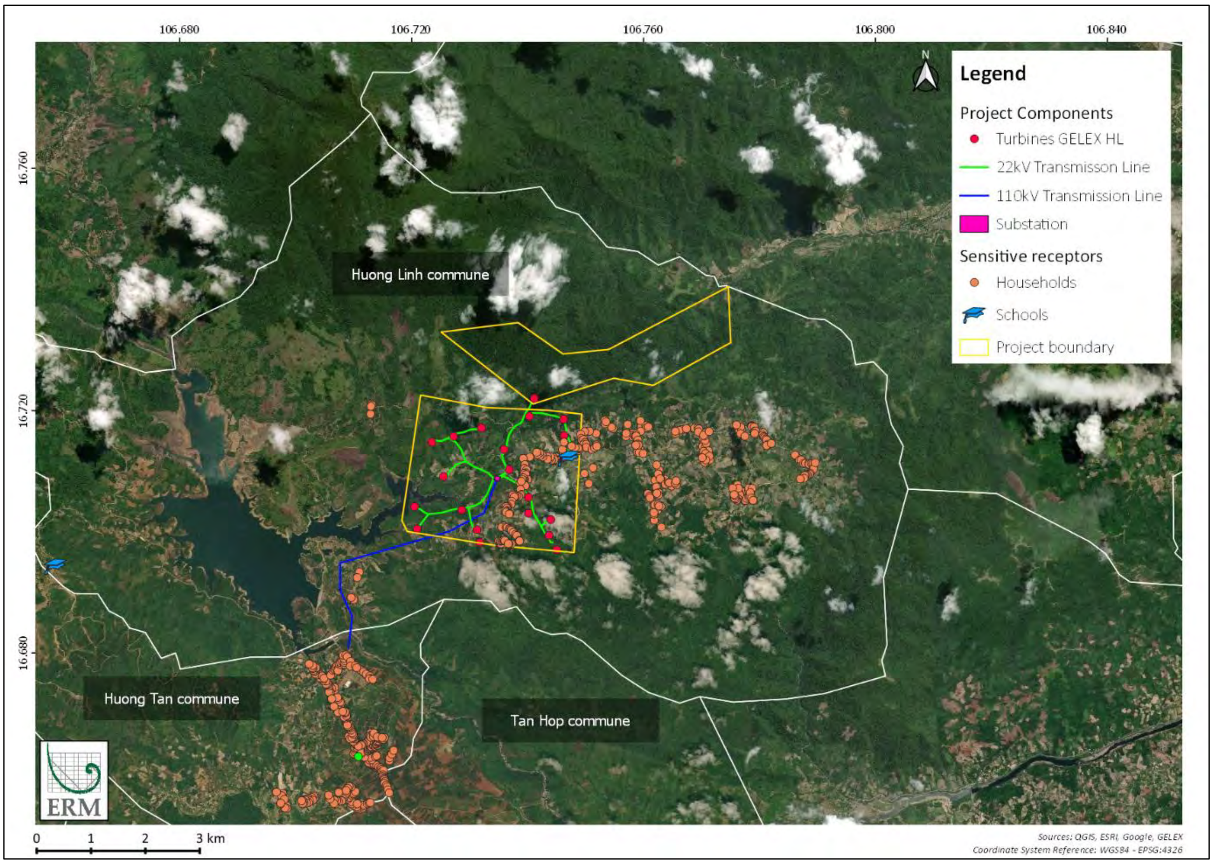


Figure 5.3 Sensitive Receptors

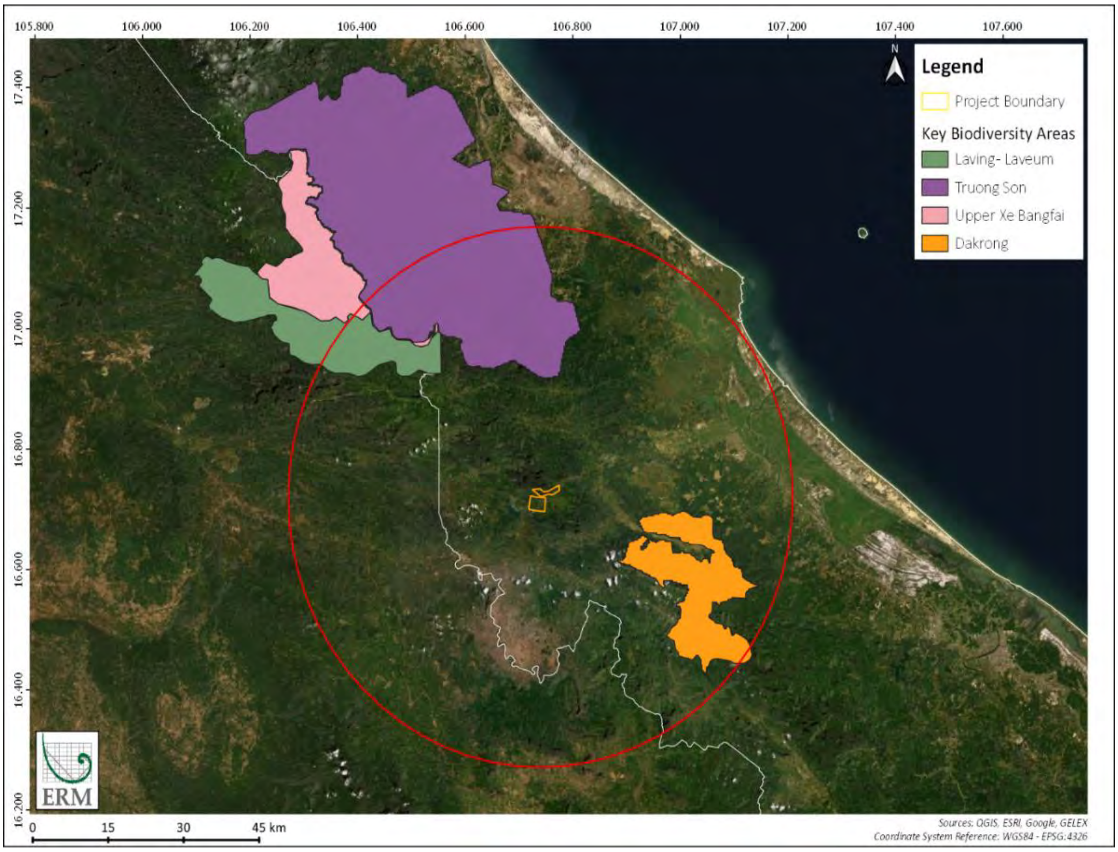


Figure 5.4 Key Biodiversity Area

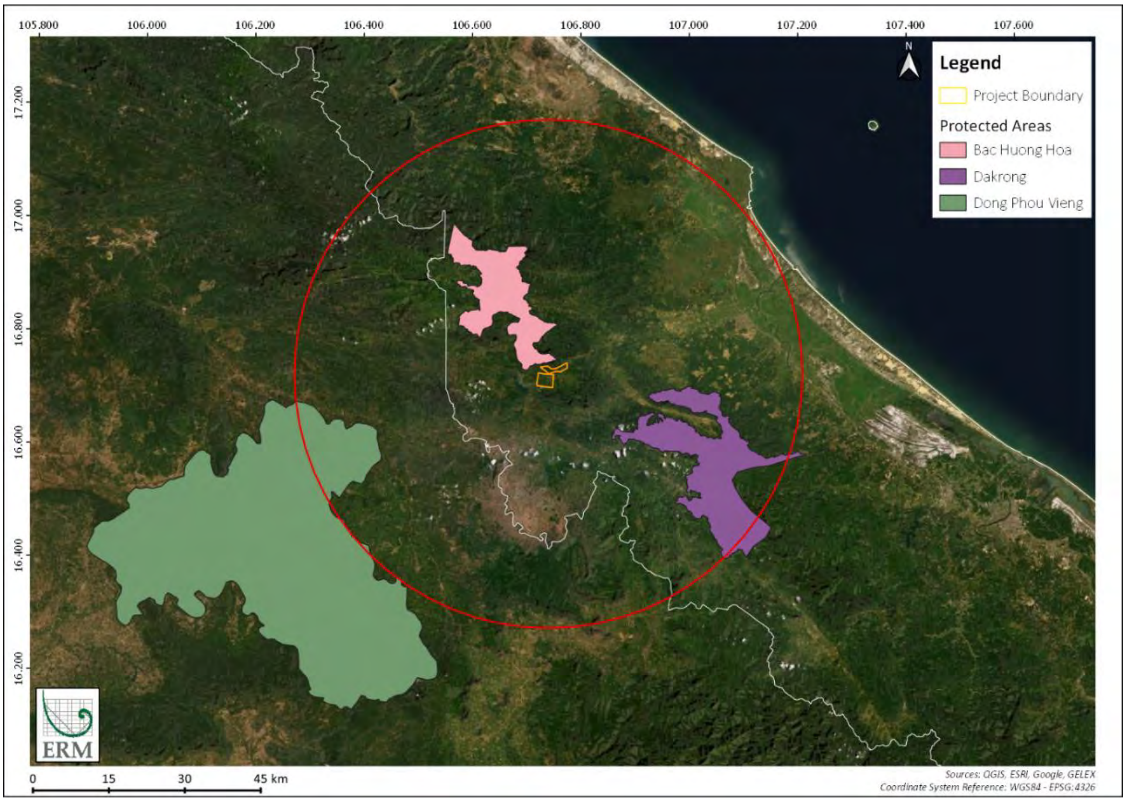


Figure 5.5 Key Protected Area

5.6 Scoping Matrix

Following the determination of AoI, a Scoping Matrix is used as a tool to support a methodological identification of potential interactions for each Project activity and the resources/receptors within the AoI. It consists of a list of Project activities during the construction and operation phases which may give rise to significant impacts. These are sets against a list of environmental and social resources/receptors within the AoI that they have the potential to interact with.

Scope in/out	Description
Scoped Out	■ An interaction is not reasonably expected
Scoped Out or integrated with other major interactions	■ An interaction is reasonably possible but none of the resulting impacts are likely to lead to significant effects
Further Consideration in Impact Assessment	■ The interaction is reasonably possible and at least one of the resulting impacts is likely to lead to an effect that is significant
Interaction likely to lead to Potential Positive Impacts	■ An interaction with positive impact expected

All potential interactions, regardless of probability of occurrence, are considered at this stage. Those cells that are coloured white are ‘scoped out’ of further consideration in the IA. Interactions marked as grey are also ‘scoped out’ with supporting reasons provided to justify the decision. Those interactions that are shaded black are retained for further consideration in the IA process.

Note that at this stage, detailed construction methodology is not available and so the scoping of these potential impacts has been based on experience with similar projects and professional judgment. A conservative approach is undertaken at this preliminary stage. When this information is available, the potential impacts associated with the activities will be revisited in the ESIA.

Table 5.3 Scoping Matrix

PROJECT PHASES AND ACTIVITIES	Environment							Social							
	Ambient Air Quality	Noise and Vibration	Soil Quality	Surface Water Quality	Groundwater Quality	Terrestrial Fauna and Flora	Avifauna	Economy& Employment	Livelihood	Visual Amenity	Land Use	Infrastructure/ Public Services	Occupational Health and Safety	Community Health, Safety and Security	Indigenous People
Pre-Construction															
Land Acquisition															
Workforce Mobilisation and Presence															
Land Preparation (site clearance, excavation and levelling), fencing, and civil works															
Construction															
Equipment and material transport and supply															
Construction of turbine foundations, transmission line pylons , internal road, auxiliary works and turbine installation															
Wastes, emissions and discharges generation, handling and disposal															
Operation of associated facilities such as the concrete batching plant,															
Construction water usage															

PROJECT PHASES AND ACTIVITIES	Environment							Social								
	Ambient Air Quality	Noise and Vibration	Soil Quality	Surface Water Quality	Groundwater Quality	Terrestrial Fauna and Flora	Avifauna	Economy& Employment	Livelihood	Visual Amenity	Land Use	Infrastructure/ Public Services	Occupational Health and Safety	Community Health, Safety and Security	Indigenous People
Commissioning and Operation															
Workforce Presence															
WTG Operation															
WTG Inspection and Maintenance															
Waste, emissions and discharge generation, handling and disposal															
Unplanned Events															
Leakage and spill incident															
Fire and explosion															
Vehicle collision															
Blade throw															
Transmission line snapping															
Natural Hazards (Flood, Storm, etc.)															

6. STAKEHOLDER ENGAGEMENT

6.1 Stakeholder Engagement during EIA process

Due to the total project site area is less than 200 hectare, the project is required to conduct the Environment Protection Plan (EPP) instead of the local EIA. Thus, there is no requirement for conducting the public consultation; however, the Project developer has to disclose the Environment Management Plan (EMP) according to the Appendix II of the Decree No. 40/2019 ND-CP dated 13th May 2019 by the Government on guidelines for the Law on environment protection.

6.2 Stakeholder Engagement during ESIA process

6.2.1 Meeting with Authorities

On the 11th February 2020, Project Owner and the Project's consultant – ERM Vietnam Company Limited (ERM), have conducted formal meeting with People's Committee of Huong Linh Commune to:

- Follow-up the current socio - economic conditions and future socio-economic development plans of the Project area; and
- Obtain their opinions and concerns on the development of the Project;

A summary of discussions and concerns generated in the course of Project Owner's engagement with authorities during ESIA process is provided in Table 6.1 below. Corresponding minutes of meetings with detailed discussion as well as full lists of meeting participants are attached in Appendix N.

6.2.2 Engagement with Local Communities for Baseline Data and Perceptions

Simultaneously with authority meeting, the Project team and ERM organised multiple engagement activities at the local community level from 11th to 14th February 2020 mainly to collect the updated socio-economic baseline data and local communities' opinions and concerns on the development of the Project. The consultations were in the form of focus group discussions, key informant interviews and household surveys as discussed below.

Focused Group Discussions (FGDs)

Focused Group Discussion was chosen as a tool to elicit households' subjective attitudes and experiences by grouping people with similar livelihood profiles or household economic conditions. Each group included 6 - 8 participants for a discussion within 60 minutes. Focus group was homogenous in a manner that it represented the affected households. Three groups of project affected which include Van Kieu ethnic minority group, agriculture and forestry group and vulnerable group currently living in Huong Linh Commune were selected.

Key informant interviews (KIIs)

The KIIs were conducted with village head of the three communes i.e. Hoong Moi, Xa Bai and Cooc villages and one village patriarch (Xa Bai village). The KIIs were semi-structured with major questions prepared in advance in the form of open-ended questions and a statistic data table. The questions concentrated on general information about the community, infrastructure, ethnicity, vulnerable groups, education, livelihoods and employment, health, cultural heritage and perceptions about the Project.

Household Surveys

In order to understand the socio-economic baseline including current livelihoods, income, health profile and the awareness and concerns of the affected communities about the Project, face-to-face interviews were undertaken for 35 households living in Huong Linh Commune. Primary data from the household surveys were used to form the socio-economic baseline section of the ESIA report and to propose livelihood restoration and community development plans of the Project.

Topic of engagement and feedback including concerns and suggestions from the FGDs, KIIs and Household surveys are summarised in Table 6.1

Table 6.1 Summary of Stakeholder Engagement Activities during ESIA Process

Interviewed Group	Organisations	Topics covered in the interview meetings
Commune authority	PC of Commune	■ Update the authority with Project development; ■ Obtain to-date socio-economic data/information including infrastructure and public services development of the Commune, health, livelihoods and employment of the people in the Commune; ■ Gain feedback/perceptions on the Project development; and ■ Ask for acceptance and support from the People's Committee to conduct the household survey in the area.
Focused group	Van Kieu ethnic minority group, agriculture and forestry group and vulnerable group	■ Each group will have different question design, in general, the following information was collected from the interviewed groups of FGD: ■ Demographic information of the affected villages; ■ Main livelihoods in this community area; ■ Investment cost for and income from their main livelihoods; ■ Vulnerable status (i.e. who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status that may be more adversely affected by the Project development); and ■ Awareness of the Project and any concern about the Project development.
Key informant interviews	Three Villages head and one patriarch of: ■ Hoong Moi Village ■ Xa Bai Village ■ Cooc Village	■ The questionnaire of the KII interview was designed to collect the following: ■ The history and organizational structure; ■ Housing and land (i.e. land use and land tenure); ■ Main livelihoods in this community area; ■ Infrastructure status; ■ Access to and availability of public facilities (i.e. electricity, water supply, etc.); ■ Financial situation; ■ Future-oriented development; and ■ Awareness on the development of the Project and its engagement activities.
Household	35 households living in Huong Linh Commune	■ The questionnaire of the household interview was designed to collect the following: ■ Family status and demographics; ■ Vulnerable status (i.e. who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social

Interviewed Group	Organisations	Topics covered in the interview meetings
		status that may be more adversely affected by the Project development); ■ Livelihoods and employment (i.e. their livelihoods/employment); ■ Household income and expenditure; ■ Housing and land (i.e. land use and land tenure); ■ Education background (i.e. education level of members in the surveyed households); ■ Health status/profile and health care practice; ■ Access to and availability of public facilities (i.e. electricity, water supply, etc.); and ■ Awareness on the development of the Project and its engagement activities.

6.2.3 Concerns from the Interviewed Authorities and Community

The concerns of local authorities and people regarding environmental, health, social and economic issues relating to the Project collected from the aforementioned engagement activities are summarised in Table 6.2 and Table 6.3.

6.2.3.1 Authority

Table 6.2 Concerns from Authorities during ESIA Engagement

Areas	Concerns
Environmental	■ Noise ■ Impacts on climate in the surrounding area
Health	No concern
Socio-economic and Cultural	■ Impacts on agricultural production (cultivation and husbandry) ■ Land acquisition
Technical issues	No concern

6.2.3.2 Community

Table 6.3 Concerns from Communities during ESIA Engagement

Areas	Concerns
Environmental	■ Polluted environment and biodiversity during the Project implementation process ■ Impacts on climate in the surrounding area
Health	Impacts on health in the surrounding area
Socio-economic and Cultural	■ Concern on land acquisition and compensation ■ Affecting cultivation season and animal husbandry ■ Impacts on local livelihoods (farming and husbandry)

Areas	Concerns
	■ Affecting local route and traffic safety situation due to the project's heavy transportation ■ Concern on the order security situation and the social evils of the immigrant workforce
Technical issues	No concern

6.2.4 Local Perception and Understanding about the Project

The household survey results suggest that 65.7% of surveyed respondents have heard about the Project, but that 34.3% of respondents do not know about it (see Table 6.4). Of the 23 respondents who are informed about the Project, the majority live in Hoong Moi village (10 households).

Table 6.4 Project Acknowledgement by Villagers

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Three Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Yes	10	71.43	7	70.00	6	54.55	23	65.71
No	4	28.57	3	30.00	5	45.45	12	34.29
Total	14	100.00	10	100.00	11	100.00	35	100.00

Source: Socio-economic survey conducted by ERM, 2020

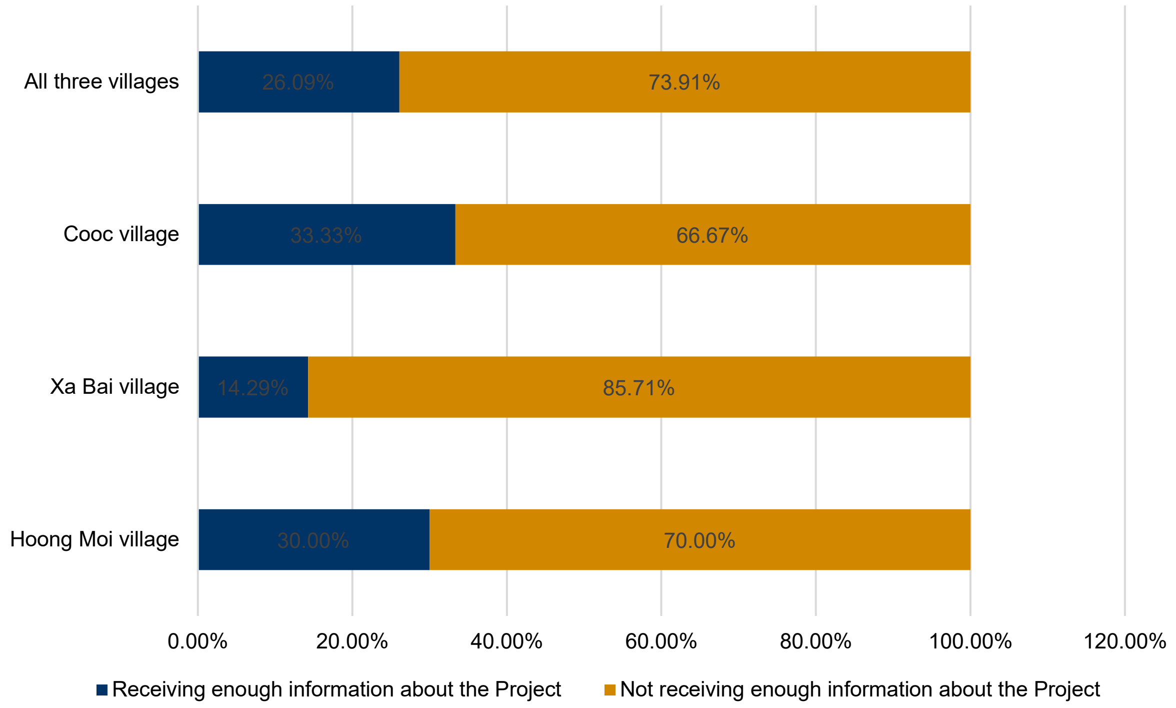
The highest share of the 23 respondents who know about the Project (47.4%) get information from local authorities (see Table 6.5). Nine households (39.1%) know about the Project from relative and neighbors, and one household approach to Project's information by the Project owners during the environment impact assessment process (4.4%). One households (4.4%) hear about the Project through TV, press. As confirmed by the heads of Cooc and Hoong Moi villages, the Project information is only disclosed to the commune officials, but not announced to the public (KII, male respondents, Van Kieu ethnic group, Cooc and Hoong villages, 13th - 14th February 2020).

Table 6.5 Project Information Receiving Channels

	Hoong Moi Village (N=10)		Xa Bai Village (N=7)		Cooc Village (N=6)		All Three Surveyed Villages (N=23)	
	N	%	N	%	N	%	N	%
Local authorities	6	60.00	1	14.29	4	66.67	11	47.38
Relatives and neighbors	4	40.00	4	57.14	1	16.67	9	39.13
Project owners during the environment impact assessment process	1	10.00	-	-	-	-	1	4.35
TV, press	-	-	1	14.29	-	-	1	4.35

Source: Socio-economic survey conducted by ERM, 2020

Of the 23 surveyed respondents who have Project information, only six households (26.1%) say they have sufficient information, while most (73.9% or 17 households) want to know further about the Project (see Figure 6.1). Of the 17 households, most of them want to get further information about the Project related to Project description, Project impacts and Project impacts mitigation.



Source: Socio-economic survey conducted by ERM, 2020

Figure 6.1 Local Responses to Project Information Efficiency

6.2.5 Recommendations from the Interviewed Authorities and Community

The key topics arising from the above meetings were in relation to queries regarding how the Project would benefit local communities in terms of employment opportunities and trainings for affected people and how the development would affect the environment and human health. During the engagement, Project team emphasised that the ESIA process had been looking at all potential effects of the Project on environmental and social aspects; the results of stakeholder engagement activities would be used to influence the design of the project and mitigation measures would be recommended to minimise any potentially negative effects. Summary of recommendations from interviewed parties is outlined below

Table 6.6 Recommendations from Stakeholder Engagement during ESIA Process

Recommendations	Commune Authorities	Local Communities
Environmental		
Comply with all relevant regulatory requirements on environmental protection to minimise potential environmental issues during Project's construction and operations phases	✓	
Health		
No recommendation	✓	✓

Recommendations	Commune Authorities	Local Communities
Socio-Economic and Cultural		
Priorities local recruitment to support local improvement	✓	✓
Development of agricultural farm models and high value crops (passion fruit, avocado, durian, guava, mango, and rambutan)		
Conduct social management programs to support project affected people	✓	✓
Engage relevant stakeholders to increase awareness of Project's development plan, construction schedule and potential impacts in a timely manner	✓	✓
Develop local infrastructure (build new concrete roads, well construction for local water supply and renovate the community houses)	✓	✓
Carry out asset inventory in accordance with the process and regulations and compensate and support for Project affected people		✓
Technical		
Manage activities of operation phase to ensure it does not affect local environment Measures and well prepared mitigation plan to against slip and landslide during the construction phase	✓	

7. ENVIRONMENTAL BASELINE

7.1 Introduction

This chapter provides an overview of environmental baseline conditions within the Project area and its surroundings, including topography conditions, climate and meteorology, air and surface water quality, noise and biodiversity. This information is to assess potential impacts caused by the Project in both construction and operation phases and provide mitigation measures and monitoring programs to reduce adverse impacts.

Information in this chapter is primarily based on studies undertaken for the local EPPs, the Feasibility Study Report and a desktop review of reliable information sources as well as the additional noise, bird and bat surveys undertaken by ERM. The noise survey was conduct from 12 to 16 February 2020. The biodiversity surveys were conducted including the bird survey in January 2020, the fauna and flora survey in February 2020 and bird survey in May for bird migration season.

7.2 Topography and Geology Conditions

7.2.1 Topography

The project is located in the north-west mountainous region in Huong Linh Commune, Huong Hoa District, Quang Tri Province. Due to the Annamite Range, Quang Tri topography is lower from west to east and southeast and the landform on which the Project located is the western high-mountain terrain with short and steep rivers and streams system. The elevation is from 450 – 540 m above sea level. The area are mostly mountains with many flat ranges, high mountains and hills which are suitable for planting industrial trees such as coffee and rubber.

Along valley stream, the flow is mainly horizontal erosion, the terrain is created mainly from layers of floods and sediments. Both sides of the steams are eroded topography of low hills and mountains, the main agent of erosion is overflowing water.

7.2.2 Geological Conditions

The geological survey was conducted in September 2019 for GELEX 1, 2 & 3 Wind Farm by SCI Join Stock Company. The results of the geological survey are presented Table 7.1.

Table 7.1 Geological Conditions

GELEX 1 and GELEX 2	GELEX 3
The geological structure consists mainly of 4 soil layers, of which 03 layers are on soft loose soil from the Quaternary. The soil layers have a dense distribution depending on the complete weathering of the Ben Giang - Que Son granite zone.	The geological structure consists mainly of two soil layers, of which 02 layers are on soft loose soil from the Quaternary. The soil layers have a dense distribution depending on the complete weathering of Ben Giang - Que Son granite zone.
Soil layer No. 01, 02: This layer of soil has large compressive properties, relatively large hollow coefficient so the structure is relatively porous, small strength, low load capacity. Most of the construction properties are not conducive to large load constructions. The soil layer No. 03 has relatively favourable construction properties for construction works, average load-bearing capacity, average subsidence as well as penetration resistance increase in the top-down, but locally distributed at two turbine locations and distributed at depth ⩾ 15.0 m.	Soil layer No. 01, 02: This layer of soil has large compressive properties, relatively large hollow coefficient so the structure is relatively porous, small strength, low load capacity. Most of the construction properties are not conducive to large load constructions.

7.3 Climate and Meteorology

Data on climate and meteorology are primarily obtained from:

- Environmental Protection Plan Reports of GELEX 1 and 2;
- Khe Sanh meteorological Station; and
- The Website of Quang Tri Province (Quang Tri Province Portal, 2019).

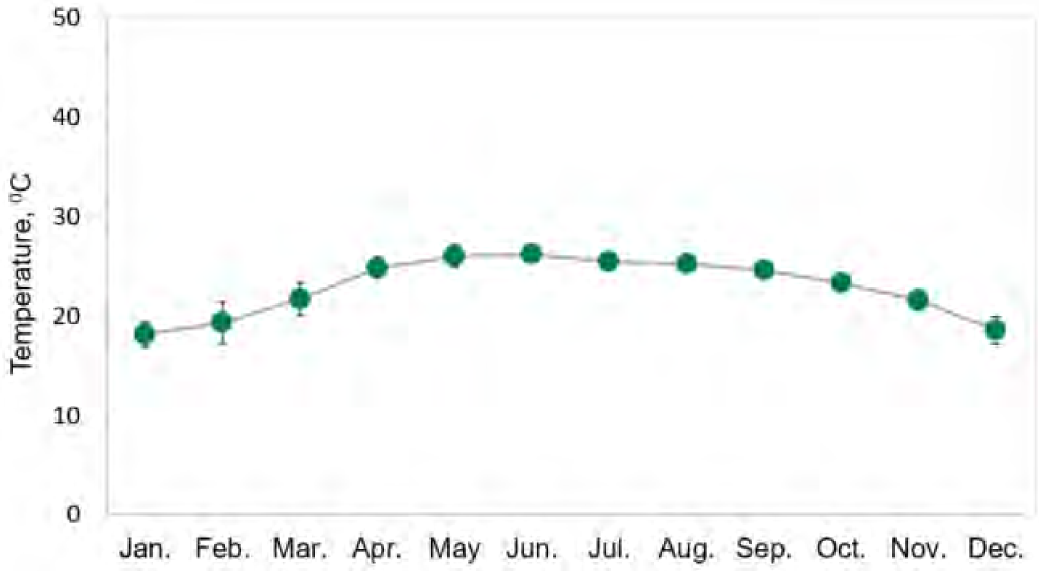
7.3.1 Temperature

Quang Tri Province has a tropical monsoon climate, with annual average temperature between 24 – 25^{0}C in low terrains and between 22 – 23^{0}C at an altitude of over 500 m (Quang Tri Province Portal 2019). The Province undergoes two (2) seasons, including:

- Winter season: lasts over three (03) months (December through February). The temperature in winter season could go down to 22^{0}C in low plains or 20^{0}C at high attitudes of over 500 m;
- Summer season is between May and August with a high average temperature of 28^{0}C. Temperatures are highest between June and July and they can go up to 42^{0}C. High temperatures in the areas are considered favourable for some agricultural and industrial plants (Quang Tri Province Portal 2019).

The average monthly temperature in Huong Hoa District fluctuates between 18.1^{0}C and 26.3^{0}C. Temperatures differ between winter and summer seasons, including:

- Winter season: average monthly temperatures are between 18^{0}C and 19.3^{0}C; and
- Summer season: average monthly temperatures can go up to above 26^{0}C (Figure 7.1).



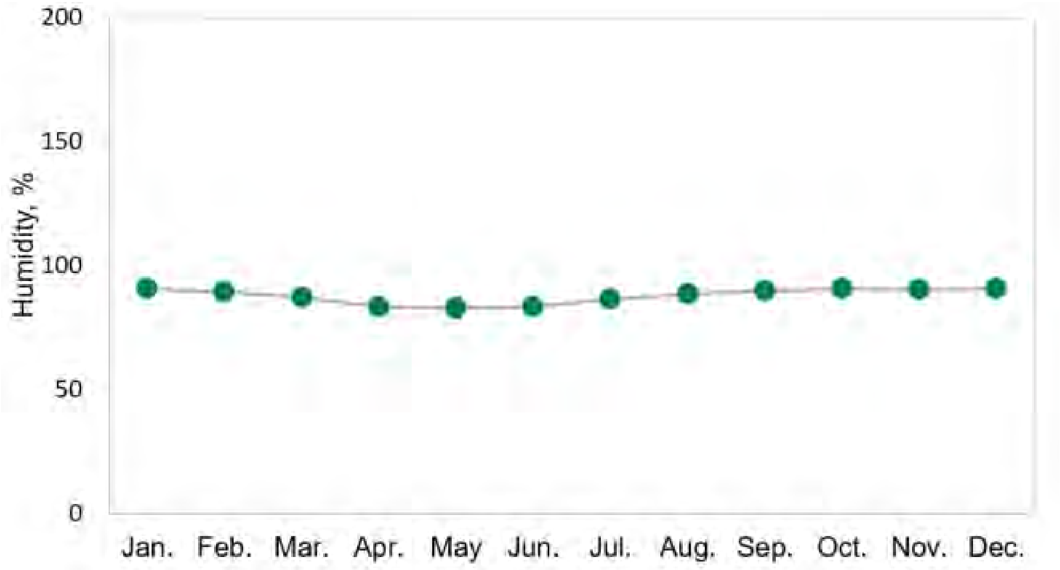
Source: Khe Sanh Meteorology Station

Figure 7.1 Average Monthly Temperature in Huong Hoa District (1998 – 2017)

7.3.2 Humidity

Relative humidity in Quang Tri Province is considered high with an annual average of between 83% and 88%. In the rainy months, the average relative humidity is approximately 85% and it sometimes can go up to 90%. Humidity on the eastern and western sides of Truong Son Mountain Range fluctuates over time and it could deep as low as 22% in April (Quang Tri Province Portal 2019).

The average monthly humidity in Huong Hoa District fluctuates between 84.5% and 90.7%. Minimum monthly humidity usually occurs during the summer season (April through July) and it could go down to 83% in May (Figure 7.2).

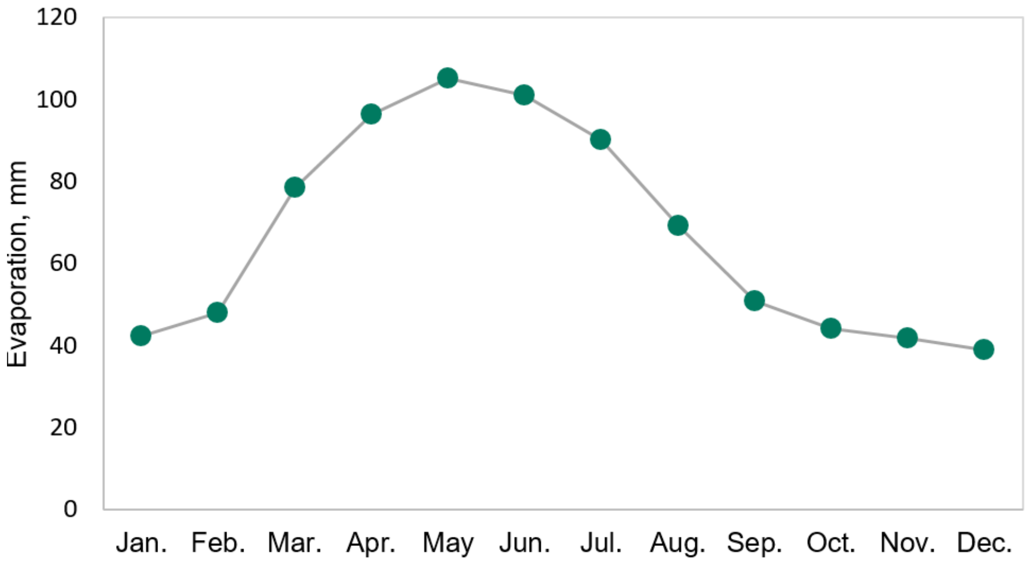


Source: Khe Sanh Meteorology Station

Figure 7.2 Average Monthly Humidity in Huong Hoa District (1998 - 2017)

7.3.3 Evaporation

The monthly evaporation measured in the area varies between 41.6 and 105.0 mm. Evaporation can peak above 100 mm per month in May and June and it can dip below 40.0 mm per month in December (Figure 7.3).

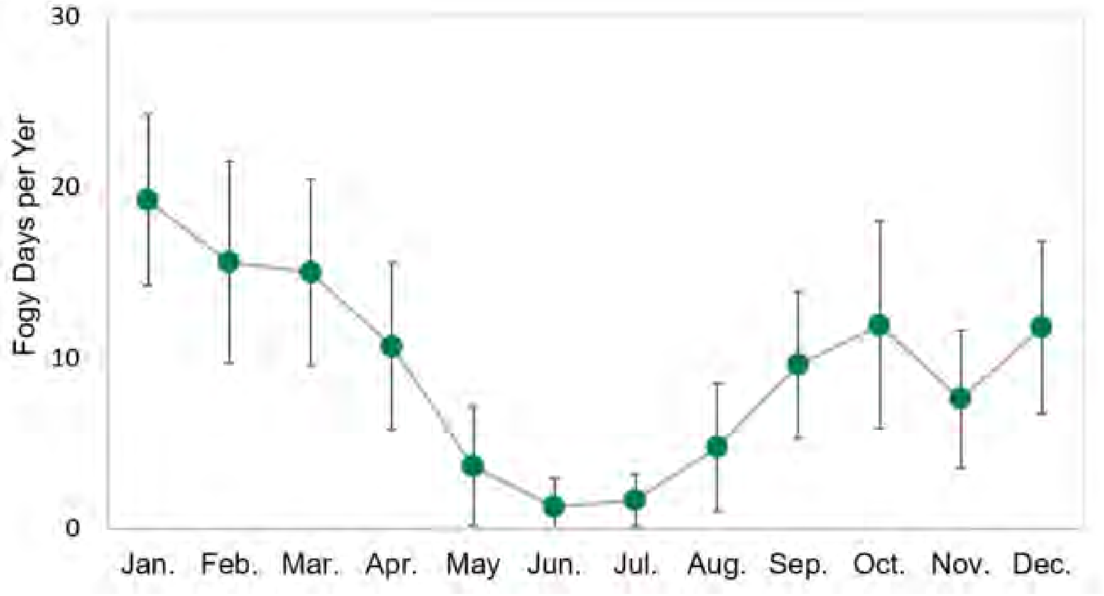


Source: Khe Sanh Meteorology Station

Figure 7.3 Monthly Evaporation (1977 – 2017)

7.3.4 Fog

Heavy fog and light rains in late afternoon and early morning usually occur during the spring monsoons from December through March, causing limited visibility in the area. The average number of foggy days per month recorded by Khe Sanh Meteorology Station in the period of 2007 to 2018 is between 58 and 149 days. Of this, maximum numbers of foggy days can go up to 19.3 days per month between December through March and minimum numbers of foggy days are between 1.3 and 4.8 days per month between May and August (Figure 7.4).

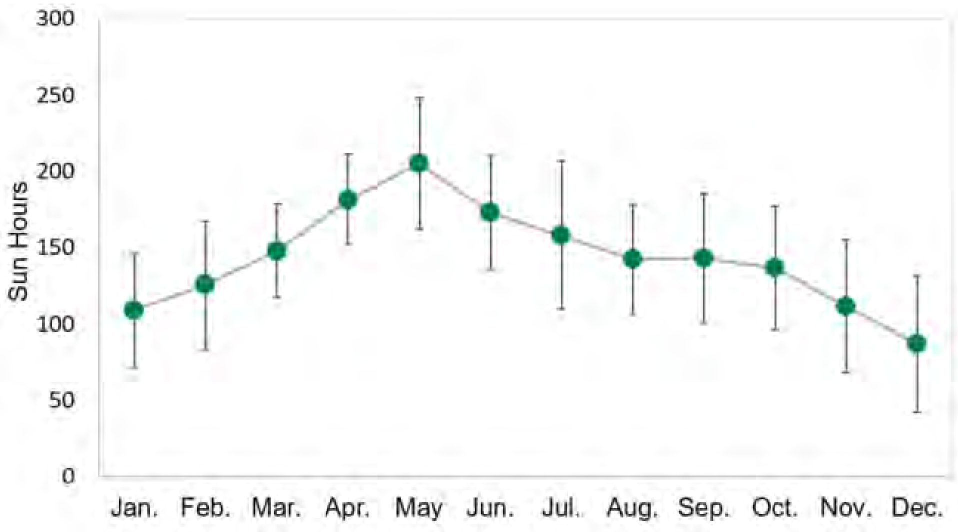


Source: Khe Sanh Meteorology Station

Figure 7.4 Average Number of Foggy Days per Month in Huong Hoa District (2007 – 2018)

7.3.5 Sun Hours

The average sun hours in Huong Hoa District varies between 87 and 205 hours per month. Sun hours can peak above 200 hours per month sometime between May and August while minimum monthly sun hours can be lower than 100 hours during the autumn and winter months (November through next February) (Figure 7.5).



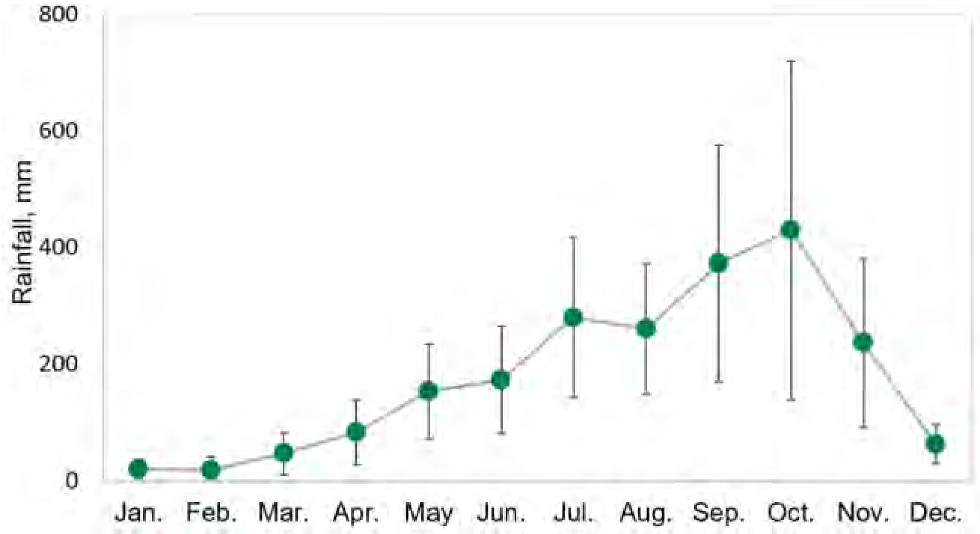
Source: Khe Sanh Meteorology Station

Figure 7.5 Average Monthly Sun Hours in Huong Hoa District (1998 – 2018)

7.3.6 Rainfall

The average annual rainfall in Quang Tri Province is between 2,200 – 2,500 mm. Maximum rainfalls usually occur from September through December and distribute to over 70% of the annual rainfall. The number of rainy days in the Province is between 154 and 190 days per year.

The monthly rainfall in Khe Sanh Town greatly varies throughout the year to be between 18.1 mm and 430 mm per month and it could reach 430 mm in October (Figure 7.6). Maximum rainfalls usually occur between August and November, contributing approximately 72.8% of the annual rainfall in Huong Hoa District.



- Source: Khe Sanh Meteorology Station

Figure 7.6 Average Rainfall in Khe Sanh Town (1998 – 2018)

7.3.7 Winds

In Quang Tri province, the prevailing wind directions have a seasonal change significantly. The winter monsoon occurs from November and ending in March while the summer monsoon occurs from May to September.

The statistics of average and maximum wind speed of stations are shown in Table 7.2 and Table 7.3.

Table 7.2 Average Wind Speed of Khe Sanh and Dong Ha Stations from 1987 – 2017

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Dong Ha	2.29	2.25	2.10	1.95	2.29	3.53	3.78	3.40	1.87	2.18	2.58	2.56	2.57
Khe Sanh	3.00	2.85	2.68	2.20	2.24	2.83	2.96	2.62	1.63	2.35	3.13	3.03	2.62

Table 7.3 Maximum Wind Speed of Khe Sanh and Dong Ha Stations from 1987 – 2017

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Dong Ha	12	12	10	12	14	14	13	13	18	12	12	10	18
Khe Sanh	14	12	14	15	12	12	13	17	16	15	15	14	17

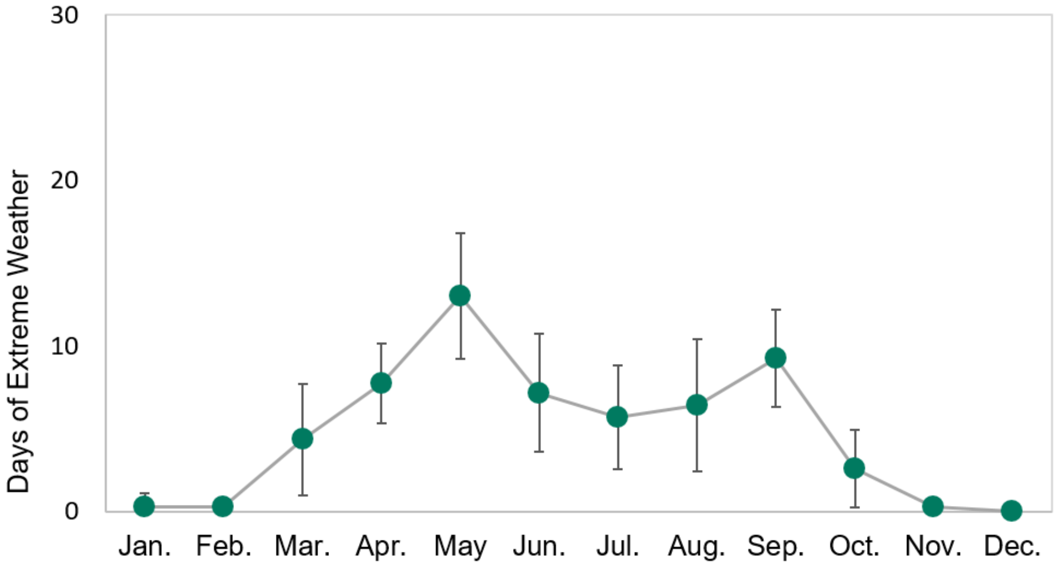
Unit: m/s

7.3.8 Extreme Weather

Storms and floods usually occur from July to November, mainly August, September and October. With steep and very steep terrain, heavy rain, short width of revers and steams, floods often occur very strongly, causing erosion and landslide.

There has been no flash flood phenomenon in some recent years but landslides occurred. In some places, the scale of landslides is very small due to prolonged heavy rains, causing the soil to lose its cohesion, combined with the steep terrain.

Quang Tri Province is also prone to extreme weather conditions associated with thunderstorms, strong winds and heavy rains. Days of extreme weather in the Province is approximately 57.3 days per year; while it is between 54 and 63 days per year in Huong Hoa District. Extreme weather in the District usually occurs between April and September and the number of days can go up to 13 days in May.



Source: Khe Sanh Meteorology Station

Figure 7.7 Days of Extreme Weather in Huong Hoa District (2007 – 2018)

7.4 Hydrology

Quang Tri Province has a dense network of canals and rivers (e.g Tam Giang, Ganh Hao, Bay Hap, Song Doc, Huong Hoa, The Ship, Trem Trem Rivers). There are three (03) main river systems in the Province, including:

- Thach Han River System (also called Quang Tri River): include 37 rivers which have 17 branches at level I (e.g. Vinh Phuoc, Rao Quan and Cam Lo branches), 13 branches at level II and 6 branches at level III. The system has a river net density of 0.92, an averaged elevation of 301 m and is lopping at 20.1%. The length of the System is approximately 156 km, measured based on its longest river. The basin is 36.8 km wide at average and has a total area of approximately 2,660 km^2;
- Ben Hai River System has a basin capacity of approximately 809 km^2 and it is approximately 64.5 km long. The basin has an elevation of 115 m and is sloping at 15.7%. The system has a river network density of 1.15 and a meandering coefficient of 1.43;
- O Lau River System which belongs to My Chanh River running through Tam Giang lagoon to Thuan An estuary. The system covers an area of 855 km^2 and is approximately 65 km long. The upper River is running through Thua Thien – Hue Province.

7.5 Air Quality

The air quality data are referenced from the 2019 environmental monitoring report of Huong Linh 2 Wind Farm Project which is far about 3 km to the east.

The sample was taken by Center for Natural Resources and Environment Monitoring of Quang Tri on 8 August 2019 and 15 November 2019 at the Huong Linh 2's substation for analysing parameters of air quality, based on 05:2013/BTNMT – National Technical Regulation on Ambient Air Quality.

The monitoring location is presented in Figure 7.8.

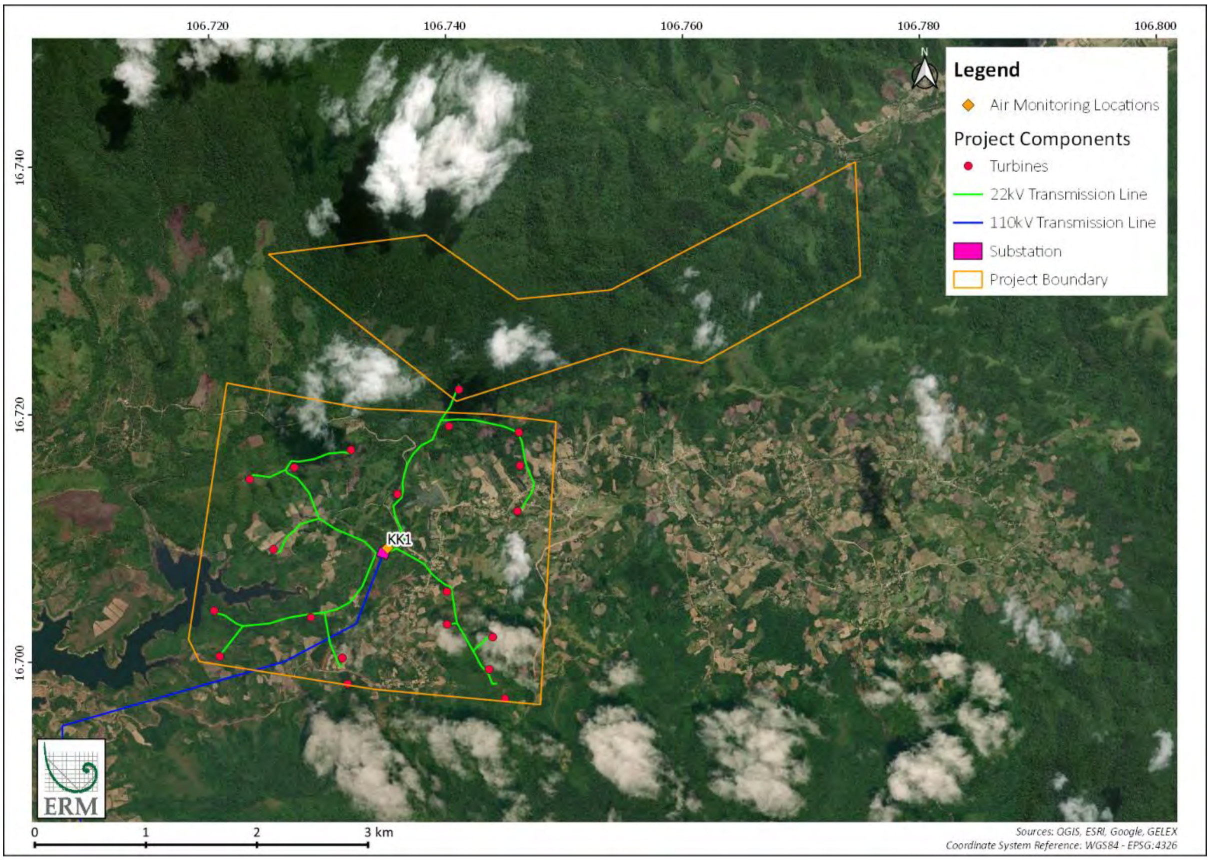


Figure 7.8 Air Quality Monitoring Location

The results showed that at the sampling time, all analysed parameters fell below thresholds' value of the QCVN 05:2013/BTNMT – National Technical Regulation on Ambient Air Quality. Therefore the air quality is generally in good conditions.

Table 7.4 Ambient Air Quality Results

No.	Parameters	Unit	Results		QCVN 05:2013/BTNMT (Average 01 hour)
			8/8/2019	15/11/2019	
1	Temperature	^oC	28.5	24.5	-
2	Humidity	%	62	71	-
3	Wind speed	m/s	4.2	5.5	-
4	Dust	$\mu g/m^3$	167	167	**300**
5	SO_2	$\mu g/m^3$	21	27	**350**
6	NO_2	$\mu g/m^3$	12	12	**200**
7	CO	$\mu g/m^3$	KPH	KPH	**30,000**

Note:
(-) Non-specified standards
KPH: Not detected

7.6 Surface Water Quality

The surface water quality data are referenced from the 2019 environmental monitoring report of Huong Linh 2 Wind Farm Project which is far about 3 km to the east.

The sample was taken by Center for Natural Resources and Environment Monitoring of Quang Tri on 8 August 2019 and 15 November 2019 at Khe Nghi point (the intersection with Hoong Coc inter-village road) (Figure 7.9) for analysing parameters of water quality, based on QCVN 08-MT:2013/BTNMT – National Technical Regulation on Surface Quality.

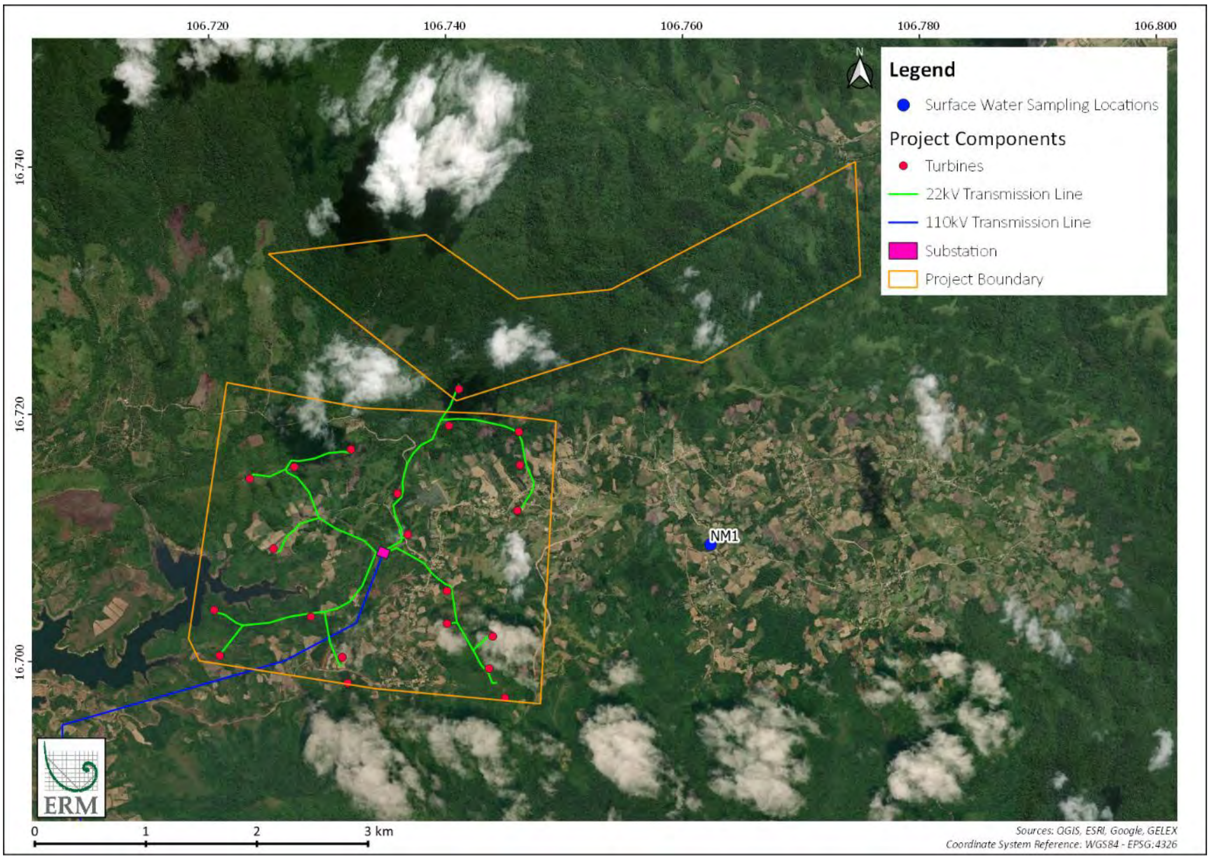


Figure 7.9 Surface Water Monitoring Location

The results showed that the sampling time, all the surface parameters fell below thresholds' of column B1 - QCVN 08-MT:2015/BTNMT – National Technical Regulation on Surface Quality.

Table 7.5 Surface Water Quality Results

No.	Criteria	Unit	Analysis result		QCVN 08-MT:2015/BTNMT
			8/8/2019	15/11/2019	B1
1	pH	-	7.0	6.9	5.5 - 9
2	DO	mg/L	6.7	7.3	≥4
3	TSS	mg/L	3.0	4.2	50
4	BOD_5	mg/L	1.5	1.7	15
5	COD	mg/L	7	9	30
6	Clo	mg/L	KPH (<5*)	7	350
7	$N0_3$-N	mg/L	0.26	0.13	10
8	$P0_4$-P	mg/L	KPH (<0.04*)	KPH (<0.04*)	0.3
9	Fe	mg/L	KPH (<0.021*)	0.27	1.5

No.	Criteria	Unit	Analysis result		QCVN 08-MT:2015/BTNMT
			8/8/2019	15/11/2019	B1
10	Oil and grease	mg/L	KPH (<0.18*)	KPH (<0.18*)	1

Note:
QCVN 08-MT:2015/BTNMT - National technical regulation on surface water
The classification of surface water sources is to assess and control water quality, serving different purposes:
B1: for irrigation or other uses with similar water quality requirements or uses such as B2; and
KPH: not detected
(-): Non-specified standards

7.7 Noise

A noise monitoring survey was conducted to collect the noise baseline condition for the Project between 12 and 16 February 2020. The selection of the monitoring locations and monitoring procedure were implemented based on the IFC noise management Guidance. Noise measured is assessed against the IFC Criteria (Table 7.6). Detailed information of the noise survey can be found in Appendix A

Table 7.6 IFC Noise Level Guidelines

Receptor	On Hour L_{Aeq} (dBA)	
	Day time 7:00 – 20:00	Night time 22:00 – 7:00
Residential, institutional, educational	55	45

Source: IFC General EHS Guidelines – Noise Management, 2007

7.7.1 Noise Monitoring Locations

Noise monitoring was conducted at three (03) locations in Huong Linh Commune (Figure 7.10). These monitoring locations were representative of noise sensitive receptors around the Project site. Three locations of noise survey including N1, N2 and N3 were selected for the monitoring and described in the Table. The noise monitoring locations are described below:

Table 7.7 Noise Monitoring Locations

Sampling locations	Description	Coordinate	
N1	Xa Bai village, Huong Linh commune	16⁰42'32.948"N	106⁰44'11.621"E
N2	Moi village, Huong Linh commune	16°42'51.735N	106°44'53.861"E
N3	Xa Bai village, Huong Linh commune	16°42'21.3"N	106°44'18.5"E

Noise monitoring location is illustrated in the Figure 7.10.

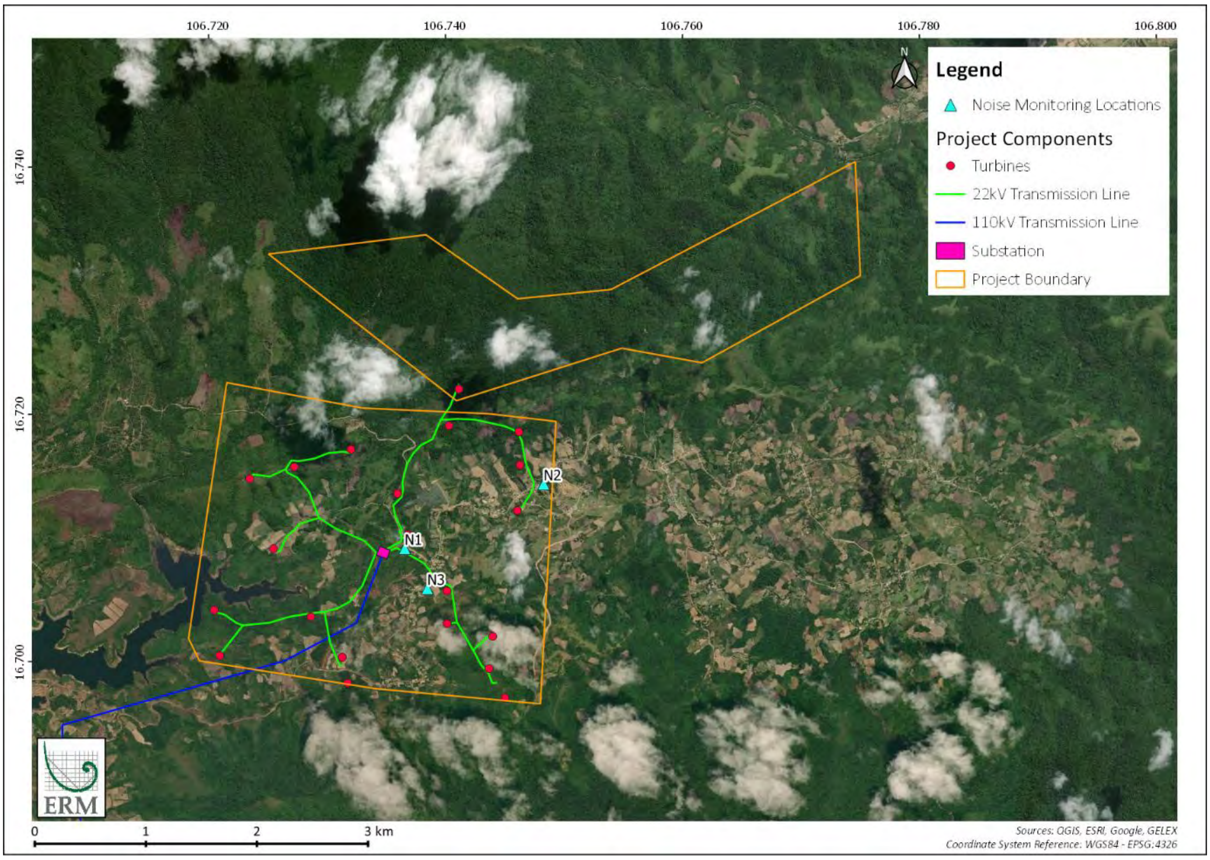


Figure 7.10 Noise Monitoring Locations Within and Around Project Area

7.7.2 Noise Monitoring Procedure

The noise monitoring procedure was conducted based on the IFC Guideline. L_{Aeq}, L_{A90} and L_{A10} noise levels were measured continuously for 48 hours with data logging for every 10 minutes. Weather conditions (e.g. wind speeds), exciting industrial condition and noise contribution from other noise sources at the monitoring locations were recorded and used for noise analysis. Detailed noise monitoring results about L_{Aeq}, L_{A90} and L_{A10} are listed in the Noise survey report in the Appendix A.

7.7.3 Noise Monitoring Results

Noise level (equivalent continuous sound pressure level with “A” frequency weighting – LAeq) measured at three monitoring locations met the IFC criteria for most of the monitoring duration in the night time. The exceeded noise level measured in the day time due to the sound of dogs barking, roosters crowing or motorbike passing. Noise monitoring results for each monitoring locations are shown in Figure 7.11, Figure 7.12 and Figure 7.13 and discussed in detailed below.

Location N1: Noise level Leq.1h at position N1 (ranged from 36.5 dBA to 56.6 dBA). All Leq.1h noise levels were lower than the IFC standard for both daytime and nightime (100%).

Location N2: Noise level Leq.1h at position N1 ranged from 38.5 dBA to 63.6 dBA. Most Leq.1h noise levels were lower than 55dBA - the IFC standard for daytime (93.3%). In nighttime, only 66.7% of Leq.1h samples met IFC noise standards.

Location N3: Noise level Leq.1h at position N3 ranged from 37.7 dBA to 61.5dBA. Most Leq.1h noise levels were lower than 55dBA - the IFC standard for daytime (54.8%). In nighttime, 83.3% of Leq.1h samples met IFC noise standards.

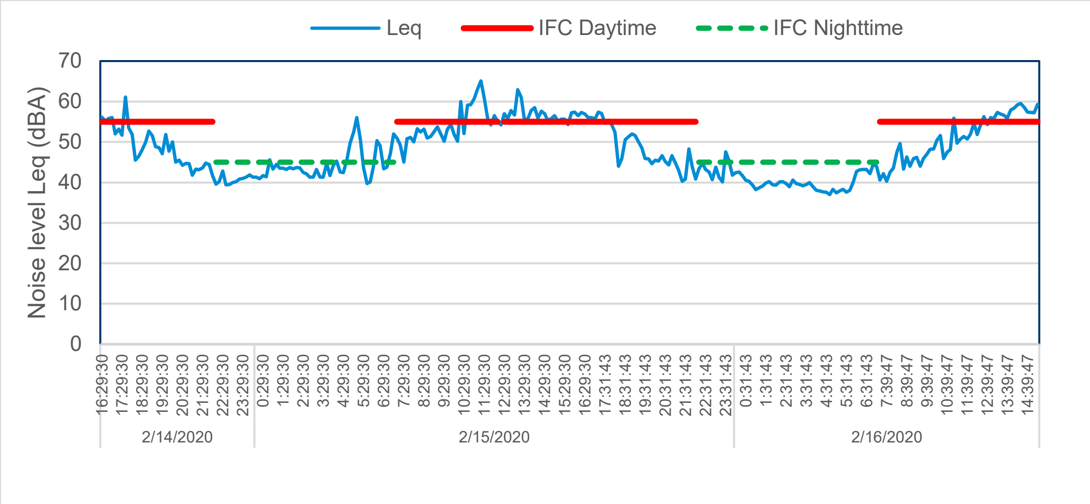


Figure 7.11 Leq, 10min (dBA) at Noise Monitoring Location N1

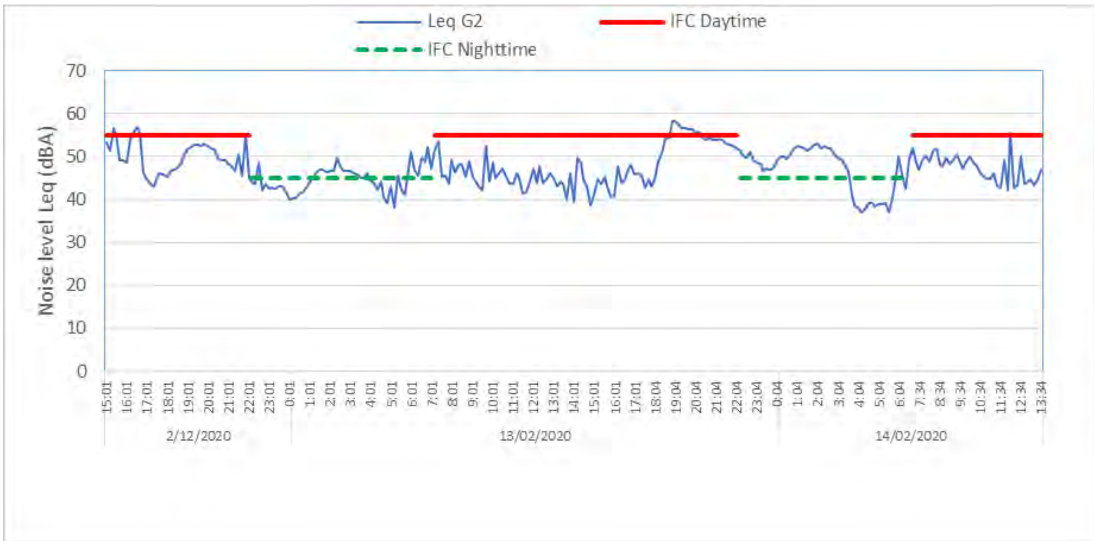


Figure 7.12 Leq, 10min (dBA) at Noise Monitoring Location N2

Figure 7.13 Leq, 10min (dBA) at Noise Monitoring Location N3

8. BIODIVERSITY BASELINE

8.1 Biodiversity

The biodiversity section provides an overview of protected areas, critical, natural and modified habitats, conservation significant species, terrestrial and marine biodiversity in the region, with a focus on the Project Area. The information presented in this section is primarily derived from a desktop review of relevant publications and online resources, biodiversity surveys conducted and the IBAT (Integrated Biodiversity Assessment Tool).

8.1.1 Background Assessment

This section summarises information from several databases and online data sources on biodiversity values within the landscape to determine predicted biodiversity values associated with the Project Area.

The following definition of areas have been used:

- The Project Area is defined as the development boundaries located in the terrestrial and marine zones. It is the footprint of disturbance required for the Project (Figure 8.1);
- The Study Area encompasses a 50 km buffer of the Project and has been used to identify biodiversity habitats and values for consideration based on the Integrated Biodiversity Assessment Tool (IBAT) (Figure 8.1);
- The Project Area of Influence (AoI) is the region in a 1 km radius from the boundary of the Project Area and has been assessed to define habitat values in the immediate project vicinity where species may regularly occur (Figure 8.1); and
- Where a species is identified to have or is likely to have a regular occurrence in the Project AoI, the Ecologically Appropriate Area of Analysis (EAAA) has been defined as required under IFC PS6 for that species. The EAAA is used to identify the presence of critical habitat for that species (through application of the IFC PS6 critical habitat thresholds outlined in the IFC PS6 Guidance Note (IFC, 2019)) (Section 8.1.4).

The desktop review considered online sources, literature and environmental studies undertaken within the Study Area. Key sources include:

- NGO webpages and databases including those belonging to the Worldwide Fund for Nature (WWF);
- Alliance for Zero Extinction (AZE);
- BirdLife International;
- Global Biodiversity Information Facility (GBIF);
- International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (the 'IUCN Red List') and their profiles;
- IUCN Red List of Ecosystems; and
- IBAT IFC/WB ESS6 Risk Report (dated 18 March 2020).
- The information is combined with field-recorded data obtained from field assessments undertaken for the Project and used to evaluate potential critical habitat triggers that may be associated with the EAAA. Critical habitat is assessed by screening desktop, historic and survey data to identify these triggers. Data is screened to determine whether a species or habitat is likely to meet a critical habitat threshold. The EAAA for this project is discussed in Section 8.1.1.11.

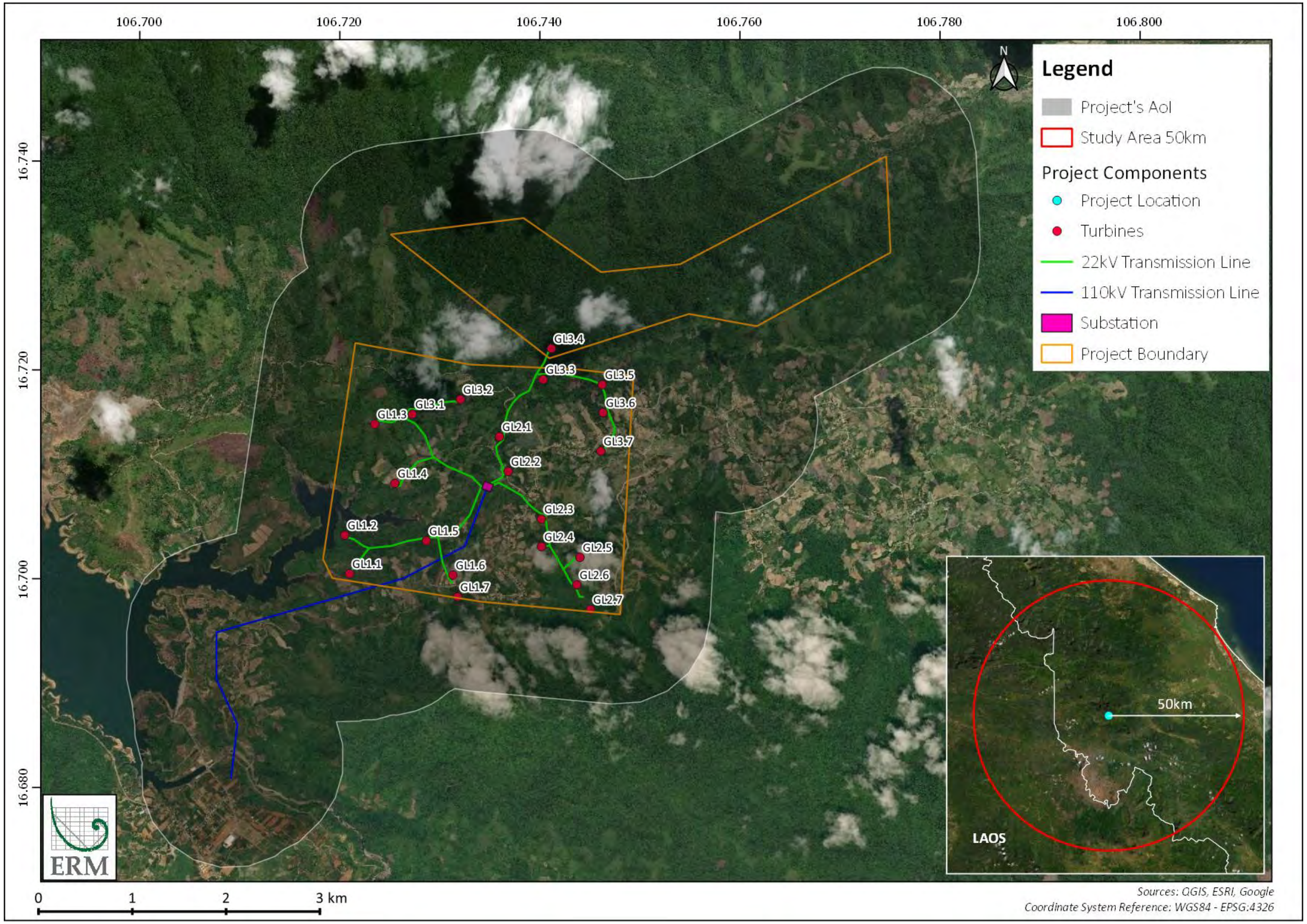


Figure 8.1 **Biodiversity Assessment Areas within Study Area**

8.1.1.1 Ecoregion Description

The Study Area lies within the North Central Coast of Vietnam, which is represented by two ecoregions: Northern Annamites Rain Forests (WWF, 2020a) and Northern Vietnam Lowland Rain Forests (WWF, 2020b). Both ecoregions also overlap with an EBA, the Annamese Lowlands. The ecoregions are described in the following sections to describe the habitat values of the greater landscape.

8.1.1.1.1 Northern Annamites Rain Forests

This ecoregion consists of mesic lower montane forests across Laos and Vietnam, with the Vietnamese portion noted for its high species diversity and significant endemism.

Of the 134 mammals discovered in the ecoregion, those of conservation significance include four endemic species, namely the Saola (*Pseudoryx nghetinhensis*; IUCN CR), Giant Muntjac (*Megamuntiacus vuquangensis*; IUCN CR), Annamite Muntjac (*Muntiacus truongsonensis*; IUCN CR*)* and *Muntiacus* sp. (*Buhouang muntjak*). Near endemic mammals include the Francois' Monkey (*Semnopithecus francoisi*; IUCN EN), Yellow-cheeked Gibbon (*Hylobates gabriellae*; IUCN EN), and Red-shanked Douc Langur (*Pygathrix nemaeus*; IUCN CR). The mammal assemblage also includes several threatened species, including the endangered Douc Langur, Tiger (*Panthera tigris*), Banteng (*Bos javanicus*), and Asian Elephant (*Elephas maximus*); vulnerable Gaur (*Bos gaurus*) and Serow (*Capricornis sumatraensis*).

The bird fauna in the ecoregion is estimated at more than 525 species, including near-endemic and endemic species. Endemic species include the Imperial Pheasant (*Lophura imperialis*) and Sooty Babbler (*Stachyris herberti*), while near-endemic species include the Vietnam Pheasant (*Lophura edwardsi*), Crested Argus (*Rheinardia ocellata*) and Short-tailed Scimitar-babbler (*Jabouilleia danjoui*). The Imperial Pheasant (*L. imperialis*) and Vietnam Pheasant (*L. edwardsi*) are also critically endangered, while the White-winged Duck (*Cairina scutulata*) are endangered species found in this ecoregion.

The size of this ecoregion is approximately 47,053 km^2, and more than half of the area has been cleared or degraded due to shifting cultivation and logging. Other threats to this ecoregion include wildlife poaching and the presence of unexploded ordnances.

8.1.1.1.2 Northern Vietnam Lowland Rain Forests

The Northern Vietnam Lowland Rain Forests ecoregion extends from the freshwater swamp forests of the Red River Valley south along the north-central coast of Vietnam to the region south of Tam Ky. Although much of this ecoregion's biodiversity has been lost due to extensive habitat loss, it still harbors several mammals and birds of conservation significance.

Mammals of conservation significance includes the Owston's Banded Civet (*Hemigalus owstoni*; IUCN EN), White-cheeked Gibbon (*Hylobates leucogenys*; IUCN CR), Red-shanked Douc Langur (*P. nemaeus*; IUCN CR), and Francois' Leaf Monkey (*S. francoisi*; IUCN EN). One endemic bat species, the Vietnam Leaf-nosed Bat (*Paracoelops megalotis*) is also present.

There are more than 300 bird species in this ecoregion, including one endemic and three near-endemic spcies. Endemic species include the Annam Partridge (*Arborophila merlini*), while the near-endemic species include the Vietnam Pheasant (*L. edwardsi*), Short-tailed Scimitar-babbler (*J. danjoui*) and Grey-faced Tit-babbler (*Macronous kelleyi*).

The size of this ecoregion is approximately 22,522 km^2. However, less than 10% of the native vegetation remains and is protected due to Vietnam's high human population density and illegal wildlife trade.

8.1.1.2 World Heritage Areas

World Heritage Areas are areas of outstanding universal value designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), as detailed in the following Sections 8.1.1.2.1 and 8.1.1.2.2.

8.1.1.2.1 World Heritage Sites

World Heritage Sites are sites selected by UNESCO as having cultural, historic, scientific or other form of significance. These areas are legally protected by international treaties and demarcated by UNESCO as protected zones. This allows for practical conservation of areas which would otherwise be subjected to threats such as uncontrolled and unrestricted access, and associated activities such as poaching and illegal logging.

Vietnam has eight registered World Heritage Sites (UNESCO, 2020a), with the closest being the Phong Nha-Ke Bang National Park, known for its limestone karst cave systems and primary forest. The 123,326 ha core zone is located 90 km northwest, while the 220,055 ha buffer zone is 50 km northwest of the Project Area. As none of the World Heritage Sites overlap with the Study Area and the AoI, World Heritage Sites are not considered relevant for this assessment.

8.1.1.2.2 Biosphere Reserves

Biosphere Reserves are areas made up of terrestrial, coastal and marine ecosystems, internationally recognized under UNESCO's Man and Biosphere Programme. They are intended to be learning sites for sustainable development where each reserve encourages sustainable management of interactions between social and ecological systems (UNESCO, 2020b).

Vietnam has nine Biosphere Reserves. None of the Biosphere Reserves are within the Study Area, and the closest Biosphere Reserve is the Western Nghe An Biosphere Reserve located approximately 310 km to the northwest, outside the Study Area. As such, Biosphere Reserves are not considered relevant for this assessment.

8.1.1.3 Ramsar Sites

The Convention of Wetlands, also known as the Ramsar Convention, is an intergovernmental treaty that provides the framework for the conservation and use of wetlands and their resources (Ramsar Convention on Wetlands, 2020). The Ramsar Convention for Vietnam has been effective from 20 January 1989, and currently has nine sites designated as Wetlands of International Importance, which cover an approximate surface area of 120,549 ha (Ramsar Convention on Wetlands, 2011). None of these sites are within the Study Area, and hence Ramsar sites are not considered relevant for this assessment.

8.1.1.4 Biodiversity Hotspots

Vietnam, along with Cambodia, China, Lao PDR, Myanmar and Thailand, is identified as part of the Indo-Burma Biodiversity Hotspot (Conservation International, 2020). The Hotspot covers a land area of 2,308,815 km^2, and is one of the most biologically important regions on the planet. The Indo-Burma Hotspot has a diversity of landforms and climatic zones encompassing a number of complete mountain ranges and sections of others. It features isolated massifs and plateaus, extensive areas of limestone karst and several of Asia's largest rivers. As a result there is a high variety of habitats and thus biodiversity (Critical Ecosystem Partnership Fund, 2007).

8.1.1.5 Key Biodiversity Areas

Key Biodiversity Areas (KBAs) are defined by the Key Biodiversity Areas Partnership[7] as sites that contribute significantly to the global persistence of biodiversity, applicable to terrestrial, freshwater, and marine ecosystems. Sites qualify as global KBAs if they meet one or more of 11 criteria as defined by the Partnership, grouped into the following five categories: threatened biodiversity, geographically restricted biodiversity, ecological integrity, biological processes and irreplaceability (BirdLife International, 2018). KBAs include Important Bird and Biodiversity Areas (IBA), Alliance for Zero Extinction (AZE), Important Plant Areas (IPA) and Important Sites for Freshwater Biodiversity. KBAs that have been identified within the Study Area are listed in Table 8.1. The location of KBAs relative to the Project components is shown in Figure 8.2.

Table 8.1 KBAs Identified within the Study Area

S/N	Name	Area (ha)	Country	IBA	Distance and Direction
1	Dakrong	41,689	Vietnam	Yes	20 km southeast of Project Area
2	Laving-Laveun	38,103	Laos	No	35 km northwest of Project Area
3	Phong Dien	41,874	Vietnam	Yes	40 km southeast of Project Area
4	Truong Son	191,094	Vietnam	Yes	25 km northwest of Project Area
5	Upper Xe Bangfai	30,481	Laos	Yes	50 km northwest of Project Area

Source: IBAT, 2020

[7] Key Biodiversity Partnership comprises a consortium of 12 conservation NGOs including BirdLife International, IUCN, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Rainforest Trust, Royal Society of the Protection of Birds, WWF and Wildlife Conservation Society.

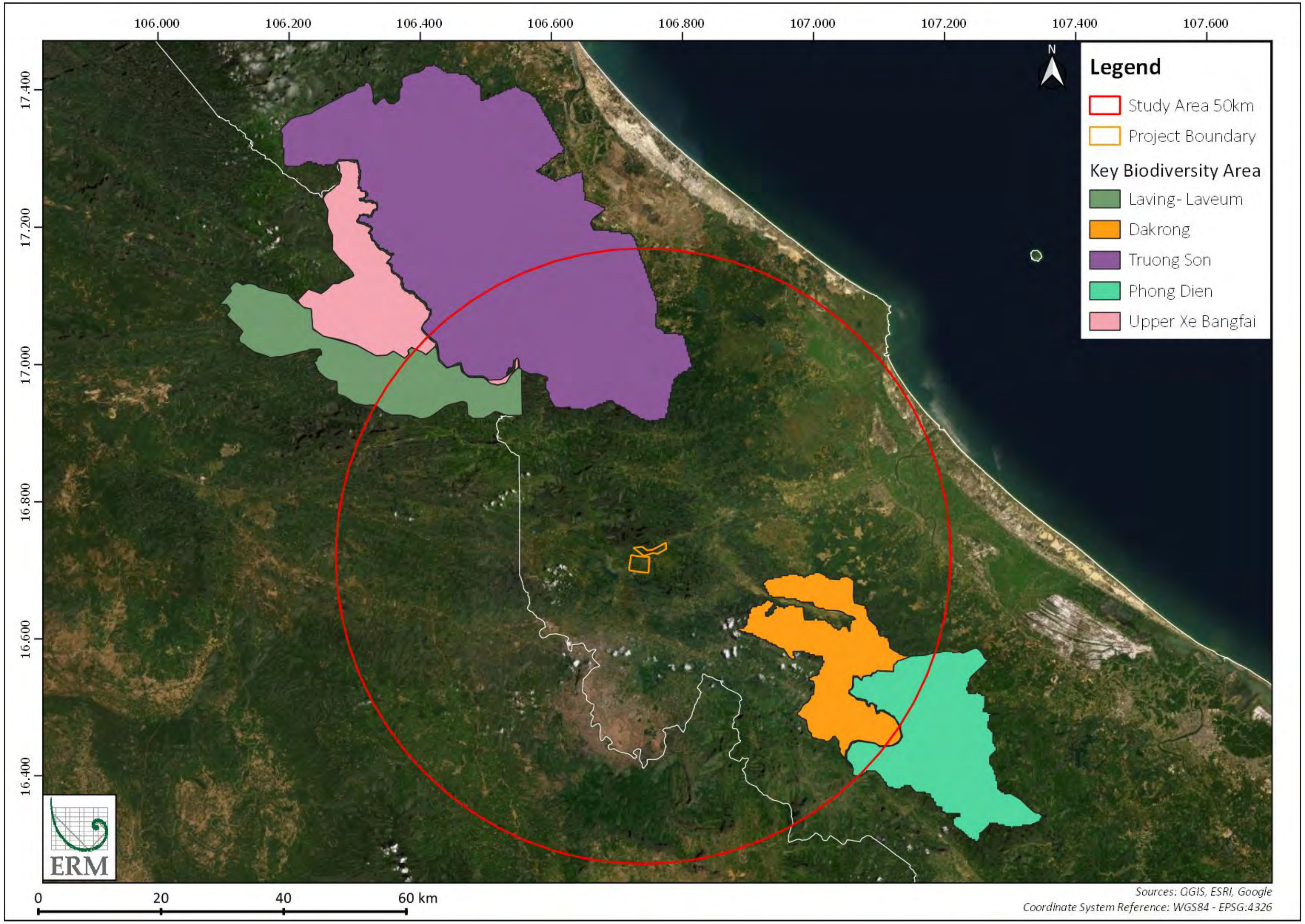


Figure 8.2 KBAs in Proximity to the Project Area

8.1.1.5.1 Important Bird and Biodiversity Areas

An Important Bird and Biodiversity Area (IBA) is an area that is globally important for the conservation of birds and other biodiversity. The summary of IBAs identified within the Study Area is shown in Table 8.2.

Table 8.2 IBAs Identified within the Study Area

S/N	Area Name	Summary
1	Dakrong	Dakrong is classified as an IBA approximately 40,526 ha in size, located approximately 20 km from the Project Area. The Dakrong proposed nature reserve is situated on a ridge of low mountains and is located in the southern part of the Annamese Lowlands EBA. Current threats to biodiversity at Dakrong include small-scale timber extraction, trapping and hunting, clearance of land for agriculture, mining and livestock grazing. Bird species of conservation concern include the Vietnam Pheasant (*Lophura edwardsi*) and Imperial Pheasant (*Lophura imperialis*) (BirdLife International, 2020a).
2	Phong Dien	Phong Dien is classified as an IBA approximately 41,548 ha in size, located approximately 40 km from the Project Area. The Phong Dien proposed nature reserve is contiguous with the Dakrong nature reserve and is similarly situated on a ridge of low mountains. The main threats to biodiversity at Phong Dien include hunting, illegal timber cutting, forest fires and deforestation for agriculture. Trigger species known to use this area include Vietnam Pheasant (*Lophura edwardsi*) and Crested Argus (*Rheinardia ocellata*) (BirdLife International, 2020b).
3	Truong Son	Truong Son is classified as an IBA approximately 50,000 ha in size, located approximately 25 km from the Project Area. The sole trigger species known to use this area is the Crested Argus (*Rheinardia ocellata*) (BirdLife International, 2020c).
4	Upper Xe Bangfai	Upper Xe Bangfai is classified as an IBA approximately 31,300 ha in size, located approximately 50 km from the Project Area. This bird sanctuary is located in the upper catchment of the Xe Bangfai, to the south of Hin Namno National Protected Area, in central Laos. The eastern perimeter of this IBA is contiguous with Truong Son IBA in Vietnam, which supports populations of many of the key species found at Upper Xe Bangfai. Threats to biodiversity include conversion of forest to agriculture and hunting. Trigger species known to use this area include the Crested Argus (*Rheinardia ocellata*), Grey-headed Parakeet (*Psittacula finschii*), Siamese Fireback (*Lophura diardi*), Lesser Fish Eagle (*Ichthyophaga humilis*), Bar-backed Partridge (*Arborophila brunneopectus),* Ashy Woodswallow (*Artamus fuscus)*, Lesser Necklaced Laughingthrush (*Garrulax monileger*), and Black-collared Starling (*Gracupica nigricollis)* (BirdLife International, 2020d).

Source: BirdLife International, 2020.

8.1.1.5.2 Alliance for Zero Extinction Sites

The Alliance for Zero Extinction (AZE) sites work to safeguard and increase populations of critically endangered and endangered species (AZE, 2020). This involves eliminating human threats such as commercial exploitation, disease, and introduction of invasive species. There are no AZE sites within the Study Area, with the closest being Phou Ahyon in Laos, approximately 90 km southeast from the site. The AZE status for Phou Ahyon is triggered by the presence of the endangered Phou Ajol Spadefoot Toad (*Leptobrachium xanthops*).

8.1.1.6 Endemic Bird Areas

An Endemic Bird Area (EBA) is an area to which at least two restricted range bird species (species with extent of occurrence (EOO) of ≤ 50,000 km^2) are entirely confined (BirdLife International, 2020e). Vietnam has a total of seven EBAs, one of which overlaps with the Study Area: the Annamese Lowlands EBA in north-central Vietnam and Laos, which has an area of 51,000 km^2 (BirdLife International, 2020f). The Annamese Lowlands EBA also contains all the IBAs identified within the Study Area.

8.1.1.7 Protected Areas

According to the IUCN (2008), a Protected Area is "A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve long-term conservation of nature with associated ecosystem services and cultural values". Under the provisions of IFC PS6, a Protected Area and Internationally Recognized area require specific management actions if development proceeds within the boundary (see requirements under KBAs outlined above). Consultation with protected area managers and the community will be required.

Where a proposed project is located within a legally protected area, IFC PS6 requires that:

- The natural habitats are not significantly degraded;
- Mitigations are designed to achieve no net loss of biodiversity where feasible project activities are not implemented within critical habitat;
- Demonstrate that the project's significant residual impacts on biodiversity are adequately mitigated;
- Demonstrate the proposed development is legally permitted;
- The client will act in a manner consistent with any government recognised management plans;
- Protected area sponsors and management, Affected Communities, Indigenous Peoples and other stakeholders are consulted as appropriate; and
- Additional programs to promote and enhance the conservation aims and effective management of the area are implemented as appropriate.

8.1.1.7.1 ASEAN Heritage Parks

ASEAN Heritage Parks (AHPs) are selected protected areas in the ASEAN region recognized for their unique flora and fauna and ecosystems, wilderness and excellent values (ASEAN Centre for Biodiversity, 2020). There are no AHPs located within the Study Area. The closest AHP to the Project Area is the Chu Mom Ray National Park, approximately 240 km to the southeast. As such, ASEAN Heritage Parks are not considered relevant for this assessment.

8.1.1.7.2 Nationally Protected Areas

Four Nationally Protected Areas exists within the Study Area, highlighted in Table 8.3 and shown in Figure 8.3.

Table 8.3 Protected Areas Identified within the Study Area

S/N	Name	Area (ha)	IUCN Category	Summary
1	Dakrong	40,526	Not Reported	Dakrong Nature Reserve is located in Vietnam, approximately 20 km from the Project Area. The Dakrong proposed nature reserve is situated on a ridge of low mountains and is located in the southern part of the Annamese Lowlands EBA. It is also a KBA (IBA).

S/N	Name	Area (ha)	IUCN Category	Summary
2	Phong Dien	41,548	IV	Phong Dien Nature Reserve is located in Vietnam, approximately 40 km from the Project Area. The Phong Dien proposed nature reserve is contiguous with the Dakrong Nature Reserve and is similarly situated on a ridge of low mountains. It is also a KBA (IBA).
3	Dong Phou Vieng	299,000	VI	Dong Phou Vieng National Biodiversity Conservation Area is located in central Laos, approximately 40 km from the Project Area. A dry lowland forest with open canopy, trigger species known to use this area include the Indochinese Silvered Leaf Monkey (*Trachypithecus germaini*) (Protected Planet, 2020a; Timmins et al., 2013).
4	Bac Huong Hoa	23,486	Not Reported	Bac Huong Hoa Nature Reserve is located in central Vietnam, with the southern edge close to the northern boundary of Project Area. It encompasses an area of lowland and mid-montane evergreen forest in central Vietnam, adjacent to the international border with Laos. The forests supports a number of globally threatened mammals such as the Saola and Red-shanked Duoc Langur, as well as four of seven restricted-range bird species which define the Annamese Lowlands EBA – Vietnam Pheasant, Crested Argus, Grey-faced Tit-babbler and White-cheeked Laughingthrush. Almost 85% of the nature reserve still retains natural forest cover, of various degrees of quality. It is bisected by the Ho Chi Minh Highway (Mahood & Van Trần, 2008; Protected Planet, 2020b).

Source: IBAT, 2020.

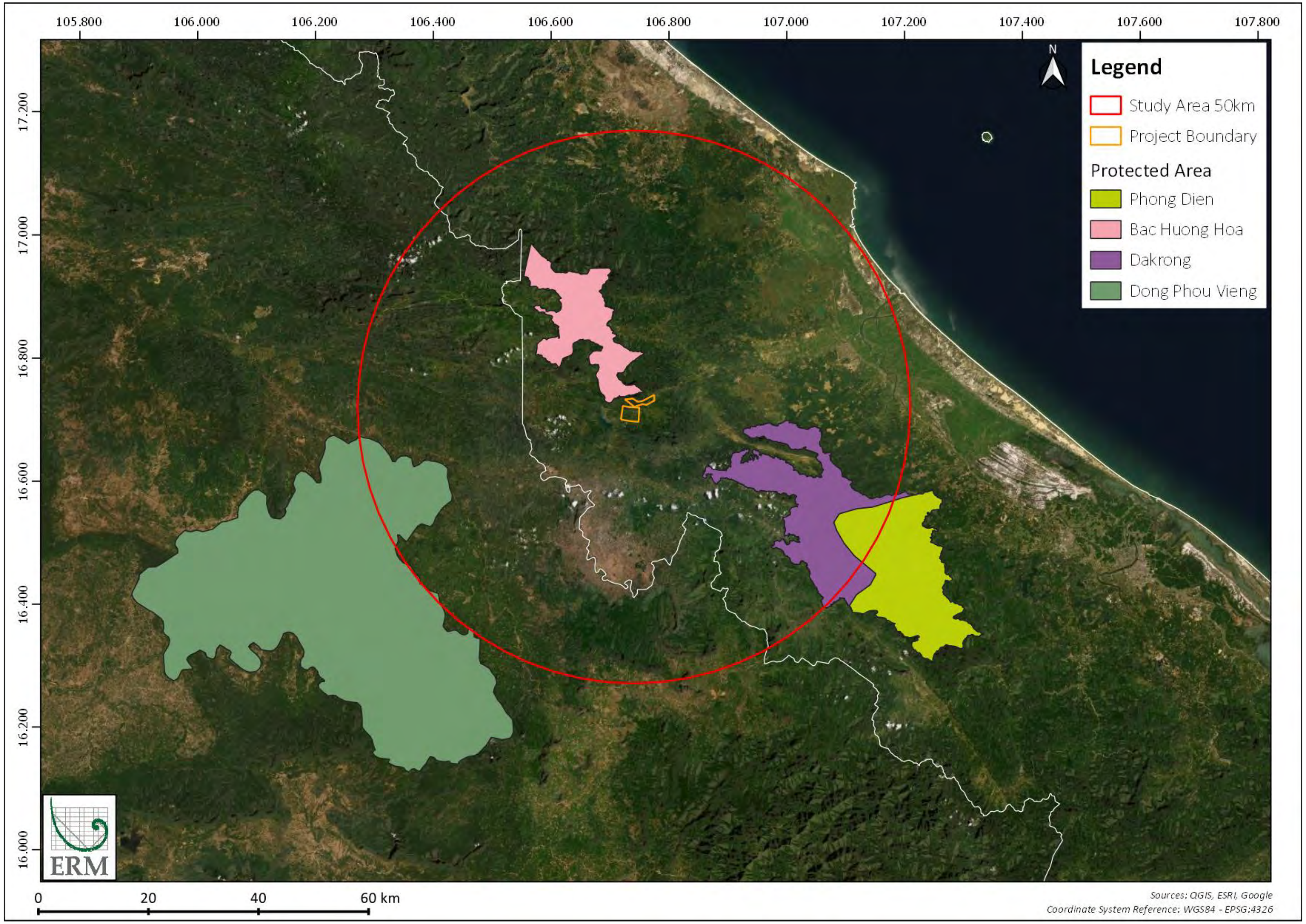


Figure 8.3 Protected Area within the Study Area

8.1.1.8 Vietnam Forest Classifications

Vietnam's forests can be categorized into three categories (Forest Science Institute of Vietnam, 2009), namely special use, production and protection under the Law on Protection and Development of Forest of the National Assembly (Forest Law) (The REDD Desk, 2004):

- Special-use forest: Special-use forests, which are used mainly for conservation of nature, specimens of the national forest ecosystems and forest biological gene sources; for scientific research; protection of historical and cultural relics as well as landscapes; in service of recreation and tourism in combination with protection, contributing to environmental protection. Special-use forest may include (1) national parks; (2) nature conservation zones; (3) landscape protection areas; and (4) scientific research and experiment forests.
- Production forest: Production forests are used mainly for production and trading of timber and non-timber forest products in combination with protection, contributing to environmental protection, including (1) natural production forests; (2) planted production forests; (3) seeding forests, including the selected and recognized planted forests and natural forests.
- Protection forest: Protection forests are used mainly to protect water sources and land, prevent erosion and desertification, restrict natural calamities and regulate climate, thus contributing to environmental protection. Protection forest may include (1) headwater protection forests; (2) wind- and sand-shielding protection forests; (3) protection forests for tide shielding and sea encroachment prevention; and (4) protection forests for environmental protection.
- The map of Vietnam Forest Classifications within the Study Area is shown in Figure 8.4.

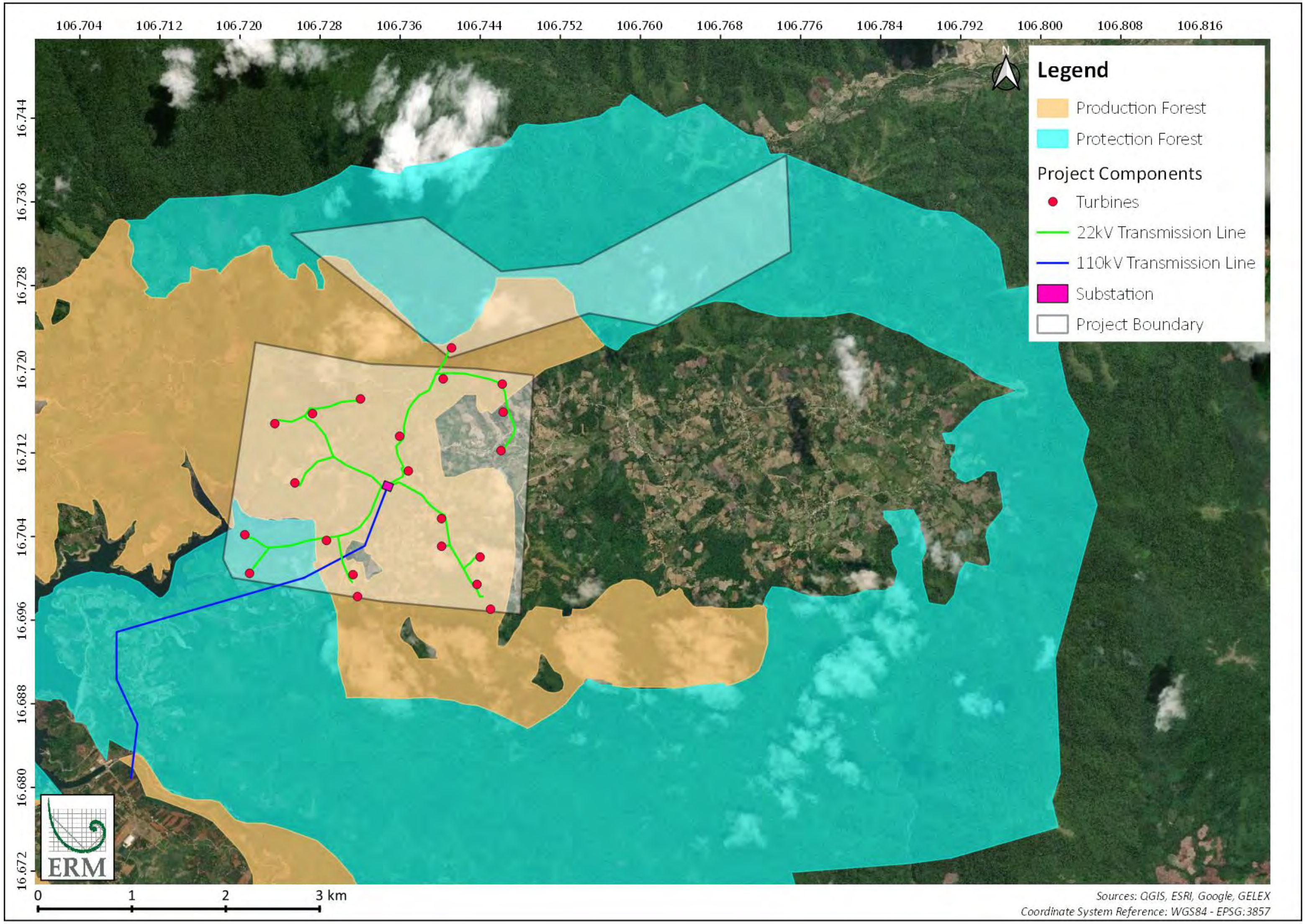


Figure 8.4 Vietnam Forest Classifications

8.1.1.9 Conservation Significant Species

The IBAT database was used to identify potential critical habitat species (Critically Endangered, Endangered species, and Restricted Range species) within the Study Area in order to assess against the thresholds for Critical Habitat Criterion 1 (Critically endangered and endangered species) and Criterion 2 (Endemic and/or restricted-range species). The complete IBAT risk screen report (dated 18 March 2020) is shown in Appendix E.

8.1.1.9.1 Threatened Species

Threatened species are identified as those classified on the IUCN Red List of Threatened Species. The Red List defines threatened species as those listed as being Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). CR and EN species are considered to be at a heightened risk of extinction and are awarded an elevated level of consideration under IFC PS6. These species are candidates for screening against Critical Habitat Criterion 1. VU species are also considered under Criterion 1 where the Project impacts may impact the species to an extent as to warrant the species' reclassification as either CR or EN.

74 threatened species have been identified within the Study Area are listed in Table 8.4, after screening out marine species as the Project Area and EAAA are located within a terrestrial environment.

Table 8.4 Threatened Species Identified within the Study Area

S/N	Scientific Name	Common Name	IUCN Category	Class
1	*Crocodylus siamensis*	Siamese Crocodile	CR	Reptile
2	*Indotestudo elongata*	Elongated Tortoise	CR	Reptile
3	*Manis javanica*	Sunda Pangolin	CR	Mammal
4	*Manis pentadactyla*	Chinese Pangolin	CR	Mammal
5	*Pangasius sanitwongsei*	Giant Pangasius	CR	Ray-finned fish
6	*Pseudoryx nghetinhensis*	Saola	CR	Mammal
7	*Muntiacus vuquangensis*	Large-antlered Muntjac	CR	Mammal
8	*Cuora bourreti*	Bourret's Box Turtle	CR	Reptile
9	*Catlocarpio siamensis*	Giant Carp	CR	Ray-finned fish
10	*Gyps bengalensis*	White-rumped Vulture	CR	Bird
11	*Sarcogyps calvus*	Red-headed Vulture	CR	Bird
12	*Emberiza aureola*	Yellow-breasted Bunting	CR	Bird
13	*Gyps tenuirostris*	Slender-billed Vulture	CR	Bird
14	*Lophura edwardsi*	Vietnam Pheasant	CR	Bird
15	*Panthera pardus ssp. delacouri*	Indochinese Leopard	CR	Mammal
16	*Pygathrix nemaeus*	Red-shanked Douc Langur	CR	Mammal
17	*Nomascus siki*	Southern White-cheeked Gibbon	CR	Mammal
18	*Laubuka caeruleostigmata*	Flying Minnow	EN	Ray-finned fish
19	*Chrotogale owstoni*	Owston's Civet	EN	Mammal

S/N	Scientific Name	Common Name	IUCN Category	Class
20	*Cuon alpinus*	Dhole	EN	Mammal
21	*Elephas maximus*	Asian Elephant	EN	Mammal
22	*Panthera tigris*	Tiger	EN	Mammal
23	*Hemitrygon laosensis*	Mekong Freshwater Stingray	EN	Cartilaginous fish
24	*Nomascus gabriellae*	Red-cheeked Gibbon	EN	Mammal
25	*Nycticebus pygmaeus*	Pygmy Slow Loris	EN	Mammal
26	*Trachypithecus germaini*	Indochinese Lutung	EN	Mammal
27	*Trachypithecus hatinhensis*	Hatinh Langur	EN	Mammal
28	*Nesolagus timminsi*	Annamite Striped Rabbit	EN	Mammal
29	*Viverra megaspila*	Large-spotted Civet	EN	Mammal
30	*Cuora mouhotii*	Keeled Box Turtle	EN	Reptile
31	*Protobothrops sieversorum*	Three Horned-scaled Pitviper	EN	Reptile
32	*Pangasianodon hypophthalmus*	Striped Catfish	EN	Ray-finned fish
33	*Schistura nudidorsum*	-	EN	Ray-finned fish
34	*Poropuntius deauratus*	Yellow Tail Brook Barb	EN	Ray-finned fish
35	*Terateleotris aspro*	-	EN	Ray-finned fish
36	*Rheinardia ocellata*	Crested Argus	EN	Bird
37	*Pavo muticus*	Green Peafowl	EN	Bird
38	*Sterna acuticauda*	Black-bellied Tern	EN	Bird
39	*Lonchura oryzivora*	Java Sparrow	EN	Bird
40	*Calostoma insigne*	-	EN	Fungi
41	*Bos gaurus*	Gaur	VU	Mammal
42	*Helarctos malayanus*	Sun Bear	VU	Mammal
43	*Macaca arctoides*	Stump-tailed Macaque	VU	Mammal
44	*Panthera pardus*	Leopard	VU	Mammal
45	*Ursus thibetanus*	Asiatic Black Bear	VU	Mammal
46	*Nycticebus bengalensis*	Bengal Slow Loris	VU	Mammal
47	*Macaca leonina*	Northern Pig-tailed Macaque	VU	Mammal
48	*Arctictis binturong*	Binturong	VU	Mammal
49	*Rusa unicolor*	Sambar	VU	Mammal
50	*Hipposideros scutinares*	Shield-nosed Leaf-nosed Bat	VU	Mammal
51	*Wallago attu*	-	VU	Ray-finned fish
52	*Pseudohemiculter dispar*	-	VU	Ray-finned fish
53	*Osphronemus exodon*	Elephant Ear Gourami	VU	Ray-finned fish
54	*Oxygaster pointoni*	-	VU	Ray-finned fish
55	*Lycodon paucifasciatus*	Rendahl's Wolf Snake	VU	Reptile

S/N	Scientific Name	Common Name	IUCN Category	Class
56	*Naja siamensis*	Black And White Spitting Cobra	VU	Reptile
57	*Ophiophagus hannah*	King Cobra	VU	Reptile
58	*Bangana behri*	-	VU	Ray-finned fish
59	*Schistura kaysonei*	Laotian Cave Loach	VU	Ray-finned fish
60	*Labeo pierrei*	-	VU	Ray-finned fish
61	*Tor sinensis*	Red Mahseer	VU	Ray-finned fish
62	*Yasuhikotakia nigrolineata*	Black-Lined Loach	VU	Ray-finned fish
63	*Bungarus slowinskii*	Red River Krait	VU	Reptile
64	*Python bivittatus*	Burmese Python	VU	Reptile
65	*Bangana musaei*	-	VU	Ray-finned fish
66	*Mulleripicus pulverulentus*	Great Slaty Woodpecker	VU	Bird
67	*Buceros bicornis*	Great Hornbill	VU	Bird
68	*Rhyticeros undulatus*	Wreathed Hornbill	VU	Bird
69	*Carpococcyx renauldi*	Coral-billed Ground-cuckoo	VU	Bird
70	*Clanga clanga*	Greater Spotted Eagle	VU	Bird
71	*Aquila heliaca*	Eastern Imperial Eagle	VU	Bird
72	*Garrulax konkakinhensis*	Chestnut-eared Laughingthrush	VU	Bird
73	*Arctonyx collaris*	Greater Hog Badger	VU	Mammal
74	*Physignathus cocincinus*	Chinese Water Dragon	VU	Reptile

Source: IBAT, 2020.

Note: *CR – Critically Endangered*
EN – Endangered
VU – Vulnerable

8.1.1.9.2 Restricted Range Species

According to IFC PS6, restricted range species is defined as species with an estimated extent of occurrence (EOO) of ≤ 50,000 km^2 for terrestrial vertebrates and ≤ 100,000 km^2 for marine species. These species are candidates for screening against Critical Habitat Criterion 2. 8 restricted range species has been identified within the Study Area in the IBAT report, as shown in Table 8.5.

Table 8.5 Restricted Range Species Identified within the Study Area

S/N	Scientific Name	Common Name	IUCN Category	EOO (km^2)	Class
1	*Pseudoryx nghetinhensis*	Saola	CR	<10,000	Mammal
2	*Lophura edwardsi*	Vietnam Pheasant	CR	18,000	Bird
3	*Garrulax konkakinhensis*	Chestnut-eared Laughingthrush	VU	19,400	Bird
4	*Gracixalus supercornutus*	-	NT or LR/NT	21,941	Amphibian
5	*Stachyris herberti*	Sooty Babbler	LC or LR/LC	28,500	Bird

6	*Nok hualon*	Bare-faced Bulbul	LC or LR/LC	34,000	Bird
7	*Theloderma truongsonense*	-	DD	-	Amphibian
8	*Hylomys megalotis*	Long-eared Gymnure	DD	-	Mammal

Source: BirdLife International, 2000; IBAT, 2020; IUCN, 2020.

Note: *CR – Critically Endangered*
VU – Vulnerable
NT – Near Threatened
LR – Lower Risk
LC – Least Concern
DD – Data Deficient

For *Theloderma truongsonense* and Long-eared Gymnure which are data deficient, no EOO could be obtained. However, the Long-eared Gymnure has reportedly only been found from Khammouan Province in central Lao PDR (Chiozza, 2016), while *T. truongsonense* has been recorded in the mountains of central Vietnam and is expected to be present in Laos (Stuart, 2008).

8.1.1.9.3 Migratory and/or Congregatory Species

Species identified as migratory and/or congregatory within the Study Area using the relevant BirdLife International database and IUCN species profiles are also listed in order to assess against the thresholds for critical habitat Criterion 3 (Migratory and/or congregatory species). 205 migratory birds were identified as candidates, as shown in Appendix I.

8.1.1.10 Invasive Species

Invasive species are non-native species to a particular ecosystem and whose introduction and spread causes, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health. These species become naturalized in their introduced range, and often reproduce in large numbers spread over a large area. This can result in competition and damage to native species.

Invasive species have the capacity to exacerbate their role in ecosystem degradation through combined threats of habitat change, climate change, over-exploitation of ecosystem resources and pollution. These further enhance their threat to biodiversity and the human condition.

According to the Global Invasive Species Database (GISD, 2020), Vietnam is home to 131 invasive species, of which 102 are terrestrial species and 29 are aquatic species (freshwater and marine). The list of invasive species in Vietnam are shown in Appendix F. The invasive species recorded during field surveys are listed in Section 8.1.3.

8.1.1.11 Ecologically Appropriate Area of Analysis

In accordance with PS6 an EAAA should be identified to determine the presence of critical habitat for each species. This is the area of analysis to assess the applicability of the critical habitat criteria and thresholds. PS6 notes when defining the boundaries the following aspects should be a consideration: distribution of the species or ecosystems, ecological patterns, processes, features, and functions that are necessary for maintaining them.

The EAAA was defined based on the existing Project Area condition, surrounding environment condition, surrounding land uses, likely conservation significant species present, natural barriers and existing anthropogenic impacts. The EAAA for this project generally incorporates terrestrial habitats. It includes part of the Annamite Range that are in close proximity to Project infrastructure or are likely to be impacted by Project operations. A range of terrestrial habitats (e.g. forests and cultivated land) are included within the EAAA.

The EAAA is largely defined by the topography of the region (e.g. ridgelines). Key natural barriers include the large and steep mountains of the Annamite Range. The heights of ridges to the north of the Project EAAA range from 400 – 1600 m.

The identified candidate species groups, main habitat types associated with these species, and components of EAAA that these habitat types have been included in are outlined below in Table 8.6. The EAAA is shown in Figure 8.5.

Table 8.6 Candidate Species Habitat Requirements and EAAA

S/N	Identified candidate species groups	EAAA	Comment on inclusion/exclusion of habitat type
1	Migratory birds; resident birds, forest dwelling herpetofauna (especially turtles) and mammals (especially langurs and gibbons), plants	Forest	The area within and surrounding the Project boundary contains lowland and upland evergreen and semi-evergreen forest, which could be used by candidate species assessed.
2	Migratory birds; resident birds	Residential, agricultural and cleared land	The area within and surrounding the Project boundary contains cleared and cultivated areas, which may be used by candidate species assessed.
3	Migratory birds, resident birds, fishes	Inland wetlands, inland rivers/lakes	The area within and surrounding the Project boundary contains scattered rivers and lakes which could be used by candidate species assessed.

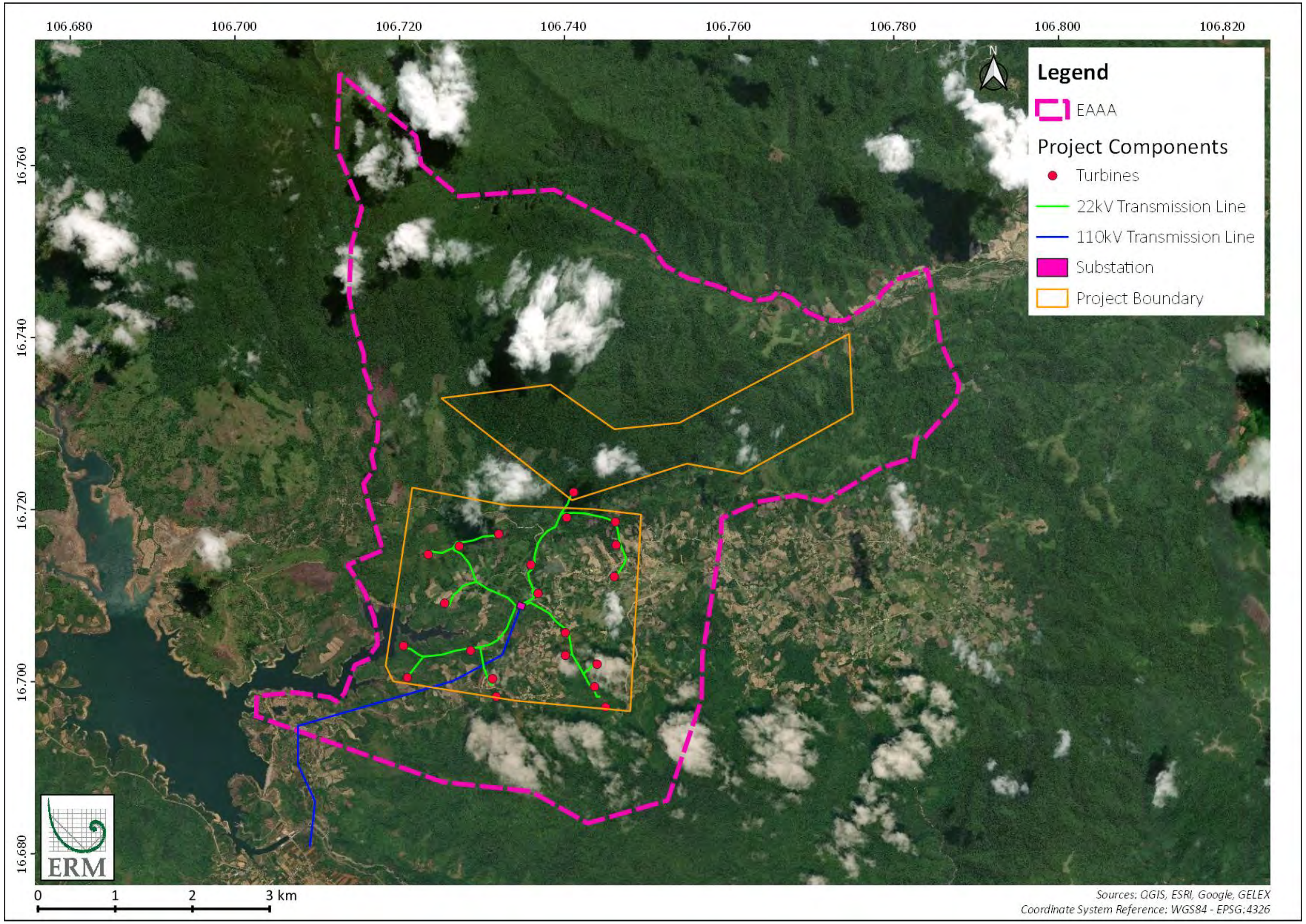


Figure 8.5 Project EAAA

8.1.1.12 Natural Habitat and Modified Habitat Assessment

8.1.1.12.1 Vegetation Classification

Landcover analysis (Landsat 8) was used to calculate the Normalised Difference Vegetation Index (NDVI) of the Study Area, which was subsequently used to determine the vegetation classes. Vegetation classes derived from the Study Area are described below with satellite imagery and photographs. All satellite imagery were obtained from Google Earth and all site photographs were taken by ERM.

- Plantation: Plantation refers to large-scale area meant for farming that specializes in cash crops such as coffee, banana and cassava. These may potentially attract fauna given that they are food sources. Other species found include *Neyraudia arundinacea*, *Chromolaena odorata*, *Cyanthillium cinereum*, *Acacia auriculiformis*, *Acacia mangium*, *Mimosa pudica, Bidens pilosa*, which are mostly cultivated and non-native herbs and weeds. This area is considered to be modified habitat.

Satellite imagery of plantation

Photograph of plantation

Figure 8.6 Satellite Imagery and Photographs of Plantation

- Agricultural land: Agricultural land refers to land used for agriculture such as annual crop land. Species of conservation significance may include (migratory) bird species such as Yellow-breasted Bunting, Black-browed Reed Warbler and Grey Heron. This area is considered to be modified habitat.

Satellite imagery of agricultural land

Photograph of agricultural land

Figure 8.7 Satellite Imagery and Photographs of Agricultural Land

- Built-up area (Infrastructure): Built-up area refers to urban and built-up land that is generally void of vegetation. No species of conservation significance are identified to potentially occur in this class. This area is considered to be modified habitat.

Satellite imagery of built-up area

Photograph of built-up area

Figure 8.8 Satellite Imagery and Photographs of Built-up Area

- Bare land: Bare land generally refers to areas with no dominant vegetation cover and are not built-up as well. This area is considered to be modified habitat.

Satellite imagery of bare land

Photograph of bare land

Figure 8.9 Satellite Imagery and Photographs of Bare Land

- Forest: Forest refers to area covered with trees and plants of native origins. Species of conservation significance may include forest-dependent flora and fauna such as mammals including the Red-shanked Douc Langur and Southern White-cheeked Gibbon. This area is considered to be natural habitat.

Satellite imagery of forest

Photograph of forest

Figure 8.10 Satellite Imagery and Photographs of Forest

- Surface water: Surface water generally refers to rivers and water bodies. Species of conservation significance may include (migratory) bird as open-water areas and large concentrations of aquatic stocks are natural attractants to many birds such as the Osprey. This area is considered to be natural habitat.

Satellite imagery of surface water

Not available

Photograph of surface water

Figure 8.11 Satellite Imagery and Photographs of Surface Water

8.1.1.12.2 Natural/Modified Habitat Classification

IFC PS6 requires the assessment of the distribution of natural habitat and modified habitat in order to identify risks and mitigations to biodiversity values during the impact assessment phase.

The definition of natural habitat according to IFC PS6 is:

"*Areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition*".

The definition of modified habitat according to IFC PS6 is:

"*Areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition*".

As required by the PS6, Clients are required to demonstrate compliance with Paragraph 14, which states:

"The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated:

- *No other viable alternatives within the region exist for development of the project on modified habitat;*
- *Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation;8 and*
- *Any conversion or degradation is mitigated according to the mitigation hierarchy".*

If Natural Habitat is impacted, the Client is to comply with paragraph 15 which states:

"*In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible. Appropriate actions include:*

- *Avoiding impacts on biodiversity through the identification and protection of set-asides;*
- *Implementing measures to minimize habitat fragmentation, such as biological corridors;*
- *Restoring habitats during operations and/or after operations; and*
- *Implementing biodiversity offsets*."

There is currently no methodology within IFC PS6 and the associated Guidance Note (GN) on the approach to assess the distribution of these habitat types. ERM has utilised methods used previously in consultation with the IFC to complete this assessment using remote sensing techniques for the Study Area. The vegetation class assessment above and remote sensing have been used to define these areas.

Figure 8.12 shows the natural and modified habitat areas within the EAAA. The approximate area of each type of habitat is summarised in Table 8.7.

Table 8.7 Natural and Modified Habitat Areas within the EAAA

Area	Natural Habitat (ha)	Modified Habitat (ha)	Total (ha)
EAAA	2284.09	1958.10	4242.18
Project Area	457.62	770.74	369.63

Natural habitats within the EAAA consist of forest and river/surface water while modified habitats consist of agricultural land, plantation, bare land and built up area shown in Figure 8.13.

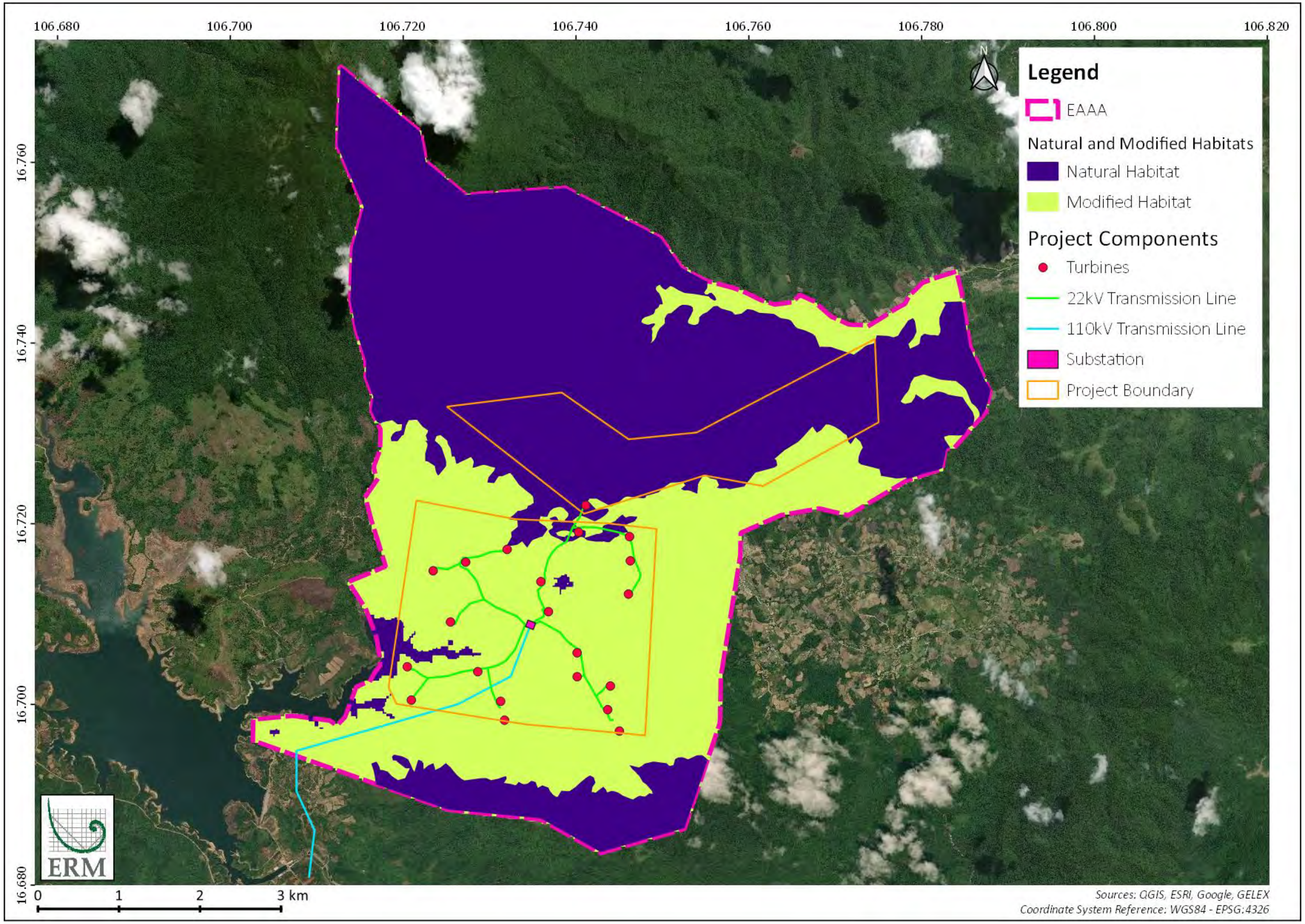


Figure 8.12 Natural and Modified Habitat Classification within EAAA

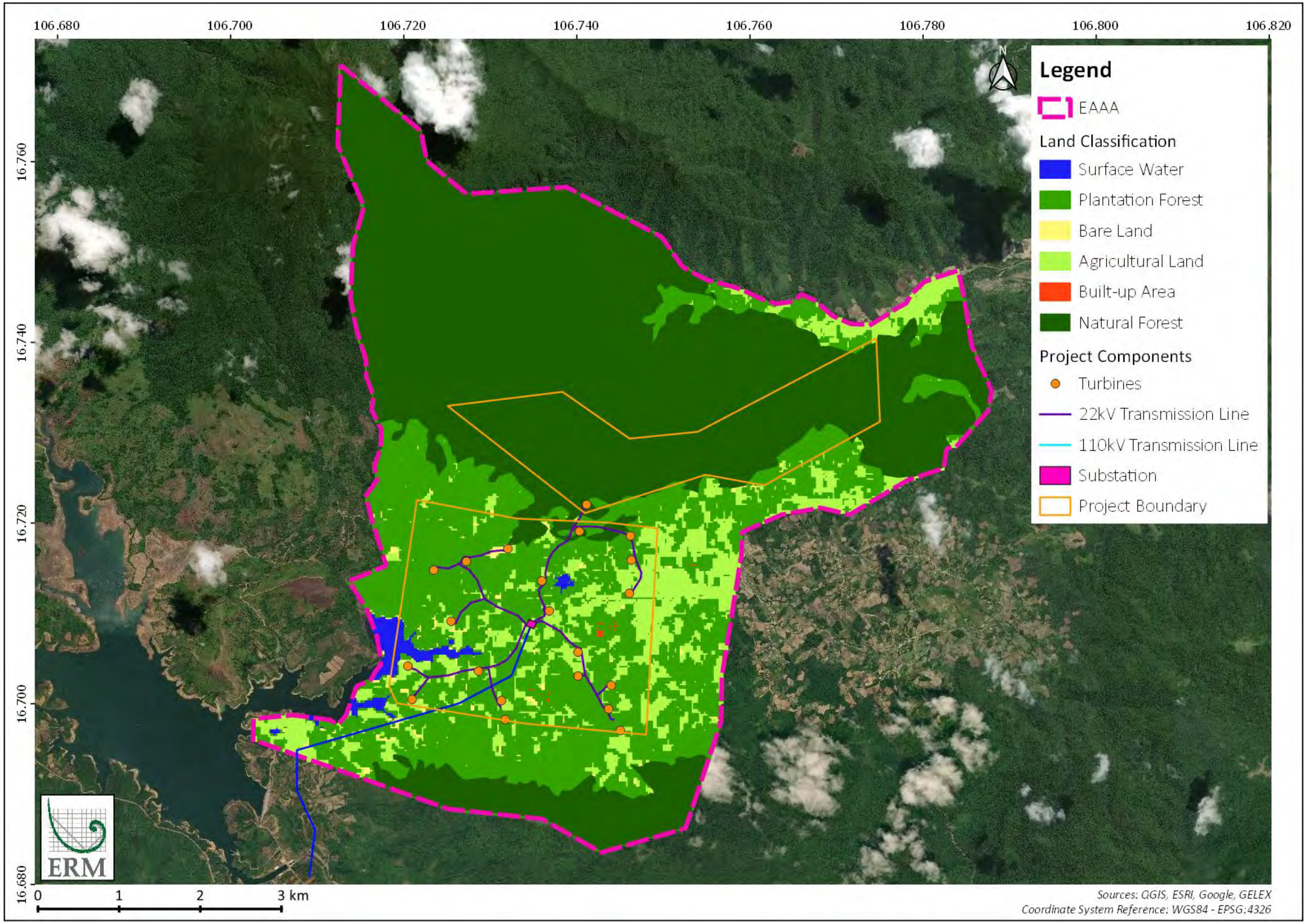


Figure 8.13 Land Classification within EAAA

8.1.2 Biodiversity Field Survey Methods

ERM contracted specialists to undertake biodiversity surveys of the Project Area and surrounds. The reports provided to ERM are found in Appendix B, Appendix C and Appendix D.

8.1.2.1 Field Survey Program

Multi-taxa field surveys were undertaken in the Project Area in January, February and May 2020. A summary of the survey activities undertaken is provided in Table 8.8.

Table 8.8 Field Surveys Undertaken within the Study Area

S/N	Dates	Target	Survey Technique	Survey Methods	Survey Effort
1	3 January – 5 January 2020 (First survey)	Avifauna	Vantage Point Survey	See Section 8.1.2.1.2.	1 surveyor at each of 3 vantage points, 12 hours per day (6:00 – 18:00) for 3 days
2	13 May – 15 May 2020 (Second survey)				1 surveyor at each of 4 vantage points, 12 hours per day (6:00 – 18:00) for 3 days
3	6 January 2020 (First survey)	Avifauna	Line Transect Survey	See Section 8.1.2.1.2.	2 line transects (6 – 7 km each) surveyed for 5 hours each by 2 surveyors
4	16 May 2020 (Second survey)				3 line transects (4.0 km, 7.2 km, 3.7 km) surveyed for 7 hours by 2 surveyors for each transect
5	11 February – 13 February 2020	Flora	Remote Sensing	Vegetation cover within the project footprint (including under proposed transmission line) was assessed using remote sensing, specifically Landsat 8 satellite imagery and Normalized Difference Vegetation Index (NDVI).	-
			Point Count Survey	See Section 8.1.2.1.1.	10 points surveyed across 3 days

S/N	Dates	Target	Survey Technique	Survey Methods	Survey Effort
6		Terrestrial Fauna (Birds, Amphibian, Reptiles and Non-volant Mammals)	Line Transect Survey	See Section 8.1.2.1.4.	9 hours (7:00 – 16:00) and 2.5 hours (18:30 – 21:00) per day
7		Bat	Acoustic Line Transect Survey	See Section 8.1.2.1.3.	3 different transects on 3 days (3 hours per day)
			Acoustic Monitoring Station	See Section 8.1.2.1.3.	3 stations deployed over 3 days, 5 hours per day (17:30 – 22:30)
			Mist-net Sampling	See Section 8.1.2.1.3.	3 mist-nets deployed over 3 days, 4 hours per day (18:00 – 22:00)
8		Terrestrial Fauna (Primates, Ungulates, Carnivores and Birds)	Semi Structured Interview	■ Semi structured interviews were systematically conducted to gain an understanding of the local biodiversity, especially species of conservation concerns such as carnivores (Leopard cats, Civets, Martens), ungulates (Saola), primates (Red-shanked Douc Langur, Southern White-cheeked Gibbon), birds (Vietnam Pheasant) and pangolins. ■ Locals were shown a photo catalogue and asked if they had encountered any of the above species. ■ Information on time, location, situation of each encounter was recorded. ■ Questions regarding potentially important habitats for taxa of conservation concern (e.g. feeding sites 9for Red-shanked Douc	2 interviewers conducted interviews with 88 locals (90% farmers) living near the Project Area

S/N	Dates	Target	Survey Technique	Survey Methods	Survey Effort
				Langur) and any visible changes in the species' populations (e.g. more common, less common compared to 5 years ago) were also asked.	
9	13 May – 16 May 2020	Terrestrial Fauna (Gibbons)	Acoustic Auditory Point Count Survey	See Section 8.1.2.1.4.	5 listening posts surveyed for 3.5 hours per day for 4 days
10		Terrestrial Fauna (Primates)	Line Transect Survey	See Section 8.1.2.1.4.	4 different transects of lengths ranging from 4 – 13 km surveyed by 2 surveyors for 9 hours each

8.1.2.1.1 Flora

Over the course of three days, plant diversity was assessed via a rapid field survey in types of vegetation and land closest to the proposed transmission line. A total of ten surveys points were chosen within the Project footprint. At each point, a circle plot of 10 m diameter was demarcated to rapidly assess plant diversity. Plants within the circle plot were recorded and identified immediately on field by a qualified botanist. Specimens of unknown identity were collected to be identified immediately after in Botany Lab of University of Science – VNU HCMC.

To assess the species richness, three approaches were used: the number of observed taxa, interpolation by rarefaction curve and extrapolation by estimator Chao. The number of observed taxa is the number of taxa recorded during the survey. Rarefaction curve method is used to interpolate the number of species as a function of the number of survey points. Lastly, Chao gives an estimation of the minimum species richness (including undetected species) for the survey area. Chao, therefore, gives an insight of how many species are still present in the survey area that was not detected/ recorded/ collected during the survey. Estimator Chao was calculated as described in Magurran and McGill (2011).

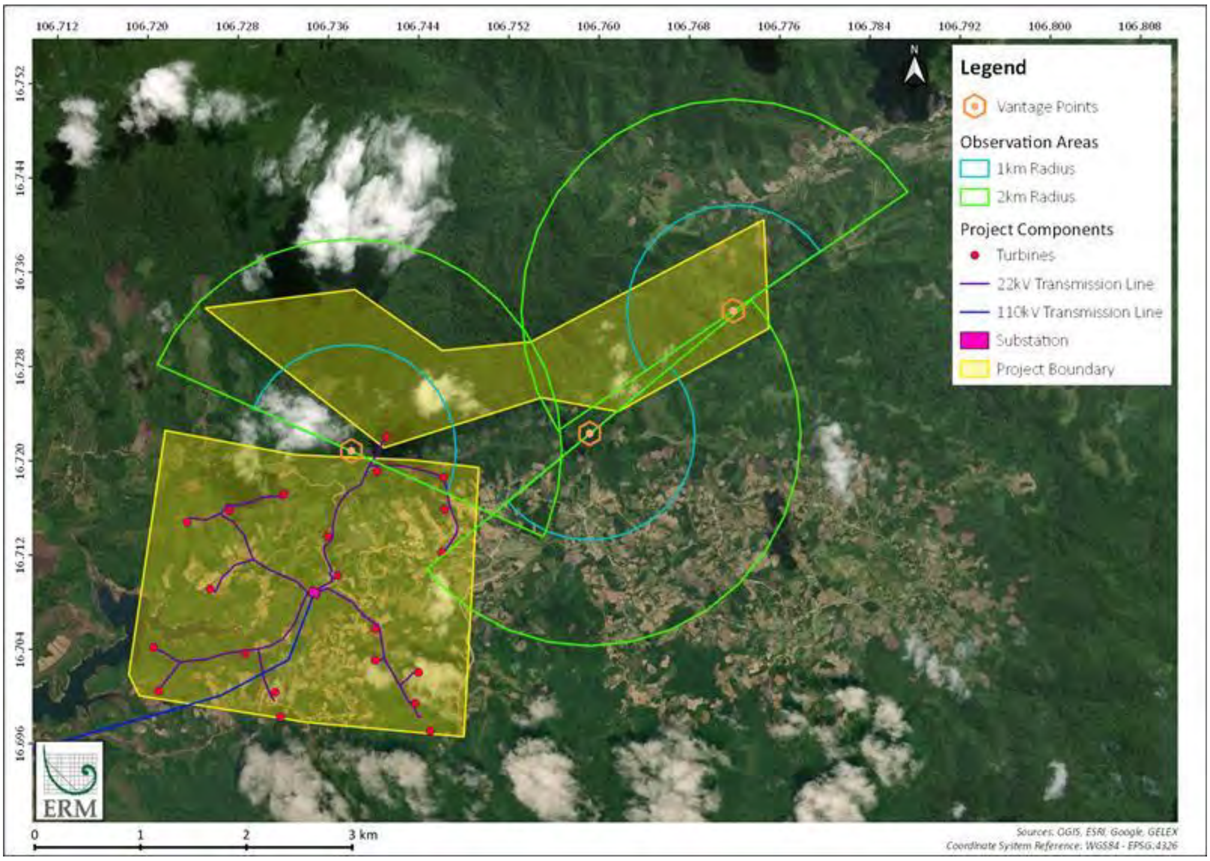
8.1.2.1.2 Birds

8.1.2.1.2.1 Vantage Point Survey

Vantage point survey was used to investigate overlap between avifauna's movements and the Project Area (Scottish Natural Heritage, 2014) in both the first (January 2020) and second (May 2020) surveys. Three vantage points in the first survey and four vantage points in the second survey (due to change in turbine layout) were located within the vicinity of the Project Area (Figure 8.14 and Figure 8.15 respectively). At each point, one experienced bird observer equipped with 7x50 built-in-compass-and-reticle binoculars and high-magnification 20x80 binoculars was stationed and actively scanned the whole area for avifauna activity within a 2 km 180^0 arc from the vantage point. Once a bird or group of birds were sighted, the observer would draw the flight path, relative to the ground as if looking down on the site from above, onto a pre-printed record sheet.

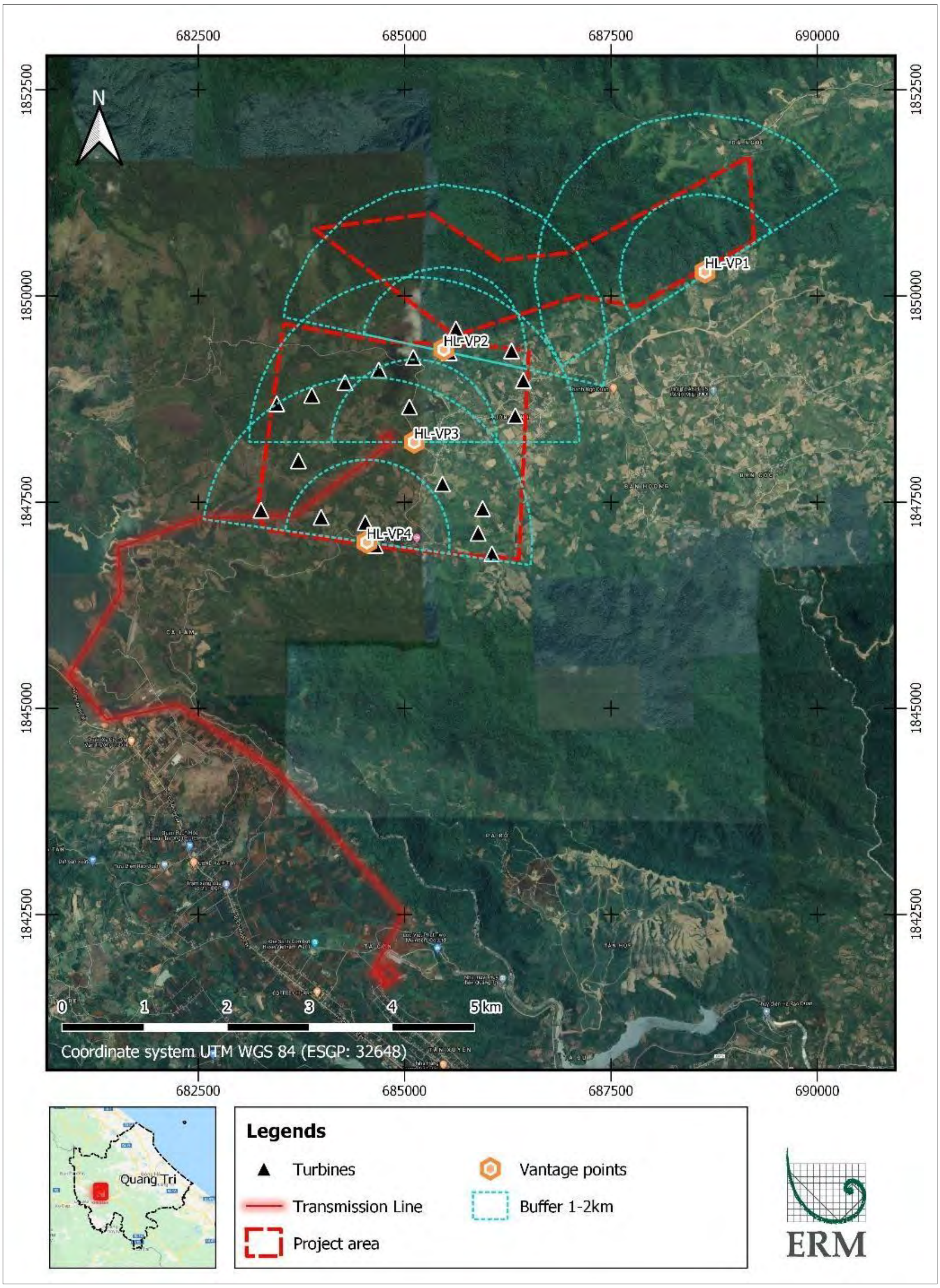
For each sighting, information on species; number of birds in the flight; start time and end time of flight; height of the flight in 15 second intervals; type of flight (flapping, soaring, gliding) and notes on activity/behaviour were all recorded. Height of the flight was recorded in three height bands, namely: below rotor height (<35 m), at rotor height in the Rotor Swept Zone (RSZ) (35-150 m) and above rotor height (>150 m). Total flying time was calculated for all bands at each vantage point.

All flying paths were digitalized into shape files (.shp) for further analysis in QGIS. A traffic density map (with a coverage grid of 250 m x 250 m cells) was generated in QGIS to visualise bird traffic in the Project Area.



Source: CIM, 2020.

Figure 8.14 Locations of Three Vantage Points Used for Avifauna Survey in January 2020



Source: CIM, 2020.

Figure 8.15 Locations of Four Vantage Points Used for Avifauna Survey in May 2020

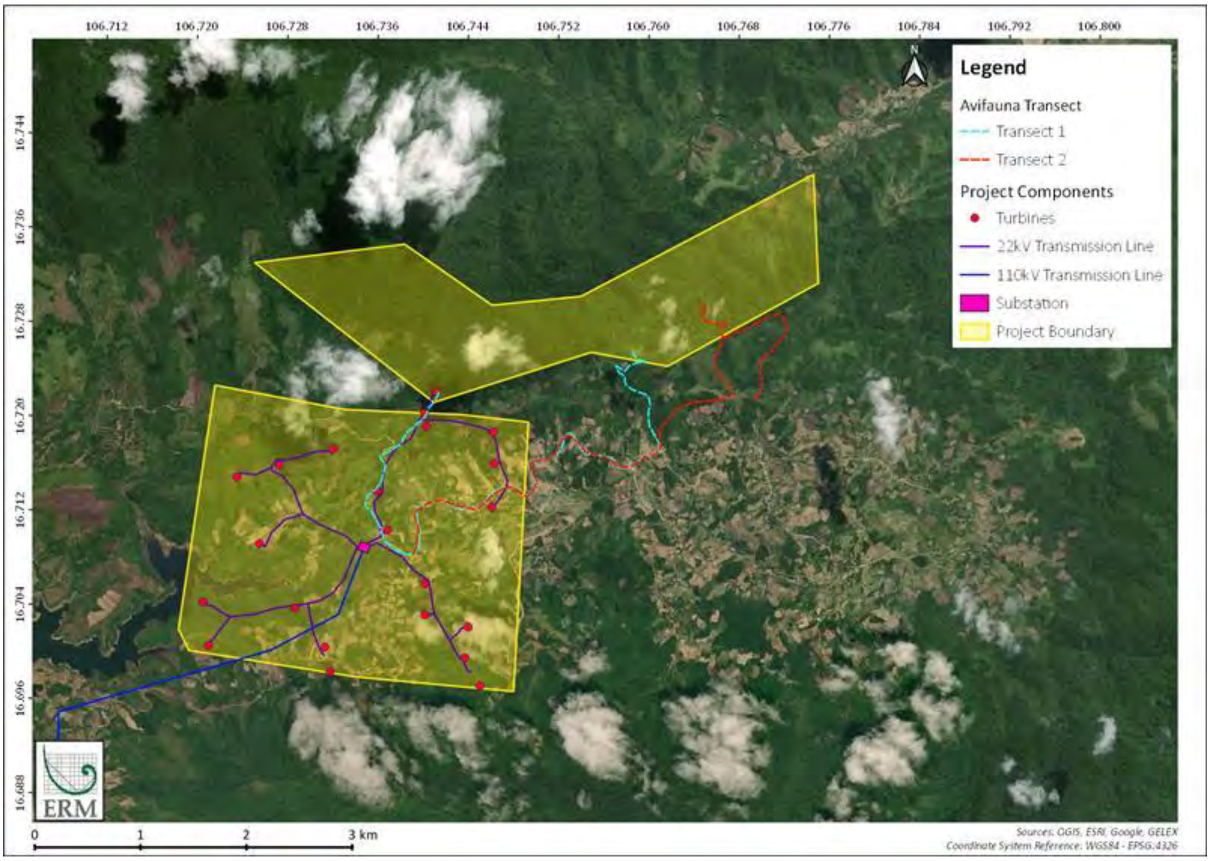
8.1.2.1.2.2 Line Transect Survey

Besides vantage point surveys, line transect surveys for avifauna were also conducted in both the first (January 2020) and second (May 2020) surveys to assess distribution and abundance of birds in the vicinity of the Project Area. Data were collected using visual surveys following available roads and trails that make up the line transects. Attempts were made to ensure that the survey transects covered different habitats of the Project Area and its vicinity. During the survey, two surveyors recorded and identified any sightings of birds along each of the transects of approximately 6 – 7.2 km in length (Figure 8.16; Figure 8.17).

Additionally, line transect survey was also conducted in February 2020 as part of another terrestrial fauna survey in both daytime (7:00 – 16:00) and night-time (18:30 – 21:00) (See Section 8.1.2.1.4 for more information).

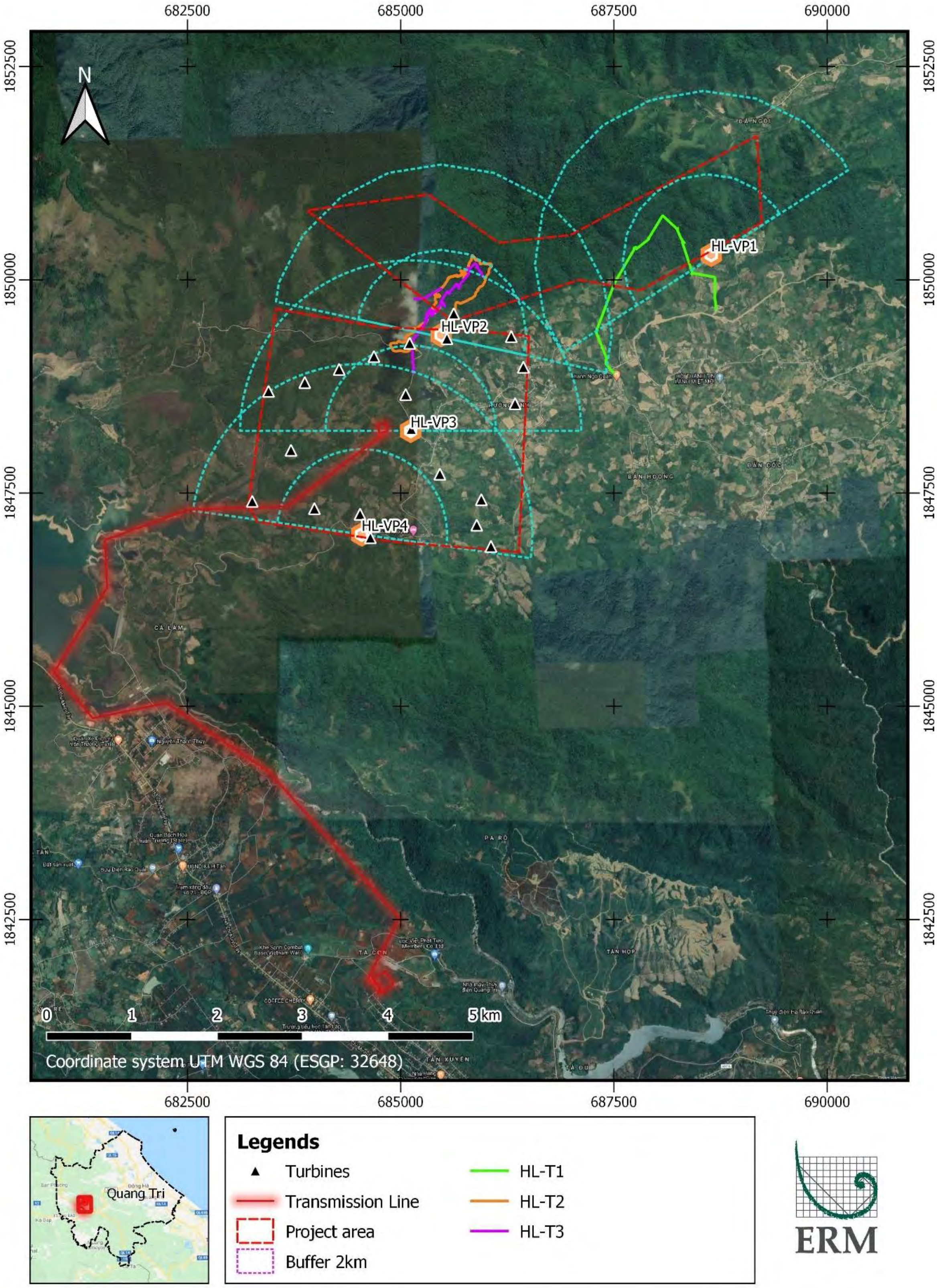
Sighted individuals were identified to the lowest possible taxonomic level. GPS locations, photographs (if possible), distance and compass bearing to the sighted birds were recorded for further analysis, such as the Maximum Entropy (MAXENT) model fitting (Phillips et al., 2004).

Species habitat modelling with maximum entropy approach, or MAXENT modelling (Phillips et al. 2004) was used to predict the distribution of recorded avian fauna. To maximize the reliability of the MAXENT model, bird species were grouped into “orders”, a taxonomic group of birds that share similar ecology or evolutionary characteristics. Potential environmental drivers for bird distribution are vegetation cover (NDVI), water (Normalised Difference Water Index; NDWI), disturbance (Normalised Difference Built-up Index; NDBI) and elevation.



Source: CIM, 2020

Figure 8.16 Locations of Terrestrial Transects Used for Avifauna Survey in January 2020



Source: CIM, 2020

Figure 8.17 Locations of Terrestrial Transects Used for Avifauna Survey in May 2020

8.1.2.1.3 Bats

For bat field surveys, acoustic line transects, acoustic monitoring stations and mist-netting were conducted.

8.1.2.1.3.1 Acoustic Line Transect Survey

Three line transects with a total length of 11.01 km were used to survey bat activities in the Project Area and its vicinity. All transects were determined using existing trails. Surveyors conducted acoustic surveys equipped with EchoMeter Pro (Wildlife Acoustics, USA) synchronized with smartphone GPS along the transects. This full spectrum recorder system records time-stamped and georeferenced echolocation signals of bats, which indicates level of bat activity in the area. Bats were identified to the lowest possible taxonomic level using their echolocation signals with BatExplorer software (Elekon AG, Switzerland).

8.1.2.1.3.2 Acoustic Monitoring Stations

To understand the spatiotemporal patterns of bat activities within the Project Area, three stationary acoustic monitoring stations were deployed in strategic points. At each station, a highly sensitive recording system BATLOGGER A: CHF 900 (Elekon AG, Switzerland) was deployed to record bat acoustic signals from sunset (approximately 17:30) to 23:00 each day. Limited deployment time was a result of challenge associated with assessing the area at night-time. Similar to the acoustic transect approach, raw data records of bat activity collected were processed using BatExplorer 2.0 (Elekon AG, Switzerland).

8.1.2.1.3.3 Mist-net Sampling

A series of mist-nets (Avinet Research Supplies, USA) were set up at pre-determined strategic points within the Project Area to collect bat samples. After the deployment of nets, the mist-netting team checked for entangled bats every ten minutes for four hours during period of intensive bat activity (Kruskop, 2013). It should be noted that due to UXO concerns, the survey team had to set up nets at safe locations near roads and wide trails in open areas. Open-space areas are generally not optimized areas to capture bats.

8.1.2.1.4 Other Terrestrial Fauna (Herpetofauna and Non-Volant Mammal)

8.1.2.1.4.1 Line Transect Survey

For the first survey (January 2020), line transect surveys were conducted in both daytime (7:00 – 16:00) and night-time (18:30 – 21:00) to record both diurnal and nocturnal terrestrial fauna activity. Each of the survey teams were equipped with appropriate equipment (e.g. binocular and telephoto camera for daytime team, head lamps and handheld torches for the night-time team). For all surveys, surveyors followed the transects (mostly determined by existing paths and trails), sighted and identified all encountered wild animals. GPS locations, photographs (where possible), distance and compass bearing to the sighted animals were recorded for further analysis, such as fitting the MAXENT Model (Phillips et al., 2004). Sighted individuals were identified on-sight to the lowest possible taxonomic level. A summary of the survey time and effort is presented in Table 8.9.

Table 8.9 Summary of Fauna Transect Surveys in January 2020

Transect	Transect length (m)	Survey date	Time of survey	Survey effort (hours)
T-HL1	48,718	11 Feb 2020	07:00 to 16:00	9
T-HL2	45,556	12 Feb 2020	07:00 to 16:00	9

Transect	Transect length (m)	Survey date	Time of survey	Survey effort (hours)
T-HL3	21,960	13 Feb 2020	07:00 to 16:00	9
Tn-HL1	4,396	11 Feb 2020	18:30 to 21:00	2.5
Tn-HL2	3,128	12 Feb 2020	18:30 to 21:00	2.5
Tn-HL3	3,487	13 Feb 2020	18:30 to 21:00	2.5

Species habitat modelling with maximum entropy approach, or MAXENT modelling (Phillips et al. 2004) was used to predict the distribution of recorded fauna during the transect survey. To maximize the reliability of the MAXENT model, recorded fauna was divided into broad taxonomic groups. For this survey, mammals, reptiles and amphibians recorded in the survey were grouped by their systematic "orders". In most cases, species belonging to the same order should share similar ecology or evolutionary characteristics which make them respond similarly to the environment. This grouping approach is mainly to increase the power of data and to make the best uses of information from a rapid survey. Whenever possible, MAXENT modelling at species level is performed if the data (number of records) allow. Potential environmental drivers for distribution of different faunal groups include vegetation cover (NDVI), water (Normalised Difference Water Index; NDWI), disturbance (Built-up Index; BU) and distance to the ocean (DistOcean).

For the second survey (May 2020), a primate-focused transect survey was conducted. Similar to the transect survey for birds, available roads and trails were utilized as transects to survey primates' distributions for Huong Linh area. During the survey, surveyors followed the transects, spotted and identified all encountered non-human primate species. A summary of the survey time and effort is presented in Table 8.10 and Figure 8.18.

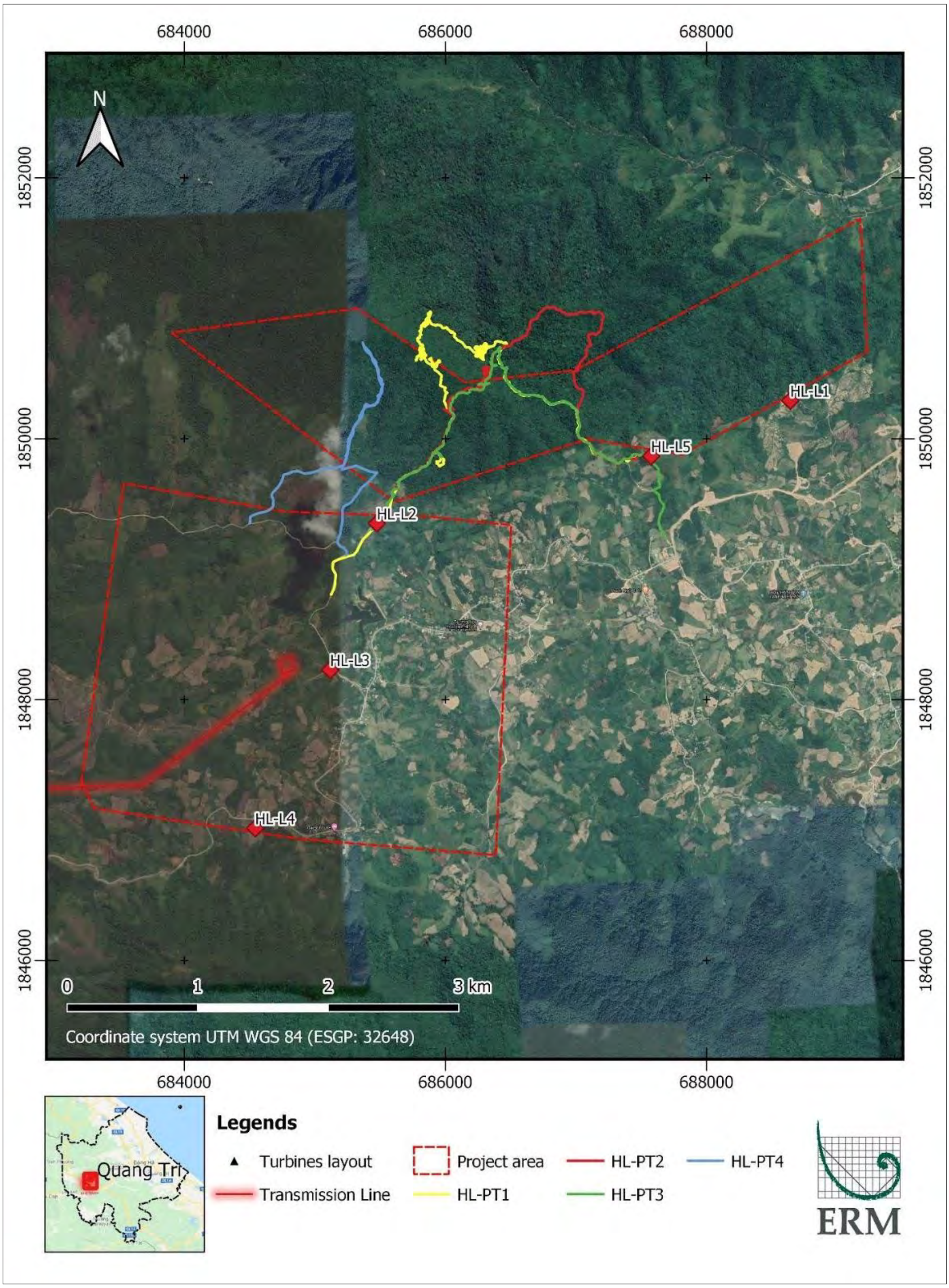
Table 8.10 Summary of Primate-Focused Transect Surveys in May 2020

Transect	Transect length (km)	Survey date	Time of survey	Survey effort (hours)
HL-PT1	12.5	13 May 2020	9:00 to 15:00	6
HL-PT2	6.8	14 May 2020	9:00 to 15:00	6
HL-PT3	6.7	15 May 2020	9:00 to 15:00	6
HL-PT4	3.7	16 May 2020	9:00 to 15:00	6

8.1.2.1.4.2 Acoustic Auditory Point Count Survey

In addition to primate-focused line transect surveys, acoustic auditory point count surveys were also conducted in May 2020. Listening posts, also known as acoustic auditory point count (Brockelman & Srikosamatara 1993), is a common method used to conduct census for gibbon species. Gibbons, the small apes of the family Hylobatidae, are cryptic primates that are sensitive to human activities. Visual survey methods such as line-transect survey will not be effective in collecting data for gibbons (Brockelman & Srikosamatara 1993). In contrast, the gibbon's charismatic songs can be used as cues to detect their occurrences. Gibbons have strong territorial behaviours. Each gibbon family, which usually consists of a pair of male-female gibbons and a juvenile, would routinely emit loud and long songs to declare their territory in the morning. Distance and compass bearing to the source of the song can be determined by trained surveyors. If a song can be heard by more than one surveyor who are stationed at least a couple hundred meters from each other (Brockelman & Srikosamatara 1993), the location of the gibbons can be triangulated.

In this survey, five listening posts were established to study the presence of gibbons in the study area. Surveyors were stationed at each listening post for 3.5 hours in the morning (5:30 – 9:00) for 4 days. The locations of listening posts (HL-L1, HL-L2, HL-L3, HL-L4, HL-L5) are shown in Figure 8.18.



Source: CIM, 2020.

Figure 8.18 Locations of Primate-Focused Transects and Gibbon Listening Posts in May 2020

8.1.3 Biodiversity Field Survey Results

8.1.3.1 Flora

8.1.3.1.1 Vegetation Cover

Vegetation cover analysis (NDVI) indicated relatively high vegetation quality in the Project Area. The proposed transmission line will mostly pass through areas with moderately dense vegetation cover, such as forest.

Habitat along the transmission line and its surrounding areas was classified into five main categories based on flora survey data, namely agricultural land, water surface, forest, urban and built up area, and barren land. The total area of each habitat/vegetation type is summarised in Table 8.11 below.

Table 8.11 Area of Each Habitat/Vegetation Type within Project Area

S/N	Habitat/Vegetation Type	Project Area with 1000m buffer (ha)	T-line with 1000m buffer (ha)	Total Area (ha)
1	Agriculture land	1361.43	1180.8	2265.48
2	Water surface	74.52	295.92	299.07
3	Forest	1923.21	742.23	2394.27
4	Urban and Built Up	135	194.49	295.29
5	Barren	143.46	159.03	247.86
6	Total	5073.57	2572.47	5501.97

Source: CIM, 2020

8.1.3.1.2 Rapid Field Survey

The field survey recorded 152 plant taxa (126 species, 19 specimens at genus level and 7 specimens at family level). The full list of flora species recorded in the rapid field survey is shown in Appendix G.

Out of the identified species, 39 species are listed in the IUCN Red List: 2 Endangered (*Cinnamomum mairei* H.Lév. and *Coffea arabica* L.); 1 Near-Threatened NT (*Podocarpus neriifoliu*s D.Don); 2 Data Deficient DD (*Microcos laurifolia* (Hook.f. ex Mast.) Burret and *Rhaphidophora laichauensis* Gagnep.) and 34 species are Least Concern LC) (Table 8.12). *Lithocarpus vestitus* (Hickel & A.Camus) *Lithocarpus vestitus* is the only species recorded in Vietnam Red Data Book. The *Coffea arabica* L. (IUCN EN) found within the Project Area were planted. The other two internationally/locally EN species (*Cinnamomum mairei* and *Lithocarpus vestitus)* were found at only one out of the ten survey points.

There were also 4 endemic species recorded during this rapid survey: *Croton dongnaiensis* Pierre ex Gagnep.; *Elaeocarpus medioglaber* Gagnep.; *Hornstedtia sanhan* M.F.Newman (IUCN LC); *Schefflera dongnaiensis* var. *langbianensis* Bui. Additionally, a total of 12 plant species were also identified as invasive species (Table 8.13).

Rarefaction curves generated indicated that were many more undetected plant species within the Project Area and under the transmission line. Calculated from the observed 152 taxa at 10 survey points, the estimator Chao for this study was rounded at 408 species with 95% confidence interval from 286 to 643 plant species. Besides the 152 observed taxa, results of Chao suggests that at least 256 (95% CI from 134 to 491) plant species are expected to be found within the Project Area and under the transmission line until each plant species is presented in at least 2 survey points. Reasons for this suggested large number of undetected plant species include the single-survey sampling and small number of sites in this rapid survey.

Table 8.12 Recorded Plant Species Listed In IUCN Red List and Vietnam Red Data Book

S/N	Scientific Name	Vietnamese Name	IUCN Category	Vietnam Red Data Book
1	*Cinnamomum mairei* H.Lév.	Quế bạc	EN	-
2	*Coffea arabica* L.	Cà phê arabica	EN	-
3	*Lithocarpus vestitus* (Hickel & A.Camus) A.Camus	Dẻ áo	-	EN
4	*Microcos laurifolia* (Hook.f. ex Mast.) Burret	Bù lốt	DD	-
5	*Podocarpus neriifolius* D.Don	Thông tre	NT	-
6	*Acacia auriculiformis* Benth.	Keo lá tràm	LC	-
7	*Alchornea rugosa* (Lour.) Müll. Arg.	Bọ nét	LC	-
8	*Aralia armata* (Wall. ex G.Don) Seem.	Đinh lăng gai	LC	-
9	*Archidendron clypearia* (Jack) I.C.Nielsen	Mán đĩa	LC	-
10	*Bischofia javanica* Blume	Bích hợp	LC	-
11	*Breynia fruticosa* (L.) Müll. Arg.	Bồ cu vẻ	LC	-
12	*Breynia vitis-idaea* (Burm.f.) C.E.C.Fisch.	Cù đề	LC	-
13	*Buddleja asiatica* Lour.	Búp lệ á	LC	-
14	*Caryota urens* L.	Đủng đỉnh ngứa	LC	-
15	*Castanopsis indica* (Roxb. ex Lindl.) A.DC.	Kha thụ ấn	LC	-
16	*Commersonia bartramia* (L.) Merr.	Thung	LC	-
17	*Decaspermum gracilentum* (Hance) Merr. & L.M.Perry	Thập tử mảnh	LC	-
18	*Dicranopteris linearis* (Burm. f.) Underw.	Ráng tây sơn ngay	LC	-
19	*Ficus fulva* Reinw. ex Blume	Ngái vàng	LC	-
20	*Ficus langkokensis* Drake	Sung Lăng Cốc	LC	-
21	*Gironniera subaequalis* Planch.	Ki gần bằng	LC	-
22	*Hornstedtia sanhan* M.F.Newman	Giả sa nhân	LC	-
23	*Knema furfuracea* (Hook. f. & Thomson) Warb.	Máu chó Pierre	LC	-
24	*Liquidambar formosana* Hance	Sâu trắng	LC	-

S/N	Scientific Name	Vietnamese Name	IUCN Category	Vietnam Red Data Book
25	*Litsea glutinosa* (Lour.) C.B.Rob.	Bời lời nhớt	LC	-
26	*Lycopodium clavatum* L.	Thạch tùng dùi	LC	-
27	*Mallotus barbatus* Müll.Arg.	Bông bệt	LC	-
28	*Mallotus paniculatus* (Lam.) Müll.Arg.	Ba bét nam	LC	-
29	*Marsilea crenata* C. Presl	Rau dệu răng	LC	-
30	*Melicope pteleifolia* (Champ. ex Benth.) T.G. Hartley	Dấu dầu ba lá	LC	-
31	*Mimosa pudica* L.	Trinh nữ	LC	-
32	*Rhodomyrtus tomentosa* (Aiton) Hassk.	Hồng sim	LC	-
33	*Scleria terrestris* (L.) Fassett	Cương đất	LC	-
34	*Sterculia lanceolata* Cav.	Trôm thon	LC	-
35	*Syzygium cumini* (L.) Skeels	Trâm mốc	LC	-
36	*Trema tomentosa* (Roxb.) H. Hara	Trần mai lông	LC	-
37	*Triadica cochinchinensis* Lour.	Sòi tía	LC	-
38	*Wrightia pubescens* subsp. *laniti* (Blanco) Ngan	Lòng mức lông	LC	-
39	*Zanthoxylum nitidum* (Roxb.) DC.	Sẻn	LC	-
40	*Rhaphidophora laichauensis* Gagnep.	Đuôi phượng	DD	-

Note: *DD – Data Deficient*
LC – Least Concern
NT – Near-Threatened
EN – Endangered

Source: CIM, 2020

Table 8.13 Invasive Plant Species Recorded in Field Survey

S/N	Scientific Name	Vietnamese Name	Family	Invasive Species
1	*Ageratum conyzoides* (L.) L.	Cứt lợn	Compositae	Weed
2	*Bidens pilosa* L.	Quỷ châm, Xuyến chi	Compositae	Weed
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Cỏ hôi	Compositae	Invasive weed
4	*Elephantopus mollis* Kunth	Chân voi mềm	Compositae	Weed
5	*Tithonia diversifolia* (Hemsl.) A.Gray	Sơn quỳ biến diệp	Compositae	Invasive
6	*Mimosa pigra* L.	Mai dương	Leguminosae	Invasive weed
7	*Mimosa pudica* L.	Trinh nữ	Leguminosae	Weed

S/N	Scientific Name	Vietnamese Name	Family	Invasive Species
8	*Syzygium cumini* (L.) Skeels	Trâm mốc	Myrtaceae	Invasive
9	*Neyraudia arundinacea* (L.) Henrard	Sậy khô nhỏ	Poaceae	Invasive weed
10	*Rubus moluccanus* L.	Dụm	Rosaceae	Weed
11	*Solanum torvum* Sw.	Cà pháo	Solanaceae	Weed
12	*Lantana camara* L.	Thơm ổi	Verbenaceae	Weed

Source: CIM, 2020

8.1.3.2 Birds

8.1.3.2.1 Vantage Point Survey

<u>January 2020</u>

For the first survey, forty-one (41) bird species were identified. A total of twenty-two (22), eighteen (18) and eighteen (18) species were recorded in VP1, VP2 and VP3 respectively. All species recorded have not been listed as species of conservation significance nationally or internationally.

A total of 7,185 seconds of bird flying was observed from the three vantage points. Most observed flights (4,740 seconds) observed occurred in band 1 (<35 m), below the RSZ, while relatively less flying time was observed to occur in band 2 (35-150 m) (1,320 seconds) and band 3 (>150 m) (1,125 seconds). Busier avian traffic was observed at VP1 and VP2 as compared to VP3. Overall, the Mountain Hawk-eagle (IUCN LC) was the most active species at the three vantage points, and it was observed to occur within bands 2 and 3. Flying activity appeared to vary within a day. At VP1 and VP3, most observed flights occurred from 7:00 – 10:00, with activity dropping in midday and increasing again at 13:00 at VP1. At VP2, flying activity peaked at 7:00 and 13:00.

Nine species (9) flew in band 2, including the Scarlet Minivet (IUCN LC), Scaly-breasted Munia (IUCN LC), Olive-backed Pipit (IUCN LC), Black Eagle (IUCN LC), Crested Goshawk (IUCN LC), Crested Serpent Eagle (IUCN LC), Mountain Hawk-eagle (IUCN LC), Carrion Crow (IUCN LC), and Besra (IUCN LC). The duration of each flight for most species in band 2 was less than 50 seconds, except one flight for the Carrion Crow and Besra at VP3 that occurred for more than 100 seconds. Flock sizes were generally smaller at VP1, ranging from 1 to 2 individuals as compared to those at VP2 which ranges from 2 to 5 indiviudals, and those at VP3 which ranges from 2 to 4 individuals. This is despite heavier avian traffic observed at VP1, which is a result of much higher frequency of birds passing through the observation zone.

<u>May 2020</u>

For the second survey, fifty-eight (58) species were identified. Among these, the Great Hornbill and the Pale-caped Pigeon were listed as IUCN VU. The Great Hornbill was observed to only fly in band 1 (75 seconds) at VP1, while the Pale-caped Pigeon was observed to only fly in band 1 (total of 150 seconds) at VP3.

A total of 10,815 seconds of bird flying was observed from the four vantage points. Overall, the duration of flights that took place in band 1 (7,650 seconds) was far greater than those in band 2 (3,015 seconds) and band 3 (150 seconds). Different species were observed to be active at different vantage points. At VP1, raptor species such as Crested Serpent-eagle (IUCN LC) and Black Eagle (IUCN LC) spent a significant amount of time (525 seconds and 225 seconds respectively) in band 2 and band 3, which makes them vulnerable to collision risk. At the other vantage points, the most active species were generally flying in band 1. At all four vantage points, flying activity appeared to be most active in the early morning (6:00 – 9:00) before falling in the middle of the day.

Fourteen (14) species flew in band 2 as shown in Table 8.14. None of these species are listed as species of conservation significance nationally or internationally.

Table 8.14 Bird Species Recorded to Fly in Band 2

S/N	Scientific Name	English Name	IUCN Category	Vietnam Red Data Book
1	*Accipiter badius*	Shikra	LC	-
2	*Ictinaetus malaiensis*	Black Eagle	LC	-
3	*Pernis ptilorhynchus*	Oriental Honey-buzzard	LC	-
4	*Spilopelia chinensis*	Eastern Spotted Dove	LC	-
5	*Falco tinnunculus*	Common Kestrel	LC	-
6	*Artamus fuscus*	Ashy Woodswallow	LC	-
7	*Dicrurus macrocercus*	Black Drongo	LC	-
8	*Hirundo rustica*	Barn Swallow	LC	-
9	*Lanius schach*	Long-tailed Shrike	LC	-
10	*Hypsipetes leucocephalus*	Black Bulbul	LC	-
11	*Acridotheres grandis*	Great Myna	LC	-
12	*Ardea intermedia*	Intermediate Egret	LC	-
13	*Psilopogon faiostrictus*	Green-eared Barbet	LC	-
14	*Psilopogon lagrandieri*	Red-vented Barbet	LC	-

Note: LC – Least Concern

Source: CIM, 2020

8.1.3.2.2 Line Transect Survey

<u>January 2020</u>

In January 2020, twenty-three (23) bird species were identified along the terrestrial transects. Many species were recorded only once during the survey.

The occurrence data input into MAXENT model included 4 records of order Accipitriformes, 1 record of order Columbiformes, 20 records of order Passeriformes, 1 record of order Pelecaniformes and 2 records of order Piciformes. Due to the paucity of data, MAXENT modelling could only predict the suitable habitat for three out of five bird orders that were included into the model – Accipitriformes, Passerriformes, and Piciformes. Results of the model suggest that the Project Area contains suitable habitat for the raptors of order Accipitriformes. This finding aligned with the vantage point survey data, which showed various bird-of-prey species utilizing the Project Area during the survey period. As these species usually glide at high elevations, they could potentially enter the RSZ, presenting a collision risk. However none of the species identified are of conservation significance. Smaller bush and forest birds of the order Passeriformes (e.g. Sparrow) are unlikely to be abundant in the Project Area in the dry season (potentially due to the lack of water sources). The forest condition in the Project Area may also support birds of order Piciformes (e.g. Woodpeckers, Barbets).

<u>February 2020</u>

In February 2020, forty-eight (48 species) were identified along the terrestrial transects. Twenty-seven (27) of these species were not recorded from earlier vantage point and line transect surveys conducted in January 2020.

The occurrence data input into MAXENT model included 6 records of order Accipitriformes, 3 records of order Columbiformes, 3 records of order Cuculiformes, 74 records of order Passeriformes, 3 records of order Pelecaniformes and 1 record of order Piciformes. MAXENT modelling could only predict the suitable habitat for three out of six bird orders that were included into the model – Accipitriformes, Passerriformes, and Pelecaniformes. The Project Area appears to contain suitable habitat for Accipitriformes, as cliffs and mountains in the Project Area provide suitable nesting place for these birds while the opposite is true for Passeriformes. In addition, the MAXENT model for the second line transect survey also indicated that the Project Area does not appear to contain important or suitable habitat for water birds of the order Pelecaniformes.

May 2020

In May 2020, twenty-six (26) species were identified along the transects. Similarly, many species were recorded only once during the survey.

The occurrence data input into MAXENT model included 1 record of order of order Accipitriformes, 4 records of order Columbiformes, 1 record of order Cuculiformes, 1 record of order Galliformes, 30 records of order Passeriformes, and 1 record of order Strigiformes. MAXENT modelling could only predict the suitable habitat for two out of six included – Columbiformes and Passeriformes. Suitable habitat for birds of order Columbiformes appeared to be scattered within the Project Area. In contrast to the results from MAXENT models ran in the previous surveys, suitable habitat for order Passeriformes appeared to be present across much of the Project Area, with areas of dense vegetation cover.

The full list of species recorded in all bird surveys in both seasons is shown in Appendix F.

8.1.3.2.3 Semi-structured Interview

From the semi-structured interview, only 9 out of 88 interviewees (10%) claimed that they have seen a pheasant in the Project Area and its vicinity after they were showed photographs of the Vietnam Pheasant (IUCN CR; VRDB EN). According to these interviewees, the birds behaved like chickens (foraging on the ground, sleeping on tree branches, one male with several females). These interviewees, who are farmers with farmland near the forest, claimed that they sometimes see the pheasants along the old trails inside the remaining forests in the Study Area.

8.1.3.3 Bats

8.1.3.3.1 Acoustic Line Transect Survey

A total of 2,069 bat calls were recorded from transects (11.01 km). A spatial variation in bat activity was detected from the transect survey in the Huong Linh area. Along the same transect, there might be several hotspots where there was high level of bat activity, and there might be areas where no bat activity was recorded. From the number of bat calls recorded along the transect, relative activity of bats (or bat-pass, defined as occurrence of bats' vocalisation per second) was calculated. According to the results, bats were most active along the transect located partly outside the Project footprint on the eastern edge of the Project Area. Four (4) bat species, none of which are of conservation significance, were identified from the bat calls (summarised in Table 8.15):

- *Rhinolophus sinicus* – Call length was about 40 ± 3.2 ms, with start frequency around 60.1 ± 2.1 kHz. These patterns were similar to those reported by Furey et al. (2009). This is an insectivorous species that forages in semi-cluttered spaces just above the canopy (edge and gap foragers). The *R. sinicus* is isolated-roosting species. Their roosting sites can be caves, tree trunks or old building (Kruskop, 2013);

- *Hipposideros armiger* – Start frequency around 66.1 ± 1.3 kHz and peak frequency (Frequency at Maximum Energy) at 66.8 ± 1.4 kHz and call length 12 ± 1.3 ms (Furey et al., 2009; Phauk et al., 2013). This is an insectivorous species that forage in semi-cluttered spaces just above the canopy (edge and gap foragers). This is a cave-dwelling bat species (Kruskop, 2013), which may sometimes utilize old buildings and man-made structures;
- *Myotis muricola* – Start frequency around 96.1 ± 18.1 kHz, peak frequency around 62.1 ± 16.3 kHz, call length around 6.1 ± 1.3ms. The *Myotis muricola* is an insectivorous bat that forage in semi-cluttered spaces or just above canopy (Kruskop, 2013);
- *Hypsugo* sp. – Start frequency 66.1 ± 9.2kHz, peak frequency 42.4 ± 2.5kHz, call length 2.2 ± 1.4ms. The calls were within the range of *Hypsugo pulveratus'* calls as described by Furey et al. (2009). However, as new *Hypsugo* species have been recently described in Vietnam (e.g. the *Hypsugo dolichodon* (Görföl et al., 2014), the identity of the species recorded in this study site is uncertain. Regardless of the taxonomical uncertainty, the *Hypsugo* genus is fast and maneuverable aerial insectivorous bats that forage in semi-cluttered spaces or just above canopy (Kruskop, 2013) (edge and gap foragers).

8.1.3.3.2 Acoustic Monitoring Stations

A total of 2,123 bat calls were recorded from 3 monitoring stations during the survey. A spatiotemporal variation in bat activities was also observed between stations. In general, bat activity was the highest in the station located in the cleared area outside the Project footprint, especially during the evening time at 19:00. Bat activity was comparatively lower and more spread out at the other two monitoring stations, which are located closer to the Project footprint. The same four (4) bat species were identified for the acoustic monitoring stations as for the acoustic line transects (Table 8.15).

8.1.3.3.3 Mist-net Sampling

During the survey period, no bat was captured in the deployed nets. This suggested bat species in the Project Area flew higher than 5 m and did not descend to the net sites.

Table 8.15 Bat Species Identified During Field Surveys

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Survey
1	*Rhinolophus sinicus*	Chinese Horseshoe Bat	LC	-	Acoustic Line Transect, Acoustic Monitoring Station
2	*Hipposideros armiger*	Great Himalayan Leaf-nosed Bat	LC	-	Acoustic Line Transect, Acoustic Monitoring Station
3	*Myotis muricola*	Nepalese Whiskered Bat	LC	-	Acoustic Line Transect, Acoustic Monitoring Station
4	*Hypsugo* sp.	-	-	-	Acoustic Line Transect, Acoustic Monitoring Station

Note: LC – Least Concern

Source: CIM, 2020

8.1.3.4 Non-volant Mammals

8.1.3.4.1 Line Transect Survey

<u>February 2020</u>

In February 2020, two (2) non-volant mammals were identified during the field survey: Red-shanked Douc Langur (IUCN CR; VRDB EN) and the Black Giant Squirrel (IUCN NT, VRDB VU). In particular, the Red-shanked Douc Langur was observed on eight different occasions over the three days for which the survey was conducted.

In addition to these visual records, the survey team also acoustically recorded the song of a gibbon family. Given the location of the Project Area and previous literature on the mammalian fauna in Huong Hoa district (Mahood & Tran 2008; Thai et al. 2013; Thanh et al. 2018), the recorded gibbons were most likely the Southern White-cheeked Gibbons (IUCN CR, VRDB EN).

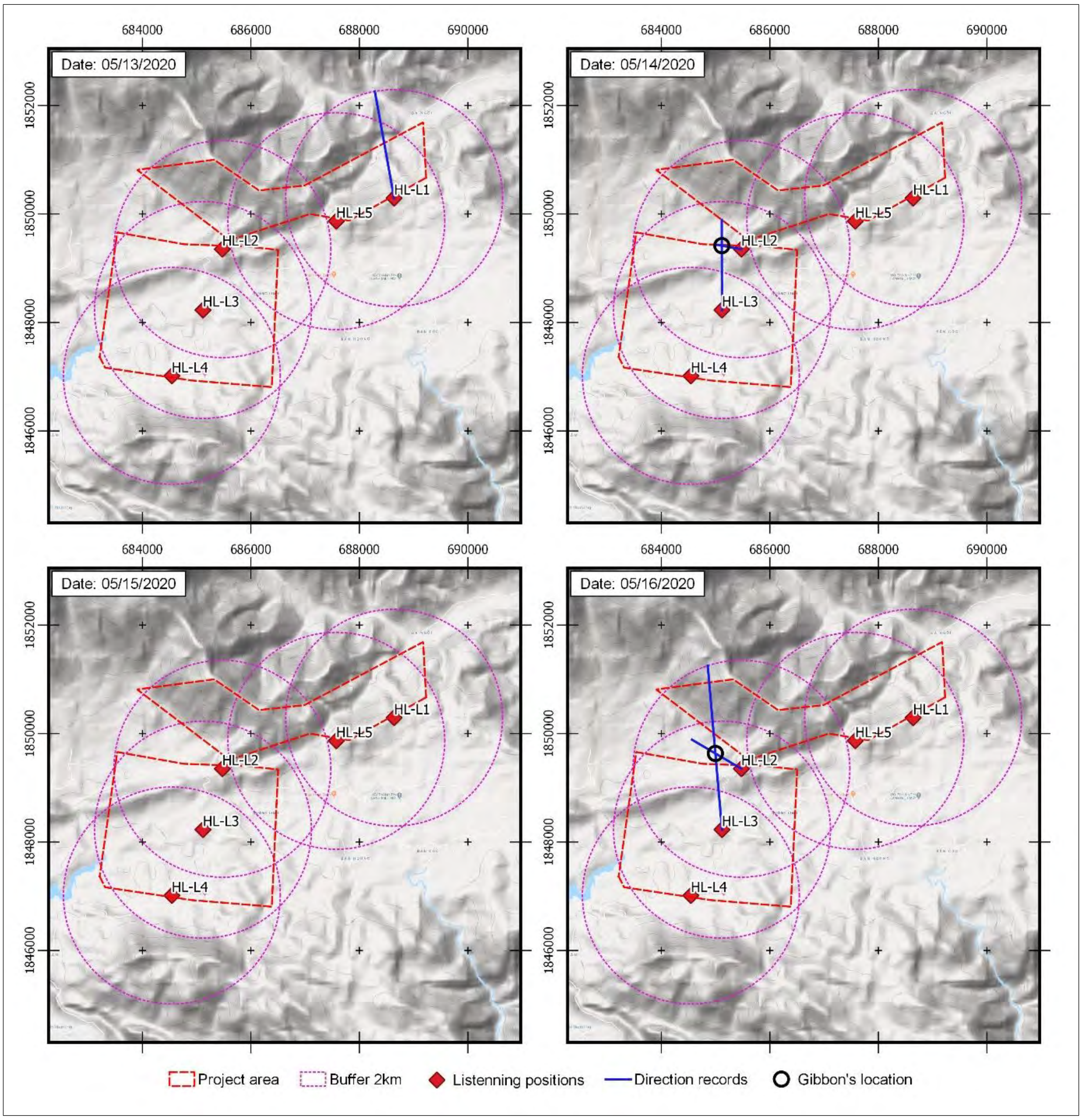
Results from MAXENT model showed that the northern part of the Project Area contains suitable habitat for Red-shanked Douc Langur (only species with sufficient records for modelling). This part of the Project Area is in close proximity to the Bac Huong Hoa Nature Reserve, which is known to support a number of globally threatened mammals.

<u>May 2020</u>

In May 2020 where primate-focused surveys were conducted, the Red-shanked Douc Langur (IUCN CR; VNRB EN) were again detected in the Study Area. Four (4) groups of the species were observed across the four days of surveys.

8.1.3.4.2 Acoustic Auditory Point Count Survey

In addition to primate-focused line transect surveys, acoustic auditory point count surveys were also conducted in May 2020. Over four days of survey, with 4.5 hours of survey time at each listening post, three (3) gibbon vocalizations were detected. On 13 May 2020, distant calls were heard at HL-L1 at 07:30. On 14 May 2020, a duet with (adult) male and female voices was heard at HL-L2 and HL-L3, which enabled the triangulation of the location of this gibbon family as shown in Figure 8.19. No gibbon vocalization was heard on 15 May 2020. On 16 May 2020, another duet of adult male-female was heard at both HL-L2 and HL-L3. The location of this family was triangulated in Figure 8.19. There is a high probability that this family was the same family that had been heard on 14 May 2020, given the male-female numbers and the territorial behaviour of gibbon species. Overall, there was a minimum of two gibbon families/ groups in the study area.



Source: CIM, 2020

Figure 8.19 Triangulated Locations of Gibbon Groups in May 2020

Analysis of the recorded female calls during the survey revealed that the recorded gibbon species was the Southern White-cheeked Gibbon (IUCN CR; VRDB EN), which was also recorded acoustically in the February 2020.

The full list of non-volant mammals identified in both surveys is shown in Table 8.16.

Table 8.16 Non-Volant Mammal Species Identified During Field Surveys

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Survey
1	*Pygathrix nemaeus*	Red-shanked Douc Langur	CR	EN	Feb, May 2020
2	*Nomascus siki*	Southern White-cheeked Gibbon	CR	EN	Feb, May 2020
3	*Ratufa bicolor*	Black Giant Squirrel	NT	VU	Feb 2020

Note: NT – Near-Threatened
VU – Vulnerable
EN – Endangered
CR – Critically Endangered

Source: CIM, 2020

8.1.3.4.3 Semi-structured Interview

For the semi-structured interviews, 88 interviewees were interviewed in the Project Area and its vicinity. Results regarding mammals of conservation significance are summaried below:

Red-shanked Douc Langur *Pygathrix nemaeus* (IUCN CR; VRDB EN): All interviewees claimed to have seen this species. However, at least 60 of them only saw the animals on television and newspapers. It turned out that various NGOs are working on conservation of the Red-shanked Douc Langur in Quang Tri Province, and images or footage of the Red-shanked Douc Langurs were often seen locally. Only 21 interviewees (24%) claimed to have sighted the animal in the Project Area. One of them was a local hunter, who even provided details on how to hunt and cook the animal. Overall, the percentage of interviewees that might have actually encountered the douc langur in the Study Area is considerable. According to those interviewees, the Red-shanked Douc Langur is still present in the Study Area in the present day and the most recent encounter with the species was a week before the interview took place.

Southern White-cheeked Gibbon *Pygathrix nemaeus* (IUCN CR; VRDB EN): Similar to the Red-shanked Douc Langurs, the gibbons were well-known among locals due to various conservation actions that have taken place in this area prior to the interview. 20 out of 88 interviewees (23%) claimed to have sighted the animal in the Project Area. According to those interviewees, the gibbons are present in the remaining evergreen forest patches in the Study Area. Those interviewees still also hear the gibbon songs near their farmland. The most recent hearing was two weeks prior to the interview. Overall, the percentage of interviewees that might have actually encountered the gibbon in the Study Area is also considerable.

Sao La *Pseudoryx nghetinhensis* (IUCN CR; VRDB EN): Only 3% of interviewees claimed that they have encountered a wild animal that resembled the famous Sao La *Pseudoryx nghetinhensis* in the Study Area. This species is so rare that it is usually referred to as the Unicorn of Indochina. Although the interviewees who claimed to have encountered Sao La were confident about their sighting, it is strongly suspected that the interviewees confused the Sao La with the Chinese Serow *Capricornis milneedwardsii* (IUCN NT). The two species are similar in appearance and are usually confusing for inexperienced people. Attempts were made to verify provided information, such as showing photographs of Sao La and Chinese Serow side by side, and questioning in detail the characteristics of the encountered animals. Most interviewees could not clearly tell the two animals apart. When asked about the sightings, all interviewees who claimed to have seen this species admitted the sighting in the forest was brief. According to them, the animal is cryptic and will run away as soon as they detect human presence.

Pangolins: According to the IUCN Red List data, two pangolin species may potentially occur in the Project Area: Sunda Pangolin (IUCN CR; VRDB EN) and the Chinese Pangolin (IUCN CR; VRDB EN). Both are listed as CR in the IUCN Red List. However, only 5 out of 88 interviewees (6% of the sample) claimed they saw the pangolin in the Project Area. An interviewee who was a local hunter told the surveyors that pangolins had been hunted to the point of being locally extinct. The last time the hunter saw a pangolin in the study area was 20 years ago. Additionally, the majority of interviewees said they have never seen a pangolin in the study area.

8.1.3.5 Herpetofauna

8.1.3.5.1 Line Transect Survey

A total of eighteen (18) herpetofauna species were recorded during the line transect survey. Almost all of the recorded species are common species that have not been listed by any conservation organization. There is only the Chinese Water Dragon (*Physignathus cocincinus*) listed as VU in the IUCN Red List and Vietnam Red Data Book.

From the MAXENT model, the Project Area appears to overlap with a portion of suitable habitat for amphibians and reptiles which are usually occurring in area of high humidity such as bushes along streams or shallow creeks, and area of higher elevation with good vegetation cover respectively.

The list of herpetofauna identified is shown in Table 8.17.

Table 8.17 Herpetofauna Species Identified During Field Surveys

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Class
1	*Fejervarya limnocharis*	Asian Grass Frog	LC	-	Amphibian
2	*Hoplobatrachus rugulosus*	East Asian Bullfrog	LC	-	Amphibian
3	*Limnonectes limborgi*	-	LC	-	Amphibian
4	*Limnonectes poilani*	-	LC	-	Amphibian
5	*Leptobrachella aerea*	-	LC	-	Amphibian
6	*Megophrys microstom*	Asian Mountain Toad	LC	-	Amphibian
7	*Microhyla fissipes*	-	LC	-	Amphibian
8	*Microhyla heymonsi*	Black-sided Narrow-mouthed Frog	LC	-	Amphibian
9	*Microhyla marmorata*	-	LC	-	Amphibian
10	*Odorrana chloronota*	Chloronate Huia Frog	LC	-	Amphibian
11	*Sylvirana nigrovittata*	Black-striped Frog	LC	-	Amphibian
12	*Polypedates megacephalus*	Hong Kong Whipping Frog	LC	-	Amphibian
13	*Draco maculatus*	Spotted Flying Dragon	LC	-	Reptile
14	*Physignathus cocincinus*	Chinese Water Dragon	VU	VU	Reptile
15	*Pseudoxenodon macrops*	Large-eyed False Cobra	LC	-	Reptile
16	*Eutropis multifasciata*	Common Mabuya	LC	-	Reptile
17	*Tropidophorus cocincinensis*	Cochinchinese Water Skink	LC	-	Reptile

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Class
18	*Trimeresurus vogeli*	Vogel's Pit Viper	-	-	Reptile

Note: LC – Least Concern
VU – Vulnerable

Source: CIM, 2020

8.1.4 Critical Habitat Assessment

8.1.4.1 Critical Habitat Screening

A Critical Habitat assessment was undertaken in accordance with the provisions of the IFC Performance Standards. Critical habitats are areas with: "high biodiversity value, including

i. Habitat of significant importance to Critically Endangered and/or Endangered species;
ii. Habitat of significant importance to endemic and/or restricted-range species;
iii. Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
iv. Highly threatened and/or unique ecosystems; and/or
v. Areas associated with key evolutionary processes".

Critical Habitat may not be limited to pristine or highly biodiverse areas, but rather may include both modified habitat and natural habitats across the broader landscape that supports the biodiversity values that trigger the Critical Habitat criterion. Critical Habitats can therefore be a subset of both modified habitat and natural habitat.

Assessment for Critical Habitat is undertaken as a screening process against the criteria defined within IFC PS 6 Guidance Note. This involved analysis of desk based data collection, habitat mapping and incorporation of field survey results. Critical Habitat criteria are defined in PS6 Guidance Note 6 (GN6), Paragraphs GN69 to 97. Table 8.18 provides detail of the qualifying requirements for Criteria 1 to 3 (i.e. thresholds), while details of the likely qualifying interests for Criterion 4 and 5 will be defined based on research and expert opinion. The criteria listed have been used to complete this assessment.

The five criteria are 'triggers' in that if an area of habitat meets any one of the criteria, it will be considered Critical Habitat irrespective of failing to meet any other criterion. This approach is generally more cautious but is used more widely in conservation. Critical Habitat criteria therefore have two distinctive characteristics. First, components of biodiversity are essentially assigned to only two levels of conservation significance, those that trigger Critical Habitat and those that do not (Tier considerations being secondary to this primary Critical Habitat determination). Second, each criterion is applied separately and not in combination, meaning that the scores are not cumulative.

Table 8.18 Critical Habitat Criteria

Criteria	Thresholds
Criterion 1: Critically Endangered (CR) / Endangered (EN) species:	■ Areas that support globally-important concentrations of an IUCN Red-listed EN or CR species (0.5 % of the global population AND 5 reproductive units of a CR or EN species); ■ Areas that support globally-important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a). ■ As appropriate, areas containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species.

Criteria	Thresholds
Criterion 2: Habitat of significant importance to endemic and/or restricted-range species;	Areas that regularly hold ≥ 10 % of the global population size AND ≥ 10 reproductive units of a species.
Criterion 3: Habitat supporting globally significant concentrations of migratory species and/or congregatory species;	Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 % of the global population of a migratory or congregatory species at any point of the species' lifecycle. Areas that predictably support ≥ 10 % of the global population of a species during periods of environmental stress.
Criterion 4: Highly threatened and/or unique ecosystems; and/or	■ Areas representing ≥ 5 % of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. ■ Other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning.
Criterion 5: Areas associated with key evolutionary processes	No set thresholds

Notes: Restricted-range/ Endemic Species = Species with global distributions of less than 50,000km^2; Migratory species = Any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem); Congregatory Species = Species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

Source: IFC, 2019

The complete critical habitat screening table is provided in Appendix J. Those considered suitable for assessment for critical habitat are discussed further in this section.

8.1.4.2 Results of Critical Habitat Screening

This section aims to identify Critical Habitat candidate species within the EAAA based on the Critical Habitat criteria defined in Section 8.1.4.1. The Critical Habitat criteria aim to identify habitat important for threatened species (e.g. endangered, critically endangered species), endemic or range-restricted species, migratory species, threatened or unique ecosystems and areas associated with key evolutionary processes. Critical Habitat determination follows these steps:

- Identification of EAAA;
- Collection and verification of available data on EAAA biodiversity; and
- Assessment of data against IFC Critical Habitat criteria.

As a result of the initial screening assessment, 253 species are considered conservation significant species, and are candidate species for the Critical Habitat Screening Assessment. Conservation significant species include 44 critically endangered species and endangered species (in accordance with the IUCN Red List and/or Vietnam Red Data Book), 8 restricted-range species and 206 migratory and/or congregatory species. The following sections determine if the candidate species assessed trigger critical habitat within the EAAA.

8.1.4.2.1 Criterion 1: Critically Endangered and/or Endangered Species

Critically Endangered (CR) and Endangered (EN) are identified as those classified on the IUCN Red List of Threatened Species. CR and EN species are considered to be at a heightened risk of extinction and are awarded an elevated level of consideration under Criterion 1 within IFC PS6. Candidates for Criterion 1 include 11 birds, 8 fish, 17 mammasl, 5 reptiles, 1 fungi and 2 plant species. **Based on the screening assessment, 3 species have been identified as likely triggering critical habitat within the EAAA.** These species are mammal and reptile species:

- Red-shanked Douc Langur (*Pygathrix nemaeus*; IUCN CR);
- Southern White-cheeked Gibbon (*Nomascus siki*; IUCN CR); and
- Bourret's Box Turtle (*Cuora bouretti*; IUCN CR).

Source: IUCN, 2020

Figure 8.20 Red-shanked Douc Langur

Source: IUCN, 2020

Figure 8.21 Red-shanked Douc Langur Species Distribution

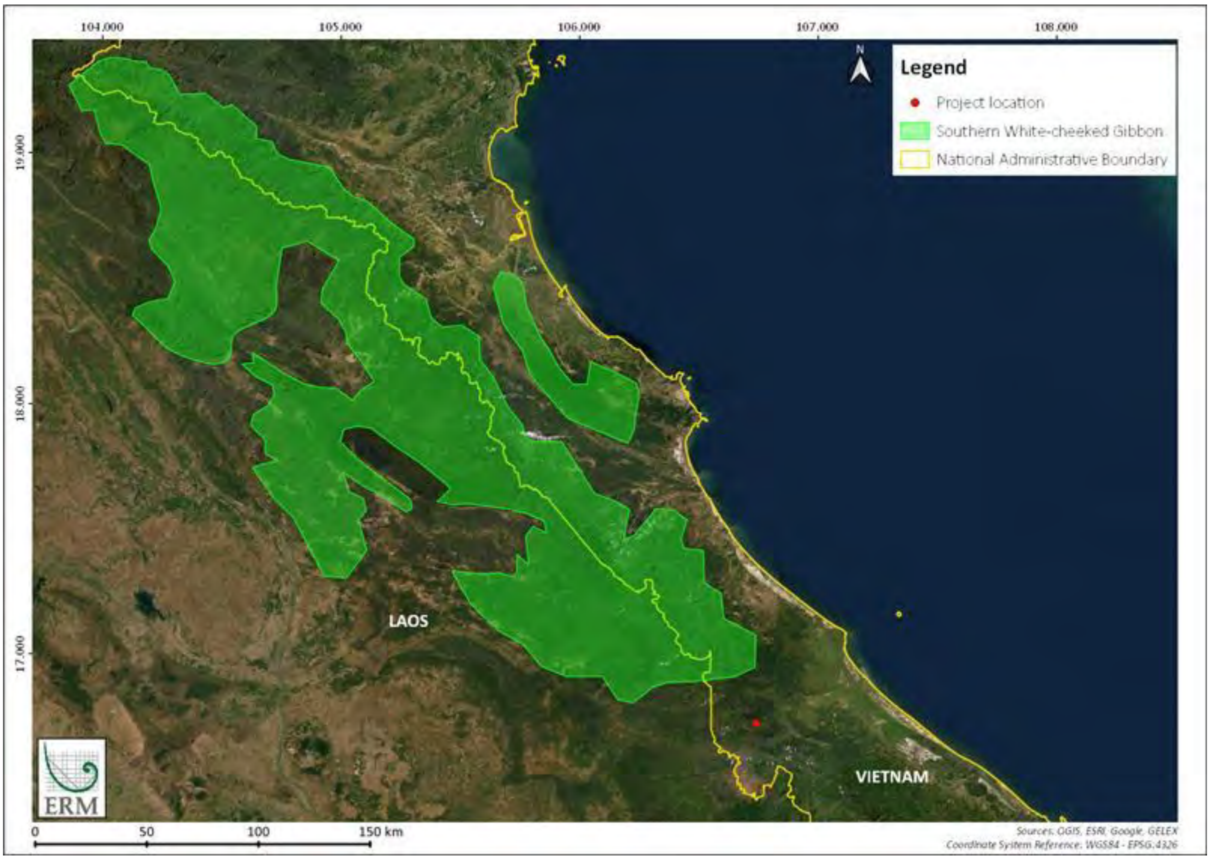
The Red-shanked Douc Langur, which is also listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), occurs in undisturbed primary and secondary evergreen and semi-evergreen broadleaf forests; and is also associated with forests on limestone (karst) (Coudrat et al., 2020). It occurs in central Laos, northern central Vietnam and has recently been recorded in northern Cambodia. There are at least 5 known localities (Bach Ma National Park, Phong Nha-Ke Bang National Park, Pu Mat National Park, proposed Khe Net Nature Reserve and Son Tra Nature Reserve) in Vietnam where this species has been found.

There is no global population estimate but it is considered to be decreasing. Population is Vietnam is likely to be small, and much less stable than that in Laos. In Laos, Nakai-Nam Theun National Protected Area probably holds the world's largest population with an estimate of at least 4,500 groups in the area's suitable habitat, estimated to comprise at least 1,600 km² (Coudrat et al., 2012, 2013). In Vietnam, the largest population is believed to be in Phong Nha Ke Bang with up to 2,000 individuals (Haus et al., 2009), although this may be an over estimate (Nadler, 2010).

Some habitat features are present within the Project Area and the species was identified several times in the both field surveys conducted in February and May 2020. In the first survey, it was identified on 8 different occasions over 3 days of surveys. In the second survey, it was identified on 4 different occasions over 4 days of surveys with 2 - 19 individuals in each group. The biodiversity specialists who conducted the surveys estimated a population size of at least 30 individuals in the Project EAAA. Interviews with locals also indicated that this species is still present in the Study Area. Furthermore, several records of this species have also been found in Bac Huong Hoa Nature Reserve (<10 km away from Project Area) in 2004 - 2008. According to Site Support Group data this species is relatively common in Bac Huong Hoa Nature Reserve (Wilkinson & Van, 2006). As such, the Project EAAA should be considered to support globally-important concentrations of an IUCN Red-listed endangered species (0.5 % of the global population AND 5 reproductive units of a CR or EN species), as well as an area that could contain nationally/regionally-important concentrations of an IUCN Red-listed CR or EN species, which would trigger critical habitat under Criterion 1(a) and (c).

Source: Endangered Primate Rescue Center, 2020

Figure 8.22 Southern White-cheeked Gibbon



Source: IUCN, 2020

Figure 8.23 Southern White-cheeked Gibbon Species Distribution

The Southern White-cheeked Gibbon occurs in tall primary broadleaf evergreen forest, and is found in the lowlands at elevations of 30 –100 m asl, in a typical wet tropical climate, with no influence of the north east monsoon and no conspicuous dry season (Nguyen et al., 2020). In some areas such as Phong Nha-Ke Bang National Park in central Vietnam, these gibbons live in steep karst forest. It is distributed in southern Lao PDR and north-central Vietnam east of the Mekong River, and is found between 17°N and about 19.3°N. Many populations in Vietnam are supported by inadequate contiguous habitat and experience too high a degree of human disturbance to remain viable, especially those in forested areas that are not shared with Lao PDR. The most important populations in Vietnam are in Phong Nha-Ke Bang National Park and Pu Mat National Park. Global population estimate is 600 individuals and it is considered to be decreasing.

Although species distribution does not include the Project EAAA (see Figure 8.23), it was recorded (acoustically) during the field surveys conducted in February and May 2020. The biodiversity specialists who conducted the surveys estimated a population size of at least 10 individuals in the Project EAAA. Results from the interviews with locals also indicated that this species is present within the Project EAAA, especially in the evergreen forest patches. In Quang Tri province, this species is also confimed to be found in Bac Huong Hoa Nature Reserve (<10 km to the North) and Dak Rong Nature Reserve (20 km to the Southeast), which are the most important conservation areas for the endangered species in Vietnam based on specialists' advice. Therefore, the Project EAAA should be considered to support globally-important concentrations of an IUCN Red-listed endangered species (0.5 % of the global population AND 5 reproductive units of a CR or EN species), as well as an area that could contain nationally/regionally-important concentrations of an IUCN Red-listed CR or EN species, which would trigger critical habitat under Criterion 1(a) and (c).

Source: IUCN, 2020

Figure 8.24 Bourret's Box Turtle

Source: IUCN, 2020

Figure 8.25 Bourret's Box Turtle Species Distribution

The Bourret's Box Turtle inhabits upland, moist, closed-canopy evergreen forest, usually between 300 and 700 m asl (McCormack & Stuart, 2020). The species is predominantly terrestrial and is not specifically associated with forest streams. It is known from central Viet Nam (Nghe An, Ha Tinh, Quang Binh, Thua Thien-Hue, Da Nang, Quang Nam, and Kon Tum provinces), as well as from adjoining

Savannakhet Province in Lao PDR. No population data is available, but it is considered to be decreasing. It is by far the most intensely traded *Cuora* species in Vietnam, as it is probably also the commonest in the wild.

No Bourret's Box Turtle individuals were identified during the field surveys, although the species could still utilise the Project EAAA given the presence of suitable habitat, especially to the north. The current Project site elevation ranges from 200 – 1000 m asl, with most approximately 400 – 600 m asl which overlaps with the species elevation range. Five specimens of this species were identified to be collected from the Bac Huong Hoa Nature Reserve in 2013 – 2014, which is contiguous with the forests adjacent to the Project Area. It is known to have already been seriously depleted throughout its range. Given the lack of information and the fact that there is likely suitable habitat present within the Project EAAA, in accordance with precautionary principle, it is possible that the Project EAAA could support nationally/regionally-important concentrations of this species and thus, could trigger critical habitat under Criterion 1(c).

8.1.4.2.2 Criterion 2: Endemic or Restricted Range Species

Endemic or Restricted Range Species are species that occur within a limited distribution and/or with specific habitat requirements. These species are considered to be at a heightened risk of extinction due to their habitat and range requirements, and are awarded an elevated level of consideration under Criterion 2 within IFC PS6. Candidates for Criterion 2 include 4 bird, 2 mammal and 2 amphibian species. Most of the candidates are distributed outside the Project EAAA. For the rest of the candidates whose distributions overlap with the Project EAAA, there is unlikely to be sufficient suitable habitat within the EAAA to regularly hold ≥ 10 % of the global population size and ≥ 10 reproductive units of the species. **Based on the screening assessment, no species have been identified as likely triggering critical habitat within the EAAA under Criterion 2.**

8.1.4.2.3 Criterion 3: Migratory and/or Congregatory Species

Migratory species are classified as animals that spend a proportion of their time in different locations throughout the world, depending on wintering and breeding habitat requirements. Congregatory species are defined as species that meet globally significant numbers at a particular place at a certain time of year for feeding, breeding or resting. These species are considered to be at a heightened risk of extinction due to habitat and population requirements. Candidates for Criterion 3 include 206 bird species. However, the Project EAAA is too small in comparison with the EOO of these species and hence it should not be considered to sustain, on a cyclical or otherwise regular basis, ≥ 1 % of the global population of a migratory or congregatory species at any point of the species' lifecycle or support ≥ 10 % of the global population of a species during periods of environmental stress. **Based on the screening assessment, no species have been identified as likely triggering critical habitat within the EAAA under Criterion 3.**

8.1.4.2.4 Criterion 4: Highly Threatened and/or Unique Ecosystems

For Criterion 4, the EAAA has not been assessed by the IUCN against relevant IUCN threatened status (Criterion 4 threshold a). Given that the areas have not yet been assessed by IUCN, an assessment is required to determine whether the habitat would be of high priority for conservation by regional or national systematic conservation planning. Similarly, Vietnam has not undertaken an assessment of high priority conservation areas (Criterion 4 threshold b).

The FAO had reported Vietnam as possessing 14.3 million ha of natural forests in 1943 (43% of the total land area). From 1980 to 1990, the report observed that Vietnam had lost an average of 100,000 ha of forests per year (Forest Science Institute of Vietnam, 2009). Forest quality had also decreased, with a rapid increase in areas of poor and regenerating forest. Tree cover loss has continued to increase steadily since 2001, approaching 1,775,945 ha lost in 2015 (Global Forest Watch, 2016). This trend has seen a reversal since 1995 with the implementation of forest rehabilitation and plantation programs.

In 2015, World Bank data shows that percentage of forested area in Vietnam is approximately 48%. However there is no indication if these forests are plantations or regenerated natural stands of habitat.

In order to inform if the lowland evergreen forest and montane forest ecosystem types present within the Project EAAA qualifies as Critical Habitat under Criterion 4, its risk status was defined based on guidelines surrounding the development of an Ecosystems Red List under the IUCN (Bland et al., 2017). The assessment was undertaken in the context of the Project EAAA and relies largely on Global Forest Watch data. Based on the information above, habitats in the Project EAAA are not decreasingly rapidly in area. It must be noted that any decline in tree cover is likely to be localised and occurring in unprotected areas around human settlement. As such, the ecosystems present within the Project EAAA are unlikely to approach a threatened/highly threatened status.

Furthermore, although the Project EAAA is part of a wider region that contains several areas of high priority for conservation by the government authorities and recognised institutions (e.g. Annamese lowlands by BirdLife International (BirdLife International, 2020g) and Saola Nature Reserves by WWF (WWF, 2007)), it does not overlap with those areas.

The Project EAAA therefore would not qualify as Critical Habitat under Criterion 4.

8.1.4.2.5 Criterion 5: Key Evolutionary Processes

Criterion 5 has no tiered system though IFC PS6 describes this Criterion to be one of the following:

- Physical features of a landscape that might be associated with particular evolutionary processes (for example isolated areas, areas of high endemism, spatial heterogeneity, environmental gradients, edaphic interfaces, biological corridors or sites of demonstrated importance to climate change adaptation); and/or
- Subpopulations of species that are phylogenetically or morphogenetically distinct and may be of special conservation concern given their distinct evolutionary history. The latter includes evolutionarily significant units and evolutionarily distinct and globally endangered species.

There are physical features within the EAAA that might be associated with evolutionary processes. Key natural barriers of the Project EAAA include the large and steep mountains of the Annamite Range along the Vietnam-Laos border. When considering the natural habitat areas within the EAAA, the natural habitat areas may be considered to substantially contribute to the biological values of the EAA that may sustain endemic populations.

The Annamite Mountain Range, to which the Project EAAA belongs, forms an important barrier between Vietnam's moist uplands and the drier monsoon ranges of Laos (Hurley, 2001). Such divergent climatic patterns, together with the complex topography, contributed to enormous species richness and high levels of endemism in the region. The east-west extension of Annamite Range, in addition to the Red and Black Rivers' gorges and deltas in the north, are considered barriers that isolated the northern and southern floral and faunal elements. Furthermore, as a glacial refugia during the last ice age, the forests covering the valleys and mountain ridges of the Annamite Range created a range of unique life forms and impressive landscapes, representing a "cradle of evolution".

Moreover, several of the world's most threatened and least-known species found in the region were only recently discovered by science, including the Saola (IUCN CR), the Large-antlered Muntjac (IUCN CR), and the Annamite Striped Rabbit (IUCN EN). In particular, the Saola may be of special conservation concern given its distinct evolutionary history and limited extent of occurrence. The Saola is included in the Zoological Society of London's global Top 100 Evolutionarily Distinct & Globally Endangered (EDGE) species, ranked at #43 (Zoological Society of London, n.d.). It was completely unknown to science until its discovery in 1992. It resembles the desert antelopes of Arabia in appearance, but is in fact more closely related to wild cattle. It is a primitive member of the ruminant artiodactyl family Bovidae, which includes antelope, buffalo, bison, cattle, goats and sheep. However, the sole member of its genus *Pseudoryx*, the Saola diverged from all other living species more than 13 million years ago.

Nonetheless, given that the above mentioned species were not detected within the Project EAAA, and that the habitat values in the Project EAAA are relatively modified, the EAAA is not representative of values associated with evolutionary processes.

Considering the above, **it is considered unlikely that the Project Area and EAAA would be considered important in the conservation of Key Evolutionary Processes, and thus, critical habitat under Criterion 5**.

9. SOCIO-ECONOMIC BASELINE

9.1 Introduction

9.1.1 Introduction to the Section

This report describes the baseline of social and economic conditions of the potentially affected community for the Gelex 1.2.3 Wind Farm Project (the Project), which is located in Huong Linh commune, Huong Hoa district, Quang Tri province. The economic and social analyses of the affected community demonstrate the Project's intention to manage and mitigate its impacts on the local community's living conditions and livelihoods. The objectives of this socio-economic survey are to:

- Gather data on the socio-economic conditions of the Project area to help identify potential socio-economic impacts; and
- Identify and understand the perception/concerns of stakeholders including local authorities and local communities, who might be affected by the Project's construction and operation activities.
- The baseline report analyses the socio-economic and cultural contexts at both national and local (provincial, district, and commune) levels. It also includes household-level socio-economic indicators and characteristics of the community which is affected by the Project. This report is one of the specialist studies for the Environmental and Social Impact Assessment (ESIA) report for the Project.
- The findings reported are based on a review of socio-economic conditions collected during site visits between 13 and 14 February 2020. As outlined in Section 9.1.2, the research and engagement methodology aims to achieve data validity with methodological triangulation and to adhere to International Finance Corporation (IFC) guidelines. Efforts have been made to highlight the differences between surveyed villages and between genders on a number of socio-economic parameters.

9.1.2 Methodology

9.1.2.1 Data Collection

The socio-economic data collection was designed so that information was gathered at the national, local, and household levels, in enough detail to detect significant changes in perceptions of stakeholders towards the Project. The task includes secondary socio-economic baseline data collection (see Section 9.1.2.1.1) and primary socio-economic data collection (see Section 9.1.2.1.2). Data for the national level is from secondary data sources and desk-based research while data for the local and household levels is based on both secondary and primary data sources. Primary socio-economic data collection was conducted through engagement with relevant state agencies, local authorities, and local communities. For local community engagement, key informant interviews (KIIs), focus group discussions (FGDs), household surveys, and field observation were carried out.

9.1.2.1.1 Secondary Socio-Economic Baseline Data Collection

The study collected secondary data sources such as socio-economic statistical data, and reports published from reliable sources at the national, provincial, and district levels. In addition, socio-economic reports were collected from the local authorities at the provincial, district, and commune levels. Secondary sources were used to build a socio-economic baseline at national and local levels that covers, but is not limited to the following aspects:

- Regional demographic profiles: population, ethnicity, and religion;
- Administration and institutions;
- Economy, livelihood, and employment;

- Land use and tenure;
- Infrastructure and public services: road network, water, electricity, irrigation system, waste management, education, and health services;
- Vulnerability; and
- Archaeological, cultural heritage, and religious sites.

Sources were also collected to provide a basis for comparison between the reported local context, and the primary baseline data collected.

9.1.2.1.2 Primary Socio-Economic Baseline Data Collection

9.1.2.1.2.1 Methods and Sampling

The study undertook the primary data collection with a multi-layer approach to socio-economic analysis using mixed methods combining qualitative and quantitative methods. Particular methods applied in this research include:

- Semi-structured interviews with local authorities;
- Key informant interviews (KIIs);
- Focus group discussions (FGDs);
- Household interviews; and
- Field observation.

In order to organise the interviews and household survey, invitation letters were prepared and sent to the local authorities prior to the meetings. The household survey and KIIs were organised in collaboration with the commune level authorities, and in particular the village heads. Respondents were recruited based on diverse and inclusive requirements related to age cohorts, education backgrounds, livelihoods, gender, and social groups. Table 9.1 shows the target population, sample size, and sample populations of the study.

Table 9.1 Research Sample by Method and Location

Province	District	Commune	Village	Number of Semi-structured Interviews with Local Authorities	Number of KIIs	Number of FGDs	Number of Household Interviews
Quang Tri	Huong Hoa	Huong Linh	Hoong Moi		1	1	14
			Xa Bai		2	1	10
			Cooc		1	1	11
Total				**1**	**4**	**3**	**35**

Source: Socio-economic survey conducted by ERM, 2020

9.1.2.1.2.2 Consultation with Local Authorities

Via semi-structured interviews, ERM collected updated information on the socio-economic conditions of the area as well as key concerns and perceptions of local authorities and related organisations about the Project. Suggestions were also presented to the Project for environmental and social performance management and impact mitigation. This consultation also assisted the team in confirming the trend of development and any changes to socio-economic conditions, infrastructure, and public services.

The consultation process was also undertaken with the aim of informing the stakeholders about the Project progress, while assessing the awareness at respective levels and simultaneously identifying some of the key issues, concerns, and expectations of the community (see Table 9.2).

Table 9.2 Engagement with Local Authorities Conducted in February 2020 for the ESIA Report Development

Interviewed Group	Organisations	Topics Covered in the Interviews and Meetings
Commune authorities	People's Committee of Huong Linh commune	■ Update the authority about Project development progress and current status of the ESHIA; ■ Obtain to-date socio-economic data/information including infrastructure and public services development of the commune, health, livelihoods, and employment of the people in the commune; ■ Gain feedback/perceptions on the Project development; ■ Ask for acceptance and support from the People's Committee to conduct the household survey in the area.

9.1.2.1.2.3 Key Informant Interviews (KIIs)

The village head and village patriarch were identified as key informants. The KIIs were semi-structured with major questions prepared in advance in the form of checklists. A name list of the KII interviewees is provided in Appendix I.

Three village heads and one village patriarch (Xa Bai village) were involved in four KIIs. The questions for the village heads and village patriarch concentrated on general information about the community, social networks, community context, employment, and perceptions about the Project. All interviews lasted approximately one hour and were recorded.

9.1.2.1.2.4 Focus Group Discussions (FGDs)

Focus group discussion was used in this survey since it enables ERM to observe a process of interaction among and between group members and to access their expressed views, opinions, experiences, and attitudes about their socio-economic conditions. This method is useful for producing a consensus as people collectively address concerned topics which they may not have previously considered as individuals.

ERM completed three focus group discussions (FGDs) including one with Van Kieu ethnic minority group, one with agriculture and forestry group, and one with vulnerable group. Each focus group interview involved a heterogeneous group of eleven people with distinctive backgrounds in terms of age, gender, economic and social status in order to obtain an inclusive perspective and objective reporting. By conducting the FGDs, ERM has obtained an understanding of the current socio-economic condition of the impacted villages, their livelihoods, customs and culture, their dependence on natural resources, their accessibility to public services, and their opinions or concerns about the Project (see Table 9.3).

Table 9.3 Focus Group Discussions by Surveyed Village

Commune	Village	Group	Number of FGD Participants		
			Female	Male	Total
Huong Linh	Hoong Moi	Van Kieu ethnic minority group	5	6	11
	Xa Bai	Agriculture and forestry group	0	11	11

Commune	Village	Group	Number of FGD Participants		
			Female	Male	Total
	Cooc	Vulnerable group	4	7	11
Total			**9**	**24**	**33**

Source: FGDs conducted by ERM, 2020

All FGDs began with an introduction about objectives and methods. The focus groups were structured into the following main sections.

- ERM enquired about the participants' socio-economic condition and their thoughts on the Project.
- Participants were asked to list stakeholders who might support them during time of need. These might include friends, family, local authority or non-governmental organisation (NGO). Based on the list of categorised stakeholders, participants were invited to rank them in terms of their importance for their needs. Visual illustrations were presented to support illiterate people during the discussions.

Photos and note-taking were carried out during all focus groups, which lasted from one to one and a half hours. The list of FGD respondents and FGD photos in the social baseline survey are provided in Appendix O and Appendix Q respectively.

9.1.2.1.2.5 Household Interviews

The survey was conducted in Huong Linh commune where the Project components will be located and/or impact on local communities. At the community level, a sample with 35 households (HHs) was selected for household interviews, including 14 households from Hoong Moi village, 10 from Xa Bai village, and 11 from Cooc village. The point of contact for interviews at the household level was any appropriate adult member of the household. The household surveys were conducted by meeting at their houses, subject to availability. Table 9.4 details the areas and number of households selected for the survey and a named list of the interviewed households and household survey photos are provided in Appendix O and Appendix Q respectively.

Table 9.4 Household Interviews by Surveyed Village

Province	District	Commune	Village	Number of Surveyed Households	Total Surveyed Population
Quang Tri	Huong Hoa	Huong Linh	Hoong Moi	14	67
			Xa Bai	10	53
			Cooc	11	56
Total				**35**	**176**

Source: Socio-economic survey conducted by ERM, 2020

The survey used the household questionnaire method, whereby a set of data was collected at the household level using structured questionnaires. The questionnaire of the household interview (see Appendix P) was designed to capture the following data and information:

- Family status and demographics;
- Education background (i.e. education level of members in the surveyed households);
- Health profile of household members being interviewed;

- Vulnerability status (i.e. who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status may be more adversely affected by the Project development);
- Economic conditions (i.e. condition of household assets and utilities, income and expenditure [seasonal income is also accounted for]);
- Occupation, livelihood, and status;
- Current condition of local public services and infrastructure including road, electricity and water supply, waste management, market, education and healthcare; as well as the household's accessibility to such services; and
- Awareness and concerns about the Project's activities.

9.1.2.1.2.6 Field Observations

Field observations were carried out during the ERM survey, at the village and commune level covering the following aspects:

- Health facilities;
- Education facilities;
- Religious facilities;
- Community security;
- Commune and village government facilities;
- Public transport services and infrastructure;
- Daily community activities; and
- Community use of natural resources and livelihood.

9.1.2.2 Data Analysis

The data collected was systematically transcribed and thematically analysed. The method for identifying, analysing, and reporting themes from data transcripts was applied. Narrative development, network analysis, and community asset mapping were also used to highlight different aspects of the research issues.

Data collected from the paper-based questionnaires of the household survey was entered using Microsoft Excel. Before the analysis however, multiple checking processes were conducted to further identify potential errors. Some of the answers were cross-checked to make sure about the consistency of the data. The final databases for both surveys were then analysed by Excel to provide different frequency and percentage tables. Baseline information for the surveyed communities is presented in terms of the following socio-economic components:

- Demographic information;
- Education;
- Employment;
- Income and expenditure;
- Health;
- Access to public services;
- Land, housing and household assets;
- Gender and vulnerability description; and

- Local perceptions and evaluation of the Project.

Where appropriate, data for each of the communities in the Project has been checked with comparable information to provide context.

9.1.2.3 Data Limitations

Even though every effort was made to achieve the best database and sample-size, the research team recognises that the key limitation to this study is the quality and extent of available information. This study relies on the most recent reports and statistical information available at the time of writing. For some indicators, the analysis has relied on information from the 2018 Statistical Yearbook and the 2009 Population and Housing Census, which may not accurately reflect current social and economic conditions. However, this information remains the most up to date source available at the time of writing. Interviews with key informants supplemented the available statistical data, helped to confirm our understandings of existing conditions, and provided insights into local issues and trends. Reasonable efforts were made to cross-check and triangulate information from different sources to confirm their accuracy.

The majority of surveyed respondents were of Van Kieu ethnic minority group, of which some do not communicate fluently with the interviewers in Vietnamese. Some household information was not obtained thoroughly. However the survey team double-checked such information with the village heads and re-contacted the respondents for data confirmation when needed.

9.2 National Context

This section describes the country of Vietnam in terms of demographics, institutional context, human rights, economy and industry.

9.2.1 Demographic Information

The Socialist Republic of Vietnam is located on the Indochina peninsula in Southeast Asia. It is bordered by China to the North, Laos and Cambodia to the West, the Gulf of Thailand to the Southwest, and the East Sea to the East and South, and is composed of a mainland area of 331,230 km^2 and more than 4,000 islands. It has a population of 94.7 million (2018), equivalent to an increase of 1.1% in comparison with 2017, of which the urban population was 33.8 million people (35.7%), and the rural population was 60.9 million people (64.3%). The male and female population was 46.8 million people and 47.9 million people respectively with the corresponding shares of 49.4% and 50.6% (GSO 2019; also see Figure 9.1).

Vietnam has a total of 54 ethnic groups. The Kinh ethnic group makes up the largest proportion with approximately 86% of the population, and mainly lives in the deltas and major cities while the other 53 ethnic minority groups, especially those with small populations, are scattered across mountain areas with very limited access to infrastructure, health care and education (World Bank 2009).

Vietnamese is the official language and is spoken by around 90% of the population. Minority groups are distinguished by distinct languages including Tay, Hmong, Thai, and Khmer in the more remote rural areas. The language of ethnic groups belongs to five linguistic families, namely Austroasiatic, Austronesia, Tai-Kadai, Miao-Yao and Sino-Tibetan (Michaud et al. 2016). Some ethnic minority groups such as Tay, Thai, Nung, Hmong, Muong, Cham, Khmer, Kohor, Ede, Bahnar, and Jarai have their own writing systems (DFAT 2017).

Despite rapid economic growth in recent decades, ethnic minority communities living in mountainous and highland areas have been trapped in poverty. According to the World Bank (2013), ethnic minorities account for 14% of the total population but they also account for up to 50% of the total poor population.

VIETNAM

Full name	**Socialist Republic of Vietnam**
Capital	**Ha Noi**
Largest city	**Ho Chi Minh**
Area	**331,235km²**
Official languages	**Vietnamese**
Ethnic groups	**85.3% Kinh** **14.7% Ethnic minorities**
Religion	**86.3% Folk (2019)** **4.8% Buddhism** **6.1% Catholicism** **2.8% Others**
Population	**96,208,984 persons (2019)**
GDP (Total)	**5,542.3 trillion VND (2018)**
GDP per capita	**58.5 million VND (2018)**

Source: GSO (2019)

Figure 9.1 Vietnam at a Glance

9.2.2 Institutional Context

Vietnam's system of governance has four levels: national, provincial, district and commune in Figure 9.2.

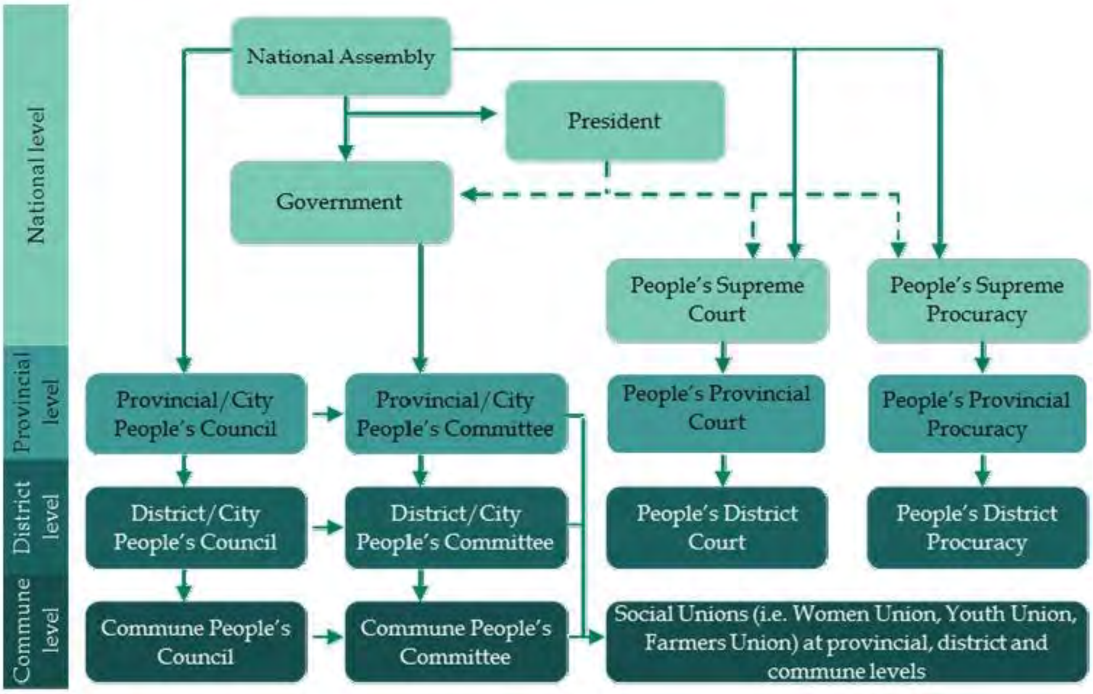


Figure 9.2 The State System of Vietnam

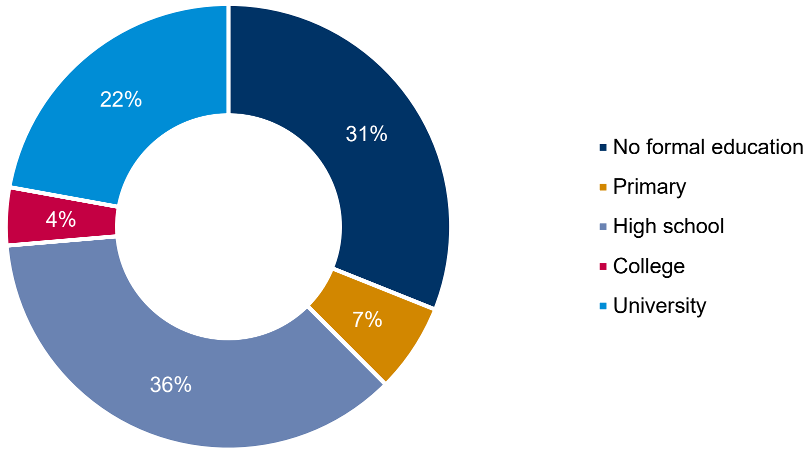
At the national level, the State of Vietnam consists of the National Assembly, the President, the Government, the People's Supreme Court and the People's Supreme Procuracy.

- The National Assembly is the supreme organ of state and the only body with constitutional and legislative power to draw up, adopt, and amend the constitution and to make and amend laws, to legislate and implement state plans and budgets, and to initiate or conclude wars, and to assume other duties and powers it deems necessary.
- The President represents Vietnam both domestically and internationally, and maintains the regular and coordinated operation and stability of the national government, and safeguards the independence and territorial integrity of the country.
- The Government is the executive organ of the National Assembly, the highest body of state administration of the Socialist Republic of Vietnam. It carries out overall management of work for the fulfilment of the political, economic, cultural, social, national defence, security and external duties of the State.
- The Supreme People's Court supervises the judicial work of both the local People's Courts, which are responsible to their corresponding People's Councils, and the Military Tribunals. The People's Courts function at all levels of government except the commune, where the commune administrative committee functions as a primary court.
- The Supreme People's Procuracy, with its local and military subdivisions, acts as a watchdog for the state. It monitors the performance of government agencies, maintains vast powers of surveillance, and acts as a prosecutor before the People's Courts.

The organisation of institutional governance from provincial/city level to commune level consists of:

- The People's Council at provincial, district, and commune levels: a body of state power at the local level, representing the rights of the people and is elected by local people; and
- The People's Committee at provincial, district, and commune levels: the executive body of the People's Councils and State administrative agencies at the local level. The People's Committee at the provincial/city and district level includes departments for different fields such as agriculture and rural development, natural resources and environment, transport etc. The number of staff varies from commune to commune depending on the population size and land mass of a commune. Currently, Vietnam has 11,162 commune-level administration units, including 1,567 wards, 597 towns and 9,064 communes[8]. The capacity of Vietnamese rural commune's human resources is required to be strengthened to meet the higher demand of the national development cause. Among 145,112 permanent staff of the commune level, 31% are reported to have no formal education (see Figure 9.3).

[8] Source: Mai Duc Ngoc. 2015. Key Communal Human Resources in Contemporary Rural Vietnam (*Can bo lanh dao chu chot cap xa o nong thon Viet Nam hien nay*). Khoa hoc Xa hoi Viet Nam 12(2015): 19-27.



Source: Mai Duc Ngoc (2015)

Figure 9.3 Formal Education Attainment of Commune-level Permanent Staff in Vietnam

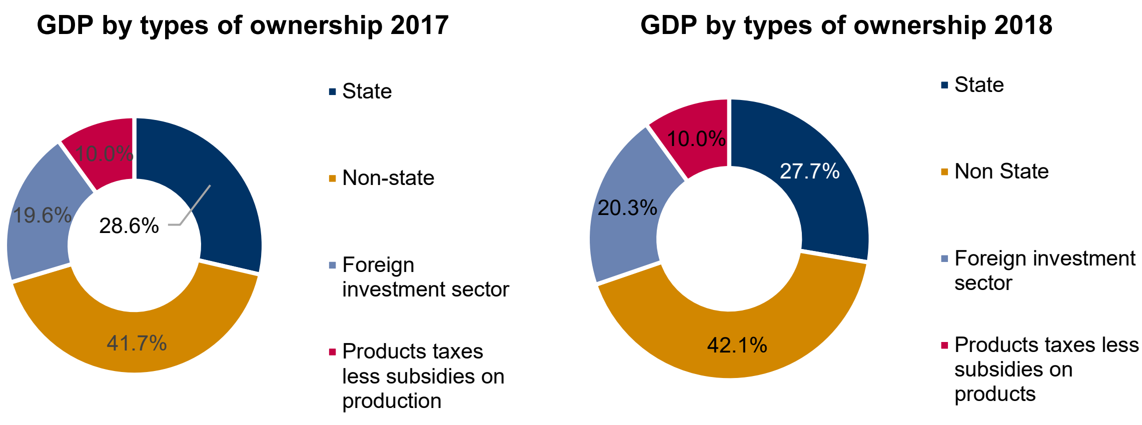
While it is not recognised within the State's local administration system, village level institutions are the basic unit of Vietnamese society and their interactions with the State are crucial to understanding Vietnamese socio-political characteristics and citizen's behaviours[9]. Due to the implementation of New Rural Development Program, village leadership and participation is becoming more important to participatory village development planning and implementation of grassroots democracy, and thus community development.

9.2.3 Economy and Industry

Vietnam is described as 'a development success story' with dramatic transformation from one of the poorest countries in the world at the time of economic reforms in the 80s (known as Doi Moi or Renovation reforms), to 'low middle income status' over a period of 25 years (DFAT 2017).

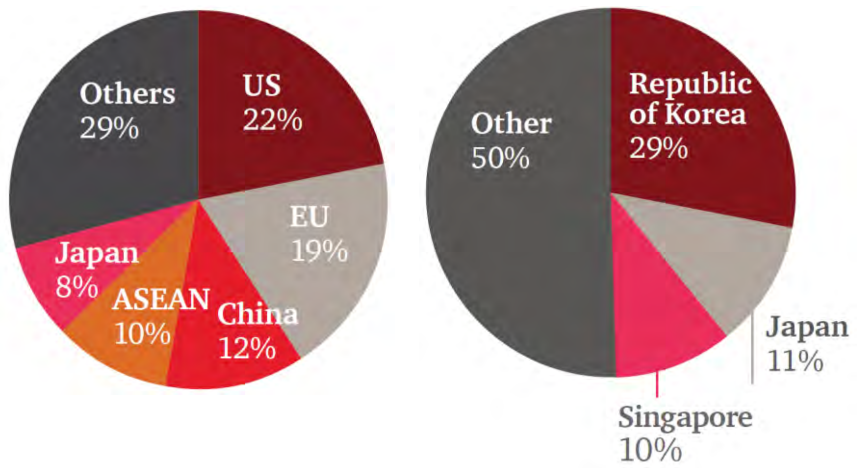
Gross domestic product (GDP) in 2018 was estimated to increase by 7.08% over 2017 of which the agriculture, forestry and fishery sector increased 3.76%; the industry and construction sector rose 8.85%; and the service sector increased 7.03%. In 2018, GDP at current prices reached 5,542 trillion VND. By type of ownership, the non-state economy (2018) accounted for the highest proportion, 42.1% while the foreign investment sector made up 20.3% (see Figure 9.4). The GDP of the non-state economy and foreign investment sector in 2018 were higher than those in 2017 while the state economy in 2018 was slightly lower. During this time, the GDP per capita in 2018 was estimated to be 58.5 million VND, an increase of 5.1 million VND over 2017. Vietnam's two largest export partners are the US and EU while its key foreign direct investment (FDI) investors include the Republic of Korea, Japan, and Singapore (see Figure 9.5).

[9] See further: Nguyen The Anh. 2003. Village versus State: The Evolution of State-Local Relations in Vietnam until 1945. Southeast Asian Studies 41(1): 101-123.



Source: GSO (2018, 2019)

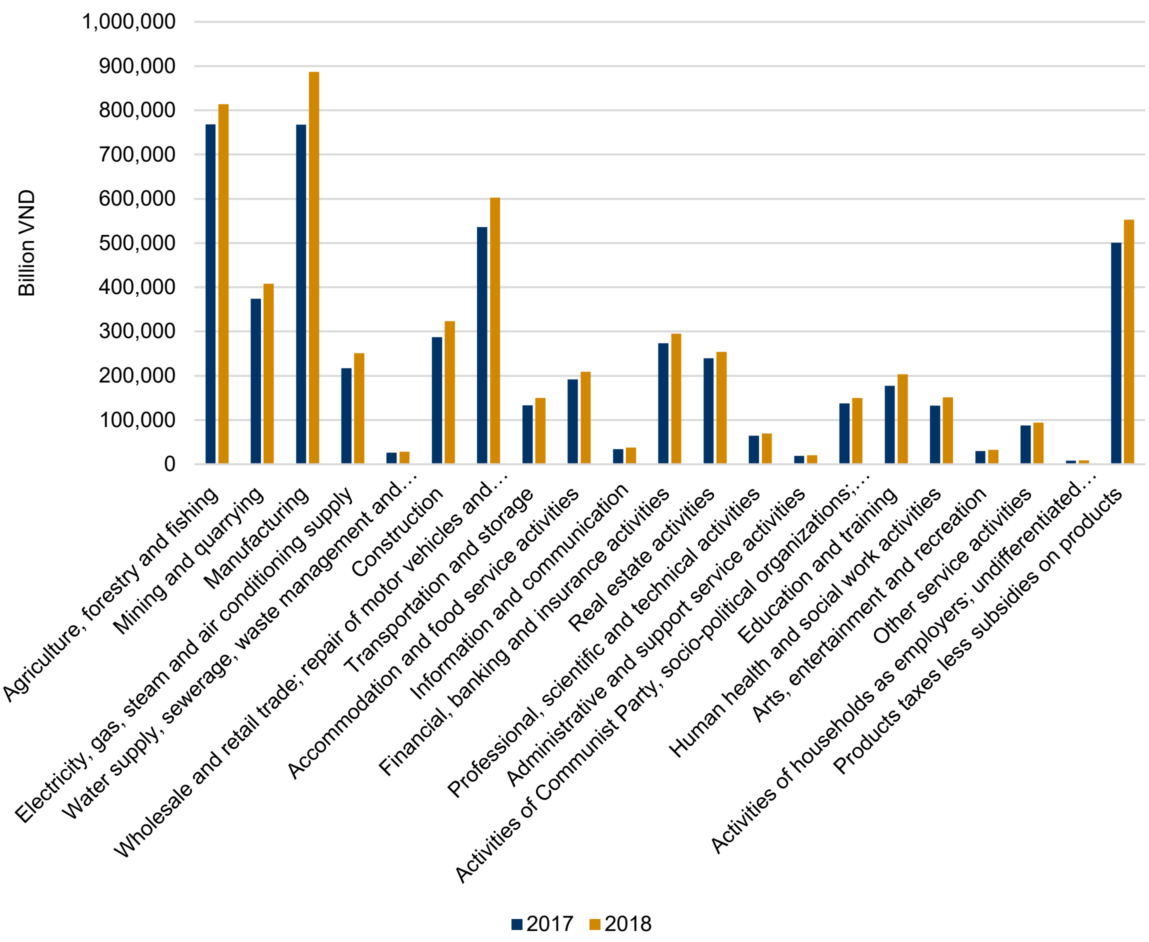
Figure 9.4 GDP at Current Prices by Types of Ownership in 2017 and 2018



Source: VCCI & PWC (2017)

Figure 9.5 Vietnam's Major Export Partners (Left) and FDI Investors (Right)

The structure of the economy has experienced a positive shift in which the share of agriculture has been gradually reduced, and the share of industry and services has increased. In 2018 the share of the agriculture, forestry, and fishery sector accounted for 14.7%, while the share of the industry and service sectors was 34.2% and 41.1% respectively and taxes less subsidies on products accounted for 9.97% (the corresponding figures in 2017 were 15.3%, 33.4%, 41.3% and 10.0%) (GSO 2019). GDP of economic activities in 2018 increased compared to those in 2017. Figure 9.6 compares the contribution of different economic activities to Vietnam's GDP in 2017 and 2018.



Source: GSO (2019)

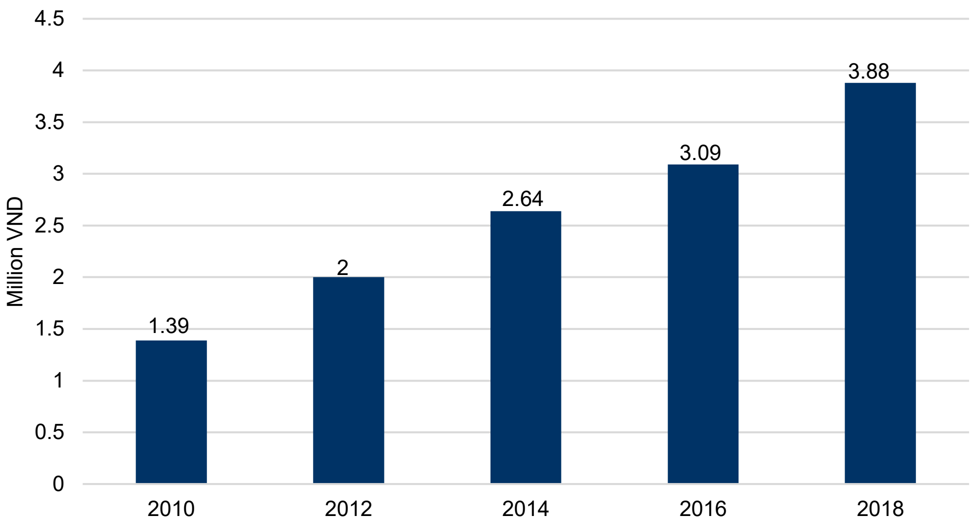
Figure 9.6 GDP at Current Prices by Kinds of Economic Activity in 2017-2018

In 2018, the labour force (people aged 15 years and over) equalled 55.4 million people. This is an increase of 530.5 thousand people since the previous year, of which 52.2% were male and 47.8% were female. The employed population aged 15 years and above working in economic activities reached 54.2 million people in 2018, an increase of 546.1 thousand people compared to that in 2017 and increased sharply in urban areas.

The unemployment rate of the labour force at working age was 2.19% in 2018. This rate is down from that in 2017 (2.24%). The North Central and Central coastal areas recorded the highest unemployment rate for the whole country, 2.68% in 2018. The underemployment rate of the labour force at working age was 1.4% in 2018, lower than in 2017 (1.7%), of which the corresponding figures for urban and rural areas were 0.65% and 1.78%.

The living standards of the population have been improved; however the improvement has not been consistent over recent years. The human development index (HDI) rose from 0.695 in 2016 to 0.700 in 2017 but slightly decreased to 0.693 in 2018. Vietnam was ranked 118 out of 189 countries in the latest United Nations Human Development Report 2019 (UNDP 2018, 2019).

There was a sharp increase in the national monthly income per capita at current prices during the period 2010-2018 (see Figure 9.7). In 2018, the national monthly income per capita at current prices reached 3.88 million VND, of which the monthly income per capita at current prices of urban and rural areas was 5.62 million VND and 2.99 million VND respectively.



Source: GSO (2019)

Figure 9.7 National Monthly Average Income per Capital at Current Prices in 2010-2018

The overall multi-dimensional poverty rate[10] was 6.8% in 2018, a decrease of 1.1 percentage points against 2017. In urban areas the rate was 1.5% and in rural areas it was 9.6% - a decline of 1.2 percentage points for both areas (GSO 2019). By region, the North midlands and mountain areas, the Central Highlands, and the North Central and Central coastal areas were the regions with the highest multi-dimensional poverty household rates, 18.4%, 13.9%, and 8.7% respectively; however these areas witnessed a remarkable reduction in the percentage of multi-dimensional poor households (by 2.6, 3.2 and 1.5 percentage points against 2017). As shown in Figure 9.8, the South East region recorded the lowest rate, 0.6% - a decrease of 0.3 percentage points over 2017.

[10] Multi-dimensional poverty households are households whose monthly average income per capita is at or below income-based poverty line (welfare poverty line) or whose monthly average income per capita is above income-based poverty line but below minimum living standard and deprives of at least 3 indices for measuring deprivation of access to basic social services. The multi-dimensional poverty line is defined upon two criteria, including income-based criteria and basic-social-service-based criteria as follows:

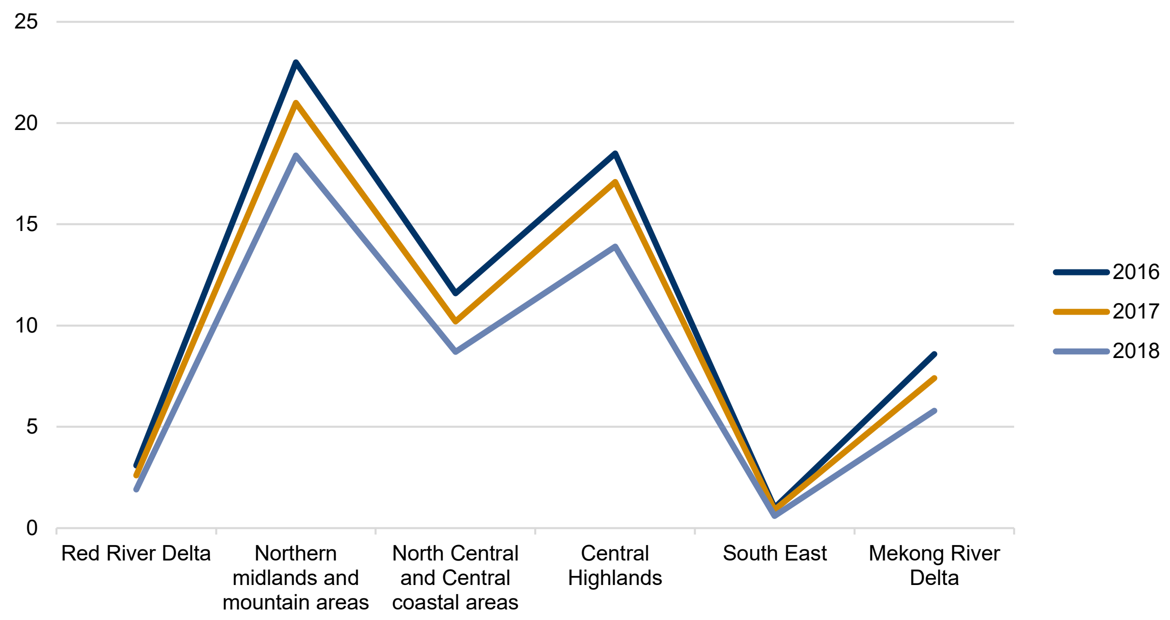
Income-based criteria:

- Income-based minimum living standard is the income level that guarantees to afford basic minimum needs for a person to survive, including food, foodstuff demands and non-food consumption suitable with socio-economic situation of the province/city directly under central management in each period.
- Income-based poverty line (also welfare poverty line) is the income level which household is considered as income poverty if its income is lower than that level.

Criteria for deprivation of accessing to basic social services:

- Five basic social services include: health, education, housing, clean water and sanitation and information accessibility.
- Ten indicators for measuring level of deprivation: (1) adult education; (2) child school attendance; (3) accessibility to health care services; (4) health insurance; (5) quality of house; (6) housing area per capita; (7) drinking water supply; (8) hygienic toilet/latrine; (9) use of telecommunication services; and (10) assets for information accessibility.

Source: GSO (2018, 771)



Source: GSO (2019)

Figure 9.8 Multi-Dimensional Poverty Rate by Region in 2016-2018

9.2.4 Renewable Energy Planning and Development

Electricity demand in Vietnam is projected to increase by eight percent annually until 2025. Therefore, the Government is promoting the development of renewable energy in addition to existing energy sources to ensure energy security and to address the growing power demand. In 2015, the Vietnam Government approved 2068/QD-TTg on the Development Strategy of Renewable Energy of Vietnam (DSRE) by 2030 with a vision to 2050. The Decision clearly states the development strategy and orientation for renewable energy as follows:

> "To encourage the mobilisation of all resources from the society and people for renewable energy development to strengthen the access to the modern, sustainable and reliable energy source with rational price for all people; promote the development and use of renewable energy, increase in domestic energy supply source, gradually increase the proportion of renewable energy in production and consumption of national energy to decrease the dependence on the fossil fuel, contribute to ensure the energy security, mitigation of climate change, environmental protection and sustainable socio-economic development."

In 2016, the Government approved the revised National Power Development Master Plan ("PDP VII") for the 2011- 2020 Period, with a vision for 2030 under the 428/QD-TTg. This Master Plan provides the development orientation for renewable energy sources in 2020, 2025, and 2030 as summarised in Table 9.5.

Table 9.5 Targets Set in PDP VII for Renewable Energy by 2020, 2025, and 2030

Type	Capacity	2020	2025	2030
Wind	Total Capacity (MW)	800	2,000	6,000
	Electricity Production (%)	0.8	1	2.1
Hydropower	Total Capacity (MW)	21,600	24,600	27,800
	Electricity Production (%)	29.5	20.5	15.5

Type	Capacity	2020	2025	2030
Biomass	Electricity Production (%)	1	1.2	2.1
Solar	Total Capacity (MW)	850	4,000	12,000
	Electricity Production (%)	0.5	1.6	3.3

Source: Vietnam Briefing (2019)

As one of the Government's incentive policies for renewable energy investment in Vietnam, feed-in-tariffs in Vietnam are currently among the lowest in the world[11].

9.2.5 Human Rights

- The 2013 Constitution states that "The Socialist Republic of Vietnam is a socialist rule of law State of the People, by the People and for the People" (Article 2) and that "The State guarantees and promotes the People's mastery; acknowledges, respects, protects and guarantees human rights and citizens' rights; implements the objectives of prosperous people, state powers, democracy, justice, civilization, and all that people enjoy that is abundant and free for a happy life with conditions for all-round development." (Article 3). For the first time in the history of constitutionalism of Vietnam, human rights have become the title of one Chapter (Chapter 2), which confirms "human rights and citizens' rights in the political, civic, economic, cultural and social fields are recognised, respected, protected, and guaranteed in concordance with the Constitution and the law".
- Vietnam has signed and ratified the following United Nations treaties: the International Covenant on Civil and Political Rights (ICCPR); the International Covenant on Economic, Social and Cultural Rights (ICESCR); the International Covenant on the Elimination of All Forms of Racial Discrimination (ICEFRD); the Convention on the Rights of the Child (CRD); the Convention on Elimination of Discrimination of Women (CEDAV) and its two Optional Protocols on the sale of children, child prostitution and child pornography (OP-CRC-SC) and on the involvement of children in armed conflict (OP-CRC-AC) (DFAT, 2017).
- Vietnam ratified the Convention against Torture and Other Cruel, Inhuman or Degrading Treatments or Punishments - one of the nine fundamental United Nations conventions on human rights - and the Convention on the Rights of Persons with Disabilities (CRPD) in 2015 (United Nations Human Rights Council 2018).
- The country's further integration into the international economy through 16 bilateral and multilateral free trade agreements with 56 economies worldwide has contributed to a more favourable business climate reform and economic structuring as well as a more transparent administration[12]. It is expected that together with EU-Vietnam Partnership and Cooperation Agreement, the EU-Vietnam Free Trade Agreement which was ratified by the European Parliament in February 2020, would serve "as the foundation for the commitment from both sides to the principles of sustainable development, human rights, and labour rights"[13].
- The past decades have witnessed significant efforts and progress to enhance gender equality in Vietnam. In line with the UN Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the 2006 Law on Gender Equality, a legislative framework on gender

[11] Source: Vietnam Briefing. 2019. Renewables in Vietnam: Current Opportunities and Future Outlook. Available at https://www.vietnam-briefing.com/news/vietnams-push-for-renewable-energy.html/. (Accessed 22 July 2019).

[12] Source: European Chamber of Commerce in Vietnam. 2019. White Book: Trade & Investment Issues and Recommendations. Hanoi: EuroCham Vietnam.

[13] Source: Tran Ngoc Diep. 2019. The EU-Vietnam Free Trade Agreement: Reflecting on the Issue of Child Labour. Brussels: European Institute for Asian Studies.

equality has been established[14]. Vietnam has also implemented a National Strategy on Gender Equality from 2011-2020 to promote women's status and close the gender gap. As reported by the World Bank[15], despite gender successes in poverty reduction, education attendance and health care provision, women in Vietnam tend to be rooted in social norms and customs that cannot be legislated away, are under-represented in leadership positions at all levels, and are vulnerable to the expanded formal economy and globalisation. It is highlighted in the report's recommendations that gender awareness and capacity building should be prioritised, and that research on gender issues should be promoted systematically to inform policymaking.

- Poverty alleviation and economic development is a foundation, but not a guarantee to protect and promote human rights - civil and political, as well as economic and social. As such, while further Government actions are necessary, the private sector - apart from harnessing economic benefits for social ends - should be promoted to directly advance human rights[16].

9.3 Local Context – Provincial Level: Quang Tri Province

This section provides details about the local context where the Project components are located, including demographic information (i.e. population, ethnicity, and religion), public infrastructure and facilities, education, health, land use, economy, vulnerability and cultural sites. The local context includes three levels of analysis: provincial (Quang Tri province), district (Huong Hoa district) and communal (Huong Linh commune) levels.

9.3.1 Overview of Quang Tri Province

- Quang Tri is a coastal province in the North Central Coasts region of Vietnam (see Figure 9.9). It borders Le Thuy district in Quang Binh province to the north, Phong Dien and A Luoi districts in Thua Thien Hue province to the south; Savanakhet and Salavan in the Lao People's Democratic Republic to the west and the East Sea to the east. The center of the province is Dong Ha city, about 1,120km away from Ho Chi Minh city to the south, about 593km away from Ha Noi city to the north. The province has a total of 4,737 km^2 natural area (accounting for 1.4% of the national natural area) and a population of 630,545 people (accounting for 0.7% of the national population). Quang Tri is located at the intersection of national arterial roads: National Highway 1A, Ho Chi Minh road (including East Ho Chi Minh road and West Ho Chi Minh road), National Highway 9 linked to trans-Asian road (Asian Highway Network), Highway 15D, and the north-south railway, connecting with Cua Viet port and My Thuy seaport. Dong Hoi-Quang Binh airport is to the north and Phu Bai airport and Da Nang international airport are to the south of Dong Ha city (Quang Tri Province Portal 2019)[17].

[14] Source: JICA. 2011. Country Gender Profile: Vietnam. Japan International Cooperation Agency.

[15] Source: World Bank. 2011. Vietnam Country Gender Assessment.

[16] See further: Kinley, David and Hai Nguyen. 2008. Vietnam, Human Rights and Trade: Implications of Vietnam's Accession to the WTO. Dialogue on Globalization. Occasional Papers No. 39. Geneva: Friedrich Ebert Stiftung.

[17] Source: Quang Tri Province Portal. 2019. Introduction about Quang Tri. https://www.quangtri.gov.vn/xem-chi-tiet-gioi-thieu-tong-quan/-/view-article/1/35001135398633365771/1573630224087 (Accessed 22 March 2020).

QUANG TRI PROVINCE

Number of city	**01 (Dong Ha)**
Number of town/district	**09**
Area	**4,737 km²**
Population	**630,545 persons (2017)**
Population Density	**113 people/km²**
Poverty proportion	**9.77%**
Ethnic groups	**Kinh, Van Kieu, Pa Co**

Source: Quang Tri Statistics Office (2019)

Figure 9.9 Quang Tri at a Glance

Quang Tri contains ten administrative units including a city (Dong Ha city), a town (Quang Tri), and eight districts (Vinh Linh, Huong Hoa, Gio Linh, Dakrong, Cam Lo, Trieu Phong, Hai Lang, and Con Co district) (see Table 9.6). There are 141 communes, wards, and townships in the province. Dong Ha city is the political, economic, and cultural center of the province.

Table 9.6 Administrative Units in Quang Tri Province

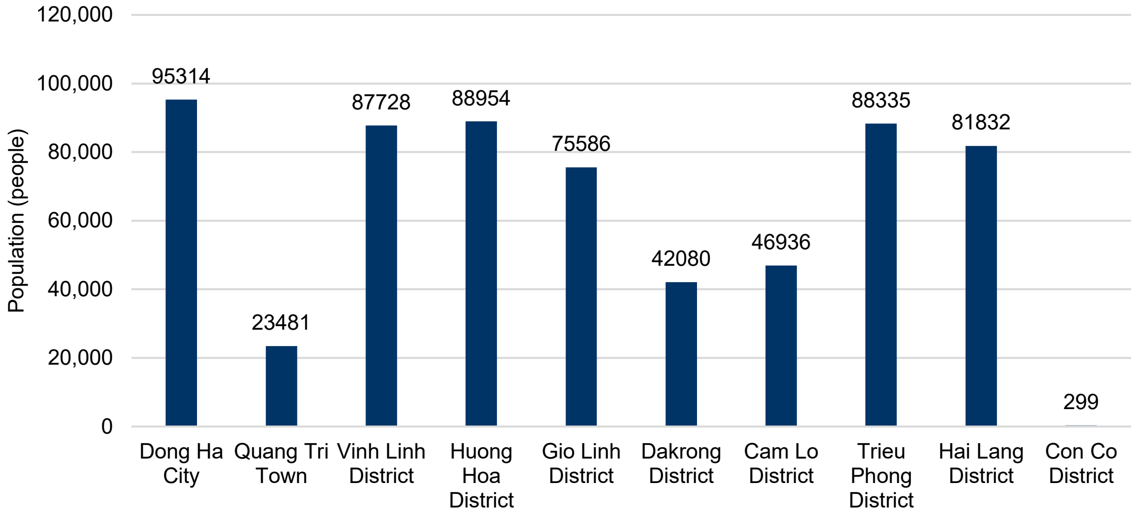
Administrative units	Wards	Town under district	Communes	Total
Dong Ha city	9	-	-	9
Quang Tri town	4	-	1	5
Vinh Linh district	-	3	19	22
Huong Hoa district	-	2	20	22
Gio Linh district	-	2	19	21
Dakrong district	-	1	13	14
Cam Lo district	-	1	8	9
Trieu Phong district	-	1	18	19
Hai Lang district	-	1	19	20
Con Co district	-	-	-	-
Total	**13**	**11**	**117**	**141**

Source: Quang Tri Statistics Office (2019)

9.3.2 Population, Ethnicity and Religion

9.3.2.1 Population

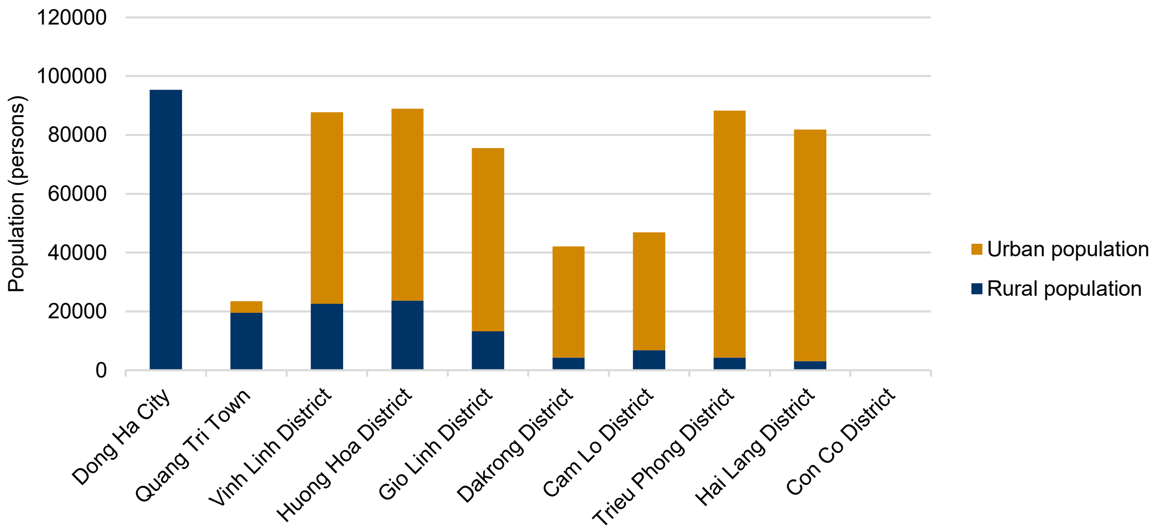
According to the Quang Tri Statistics Office (2019), the province has a total area of 4,737 km^2 and its population of 630,545 people (in 2018) (see Figure 9.10). The population is mainly concentrated in Dong Ha city with 95,314 persons and next in line are the two districts Huong Hoa and Trieu Phong with 88,954 persons and 88,335 persons respectively. Con Co district has the lowest population with 299 persons.



Source: Quang Tri Statistics Office (2019)

Figure 9.10 Average Population of Quang Tri Province by City/Town/District in 2018

Based on the Quang Tri Statistics Office (2019), the male and female population was 308,126 people and 322,419 people respectively (48.9% and 51.1%). The urban population was 192,929 people (30.6%), and the rural population was 437,616 people (69.4%). Dong Ha city has no rural population, while Con Co island district has no urban population (see Figure 9.11).



Source: Quang Tri Statistics Office (2019)

Figure 9.11 Population of Quang Tri Province by District and by Residence in 2018

As shown in Table 9.7, the whole province has a population of 630,545 people, an increase of 0.5% compared to 2017, and its population density is 133 person/km^2. The highest population density is in Dong Ha city with 1,304 person/km^2 while Dakrong has the lowest with 34 person/km^2 and Huong Hoa has 77 person/km^2 (the second lowest).

Table 9.7 Natural Area, Population and Population Density of Quang Tri Province by District in 2018

Administrative Units	Natural Area (km^2)	Number of Communes and Wards	Population (people)	Population Density (person/km^2)
Dong Ha city	73,09	9	95,314	1,304
Quang Tri town	72,82	5	23,481	322
Vinh Linh district	619,16	22	87,728	142
Huong Hoa district	1152,35	22	88,954	77
Gio Linh district	470,68	21	75,586	161
Dakrong district	1224,67	14	42,080	34
Cam Lo district	344,21	9	46,936	136
Trieu Phong district	353,36	19	88,335	250
Hai Lang district	424,80	20	81,832	193
Con Co district	2,30	-	299	130
Total	**4737,44**	**141**	**630,545**	**133**

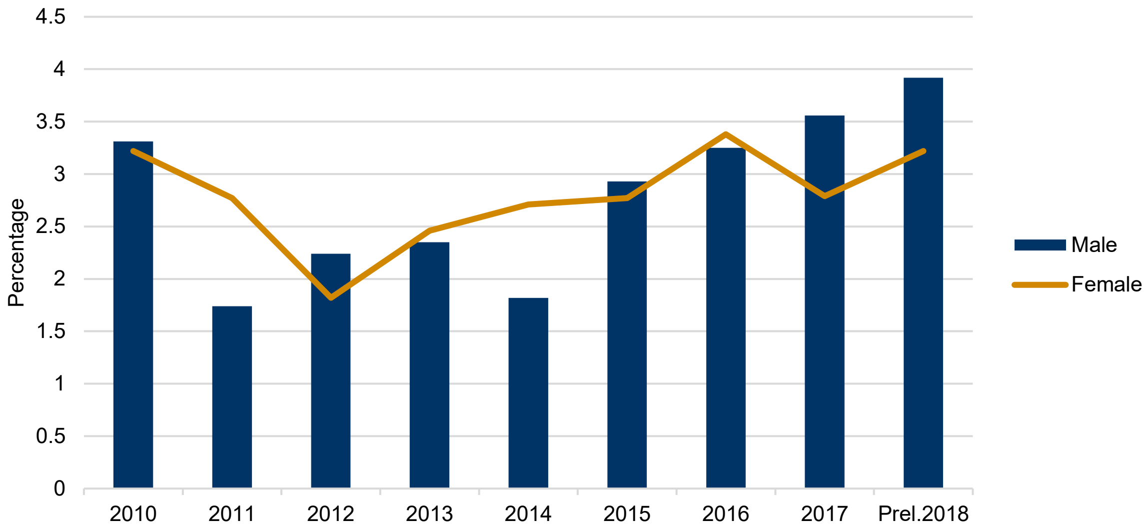
Source: Quang Tri Statistics Office (2019)

According to the Quang Tri Statistics Office (2019), the province has 459,254 people who are aged 15 and above. This includes 94,172 single, 323,452 married, 34,953 widowed and 6,677 divorced or separated. The average age of first marriage has gone up from 24.9 in 2010 to 25.3 in 2018 and the natural growth rate was 7.6% which is lower than the previous year (9.8%). The crude birth rate was 16.2% and the crude death rate was 8.7% in 2018, and the fertility rate was 2.61 children per woman, of which the corresponding figures for urban and rural areas were 8.4% and 7.2% respectively. The literacy rate for 15 years of age and above was 92.7%, 93.2%, and 92.6% in 2016, 2017 and 2018 respectively.

The labour force (15 years of age and above) was 338,596 people, equivalent to more than half of the province total population (53.7%), with 171,243 male and 167,353 female (53.2% and 51.7% respectively of the labour force).

From 2010-2018, both male and female unemployment rates experienced an upward trend. The rate of male unemployment was 3.9% and female unemployment was 3.2% in 2018, which was greater than in 2017 (3. 6% and 2.8% respectively) (see Figure 9.12).

The province is currently implementing many solutions to improve the quality of human resources. These include policies on employment, remuneration, attracting high-qualified experts and skilled labourers, upgrading vocational schools, and adopting policies to support investors to train workers (Quang Tri People's Committee 2019).



Source: Quang Tri Statistics Office (2019)

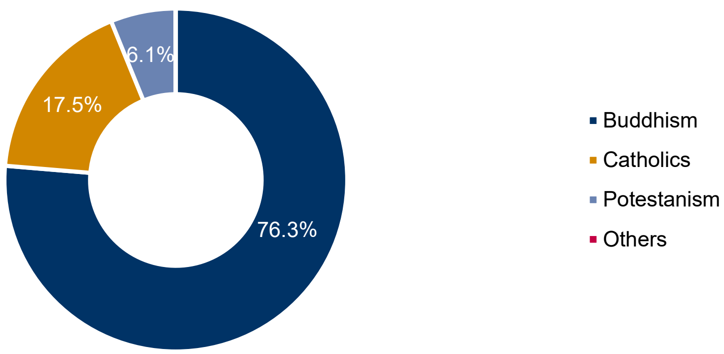
Figure 9.12 Unemployment Rate of Quang Tri Province by Year and Gender in 2010-2018

9.3.2.2 Ethnicity

Quang Tri has three main ethnic groups: Kinh, Van Kieu, and Pa Co. Ethnic minorities account for about 9% of the total population. Each ethnic minority group has a long cultural history with rich and unique traditions and folk culture. Ethnic minorities such as Van Kieu and Pa Co live mainly in mountainous districts in the west of the province, including the Huong Hoa and Dakrong districts[18].

9.3.2.3 Religion

In 2009, Quang Tri had 12 different religions with a total of 55,014 adherents, of which 44,990 were identified as Buddhist (76.3%), 9,634 as Catholics (17.5%), and 3,378 as Protestants (6.1%) (see Figure 9.13) (Central Population and Housing Census Steering Committee 2010). Only a very small number (12 out of 55,014 religious people) practice other religions such as Hoahaoism, Muslim, Caodaism, Tinh Do Cu Si Phat Hoi Viet Nam, Dao Tu An Hieu Nghia, and Ba Ha'i.



Source: Central Population and Housing Census Steering Committee (2010)

Figure 9.13 Religion Structure in Quang Tri Population in 2009

[18] Source: Photo Newspaper on Ethnicity and Mountainous Areas. 2017. General Information about Quang Tri (*Quang Tri vai net tong quan*). https://dantocmiennui.vn/xa-hoi/quang-tri-vai-net-tong-quan/172691.html (Accessed 22 March 2020).

9.3.3 Infrastructure and Public Facilities

9.3.3.1 Road Network

Quang Tri has a well-developed and convenient transport system in terms of roads, railways and waterways. Highways have been upgraded and provincial and district roads connecting urban centers have been asphalted. All communes are accessible by car throughout the year (Quang Tri Province Portal 2019).

Cua Viet Port is being upgraded to accommodate ships of up to 5,000 tons deadweight (DWT). My Thuy deep-water seaport connecting to the Southeast Economic Zone (the nearest gateway to the East Sea for the East-West Economic Corridor) has been approved by the government and is expected to accommodate ships of up to 100,000 DWT (Quang Tri Province Portal 2019).

9.3.3.2 Electricity

In October 2019, Quang Tri province had 68 wind power projects either operating, under construction, or under research and survey, with a total capacity of over 3,600 MW. Of these, the Huong Linh Wind Farm 2 is now operating, 16 projects with a total capacity of 578 MW have been approved, 45 projects with a capacity of over 2,500 MW have been submitted to the Ministry of Industry and Trade for approval, eight projects with a capacity of 400 MW have been approved by Quang Tri Provincial People's Committee for research and survey, and two projects with a capacity of 100 MW are being investigated[19].

In 2018, 99.6% of households using electricity was recorded in Quang Tri province (GSO 2019).

9.3.3.3 Water Supply

Quang Tri has three main river systems flowing to the sea: the Ben Hai, Thach Han and O Lau which provide water for production and domestic purposes. The rivers have large flows during the rainy seasons, but in the dry season some small streams and rivers are often depleted causing water shortages.

- Ground water in sedimentary and weathered strata develops in low mountains and terrain along rivers, which provides a useful water supply for production and living. The water in weathered red basalt soils has a good quality and chemical specifications, and is very valuable for people living in mountainous areas. Water exploitation is mainly from ground water wells, but with a low quality and quantity[20].
- According to the Quang Tri Statistics Office (2019), 91.5% of urban population obtained clean water from a centralised water supply system, and 98.2% of households obtained hygienic water[21] in 2018.

9.3.3.4 Irrigation System

- Quang Tri has a dense river network with an average density of 0.8-1 kilometre/km^2. The Ben Hai River system starts at a height of 1,257m with a length of 65km, and an average annual flow of

[19] Source: Minh Anh. 2019. Quang Tri: Potentials for renewable energy (*Quang Tri: Danh thuc tiem nang nguon nang luong tai tao*). https://moitruong.net.vn/quang-tri-danh-thuc-tiem-nang-nguon-nang-luong-tai-tao/ (Accessed on 17 March 2020).

[20] Source: Photo Newspaper on Ethnicity and Mountainous Areas. 2017. General Information about Quang Tri (*Quang Tri vai net tong quan*). https://dantocmiennui.vn/xa-hoi/quang-tri-vai-net-tong-quan/172691.html (Accessed 22 March 2020).

[21] Vietnam Government set targets and monitoring indicators in terms of 'hygienic', 'clean' and 'safe' water which have been subject to change. 'Clean' water is currently defined as water that meets the Ministry of Health Quality Standard QCVN 02-BYT. With lesser standards, 'hygienic' water, means water that would be safe for drinking after filtering or boiling (World Bank. 2014. Water Supply and Sanitation in Vietnam: Turning Finance into Services for the Future).

43.4 m^3/s. The Thach Han River has a length of 155km with the largest basin area of 2.660 km^2. The O Lau River has two main tributaries: the O Lau branch in the south and the My Chanh River in the north. In the west of Quang Tri province, there are several tributaries flowing west to the Mekong River system.

- Quang Tri also has a dense upstream stream network. In general, rivers and streams are widely distributed with favourable hydrological conditions provide abundant water for production and people's livelihoods (Quang Tri Province Portal 2019).

9.3.3.5 Domestic Waste Management and Drainage

- In 2018, average collected solid waste collected per day in Quang Tri was 363 tons, but 269 tons were treated in accordance with corresponding defined national criteria (GSO 2019). On December 8, 2018, the provincial People's Council issued Resolution No. 30/2018/NQ-HDND. The resolution comprises a plan to control establishments causing pollution in rural areas, and sets out goals for 2019-2021 which concentrate on controlling 75% of the areas and establishments which cause the pollution and preventing new cases from arising. The implementation of the plan is divided into two stages as follows.
- Period 2019 - 2021: Treating pollution and improving the environment for 17 areas suffering from chemical pollution. Waste treatment at four unhygienic solid waste disposal sites, including the Dong Ha, Khe Sanh, Vinh Linh, and Dakrong landfills. Treating pollution and improving the environment at Cam Thach village (Cam An commune, Cam Lo district), Linh Chieu village, and Thuong Trach village (Trieu Son commune, Trieu Phong district).
- Vision to 2025: Treating pollution and improving the environment for 19 areas contaminated by chemical pollution. Investment in construction of the Dong Ha landfill, the Khe Sanh town landfill site, and completing stage 2 investment for four landfill sites in the towns (Hai Lang, Ai Tu, Gio Linh, and Cam Lo towns). Dealing with pollution in five markets including Khe Sanh, Bo Ban, My Chanh, Cam Lo, and Cau markets. Handling pollution treatment from slaughtered cattle at the abattoir in Ward 1 (Dong Ha city); the abattoir in Ward 2 (Quang Tri town) and Khe Sanh town Abattoir Cooperative.

Through control of establishments causing environmental pollution is a long-term mission for the province, and requires increased resources to contribute to sustainable development in the area[22].

9.3.3.6 Telecommunications

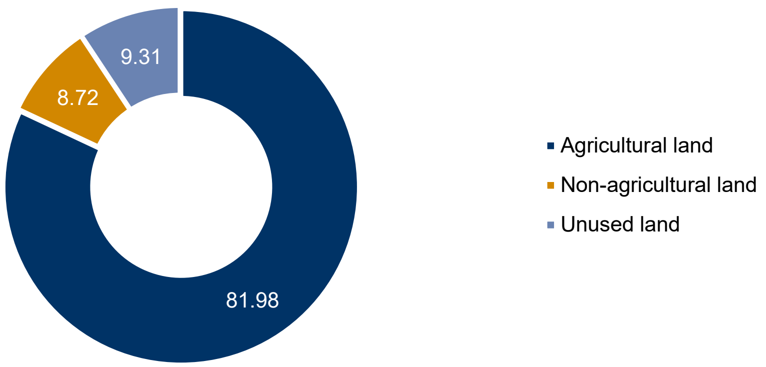
In 2018, there were 72,979 internet subscribers and 625,273 telephone subscribers recorded. Compared to 2017, the number of internet and telephone subscribers increased (9,918 and 42,836 subscribers respectively). Among 625,273 telephone subscribers, 97.7% (611,054) of subscribers were mobile phone. Telecommunication infrastructure management has been carried out in accordance with local authority regulations to ensure service quality.

Telecommunication and information technology revenue was 1,462 billion VND in 2019, up by 8.6% over 2018. The province had 178 postal service stations and 2,310 base transceiver stations (Quang Tri People's Committee 2019).

[22] Source: Phuong Tam. 2019. Quang Tri focuses on solving establishments causing serious environmental pollution (*Quang Tri tap trung nguon luc cho cong tac xu ly triet de cac co so gay o nhiem moi truong nghiem trong*). http://tapchimoitruong.vn/pages/article.aspx?item=Qu%E1%BA%A3ng-Tr%E1%BB%8B-t%E1%BA%ADp-trung-ngu%E1%BB%93n-l%E1%BB%B1c-cho-c%C3%B4ng-t%C3%A1c-x%E1%BB%AD-l%C3%BD-tri%E1%BB%87t-%C4%91%E1%BB%83-c%C3%A1c-c%C6%A1-s%E1%BB%9F-g%C3%A2y-%C3%B4-nhi%E1%BB%85m-m%C3%B4i-tr%C6%B0%E1%BB%9Dng-nghi%C3%AAm-tr%E1%BB%8Dng-50206 (Accessed 22 March 2020)

9.3.4 Land Tenure and Land Use

- As shown in Figure 9.14, the total land area in the province is 473,744 ha including 388,353 ha agricultural land, 41,306 ha non-agricultural land and 44,085 ha unused land (81.9%, 8.7%, and 9.3% respectively). Agricultural land includes land for agriculture, forestry, aquaculture and other agricultural production lands, and non-agricultural land includes land for housing, special uses, religion, cemeteries and other uses.



Source: Binh Thuan Statistics Office (2019)

Figure 9.14 Land Use Structure in Quang Tri Province 2018

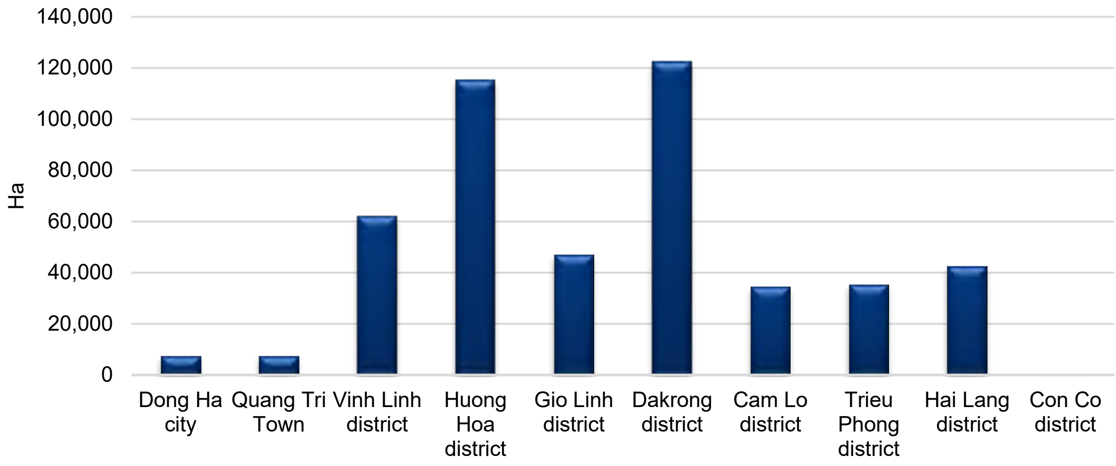
As shown in Table 9.8, forestry recorded the greatest share of land use (55.6% or 263,450 ha), while housing land had the lowest share of land use in the province (0.9% or 4,356 ha).

Table 9.8 Breakdown of Land Use Structure in Quang Tri Province 2018

	Total	Land for Agricultural Production	Land for Forestry	Special Use Land	Land for Housing
Hectare (ha)	473,744	121,807	263,450	18,478	4,356
Percentage (%)	100.00	25.71	55.61	3.90	0.92

Source: Quang Tri Statistics Office (2019)

Of a provincial total of 473,744 ha land area, Dakrong district accounts for the largest share (122,467 ha) and Huong Hoa district occupies the second largest share (115,235 ha) while the land area of Con Co island district is the lowest (230 ha) (see Figure 9.15).

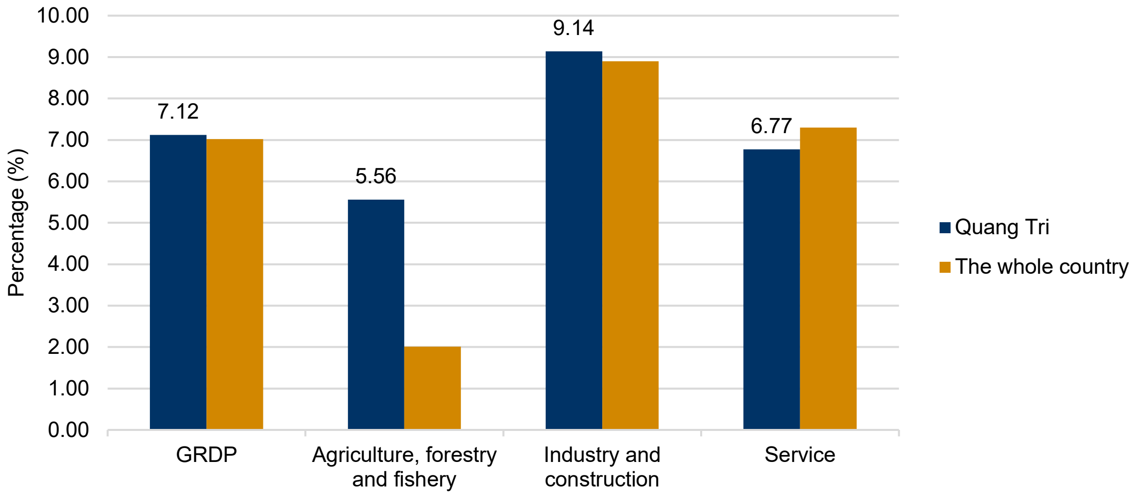


Source: Quang Tri Statistics Office (2019)

Figure 9.15 Land Area of Quang Tri Province by District in 2018

9.3.5 Economy and Industry

- Gross regional domestic production (GRDP) at current prices was 27,503 billion VND, increasing 7.1% compared to 2017. Of this, the agriculture, forestry and fishery sector is estimated at 5,687 billion VND (increasing 5.6%), the industry and construction sector is 6,642 billion VND (growing by 9.1%), and the service sector is estimated at 14,097 billion VND (expanding by 6.8%). Corresponding figures for the whole country for 2018 were 3.8%, 8.9% and 7.0%, respectively) (Quang Tri Statistics Office 2019; GSO 2019[23]) (see Figure 9.16).

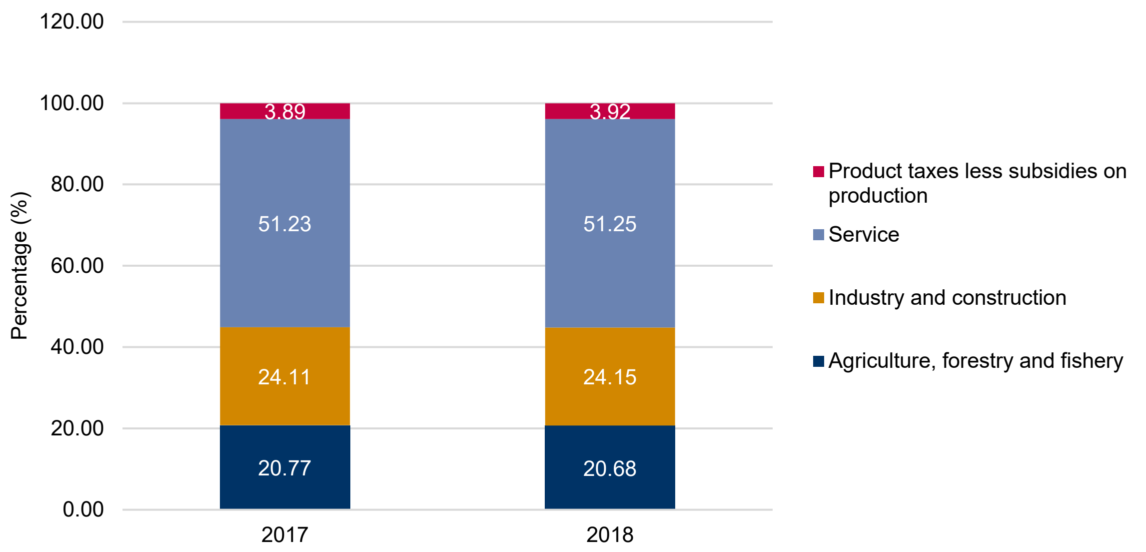


Source: Quang Tri Statistics Office (2019); GSO (2019)

Figure 9.16 Economic Growth Rate of Quang Tri Province Compared to the Whole Country 2018

The structure of GRDP for Quang Tri Province for 2017-2018 shows small increases in industry and production, service and product taxes less subsidies on production, and a slight decline in the agriculture, forestry and fishery sector (see Figure 9.17). GRDP per capita in 2018 at current prices was 43.6 million VND, up by 8.75% over 2017. The agriculture, forestry, and fishery sector made up 20.7%, industry and construction comprised 24.2%, the service sector accounted for 51.3%, and production taxes less subsidies on production was 3.9% (corresponding figures for 2017 were 20.8%, 24.1%, 51.2% and 3.9% respectively) (Quang Tri Statistics Office 2019).

[23] Source: https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=19454



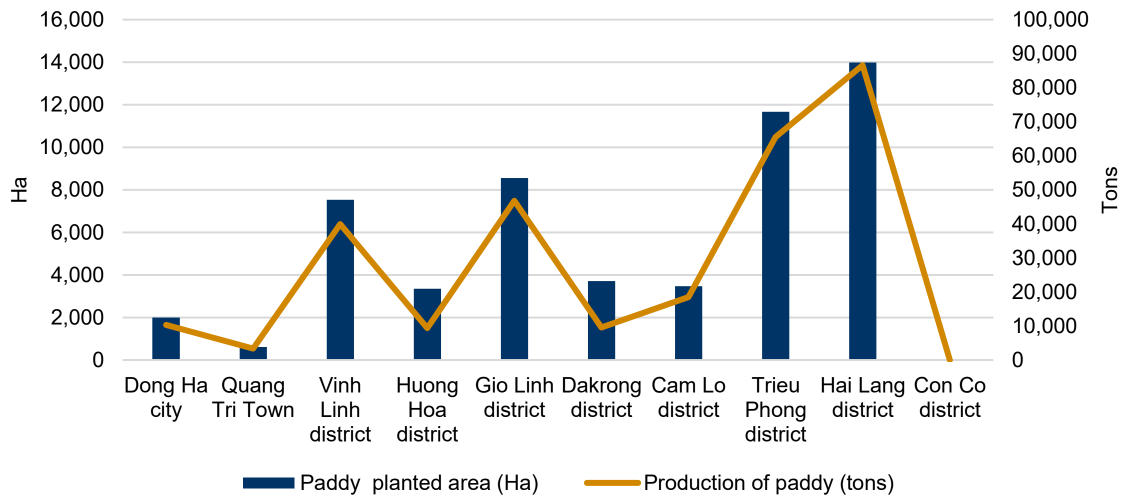
Source: Quang Tri Statistics Office (2019)

Figure 9.17 Economic Structure in Quang Tri Province 2017-2018

9.3.5.1 Agriculture, Forestry and Fishery

9.3.5.1.1 Cultivation

Paddy: According to the Quang Tri Statistics Office (2019), total cultivation area for paddy was 50,708 ha, with a harvest of 275,499 tons in 2018. Hai Lang district has the largest paddy area (13,541 ha) and also the greatest production (84,361 tons), while Quang Tri town has the lowest production area (540 ha) and production tonnage (2,939 tons) in 2018 (see Figure 9.18). There was no paddy production in Con Co island district.

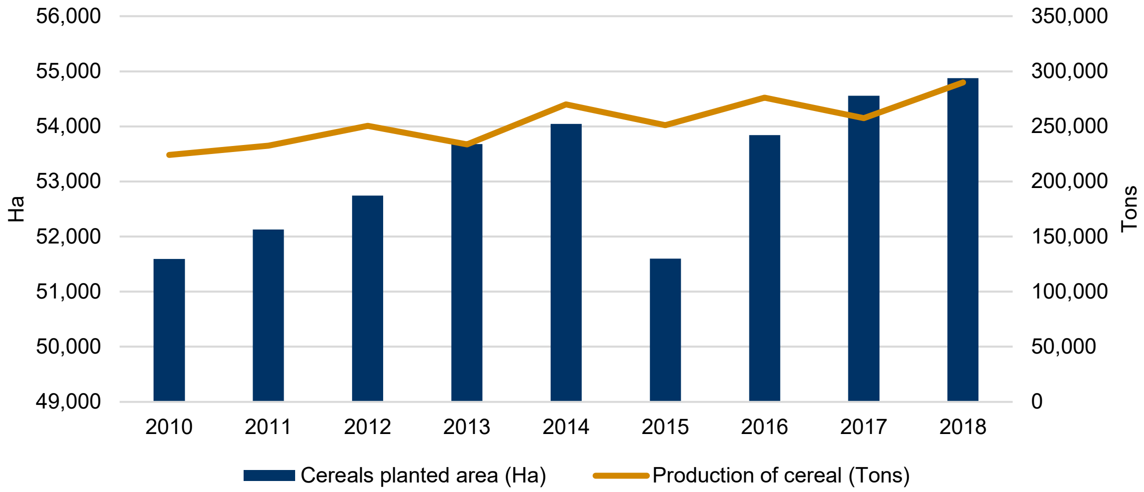


Source: Quang Tri Statistics Office (2019)

Figure 9.18 Paddy Planted Area and Production in Quang Tri Province 2018

In 2018, paddy production for the spring season was 151,813 tons, for the autumn season it was 121,587 tons, and for the winter season it was 2,099 tons (Quang Tri Statistics Office 2019).

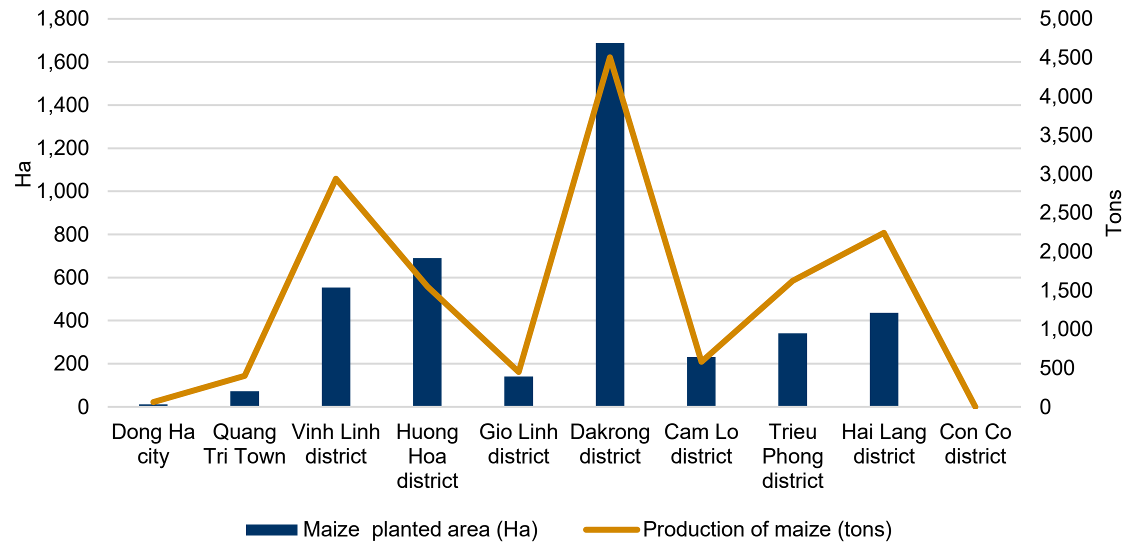
Cereals: Overall, the planted area and productions for cereals rose during 2010-2018, increasing from 224,094 tons in 2010 (51,593 ha) to 289,867 tons in 2018 (54,876 ha). During this period, the production area dropped dramatically in 2015 and increased sharply again in 2016-2018 (see Figure 9.19). In 2018, of the 289,867 tons of cereals, 275,499 tons were paddy production and 14,356 tons were from maize. There were no cultivation of cereals in Con Co island district during 2010-2018.



Source: Quang Tri Statistics Office (2019)

Figure 9.19 Cereal Planted Area and Production in Quang Tri Province 2010-2018

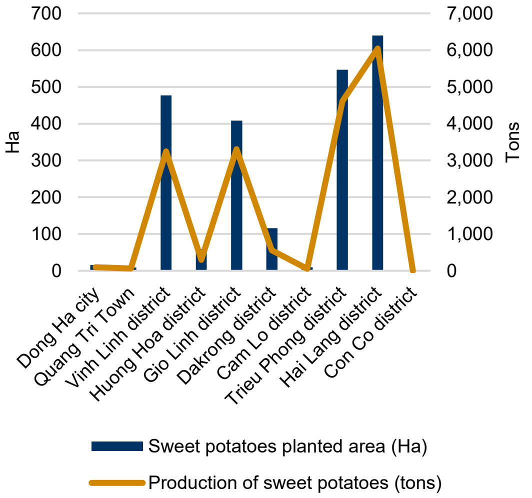
Maize: The province had a total of 4,165 ha under maize cultivation and production was 14,356 tons in 2018 (see Figure 9.20). Dakrong district has the largest area with 1,687 ha and also the top production with 4,505 tons. In contrast, Dong Ha city has the smallest cultivation area and production with 11.2 ha and 61.2 tons respectively. Again, Con Co island district has no maize agriculture in 2018.



Source: Quang Tri Statistics Office (2019)

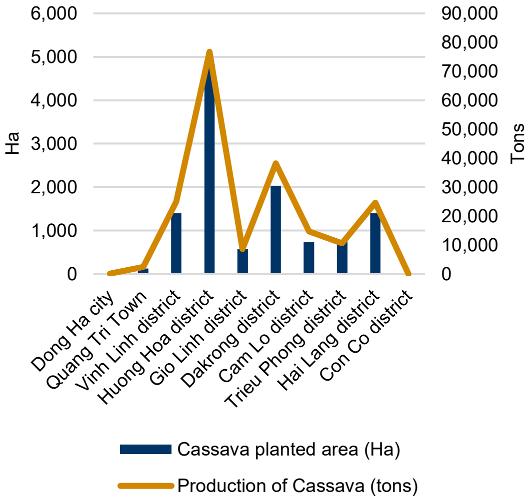
Figure 9.20 Maize Planted Area and Production in Quang Tri Province 2018

Sweet potatoes and cassava: In Quang Tri province, 2,282 ha were planted for sweet potato cultivation and 11,884 ha were used for cassava cultivation. Production in 2018 was 18,290 tons for sweet potatoes and 200,971 tons for cassava (see Figure 9.21 and Figure 9.22).



Source: Quang Tri Statistics Office (2019)

Figure 9.21 Sweet Potatoes Planted Area and Production in Quang Tri Province 2018

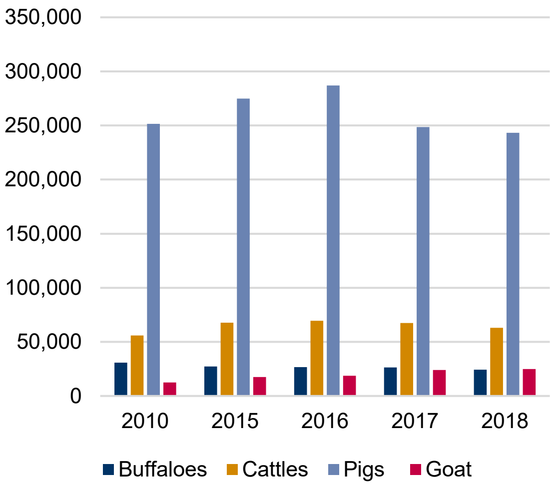


Source: Quang Tri Statistics Office (2019)

Figure 9.22 Cassava Planted Area and Production in Quang Tri Province 2018

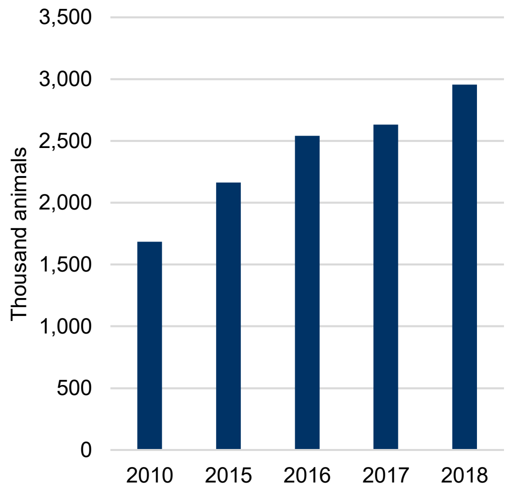
9.3.5.1.2 Animal Husbandry

Animal husbandry output decreased in 2018 in terms of buffaloes, cattle and pigs while poultry experienced a slight increase. The total number of animals was reported at 24,297 buffaloes (a fall of 7.8% compared to 2017), 62,923 cows (a fall of 6.7%), 243,243 pigs (a fall of 2.2%), 24,796 goats (an increase of 3.9%), and 2,955,300 poultry - an increase of 12.3% compared to 2017 (refer to Figure 9.23 and Figure 9.24).



Source: Quang Tri Statistics Office (2019)

Figure 9.23 Number of Buffaloes, Cattle, Pigs and Goats in Quang Tri Province 2010-2018



Source: Quang Tri Statistics Office (2019)

Figure 9.24 Number of Poultry in Quang Tri Province 2010-2018

9.3.5.1.3 Forestry

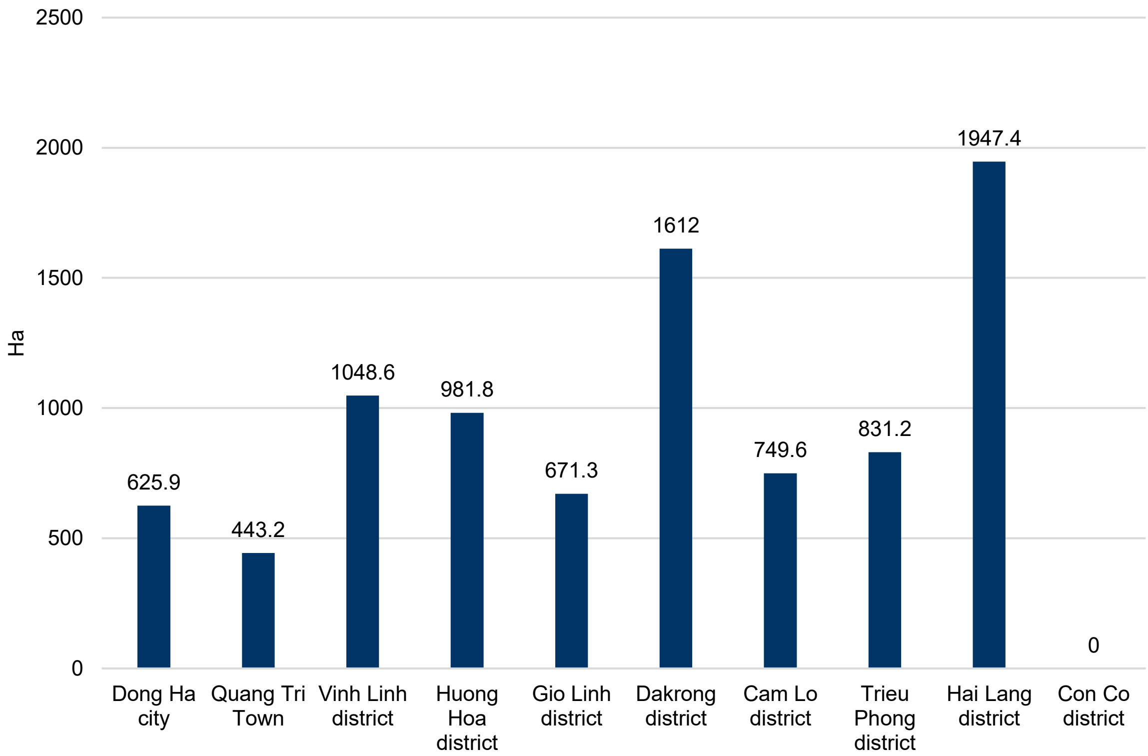
The province had a total of 8,911 ha forest land, including 8,719 ha of production forest and 191.7 ha of protected forest. No land has been used for specialised forest since 2014 (see Table 9.9).

Table 9.9 Area of Forest Land by Type of Forest

Year	Total	Production Forest	Protection Forest	Specialised forest
2010	7,439	6,023	1,415	-
2011	6,095	5,870	225	-
2012	791.8	6,445	596	50
2013	7,392	6,595	647	150
2014	7,004	5,448	1,556	-
2015	7,125	5,739	1,386	-
2016	8,453	7,678	775	-
2017	8,956	8,799	156	-
2018	8,911	8,719	191	-

Source: Quang Tri Statistics Office (2019)

Con Co island district has no forest land while Hai Lang district has the greatest area with 1,947 ha in 2018 (see Figure 9.25). Dakrong district and Vinh Linh district had the second and third largest forest area with 1,612 ha and 1,048 ha respectively.



Source: Quang Tri Statistics Office (2019)

Figure 9.25 Area of Forest Land by District in 2018

In 2019, area of newly concentrated plantation forests was 9,320 ha, an increase of 4.6% over the previous year and the output of exploited timber was 945,000m^2, an increase of 14.8%. The rate of forest cover remained stable, above 50% (Quang Tri People's Committee 2019).

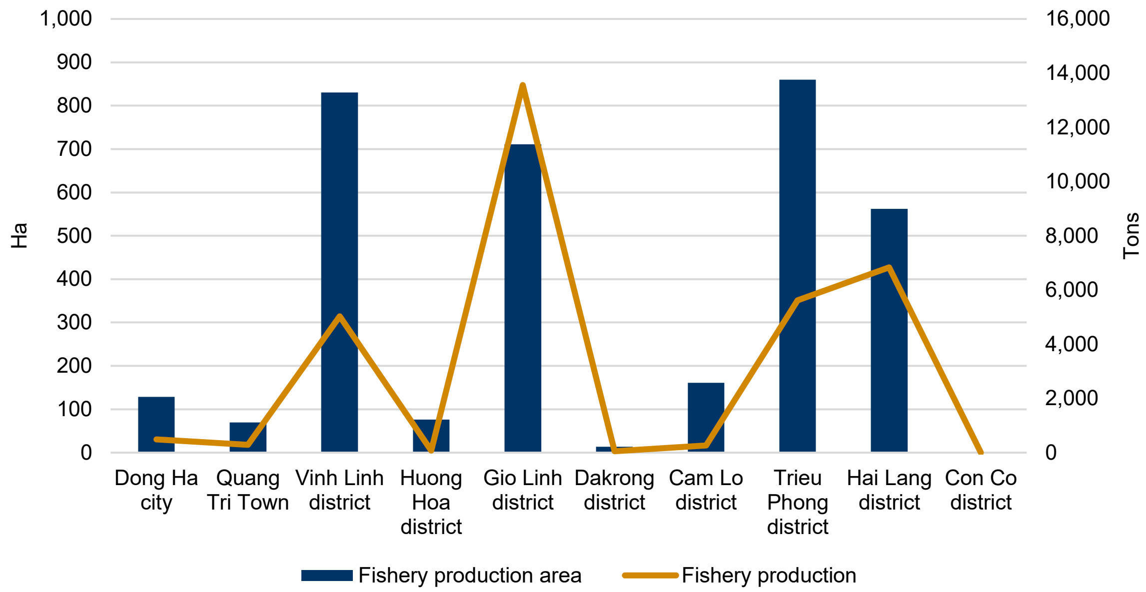
Aquaculture

The total area of aquaculture in the province was 3,412 ha in 2018. Fishery production increased significantly over the period 2010-2018, from 24,668 tons in 2010 to 32,216 tons in 2018 (see Table 9.10). There was no fishery production in Con Co district. Gio Linh and Hai Lang districts recorded the highest fishery production in 2018 with 13,562 and 6,840 tons respectively (see Figure 9.26).

Table 9.10 Fishery Production in Quang Tri Province 2010-2018

	2010	2015	2016	2017	2018
Catch (tons)	16,898.9	25,432.2	15,723.9	23,425.5	24,192.0
Aquaculture (tons)	7,769.3	8,464.0	8,071.0	7,354.5	8,024.0
Total	**24,668.2**	**33,896.2**	**23,794.9**	**30,780.0**	**32,216.0**

Source: Quang Tri Statistics Office (2019)



Source: Quang Tri Statistics Office (2019)

Figure 9.26 Fishery Area and Production in Quang Tri Province by District in 2018

In 2019, with the implementation of aquaculture development policies, the total area of aquaculture of the province continuously increased to 3,450 ha, up by 1.1% from 2018 and fishery production was 35,250 tons, up by 9.4% over 2018 (Quang Tri People’s Committee 2019).

9.3.5.2 Industry

In 2018, industrial production continued to grow but at a much slower rate than in 2017 due to the slowdown in manufacturing and processing industry. In 2018, the index of industrial production increased by 9.2% over the previous year (compared to an increase of 15% in 2017). Of this industry, mining increased by 11.1%, processing and manufacturing increased by 7.4%, electricity production and distribution increased by 17.4% and water supply, waste treatment, and wastewater increased by 8.9% (Quang Tri Statistics Office 2019).

In 2019, eight large-scale projects was licensed and put into operation with total investment of 5,120 billion VND. These projects included Huong Linh 1 wind farm project (see Figure 9.27), DaKrong 4 hydropower project, quartz sand processing plant, and other manufacturing projects (Quang Tri People’s Committee 2019).

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.27 Huong Linh 1 Wind Farm Project under Operation Phase

Wind Power Development and Planning: As described in the Decision 6185/QĐ-BCT dated 19/6/2015 by the Ministry of Industry and Trade on "Wind power planning in Quang Tri until 2020, vision to 2030", the province has three regions (6,707 ha) planned for wind power development (see Table 9.11). It is stated in this Decision that four wind power projects are located in Huong Hoa District to produce 110 MW by 2020. They include Huong Phung 1 (30KW), Huong Phung 2 (20KW), Huong Linh 1 (30KW) and Huong Linh 2 (30KW).

Table 9.11 Wind Power Planning in Quang Tri until 2030

Region	Communes	Area (ha)	Annual Average Wind Speed
1	Huong Son, Huong Lap and Huong Phung Communes, Huong Hoa District	2,789	More than 7 m/s
2	Huong Linh, Huong Lap, Huong Hiep Communes, Huong Hoa District	2,882	6 – 7 m/s
3	Gio Viet, Gio Hai, Gio Thanh Communes, Gio Linh District; Vinh Tan Commune and seawater surface areas of Vinh Ninh and Con Co Districts	1,036	Approximately 6 m/s

Source: Decision 6185/QD-BCT dated 19 June 2015 by the Vietnam's Ministry of Industry and Trade

Minerals: There is good quality limestone in Tan Lam and Ta Rung with large reserves (over three billion tons) and titanium in Vinh Linh, Gio Linh. The quartz sand mines in the south (north of Cua Viet and Hai Lang regions) have a total reserve of up to 277 million tons. These provide the raw material for producing high-class glass, ceramics, construction additives and materials, optical cables and liquid crystal displays, fiberglass from silicate powder and ceramics (Quang Tri Statistics Office 2019).

Gas: According to the development direction for Vietnam's gas industry (Decision No. 60/QD-TTg on January 16th, 2017, of the Prime Minister), the Bao Vang gas field in Quang Tri will be developed with a system of pipelines and a gas treatment factory at a scale of 2-3 billion m^3/ year (Quang Tri Statistics Office 2019).

9.3.5.3 Trade and Tourism

The retail market for consumer goods and services in 2018 fluctuated significantly, and the province attracted a large number of visitors with many successful political and cultural events. With stable prices and a diversity of goods, retail sales of goods and services increased over the same period from last year. Preliminary figures for 2018 showed retail sales of consumer goods and services at 27,172 billion VND and a growth of 10.4%. Retail sales of goods was 22,986 billion VND (accounting for 84.6% of the total and increasing by 10.3%); accommodation and catering revenue was 2,807 billion VND, accounting for 10.3% of and increasing by 11.8%); tourism revenue was 31.6 billion VND (0.1% of the total and up by 9.0%), and other service revenue was 1,347 billion VND, 4.7% of the total and up by 8.2% (Quang Tri Statistics Office 2019).

According to the report from Quang Tri People's Committee (2019), in 2019 accommodation and catering revenue was 3,135 billion VND (up by 11.1% from 2018) and tourism revenue was 35.2% billion VND (up by 11.4% from 2018).

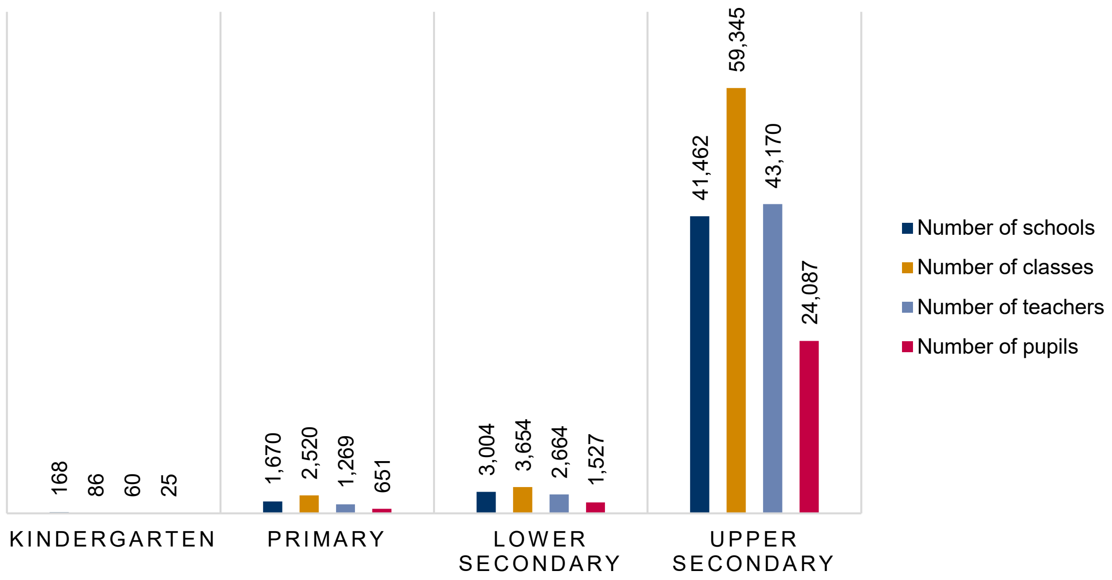
Transport business activities in the province have maintained a relatively high growth rate. Overall, transport revenue in 2019 was 1,510 billion VND (an increase of 10.9% over the previous year), the number of passengers was 7,789 thousand passenger-kilometres (up by 3.9%), and the amount of freight was 9,699 thousand tons, an increase of 5.6% (Quang Tri People's Committee 2019).

The number of overnight visitors in 2019 was two million, with growth of 11.4% over the previous year. Of which, the number of foreign visitors was 176,000, up by 4.7% over 2018 and the number of domestic visitors was 1.9 million, an increase of 11.5%[24].

9.3.6 Education

In the school year 2018-2019, Quang Tri had 168 kindergartens, 86 primary schools, 60 lower secondary schools, 25 upper secondary schools, 67 primary and lower schools and five lower and upper secondary schools. There were 195/411 schools meeting national standards, accounting for 47.5% (Quang Tri People's Committee 2019). The province also has three professional secondary schools with 60 teachers and 502 students, two colleges with 119 teachers and 1,099 students, and one university with 44 teachers and 198 students. The number of schools, classes, teachers, and pupils for the school year 2018-2019 are presented in Figure 9.28.

[24] Source: Thuy Bich. 2019. Quang Tri: Setting a goal of 2.3 million visitors in 2020 (*Quang Tri: Dat muc tieu da hon 2.3 trieu luot khach du lich nam 2020*). http://toquoc.vn/quang-tri-dat-muc-tieu-dat-hon-23-trieu-luot-khach-du-lich-nam-2020-20191031171938609.htm (Accessed 22 March 2020).

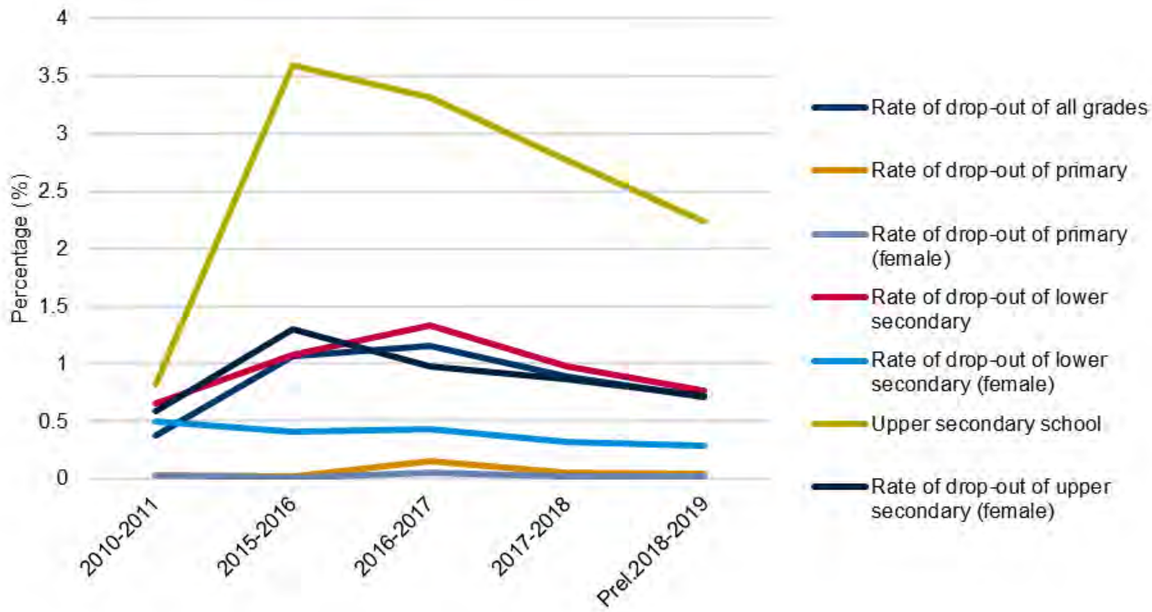


Source: Quang Tri Statistics Office (2019)

Figure 9.28 Number of Schools, Classes, Teachers, and Pupils in Quang Tri Province for the School Year 2018-2019

In the school year 2018-2019, there were 25 pupils per class in kindergarten schools, 24 pupils per class in primary schools, 34 pupils per class in lower secondary schools, and 37 pupils per class in upper secondary schools. The average number of pupils per teacher in primary schools, lower secondary schools and upper secondary schools had the same figure of 16 (Quang Tri Statistics Office 2019).

The rate of drop-outs has gone up from 0.4% in 2010-2011 to 0.7% in 2018-2019, with the rate of drop-out increasing dramatically for upper secondary levels of education (from 0.8% in 2019-2011 to 2.2% in 2018-2019). The drop-out rate of all grades reached a peak of 1.2% in the school-year 2016-2017 but showed a downward trend for the school year 2018-2019 with 0.7% (see Figure 9.29).



Source: Quang Tri Statistics Office (2019)

Figure 9.29 School Drop-out Rates in Quang Tri Province 2010-2018

The enrolment rate for general education was 91.4%, with females at 94% in 2018. The percentage of graduates in upper secondary education in 2017-2018 was 94.8% with female participation at 97.6%.

There were 60 scientific and technological organisations in the province in 2018, including two education and training establishments, and 58 scientific and technology service organisations. In addition, Quang Tri has four vocational schools and several vocational guidance centers meeting the demand for vocational training for production and business in local area. In particular, in 2018 the Ischool Quang Tri International Integration School was built and started operating, and will offer the highest standards of the International Ischool education system (Quang Tri Statistics Office 2019).

9.3.7 Health

Local health care services are reported to meet the basic health care needs of people in the province and the region. There has been continuing investment in medical equipment, and improving the ethics and professional skills of the health care work force. The province had 162 health establishments with a total of 2,821 beds. This includes 11 hospitals, one sanatorium and rehabilitation hospital, seven regional polyclinics, 141 commune-level health stations, and two others. The rate of communes and wards in the province with doctors was 90. 8% and in 2018, the province had 2,779 medical staff including 610 doctors, 269 physicians, 827 nurses, 385 midwives, 220 medical technicians, 468 others, and 211 pharmaceutical staff. The number of doctors per 10,000 inhabitants was 9.7 person and the rate of fully vaccinated children under-one-year was 98.1% (Quang Tri Statistics Office 2019).

In 2018, the rate of communes and wards meeting national health standards was 97.9%, with 100% having midwives and eight cities/town/districts out of ten administrative units meet national health standards. The province recorded 225 HIV infected persons and 68 persons suffering from AIDS in 2018, and there were eight new cases of HIV infected persons and three new cases of AIDS in 2018 (Quang Tri Statistics Office 2019).

Table 9.12 Statistics on Health Services in Quang Tri Province 2018

	Number
Total health care establishments, including:	**162**
Hospital	11
Sanatorium and rehabilitation hospital	1
Regional polyclinic	7
Health stations in communes, precincts	141
Others	2
Total personnel, including:	**2,990**
Medical staff	2,779
Pharmaceutical staff	211
Beds	**2,821**

Source: Quang Tri Statistics Office (2019)

According to the report from the Quang Tri People's Committee (2019), the rate of people with medical insurance was 95.5% and the rate of under-five-year-old malnutrition declined to 13.5% in 2019.

9.3.8 Security and Rule of Law/Governance

In 2018, there were 188 traffic accidents in Quang Tri province, causing 116 deaths and 146 injuries. Compared to the figures for 2017, the number of traffic accidents declined by 9.2%, the number of deaths fell by 3.3%, and injuries went down by 20.7%. There were 67 fire and explosion incidents, causing five injuries and no deaths. There were eight deaths and 760 houses damaged by natural disasters in 2018 and agriculture was also affected in terms of rice and vegetable production. Total financial loss caused by disaster was 122.1 billion VND in 2018 (Quang tri Statistics Office 2019).

With regard to judicial activities, there were 299 prosecution cases with 480 defendants, and 290 cases were prosecuted (472 defendants). Some 287 cases were sentenced (470 criminals) and 66 people received legal aid (Quang Tri Statistics Office 2019).

9.3.9 Vulnerability

According to Decision 582/QD-TTg dated 28/4/2017 by the Prime Minister, communes of ethnic minority and mountainous areas are defined in three zones. Zone III communes are the most vulnerable communes in terms of socio-economic development; Zone II communes has difficulties but temporarily stable socio-economic conditions; Zone I communes are the remaining. Quang Tri province has six Zone I communes, 15 Zone II communes and 26 Zone III communes with 213 villages categorised “with special difficulties” (see Figure 9.16).

Table 9.13 Number of Villages “with Special Difficulties” in Quang Tri

Zoning	Number of Communes	Number of Villages Categorised “With Special Difficulties”
Zone I	6	0
Zone II	15	29
Zone III[25]	26	184
Total	**47**	**213**

Source: Decision 582/QĐ-TTg dated 28/4/2017 by the Prime Minister

According to the Quang Tri Statistics Office (2018)[26], the poverty rate across the province decreased by 1.8% (decreased by 2,940 households). At the end of 2018, there were 16,601 poor households in the province, which was 9.77% of the total number of households. The number of poor households in Dakrong district decreased by 480 households (5%) and at the end of 2018, there were only 4,006 households (40.6%).

Quang Tri achieved significant results in reducing the poverty rate from 13.5% in 2010 (using the Government’s poverty line) to 9.77% in 2018 (according to the multi-dimension poverty rate). This rate

[25] Zone III communes have at least four out of five criteria as follows: (i) Number of extremely difficult villages is 35% and above (compulsory criteria); (ii) The rate of poor and near poor households is 45% and above; in which the rate of poor households is 20% and above; (iii) Satisfying at least three out of five following conditions: Communal or inter-commune roads are not concreted; At least one village is not connected to the national electricity grid; Lack of primary classrooms or village classrooms as regulated by the Ministry of Education and Training; Communal health station does not satisfy requirements of the Ministry of Health; Communal culture house does not satisfy requirements of the Ministry of Culture, Sports, and Tourism; (iv) Having at least two out of three following conditions: From 30% of households do not access clean water; The rate of untrained laborer is over 60%; Over 50% of specialized cadres and communal civil servants do not satisfy qualification requirements as regulated; and (v) Having at least two out of three following conditions: 20% of households lack production areas as regulated; Lack of qualified agriculture, forestry, fishery extension officer; Below 10% of households work in the non-agriculture field.

[26] Source: http://cucthongke.quangtri.gov.vn/News/?ID=473

is however higher than the rate for the whole country (6.8%) and the rate for the North Central and Central coastal areas (8.7%).

9.3.10 Archaeological, Cultural Heritage, and Religious Sites

Quang Tri is well-known for its historical relics. These include the Quang Tri Ancient Citadel, the Hien Luong bridge on the Ben Hai river, Road 9 (Khe Sanh), the Ho Chi Minh trail, the Vinh Moc tunnels, Ta Con airport, McNamara line, Lao Bao prison, Con Co island with the Truong Son Military Cemetery, and the National Road 9 Military Cemetery (see Figure 9.30). This makes Quang Tri's war relic collection a unique attraction for the province (Quang Tri Statistics Office 2019).

In addition, Quang Tri also has many beautiful landscapes such as Tram Tra Loc, Ru Linh ancient forest, the Brai cave, and Mui Treo-Ru Bau and many beautiful beaches such as Cua Tung, Cua Viet, and Vinh Thai which are special because of their white sand and clean water (Quang Tri Statistics Office 2019).

Quang Tri also has many unique spiritual and cultural relics, folk festivals, and revolutionary festivals. The Sac Tu Temple is one of the oldest temples in Central Vietnam and the Pilgrimage Center of Our Lady of La Vang attracts thousands of worshipers and tourists to the province. Quang Tri also has many well-known tours including the "Central Heritage Road", "The legendary path" and "Nostalgia for the battlefield and comrade in the wartime" (Quang Tri Statistics Office 2019).

Figure 9.30 Pilgrimage Center of Our Lady of La Vang[27] and Quang Tri Ancient Citadel[28] (Left to Right)

9.4 Local Context – District Level: Huong Hoa District

9.4.1 Overview of Huong Hoa District

Huong Hoa is a mountainous district in the west of Quang Tri province and is one of the ten administrative units of the province (see Figure 9.31). The district is about 65 kilometres from Khe Sanh town which is the district center. Huong Hoa is bordered by Quang Binh province to the north, by the People's Democratic Republic of Laos to the south and west, and by Do Linh, Vinh Linh and Dakrong districts to the east. Its geographical coordinates are N16°42' latitude and W106°42' longitude[29].

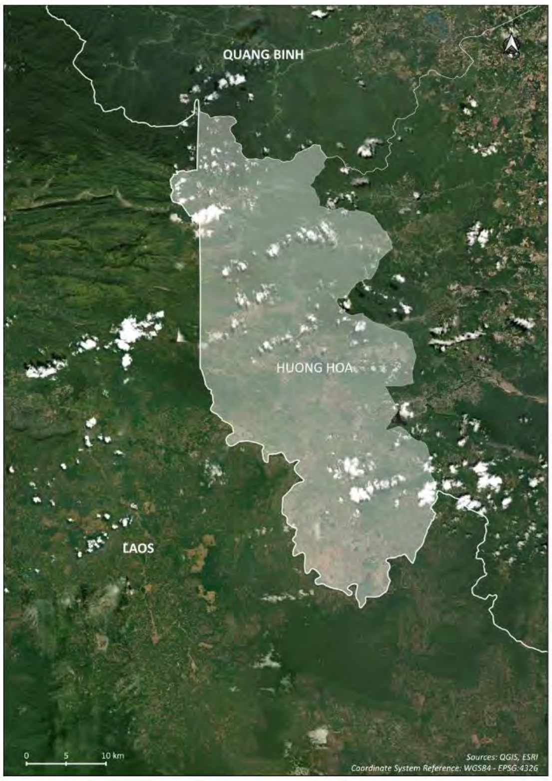
[27] Source: https://medium.com/@infoexplorevietnam/quang-tri-ancient-citadel-the-great-evidence-for-vietnam-war-c62c44865618

[28] Source: https://huesmiletravel.com.vn/blog/779-thanh-dia-la-vang

[29] Source: https://vi.wikipedia.org/wiki/H%C6%B0%E1%BB%9Bng_H%C3%B3a

HUONG HOA DISTRICT

Number of townships	**01 (Khe Sanh and Lao Bao)**
Number of communes	**20**
Area	**1,152 km² (2018)**
Population	**87,782 people (2018)**
Population density	**76,2 people/km² (2018)**
Poverty proportion	**4,708 households (2019)**
Ethnic groups	**Kinh, Van Kieu, Pa Co**



Source: Huong Hoa Statistics Office (2019); Huong Hoa People's Committee (2019)

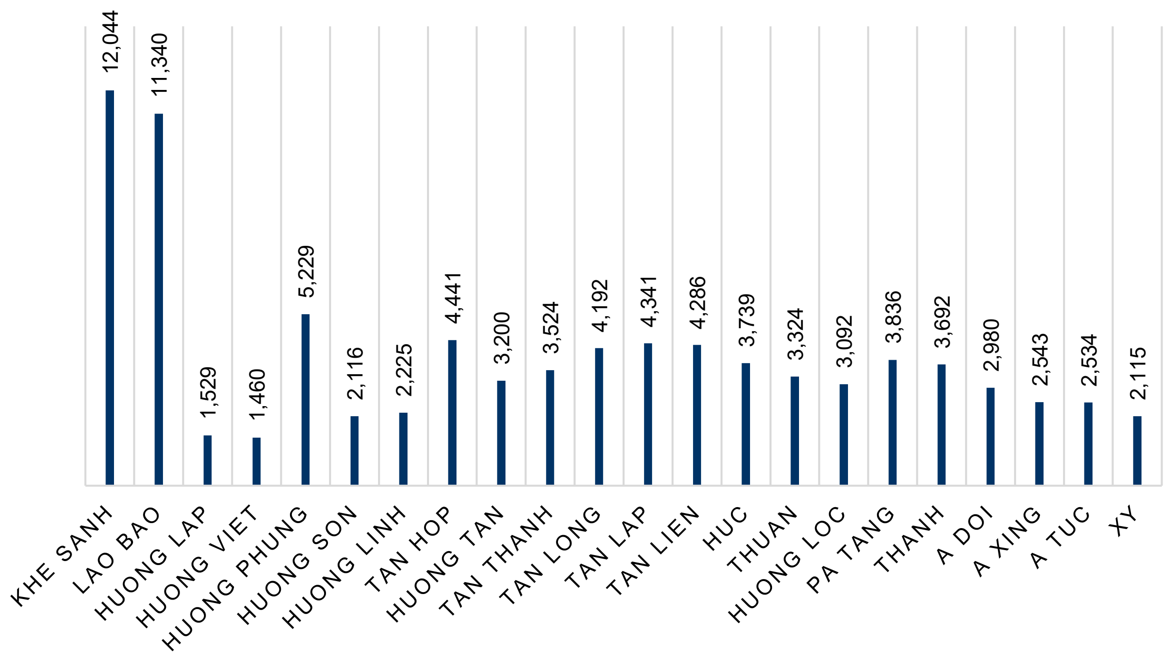
Figure 9.31 Huong Hoa District at a Glance

The whole district has 22 administrative units including two towns (Khe Sanh and Lao Bao) and 20 communes (Tan Hop, Tan Lien, Tan Lap, Tan Long, Tan Thanh, Thuan, Xy, Thanh, A Xing, A Tuc, Huong Loc, Pa Tang, A Doi, Huong Tan, Huc, Huong Linh, Huong Son, Huong Phung, Huong Viet and Huong Lap). Of those 20 communes, 13 are classified as extremely difficult and 11 communes have a border with Laos. There were no changes to the Huong Hoa administrative units during 2010-2018 (Huong Hoa Statistics Office 2019).

9.4.2 Population, Ethnicity and Religion

According to the Huong Hoa Statistics Office (2019), the population of the district by towns/communes was 87,782 people in 2018. The population density was 76.2 people per km^2 in a district area of 1,152 km^2. The highest population densities were at Khe Sanh (935.8 people/km^2) and Lao Bao (660.5 people/km^2), while the lowest were at Huong Lap commune with 9.5 people/km^2.

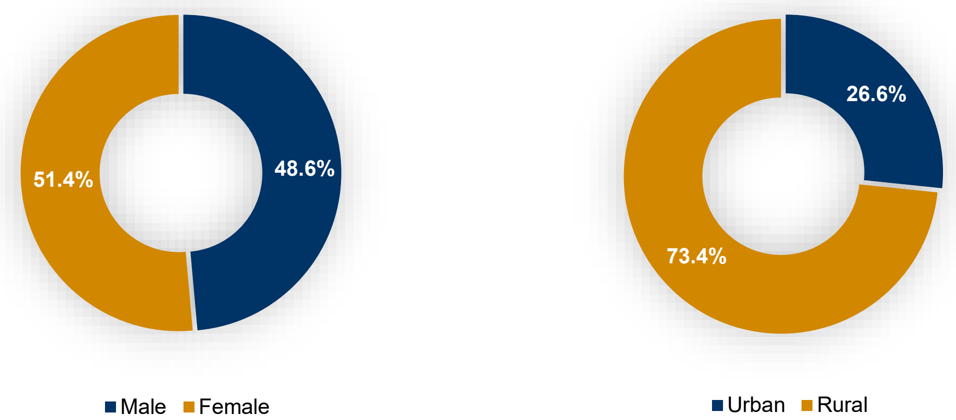
As shown in Figure 9.32, the majority of the population is concentrated in two towns (Khe Sanh and Lao Bao) with 12,044 people and 11,340 people respectively. Next in line are Huong Phung commune (5,229 people) and Tan Hop commune (4,441 people). Huong Lap and Huong Viet communes have the lowest populations with 1,529 people and 1,460 people respectively (Huong Hoa Statistics Office 2019).



Source: Huong Hoa Statistics Office (2019)

Figure 9.32 Average Population of Huong Hoa District by Town/Commune in 2018

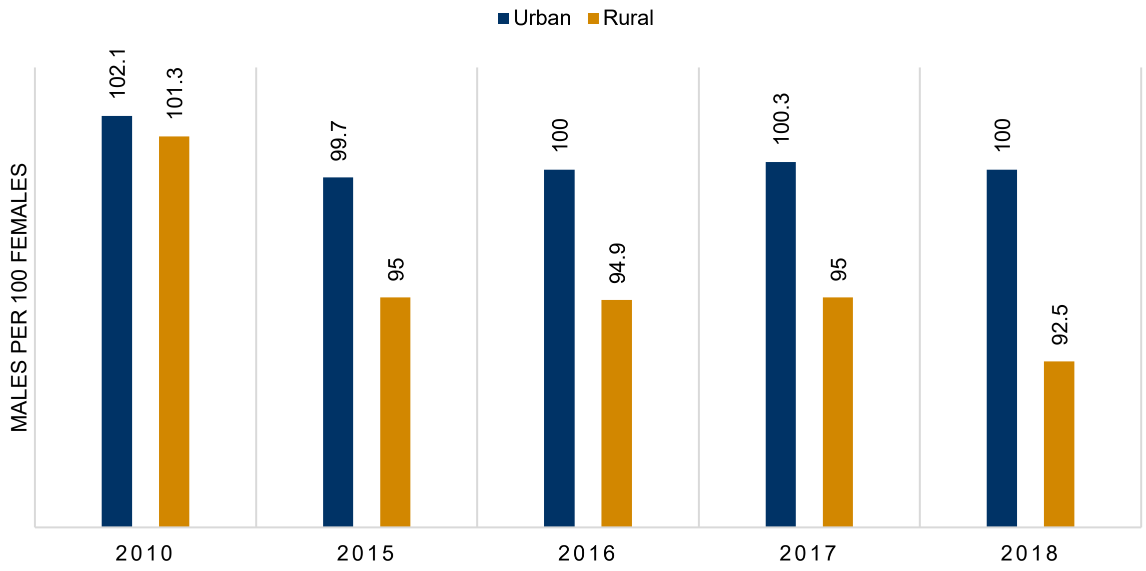
The whole district has 87,782 people, with 45,144 females and 42,638 males (51.4% and 48.6% respectively). As shown in Figure 9.33, the majority of the population is rural with 64,397 persons (73.4%), while the remainder are urban with 23,385 persons (26.6%).



Source: Huong Hoa Statistics Office (2019)

Figure 9.33 Population of Huong Hoa District by Gender and Residence in 2018

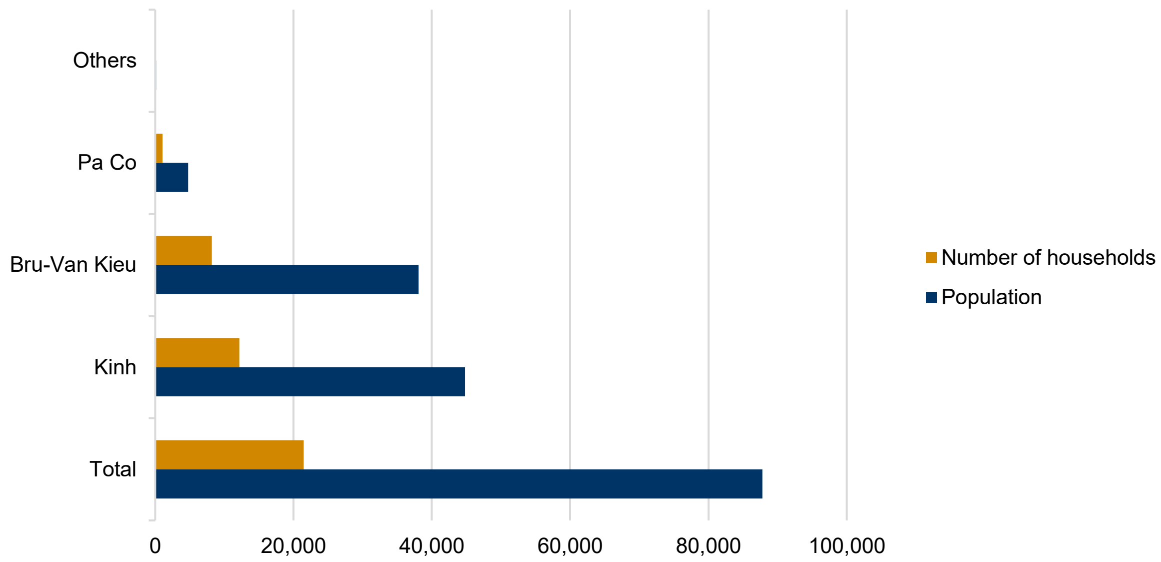
Figure 9.34 shows the gender difference between rural and urban areas in Huong Hoa district during 2010-2018. In 2010, the proportion of males in both regions was similar with 102.1 males in rural areas and 101.3 males in urban areas, but there was a wider gap by 2015-2018 with figures of 100 males in rural areas and 92.5 males in urban areas at the end of the period.



Source: Huong Hoa Statistics Office (2019)

Figure 9.34 Population Sex Ratio of Huong Hoa District by Residence in 2010-2018

As Table 3.6 shows there are 21,451 households in the district with 87,782 people. The ethnic groups comprise 12,159 Kinh households (44,810 people), 8,211 Bru-Van Kieu households (38,091 people), 1,057 households of Pa Co group (4,755), and 24 households of other ethnic minority groups (126 people). The Kinh people are mainly found in Khe Sanh and Lao Bao towns with 2,689 households and 2,496 households respectively, but there are no Kinh people recorded in Thanh commune. Most of the Van Kieu people live in Huc commune (765 households) and there are only 46 households living in Tan Hop commune. Most of the Pa Co people live in A Xing commune (486 households), while the other ethnic minority communities are mainly located in Tan Hop with six households (Huong Hoa Statistics Office 2019).



Source: Huong Hoa Statistics Office (2019)

Figure 9.35 Population and Number of Households by Ethnic Group in Huong Hoa District 2018

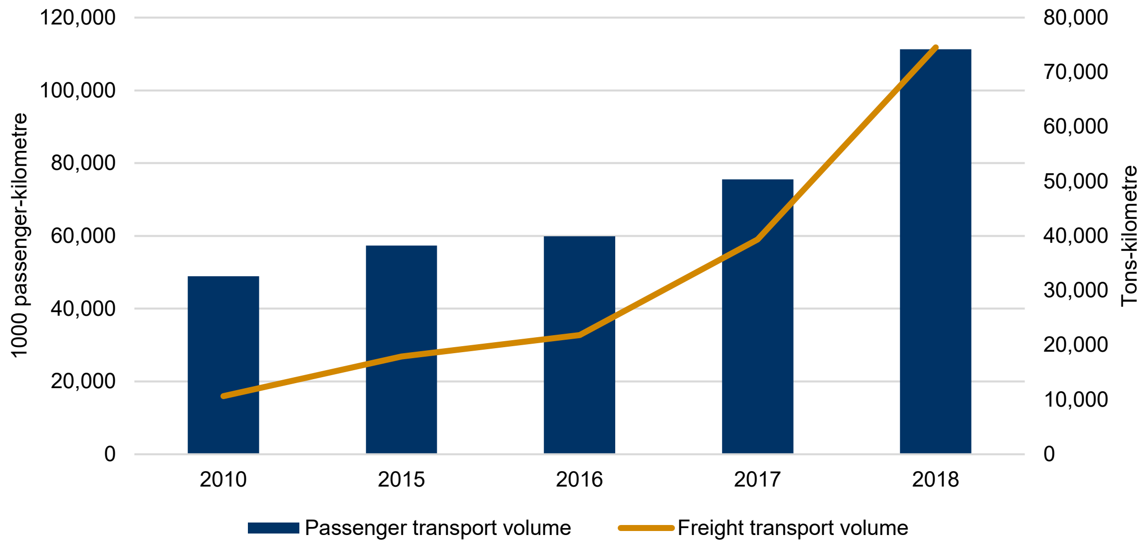
9.4.3 Infrastructure and Public Facilities

9.4.3.1 Road and Transportation

Huong Hoa district has a number of major routes including National Road 9, the Ho Chi Minh Road, Provincial Road 586, and the urban and rural road system. National Road 9A connects Vietnam with Lao and is entirely within Quang Tri province. In 2019, the district upgraded and repaired routes with funding from State Program 135 and planned to carry out regular maintenance to communal and district routes.

Transport volumes are the total movement of passengers and freight using road transport on a given network. Figure 9.36 is expressed in thousand passenger-kilometres (p.km) and ton-kilometres (tons.km), which represent the transport of passengers and freight over one kilometre.

Overall, passenger transportation in the district shows an upward trend from 2010-2018. In 2010, the number of passengers transported was 48,895 p.km and increased to 111,342 p.km in 2018 (a growth index of 47.4%). Freight transport increased similarly from 10,652 tons.km in 2010 to 39,364 tons.km in 2017 then rising rapidly to 74,543 tons.km in 2018, growth index of 89.4%. There were no inland waterway transport activities in the district.



Source: Huong Hoa Statistics Office (2019)

Figure 9.36 Passenger Transport and Freight Transport Volume in Huong Hoa District 2010-2018

9.4.3.2 Electricity

There are many wind power projects under construction in the district, including one in Huong Linh and Huong Tan communes with a capacity of 48MW, another in Tan Thanh and Huong Tan communes with capacity of 48MW and a project in Tan Thanh and Huong Phung communes with a capacity of 48MW[30]. Wind power is considered as a good option for developing clean energy while minimising impacts on

[30] Source: Nguyen Tuan. 2020. Quang Tri starts three wind power projects with total investment of nearly 5,000 billion VND (*Quang Tri khoi cong ba du an dien gio voi tong muc dau tu gan 5000 ty dong*) https://congthuong.vn/quang-tri-khoi-cong-3-du-an-nha-may-dien-gio-voi-tong-muc-dau-tu-gan-5000-ty-130944.html (Accessed 22 March 2020).

the environment, water sources and emissions. Wind power is also a practical solution which can enhance people's lives in the project areas[31].

9.4.3.3 Water Supply and Irrigation System

The district has abundant water sources from rivers such as the Se Pang Hieng, Se Pon, and Rao Quan and from ponds, streams, and underground water which meet people's needs for living and production. The Ha Rao Quan and La La hydropower projects are also under construction and will create favourable conditions for hydropower in the district with a better irrigation system for local agricultural production[32].

According to the report by Quang Tri People's Committee (2019), 75.2% of households accessed hygiene water and 64.4% of households used clean water in 2019.

9.4.3.4 Domestic Waste Management and Drainage

The Urban and Environment Center is responsible for solid waste collection and treatment in Huong Hoa district. Solid waste collection and management is implemented in seven out of 22 communes and towns with a total collected volume of 18,542 ton solid waste per year. According to the report by Huong Hoa People's Committee (2020), the rate of solid waste collection and treatment is 39.3%. Solid waste management is carried out in communes in the district center and along National Road 9, but is not conducted in remote communes because of the higher costs.

Huong Hoa has landfills in Khe Sanh and Lao Bao towns which are managed by the Urban and Environment Center. Both landfills do not meet technical and environmental standards and the landfill in Khe Sanh causes serious environmental pollution and has to be closed under the Prime Minister's Decision No. 1788/QD-TTg.

Solid waste collection and management is funded by fees from organisations, households and individuals and through funding by the State.

9.4.4 Land Tenure and Land Use

Of the district's 115,236 ha, 80% (92,241 ha) was used for agriculture, 4% (4,647 ha) for non-agricultural use and 15.9% (18,348 ha) was unused land (see). Agricultural land includes land for agriculture, forestry, aquaculture and other agricultural activities, while non-agricultural land includes land for housing, religion, special uses and other uses.

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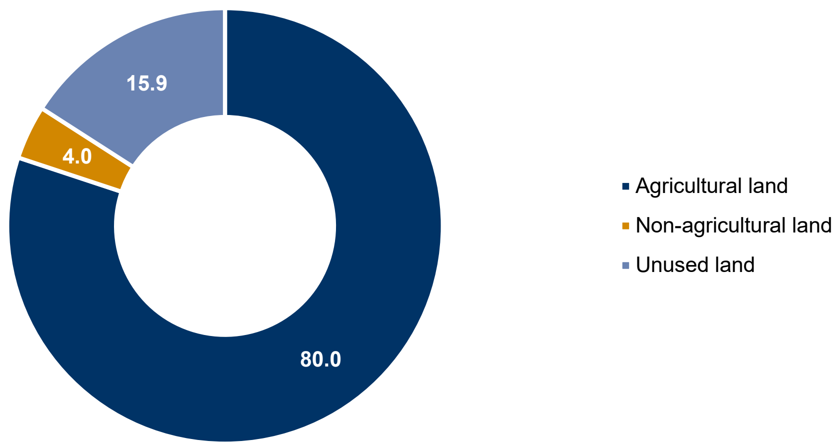
[31] Source: Bich Lien and Khanh Hung. 2019. Huong Hoa focuses on attracting investment in wind power farms (*Huong Hoa: Chu trong keu goi dau tu vao nang luong dien gio*). http://huonghoa.quangtri.gov.vn/Kinh-te-Thi-truong/huong-hoa-chu-trong-keu-goi-dau-tu-vao-nang-luong-dien-gio-945.html (Accessed 22 March 2020).

[32] Source: Huong Hoa District Portal. 2020. Introduction about Huong Hoa (*Gioi thieu chung ve huyen Huong Hoa)*. http://huonghoa.quangtri.gov.vn/about/Gioi-thieu-chung-ve-huyen-Huong-Hoa.html (Accessed 22 March 2020).



Source: Huong Hoa Statistics Office (2019)

Figure 9.37 Land Use Structure in Huong Hoa District 2018

As shown in Table 9.14, for the district total of 94,177 ha land in use, forestry comprises the largest proportion (65.2% or 61,370 ha) while aquaculture occupies the lowest (0.1% or 108 ha). Agricultural production also comprises a significant proportion of land use with 32.7% or 30,759 ha.

Table 9.14 Breakdown of Land Use Structure in Huong Hoa District 2018

	Land for Agricultural Production	Land for Forestry	Land for Aquaculture	Special Use Land	Land for Housing	Total
Hectare (ha)	30,759	61,370	108	1,400	540	94,177
Percentage (%)	32.67	65.16	0.11	1.49	0.57	100.00

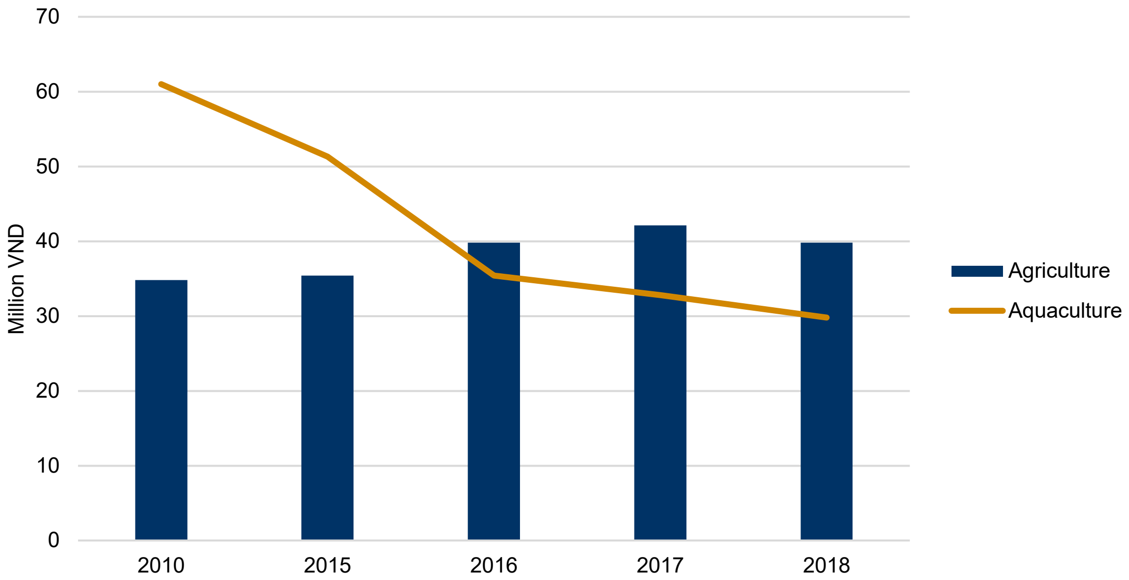
Source: Huong Hoa Statistics Office (2019)

The main area of agricultural production is in Huong Phung commune with 4,747 ha. Of the 61,370 ha of forestry land, Huong Son commune has the largest area (17,588 ha). The majority of land for aquaculture is in Tan Lien commune with 19.2 ha, and the majority of land for special uses is in Tan Hop commune with 198.3 ha. The largest area for housing is in Lao Bao town with 64.2 ha (Huong Hoa Statistics Office 2019).

9.4.5 Economy and Industry

9.4.5.1 Agriculture, Aquaculture and Fishery

While the production value per hectare of aquaculture dropped sharply during 2010-2018 in Huong Hoa, the production value of agriculture fluctuated over this period. Aquaculture production value per hectare was 61.0 million VND in 2010 and fell to 29.8 million VND in 2018. Meanwhile, the agriculture production value per hectare increased during 2010-2016 reaching a peak of 42.1 million VND in 2017 before falling to 39.8 million VND in 2018. In 2018, production value was 39.8 million VND per hectare of agricultural land and 29.8 million VND per hectare of aquaculture (see Figure 9.38).

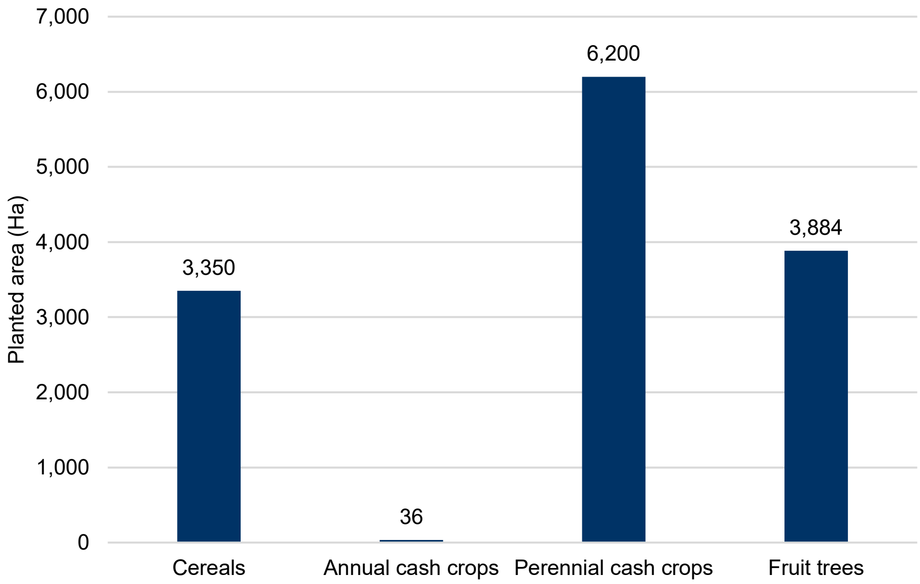


Source: Huong Hoa Statistics Office (2019)

Figure 9.38 Production Value per Hectare of Agriculture and Aquaculture Land in Huong Hoa District 2018

9.4.5.1.1 Cultivation

For the agriculture sectors, the total cultivation in 2018 was 19,609 ha, of which 8,777 ha was used for annual crops with 3,350 ha of cereal crops and 35.6 ha of annual cash crops. Some 10,832 ha was for perennial crops including 6,200 ha of cash crops and 3,884 ha of fruit trees (see Figure 9.39).

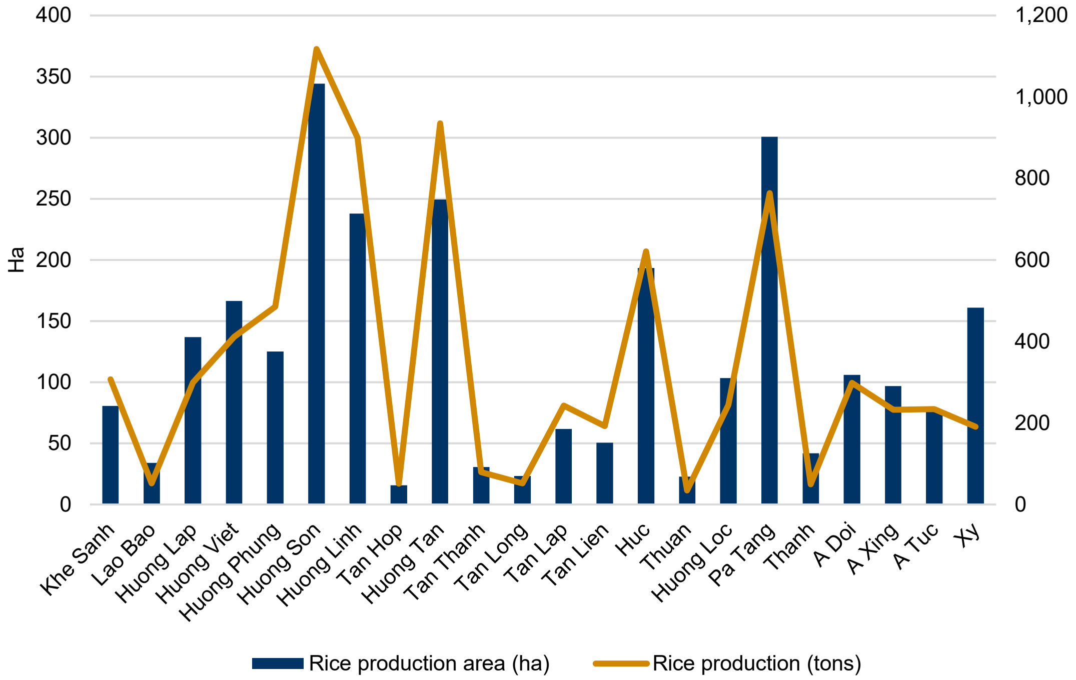


Source: Huong Hoa Statistics Office (2019)

Figure 9.39 Total Planted Area by Crop in Huong Hoa District 2018

Rice: Rice is one of the main agriculture activities in the district and is a key food for the local community. According to the Huong Hoa Statistics Office (2019), the planted area for rice was 2,660 ha and the production was 7,796 tons in 2018. In 2018, production for the winter-spring crop was 3,770 tons with 912 ha planted area, 2,822 tons with 732 ha planted area for the summer-autumn-winter crop, and 1,204 tons with 1,016 ha planted area for seasonal crops (Huong Hoa Statistics Office 2019).

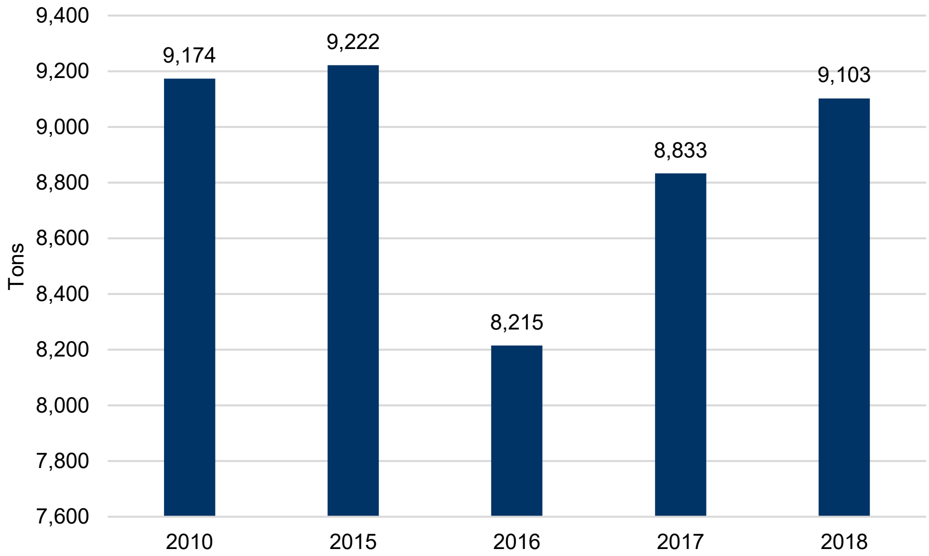
Huong Son and Huong Tan communes were the biggest rice producers in the district, with production going up 1,118 tons and 936 tons respectively in 2018. The main planted areas were at Huong Son and Ba Tang communes with 250 ha and 301 ha respectively, while Tan Hop commune had the lowest planted area with only 15.6 ha and production of 51 tons in 2018 (see Figure 9.40).



Source: Huong Hoa Statistics Office (2019)

Figure 9.40 Rice Planted Area and Production in Huong Hoa District by Commune 2018

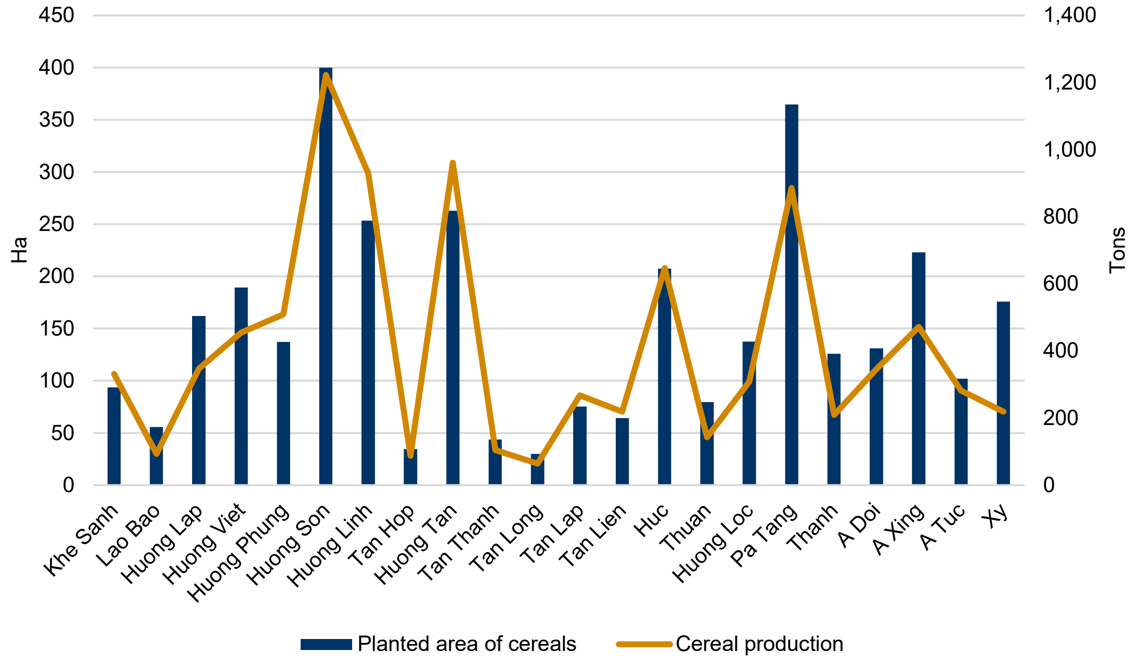
Cereals: District cereals production varied during 2010-2018, with the highest production of 9,222 tons in 2015 but dropping to 8,215 tons in 2016. However, production increased during 2017-2018 with 8,833 tons and 9,103 respectively (see Figure 9.41).



Source: Huong Hoa Statistics Office (2019)

Figure 9.41 Cereal Production in Huong Hoa District 2010-2018

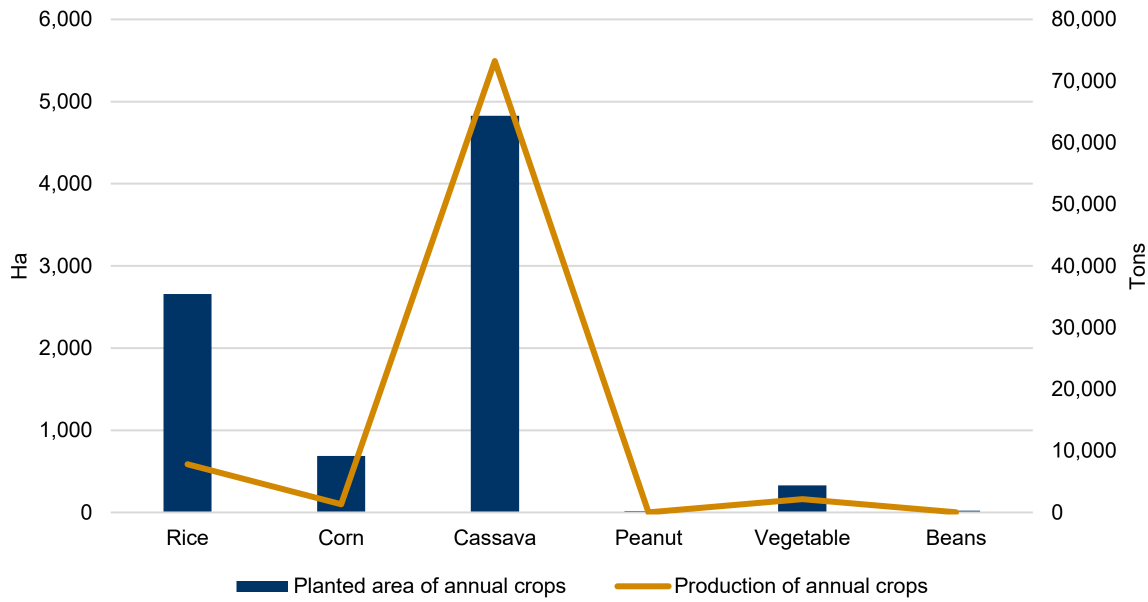
According to the Huong Hoa Statistics Office (2019), the whole district harvested 9,103 tons of cereals in 2018. Huong Son and Huong Tan communes were the highest producers with 1,223 tons and 961 tons, respectively in 2018. Lowest cereal production was at Tan Long and Tan Hop communes with 64.1 tons and 87 tons, respectively (see Figure 9.42).



Source: Huong Hoa Statistics Office (2019)

Figure 9.42 Planted Area and Production of Cereals in Huong Hoa District by Commune 2018

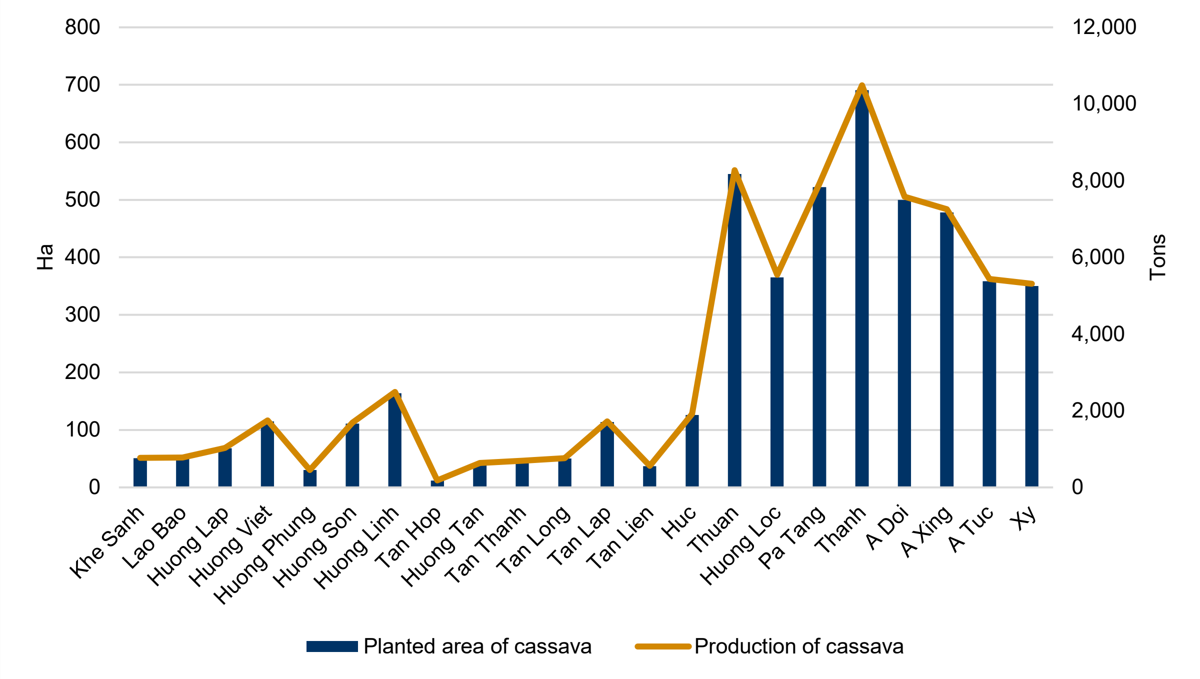
Cassava: Cassava is the main agricultural product, followed by rice while peanut and bean production had the lowest production with 18.6 tons and 20.9 tons respectively. Cassava and rice produced 73,246 tons and 7,796 tons respectively in 2018, and these crops also occupied the largest planted areas with 4,826 ha and 2,660 ha respectively (refer to Figure 9.43).



Source: Huong Hoa Statistics Office (2019)

Figure 9.43 Planted Area and Production of Annual Crops in Huong Hoa District 2018

As shown in Figure 9.44, Thanh commune had the highest production of cassava with 10,489 tons, followed by Thuan commune with 8,273 tons in 2018. In contrast, Tan Hop commune produced only 182.1 tons of cassava.



Source: Huong Hoa Statistics Office (2019)

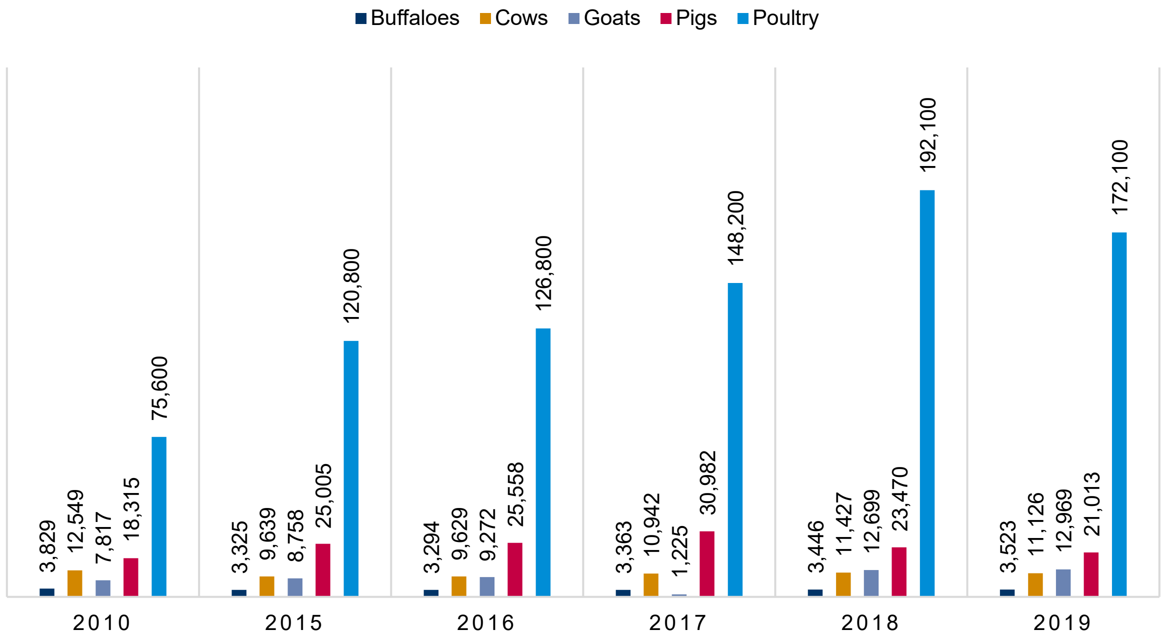
Figure 9.44 Planted Area and Production of Cassava in Huong Hoa District by Commune 2018

Perennial crops: In 2018, production of perennial cash crops in the district included 4.3 tons of cashews, 390 tons of rubber, 5,529 tons of coffee, 66 tons of tea and 134 tons of pepper. Production of perennial fruit trees included 49,306 tons of bananas, 242 tons of mangos, 143 tons of oranges, 109 tons of longings and 108 tons of rambutans and lychees (Huong Hoa Statistics Office 2019).

9.4.5.1.2 Animal Husbandry

There was a total of 51,234 animals in 2018 including 3,446 buffaloes, 11,427 cows, 12,699 goats, 23,470 pigs and 192,100 poultry (see Figure 9.45). The numbers of goats and poultry increased during 2010-2018 compared to other animals. There were 3,829 buffaloes and 12,549 cows in 2010 but these numbers fell to 3,446 buffaloes and 11,427 cows in 2018. The number of pigs remained steady from 2010-2017 (18,315 pigs in 2010 and 30,982 in 2017) but then fell to 23,470 pigs in 2018 (Huong Hoa Statistic Office 2019).

In 2019, there were challenges from African swine fever virus. According to statistical data from the Huong Hoa People's Committee (2019), 576 pigs infected with African swine fever virus from 98 households in 10 communes were destroyed. In 2019, the district had 3,523 buffaloes (up 2.2% over 2018), 11,126 cows (down 0.3% from 2018), 12,969 goats (up 2.1% from 2018), 21,013 pigs (down 10.5% from 2018), and 172,100 poultry (down 10.4% from 2018) (Huong Hoa People's Committee 2019).

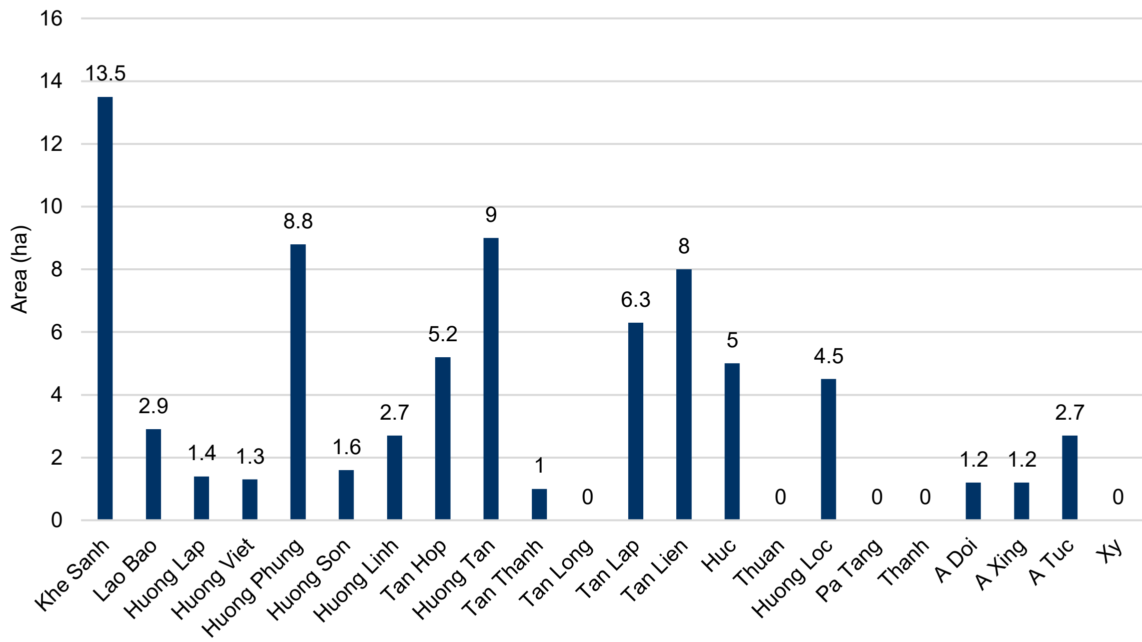


Source: Huong Hoa Statistics Office (2019)

Figure 9.45 Number of Buffaloes, Cows, Goats, Pigs and Poultry in Huong Hoa District 2010-2018

9.4.5.1.3 Aquaculture

The total area for aquaculture in the district was 76.2 ha in 2018 and this was for fish cultivation only. The largest aquaculture area was at Khe Sanh town with 13.5 ha, while 16 other towns/communes shared the remaining of 62.7 ha area. In 2018, five communes had no aquaculture in the district, including Tan Long, Thuan, Ba Tang, Thanh, and Xy (see Figure 9.46) (Huong Hoa Statistics Office 2019).



Source: Huong Hoa Statistics Office (2019)

Figure 9.46 Aquaculture Area in Huong Hoa District by Commune in 2018

9.4.5.1.4 Forestry

During the period 2010-2018, there was no area of special-use forest in the district. Production forest area increased dramatically, rising from nil in 2010 to 357.5 ha in 2017 but then reduced sharply to 76.9 ha in 2018. The protection forest area fluctuated during 2010-2018. There was no protection forest area at the beginning of the period but it grew to 267 ha in 2015 and then dropped to 130 ha in 2016 and to nil in 2017. By 2018, the district had a total of 141 ha protection forest area (see Table 9.15).

Table 9.15 Forest Area in Huong Hoa District 2010-2018

Year	Production Forest	Protection Forest	Special Use Forest	Total
2010	0	0	0	872.5
2015	250.0	267.0	0	517.0
2016	251.0	130.0	0	381.0
2017	357.5	0.0	0	357.5
2018	76.87	141	0	217.9

Source: Huong Hoa Statistics Office (2019)

9.4.5.2 Industry

The production value of industrial sectors increased by 3,251 billion VND in 2019, an increase of 10.2% over 2018. Manufacturing products in the district comprises stone and sand with 33,197 m^3 (up 4.5% over 2018), 22.5 million bricks (up 0.5%), 594.8 million kW/h electricity (up 8%), 18.8 m^3 piped water (up 2.7%) and 368,500 clothes (up 0.1% over 2018) (Huong Hoa People’s Committee 2019).

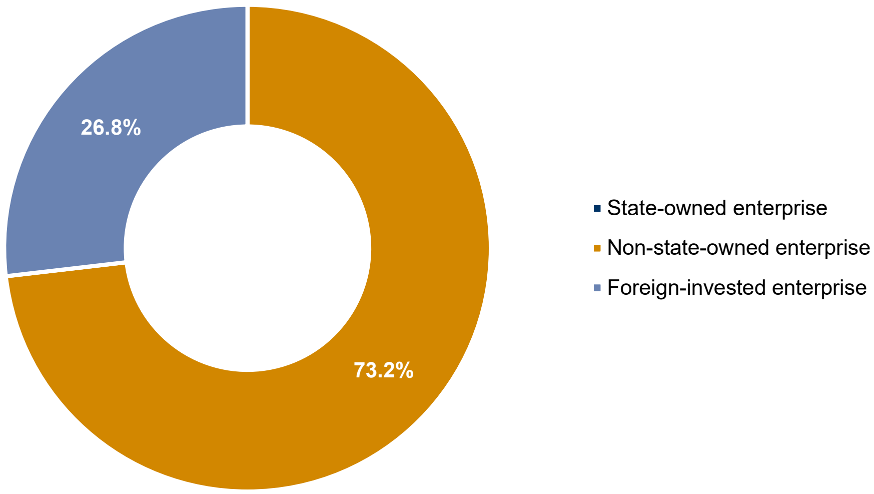
9.4.5.3 Local Enterprises

In 2018, the district had a total of 267 active enterprises. Nearly all were non-state-owned enterprises - 264 of which 31 are private enterprises and two were collective enterprises (see Figure 9.47). Some 208 are limited liability companies with State capital, and 23 are joint stock companies without State capital. There were three 100% foreign-owned enterprises, and no state-owned enterprises in the district.

There were 1,529 employees in the 264 non-state owned enterprises, comprising 73.2% of the Huong Hoa labour force. The foreign-owned enterprise had 561 employees (26.8% of the labour force) (see Figure 9.47).

There is a huge difference between the three leading sectors (wholesale and retail activities, repair of cars, motorbikes, and motor vehicles; transportation and storage; and manufacturing industry) and the other 12 business activities in the district.

The wholesale and retail activities, and repair of vehicles sector has 2,286 enterprises, and also the biggest labour force with 2,793 employees. The transportation and storage sector has 783 enterprises and 1,167 employees, and the manufacturing industry sector has 661 enterprises and 860 employees in 2018. In contrast, there were only eight enterprises and nine employees in the financial, banking and insurance sectors (Huong Hoa Statistics Office 2019).



Source: Huong Hoa Statistics Office (2019)

Figure 9.47 Structure of the Labour Force of Huong Hoa District by Enterprise Type in 2018

9.4.6 Education

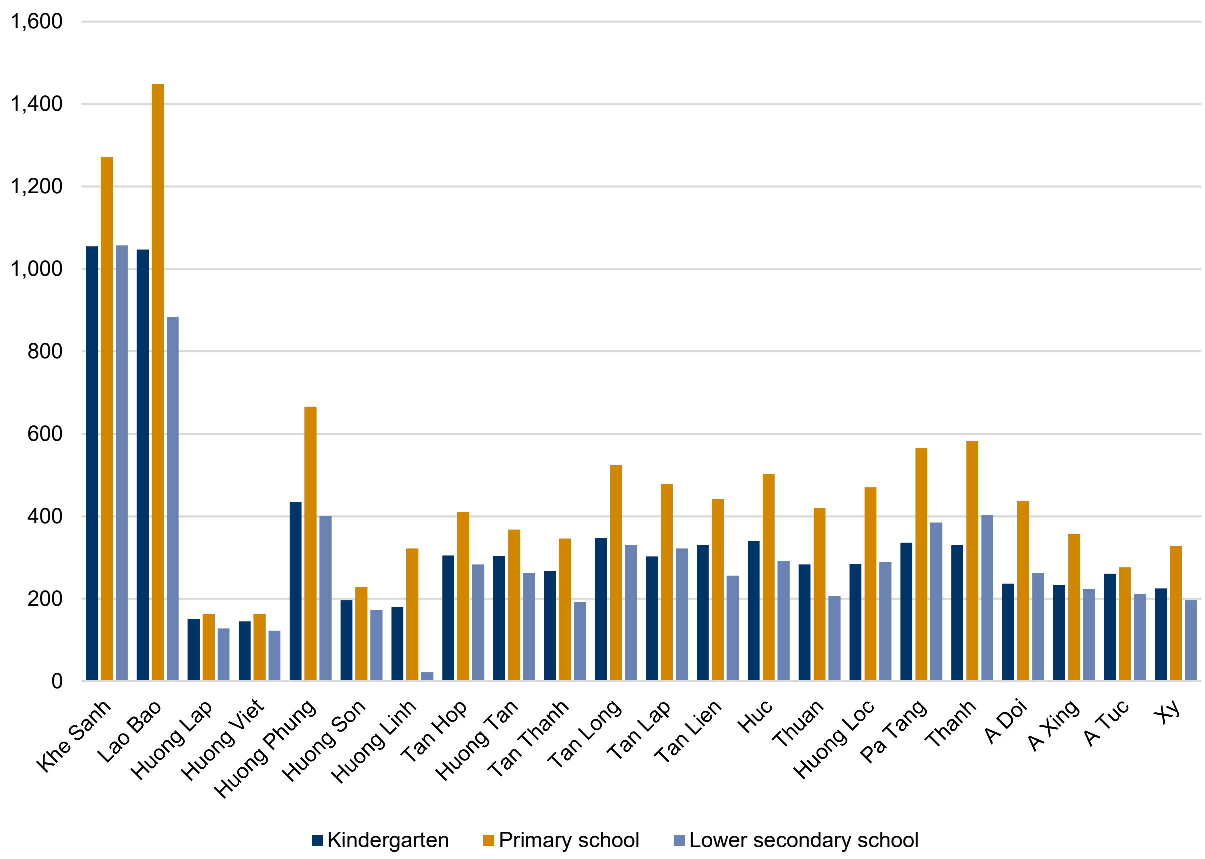
In the 2018-2019 school year, the district had 25 kindergartens, 15 primary schools, 14 lower secondary schools and nine upper secondary schools. The number of schools, classes, teachers, and pupils for the school year 2018-2019 are shown in Table 9.16.

Table 9.16 Number of Schools, Classes, Teachers and Pupils in Huong Hoa District for the 2018-2019 School Year

	Number of Schools	Number of Classes	Number of Teachers	Number of Pupils
Kindergarten	25	317	494	7,596
Primary	15	500	588	10,775
Lower secondary	14	211	423	7,105

Source: Huong Hoa Statistics Office (2019)

In the 2018-2019 school year, Huong Hoa district had 25,476 pupils with 7,596 pupils in kindergarten, 10,775 pupils in primary schools, and 7,105 pupils in secondary schools. The majority of pupils in the district are in Khe Sanh and Lao Bao towns with 3,384 pupils and 3,379 pupils respectively, followed by that of Huong Phung commune with 1,502 pupils. Huong Viet commune has the smallest number with 432 pupils. The largest number of kindergarten pupils was in Khe Sanh town with 1,055 pupils, and the least number was in Huong Viet commune with 145 pupils. Lao Bao town had the highest number of pupils attending primary schools with 1,448 pupils, and Huong Lap commune had the lowest with 164 pupils. Khe Sanh town also had the largest number of lower secondary pupils with 1,057 pupils, while Huong Linh commune had only 22 pupils in lower secondary (see Figure 9.48). There were 586 primary teachers, and 423 secondary teachers meeting the required professional standards for teachers.



Source: Huong Hoa Statistics Office (2019)

Figure 9.48 Number of Pupils of Huong Hoa District in the 2018-2019 School Year

According to the report of the Huong Hoa People's Committee (2019), in 2018, all communes and towns achieve universal preschool education for five-year-old children, primary and lower secondary education. Two communes (Tan Hop and Tan Lien) achieve universal upper secondary education. The district has 20 schools meeting national standards including 7/24 kindergartens, 8/15 primary school and 5/14 lower secondary school, 29.2%, 53.3% and 35.7% respectively. The district organised six classes for 179 pupils to eradicate illiteracy including three classes in Huc commune with 134 pupils and three classes in Huong Linh commune with 45 pupils.

9.4.7 Health

As shown in Table 9.17, in 2018 there were 25 health care establishments in the district, including one district hospital, two regional polyclinics and 22 medical service units in communes, precincts, offices and enterprises. There were no sanatorium and rehabilitation hospitals, dermatology and venereology hospitals or maternity clinics in the district. The district had 188 beds, of which the district hospital had 130 beds, the regional clinics had 10 beds and the other medical service units in communes, precincts, offices and enterprises had 48 beds (Huong Hoa Statistics Office 2019).

In 2018, the district health care system employed 244 people including 60 doctors, 29 physicians, 57 nurses, 39 midwives, 14 technicians, 45 other staff and 22 pharmaceutical staff. The rate of vaccination for children under one year was 96.7%, of which three out of 22 communes/towns achieved 100% vaccination rates.

Table 9.17 Statistics on Health Services in Huong Hoa District 2018

	Number
Total health care establishments, including:	**25**
District hospital	1
Regional polyclinics	2
Medical service units in communes, precincts, offices and enterprises	22
Total personnel, including:	**244**
Doctors	60
Physicians	29
Nurses	57
Midwives	39
Medical technicians	14
Other	45
Pharmaceutical staff	**22**

Source: Huong Hoa Statistics Office (2019)

According to the 2019 socio-economic report (Huong Hoa People's Committee 2019), the district hospital and clinics delivered health check-ups and treatment services to 42,063 patients in 2019 including 7,296 inpatients - an increase of 617 compared to 2018. Communal health stations provided health care services to 53,736 patients. In 2019, 1,831 cases with dengue fever were recorded in 97 villages from 16/22 communes/town.

The rate of height for age malnutrition in communes reduced in 2019, but there was a big difference between ethnic minority communes and communes/towns along Road 9 of the district. Seven communes along Road 9 had a 10% malnutrition for children under five years old, while that for ethnic minority communes was 25% (Huong Hoa People's Committee 2019).

The district recorded 12 HIV infected persons and there were no reported cases of AIDS. In 2018, there were no fatalities from HIV/ AIDS and nor were any new HIV/AIDS cases recorded in the district (Huong Hoa Statistics Office 2019).

9.4.8 Security and Rule of Law/Governance

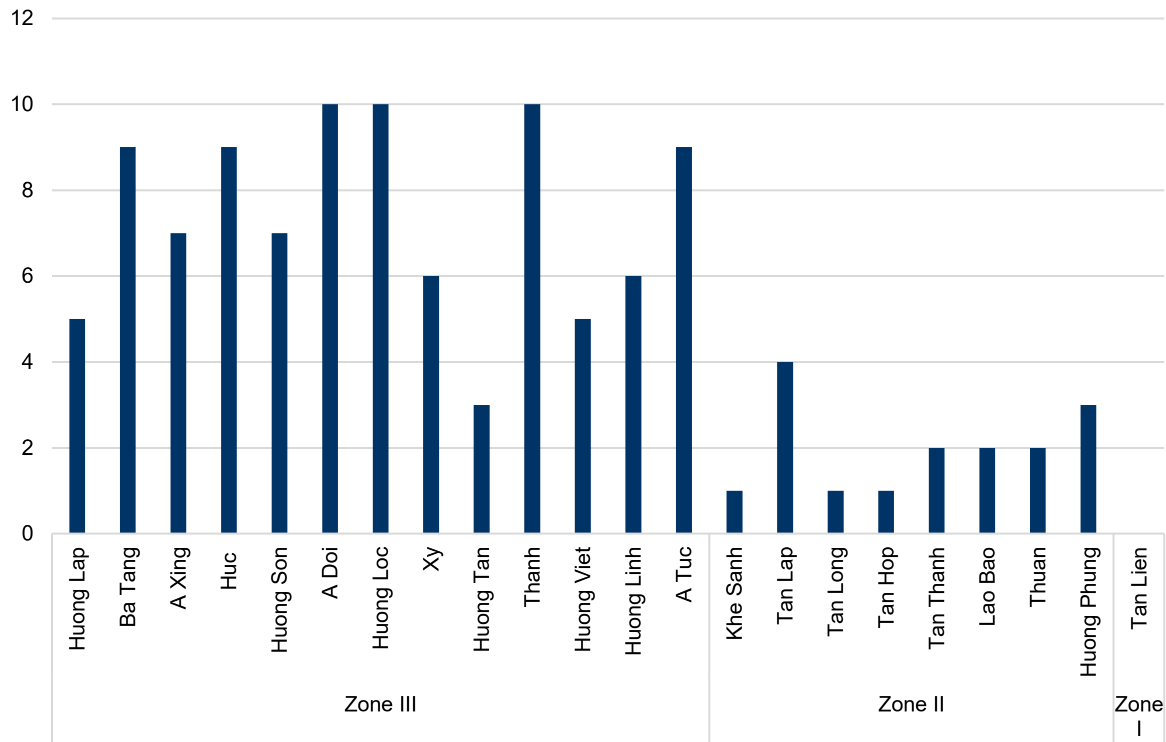
In 2018, 23 traffic accidents occurred in Huong Hoa district causing 13 deaths and 20 injuries and according to the Huong Hoa Statistics Office (2019), this was a reduction from 2017. The number of accidents declined from 36 cases in 2017 to 23 in 2018. There were two fire and explosion incidents in 2018 causing damage estimated at 20 million VND, but there was no damage to people or agriculture from natural disasters in 2018.

With regard to judicial activities, there were 62 prosecution cases in 2018 with 85 defendants, and 45 of these with 69 defendants were prosecuted. Some 39 cases involving 62 criminals were sentenced (Huong Hoa Statistics Office 2019).

According to the Huong Hoa People's Committee socio-economic report (2019), fraud cases increased with 42 cases (33 people) trading illegally in prohibited goods. Thirty three cases (45 people) were arrested for using drugs comprising 6,267 synthetic pills and 14.7 kg of ice (an increase of 11 cases with 14 people from 2018). There were 692 people accused of illegal use of other drugs. There were even cases relating to social evils with 19 people involved in gambling and using drugs who were charged the administrative penalty of 30,500,000 VND.

9.4.9 Vulnerability

In Huong Hoa district, there are 13 communes categorised as Zone III commune (Huong Lap, Tan Viet, Huong Son, Huong Linh, Huong Tan, Huc, Huong Loc, Thanh, A Xing, A Tuc, Xi, A Doi, and Ba Tang), eight as Zone II communes (Khe Sanh, Tan Lap, Tan Long, Tan Hop, Tan Thanh, Lao Bao, Thuan, and Huong Phung), and only one commune (Tan Lien) categorised as Zone I commune (see Figure 9.39). Among 13 Zone III communes, A Doi, Huong Loc, and Thanh have the highest number of villages with special difficulties while Huong Tan has the lowest number of villages with special difficulties (three villages).

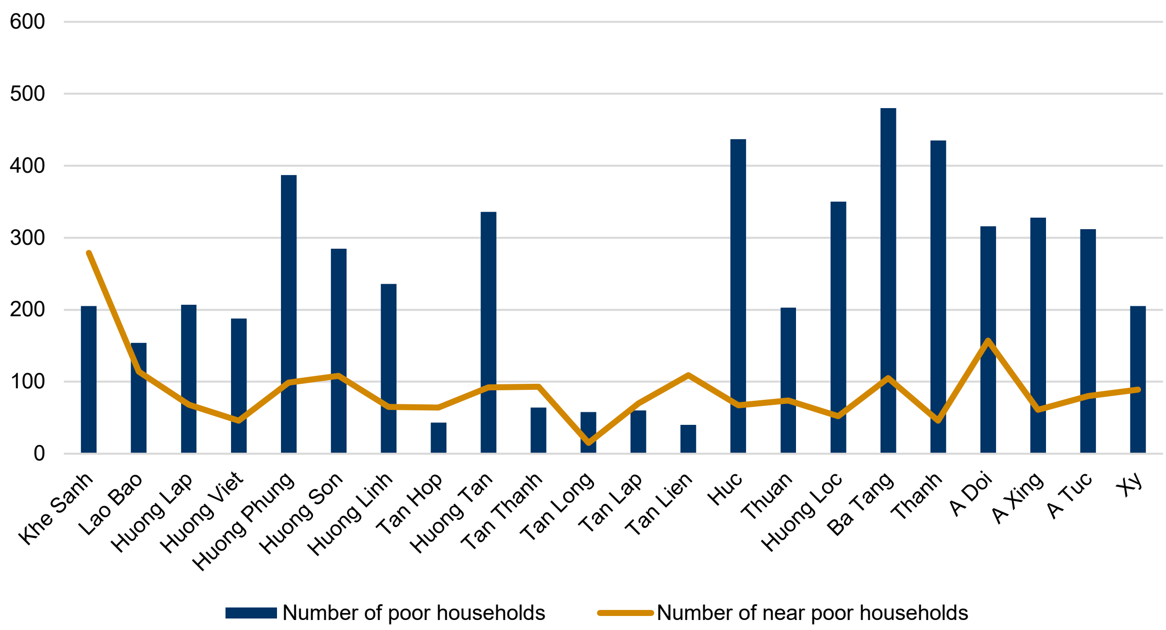


Source: Decision 582/QD-TTg dated 28/4/2017 by the Prime Minister

Figure 9.49 Number of Villages with Special Difficulties in Huong Hoa District by Commune and by Zone

According to the Huong Hoa Statistics Office (2019), in 2018 the whole district had 5,329 poor households, of which Ba Tang commune had the highest number with 480 households and Tan Lien commune had the lowest with 40 households. As shown in Figure 9.50, near poor households comprised 1,953 households in 2018, with Khe Sanh town having the greatest number (279 households) and Tan Long commune having the least with 15 households.

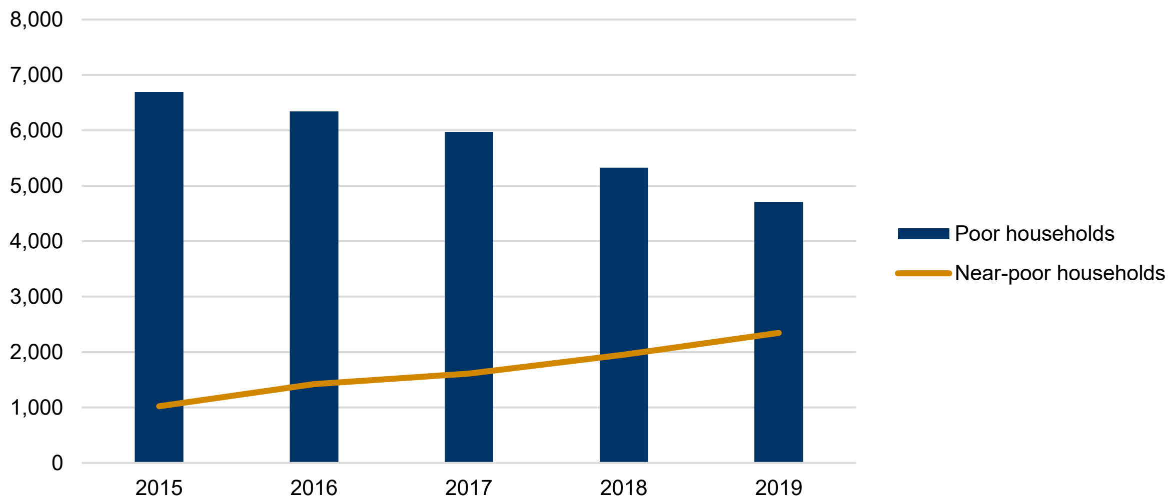
According to the report on multi-dimensional poverty rate by Huong Hoa People's Committee (2019), at the end of 2018, the district had 21,678 households including 11,862 ethnic minority households. There were 5,329 poor households, accounting for 24.6% of total households. Among 5,329 poor households, there were 4,960 poor ethnic minority households (41.8% of total ethnic minority households and 93.1% of the district's poor households); 116 poor households under the category of social sponsor policy (2.2% of total poor households); 185 poor households under the category of people with meritorious services to the revolution (1.6% of total poor households).



Source: Huong Hoa Statistics Office (2019)

Figure 9.50 Number of Poor and Near Poor Households in Huong Hoa District 2018

Over the period 2015-2019, the district's poverty rate declined, from 6,695 poor households to 4,708 poor households at the end of the period (of which 4,408 households are of ethnic minority groups) (see Figure 9.51). The number of near poor households increased from 1,022 households to 2,346 households over the same period (Huong Hoa People's Committee 2019; Huong Hoa Statistics Office 2019)



Source: Huong Hoa Statistics Office (2019); Huong Hoa People's Committee (2019)

Figure 9.51 Number of Poor and Near Poor Households in Huong Hoa District 2015-2019

At the end of 2019, the rate of poor households and near poor households were 21.3% and 10.6% respectively. To achieve the poverty rate as above, the district carried out various effective programs such as preferential loans, vocational training and employment creation, production support, education support, medical support, housing support, legal support and information policies for the poor; and other social welfare policies. By 2019, the district had 2,665 poor and near poor household accessing loans; 77 people working abroad in South Korea, Japan and Taiwan; 27,749 population from poor households granted medical insurance; 22 houses for poor households; and 142 cultural houses at 149 villages for meeting and information exchange purposes (Huong Hoa People's Committee 2020).

9.4.10 Archaeological, Cultural Heritage and Religious Sites

The historic San bay Ta Con (Ta Con Airport), Nha tu Lao Bao (Lao Bao Prison), and the Thac Ta Puong (Ta Puong Waterfall) are notable sites in Huong Hoa district (see Figure 9.52).

Figure 9.52 San bay Ta Con (Ta Con Airport), Nha tu Lao Bao (Lao Bao Prison), and Thac Ta Puong (Ta Puong Waterfall) (left to right)[33]

Ta Con Airport is a historic site located in Hoa Thanh village, Tan Hop commune, Huong Hoa district. It has a museum with exhibits of aircrafts, helicopters, and tanks.

Lao Bao prison was built in Lao Bao town in 1908, Huong Hoa district and is regarded as one of the five largest prisons in Indochina. It served to imprison patriots and communist soldiers from the Central region and on 25th January 1991, it was recognised as a national historical and cultural relic.

Thac Ta Puong (Ta Puong Waterfall) is 30-35 metres high, with a huge flow and majestic flowing water all year round like white silk in the forest, creating a pristine and charming beauty for the district.

9.5 Local Context – Communal Level: Huong Linh Commune

9.5.1 Demographics

Huong Linh commune borders Huong Tan and Tan Hop communes to the south, Huong Phung to the west, Huong Son to the north, Gio Linh and Dakrong districts to the east. Huong Linh commune covers an area of 114.6 km^2 with total population of 2,225 people and 524 households (2018) (see Figure 9.53). The population density is 19.4 people per km^2, and the household size is 4.24 persons per household. The male population is relatively equal to the female population (1,057 and 1,168 respectively) (see Table 9.18). Some 46% of total population are within working age (1,015 people including 506 males and 509 females) (Huong Hoa Statistics Office 2019).

Table 9.18 Population and Working Age Population by Gender

	Male	Female	Total
Population	1,057	1,168	2,225
Working age population	506	509	1,015

Source: Huong Hoa Statistics Office (2019)

[33] Source: Internet

The commune has five villages including Hoong Moi, Miet Cu, Miet Pa Cong, Xa Bai, and Cooc. Except for Miet Cu village which is situated outside the commune center, the rest villages are located in the commune center.

In 2019, the whole commune had 63 households (308 people) practising Protestantism (Huong Linh People's Committee 2019).

HUONG LINH COMMUNE

Area	**114.6 km²**
Population	**2,225 people**
Population density	**19.4 people/km²**
Number of villages	**05**
Number of households	**524**
Poverty proportion	**210 households (2019)**
Ethnic groups	**Kinh, Van Kieu**

Source: Huong Hoa Statistics Office (2019)

Figure 9.53 Huong Linh Commune at a Glance

9.5.2 Ethnicity

There are two main ethnic groups in the commune - Van Kieu and Kinh people. According to data from the Huong Hoa Statistics Office (2019), the commune has 509 Van Kieu households with 2,166 people, and 14 Kinh households with 54 people, accounting for 97.3% and 2.42% of the commune population respectively.

The Van Kieu ethnic minority group has their own verbal language, but no writing system. Both the young and the elderly people can use Vietnamese and Van Kieu languages for daily life. Van Kieu and Kinh people live together in harmony (KII, male respondent, Van Kieu ethnic group, Xa Bai village, 13th February 2020).

In the Van Kieu community, the village patriarch is the hereditary leader with a powerful role in terms of community unity, traditional functions, community property use, and dispute settlement. He is "the court", as metaphorically expressed by an interviewee, particularly in boundary disputes between villagers over newly reclaimed land. Even though the village leader - frequently younger and with fixed term elections - officially has a more important role in local administration, the village patriarch is respectful and trusted for his advice and decisions about the ethnic community.

According to the sharing by the village patriarch of Xa Bai village, the village patriarch previously solved all conflicts among households as he was the most powerful person in the village who took care of everything in the village. Nowadays community conflicts are addressed by a reconciliation team including village patriarch, village head, head of residential areas and representatives of mass organizations such as the Veteran Association, Women's Union and others. Beside the community affairs, the village patriarch also supports programs and policies promulgated by the State (KII, male respondent, Van Kieu ethnic group, Xa Bai village, 13th February 2020).

In addition, the village patriarch is responsible for organising worshipping activities for the village twice a year. In lunar January, each household offers one chicken to pray for good health and prosperity. In lunar June, each household contributes 50,000 VND to prepare offerings (normally a pig) to pray the gods for water to supply rice fields. All ceremonies are organised in the village sacred forests (KII, male respondent, Van Kieu ethnic group, Xa Bai village, 13th February 2020).

9.5.3 Infrastructure and Public Facilities

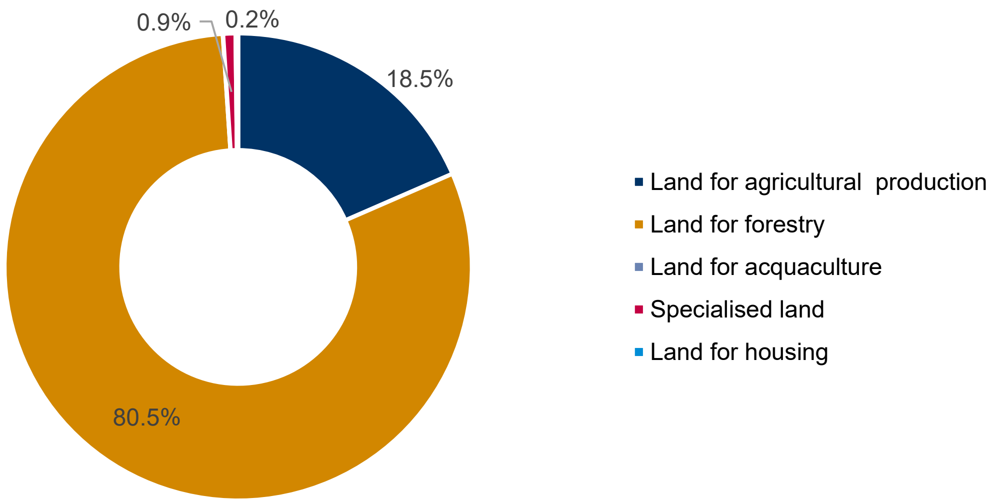
The commune's main road system includes a paved road connecting from the National Road 9 (West direction) to Huong Linh commune, and a network of concreted inter-village roads between the Miet – Cooc and Hoong Moi – Cooc villages, and a road to the Hoong Moi village production area. According to the report of Huong Linh People's Committee (2019), Hoong Moi inter-village road (phase 1) with total investment of 842 million VND was completed and put into operation. In addition, there are some small village tracks for local transportation. In general, the local transportation system satisfies the criteria of new rural development.

The commune has worked with the Huong Hoa Development Program to successfully build an irrigation system in Cooc village and other irrigation works in Xa Bai village (Socio-economic report by ERM 2019).

Solid waste collection service is not available in Huong Linh commune. Normally, domestic wastes are generally collected and treated by each household by burning or disposing at a small spot nearby their adjacent land. The national power grid covers the whole commune. Local people use water from wells and springs for their domestic activities.

9.5.4 Land Tenure and Land Use

Total land area of the Huong Linh commune is 7,764 ha, mostly covered with forest (80.5%). The rest areas are for agricultural production (18.5%), and very small proportions of land for special purposes (0.9%), residential (0.2%), and aquaculture (0.03%).

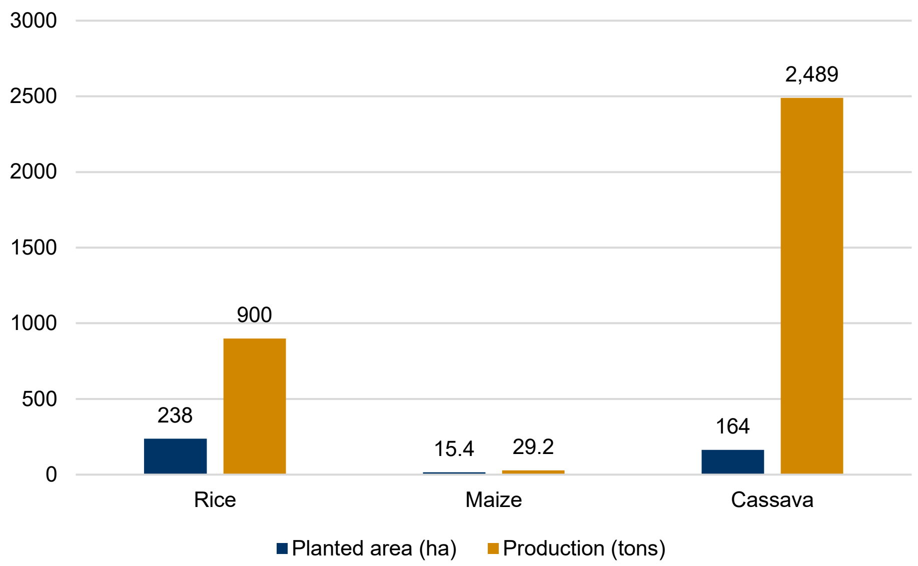


Source: Huong Hoa Statistics Office (2019)

Figure 9.54 Land Use Structure of Huong Linh Commune in 2018

9.5.5 Economy

The planted area and production for cereals (rice and maize) and cassava in Huong Linh in 2018 are shown in Figure 9.55. Cereals (rice and maize) and cassava are the main crops in the commune with large planted areas (253 and 164 ha, that account for 17.6% and 11.4% of the commune's agriculture production land area in 2018 respectively), and high production (929 and 2,489 tons in 2018 respectively). Of the total 929 ton cereals production, rice production was 900 tons and maize production was 29.2 tons (Huong Hoa Statistic Office (2019).



Source: Huong Hoa Statistics Office (2019)

Figure 9.55 Planted Areas and Production of Rice, Maize, and Cassava in Huong Linh Commune in 2018

The socio-economic report of the Huong Linh People's Committee reports that in 2019, the total planted area of annual crops for the whole commune was 225 ha - down from 365 ha in 2018. The commune has 135 ha of wet rice with yield at 18.5 quintals per ha, a reduction of 11.5 quintals/ha compared to the previous year. Total wet rice production was 250 tons, a fall of 336 tons in the previous year. Wet rice production and yield in 2019 were lower than in 2018 because of the lasting hot and dry weather. In 2019, the commune had 90 ha planted for raw cassava with its yield of 11.5 tons per ha and total production of 1,035 tons.

In 2019, the whole commune had 2,391 cattle, 818 buffaloes, 978 cows, 301 pigs, 294 goats and 4,647 poultry. In terms of aquaculture, the commune had 54 ponds with a total area of 2.7 ha for raising carp, tilapia, and others. Aquaculture yield remained low and was mainly for domestic use.

According to the report of Huong Linh People's Committee (2019), the commune developed a forest fire prevention plan and supported a group of villagers as a forest owner and other 11 forest owners as households to develop forest fire prevention plans as regulated. The commune forest ranger station, police security, and military coordinated to organise information dissemination sessions related to forest protection to 396 local villagers in seven hamlets. In 2019, the commune received and planted 4,000 acacia, 20 lagerstroemia (*bằng lăng*), 20 chukrasia tabularis (*lát hoa*) and other trees. Some 26.8 ha of forestry trees were completely planted in 2019.

9.5.6 Education

There is a kindergarten, a primary and lower secondary school in Huong Linh commune. The schools are under the management of the local authority. There is no upper secondary school located in the commune, thus, high school students have to attend classes in Huong Hoa district. Schools meet national standards and facilities have been reportedly upgraded. The number of schools, classes, teachers and pupils for kindergarten level, primary and secondary level are presented in Table 9.19.

Table 9.19 Number of Schools, Classes, Teachers, and Pupils in Huong Linh Commune for the 2018-2019 School Year

	Number of Schools	Number of Classes	Number of Teachers	Number of Pupils
Kindergarten	1	9	14	180
Primary and lower secondary school	1	20 (Primary)	23 (Primary)	322 (Primary)
		8 (Lower secondary)	14 (Lower secondary)	222 (Lower secondary)

Source: Huong Hoa Statistics Office (2019)

According to the socio-economic report of Huong Linh People's Committee (2019), 93% of preschool age children attended kindergarten, and 100% and 99.5% respectively of pupils at the right age attended schools for primary and secondary education in 2019. The commune had 100% of pupils completing their preschool education program in the school year 2018-2019, and 99.1% completing their primary education program (three pupils who have not completed their study received further education support from the schools). The rate of pupils graduating from primary and secondary schools was 100%.

Huong Linh Primary School - Hoong Branch

Huong Linh Primary and Lower Secondary School

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.56 Local Schools in Huong Linh Commune

9.5.7 Health

Huong Linh commune has one public communal health station which meets basic medical needs for local people, who visit the clinic for vaccinations, vitamins, and treatment for common diseases such as colds, headaches, stomach-aches. A new communal health station was built in 2019 to replace the old one, but has not yet been put into operation (see Figure 9.57). In 2018, 98.6% of children under one year old received full vaccination, which is a relatively high rate compared to other communes in Huong Hoa district (Huong Hoa Statistics Office 2019).

The socio-economic report of the Huong Linh People's Committee (2019) reports that the number of children under-five who are malnourished by weight is 85 out of 305 children (27.9%), reducing by 1.38% over 2018. The number of height for age malnutrition is 126 out of 305 children (41.3%), a decrease of 0.19% compared to 2018. In 2019, 52 out of 53 babies were born at the commune health station with one baby born at home.

Huong Linh Health Station (old)

Huong Linh Health Station (new)

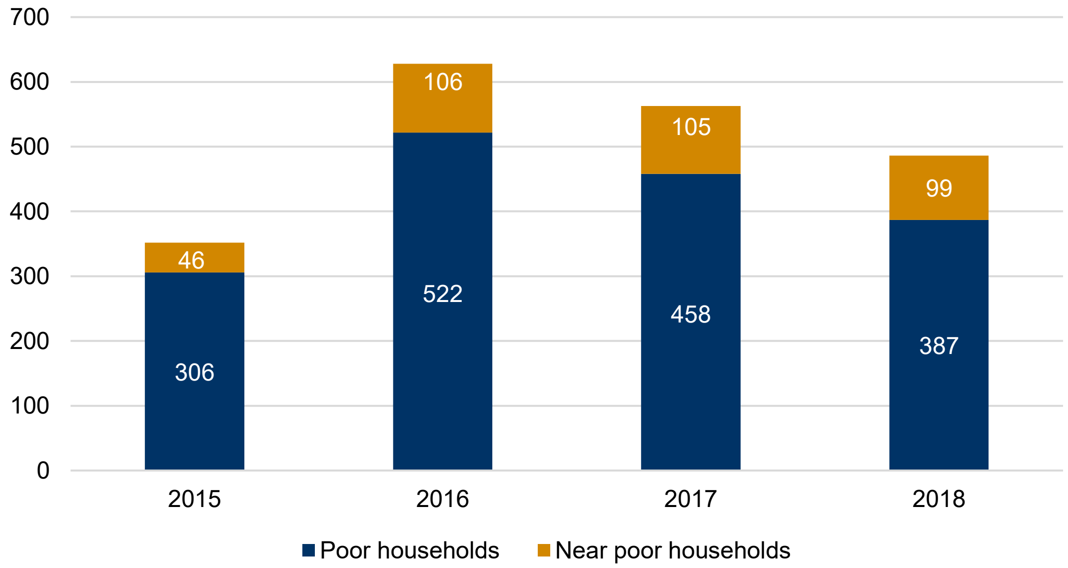
Source: Socio-economic survey conducted by ERM, 2020

Figure 9.57 Health Station in Huong Linh Commune

9.5.8 Vulnerability

Huong Linh is classed as a Zone III commune "with special difficulties", with six extremely difficult villages[34] (namely Xa Bai, Moi, Hong, Cooc, Pa Cong, and Miet Cu). This is one of the most vulnerable communes in terms of socio-economic development in the district.

In 2018, there were 236 households classified as poor and 65 households classified as near poor in Huong Linh commune (Huong Hoa Statistics Office 2019). As shown in Figure 9.58, from 2015-2018 the number of near poor households increased while the number of poor households decreased dramatically.



Source: Huong Hoa Statistics Office (2019)

Figure 9.58 Number of Poor and Near Poor Households in Huong Linh Commune 2018

[34] According to the Decision No. 582/QD-TTg dated 28 April 2017 by the Prime Minister, Huong Linh commune has six villages with special difficulties, including Xa Bai, Moi, Hoong. Cooc, Pa Cong and Miet Cu. Currently, Hoong and Moi villages are merged into one (called Hoong Moi).

In 2019, the commune had 210 poor households (39.5% of total households) and 66 near poor households (12.4%). The annual rate of poverty reduction in 2019 was 5.5% (Huong Linh People's Committee 2019).

Table 9.20 shows the number of poor and near poor households in the three surveyed villages in Huong Linh commune in 2019.

Table 9.20 The Current Number of Poor and Near Poor Households in the Three Surveyed Villages in Huong Linh Commune

	Hoong Moi Village	Xa Bai Village	Cooc Village
Total number of households in the village	164	101	94
Number of poor households	53	47	39
Number of near poor households	27	9	7

Source: Socio-economic surveyed conducted by ERM, 2020

9.5.9 Archaeological, Cultural Heritage, and Religious Sites

There are "ghost" forests for the Van Kieu people which are the holy cemeteries for their family lines in villages of Huong Linh commune. Figure 9.59 shows the community map of Cooc village with ghost forests. Cooc village has five or six ghost forests, about 1 km away from the village community house (KII, male respondent, Van Kieu ethnic group, Cooc village, 13th February 2020). Like the stilt houses for the living Van Kieu indigenous people, ghost forests are homes for the dead. Van Kieu people maintain a belief that ghost forests must be a quiet and "green" place for the dead and outsiders must obtain permission from the head of the family line if they wish to enter this area. In addition, there are several sacred forests in the commune, in which exploitation is prohibited due to spiritual, cultural and social rules.

Source: FGD conducted by ERM, 2020

Figure 9.59 Ghost Forests in Cooc Village as Identified by Local Villagers

9.6 Local Context – Surveyed Households

This section analyses the findings of the household survey undertaken in Hoong Moi, Xa Bai, and Cooc villages of Huong Linh commune, Huong Hoa district. A total of 35 households from the listed villages were randomly selected and interviewed from the 13th to 14th February 2020. The interviews were often conducted at the respondent's house; however subject to their availability and convenience, some interviews were organised at the village head's house or community house. In all cases, respondent's home visits were maintained by the interviewers. The detailed methodology and applied methods for this study are presented in Section 4. Table 9.21 presents the number of households engaging in the survey.

Table 9.21 Surveyed Households by Village

Province	District	Commune	Village	Number of Surveyed Households	%
Quang Tri	Huong Hoa	Huong Linh	Hoong Moi	14	40.00
			Xa Bai	10	28.57
			Cooc	11	31.43
Total				**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.1 Demographic Information

9.6.1.1 Population

Total population of the 35 surveyed households is 176 people. Household members in this survey are those meeting at least one of the following criteria: (1) those who are registered in the household record book and living in the households; (2) those who are registered in the household record book but are not currently living in the households; and (3) those who are not registered in the household record book but are currently living in the households (see Table 9.22).

In presenting the data, it should be noted that there are a number of household members whose names are recorded in the formal household registration book (which has to be kept and continually updated in Vietnam) but were not living with the family at time of survey (for example: children getting married and living separately from parents, or those who moves out of town for work and do not frequently contribute to the household income and expenditure. For these case, their information are included in the demographic statistics but excluded from household expenditure and income statistics. However, those listed as students living in other areas are still included in household expenditure calculations and have been reported.

Table 9.22 Surveyed Households and Population by Village

Province	District	Commune	Village	Surveyed Households		Surveyed Population	
				N	%	N	%
Quang Tri	Huong Hoa	Huong Linh	Hoong Moi	14	40.00	67	38.07
			Xa Bai	10	28.57	53	30.11
			Cooc	11	31.43	56	31.82
Total				**35**	**100.00**	**176**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

The average household size is five people per household with the highest number of household members at nine people. As shown in Table 9.23, the households in Xa Bai village have the largest average family size at 5.3.

Table 9.23 Household Size by Surveyed Village

Village	Average Family Size	Minimum Family Size	Maximum Family Size
Hoong Moi (N=14)	4.78	2	9
Xa Bai (N=10)	5.30	3	8
Cooc (N=11)	5.09	1	7
All Surveyed Villages (N=35)	**5.03**	**1**	**9**

Source: Socio-economic survey conducted by ERM, 2020

Of the surveyed population, 85 are males (48.3%) and 91 are females (51.7%). Nearly two thirds of people are between 15 and 60 years old (working age) accounting for 62.5% of the total sample. Some 31.3% are below 15 years old and the other 6.2% are people over 60 years old (see Table 9.24).

Table 9.24 Population of the Surveyed Households by Age Group

Village	Below 15 years old		15-60 years old		Over 60 years old		Total	
	N	%	N	%	N	%	N	%
Hoong Moi	19	28.36	39	58.21	9	13.43	67	100.00
Xa Bai	19	35.85	32	60.38	2	3.77	53	100.00
Cooc	17	30.36	39	69.64	0	0.00	56	100.00
All Surveyed Villages	**55**	**31.25**	**110**	**62.50**	**11**	**6.25**	**176**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

In each age group, there are significant differences in sex ratio for the below 15 years old and over 60 years old groups, except for the 15-60 years old group where the percentages of males and females are relatively equal, 52% and 48% respectively. Table 9.25 outlines the composition of the households by gender.

Table 9.25 Population of the Surveyed Households by Gender

Age Cohorts	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Below 15 years old	24	43.64	31	56.36	55	100.00
15-60 years old	57	51.82	53	48.18	110	100.00
Above 60 years old	4	36.36	7	63.64	11	100.00
Total	**85**	**48.30**	**91**	**51.70**	**176**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.1.2 Residence Length at the Current Village

The average number of years of residence in the locality for surveyed households is 36.3 years. Notably, three Van Kieu households in Hoong Moi village have lived there for 90 years and above, through many generations. One Kinh household resides in Khe Sanh town but has recently moved to Hoong Moi village for setting up a restaurant four years ago.

The FGD results with a group of 11 Van Kieu ethnic minority people in Hoong Moi show that two of them have been living in the locality since birth, three have lived there since 1973, two moved to the village under the State's vocational orientation program since 2006 and the remaining moved there for marriage or other purposes (FGD, Van Kieu ethnic minority group, Hoong Moi village, 13th February 2020).

Van Kieu ethnic minority people have lived in the commune for a very long time, particularly in Hoong Moi village since 1945 (KII, male respondent, Van Kieu ethnic group, Hoong Moi village, 13th February 2020). Miet Pa Kong and Xa Bai villages are the home of households affected by Rao Quan hydropower development project. All 101 households in Xa Bai village were in this village since end 2006 by Rao Quan hydropower project (KII, male, Van Kieu ethnic minority, Xa Bai village, 13th February 2020) (see Figure 9.62).

9.6.1.3 Ethnicity

The KIIs with the heads of Hoong Moi, Xa Bai, and Cooc villages indicate that Van Kieu ethnic minority people are predominant in the surveyed villages (see Table 9.26).

Table 9.26 Households by Ethnicity and Village

Village	Number of Kinh Households	Number of Van Kieu Households	Number of Thai Households	Total Households	Total Population
Hoong Moi	5	159	0	164	727
Xa Bai	3	97	1	101	657
Cooc	1	91	2	94	442

Source: Socio-economic survey conducted by ERM, 2020

Of 35 households surveyed, 33 households identify themselves as Van Kieu ethnic minority people and two households are of Kinh ethnic group. All 33 participants of FGDs are of Van Kieu ethnic minority community, except for one Thai ethnic woman who was married to a Van Kieu family two years ago. Both Kinh households came to settle at the village and engaged in business development four and 12 years ago.

9.6.1.4 Religion

Almost surveyed households (97.1%) identified themselves as non-religious, except for only one Van Kieu household from Xa Bai village as Protestants. The FGD with a group of eleven Van Kieu ethnic minority people shows that all respondents are non-religious. Table 9.27 presents an overview of the religions of the participating households.

Table 9.27 Religion Reported by Surveyed Households

Village	Protestantism		No Religion		Total	
	N	%	N	%	N	%
Hoong Moi	0	0.00	14	100.00	14	100.00
Xa Bai	1	10.00	9	90.00	10	100.00
Cooc	0	0.00	11	100.00	11	100.00
All Surveyed Villages	**1**	**2.86**	**34**	**97.14**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.1.5 Marital Status

73 out of the 176 surveyed population are married, accounting for 41.5% (see Table 9.28). Some 62 out of 176 surveyed people are under the marriage age[35] which is equivalent to 35.2%, and 22 people within marriage age are single (12.5%). One person in Cooc village is divorced (0.6%). Ten people are widowed (5.7%) including two males and eight females.

The study records cases of child marriage in the surveyed villages. To be specific, eight people got married before the age of 18 for female and 20 for male including five people in Hoong Moi village and

[35] The 2014 Marriage and Family Law regulates that the marriage age is 18 years or older for women and 20 years or older for men.

three people in Cooc village, so they could not obtain the marriage registration at the time of their marriage. Some people shared that they would get a marriage certificate with local authorities when they are eligible for it.

> "I got married when I was 17 years old. I am 18 years old now and we are going to register a marriage certificate (HL13, female respondent, 18 years old, Thai enthnic group, Hoong Moi village, 13th February 2020).

Table 9.28 Marital Status by Surveyed Population

	Hoong Moi Village		Xa Bai Village		Cooc Village		All Surveyed Villages	
	N	%	N	%	N	%	N	%
Married	28	41.79	22	41.51	23	41.07	73	41.48
Single (within marriage age)	7	10.45	8	15.09	7	12.50	22	12.50
Divorced	0	0.00	0	0.00	1	1.79	1	0.57
Widowed	5	7.46	3	5.66	2	3.57	10	5.68
Married without registration (underage marriages)	5	7.46	0	0.00	3	5.36	8	4.55
Under marriage age	22	32.84	20	37.74	20	35.71	62	35.23
Total	**67**	**100.00**	**53**	**100.00**	**56**	**100.00**	**176**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.1.6 Labour Force

The survey data indicates that 110 people (62.5% of surveyed people) are of working age, defined as between 15 and 60[36] (see Table 9.29). However, only 94 of these 110 people are engaged in work, accounting for 85.5%. As well as the 94 people of working age engaged in work, there are two people over the working age who are engaged in work. The remaining 16 people (14.5% of working age people) are engaged in unpaid activities (12 people in studentship; three people in housework or military service) and unemployed (one people).

Table 9.29 Ratio of Labour Resources of the Surveyed Households

	Hoong Moi Village (N=67)		Xa Bai Village (N=53)		Cooc Village (N=56)		All Surveyed Villages (N=176)	
	N	%	N	%	N	%	N	%
People with 15-60 years old	39	58.21	32	60.38	39	69.64	110	62.50
People within15-60 years old engaging in work	31	79.49	28	87.50	35	89.74	94	85.45

Source: Socio-economic survey conducted by ERM, 2020

[36] Under the Vietnam's Labour Code, the labour force is defined between 15 and 55 years old for females and 15-60 for males. In this report, population within 15-60 is categorised under the labour force group.

9.6.2 Educational Attainment

Education levels were calculated for household members who were six years old[37] and older at time of the survey. Twenty-five people under six years old were excluded from the education level analysis and thus, educational attainment is analysed for a sample of 151 people. There were 28 illiterate people in the surveyed population (18.5%). Illiteracy not only occurs among the elderly but also among young people and people within working age. Indeed, 19 of the 28 illiterate people are of working age (from 27 to 51 years old), one person is under working age (below 15 years old), and the remainder are over 60 years old. The youngest illiterate person is nine years old due to mental disability, the oldest illiterate one is 91 years old, and all of them live in Hoong Moi village. While reasons for this were not investigated in the survey, they may be related to difficult living conditions and their ability to study. In addition, difficulties in school accessibility due to long distance between schools and residential areas are reported as a reason for early school drop-out among the surveyed people. A female respondent shares that a high school is far away from the locality so children gave up their study (HL29, female respondent, 28 years old, Van Kieu ethnic group, Cooc village, 14th February 2020).

In Hoong Moi village, thirteen out of 58 surveyed people are illiterate (22.4%) and ten out of 45 surveyed people are illiterate in Xa Bai village (22.2%). Cooc village has lower proportion of illiterate people (10.4%).Table below shows illiteracy and literacy in the surveyed households by village.

Table 9.30 Illiteracy and Literacy of People over School Age in the Surveyed Villages

Village	Illiteracy		Literacy		Total	
	N	%	N	%	N	%
Hoong Moi	13	22.41	45	77.59	58	38.41
Xa Bai	10	22.22	35	77.78	45	29.80
Cooc	5	10.42	43	89.58	48	31.79
All Surveyed Villages	**28**	**18.54**	**123**	**81.46**	**151**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

As shown in Table 9.31, of the 151 surveyed population, 55 persons (36.2%) have completed their lower secondary school education, whist 25% and 15% of the surveyed population has gained primary and high school education respectively. Only two people (1.3%) have attended vocational training schools, and of these, one person works as a public servant and one is under unemployment. Three people (approximately 2%) have attended college, and of these, two are doing cultivation activities and one is a public servant in the commune. Three people, representing approximately 2%, are pursuing their undergraduate study in Hue city and Ha Noi city.

Table 9.31 Education Level of People over School Age in the Surveyed Households

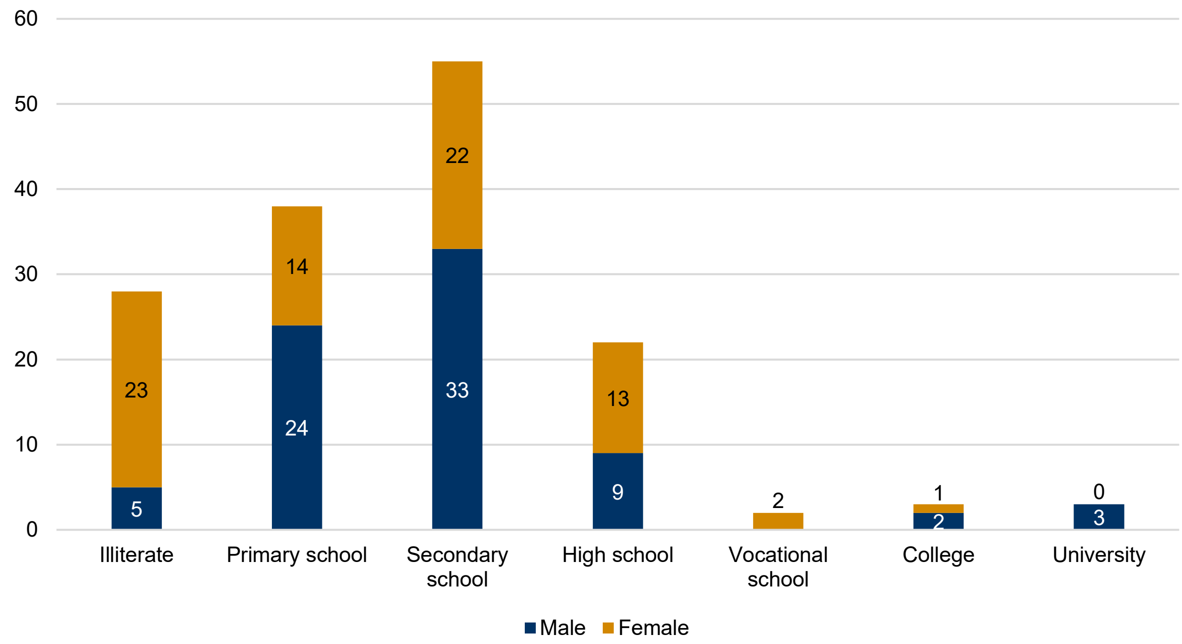
Educational Attainment	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Illiterate	5	6.58	23	30.67	28	18.54
Primary level	24	31.58	14	18.67	38	25.17

[37] At the time of the survey (January 2020), six years old kid have entered the 1st grade class.

Educational Attainment	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Secondary level	33	43.42	22	29.33	55	36.42
High school level	9	11.84	13	17.33	22	14.57
Vocational training level[38]	0	0.00	2	2.67	2	1.32
College	2	2.63	1	1.33	3	1.99
University level	3	3.95	0	0.00	3	1.99
Total	**76**	**100.00**	**75**	**100.00**	**151**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

With regards to gender, men outnumber women at primary and secondary level. The rate is 24 men versus 14 women for primary level, and 33 men versus 22 women for secondary level. However, women make up a higher proportion of those who have attained high school education level (13 women versus nine men). Figure 9.60 shows that all surveyed people at vocational training level are female while three surveyed people at the university level are male. At the college education level, men make up a higher proportion than women (two men versus one woman). Notably, more women are illiterate (23 women versus five men).



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.60 Education Level of Population from Six Years Old in the Surveyed Households by Gender

[38] Trade school or vocational college is a type of educational institution of post-secondary education designed to provide vocational education or technical skills required to perform the tasks of a particular and specific job.

9.6.3 Employment and Livelihoods

9.6.3.1 Livelihood Engagement

As discussed in Section 9.6.1, there are 110 out of 176 surveyed people (62.5%) are of working age, defined as between 15 and 60[39]. However, only 94 of them are engaged in work, accounting for 85.5%. Additionally, two people over 60 years old were found engaging in agriculture activities, making a total of 96 people engaged in work.

Of the 96 working people, 78 people described their work as stable (81.2%) while 18 people saw it temporary (18.8%) (Table 9.32). The smallest share with temporary occupation status is in Xa Bai village (four out of 96 people among three surveyed villages).

Table 9.32 Work Status of Surveyed Population Engaging in Work

	Hoong Moi Village		Xa Bai Village		Cooc Village		All Surveyed Villages	
	N	%	N	%	N	%	N	%
Stable	26	76.47	23	85.19	29	82.86	78	81.25
Temporary	8	23.53	4	14.81	6	17.14	18	18.75
Total	**34**	**100.00**	**27**	**100.00**	**35**	**100.00**	**96**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

There are three main livelihood categories including land-based, wage-based, and enterprise-based activities. As shown in Table 9.33, land-based livelihoods, which include cultivation, husbandry, and forestation, dominate with 81 people, accounting for 83.3% of the sample population. Of which, only two people do animal husbandry, one does forestry, and 78 people are cultivation farmers. Wage-based livelihoods makes up 10.5% of the surveyed population, while a very small proportion (5.2%) relies on enterprise-based livelihoods, particularly small businesses/services. There is almost no significant difference in terms of livelihood structure among the surveyed villages.

Table 9.33 Livelihoods of the Surveyed Households

Livelihoods		Hoong Moi Village		Xa Bai Village		Cooc Village		All Surveyed Villages		Total by Livelihoods	
		N	%	N	%	N	%	N	%	N	%
Land-based livelihoods	Cultivation	24	72.73	25	89.29	29	82.86	78	81.25	81	83.33
	Husbandry	2	6.06	0	0	0	0	2	2.08		
	Forestation	0	0	1	3.57	0	0	1	1.04		
Wage-based livelihoods	Public employment	1	3.03	1	3.57	2	5.71	4	4.17	10	10.42
	Company staff	1	3.03	1	3.57	1	2.86	3	3.13		
	Day labour	1	3.03	0	0	2	5.71	3	3.13		

[39] Under the Vietnam's Labour Code, the labour force is defined between 15 and 55 years old for females and 15-60 for males. In this report, population within 15-60 is categorised under the labour force group.

Livelihoods		Hoong Moi Village		Xa Bai Village		Cooc Village		All Surveyed Villages		Total by Livelihoods	
		N	%	N	%	N	%	N	%	N	%
Enterprise-based livelihoods	Small business/ service	4	12.12	0	0	1	2.86	5	5.21	5	5.21
Total		**33**	**100.00**	**28**	**100.00**	**35**	**100.00**	**96**	**100.00**	**96**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

Of the 96 working people, the male to female ratio is 53.1% and 46.9% (51 men versus 45 women). Gender disaggregated data shows that the number of men and women in cultivation is relatively similar (37 men versus 41 women or 47.4% versus 52.6%). However, men outnumber women for other types of livelihoods (See Table 9.34).

Table 9.34 Livelihoods of the Surveyed Working Population by Gender

Livelihoods		**Male**		**Female**		**Total**	
		N	**%**	**N**	**%**	**N**	**%**
Land-based livelihoods	Cultivation	37	47.44	41	52.56	78	100.00
	Husbandry	1	100.00	0	0.00	1	100.00
	Forestation	2	100.00	0	0.00	1	100.00
Wage-based livelihoods	Public employment	3	75.00	1	25.00	4	100.00
	Company staff	2	66.67	1	33.33	3	100.00
	Day labour	3	100.00	0	0.00	3	100.00
Enterprise-based livelihoods	Small business/ service	3	60.00	2	40.00	5	100.00
Total		**51**	**53.13**	**45**	**46.88**	**96**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

Of the 96 working people (15 years old and over), 34 people have secondary occupation, in which three people carry out cultivation, seven people do husbandry, three people do forestation, one person does small business/services, five people does social work, and 15 people are day labourers. Of those people, there are two people having two secondary occupations, including one person over 60 years old in Hoong Moi village carry out husbandry and public employment, and one in Cooc village do husbandry and small business.

Table 9.35 Surveyed Working People with Secondary Occupation

Number of Surveyed Working People with Secondary Occupation (N=34)		Description of Secondary and Main Occupations	
N	%	Secondary occupation	Main occupation

Number of Surveyed Working People with Secondary Occupation (N=34)		Description of Secondary and Main Occupations	
3	8.82	Cultivation	Public cadre (2) Forestation (1)
7	20.59	Husbandry	Cultivation (7)
3	8.82	Forestation	Cultivation (2) Small business (1)
1	2.94	Small business/service	Cultivation (1)
5	14.71	Social work	Cultivation (4) Husbandry (1)
15	44.12	Day labour	Cultivation (15)
34	**100.00**		

Source: Socio-economic survey conducted by ERM, 2020

To understand resilience of surveyed households when having any impacts on their livelihood, livelihood diversification among the 35 surveyed households was analysed. In terms of types of livelihood, 11 out of 35 surveyed households rely on single livelihood, equivalent 31.4% including seven households with land-based livelihoods, one households with wage-based livelihoods, two households with enterprise-based livelihoods and one household rely on other sources of income such as State allowance. Another 22 households have two types of livelihoods (62.9%). Of these households, land-based and wage-based livelihoods are the dominant combination of 18 households (51.4%) for their income security. In addition, two households have income from more than two livelihoods (5.7%) (see Table 9.36).

Apart from the three main land-based, wage-based and enterprise-based livelihoods, 12 surveyed households get other income from social allowances (for the elderly, students, electricity allowance, and financial support from other family members).

Table 9.36 Livelihood Diversification of the Surveyed Households

Number of Livelihoods	Livelihoods	Surveyed Households		Surveyed Households by Livelihood	
		N	%	N	%
Single livelihood	Land-based	7	20.00	11	31.43
	Wage-based	1	2.86		
	Enterprise-based	2	5.71		
	Other sources	1	2.86		
Two livelihoods	Land-based and wage-based	18	51.43	22	62.86
	Land-based and enterprise-based	2	5.71		
	Wage-based and enterprise-based	2	5.71		
Three livelihoods	Land-based, wage-based, and enterprise-based	2	5.71	2	5.71

Number of Livelihoods	Livelihoods	Surveyed Households		Surveyed Households by Livelihood	
		N	%	N	%
Total		**35**	**100.000**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.3.2 Land-based Livelihoods

As mentioned above, land-based livelihoods are dominant with 83.3% of surveyed people engaging in cultivation, husbandry, and forestation. Outcomes of the three FGDs with 33 households in Hoong Moi, Xa Bai, and Cooc villages and three KIIs with the heads of Hoong Moi, Xa Bai, and Cooc villages also indicate the same conclusion.

Planting rice in Hoong Moi village

Planting cassava in Cooc village

Pig husbandry in Hoong Moi village

Goat husbandry in Huong Linh commune

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.61 Land-based Livelihoods in Surveyed Villages

9.6.3.2.1 Cultivation

9.6.3.2.1.1 Cultivation area

Through the household interviews, majority of surveyed households have their own land for agriculture with areas ranging from 0.1 ha to 6.3 ha per household. On average, one surveyed household owns 1.7 ha of agriculture land.

Figure 9.62 illustrates the agricultural production area in Xa Bai village. This map was developed by eleven Van Kieu respondents aged from 19 to 44 years old during the agriculture and forestry farming group in this village. All of the participants were resettled in the village due to Rao Quan Hydropower Project since 2006 and their households have been reliant on farming. Rice and cassava are main crops for these households. Their cultivation area is quite large, ranging from 3,500m^2 to eight ha. As illustrated in the map, rice cultivation land plots are located along streams which provide water for irrigation. The shortest distance from their house to their cultivation land is one km and the longest one is four to five km. Most of them travel to their land by motorbikes. The FGD with vulnerable households in Cooc village indicate that households mainly walk to their cultivation land plots.

Figure 9.63 illustrates a map of agricultural production area of households in Hoong Moi village. The cultivation area range is from 2,500m^2 to over three ha. The vulnerable group in Cooc village has quite small cultivation area with an average of 5,000m^2 per household.

9.6.3.2.1.2 Products

Rice and cassava planting are common agricultural activities among participating households. While rice cultivation is for domestic use, cassava production are for sale.

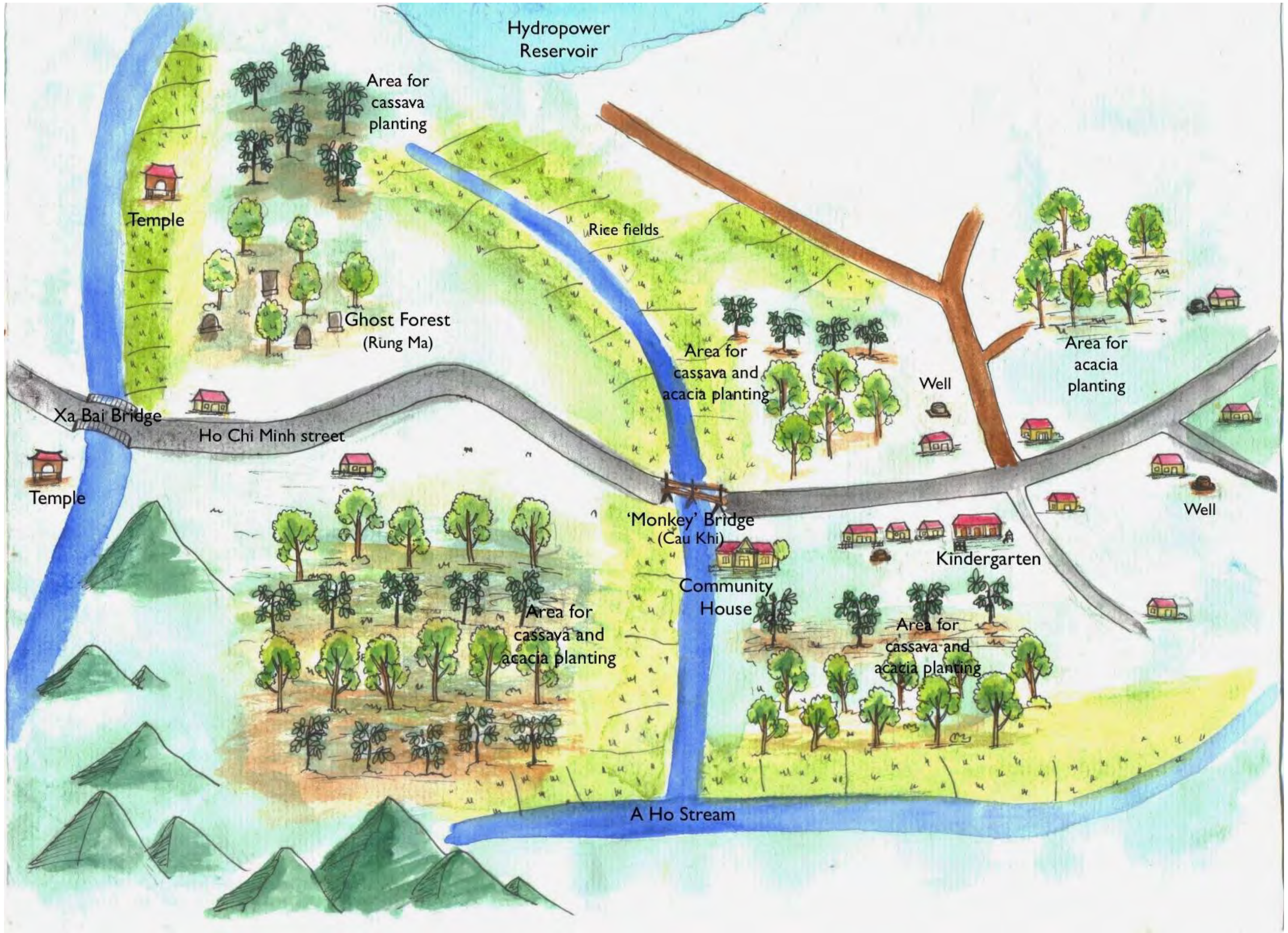
9.6.3.2.1.3 Rice

Rice is planted with two crops per year (one crop from October to May and the other from August to November) and is mainly kept for domestic use. Rice production ranges from four quintals to 1.5 tons per year. On average, one ton of rice is enough for a household with four members in one year. Of the 11 households attending the FGD, only three households produced more than one ton of rice in 2019 while the majority could only produce from two to six quintals per year that are not enough for feeding their whole family with four members and over (FGD, agriculture and forestry group, Xa Bai village, 13th February 2020).

9.6.3.2.1.4 Cassava

Cassava is the main crop for income generation. It is harvested once a year, normally from lunar July to lunar November. Cassava was sold at the price of around 1,500 VND/kg in 2019. The majority of FGD households in Xa Bai village do not have land use right certificate (LURCs) for their cassava cultivation land. Their cultivated area of cassava is from 2,500m^2 to 1.5 ha with its production of two to 17 tons, depending on cultivation area (FGD, agriculture and forestry group, Xa Bai village, 13th February 2020). Cassava crop brings a relatively stable annual income for households with an average income from 7,000,000 VND to 24,000,000 VND per year, depending on planted area of cassava (FGD, Van Kieu ethnic minority group, Hoong Moi village, 13th February 2020).

The labour supply for their agricultural production comes from family members or labour exchanges. Labour exchange is quite popular among farming households when they do not have enough money to hire casual workers or to pay their debts, but it can still be considered as hired labour with payment received in-kind based on the labour contribution. Labour exchange is usually among close-knit groups, extended family or agricultural production group. In addition, the Van Kieu ethnic group organises special ceremonies for the new crop, for seed sowing, threshing, and post harvesting, and for praying for a good crop.



Source: FGD conducted by ERM, 2020

Figure 9.62 Agriculture Production Area Map of Xa Bai Village

Source: FGD conducted by ERM, 2020

Figure 9.63 Agriculture Production Area Map of Hoong Moi Village

9.6.3.2.2 *Forestation*

Among 81 surveyed people engaging in land-based livelihood, only one person considers forestation as their main occupation and three households rely on forestation as their secondary occupation for income generation. According to the survey interviews, 16 out of total 35 surveyed households have forest farming land with a total area of 614,179 m^2, of which Hoong Moi village has forest farming land of 42,500 m^2, Xa Bai village owning forestation area of 556,679 m^2, and Cooc village possessing forest farming land of 15,000 m^2 (see Table 9.37 and see further in section 9.6.7.1).

Table 9.37 Forest Farming Land Area by Village

Forest Farming Land Area	Hoong Moi Village	Xa Bai Village	Cooc Village
Number of households having forest farming land	4	10	2
Number of Households having a land use right certificate (LURC) for forest farming land	2	3	1
Total forest farming land area of surveyed households (m^2)	42,500	556,679	15,000
Average forest farming land area per household (m^2)	10,625	55,667	7,500
Minimum forest farming land area (m^2)	1,000	5,000	5,000
Maximum forest farming land area (m^2)	30,000	170,000	10,000

Source: Socio-economic survey conducted by ERM, 2020

The FGD with Xa Bai agriculture and forestry group shows that all ten households have forest farming land for acacia planting, ranging from 0.5 ha to 2.5 ha; however the majority do not have LURCs for their forest farming land (FGD, agriculture and forestry group, Xa Bai village, 13th February 2020). Acacia is harvested within five to seven years, with an average income from 1.6 million VND to 24 million VND per year in Hoong Moi village or four million VND to 10 million VND per year in Xa Bai village, depending on cultivation area. Four out of 11 vulnerable households participating in the FGD in Cooc village have land for planting acacia and most of FGD participating households go to forest every day to seek food such as banana, vegetable, bamboo and other food sources for daily living (FGD, vulnerable group, Cooc village, 14th February 2020).

9.6.3.2.3 *Animal Husbandry*

Of the 81 surveyed people who rely on land-based livelihoods, only two people (2.1%) see husbandry as the main occupation. Husbandry is mainly seen as a secondary occupation for some households to increase their income. Households mainly raise cows, buffaloes, chickens, and pigs for domestic use or for income generation.

According to respondents in Hoong Moi village, local husbandry is assisted by community development programs run by World Vision in Vietnam (WVV) in terms of husbandry techniques and animal breeds (FGD, Van Kieu ethnic group, Hoong Moi village, 13th February 2020; and FGD, vulnerable group, Cooc village, 14th February 2020).

9.6.3.2.4 *Changes in Agriculture Production*

Some changes in agriculture activities have been observed over the last five years, and were reported by respondents during the FGDs. Respondents from Cooc and Xa Bai villages identified the some negative trends as following: (1) reduced rice production due to mudslides; (2) water scarcity due to drought; (3) lack of cultivation land; (4) limited labour force in agricultural production; (5) degrading roads, and (6) a delay in land use right certificate (LURC) issuance for cultivation land. The number of population in the village increases time by time while planted area is decreasing (FGD, agriculture and forestry group, Xa Bai village, 13th February 2020). However, respondents in Cooc village describe positive support in cultivation activities with seedling, fertilizer, and technique training courses for farmers from local Farmer's Union (FGD, vulnerable group, Cooc village, 14th February 2020).

Table 9.38 Changes in Agricultural Production Activities over the Last Five Years from FGDs

Positive Changes	Negative Changes
■ WVV provides supporting programs in animal husbandry activities for the locals ■ Seedling and fertilizer support and technical support from local Farmer's Union	■ Reduced rice production due to mudslides ■ Water scarcity ■ Limited labour force ■ Degraded roads ■ Delay in LURC issuance for cultivation land ■ Negative impacts to plant growth due to wind farm projects

Source: FGD conducted by ERM, 2020

9.6.3.3 Wage-based Livelihoods

Some 10 surveyed people, equalling to 10.5% of the working people in the survey rely on wage-based work for their primary occupation. Four out of the 10 people work for governmental organisations, three people work as day labourers, and three people work as staff in private companies. The average monthly salary for a person with a wage-based livelihood is around 3.5 million VND.

Wage-based work is also considered a secondary source of income for many households. To be specific, five people are part-time public servants, who work as collaborators for the commune's mass organizations such as the Red Cross, Elderly Union, and Veterans Union and only receive monthly allowance of 300,000 - 460,000 VND each person. Notably, there are three people who work full-time for the commune's forest protection taskforce and get a monthly income of one to five million VND per person. Although the wage is higher than income from the land-based works, it is still considered a secondary livelihood as doing agriculture ensures food security for their family (HL17, male respondent, Van Kieu ethnic group, Xa Bai village, 13th February 2020).

Only three people (3.1%) choose day labour as their main occupation while this type of work is most commonly chosen as secondary source of income, with 15 people nominating day labour especially during their free time from agriculture activities. However, the job opportunities for day labour in the locality are limited and people tend to practise labour exchange in their cultivation community.

Three people (3.1%) choose working for private companies as their primary occupation, of which two are working in Ho Chi Minh City and one is working in Dong Ha city. During interviews with village heads, young labour force in the surveyed villages tend to work in companies or corporations in other cities or provinces such as Da Nang city, Long An province, Binh Thuan province, and Binh Duong province (KII, male respondents, Van Kieu ethnic group, Hoong Moi, Xa Bai and Cooc villages, 13th - 14th February 2020).

9.6.3.4 Enterprise-based Livelihoods

Enterprise-based work is the least common type of livelihood with five out of 96 people engaged in work running small business (5.2%) as their primary occupation, and one person running small business as a secondary occupation. Small businesses include groceries, rice grinding services, restaurant, transport services, and firewood sale.

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.64 A Local Restaurant Run by a Kinh Household in Hoong Moi Village

9.6.4 Income and Expenditure

Household income and expenditure is calculated from data from 35 surveyed households with 162 people. Data from some 14 people (three in Hoong Moi village, five in Xa Bai village, and six in Cooc village) is not included as they are currently not living with the household and do not contribute to household expenditure and income.

9.6.4.1 Income

The average monthly household income of the 35 surveyed households is 4,508,190 VND, and the monthly income per capita is 973,992 VND (see Table 9.39). The average monthly incomes per household and per capita are the lowest in Cooc village and the highest in Hoong Moi village.

Table 9.39 Average Monthly Income per Household and per Capita in the Surveyed Villages

	Hoong Moi Village	Xa Bai Village	Cooc Village	All Surveyed Villages
Monthly average income per household (VND)	5,399,417	4,031,350	3,807,394	4,508,190
Monthly average income per capita (VND)	1,181,122	839,865	837,627	973,992
Minimum monthly household income (VND)	542,000	858,000	1,700,000	542,000
Maximum monthly household income (VND)	15,833,000	14,167,000	7,400,000	15,833,000

Source: Socio-economic survey conducted by ERM, 2020

According to Government Decision 59/2015/QD-TTg (2015) regarding multidimensional poverty for 2016-2020, the poverty levels for those living in rural areas are 700,000 VND/month/capita for poor households, and between 700,000 - 1,000,000 VND/month/capita for near poor households. Using this standard, the survey results revealed that the average monthly income per capita in the surveyed communities (973,992 VND) approximately equals to the rural poverty level for near poor households.

Of 35 households, 18 households have monthly income per capita below the rural national poverty level for poor households (700,000 VND) and three households under the rural national poverty level for near poor households (700,000 - 1,000,000 VND). Of these, only ten households are classified as poor and three as near poor by the State, while eight others are not as they can access more than at least three basic social services, according to the multi-dimensional poverty standard[40].

When disaggregated by livelihood type, Table 9.40 shows that land-based livelihood is the largest contributor to the annual income of all surveyed households with 36.2%. Its overall contribution is very high in Xa Bai village (54.8%) and in Cooc village (58.7%). The numbers of people in agriculture are high and income from this livelihood is significant. This can be further explained that agricultural production activities not only ensure domestic food security but also provide a main income source for the surveyed households.

Wage-based livelihood (31.1%) is the second main contributor to the annual income of all 35 households, with the corresponding figures for Hoong Moi village, Xa Bai village and Cooc village at 24.9%, 42.2% and 31.3% respectively. Enterprise-based income contributes 23.8% to the annual income of all surveyed households. Notably, the number of households with enterprise-based livelihood in Hoong Moi village is modest, but its income makes up the largest share (47.3%) of total 14 households' income.

Apart from the three main livelihoods, surveyed households get other incomes from retirement wage, social allowances, and financial support from children which contribute 9% of the annual income. Households in the surveyed villages report a range of livelihood types which suggest that diversified strategies are one way of coping with fluctuating income levels.

[40] The poverty certificate will be given yearly to households with low income and accessibility to basic social services under national standards as described in Decision 59/2015/QD-TTg which was valid from 1/1/2016.

Income norms:

(a) Having a monthly per capita income of VND 700,000 or lower for rural areas and VND 900,000 or lower for urban areas; or

(b) Having a monthly per capita income of between VND 700,000 and VND 1,000,000 for rural areas and between VND 900,000 and VND 1,300,000 for urban areas, and deprived of at least three indicators measuring deprivation of access to basic social services.

(c) Norms on deprivation of accessing to basic social services:

(d) Basic social services (5 services): health; education; housing; clean water and sanitation; and information;

(e) Indicators measuring the level of deprivation of access to basic social services (10 indicators): accessibility to health care services; health insurance; adult education; child school attendance; housing quality; housing area per capita; drinking water supply; hygienic toilet/latrine; use of telecommunication services; and assets for information accessibility.

Table 9.40 Annual Income by Livelihood Types

Livelihoods	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	Annual Income (VND '000)	%	Annual Income (VND '000)	%	Annual Income (VND '000)	%	Annual Income (VND '000)	%
Land-based	124,800	13.76	265,012	54.78	295,050	58.71	684,862	36.17
Wage-based	226,120	24.93	204,350	42.24	157,446	31.33	587,916	31.05
Enterprise-based	429,060	47.30	6,400	1.32	14,400	2.87	449,860	23.76
Other	127,122	14.01	8,000	1.65	35,680	7.10	170,802	9.02
Total	**907,102**	**100.00**	**483,762**	**100.00**	**502,576**	**100.00**	**1,893,440**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.4.2 Expenditure

Average monthly expenditure per household is 4,364,060 VND which is relatively below average monthly income (4,508,190 VND). Over the past 12 months, many households had unexpected expenditures. Three out of 35 households spent a total of 90 million VND on housing repairs or construction, 13 households paid 88.9 million VND for serious medical conditions such as accidents or surgery, and eight households had costs of 277.9 million VND for other purposes such as purchasing new equipment, organising weddings, paying day labour, buying fertilizers for cultivation, and livelihood improvement. Since these expenditures are unexpected, they are not included in the calculations for average monthly household expenditure. Table 9.41 presents average monthly expenditure per household against average monthly household income.

Table 9.41 Average Monthly Expenditure of the Surveyed Households

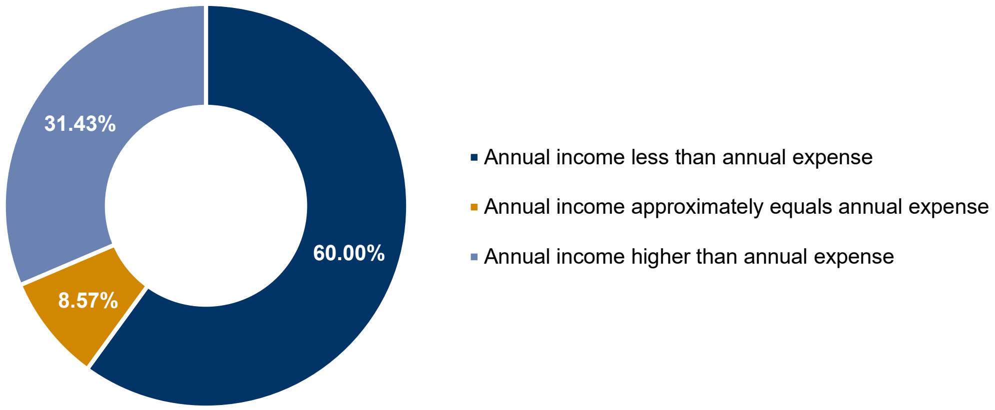
	Surveyed Households (N=35)	
	Amount (VND)	%
Food and daily commodities	1,423,714	32.62
Clothing, entertainment, and community activities	1,028,095	23.56
Daily expenses (Electricity/ Energy/ Transportation, etc.)	823,326	18.87
Financial expenditure (debt interest payment)	605,562	13.88
Education	119,195	2.73
Health care	75,595	1.73
Support for other members living away	288,571	6.61
Total monthly expenditure per household	**4,364,060**	**100.00**
Total monthly income per household	**4,508,190**	

Source: Socio-economic survey conducted by ERM, 2020

'Food and daily commodities' and 'Clothing, entertainment and community activities' are the highest expenditure items accounting for 32.6% and 23.6% of the monthly household expense respectively. In addition, expenditure for daily expenses (electricity/energy/transportation/communications) and financial expenditure (debt interest payment) are considerable (18.9% and 13.9% respectively).

9.6.4.3 Income and Expenditure Balance

Most of surveyed households (60%) have expenditure higher than their annual income (Figure 9.65), and they have to borrow money (with or without interest), sell assets, or spend savings to make up for the difference. Some households earn income which exceeds their annual expenditure (31.4%) and three households (8.6%) have annual income approximately equal to their expenditure (equal or less than one million VND).



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.65 Income and Expenditure Balance of Surveyed Households

Balancing income and expenditure is a concern. 88.6% of households had to get financial support, as their monthly income over the preceding three years did not cover their household expenditure.

Table 9.42 Financial Support to Cover Expenditure during Last Three Years

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Yes	12	85.71	9	90.00	10	90.91	31	88.57
No	2	14.29	1	10.00	1	0.09	4	11.43
Total	**14**	**100.00**	**10**	**100.00**	**11**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

Table 9.43 shows how households obtained financial support to cover their expenditure over the last three years. Of 31 households seeking financial support, 54.8% borrowed money from banks, 38.7% got financial support from their relatives, and 16.1% used other financial support such as borrowing money from fertiliser wholesalers or mobile goods vendors to cover shortcomings.

Table 9.43 Sources of Financial Support

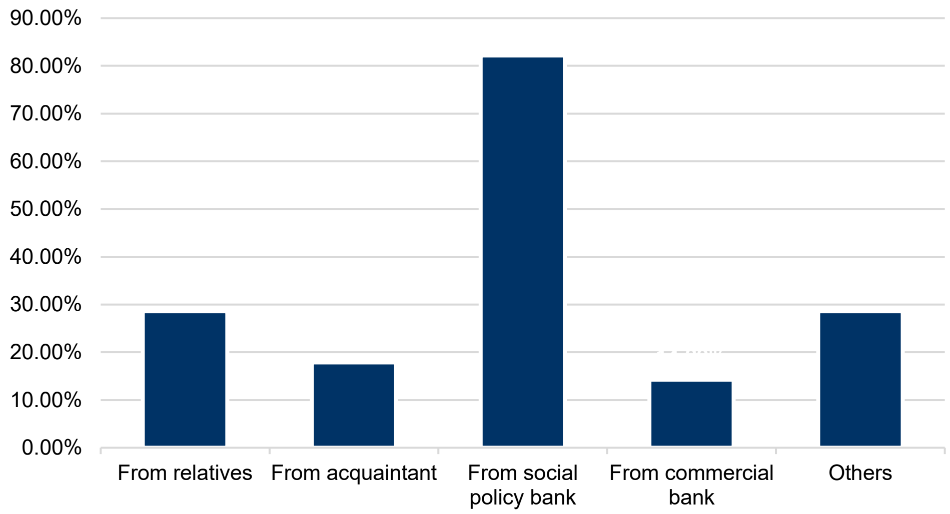
	Hoong Moi Village (N=12)		Xa Bai Village (N=9)		Cooc Village (N=10)		All Surveyed Villages (N=31)	
	N	%	N	%	N	%	N	%
Relatives	4	33.33	7	77.78	1	10.00	12	38.71
Banks	7	58.33	3	33.33	7	70.00	17	54.84
Others	2	16.67	1	11.11	2	20.00	5	16.13

Source: Socio-economic survey conducted by ERM, 2020

9.6.4.4 Debts

80% of surveyed households (28 out of 35 surveyed households) are in debt while 20% are not. Among the 28 households, 10 are from Hoong Moi village, eight are from Xa Bai village, and 10 are from Cooc village. The total amount of loans for these households is 1,321,700,000 VND (the biggest loan is 300 million VND and the smallest is one million VND), and the average loan per household is 47,203,571 VND.

Social policy banks or various Government's loan programs such as retirement loans and women loans with preferential interest rates are the most common sources with 82.1% of the households with debts. Some 28.6% of households had loans from relatives, while 17.9% of households borrowed money from acquaints. 14.3% of households got loans from commercial banks such as Sai Gon Thuong Tin Commercial Joint-Stock Bank (Sacombank) with preferential interest rates and under various loan programs such as mortgage loan (see Figure 9.66). There is also a significant number of households receive loans from other sources (28.6%) (wholesalers, agribusiness, and rural development programs). Debts are used for purposes such as purchasing equipment for production, building or fixing a house, investing in new crops, children's education, health treatment or daily expenses.



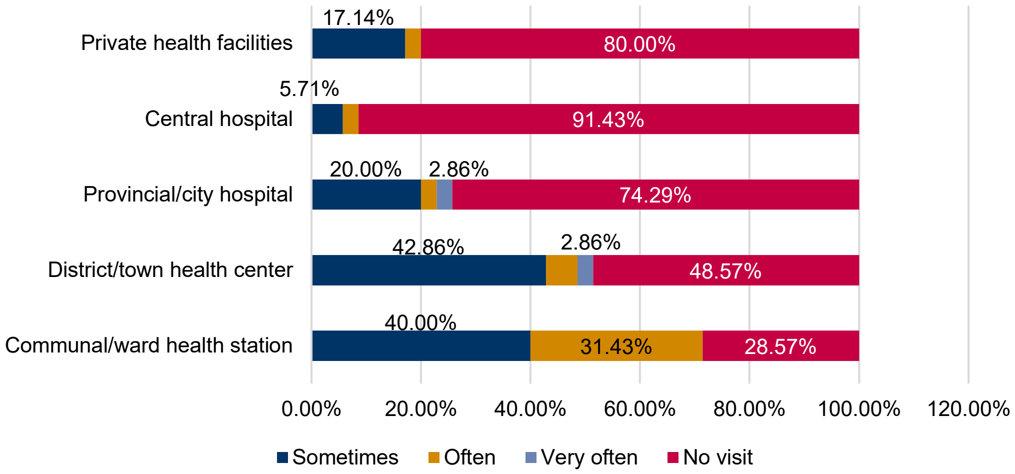
Source: Socio-economic survey conducted by ERM, 2020

Figure 9.66 Sources of Loans/Debts of the Surveyed Households

9.6.5 Health Issues

Two out of 35 (5.71%) surveyed households did not visit a health establishment over the last 12 months because they had no health issue or low need for health care. But most households sometimes visit an establishment, namely a communal/ward health station (40%), district/town health centre (42.9%), provincial/city hospital (20%), private health facilities (17.1%), or central hospital (5.7%) (see Figure 9.67). Huong Hoa district has 22 medical service units in communes, precincts, offices and enterprises, and in Huong Linh commune, there is a health station with first aid and basic treatments such as vaccinations, vitamins, maternal healthcare, and medical treatment for common diseases (i.e. colds, headaches, stomach ache, common flu and blood pressure checks). However, households tend to prefer the district level hospitals when they get sick or have a serious health issue. No surveyed households visit traditional doctors for health treatment.

All people in the surveyed villages are entitled to free-of-charge health insurance as they are under the category "ethnic minorities are living in areas with difficult socio-economic conditions".



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.67 Frequency of Health Facilities Use over 12 Months

Of the 35 surveyed households, there were three households with their youngest member born before 2000, ten households with their youngest born in the 2000s, and 22 born from 2010 to 2019, with corresponding shares of 8.6%, 28.6%, and 62.8% (see Table 9.44).

It is noted that before the year of 2000, three surveyed households (100%) had their youngest members born at home. During 2000-2009, 70% of surveyed households had their youngest members born at home and in the 2010s, only one household had a youngest member born at home (4.6%). People tend to access health establishments at the commune/ward health station for health care services such as giving birth during the 2010s (63.6%).

Table 9.44 Timeframe of when the Youngest Members were Born in the Surveyed Areas

	Before 2000		2000-2009		2010-2019		Total	
	N	%	N	%	N	%	N	%
Communal health station	0	0.00	1	10.00	14	63.64	15	42.86
District/town health centre	0	0.00	2	20.00	7	31.82	9	25.71
At home	3	100.00	7	70.00	1	4.55	11	31.43
Total	**3**	**100.00**	**10**	**100.00**	**22**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

Over the last 12 months, common diseases reported by the 176 surveyed population include gastritis (nine people or 5.1%), hypertension (eight people or 4.6%), disease caused by exposure to dangerous chemicals (five people or 2.8%), and traffic accidents (three people or 1.7%) (see Table 9.45). Some surveyed people suffer from malaria, dengue fever, tuberculosis, hepatitis B, diabetes, heart disease, cancer, rickets, and anaemia. Apart from the diseases listed, surveyed households have other health issues such as arthritis, high cholesterol, degenerative spine, inflammatory bowel disease, liver diseases, and sciatica.

Table 9.45 Common Diseases in Surveyed Households over the 12 Months

	All Surveyed Villages (N=176)	
	N	%
Gastritis	9	5.11
Hypertension	8	4.55
Disease caused by exposure to dangerous chemicals	5	2.84
Traffic accidents	3	1.70
Lack of micro elements	2	1.14
Malaria	1	0.57
Dengue fever	1	0.57
Tuberculosis	1	0.57
Hepatitis B	1	0.57
Diabetes	1	0.57
Heart disease	1	0.57
Cancer	1	0.57

Source: Socio-economic survey conducted by ERM, 2020

Of the 35 surveyed households, 18 households (51.4%) did not have any health issues over the past 12 months (see Table 9.46). Nine households (25.7%) had at least one health issues, five households (14.3%) had three health issues, and three households (8.6%) had two health issues over the last 12 months.

Table 9.46 Health Issues by Surveyed Households over the Last 12 Months

	N	%
Household without any health issues	18	51.43
Household with one health issue	9	25.71
Household with two health issues	3	8.57
Household with three health issues	5	14.29
Total	**35**	**100**

Source: Socio-economic survey conducted by ERM, 2020

Among the 176 surveyed population, 22 people are addicted to tobacco (12.5%) and eight people abuse alcohol[41] (4.6%) (see Table 9.47). The highest number of cigarettes smoked per day is 40 (two packs of cigarettes) and most of people addicted to tobacco are male. No case of drug addiction is recorded among the surveyed households.

Table 9.47 Number of Household Members with Alcohol and Tobacco Use Habits

	Hoong Moi Village (N=67)		Xa Bai Village (N=53)		Cooc Village (N=56)		All Surveyed Villages (N=176)	
	N	%	N	%	N	%	N	%
Tobacco addiction	8	11.94	8	15.09	6	10.71	22	12.50
Alcohol abuse	3	4.48	2	3.77	3	5.36	8	4.55

Source: Socio-economic survey conducted by ERM, 2020

9.6.6 Access to Public Services

The survey evaluates the access of surveyed households to public facilities and services including local health stations, schools, water and electricity supply, waste collection, local markets, and roads. Satisfaction levels for households were also recorded. In general, all surveyed households can access public services/facilities, but detailed results are discussed below.

9.6.6.1 Commune Health Station

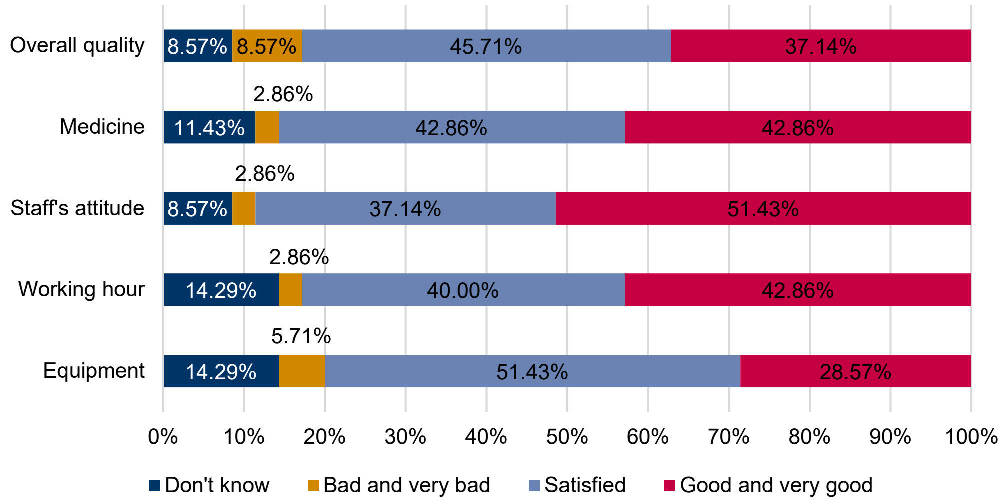
As discussed in Section 9.6.5, local households often visit the communal health station rather than the other health care establishments in the district. However, many households prefer the provincial or district level hospitals when they need health care services for serious health diseases. This may be because the health station in Huong Linh commune is only able to provide primary health care where local people typically seek treatment for illnesses such as degenerative spine, inflammatory bowel disease, liver diseases or sciatica. For medical complications, local people go to the district, provincial or central hospitals.

Overall, surveyed respondents are satisfied with the quality of the local health station. In particular, staff attitudes are highly evaluated by surveyed households (51.4%), but a number of households are not satisfied with the overall quality of health care (8.6%), medical equipment (5.7%), medicine (2.9%), staff attitudes (2.9%), and working hour (2.9%) (see Figure 9.68). A respondent insists that "attitude to patients, health equipment, availability of medicines and working time need to be improved" (HL25, male respondent, 45 years old, Van Kieu ethnic group, Cooc village, 14th February 2020). Some households complain that local health check-up and treatment facilities are limited and health services do not meet local needs. There is inadequate medicine so many households go further away for health treatment, such as to Quang Tri province hospital or higher-level facilities such as Hue Central hospital, or to local private health facilities.

[41] Alcohol abuse: For men: more than two units of alcohol (*) per day or more than 14 alcohol units per week. For women: more than one alcohol unit per day or more than seven alcohol units per week

Tobacco abuse: those who use tobacco at least once a day, as defined by WHO

(*) As defined by the World Health Organization, alcohol unit contains more than 10 grams of alcohol (12.5ml of pure alcohol). Percent of pure alcohol, calculated by the ratio of alcohol on volume (alc/vol) varies with each type of wine. In Vietnam, a unit of alcohol corresponds to 1 bottle of 330 ml beer, 120 ml of 12% ABC alcohol, or 30 ml of 40% ABV alcohol. The Ministry of Health of Vietnam recommends that men should use no more than two units of alcohol per day and women should use no more than one unit of alcohol per day.



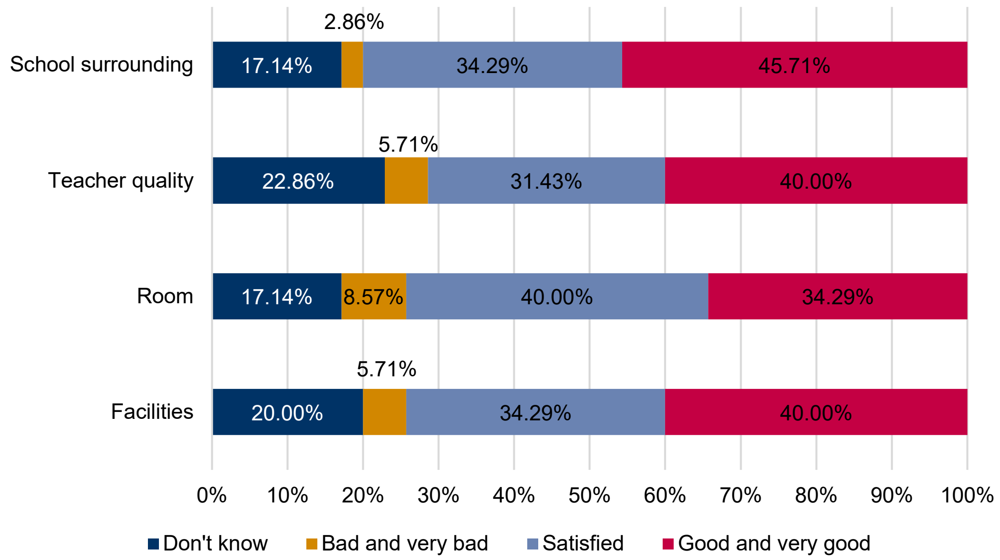
Source: Socio-economic survey conducted by ERM, 2020

Figure 9.68 Level of Satisfaction of Surveyed Households with the Local Health Station

9.6.6.2 Local Schools

Huong Linh commune has one kindergarten, one primary school, and lower secondary school. There are kindergarten branches in all three surveyed villages, but primary schools are only located in Hoong Moi and Cooc villages, not in Xa Bai village. Local pupils in Xa Bai village have to go to other villages for primary education level. For secondary education level, pupils in all three villages study at a lower secondary school in the commune which is three km away from their villages or at schools in Huong Phung commune or Khe Sanh town (KII, male respondents, Van Kieu ethnic group, Cooc, Hoong Moi and Xa Bai villages, 13th-14th February 2020).

Overall, respondents in the survey are satisfied with the facilities, rooms and buildings, study environment, and teacher quality at the schools (see Figure 9.69). But some suggestions were made during interviews about school locations. More schools are available at the locality that encourage local pupils to pursue their study.

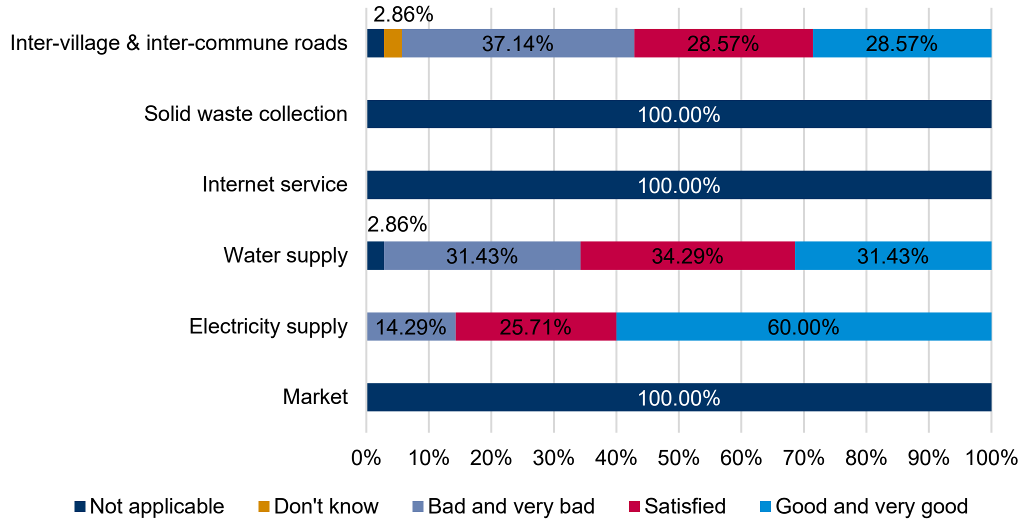


Source: Socio-economic survey conducted by ERM, 2020

Figure 9.69 Level of Satisfaction of Surveyed Households with the Local Schools

9.6.6.3 Infrastructure and Public Services

Surveyed respondents show their satisfaction with local infrastructure and public services in terms of electricity supply, water supply, inter-village and inter-commune roads (see Figure 9.70). But solid waste collection, internet service, and market were not evaluated by surveyed respondents due to lack of official waste collection service or an official market in the locality.



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.70 Evaluation of Satisfaction of Surveyed Households with Local Infrastructure and Public Facilities/Services

9.6.6.3.1 Market

Surveyed people express their demand for a market in the villages as there is no market in the surveyed villages of Huong Linh commune. Trading in goods from motorbikes is common in the surveyed areas (see Figure 9.71). Everyday, mobile goods vendors, who are Kinh from the township, carry a lot of goods and food on motorbikes and sell them to local people which party meet local needs for food and daily necessities. Mobile goods vendors often sell goods to local people in debts and the locals pay debts by either giving their agricultural products such as cassava, tung trees, and brooms to traders or paying in-kind with their labour input (HL09, female respondent, 43 years old, Van Kieu ethnic group, Hoong Moi village, 13th February 2020). In many cases, these traders help to buy medicines, clothes or other goods as requested by the locals. For higher level shopping needs, people go to the bigger markets in Huong Phung commune or in Khe Sanh township, but they go to this market one or twice per year upon harvesting time.

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.71 Trading in Goods on Motorbike in Hoong Moi village

9.6.6.3.2 Electricity Supply

100% of surveyed households (35 households) are connected to the National Electricity Grid. Some 60% of respondents rank the power supply as ‘good and very good’ and 25.7% of respondents express satisfaction with the power supply although some respondents are not satisfied in terms of power losses (14.3%). A male respondent reports old electric wire lines, frequent electricity failure, broken electricity meters, and unstable electricity quality (HL03, male respondent, 60 years old, Van Kieu ethnic group, Hoong Moi village, 13th February 2020).

9.6.6.3.3 Water Supply

The majority of surveyed respondents (65.7%) express their satisfaction with the water supply, but 31.4% of surveyed respondents dissatisfy water supply. This reflects the water supply partly meet local people needs while some limitations are still taken into account. The locals mainly use water source from wells and streams that become scarcer in dry seasons.

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.72 Water Sources in Huong Linh Commune

9.6.6.3.4 Internet Service

All surveyed households do not use internet services so they cannot give an evaluation of the service. In some cases, local people, especially the young, use 3G or 4G wireless data services; however the number of people accessing these services remain limited.

9.6.6.3.5 Solid Waste Collection

As shown in Figure 9.70, all respondents cannot give an evaluation of the solid waste collection as there is no official waste management system in most villages. Households mainly dump or throw garbage into surrounding areas or burn their domestic waste. There is no waste collection service and designated areas for burning waste in the surveyed villages. The local community burn their waste in different ways. Mostly households dig holes for domestic waste or take it to their fields to burn. They know burning waste causes air pollution but they see this as unavoidable.

9.6.6.3.6 Local Roads

Some 28.6% of surveyed respondents in the surveyed villages are satisfied and another 28.6% are highly satisfied with the conditions of local roads. Some 37.1% of surveyed households are dissatisfied with inter-village and inter-commune roads, but see a need for more concrete roads between villages and communes to transport agricultural products from the fields, to easily travel, and to reduce damages related to transport vehicles.

In the surveyed villages, inter-commune roads are concreted while inter-village roads are increasingly degraded due to circulation of big trucks in Cooc village. In Xa Bai village, soil inter-village roads cause a lot of difficulties for the locals when commuting (KII, male respondents, Van Kieu ethnic group, Xa Bai and Cooc villages, 13th - 14th February 2020).

9.6.7 Land, Housing and Household Assets

9.6.7.1 Land

9.6.7.1.1 Residential Land (Including Garden Area)

Table 9.48 shows that all of 35 households own residential and garden land. Of the 35 surveyed households, two households have two residential and garden land plots (one household in Hoong Moi village and one in Cooc village), and all households have their houses on their residential land. The average residential and garden land area per household is 2,069 m^2. Twenty-seven households (77.1%) have land use right certificates (LURC) for their residential land, with figures of 71.4% for Hoong

Moi village, 80% for Xa Bai village, and 81.8% for Cooc village. Eight households including four in Hoong Moi village, two in Xa Bai village and two in Cooc village do not have a LURC for their residential land.

Table 9.48 Residential and Garden Land by Surveyed Households

	Residential and (including Garden Area)		Total Area (m^2)	Average Area per Household (m^2)	Total Residential and Garden Land Plots	LURC among Surveyed Households with Residential Land (including Garden Area)	
	N	%				N	%
Hoong Moi village (N=14)	14	100.00	33,239	2,374	15	10	71.43
Xa Bai village (N=10)	10	100.00	22,780	2,278	10	8	80.00
Cooc village (N=11)	11	100.00	16,400	1,490	12	9	81.82
All three villages (N=35)	**35**	**100.00**	**72,419**	**2,069**	**37**	**27**	**77.14**

Source: Socio-economic survey conducted by ERM, 2020

9.6.7.1.2 Agricultural Land

Thirty-one out of 35 surveyed households own agricultural land with a total of 60 plots and a total area of 517,250 m^2 (see Table 9.49). All households with agricultural land plots currently carry out cultivation activities. The average area of agricultural land per household is 16,685 m^2, the smallest area is 0.1 ha, and the largest area is 6.3 ha. Some households have more than one agricultural land plot. Notably, among the 10 households owning agricultural land in Hoong Moi village, eight households have more than one agricultural land plots. Similarly, seven out of ten households in Xa Bai village and eight out of eleven households in Cooc village have more than one agricultural land plots. The households mainly grow cassava, rice, coffee, cajuput, and tung trees (vernicia montana).

Of the 31 households with agricultural land, 21 households have LURCs, accounting for 67.7%, in which the corresponding figures are 60%, 60%, and 81.8% in Hoong Moi village, Xa Bai village and Cooc village.

Table 9.49 Agricultural Land by Surveyed Households

	Number of Households with Agricultural Land		Total Area (m^2)	Average Area per Household (m^2)	Total Agricultural Land Plots	LURC among Households with Agricultural Land Plots	
	N	%				N	%
Hoong Moi village (N=14)	10	71.43	154,000	15,400	22	6	60.00
Xa Bai village (N=10)	10	100	144,750	14,475	18	6	60.00
Cooc village (N=11)	11	100	218,500	19,863	20	9	81.82
All three villages (N=35)	**31**	**88.57**	**517,250**	**16,685**	**60**	**21**	**67.74**

Source: Socio-economic survey conducted by ERM, 2020

9.6.7.1.3 Forest Farming Land

Sixteen out of 35 households (45.7%) own forest farming land with the total area of 614,179 m^2 (the smallest area is 0.1 ha and the largest is 17 ha), of which six households have LURCs and the remaining ten households do not have LURCs for their land (see Table 9.50). The average area of forest farming land per household is 38,386 m^2. All of the forest farming land plots are in use for planting cassava, acacia, tung trees, and litsea. Notably, two out of ten households with forest farming land in Xa Bai village have more than two land plots, of which one household plant acacia in forest farming land provided by a development project.

Table 9.50 Forest Farming Land by Surveyed Households

	Number of Households with Forest Land		Total Area (m^2)	Average Area per Household (m^2)	Total Forest Land Plots	LURC among Households Having Forest Land Plots	
	N	%				N	%
Hoong Moi village (N=14)	4	28.57	42,500	10,625	4	2	50.00
Xa Bai village (N=10)	10	100.00	556,679	55,667	12	3	30.00
Cooc village (N=11)	2	18.18	15,000	7,500	2	1	50.00
All three villages (N=35)	**16**	**45.71**	**614,179**	**38,386**	**18**	**6**	**37.50**

Source: Socio-economic survey conducted by ERM, 2020

9.6.7.2 Housing

34 out of 35 households (97.1%) own their current house privately, while one household has loaned their house from relatives (2.9%) (see Table 9.51). All households have their houses built on residential land. On average, households in the surveyed areas have been living in their house for nearly 13.2 years.

Table 9.51 House Ownership by Surveyed Households

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Privately owned	13	92.86	10	100.00	11	100.00	34	97.14
Borrow from relatives	1	7.14	0	0.00	0	0.00	1	2.86
Total	**14**	**100.00**	**10**	**100.00**	**11**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

As shown in Table 9.52, the majority of surveyed households own at least one house (88.6%). Four households (11.4%) have two houses (three households in Hoong Moi village and one household in Xa Bai village).

Table 9.52 Number of Houses Owned by the Surveyed Households

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
One house	11	78.57	9	90.00	11	100.00	31	88.57
Two houses	3	21.43	1	10.00	0	0.00	4	11.43
Total	**14**	**100.00**	**10**	**100.00**	**11**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

The survey suggests that most houses are either semi-permanent or permanent with one storey (see Figure 9.73). The typical house design in the surveyed area is a semi-permanent house[42] (mainly in the form of a stilt house) with oak woods, and this design was noted 26 times. Seven surveyed households (20%) live in permanent one-storey houses. Two non-permanent houses are recorded representing 5.7% (see Table 9.53). It is noted that houses in Xa Bai village share the same design that were built by Rao Quan hydropower project. Basic infrastructure in this village such as housing, roads and public services (electricity supply, school and health station) have been also invested and upgraded by the Rao Quan project and the State (KII, male respondent, Van Kieu ethnic group, Xa Bai village, 13th February 2020).

Table 9.53 Number of Different Types of Houses Owned by the Surveyed Households

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
No permanent/Temporary house	0	0.00	0	0.00	2	18.18	2	5.71
Semi-permanent house	13	92.86	8	80.00	5	45.45	26	74.29
Permanent house with one storey	1	7.14	2	20.00	4	36.36	7	20.00
Total	**14**	**100.00**	**10**	**100.00**	**11**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

[42] According to the definition of the Ministry of Construction on permanent and semi-permanent houses, there are three criteria to categorise permanent house and semi-permanent house. In particular, permanent house is a house meets all three criteria, and semi-permanent house is a house meets two criteria. The criteria include: (1) Pillar made of materials: concrete, brick/stone, iron/steel/ durable wood; (2) Roof made of materials: concrete, tile (cement, terracotta); (3) Wall made of materials: concrete, brick / stone, wood/metal.

A permanent house with one-storey (stilt house)

A permanent house with one storey

A semi-permanent house

A temporary house

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.73 House Types in the Surveyed Villages

9.6.7.3 Toilets

The survey indicates that 16 out of 35 households (45.7%) do not have a toilet, and there is outside defecation in fields or in the forest. The remaining five households (14.3%) use a toilet with a septic tank, five households (14.3%) use a toilet with no septic tank, and nine households have latrines (25.7%) (see Table 9.54). Field observation indicates that the construction style and sanitation conditions of toilets is not hygienic.

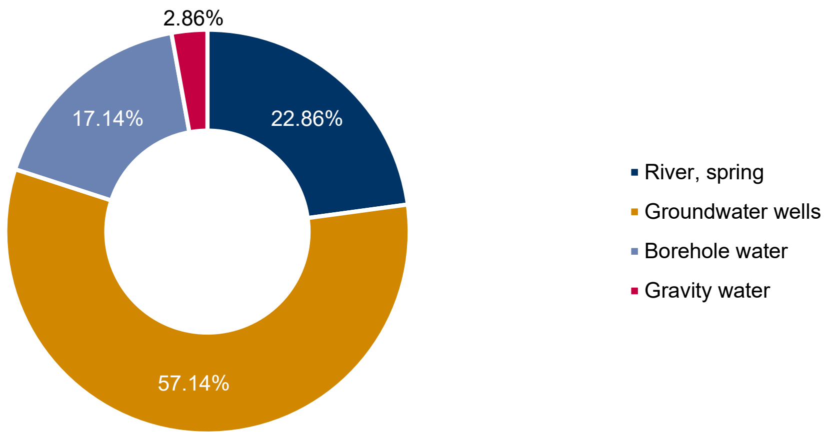
Table 9.54 Toilet Conditions by Surveyed Households

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Toilet with septic tank	2	14.29	1	10.00	2	18.18	5	14.29
Toilet with no septic tank	2	14.29	2	20.00	1	9.09	5	14.29
Latrine	4	28.57	2	20.00	3	27.27	9	25.71
No toilet	6	42.86	5	50.00	5	45.45	16	45.71
Total	**14**	**100.00**	**10**	**100.00**	**11**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

9.6.7.4 Sources of Drinking Water

The survey data shows that the most households (20 households or 57.1%) use groundwater wells for their drinking water. As shown in Figure 9.74, of 35 surveyed households, eight households use drinking water from rivers and springs (22.9%); six use bore water for drinking (17.1%), and one use gravity water (2.9%). In Xa Bai village, a male respondent shares that WVV have invested some groundwater wells for the locality with the average depth of 30-50 metres and water pumps for each water well. One groundwater well could serve five to ten households for their daily use (HL23, male respondent, 38 years old, Van Kieu ethnic group, Xa Bai village, 13th February 2020). In Cooc village, there is a clean water tank invested by the State to store water from the mountain (HL01, male respondent, 33 years old, Van Kieu ethnic group, Cooc village, 13th February 2020). Notably, centralised water system and bottled water containers are not available for drinking supply in the surveyed villages. According to an interview with the Hoong Moi village head, local people raise their demand of groundwater wells in the village.



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.74 Sources of Drinking Water of the Surveyed Households

Water tank in Cooc village

Water tank in Hoong Moi village

Groundwater well in Cooc village

Gravity water from streams in Xa Bai village

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.75 Photos on Sources of Drinking Water of the Surveyed Households

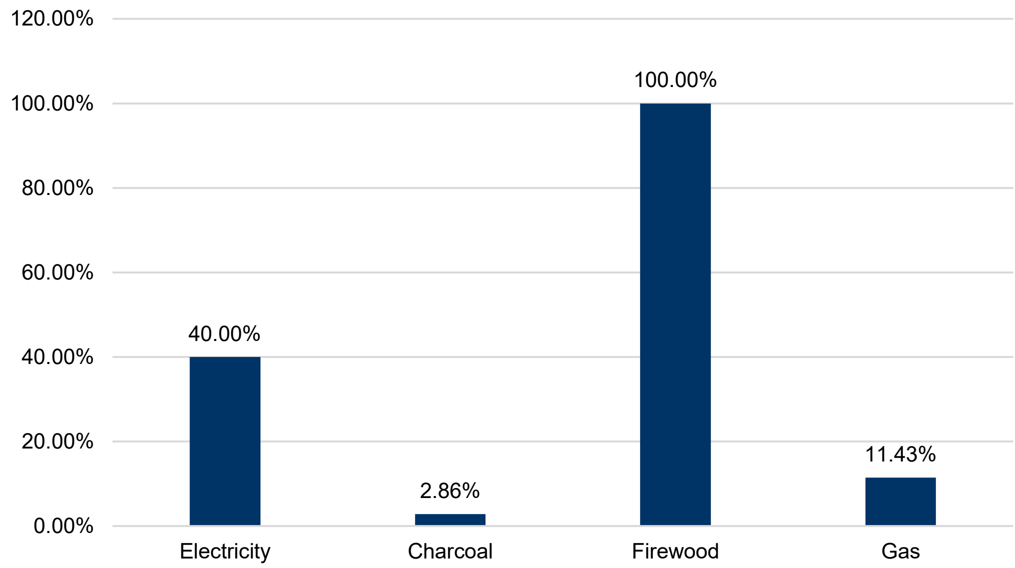
9.6.7.5 Sources of Cooking Energy

Firewood (see Figure 9.76) is the most popular cooking fuel among the surveyed households. 100% of the households in Huong Linh commune collect trees or wood from forests or their land for domestic use.

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.76 Firewood as a Main Cooking Fuel among the Surveyed Households

Many also use electricity for appliances such as rice cookers and kettles (40%). Only one household uses coal for cooking (2.9%) and four households (11.4%) use gas. No household uses solar power or biogas for cooking (Figure 9.77).

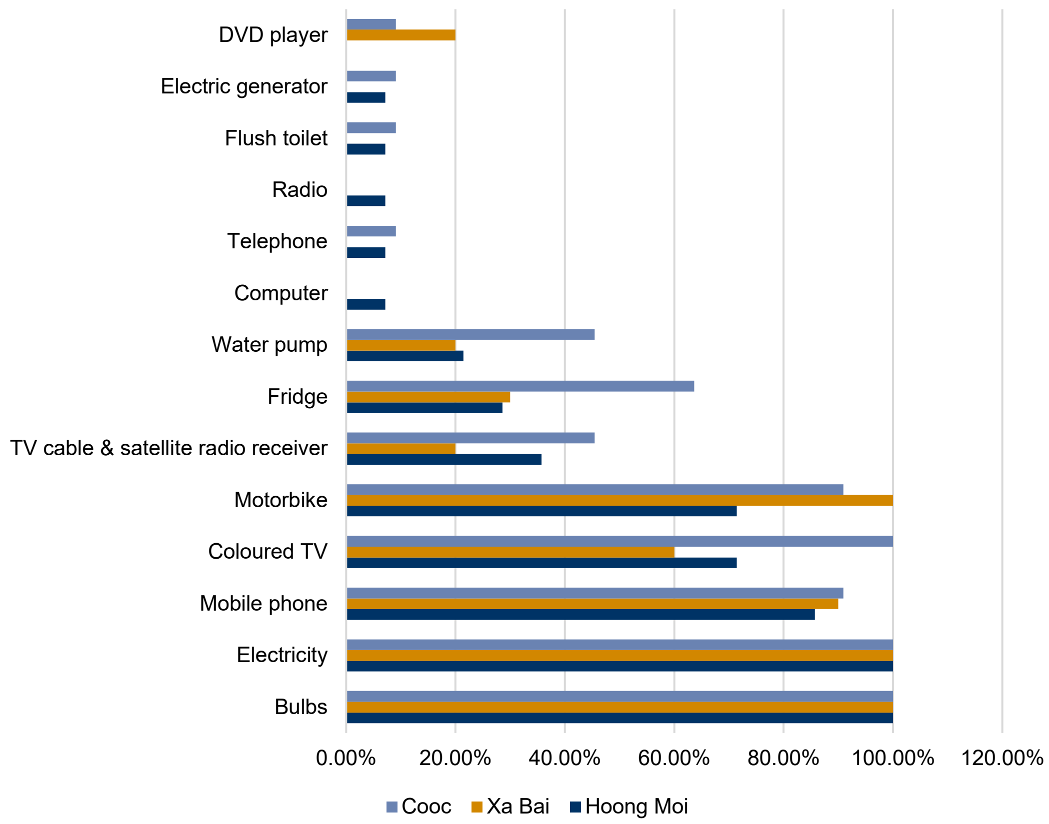


Source: Socio-economic survey conducted by ERM, 2020

Figure 9.77 Sources of Cooking Energy by Surveyed Households

9.6.7.6 Household Assets

The majority of households own basic home appliances (light bulbs and coloured television), communication devices (mobile phone), and transport vehicles (motorbikes) (see Figure 9.78). Apart from basic home equipment, a small number of surveyed households have high-grade assets such as computers (one households or 2.9%), TV cable and satellite radio receiver (12 households or 34.3%), and DVD player (three households or 8.6%).



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.78 Different Household Asset Items Owned by the Surveyed Households

All surveyed households are currently connected to the national electricity grid. Two out of 35 households have flush toilets (5.7%), ten surveyed households (28.6%) own water pump, and two households have electric generator (5.7%).

Other facilities recorded include rice grinder, rice cooker, kettle, electric fan, 3G service for Internet, and lawn mower. There is no households owning an air conditioner, washing machine, sewing machine, car, or solar energy equipment. No household accesses centralised piped water system or internet as the services are not available.

The Van Kieu respondents through FGD in Hoong Moi village recognise improvement in their living and community in terms of living condition as house assets (home appliances, house, and toilet), transport vehicles, and infrastructure (concrete roads, electricity supply, and health stations) (FGD, Van Kieu ethnic group, Hoong Moi village, 13th February 2020).

9.6.8 Gender and Vulnerability Description

9.6.8.1 Gender Relations

As shared by the village patriarch of Xa Bai village, gender equality is observed in most of local households when there is a shared responsibility between men and women in both family work and income generation activities.

Women and men take responsibilities in taking care of children and carrying out household work. Both husband and wife have discussion before giving any decisions related to their family; however final decisions are mainly made by men. Domestic violence rarely happens in the locality but quarrels can be observed. A male respondent shares that quarrels are not avoidable when we have disagreement in family affairs; but there is no domestic violence (FGD, vulnerable group, Cooc village, 14th February 2020). In terms of income generation activities, both husband and wife involve in farming activities, but wife often takes light work (FGD, Van Kieu ethnic group, Hoong Moi village, 13th February 2020).

9.6.8.2 Vulnerability

Vulnerable households are defined as meeting at least one of the following criteria:

- Poor and near-poor households certified by the Government;
- Households with orphans/abandoned children;
- Households of elderly people above the age of 60 living alone;
- Households with elderly people over 80 without social welfare or insurance;
- Households with physically disabled members;
- Households with mentally disabled members who are unable to work;
- Households with members with HIV/AIDS and incapability of work;
- Households with a single parent in a poor household who are raising children under the age of 16, or children aged 16-18 and attending school;
- Households with an illiterate breadwinner; and
- Female-headed households.
- A total of 20 households (57.1%) have been identified as vulnerable (see Table 9.55).

Table 9.55 Number of Vulnerable Households

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Vulnerable households	8	57.14	6	60.00	6	54.55	20	57.14
Non-vulnerable households	6	42.86	4	40.00	5	45.45	15	42.86
Total	**14**	**100.00**	**10**	**100.00**	**11**	**100.00**	**35**	**100.00**

Source: Socio-economic survey conducted by ERM, 2020

Table 9.56 shows that 12 households are recognised as poor households, and this is the highest category (34.3%). Four households (11.4%) are classified as near-poor, three households (8.6%) are female-headed, and two households (5.7%) have elderly people from 80 years old without social allowance or insurance. There are two households (5.7%) with a single parent in a poor household raising children under the age of 16 or children aged 16-18 and attending school (one single-father household in Xa Bai village and one single-mom household in Cooc village), and two households (5.7%) have an illiterate main bread-winner.

Two vulnerable households (5.7%) have family members who are disabled physically. A male blind in one eye due to landmine explosion in Cooc village receives a monthly social allowance of 540,000 VND and one blind person in Hoong Moi village is entitled to an allowance of 400,000 VND per month. There is one household (2.9%) with a family member who is mentally disabled with the Down syndrome and has a social allowance of 500,000 VND per month.

Table 9.56 Vulnerable Household Cases by Category

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Poor household	6	42.86	3	30.00	3	27.27	12	34.29
Near-poor household	1	7.14	2	20.00	1	9.09	4	11.43
Female-headed household	2	14.29	0	0	1	9.09	3	8.57
Household with elderly person from 80 years old without social allowance or insurance	1	7.14	1	10.00	0	0	2	5.71
Single parent in a poor household	0	0	1	10.00	1	9.09	2	5.71
Household with illiterate main worker	1	7.14	1	10.00	0	0	2	5.71
Household with physically disabled people	1	7.14	0	0	1	9.09	2	5.71
Household with mentally disabled people not working	1	7.14	0	0	0	0	1	2.86

Source: Socio-economic survey conducted by ERM, 2020

Vulnerable households can have more than one vulnerability criteria. Fifteen households (42.8% of 35 surveyed households) have one vulnerable criteria (see Table 9.57). Two households (5.7%) in the surveyed group have these double vulnerabilities, of which one household in Hoong Moi village is classified as poor and with a mentally disabled household member and one in Cooc village is as poor and under the category of single parent in poor household raising children under age of 16 or children aged 16-18 and attending school. Three households (8.5%) has triple vulnerabilities, including two households in Hoong Moi village (one with poor, female-headed and illiterate main work, and one with poor, female-headed and physically disabled) and one in Xa Bai village (poor, illiterate main worker, and single parent).

Table 9.57 Vulnerability Criteria

	Hoong Moi Village (N=14)		Xa Bai Village (N=10)		Cooc Village (N=11)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Household with one vulnerability	5	35.71	5	50.00	5	45.45	15	42.86
Household with two vulnerabilities	1	7.14	0	0	1	9.09	2	5.71
Household with three vulnerabilities	2	14.29	1	10.00	0	0	3	8.57
Total vulnerable households	**8**	**57.14**	**6**	**60.00**	**6**	**54.55**	**20**	**57.14**

Source: Socio-economic survey conducted by ERM, 2020

The FGD results with a group of 11 vulnerable households in Cooc village show that one household in the group match more than one vulnerability criteria. There are six households having family members with physical and mental disability (broken leg, blind, and epileptic), two elderly households living alone, and five households as poor. Of these six households with disabled members, three households are entitled to receive social allowance from the State with a monthly allowance of 400,000 VND - 540,000 VND. These vulnerable households being not entitled to social allowance sometimes get in-kind support from local authorities and mass organisations such as seedling, fertiliser and training support (FGD, vulnerable group, Van Kieu ethnic group, Cooc village, 14th February 2020).

Table 9.58 shows how satisfied vulnerable participants feel about specific aspects of their life, on a scale of 0 to 10 (Zero means "not at all satisfied" and 10 means "completely satisfied"). All respondents show high satisfaction towards personal relationships and community cohesion. All vulnerable households have a close relationship with the community. They further insist when any person in the village get sick or in difficulty, he/she receives care and support from neighbours. The most concerned aspects of their well-being are living quality, time allocation for their hobby, and achievement in life (FGD, vulnerable group, Cooc village, 14th February 2020).

Table 9.58 Well-Being Ranking by Local Groups

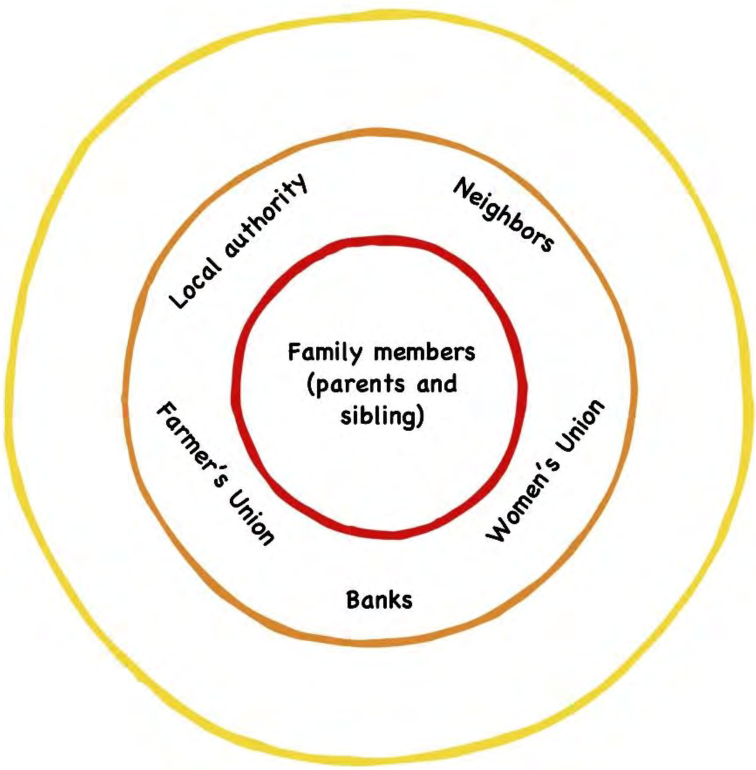
No.	Aspects of Well-being	Ranking Score		
		Vulnerable Group	Van Kieu Group	Agriculture and Forestry Group
1	How satisfied are you with your standard of living?	3	9.3	8.8
2	How satisfied are your with your health?	5	8.7	6.5
3	How satisfied are you with what you are achieving in life?	4	8.0	9.3
4	How satisfied are you with your personal relationships?	10	9.9	9.2
5	How satisfied are you with how safe you feel?	6	9.4	6.2
6	How satisfied are you with feeling part of your community?	9	9.4	9.0
7	How satisfied are you with the quality of your local environment?	5	9.0	9.2
8	How satisfied are you with time allocation for a hobby?	3	8.7	7.8

Source: Socio-economic survey conducted by ERM, 2020

Well-being ranking by vulnerable groups is relatively similar to the Van Kieu group. In the Van Kieu group, all respondents show high satisfaction towards personal relationships and community cohesion, but they are concerned about achievement in life, health status, and time allocation for a hobby (FGD, Van Kieu group, Hoong Moi village, 13th February 2020). Through the FGD with the agriculture and forestry group in Xa Bai village, all respondents rank the highest satisfaction towards achievement in life, local environment, and community cohesion, but the most serious aspects of their well-being are health issues and local security (FGD, agriculture and forestry group, Xa Bai village, 13th February 2020).

In terms of circles of support, the most important groups for vulnerable group are family members including parents and siblings (see Figure 9.79). Neighbours, local authorities, Farmer's Union, Women's Union, and banks are seen as a second order circle of support. Neighbours provide support in cultivation activities by working together. Households can borrow money from each other for weddings or in need cases and then they use their own labour for paying debts. Local authorities provide people with information about training program and cultivation support. Farmer's Union provide seedlings, fertilizers and training for farmers while Women's Union support local people with production loans program. In addition, local people can get support from social policy banks for loans.

The FGD with the vulnerable group also indicates that all vulnerable households struggle with their daily living when they have no enough food. Most of them have to go to local forests for seeking food such as bamboo, vegetable, banana, and other forest products.



Source: Socio-economic survey conducted by ERM, 2020

Figure 9.79 Circles of Support Defined by Vulnerable Group

10. ENVIRONMENTAL IMPACT ASSESSMENT

This chapter presents the impact assessment for key scoped in environmental aspects for this Project, which are identified in the scoping matrix (Table 5.3). The impact assessment method is described in Chapter 4. The outcomes of the assessment will inform the development of the ESMP, which be used to provided details of the mitigation measures, monitoring and auditing of potential impacts.

10.1 Air Quality Impact Assessment

10.1.1 Scope of Assessment

Activities in the construction phase which causing the potential impacts to air quality and stakeholders who are identified as receptors of the impacts are listed in Table 10.1.

Activities during the operation phase is likely to have an insignificant impact on air quality. Therefore, the scope for impact assessment on air quality is limited to only activities in the construction phase for this ESIA.

Table 10.1 Scope of Air Quality Impact Assessment

Phases	Potential Activities	Potential Impacts	Potential Consequences	Receptor
■ Pre-Construction, ■ Construction and Decommissions	Land preparation and civil works such as land clearance, demolition, earthworks	■ Increased dust (e.g. PM10) from ground preparation, work sites and material / equipment transportation ■ Exhaust emissions (e.g. SOx, CO, NOx) from movement and operation of construction vehicles, machinery and other heavy equipment such as bulldozers, excavators, compactors and diesel generator	■ Annoyance and nuisance to the general public as a result of dust deposition on properties, dwellings, cultural heritage sites and places of business ■ Increased effects of morbidity/ reduced health due to exposure to dust and exhaust emissions	■ Nearby residents ■ Construction workers
	Substation, transmission line, access road, laydown area construction			
	Operation of associated facilities such as the concrete batching plant, diesel generator for power supply			
	Transportation of equipment and materials, workers daily movement			

10.1.2 Relevant Guidelines and Criteria

10.1.2.1 Vietnam Regulations

- Circular No. 16/2009/TT-BTNMT dated 7th October 2009 on guiding the implementation of National technical regulations on environmental protection;
- Circular No. 32/2013/TT-BTNMT dated 25th October 2013 on guiding the promulgation of National technical regulations on environment;
- QCVN 05:2013/BTNMT - National Technical Regulation on Ambient Air Quality;
- QCVN 06:2009/BTNMT - National Technical Regulation on Hazardous Substance in Ambient Air.

10.1.2.2 International Guidelines

- IFC Performance Standards 3: Resource Efficiency and Pollution Prevention requires to the Project to consider ambient conditions and apply technically and financially feasible resources efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimise adverse impacts on human health and environment;
- IFC EHS General Guidelines (Section 1.1, 2007): Air Emission and Ambient Air Quality contains common techniques for emission management that can be applied to a range of industry sectors. The guideline provides suggested approaches for the management of potentially significant emission sources and includes specific guidance for monitoring and assessment of impacts.

10.1.3 Baseline Conditions

The air quality data are referenced from the 2019 Environmental Monitoring Report of Huong Linh 2 Wind Farm Project which is far about 3 km to the east.

The sample was taken by Center for Natural Resources and Environment Monitoring of Quang Tri on 8th August 2019 and 15th November 2019 at the Huong Linh 2's substation for analysing parameters of air quality, based on 05:2013/BTNMT – National Technical Regulation on Ambient Air Quality.

The results showed that at the sampling time, all analysed parameters fell below thresholds' value of the QCVN 05:2013/BTNMT. Therefore the air quality is generally in good conditions.

10.1.4 Impact Assessment during the Pre-construction and Construction phase

10.1.4.1 Potential Impacts

The assessment identified the following impacts that may arise from construction activities:

- Increase dust and particulate matter emission (TSP, $PM_{2.5}$, and PM_{10}) from earthworks, site preparation activities (land clearing, levelling, excavation, etc.) and construction activities;
- Generate gaseous pollutants from fuel combustion by machines;
- Exhaust emissions from construction machinery and other heavy equipment such as bulldozers, excavators, compactors and diesel generator;
- Exhaust emission (SO_2, CO, NO_2, NH_3) from road transport of equipment and material;
- Exhaust smoke from burning cleared vegetation; and
- Exhaust emissions from strengthening and maintenance activities of access roads.

10.1.4.2 Existing controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Impacts of dust and air emission from vehicle
  - Establish the schedule for construction phase and construction methods, choose transport route and types of vehicle approximately to reduce impacts of dust and air emission;
  - Spray water and shield at the construction area in sunny and windy days;
  - Separate lanes of vehicles at construction areas. Cleaning workers will be arrange to ensure clean the project areas;
  - The certificates of technical safety and environmental protection of road vehicles are requires for vehicles, machinery and equipment which will be used; and
  - Install waring and traffic signs to ensure safety in transportation.

- Impacts of dust from excavation and levelling activities
  - Spray water at the construction area;
  - Deploy constructions activities of each package until completion to easily control and limit pollution on a large scale;
  - Arrange daily cleaning workers at the intersection with the road to the project area; and
  - Provide PPEs for workers.

10.1.4.3 Significant of Impacts

The Institute of Air Quality Management (IAQM) screening criteria states that a detailed assessment will normally be required where there is:

- A human receptor within:
  - 350 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).
- An ecological receptor within:
  - 50 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

The construction activities will likely cause some impacts to the communities living along the transportation routes and nearby the Project area. Therefore, a detailed assessment will be necessary.

10.1.4.3.1 Determine the Magnitude of the Impact

10.1.4.3.1.1 Methodology

The IAQM defines the dust emission magnitude based on the scale of the anticipated works. The criteria for estimating the magnitude of dust impacts from demolition[43] , earthworks[44] , construction[45] and track-out[46] as per the IAQM guidance note is presented in Table 10.2 and is used to inform the impact assessment.

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[43] Demolition is any activity involved with the removal of an existing structure (or structures). This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time.

[44] Earthworks covers the processes of soil-stripping, ground-levelling, excavation and landscaping.

[45] Construction is any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc.

[46] Track-out is the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

Table 10.2 Dust Emission Magnitude

Activity	Impact Magnitude		
	Small	**Medium**	**Large**
Demolition	Total building volume < 20,000 m3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities < 10 m above ground, demolition during wetter months.	Total building volume 20,000 m3 – 50,000 m3, potentially dusty construction material, demolition activities 10-20 m above ground level.	Total building volume >50,000 m3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.
Earthworks	Total site area < 2,500 m2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 20,000 tonnes, earthworks during wetter months.	Total site area 2,500 m2 – 10,000 m2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m - 8 m in height, total material moved 20,000 tonnes - 100,000 tonnes.	Total site area >10,000 m2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved >100,000 tonnes.
Construction	Total building volume < 25,000 m3, construction material with low potential for dust release (e.g. metal cladding or timber).	Total building volume 25,000 m3 – 100,000 m3, potentially dusty construction material (e.g. concrete), on site concrete batching.	Total building volume >100,000 m3, on site concrete batching, sandblasting.
Track-out	<10 HDV (> 3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.	10 - 50 HDV (> 3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.	> 50 HDV (> 3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100 m.

10.1.4.3.1.2 Assessment

Soil will be excavated broadly within 26.36 ha of the Project's fixed land occupation area. According to the construction plan of the Project, soil volume will be excavated and of which (100%) will be reused for ground levelling. Therefore no excavated soil will be transported out of the Project site. According to Table 10.2, the impact magnitude is Small.

The construction materials (sand, stones, cement, bricks) will be transported to the Project site by 3.5-ton to 12-ton trucks via National route and inter-village route. The construction period is estimated about 15 months. Considering that the National route No. 9 is in very good condition which will unlikely generate any dust from the road surface, the intervillage route is unpaved road which may increase dust from the road surface but this impact will occur only in 15 months of construction phase. Therefore, impact magnitude of dust emission during materials transportation period is considered Small.

In conclusion, the magnitude of impact from construction activities to air quality is considered Small.

10.1.4.3.2 Determine the Sensitivity of the Area

The IAQM defines the sensitivity of the area based on receptor type and the number of receptors within a certain distance from the source. Residential properties, schools, and hospitals are classified as high sensitivity to dust soiling and health effects. Locations where there are particularly important plant species (i.e. rice paddy) are classified as medium sensitivity. The criteria for estimating the sensitivity of the area as per IAQM guidance is presented in Table 10.3 and Table 10.4. The guidance provides a screening criterion of 350 m and 50 m from the construction site and access road respectively, beyond which impacts are not considered likely.

Table 10.3 Criteria for Assessing the Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: For track-out the distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, track-out may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider track-out impacts up to 50 m from the edge of the road.

Table 10.4 Criteria for Assessing the Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>=1	Low	Low	Low	Low	Low

Note: For track-out the distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, track-out may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider track-out impacts up to 50 m from the edge of the road.

10.1.4.3.2.1 Assessment

The scoping study, information from the FS and satellite imagery identified that:

- The distance from the turbines to the nearest households is greater than 300 m, complying with Circular No. 02/2019/TT-BCT on Wind Power Project Development and Power Purchase Agreement for Projects Thereof. Therefore, the sensitivity of the Area to Dust Soiling Effect is considered Low;
- The Sensitivity of the Area to Dust Effects on People living along transportation route is considered Medium;
- The results of the baseline ambient air quality monitoring showed the air quality of the project area and surrounding area is good. Therefore, the Sensitivity of the Area to Human Health Impacts of these receptors is considered Low.
- Overall, bases on above analysis, the Sensitivity of receptors is considered Low.

10.1.4.3.3 Determine the Impact Significance

The significance of impacts on air quality during the construction phase is presented in Table 10.5.

Table 10.5 Impacts on Air Quality during Construction Phase

<table>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Increased dust and gaseous pollutants are considered Negative</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">Nearby residential areas are directly impacted by increased dust and gaseous pollutants</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td colspan="2">Permanent</td></tr>
<tr><td colspan="5">Impacts are temporary and only present when stated activities are ongoing during the construction phase</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>Global</td></tr>
<tr><td colspan="5">Impacts are within the Project area and the immediate surroundings</td></tr>
<tr><td>Impact Frequency</td><td colspan="5">Intermittent over the construction period</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">The impact magnitude is Small</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td colspan="2">Low</td><td colspan="2">Medium</td><td>High</td></tr>
<tr><td colspan="5">Residential areas, construction workers and farm houses near the project area may be inadvertently affected</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">The significance is Negligible</td></tr>
</table>

10.1.4.4 Additional mitigation measures

The following additional mitigations measures are based on ESIA requirements to minimise impacts associated with air emissions:

- Develop and implement a Traffic Management Plan to reduce the impacts of dust and emissions from transport vehicles;
- Install fences at least 1 m height in compliance with the Circular No. 14/2014/TT-BXD around the construction sites to prevent dust dispersion to surrounding areas;
- Cover construction material trucks during the transportation;
- Control the speed limit of trucks and other vehicles, so as not to exceed 10 km/h within the Project's boundaries;
- Design areas of construction, stockpile areas and other exposed soils such as in order to minimise vehicle movements over these areas;
- Maintain all vehicles and equipment in good working order; and
- No open burning on the construction site. If required, cleared vegetation should be transferred to competent non-hazardous waste disposal contractors, composed or reused for stabilisation purposes.

10.1.4.5 Monitoring and Auditing

The local EPP recommended for air monitoring program in construction phase:

- Parameters: Temperature, humidity, wind speed, dust, CO, NOx, SO_2.
- Monitoring locations: 03 locations
  - 02 location at the construction site; and
  - 01 location at the road to access the Project area.
- Frequency: every six months.
- Regulations:
  - QCVN 05:2013/BTNMT – National Technical Regulation on Ambient Air Quality;
  - QCVN 26:2016/BYT – National Technical Regulation on Microclimate – Permissible Value of Microclimate in the Workplace.
- No additional specific monitoring or auditing is recommended.

10.1.4.6 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be expected to Negligible.

10.1.5 Impact Assessment during Operation Phase

The potential impacts on air quality from operation activities (e.g. WTG operations, inspection and maintenance) are considered negligible so no further assessment is needed.

10.2 Water Resource Impact Assessment

10.2.1 Scope of Assessment

This section discussed the potential impacts of the Project's construction activities to the water resources (surface water and groundwater). Activities causing the potential impacts to water availability and quality as well as receptors of the impacts are described in Table 10.6.

Activities causing the potential impacts to freshwater quality including:

- Land preparation and civil works;
- Substation, transmission line, laydown area and office construction;
- Operation of associated facilities such as the concrete batching plant;
- Waste and wastewater management from construction activities and worker's activities; and
- Hazardous storage and handling.
- Activities during the operation phase is likely to have an insignificant impact on water quantity and quality. Therefore, the scope for impact assessment on water resources is limited to only activities in the construction phase for this ESIA.

Table 10.6 Scope of Water Resource Assessment – Construction Phase

Potential Activities	Potential Impacts	Potential consequences	Receptors
■ Land preparation and civil works ■ Substation, transmission line, access road, laydown area construction	■ Increased turbidity due to suspended sediment washed into stream and creeks ■ Increased contaminants such as heavy metals, oil and grease etc. washed into surface water bodies	■ Aquatic ecology is affected due to increased turbidity and pollution ■ Decreased quality of surface water which	Nearby surface water bodies

Potential Activities	Potential Impacts	Potential consequences	Receptors
■ Operation of associated facilities such as the concrete batching plant ■ Waste and wastewater management from construction activities and worker's activities ■ Hazardous waste storage and handling	(such as creeks) from construction activities ■ Waste discharged from construction activities and worker's activities ■ Spillage of oil, chemicals, hazardous chemical from use of vehicles and construction machines during the construction phase ■ Reduction in downstream water availability and groundwater resources which may cause conflicts of water demand of local community	is used for domestic lives of local people	

10.2.2 Relevant Guidelines and Criteria

10.2.2.1 Vietnam Regulations

- Circular No. 16/2009/TT-BTNMT dated 7th October 2009 on guiding the implementation of National technical regulations on environmental protection;
- Circular No. 32/2013/TT-BTNMT dated 25th October 2013 on guiding the promulgation of National technical regulations on environment;
- QCVN 08-MT:2015/BTNMT – National Technical Regulation on Surface Water Quality;
- QCVN 09-MT:2015/BTNMT – National Technical Regulation on Groundwater Quality;
- QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater;
- Decree No. 149/2004/ND-CP: Government Decree on Regulation on Insurance of Permits for Water Resource Exploration, Exploitation and Use, or for Discharge of Wastewater into Water Source; and
- Decree No. 67/2003/ND-CP regarding Environmental Protection Fees and Charges for Wastewater.

10.2.2.2 International Guidelines

- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention requires the Project to consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and environment;
- IFC Performance Standard 6: Biodiversity Conversation and Sustainable Management of Living Natural Resources recognized that protecting and conserving biodiversity, maintaining ecosystem services and sustainably managing living natural resources and fundamental to sustainable development;
- IFC General EHS Guidelines (Section 1.3, 2007): Wastewater and Ambient Water Quality contains guidelines for projects that have discharge of process water, wastewater from utility operations or storm water to environment. The guidelines provide suggested approaches for the management of wastewater, including water conservation, wastewater treatment, storm water management and wastewater and water quality monitoring;
- IFC General EHS Guidelines (Section 1.4, 2007): Water Conservation contains general recommendations for water conservation programmes, water monitoring and management programmes and process water reuse and recycling; and

- IFC General EHS Guidelines (Section 4.0, 2007): Construction and Decommissioning provides specific guidance on prevention and control of community health and safety impacts that may occur during new project development. It covers various aspects of the environment, including noise and vibration, soil erosion, air quality, solid waste, hazardous materials, wastewater discharges etc. It also covers occupational and community health and safety.

10.2.3 Baseline Conditions

A baseline of surface water quality is referenced from the 2019 environmental monitoring report of Huong Linh 2 Wind Farm Project which is far about 3 km to the east.

The sample was taken by Center for Natural Resources and Environment Monitoring of Quang Tri on 8th August 2019 and 15th November 2019 at Khe Nghi point (the intersection with Hoong Coc inter-village road) for analysing parameters of water quality, based on QCVN 08-MT:2013/BTNMT – National Technical Regulation on Surface Quality.

The results showed that all analysed parameters fell below thresholds' of QCVN 08-MT:2013/BTNMT – National Technical Regulation on Surface Quality. In conclusion, the surface water quality around the Project area is in good condition.

10.2.4 Impact Assessment

10.2.4.1 Potential Impact

The assessment identified the following impacts that may arise from construction activities:

- Increase turbidity due to sediment washed into freshwater water bodies;
- Increase contaminants washed/seep into fresh water bodies;
- Discharge waste from construction activities; and
- Reduction in downstream water availability and groundwater resources which may cause conflicts of water demand of local community.

10.2.4.2 Existing Controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Domestic waste water: To build septic toilets in construction phase for workers;
- To manage wastewater generating during construction phase as following measurements:
  - Utilise maximum water for maintenance activities;
  - Save water during concrete mixing process; and
  - To minimize the leakage of grease from machines.
- Rain water
  - To check regularly to ensure no block the drainage system;
  - To build a warehouse which stores material and/or cover machine when raining;
  - Only do maintain machine and vehicles at the garage;
  - To build the synchronized drainage system;
  - To collect solid waste into trash; and
  - Do not put material nearby drainage system to prevent falling into the system.

10.2.4.3 Significance of Impacts

For the assessment of water quantity and quality, the sensitivity and magnitude criteria are outlined in Table 10.7 and Table 10.8 respectively based on the guideline of the ERM Impact Assessment Standard.

Table 10.7 Sensitivity Assessment Criteria for Water Resources

Sensitivity Criteria	Contributing Criteria	
	Environment	Social
Water Resources – Surface water and ground water (quality/ quantity related criteria	The extent to which the water resource plays an ecosystem or amenity role in terms of supporting biodiversity either directly or indirectly, particularly with respect to dependent ecosystems.	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic or industrial, use as waterways) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation.
Low	The water resource does not support diverse aquatic habitat or populations, or supports aquatic habitat or population that is of low quality.	The water resource has little or no role in terms of provisioning services as agricultural water source, other domestic uses as washing, bathing, industrial use and waterways for the local community. The groundwater resource is not currently abstracted and used in the vicinity of the Project, but is of sufficient quality and yield to be used for that purpose in the future (and there is a reasonable potential for future use).
Medium	The water resource supports diverse populations of flora and fauna but available in the surface water bodies in the region.	The surface water resources have local importance in terms of provisioning services but there is ample capacity and/or adequate opportunity for alternative sources of comparable quality. The groundwater resource is an important water supply, and is currently being used, but there is capacity and/or adequate opportunity for alternative resources of comparable quality.
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species.	The surface water resources are wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or transboundary watershed level for provisioning services. The groundwater resources is wholly relied upon locally, with no suitable technically or economically feasible alternatives. The development stage of groundwater is critical or over exploited.

Table 10.8 Criteria for Impact Magnitude for Water Resource Impact Assessment

Magnitude Criteria	Negligible	Small	Medium	Large
General Criteria	No perceptible or readily measurable change from baseline conditions	Perceptible change from baseline conditions but likely to be within applicable norms and standards for model of use.	Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and/or likely to approach and even occasionally exceed applicable norms and standards for mode of use.	Major changes in comparison to baseline conditions and/or likely to regularly or continually exceed applicable norms and standards for mode of use.
Water Quantity	There is likely to be negligible or no consumption of surface water by the Project at any time	The Project will consume surface water, but the amounts abstracted are likely to be relatively small in comparison to the resources available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be significant in comparison to the resource available at the time of use (i.e taking into account seasonal fluctuation).	The Project will consume surface water, and the amounts abstracted are likely to be very significant in comparison to the resources available at the time of use ((i.e taking into account seasonal fluctuation).
Water Quality	Water quality impacts are likely to be well within ambient levels or allowable criteria Discharges are expected to be well within statutory limits Potential short-term localized effects on water quality but likely to be highly transitory (e.g. lasting a matter of hours) and well within natural fluctuations	Water quality impacts are likely to be well within ambient levels or allowable criteria Discharge are expected to be within statutory limits Potential short-term localized effects on water quality but which are likely to return to equilibrium conditions within a short timeframe (e.g. hours or days at most)	Water quality impacts are likely to result in occasional exceedances of ambient levels or allowable criteria Occasional breaches of statutory discharge limits (limited periods)expected Potential localized effects on water quality which are likely to be fairly long lasting (e.g. weeks or months) and/or give rise to indirect ecological and/or socio-economic impacts	Water quality impacts are likely to routinely exceed ambient criteria levels or allowable criteria over large areas. Repeated breaches of statutory discharge limits (over extended periods) expected Potentially severe effects on water quality which are likely to be long-lasting (e.g. months or more) or permanent and/or give rise to indirect ecological and/or socio – economic impacts.

The project obtains water for construction from surface water body that is seasonal flow and groundwater for domestic purpose from predefined wells. Regarding the receptor sensitivity, the sensitivity has been assessed as High for social receptor taking into account the chances of an overexploited source of groundwater, causing scarcity of water in the region. The social survey findings indicate that the vast majority of affected households rely on groundwater as a sources of drinking water. Water for domestic use (bathing, washing) is taken from two streams flowing around the village. Overall, regards to Water Quantity Impact Assessment, the impact significance in the construction phase has been assessed as Moderate.

In term of Water Quality, the water quality is reported as polluted by agricultural activities with pesticides and their residues during the social baseline survey. Therefore, the wastewater discharged from construction activities could have negative impact on surface water quality. Given good practice and existing/in-place control measures, the magnitude impact of wastewaters and waste from the construction activities and presence of the workers to surface water quality is considered to be Medium. Overall, regards to Water Quality Impact Assessment, the impact significance in the construction phase has been assessed as Moderate.

Table 10.9 and Table 10.10 and presented the Significance Impact on Water Resource in term of Water Quantity and Water Quality in the construction phase.

Table 10.9 Impact on Water Quantity during the Construction Phase

Impact Nature	**Negative**	Positive		Neutral	
	Decrease of water resources in term of surface water and ground water is considered **Negative**				
Impact Type	**Direct**	Indirect		Induced	
	Decrease of water sources **directly** affects locals that are dependent on the ground water and surface water body.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact duration is **Short-term** and only present when stated activities are ongoing during the construction phase				
Impact Extent	**Local**	Regional		Global	
	Impacts are within the Project area and the immediate surroundings.				
Impact Frequency	Intermittent over the construction period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is **Medium**				
Receptor Sensitivity	Low	Medium		**High**	
	The vulnerability of receptors is **High** taking into account the chances of an overexploited source of groundwater, causing scarcity of water in the region.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The significance is **Moderate.**				

Table 10.10 Impact on Water Quality for the Construction Phase

Impact	Water Resource Impact Assessment		
Impact Nature	**Negative**	Positive	Neutral
	Increased pollution of freshwater quality is considered **Negative**		
Impact Type	**Direct**	Indirect	Induced

	Pollution in freshwater sources **directly** affect locals that are dependent on the fresh water body.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact duration is **Short-term** and only present when stated activities are ongoing during the construction phase				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the Project area and the immediate surroundings.				
Impact Frequency	Intermittent over the construction period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is **Medium**				
Receptor Sensitivity	Low	**Medium**	High		
	The vulnerability of receptors is **Medium** as pollution of water resources will affect those locals that use fresh water bodies for domestic uses and agricultural activities.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The significance is **Moderate.**				

10.2.4.4 Additional Mitigation and Management Measures

The following additional mitigations measures are based on ESIA requirements to minimise impacts associated with freshwater quality:

- Collect and store solid waste, domestic waste and hazardous waste in containers during both construction and operation phases;
- Solid waste will be collected, stored and processed by functional units in accordance to Circular No. 36/2015/TT-BTNMT;
- Domestic solid waste will be collected daily. The project investor will sign an agreement with functional units for transporting and handling respective wastes;
- Domestic wastewater will be collected and processed by the septic tanks;
- Hazardous waste to be collected and stored by project owners and handled by the official hazardous disposal organisation, in accordance with Circular No. 36/2015/TT-BTNMT date 30/06/2015;
- Establish internal rules and activities for environmental protection, including littering and disposal of wastes;
- Select appropriate methods and equipment to reduce disturbances to fresh water;
- Develop and establish a Soil and Erosion Management Plan;
- Establish rain water/storm water drainage system to collect and remove oil prior to discharge into receiving bodies (at the operation house and the substation area);
- The storage space where materials such as sand, machinery and equipment are stored should be covered carefully and this storage space should be on a raised platform to avoid surface runoff during rainfall;
- Equipment will be regularly checked for oil leakage;
- Prohibit discharging of waste and wastewater directly into fresh water bodies; and
- Supervise implementation of proposed mitigation measures by the Contractors.

10.2.4.5 Monitoring and Auditing

The local EIA recommended for the monitoring program in construction phase:

- Parameters: pH, DO, BOD_5, TSS, COD, NO^{3-}, $PO4^{3-}$, Oil and Grease for surface water;
- Monitoring locations: 02 locations
  - 01 location at Xa Bai stream (WGS84 Latitude: 16.70566214; Longitude: 106.73090336); and
  - 01 location at Rao Quan lake (WGS Latitude: 16.70797900; Longtitude: 106.72156946).
- Frequency: Every six months.
- Regulation: QCVN 08-MT:2015/BTNMT – National Technical Regulation on Surface Water Quality.

No additional specific monitoring or auditing is recommended.

10.2.4.6 Residual Impact

With the implementation of the above mitigation measures, the residual impacts would be anticipated to be Minor.

10.3 Soil Impact Assessment

10.3.1 Scope of Assessment

The key activities that are likely to have negative impacts on land and soils, including:

- Pre- Construction and Construction Phases
  - Groundworks and construction activities resulting in soil compaction and loss of soil stabilising vegetation, hence increasing surface runoff and localised erosion such as:
    - Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon;
    - Excavation for WTG foundations and electrical poles; and
    - Construction of internal road system.
  - Accidental leaks/spills of fuel, oil and hazardous materials/waste from machine during construction phase.
- Operation phase: Spillage of fuel, oil, chemicals and hazardous materials from Operation and Maintenance activities from O&M machine and turbines that might contaminate soil.

The Scope of Soil Environment Impact Assessment which listed potential impacts and consequences as well as identified receptors is described in Table 10.11.

Table 10.11 Scope of Soil Environment Assessment

Phase	Potential Activities	Potential Impacts	Potential consequences	Receptors
Construction phase	Groundworks and construction activities: ■ Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon	■ Loss of soil stabilizing vegetation; ■ Soil compaction and erosion;	■ Loss of top soil quality would affect cultivation productivity ■ Loss of forest for WTG foundation	Soil quality in the Project area

Phase	Potential Activities	Potential Impacts	Potential consequences	Receptors
	■ Excavation for WTG foundations and electrical poles ■ Construction of internal road system	■ Soil contamination.	construction by removal of stabilized top soil might potentially result in increased sediment in surface runoff and localized soil erosion	
	■ Accidental leaks/spills of fuel, oil and hazardous materials/waste from machine during construction phase			
Operation Phase	Spillage of fuel, oil, chemicals and hazardous materials from Operation and Maintenance activities			

10.3.2 Relevant Guidelines and Criteria

10.3.2.1 Vietnam Regulations

- Circular No. 16/2009/TT-BTNMT dated 7th October 2009 on guiding the implementation of National technical regulations on environmental protection;
- Circular No. 32/2013/TT-BTNMT dated 25th October 2013 on guiding the promulgation of National technical regulations on environment; and
- QCVN 03-MT:2015/BTNMT - National Technical Regulation on the Allowable Limits of Heavy Metals in Soils.

10.3.2.2 International Guidelines

- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention requires the Project to consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and environment;
- IFC General EHS Guidelines (Section 4.0, 2007): Construction and Decommissioning provides specific guidance on prevention and control of community health and safety impacts that may occur during new project development. It covers various aspects of the environment, including noise and vibration, soil erosion, air quality, solid waste, hazardous materials, wastewater discharges etc. It also covers occupational and community health and safety.

10.3.3 Impact Assessment

10.3.3.1 Soil Compaction and Erosion

10.3.3.1.1 Potential Impact

The potential impacts from construction activities of WTG foundation, transmission line pylon and other components include:

- Loss of soil stabilizing vegetation; and
- Soil compaction and erosion.

10.3.3.1.2 Existing controls

- There are no existing controls.

10.3.3.1.3 Significance of Impact

The significance of impacts on freshwater quality during the construction phase is presented in Table 10.12.

Table 10.12 Impact on Soil compaction and erosion in the Construction and Decommissioning Phase

Impact Nature	**Negative**		Positive		Neutral
	Increased pollution of freshwater quality is considered **Negative**				
Impact Type	**Direct**		Indirect		Induced
	Soil compaction and erosion **directly** affect local community's livelihood as cultivation activities is their main livelihood.				
Impact Duration	Temporary	**Short-term**	Long-term		Permanent
	The impact duration is **Short-term** during the construction phase				
Impact Extent	**Local**		Regional		Global
	Impacts are within the Project area and the immediate surroundings.				
Impact Frequency	Intermittent over the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is **Negligible**.				
Receptor Sensitivity	Low		**Medium**		High
	The sensitivity of receptors is **Medium** as soil erosion will affect local community's livelihood in minor level.				
Impact Significance	Negligible	**Minor**	Moderate		Major
	The significance is **Minor.**				

10.3.3.1.4 Additional Mitigation Measure

- The following additional mitigations measures are based on ESIA requirements to minimise impacts, including:
- Preparation and implementation of a soil and erosion management plan during construction to incorporate requirements such as use of dust suppression, soil stabilisation during construction and storm water and sediment management and control;
- Site clearance, piling, excavation and construction of the access roads should not be carried out during the monsoon season or during heavy winds to minimize erosion and run-off.
- Procedures for responding to emergencies/accidental spills of hazardous materials, fuel and handling, and waste management are developed and implemented;
- Maintenance works are restricted to specially designated platforms with strict control of accidental spills; and
- Site should be restored at the end of the Project life-cycle to pre-Project level.

10.3.3.1.5 Monitoring and Auditing

No additional specific monitoring or auditing is recommended.

10.3.3.1.6 Residual Impact

With the implementation of the existing controls and additional mitigation and management measures, the residual impacts would be anticipated to be Negligible.

10.3.3.2 Soil Contamination

10.3.3.2.1 Potential Impact

Construction workers working on-site would also generate domestic waste and wastewater, which may be released to the ground if not properly managed. The domestic waste at the construction site include organic waste, plastic, glass. In addition, construction activities will also generate various types of hazardous wastes including oil, lubricants and diesel leaked from machine, equipment and vehicles.

Regarding Operation phase, solid waste generated by the O&M team including oil, waste fuel, grease or disposal of organic waste and domestic waste.

10.3.3.2.2 Exiting Control

The mitigation measures identified in the locally approved regulatory EPP include:

- Domestic waste
  - Provide 02 trash bin and instruct workers to keep clean; and
  - Classify wastes. Domestic waste will be collected and transported by certified agency.
- Solid waste from construction phase
  - Classify domestic solid waste and solid waste from construction phase;
  - Rock and bricks will be sued to level the ground during construction phase;
  - Metals and paper will be collected and sale to local collectors; and
  - Vehicles will be covered with tarpaulins to reduce soil spillage and reduce dust generation;
- Hazardous waste
  - Handle in accordance with Circular No. 36/2015/TT-BTNMT dated 30th June 2015 of the Ministry of Natural Resources and Environment on hazardous waste management.

10.3.3.2.3 Significance of Impact

The significance of impacts on freshwater quality during the construction phase is presented in Table 10.13.

Table 10.13 Impact on Soil Contamination in all the Project's Phase

Impact Nature	**Negative**	Positive		Neutral
Impact Type	**Direct**	Indirect		Induced
	Soil compaction and erosion **directly** affect local community's livelihood as cultivation activities is their main livelihood			
Impact Duration	Temporary	**Short-term**	Long-term	Permanent
	The impact duration is **Short-term** during the construction phase			
Impact Extent	**Local**	Regional		Global

	Impacts are within the Project area and the immediate surroundings				
Impact Frequency	Intermittent over the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The impact magnitude is **Negligible**				
Receptor Sensitivity	Low	**Medium**	High		
	The sensitivity of receptors is **Medium** as soil erosion will affect local community's livelihood in minor level.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor**				

10.3.3.2.4 Additional Mitigation Measures

- The following additional mitigations measures are based on ESIA requirements to minimise impacts, including:
- Contract a competent/licensed contractor to collect, transport and treat domestic, construction and hazardous wastes from the project site;
- Prohibit dumping any types of solid waste to the soil or burning waste on the site;
- Ensure that hazardous materials are stored in designated areas that are designed with impermeable floor, inflammable walls and accessible to authorized personnel;
- Hazardous waste shall be properly managed in accordance with Decree No. 38/2015/ND-CP, Circular No. 36/2015/TT-BTNMT and QVCN 07:2009/BTNMT on Hazardous Waste as follows:
  - Hazardous waste is prohibited to be illegally disposed into the ground;
  - All workers shall be trained on hazardous and non-hazardous waste classification and their handling methods;
  - Proper facilities shall be supplied and areas for hazardous waste storage in the construction sites should be clearly determined in accordance with Circular No. 36/2015/TT-BTNMT;
  - Appropriate organizations with proper license shall be contracted in order to periodically transport and dispose hazardous waste; and
  - A record of hazardous waste should be documented (using the form specified in Circular No. 36/2015/TT-BTNMT) to allow monitoring volume of hazardous waste generated in place and disposed by contractors of hazardous waste. The numeric data in the record must be consistent in order to ensure that no improper disposal is made in the area of the Project or other locations.
- In case of accidental/unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste.

10.3.3.2.5 Monitoring and Auditing

It is recommended that the monitoring program in construction phase should be conducted as follows:

- Parameters: Arsenic, Cadmium, Total Chromium, Copper, Lead and Zinc;
- Monitoring locations: 02 locations
  - 01 location at the substation area; and
  - 01 location at the turbine area.
- Frequency: Every six months.

- Regulation: QCVN 03-MT:2015/BTNMT - National technical regulation on the allowable limits of heavy metals in soil.
- No additional specific monitoring or auditing is recommended.

10.3.3.2.6 Residual Impact

With the additional mitigation measures, the residual impacts caused by soil contamination in all the phases are expected to be Negligible.

10.4 Noise Impact Assessment

10.4.1 Scope of Assessment

The Scope of Noise Impact assessment which listed potential impacts and consequences as well as identified receptors is described in Table 10.14.

Table 10.14 Scope of Noise Impact Assessment

Phases	Potential Activities	Potential Impacts	Potential Consequences	Receptor
Construction	Equipment and material transport and supply	Short-term increase in noise levels	Potential consequences to human health can vary, depending on other factors such as noise level, human health conditions and age. Some studies showed that noise exposure had associated with hearing loss (ADLWD 2019), tinnitus, hypertension, vasoconstriction and other cardiovascular adverse effects (University of California 2019), changes in immune system and birth effects (Passchier 2000). Chronic noise exposure can cause in sleep disturbances and increased rate of diabetes.	Nearby residents Construction workers
	Land preparation and civil works such as land clearance, demolition, earthworks			
	Substation, transmission line and laydown area construction			
	Operation of associated facilities such as the concrete batching plant			
	Transportation of equipment, workers and materials			
	Foundation construction and Installation work of the WTGs			
Operation	Operation of the WTGs and the substation	Long-term increase in noise levels		

10.4.2 Baseline Condition

As wind speed increases background noise levels generally also increase as natural sources such as wind in trees begin to dominate. Noise levels can also change as contributions from other noise sources change. The variation of background noise with wind speed is usually quite site-specific and related to various physical characteristics such as topographic shielding and the extent and height of exposed vegetation. In order to establish wind farm noise assessment criteria, it is therefore usual to carry out background noise monitoring of the pre-existing environment as a function of wind speed. As explained in Section 7.7, however, no representative wind measurement locations were present in the Huong Linh region; therefore, it was not possible to undertake baseline regression analysis of the background noise data with wind speed. Therefore, assessment criteria have been based on the modal value of the available 10-minute noise measurements.

Background noise measurements have been carried out by the ERM's subcontractor at three representative monitoring locations in the vicinity of the GELEX Huong Linh Project site (NML1–3), as shown in Figure 7.10. Details of the noise measurement methodology and measurement equipment can be found in the "Noise Levels In Huong Phung 2,3 and GELEX 1,2,3 Huong Hoa, Quang Tri Province" report. Background noise measurements were carried out between the 12th and 16th of February 2020 in Huong Linh.

The background noise measurements at the three monitoring locations were conducted for a period of 48 hours at 10-minute intervals.

Analyses of the background noise data were carried out to determine the most commonly occurring noise levels through the 48-hour measurement period. Measured noise levels at NML1 and NML3 were generally lower than the IFC noise threshold criteria (55 dB L_{Aeq} and 45 dB L_{Aeq}) during both the day and night respectively and higher at NML2. It was observed that the noise readings were affected by noise from insects at NML2 during the day and night-time, and noise from excavation at NML3 was also a significant noise source during the daytime. These extraneous noise sources were excluded from the analysis as insect noise does not form a consistent feature of the background sound throughout all of the day and night period, and noise from construction activities, such as excavation, is temporary and is not typical of the long term background noise. Therefore, for these periods, assessment criteria have been based on the modal value of the 10-minute noise measurements without these extraneous noise sources.

10.4.2.1 Measurement Locations

Background noise measurements were conducted at three representative receptor locations, which are indicated in Figure 7.10. Details of the noise measurement locations are presented in Table 10.15 below.

Table 10.15: Background Noise Measurement Locations

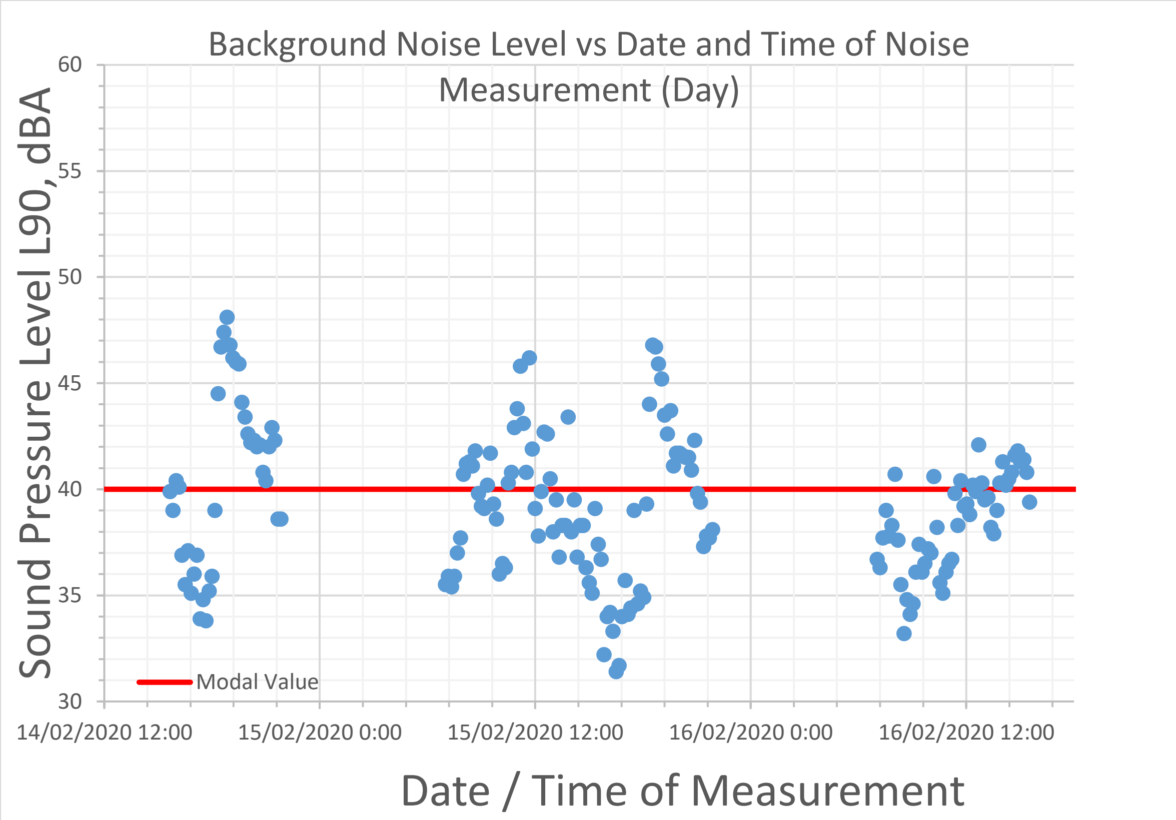
NML ID	Geographical Coordinates		Comment
	Latitude	Longitude	
1	16°42'32.95" N	106°44'11.62" E	Moi Village, Huong Linh Commune, Huong Hoa District
2	16°42'51.74" N	106°44'53.86" E	Moi Village, Huong Linh Commune, Huong Hoa District
3	16°42'19.34" N	106°44'19.56" E	Xa Bai Village, Huong Linh Commune, Huong Hoa District

Note 1: Universal Transverse Mercator coordinate system

10.4.2.2 Background Noise Plot

The measured background noise levels (L_{A90}) for the day and night-time are plotted against the measurement date and time to present typical levels during both periods. As discussed above, however, at NML2 during the day and NML3 during day and night-time, measured levels were driven by noise from excavators and insects respectively for some periods of the measurement. Therefore, the background noise data has only been considered for values of the 10-minute noise measurements where noise was not present as a conservative approach for the assessment.

The results of the background noise monitoring and analysis showing the measured noise data points are shown in Figure 10.1 to Figure 10.3 below for NMLs 1–3. The day and night-time plots show the modal value for the measurement.



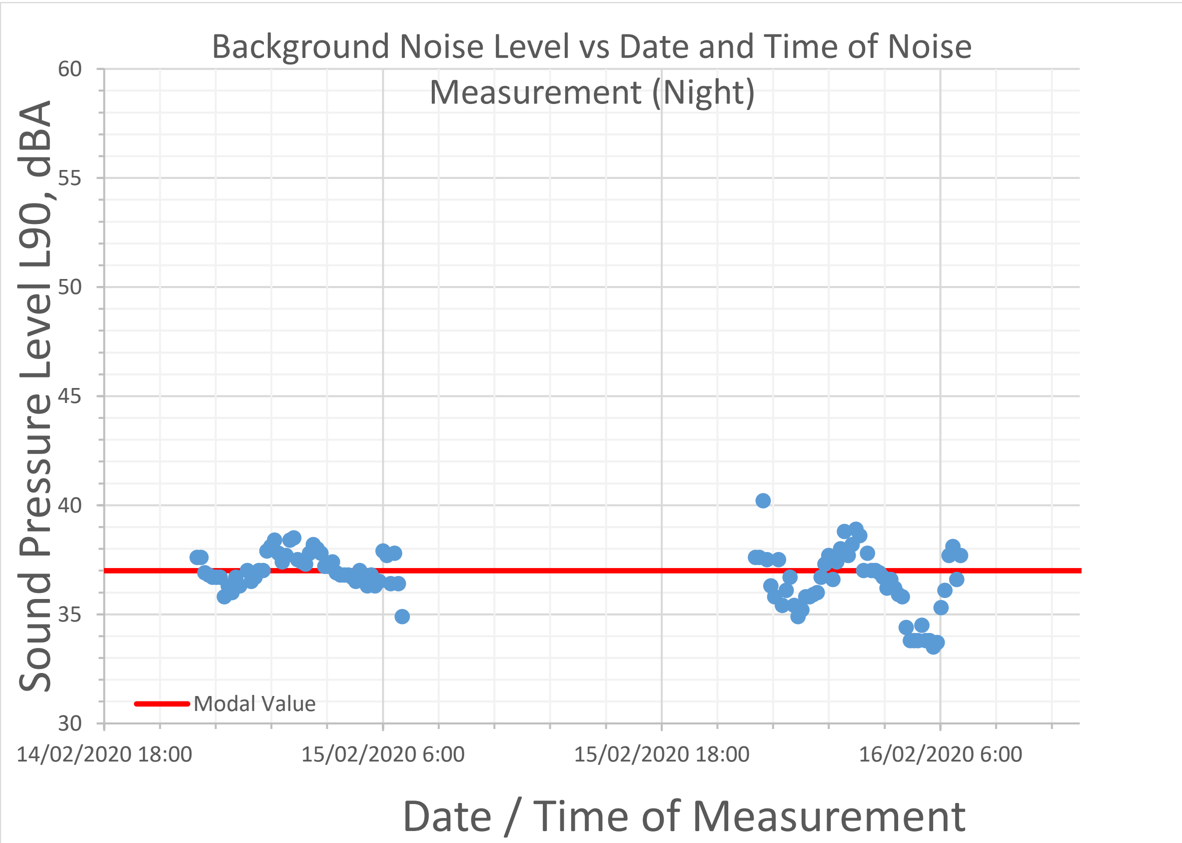
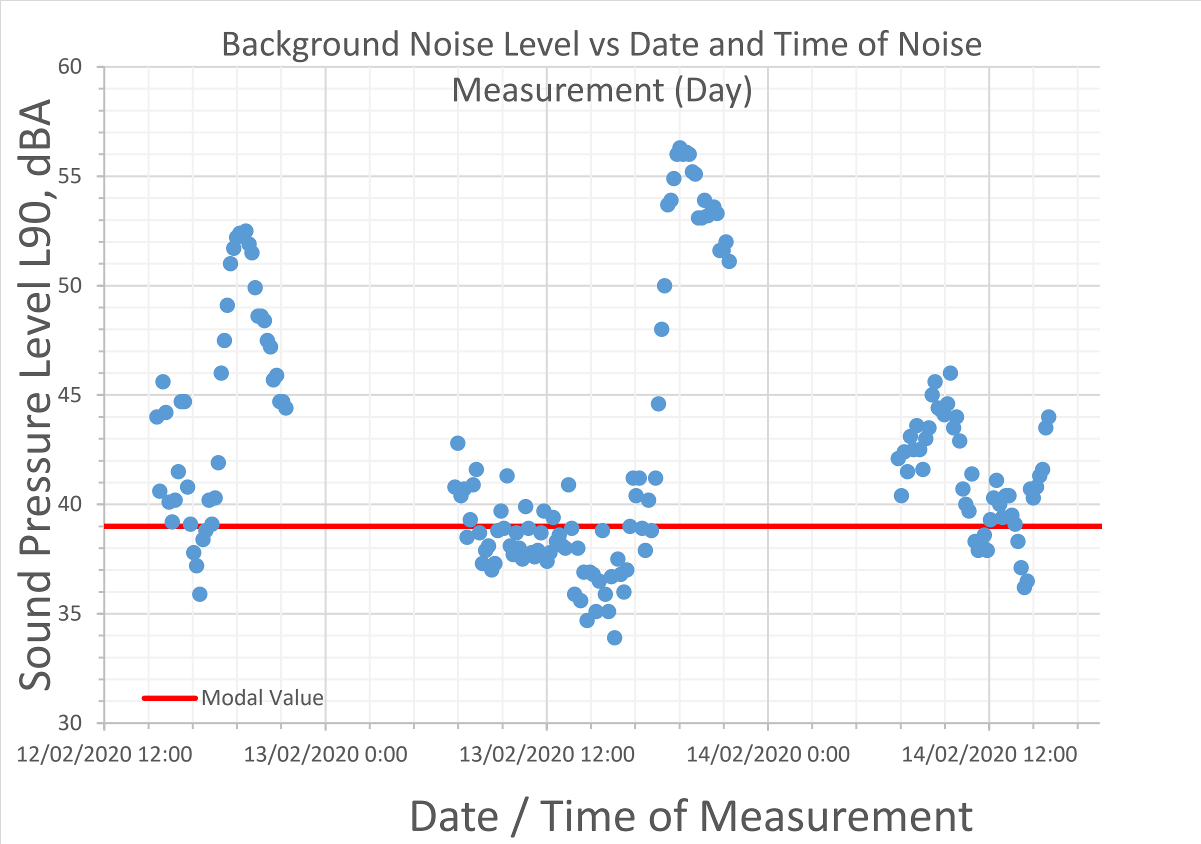


Figure 10.1 NML1 Background Noise



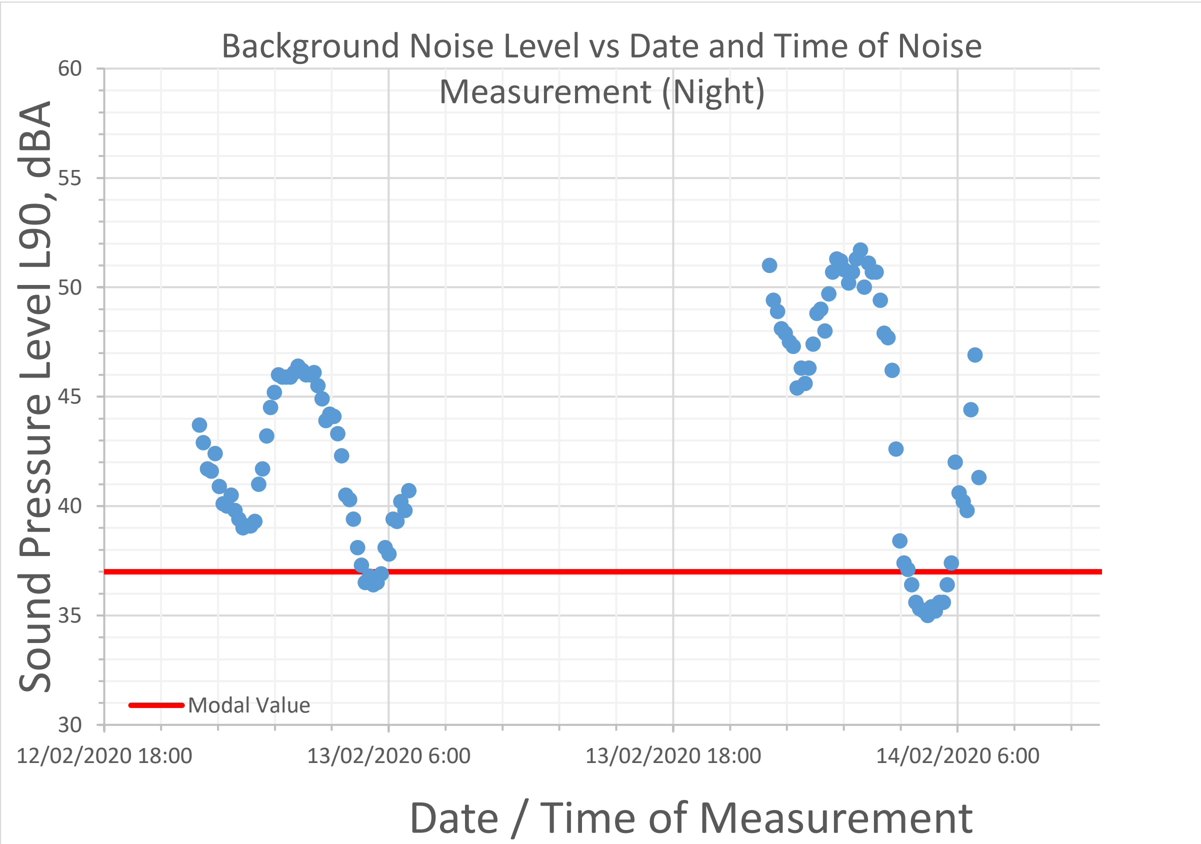
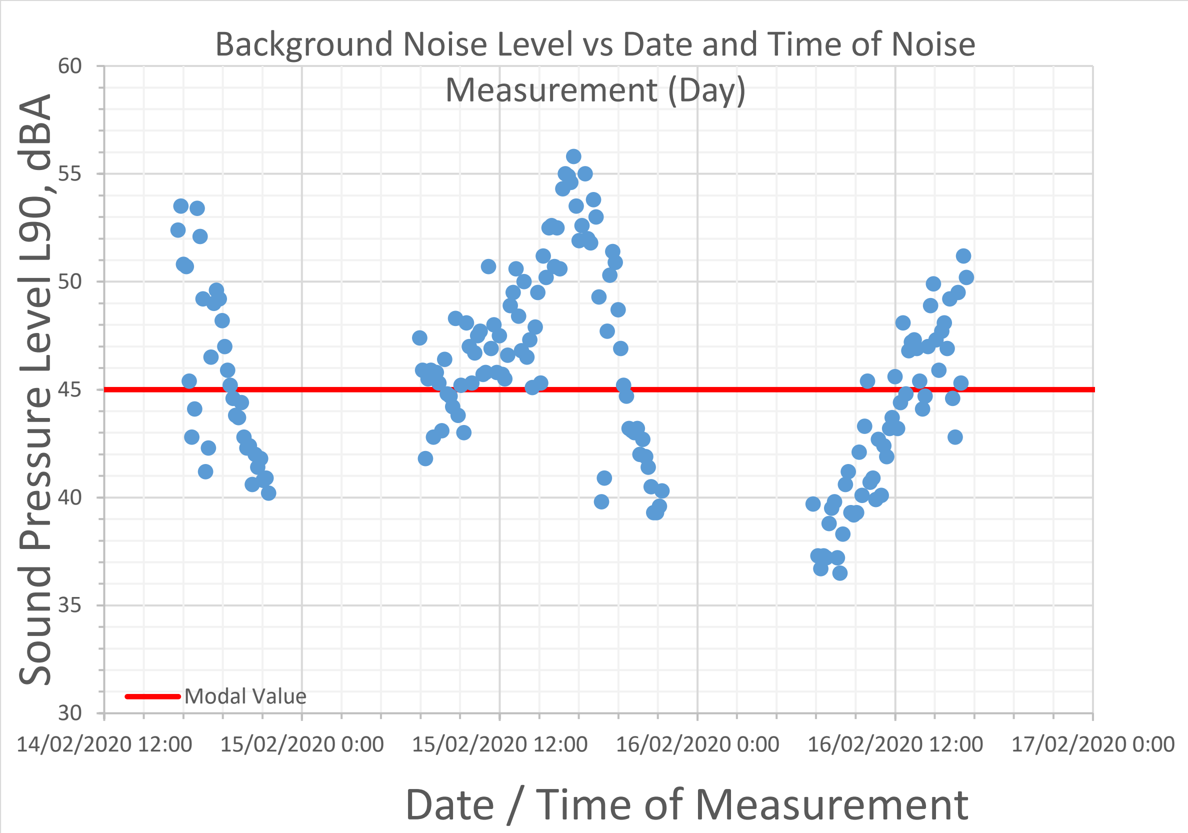


Figure 10.2 NML2 Background Noise



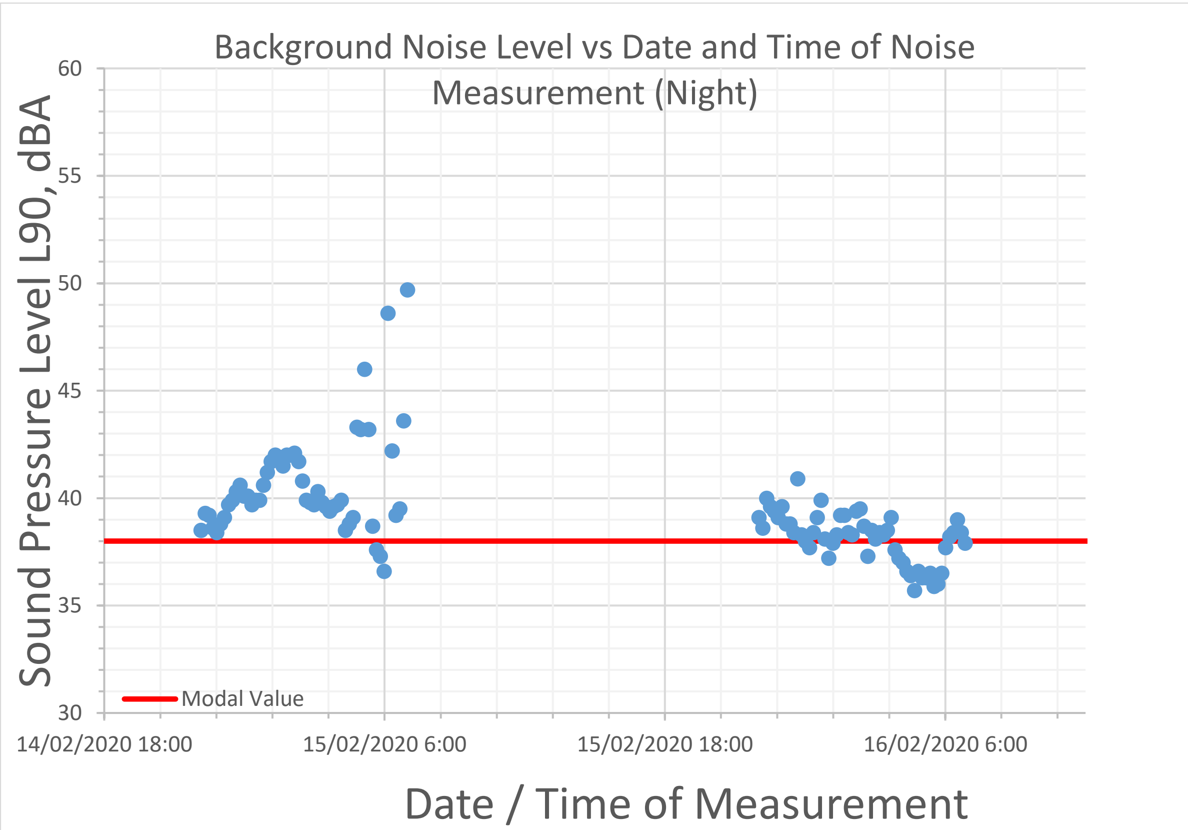


Figure 10.3 NML3 Background Noise

10.4.3 Impacts Assessment during Construction Phase

10.4.3.1 Potential Impacts

The potential impacts and consequences of increased noise levels in the Project area could include several types of disturbance to the community and local fauna. Health impacts that might result from exposure to elevated sound levels include hearing impairment, hypertension, ischemic or coronary heart disease, annoyance and sleep disturbance. Changes to the immune system and birth defects could also be attributed to high noise exposure.

10.4.3.2 Existing Controls

- The locations of turbines must meet a safe distance from the nearest residential area ⩾ 300 according to the Circular No. 02/2019/TT-BCT dated 15/01/2019 of the Ministry of Industry and Trade to minimize the impacts of noise on people;
- Technology selection with low noise and non-infrasound machinery to minimize the impact on people and animals;
- Develop regular maintenance schedules for all vehicles, machines and equipment to detect early problems and reduce unnecessary noise and vibration;
- Regulate the speed of vehicles when operating;
- Provide PPEs if workers work in places where high noise level; and
- Arrange reasonable working time in high noise areas to ensure long-term health for workers.

10.4.3.3 Significance of Impacts

The significance of impacts on freshwater quality during the construction phase is presented in Table 10.16.

Table 10.16 Impacts on Noise during Construction Phase

Impact Nature	**Negative**	Positive	Neutral		
	Disturbance and potential health impacts are considered **Negative**				
Impact Type	**Direct**	Indirect	Induced		
	Exposure to noise causes direct disturbance and potential health impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact duration is **Short-term**				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the Project area				
Impact Frequency	Construction noise will be generated during works and are not anticipated to occur continuously for the full daytime, evening or night time periods. As such, impact frequency is expected to be intermittent over the construction period				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Receptors Sensitivity	Low	**Medium**	High		
	Overall vulnerability is **Medium**				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor**				

10.4.3.4 Additional Mitigation Measures

Based on the findings of the qualitative construction noise assessment presented in the section above noise mitigation will be adopted as follows:

- During construction of the Project good-practice construction noise mitigation and management measures should be implemented to reduce noise levels and minimise any impacts as far as practicable. A range of mitigation and management measures are available and those that are considered feasible, reasonable and practical to implement the specific tasks should be considered, for example:

  - Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient;

  - Ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed from the site; and/or

  - Ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

- During the construction design, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.

- High noise-generating construction works and activities should be limited to the daytime period (7 AM to 10 PM), and work should be avoided on Sundays or public holidays if possible.

- Any works that are required during the night-time period (10 PM to 7 AM) should be justified and task-specific noise mitigation and management measures should be implemented to reduce noise impacts to acceptable levels. These additional measures should consider the potential for sleep disturbance impacts that could occur during the night-time period due to “peak” or “maximum” noise level events e.g. metal on metal contact, or general clangs and bangs.

- Works associated with transmission line and access road construction often require activities in closer proximity to receptors that are not affected by construction works at wind turbines or permanent facilities. In these circumstances, task-specific noise mitigation and management measures should be implemented (when works are close to receptors) to reduce noise impacts to acceptable levels.

- Construction road traffic and heavy vehicle movements have the potential to generate high “peak” or “maximum” noise level events and these should be limited during the night-time period and avoided if possible. Where possible, significant noise-generating vehicle movements should be limited to the daytime period. Where it is not possible for this to occur drivers should be instructed to arrive and depart as quietly as possible. Whilst on-site and in close proximity to receptors the drivers should be instructed to implement good-practice noise management measures to reduce peak noise levels and minimise any impacts as far as practicable. During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.

- If any validated noise complaints are received, the problem source and any potential noise-reducing measures should be identified and evaluated for implementation during the works. If the noise complaint cannot be validated, no further mitigation or management measures are required.

No further recommendations for construction noise mitigation and management measures to those established by the findings of this assessment, and documented in this report, are provided or warranted for the Project. The Project personnel should, however, remain aware of the potential for nuisance, or an unacceptable impact on amenity, to occur due to construction noise, continue to plan for and then manage construction works accordingly.

10.4.3.5 Monitoring and Auditing

- Parameters: Noise.
- Monitoring locations: 03 locations
  - 02 locations at the construction site; and
  - 01 location at the road to access the Project area.
- Frequency: Every six months.
- Regulations: QCVN 24:2016/BYT – National Technical Regulation on Noise – Permissible Exposure Levels of Noise in the Workplace
- No additional specific monitoring or auditing is recommended.

10.4.4 Impact Assessment in Operational Noise

10.4.4.1 Impact Assessment Criteria

The wind farm noise assessment criteria for receptors were based on the modal value of the background noise, and the limits were derived based on an approach that broadly followed the approach in the ETSU-R-97 "*The Assessment & Rating of Noise from Wind Farms*" document referenced in the IFC Environmental, Health and Safety Guidelines for Wind Energy, 2015. Using this approach a noise limit was derived based on background noise which was 5 dBA above background noise (L_{A90}). Since wind turbine noise specification data are provided in terms of L_{Aeq}, the predicted L_{Aeq} noise levels from the wind turbines cannot be compared directly to the L_{A90} criteria. A further 2 dB has been added to convert the L_{A90} criteria to enable direct comparison to the predicted L_{Aeq} noise levels. This factor is based on the approximate difference between the two parameters for a typical wind farm based on the UK Institute of Acoustics (IOA) document "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise" (2013).

The IFC General EHS Guideline noise guidelines are also referenced in the IFC wind energy guidance, which are 55 dB $L_{Aeq,1\ hour}$ during the day (07.00 to 22.00) and 45 dB $L_{Aeq,1\ hour}$ at night (22.00 to 07.00). Therefore, the limit which gives the higher noise criterion of the two discussed above has been adopted in this study.

10.4.4.2 Noise Prediction Method

The noise model used in this study to predict wind farm noise levels at sensitive receptors is based on ISO 9613-2:1996 as implemented in the Predictor computer noise model. The model predicts noise level through spherical spreading and includes the effect of air absorption (as per ISO 9613), ground attenuation and shielding. The further advice provided by the UK IOA which is referenced in the IFC wind farm guidance has also been adopted.

Predicted L_{Aeq} noise levels were calculated based upon sound power levels determined in accordance with the recognised standard IEC-61400-11:2012 "*Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques*", where available, for the wind range of 3 m/s to 20 m/s.

Key features, inputs and assumptions that have informed the noise modelling and assessment are reproduced or outlined in Table 10.17 below.

Table 10.17: Assessment Features, Inputs and Assumptions

ID	Feature	Description
1	General Acoustics	All sound pressure levels presented in this report (e.g. noise levels predicted at a receptor) are in decibels referenced to 2 x 10^{-5} Pa, with A-weighting applied. All sound power levels presented in this report (e.g. noise levels assigned to specific sources) are decibels referenced to 10^{-12} W, with A-weighting applied.
2a	Noise Modelling	Predictor noise modelling software package was utilised to calculate noise levels using the ISO9613:2 noise propagation algorithms (international method for general purpose, 1/1 octaves). For sound calculated using ISO9613:2, the indicated accuracy is ±3dBA at source to receiver distances of up to 1000 metres and unknown at distances above 1000 metres.
2b		The Predictor software package allows 3D elevation data to be combined with ground regions, water, foliage, barriers, significant building structures etc. and receptor locations, to create a detailed and accurate representation of the wind farm and surrounding area. The noise model allows for the quantification of noise levels from multiple sources, based on sound levels emitted from each source. It computes the noise propagation in the assessment area of influence to specifically quantify A-weighted decibels, L_{eq} in dBA at identified noise-sensitive receptors.
2c		A ground absorption factor of 0.5 was adopted across the entire modelled region, which represents an absorption factor for partly soft ground.
3	Noise Source Data	■ Sound Power Level (L_W, dBA) data (overall L_W values) incorporated into the project-specific noise model for the ENERCON E-138 EP3 E2 wind turbine model was provided for use in this assessment by the manufacturer. The ENERCON data identified the L_W, dBA value of: - each wind turbine model (standard blades) at wind speeds between cut-in and cut-out e.g. 2 to 28 metres per second (m/s); and - one main operational mode (Mode 0s). ■ The key document referenced to quantify main source emissions for the turbines is Document no.: D0749845-6 Data Sheet ENERCON Wind Energy Converter E-138 EP3 E2 / 4200 kW with TES (Trailing Edge Serrations). ■ Spectral data (dBA per frequency band in 1/1 octaves). ■ Hub height of 111 metres has been adopted for all ENERCON E-138 EP3 E2 turbines. ■ Potential cumulative wind farm noise impacts: - Noise modelling of potential cumulative wind farm noise takes into account predicted noise levels from the six of the eight nearby wind farms discussed in Section 13, given their potential to contribute to noise levels at NSRs associated with the Huong Linh Project. - Sound power level data was assumed in this report, adopting a worst-case approach for the candidate turbines. ■ A conservative hub height was adopted for all WTGs where data supplied by the client were unavailable

10.4.4.3 Noise Emission Sources

The noise specifications adopted for the purpose of this assessment are presented in Table 10.17. These specifications are for wind speeds between 2 m/s and 25 m/s. Below 2 m/s significant differences in levels and impacts are not anticipated and above 25 m/s noise level results are expected to be equal to that modelled for the 25 m/s wind speed scenario.

The reference spectrum (noise level in dBA for each 1/1 octave band between 31.5 Hz and 8000 Hz), was taken from the ENERCON 4.2 MW wind turbine corrected to 106 dB(A) and presented in Table 10.18. This spectrum is from Predictor V2020 wind turbines database. The sound power levels are presented for the highest overall sound power value used in the assessment (106 dBA) which applies at 12 m/s wind speed and above. The sound power spectrum has been adjusted at lower wind speeds to represent the lower sound power values that are generated.

Table 10.18: ENERCON 4.2 MW Reference Spectrum Used to Represent ENERCON E-138 EP3 E2

Make, Model, Mode, Wind Speed	Spectral Data – dBA in 1/1 Octave Bands: 31.5 to 8kHz									Overall Lw (dBA)
	31.5	63	125	250	500	1000	2000	4000	8000	
ENERCON 4.2 MW Mode 0 s	80.6	89.1	94.7	98.3	100.3	100.2	97.4	93.7	81.7	106

10.4.4.4 Predicted Wind Farm Operational Noise Levels

The resultant worst-case operational noise levels from the Project for each NSR are presented in Table 10.19. Noise contour maps for the Project operating in the acoustically worst-case mode, are provided in Figure 10.4.

Table 10.19 Predicted Operational Noise Levels at NSRs (L_{Aeq})

Wind Speed at Hub Height (m/s)	Predicted Noise Level at NSR 1	Predicted Noise Level at NSR 2	Predicted Noise Level at NSR 3	Predicted Noise Level at NSR 4	Predicted Noise Level at NSR 5	Predicted Noise Level at NSR 6	Predicted Noise Level at NSR 7
2	31	29	46	41	47	34	29
3	31	29	46	41	47	34	29
4	31	29	46	41	47	34	29
5	31	29	46	41	47	34	29
6	35	33	50	45	51	37	32
7	37	34	51	46	52	39	34
8	37	35	52	47	53	39	34
9	38	36	53	48	53	40	35
10	39	36	53	48	54	41	36
11	39	37	54	49	54	41	36

Wind Speed at Hub Height (m/s)	Predicted Noise Level at NSR 1	Predicted Noise Level at NSR 2	Predicted Noise Level at NSR 3	Predicted Noise Level at NSR 4	Predicted Noise Level at NSR 5	Predicted Noise Level at NSR 6	Predicted Noise Level at NSR 7
12	40	37	54	49	55	42	37
13	40	37	54	49	55	42	37
14	40	37	54	49	55	42	37
15	40	37	54	49	55	42	37
16	40	37	54	49	55	42	37
17	40	37	54	49	55	42	37
18	40	37	54	49	55	42	37
19	40	37	54	49	55	42	37
20	40	37	54	49	55	42	37
21	40	37	54	49	55	42	37
22	40	37	54	49	55	42	37
23	40	37	54	49	55	42	37
24	40	37	54	49	55	42	37
25	40	37	54	49	55	42	37

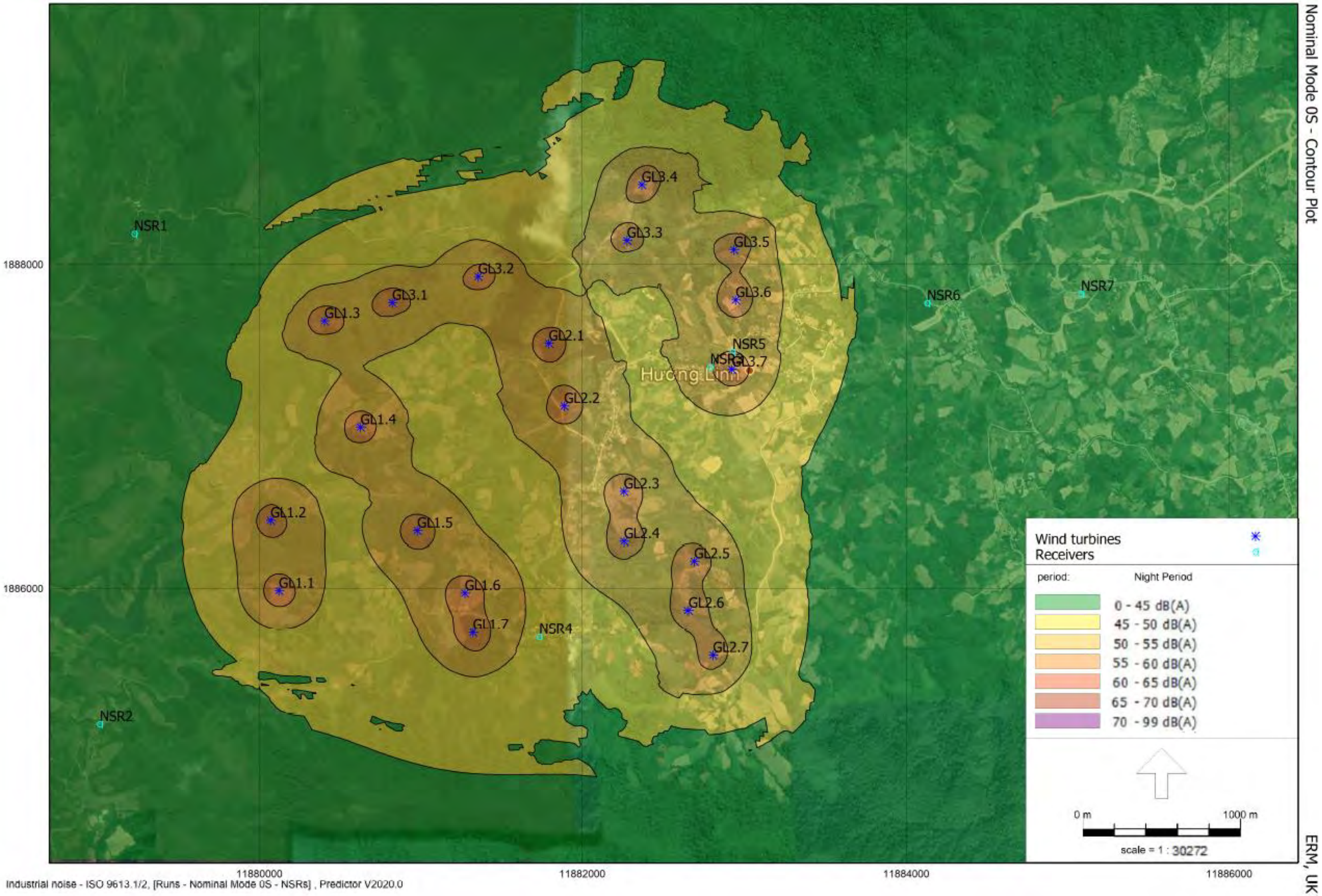


Figure 10.4 Worst-case and Operational Noise Contours of Huong Linh Project

10.4.4.5 Discussion of Predicted Wind Farm Noise

Wind farm noise predictions have been undertaken at each of the representative receptors (NSRs). Figure 10.4 show the predicted noise levels without mitigation and a comparison with the day and night-time impacts assessment criteria at the 6 NSRs. These results are discussed further below. As discussed in Section 7.7.1, noise-sensitive receptors NSR1 and NSR2 do not have representative monitoring locations within 2500m and 3000m respectively. Consequently, the IFC General EHS Guideline of 55 dB $L_{Aeq,1\ hour}$ during the day (07.00 to 22.00) and 45 dB $L_{Aeq,1\ hour}$ at night (22.00 to 07.00) noise criterion have been adopted in this study at these two locations.

10.4.4.6 Significance of Impacts

The significance of impacts on freshwater quality during the construction phase is presented in Table 10.20.

Table 10.20 Noise Impact Significance during Operation Phase

Impact Nature	**Negative**	Positive	Neutral		
	Disturbance and potential health impacts are considered **Negative**				
Impact Type	**Direct**	Indirect	Induced		
	Exposure to noise causes direct disturbance and potential health impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is **Long-term**				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the Project area				
Impact Frequency	While operational noise levels may occur intermittently or continuously depending on wind conditions and WTG operations, disturbance and potential health impacts are not likely to occur as operational noise levels are predicted to be below the compliance limits.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Receptors Sensitivity	Low	**Medium**	High		
	Overall vulnerability is **Medium**				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor**				

10.4.4.7 Additional Mitigation Measure

As predicted operational noise levels meet the necessary criteria, there are no recommended mitigation measures for this Project.

10.4.4.8 Monitoring and Auditing

- Parameters: Noise.
- Monitoring locations: 03 locations at turbine locations.
- Frequency: Every six months.
- Regulations: QCVN 24:2016/BYT – National Technical Regulation on Noise – Permissible Exposure Levels of Noise in the Workplace

- No additional specific monitoring or auditing is recommended.

10.4.5 Mitigation

Noise impacts from WTG emissions are predicted at three of the closest NSRs assessed, NSRs 3, 4 and 5 during the night at all operating wind speeds at NSR3 and NSR5, and above 6 m/s at NSR4. Modelling indicates noise levels may need to be reduced by up to 9 dB, 4 dB, and 10 dB at the three NSRs respectively during operation. NSR3 and NSR5, both in Hướng Linh, are single dwellings located approximately 130m west and 100m north of GL3.7, the closest Project WTG. NSR4 located in Lê Duẩn is also a single dwelling located approximately 350m east of the nearest Project WTG, GL1.7. It is not clear if these dwellings will remain when the wind farm is completed. Other clusters of properties (over 100) within the region are also predicted to be exceeding noise criteria.

- This assessment is based on the noisiest base mode WTG (Mode 0s). Sound Optimised modes should be selected where exceedances are predicted from WTG noise. Modes would need to be selected for the nearest turbines to the worst affected receptors, and they may also be required at adjacent turbines. These have been reviewed and the sound optimised modes would not give sufficient noise reduction at either NSR3 and NSR5 at the worst affected location for wind turbine GL3.7. Based on predictions, mitigation would also be required at turbines GL3.5 and GL3.6. During the detailed design of the wind farm, it is recommended that the design and location of turbines GL3.7, GL3.5 and GL3.6 be reviewed to avoid residual impacts at NSR3 and NSR5.
- Power Optimised Modes 1000 kW s and 500 kW s would both give sufficient noise reduction at NSR4. These modes would need to be selected for the nearest turbines to the worst affected receptors. When the final layout and turbine type is selected, the final noise optimisation mode for each turbine should be selected to ensure that there are no likely significant impacts during operation.
- It is recommended that further background noise monitoring, and obtaining representative hub height wind speed data for the periods of the monitoring should be undertaken in the worst affected locations during the detailed design stage. This would enable baseline regression analysis of the background noise data, and the hub height wind speed to establish noise impact assessment criteria as a function of wind speed to be undertaken as a cautious approach using the IFC threshold limits for this assessment has been employed.
- It is recommended that if any repeated/validated noise complaints are received then compliance monitoring should be undertaken at the most affected receptors to confirm predicted noise levels. Where noise monitoring occurs, the work should be scoped and then conducted by a suitably experienced person. The purpose of the monitoring is to understand in-situ levels and to provide a comparison to predicted levels such that any additional controls be identified and then implemented if feasible, reasonable and practical to do so. If this is required:
- All project/site noise levels should be measured in the absence of any influential source not associated with the project.
- If the measured site noise levels are below the predicted values and comply with the applicable thresholds, limits or criteria identified for each noise aspect, no further noise control is required.
- If the measured site noise levels are above the predicted noise levels or the applicable thresholds, limits or criteria identified for each noise aspect, further noise control should be considered.
- In addition to the recommendations provided above the following safeguards are provided:
- **Prior to operation:** if the turbine selection and/or layout are to be changed, and noise levels are anticipated to increase, then compliance with the noise limits would need to be reassessed.
- During operation: if the turbines change, and noise levels are anticipated to increase, then compliance with the noise limits would need to be reassessed.

- Routine maintenance of wind turbines should also be conducted, with specific attention to equipment degradation that may cause further noise impacts. Any equipment that is abnormally noisy should be evaluated and repaired as necessary to return emissions to typical operating performance.

10.5 Biodiversity Impact Assessment

In accordance with IFC PS1 and PS6, the assessment process aims to predict and assess the Project's potential adverse impacts and risks to biodiversity values, in quantitative terms where possible. The objectives of the biodiversity impact assessment are to identify and quantify the potential Project impacts; design measures to avoid, minimise or mitigate potential adverse impacts; and identify likely residual impacts. The background assessment and baseline studies to identify relevant values have been reported in Biodiversity Baseline Chapter. The remaining steps reported in this section include:

- Impact analysis to assess the extent and complexity of potential adverse impacts considering the two parameters of habitat area (spatially) and threatened species individually;
- Development of mitigation measures to avoid and minimise potential adverse impacts to biodiversity with a priority given to impacts on features with significant biodiversity values; and
- Determine residual impacts in the event significant residual impacts occur biodiversity offsets need to be considered.

10.5.1 Scope of Assessment

Table 10.21 broadly defines the threats to biodiversity values that have potential to occur as a result of a Project. These threats to biodiversity are derived from IFC PS6 and relate to the activities that are likely to occur during construction and operation phases.

Table 10.21 Potential Threats to Biodiversity Values

Term	Description
Loss of habitat at footprint of the transmission line infrastructure and turbines	Temporary and permanent loss of habitat or species due to permanent or temporary site activities.
Disturbance or displacement of individuals from light; noise and/or vibration impacts	■ Disturbance to, or displacement/exclusion of a species from foraging habitat due to construction, operation and maintenance activities. ■ Impacts from light, noise and vibration sources on surrounding habitats causing disturbance and displacement and changes in behaviour.
Barrier creation, fragmentation and edge effects	■ Creation of barriers to the movements of animals, especially fish, but also mammals, reptiles and amphibians and invertebrates and plants with limited powers of dispersal due to the transmission line. ■ Fragmentation of habitat, or permanent/temporary severance of wildlife corridors between isolated habitats of importance for biodiversity due to the transmission line. ■ Impacts that occur when a habitat is exposed to a different adjacent habitat type or structure. These impacts can include increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risk), and competition from invasive species.
Degradation of habitat from dust; water pollution; or invasive species	■ Disturbance or damage to adjacent habitat and species caused by changes in microclimate, vulnerability to predation and invasion and overall changes in conditions that can lead to a change in the community and its values for

Term	Description
	flora and fauna. This can include increased exposure to noise, light and dust. ■ Introduction or spreading of alien species during the construction works.
Mortality – vehicle strike, hunting and poaching, transmission line strike, turbine strike	■ Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during clearing activities. ■ Mortality to individual fauna species as a result of worker influx and hunting/poaching of extant fauna. ■ Mortality due to collision and electrocution with transmission line. ■ Mortality due to potential flight of avifauna and bats through the Rotor Swept Zone (RSZ) of the wind turbines.

Table 10.22 scopes the likely impacts during the construction, operation and decommissioning phases of the Project. The impact assessment for these impact types are further assessed in the subsequent sections.

Table 10.22 Scoping of Potential Impacts during Project Phases

Impact	Construction Phase	Operation Phase	Decommissioning Phase
Loss of habitat	Yes	Continuing from construction phase	No
Disturbance or displacement of fauna	Yes	Continuing from construction phase	Reassessed for decommissioning phase
Barrier creation, fragmentation and edge effects	Yes	Continuing from construction phase	Continuing from operation phase
Degradation of habitat	Yes	Continuing from construction phase	Reassessed for decommissioning phase
Mortality – vehicle strike, hunting and poaching, transmission line strike, turbine strike	Yes	Reassessed for operation phase	Continuing from construction/operation phases

Note:
***Yes:** considered to be likely impacts during the phase.*
***No:** considered to be no impacts or negligible impacts during the phase.*
***Continuing from construction and/or decommissioning phase:** impact is likely to continue from the construction and/or operation phase and the mitigations outlined are appropriate to manage impacts during construction, operation and/or decommissioning phases.*
***Reassessed for operation and/or decommissioning phase:** impact is likely to be different during the phase and hence is reassessed based on the likely impacts. Additional mitigations may be outlined to apply to this phase*

10.5.2 Impact Assessment Criteria

In order to assess the significance of impacts due to the project before and after mitigation, the following impact assessment matrices have been used to classify the severity of impacts. The matrix for habitat classification is presented in Table 10.23, while

Table 10.24 defines the criteria that will be used to define the significance of the impacts on species. The matrices outline the sensitivity of the receptor based on IFC PS6 thresholds and the magnitude of effect, which is based on changes to ecological conditions due to the project.

Table 10.23 Habitat Impact Assessment – Significance Criteria

Habitat Sensitivity/Value		Magnitude of Effect			
		Negligible	Small	Medium	Large
Low	Habitats with no or local designation/ recognition; habitats of significance for species of Least Concern; habitats which are common and widespread within the region.	Negligible	Negligible	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas; habitats of significant importance to globally Vulnerable, Near Threatened or Data Deficient species; habitats of significant importance for nationally restricted range species; habitats supporting nationally significant concentrations of migratory species and/or congregatory species; nationally threatened or unique ecosystems.	Negligible	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of importance to globally Critically Endangered or Endangered species; habitats of importance to endemic and/or globally restricted-range species; habitats supporting globally significant concentrations of migratory species and/ or congregatory species; highly threatened and/or unique ecosystems, areas associated with key evolutionary species.	Negligible	Moderate	Major	Critical

Magnitude of Effect Definition

Negligible	Effect is within the normal range of variation
Small	Affects a small area of habitat, but without the loss of viability/function of the habitat
Medium	Affects a sufficient proportion of the habitat that the viability/function of part of the habitat or the entire habitat is reduced, but does not threaten the long-term viability of the habitat or species dependent on it.
Large	Affects the entire habitat or a significant proportion of the habitat to the extent that the viability/function of the entire habitat is reduced and the long-term viability of the habitat and the species dependent on it are threatened.

Table 10.24 Species Impact Assessment – Significance Criteria

Species Sensitivity/Value		Magnitude of Effect			
		Negligible	Small	Medium	Large
Low	Species which are included on the IUCN Red List of Threatened Species as Least Concern (LC).	Negligible	Negligible	Minor	Moderate
Medium	Species included on the IUCN Red List of Threatened Species as Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD). Species protected under national legislation. Nationally restricted range species. Nationally important number of migratory or congregatory species.	Negligible	Minor	Moderate	Major
High	Species included on the IUCN Red List of Threatened Species as Critically Endangered (CR) or Endangered (EN). Species having a globally Restricted Range (i.e. plants endemic to a site or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km2. Internationally important numbers of migratory or congregatory species. Key evolutionary species.	Negligible	Moderate	Major	Critical

Magnitude of Effect Definition	
Negligible	Effect is within the normal range of variation.
Small	Affects a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself
Medium	Affects a sufficient proportion of a species population that it may bring about a substantial change in abundance and/or reduction in distribution over one or more generations, but does not threaten the long-term viability of that population or any population dependent on it.
Large	Affects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond with natural recruitment (reproduction, immigration from unaffected areas) may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.

10.5.3 Impact Assessment

10.5.3.1 Construction Phase

10.5.3.1.1 Loss of Habitat

10.5.3.1.1.1 Potential Impacts and Consequences

The geospatial assessment undertaken to define natural habitat and modified habitat has classified the majority of the Project Area as modified habitat.

Natural habitat areas in particular provide habitat values for a variety of native flora and fauna species, including species such as the Red-shanked Douc Langur (IUCN CR; VRDB EN) and Southern White-cheeked Gibbon (IUCN CR; VRDB EN) detected within the Project Area. The natural habitat areas within the Project Area are patchy and mostly found in the northern section of the Project Area. They consist mainly of natural forests. Flora species present are common to the region and most are not considered conservation significant. Albeit modified, the modified habitat areas also provide value to native species, in particular those adapted to disturbed environments (e.g. Black-striped Frog (IUCN LC)).

The Project EAAA contains three (3) Critical Habitat trigger species. The Red-shanked Douc Langur (IUCN CR) and Southern White-cheeked Gibbon (IUCN CR) were recorded and thus, known to inhabit the forests in the northern part of the Project Area. Although the Bourret's Box Turtle was not recorded during field surveys within the Project Area, it has been recorded and is known to inhabit forests in the Bac Huong Hoa Nature Reserve, which has forests contiguous with those within the Project Area. Some loss of habitat is thus likely for these species during construction. Direct impact to the species populations and habitat is expected due to the Project.

Construction of the wind turbines, transmission lines, substation and associated auxiliary facilities may lead to the permanent, direct loss of habitat within the footprint of the transmission line towers, substation and auxiliary facilities. Temporary loss of habitat is also anticipated as a result of land utilised temporarily during construction stage for laydown areas, crane installation sites etc. Table 10.25 details the terrestrial habitat area that will be permanently and temporarily lost during construction and/or throughout the operation of the Project due to the project components. Most of the project footprint will be on modified habitat, and minimal loss of natural habitat is anticipated.

Table 10.25 Land Area occupied by Project Components

Project components	Duration	Estimated land area (ha)	Habitat type
			Modified Habitat
Wind turbines (21)	Permanent	13.664	Production forest, perennial cropland, vacant land, agricultural land, land for business (13.664)
110 kV transmission line (5.08 km)	Permanent	2.528	Production forest, perennial cropland, vacant unused land, agricultural land, land for business (2.528)
22 kV transmission line (10.74 km)	Permanent	0.0773	Production forest, perennial cropland, vacant unused land, agricultural land (0.0773)
Substation and operation house	Permanent	1.896	Production forest, agricultural land (1.896)
Traffic road system (Upgraded inter-village road and new internal road)	Permanent	8.507	Production forest, perennial cropland, vacant unused land, agricultural land, land for business (8.507)
Excavated soil site	Temporary	7.04	Production forest, perennial cropland, vacant unused land, agricultural land, land for business (7.04)
Laydown area	Temporary	4.4	Vacant land (4.4)
Crane installation iite	Temporary	4.3	Vacant land (4.3)
Concrete batching plant	Temporary	3.0	Vacant land (3.0)
Construction of 110 kV transmission line	Temporary	1.313	Production forest, perennial cropland, vacant unused land, agricultural land, land for business (1.313)
Total		**Permanent: 26.672**	**Permanent: 26.672** **Temporary: 20.053**

Project components	Duration	Estimated land area (ha)	Habitat type
			Modified Habitat
		Temporary: 20.053	

The transmission line towers will be approximately 26 – 54 m in height. Not all habitat/vegetation within the Right-of-Way (ROW) of the transmission lines will be cleared for the Project. Trees and vegetation will not be required to be cleared beneath the strung wires where the canopy of the vegetation is below the minimum clearance height. Only the footprints of the wind turbines, transmission line tower footings, substation, operation house and any temporary construction areas will be cleared of vegetation (if any), during the construction phase. Induced clearing by locals as a result of increased access during the construction of transmission line is also anticipated, given that construction of new roads to connect the turbines and operation house is proposed.

10.5.3.1.1.2 Existing/ In-place Controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Project activities are to be restricted to contractually approved area.
- Access to natural or forested areas will be restricted with clear signs and barriers.
- Loss of forest (production forest) is anticipated – the Project will commit to conduct reforestation complying with Decree No. 23/2017/TT-BTNM. Otherwise, a sanction will be imposed by Quang Tri Province Forest Growth and Preservation Fund.
- The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation and hunting, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.

10.5.3.1.1.3 Significance of Impacts

No natural habitat is anticipated to be lost. A small area (7.761 ha) of production forest land (considered modified habitat) will be affected but the long-term viability/function of the habitat is unlikely to be lost. The area of modified habitat lost will consist mainly of existing vacant, perennial cropland, land for business, agricultural and production forest land underneath the transmission line routes, wind turbines, substation and associated facilities area and are not considered to be sensitive.

The nature of the impact will be direct to resident fauna within the Project Area. Parts of the Study Area consists of suitable natural habitat for Critical Habitat trigger species while most of the Study Area (especially the south) is substantially modified and is not considered of importance to resident flora and fauna as they are generally widespread and of low conservation significance. The magnitude of impact is expected to be Small as the impact affects a small area of habitat, but without the loss of viability/function of the habitat. The sensitivity of the receptor is considered to be High as the habitat in the Project Area plays host to or potentially supports IUCN listed CR species (Red-shanked Douc Langur, Southern White-cheeked Gibbon and Bourret's Box Turtle), and the Project EAAA overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve. These species may be impacted if using modified habitat to disperse or through edge effects. Nonetheless, as impacts are expected on Critical Habitat species within the Project Area[47], the overall significance is therefore considered to be Moderate.

[47] It should be noted that as required by IFC PS6, if critical habitat is determined for a species, a net-gain outcome is required to be achieved through the application of a Biodiversity Action Plan for the project, even if there are no substantive impacts to that critical habitat due to the project.

Table 10.26 Loss of Habitat Impact Assessment

Impact Type	**Direct**	Indirect	Induced		
	The footprint of habitat loss is 26.672 ha (permanent) and 20.053 ha (temporary) within the terrestrial area for the project components.				
Impact Duration	**Temporary**	Short-term	Long-term	**Permanent**	
	The footprint of the wind turbines, transmission line towers and associated facilities will result in a permanent loss of habitat, as well as temporary loss of habitat (temporary construction areas).				
Impact Extent	**Local**	Regional	International		
	Impacts on terrestrial habitat are localised.				
Impact Frequency	The impact is considered a one-off event.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered small. No loss of natural habitat expected in the EAAA, although small loss of production forest land is expected (representing a loss of 0.18% of EAAA), long term viability/function of the habitat is unlikely to be lost.				
Receptor Sensitivity	Low	Medium	**High**		
	Project EAAA contains habitat for globally EN/CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve, receptor sensitivity is therefore high.				
Impact Significance	Negligible	Minor	**Moderate**	Major	

10.5.3.1.1.4 Additional Mitigation Measures

The following mitigation measures are proposed to be applied during construction and continued during operation if necessary:

- A Biodiversity Action Plan (BAP) will be prepared for the management and monitoring of natural and critical habitats within the Project EAAA as required by IFC PS6;
- Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;
- The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing;
- A Fauna Shepherding Protocol is to be used within the Project Area to ensure that any resident species have vacated the area prior to any clearance work;
- All land rehabilitation/reforestation will be undertaken using native indigenous species.

10.5.3.1.1.5 Monitoring and Audit

The following measures are recommended:

- Regular (weekly) checks during construction are to occur along all project boundaries to ensure compliance with clearing within marked boundaries;
- Records are to be kept and regularly reviewed (quarterly) for implementation of the workforce training program for fauna/flora awareness;
- Monitoring if rehabilitation success/failure is to occur on all replanting sites. Monitoring is to consist of regular inspections (quarterly) to determine plant establishment. Where plant establishment is determined to have failed, reestablishment is to occur.

10.5.3.1.1.6 Residual Impacts

With the application of the mitigation measures, the impact due to loss of habitat within the project area during construction and operation will likely be reduced from Moderate to Minor/Negligible. Nonetheless, given that the Project has triggered critical habitat, a Biodiversity Action Plan (BAP) will be required to outline measures to manage critical habitat values. The Plan will also contain a Biodiversity Monitoring and Evaluation Plan that outlines measures to assess Critical Habitat values.

10.5.3.1.2 Disturbance and/or Displacement of Fauna

10.5.3.1.2.1 Potential Impacts and Consequences

The disturbance and displacement of resident fauna species within the footprint will primarily be caused by light, noise, and vibration impacts. The immediate displacement of fauna will occur during construction works, however the impact to these communities will continue throughout the life of the Project but will be considerably less in extent.

Noise, light, and vibration disturbances have the potential to influence breeding, roosting or foraging behaviour of fauna. During the construction phase temporary impacts from the Project are expected. Noise will be the primary disturbance of this nature due to vegetation clearing, excavation, movement of materials, drilling and general construction activities. These activities will introduce noise sources to areas not currently exposed to these disturbances. Excessive noise can impede fauna communication and deter the use of habitats nearby. Similarly, introducing light sources has the potential to deter foraging and dispersal activities of nocturnal species. In addition there may be vibration associated with drilling activities and the movement of any heavy vehicles/machinery.

The consequences of these influences are dependent on the extent of disturbance but in extreme cases these factors can influence local populations. For example if breeding and communication is inhibited influencing lifecycle, or, if individuals are displaced from noisy areas and home ranges are reduced.

There are three (3) Critical Habitat trigger species that exists or potentially exist within the Project EAAA. As per Section 10.5.3.1.1, the Red-shanked Douc Langur (IUCN CR) and Southern White-cheeked Gibbon (IUCN CR) were recorded and thus, known to inhabit the forests in the northern part of the Project Area. Although the Bourret's Box Turtle was not recorded during field surveys within the Project Area, it has been recorded and is known to inhabit forests in the Bac Huong Hoa Nature Reserve, which has forests contiguous with those within the Project Area. These species are likely to inhabit the Project Area during construction as suitable habitat does exist within that area. These species are therefore likely to be disturbed or displaced due to project construction activities.

The duration of construction activities is expected to be short-term and will not span multiple breeding seasons. Similarly, it should be noted that the noise, light and vibration disturbances will not be continuous for the construction period. They will occur throughout the Project Area during construction for the Project components identified. However, they are unlikely to occur at all locations simultaneously and will be localized.

10.5.3.1.2.2 Existing/ In-place Controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Project activities are to be restricted to contractually approved area.
- Access to natural or forested areas will be restricted with clear signs and barriers.
- Land clearance must follow procedures to allow fauna present to move away from construction area safely.
- Restrictions on vehicle speed (maximum of 20km/h within work sites) and use of car horn will be imposed.

- Construction schedule will be managed to avoid high concentration of work involving heavy machinery and equipment of high noise and intensity level.

10.5.3.1.2.3 Significance of Impacts

The nature of the impact will be negative to resident fauna within the Project Area. The impact type is likely to be direct. The magnitude of impact is expected to be Small as the impact will likely affect a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself. The sensitivity of the receptor is considered to be High, as the Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve. The overall impact significance is therefore considered Moderate.

Table 10.27 Disturbance and/or Displacement of Fauna Impact Assessment

Impact Type	**Direct**	Indirect	Induced		
	Disturbance and/or displacement impacts will occur largely during the construction phase.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	These impacts are associated with the construction (temporary) phase.				
Impact Extent	**Local**	Regional	International		
	Impacts are localised and limited to where construction activities are occurring at the time.				
Impact Frequency	The impact frequency is expected to be intermittent as the likelihood of Critical Habitat species being in the Project EAAA is anticipated to be possible for the Red-shanked Douc Langur, Southern White-cheeked Gibbon and Bourret's Box Turtle given that the Project EAAA contains suitable habitat.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered **Small** as the impact will likely affect a small proportion of populations, but does not substantially affect other species dependent on them, or the populations of the species themselves.				
Receptor Sensitivity	Low	Medium	**High**		
	Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve.				
Impact Significance	Negligible	Minor	**Moderate**	Major	

10.5.3.1.2.4 Additional Mitigation Measures

The following mitigation measures are proposed to be applied:

- Where possible, all noise-generating construction activities will be restricted to only daytime.
- All machinery and hand held equipment used must comply with required air and noise emission standards.
- All light sources are to be directed away from areas of natural habitat.
- A Fauna Shepherding Protocol is to be used within the Project Area to ensure that any resident species have vacated the area prior to any clearance work.
- Fencing is to be placed around major project sites during construction to restrict access to fauna.

10.5.3.1.2.5 Monitoring and Audit

No additional monitoring or auditing is proposed.

10.5.3.1.2.6 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts are expected to be reduced from Moderate to Minor/Negligible.

10.5.3.1.3 Barrier Creation, Fragmentation and Edge Effects

10.5.3.1.3.1 Potential Impacts and Consequences

Construction activities relating to infrastructure have potential to create a barrier to fauna movement (for some fauna groups). This includes construction of the access roads, the transmission line and other infrastructure. Most other Project components are discrete areas that may be navigated around by fauna that may be moving through the area. The construction of the project will primarily be within modified habitat.

Fragmentation of habitats can occur where currently linked habitats are disconnected through the construction of Project components. Fragmentation reduces the continuity of habitat and hence the ability for fauna to move within and between habitat patches. The resulting impact can cause reductions in access to foraging and breeding habitats. Species with limited home ranges may have a reduction in available area, leading to conflict over resources or negative interactions over territories. Fragmentation of existing habitats is not considered to be a significant impact as the infrastructure design does not lead to isolation of habitat patches and is primarily within modified habitat. This includes impacts as a result of strung wires of the transmission line, which also include bird/bat collision risks (see impact assessment for mortality below).

Edge effects may be generated when vegetation clearing or land disturbance occurs in a current unmodified environment. Creation of new edges in a landscape has potential to cause areas of natural habitat to become vulnerable to impacts such as weed invasion, opportunistic predation and changes in neighbouring vegetation communities. These aspects have potential to reduce the value of natural habitat for native flora and fauna. However, as majority of the Project Area is modified habitat, edge effects are not considered to be a significant impact.

10.5.3.1.3.2 Existing/ In-place Controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Loss of forest (production forest) is anticipated – the Project will commit to conduct reforestation complying with Decree No. 23/2017/TT-BTNM. Otherwise, a sanction will be imposed by Quang Tri Province Forest Growth and Preservation Fund.

10.5.3.1.3.3 Significance of Impacts

All these impacts are not expected to be significant on the Critical Habitat species present within the EAAA, as these species have relatively large ranges. The nature of the impact will be negative to resident fauna within the Project Area. The impact type is likely to be indirect, as a consequence of vegetation clearing and habitat disturbance during construction and ongoing during operation. The magnitude of impact is expected to be Small as the impacts affect a small area of habitat, but without the loss of viability/function of the habitat. The sensitivity of the receptor is considered to be High, as the Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve. In addition, these species may also be impacted if using modified habitat to disperse or through edge effects. The overall impact significance is therefore considered Moderate.

Table 10.28 Barrier Creation, Fragmentation and Edge Effects Impact Assessment

Impact Type	Direct	**Indirect**	Induced
	These impacts are an indirect consequence of vegetation clearing and land disturbance.		

Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	These impacts will be introduced during the construction phase and will be maintained throughout the operation of the project.				
Impact Extent	**Local**	Regional	International		
	Impacts are localised and limited to where clearing or land disturbance is required.				
Impact Frequency	Construction will occur only once.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered **small** as the effects impact on a small area of habitat, but without the loss of viability/function of the habitat.				
Receptor Sensitivity	Low	Medium	**High**		
	Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve.				
Impact Significance	Negligible	Minor	**Moderate**	Major	

10.5.3.1.3.4 Additional Mitigation Measures

The following mitigation measures are proposed to be applied:

- Disturbed land not required for the operation of the project will be rehabilitated using native species and minimising the exposed width of the transmission line ROW.

10.5.3.1.3.5 Monitoring and Audit

No specific monitoring is proposed.

10.5.3.1.3.6 Residual Impacts

The implementation of the mitigation measures are likely to limit the extent of these impacts, reducing the impact magnitude to negligible. The residual impact significance is therefore Minor/Negligible.

10.5.3.1.4 Degradation of Habitat

10.5.3.1.4.1 Potential Impacts and Consequences

A range of Project activities have the potential to lead to degradation of flora and fauna habitats including excavation, construction, land clearing, movement of vehicles, barging, drilling, refuelling, hazardous materials storage and maintenance. In general the impacts may result in: dust; erosion; release of potential contaminants; and introduction or spread of invasive species. Construction activities have been assessed for these impact types, including: construction of the access roads, erection of transmission towers, erection of wind turbines and installation of cables/wires and installation of associated infrastructure (such as the substation and operation house).

Dust

During construction, movement of vehicles, clearing and excavation activities have the potential to generate dust which may settle on vegetation adjacent to the construction area (including access roads). Excessive dust deposition on flora may act to suppress growth through limiting photosynthesis and the dusted foliage may also become unpalatable to foraging fauna. The construction activities will be temporary and dust generation is likely to be localised to active work areas. Rainfall will generally remove dust from foliage.

Erosion

Land preparation will expose earth areas to erosion (wind and/or runoff) until construction or replanting is completed to stabilise the surface. The Project Area is characterised by mountainous terrain and varied topography including steep slopes. Erosive processes transport sediment downstream depositing mobilized sediment downslope of habitats (both aquatic and terrestrial) and potentially into adjacent waterways. This indirect impact has potential to degrade downstream habitat areas or change habitat characteristics, and as such influencing suitability for native flora and fauna communities. Runoff may flow into the local river systems which may provide habitat for conservation significant and commercially utilised fish species (if present).

Release of Contaminants

Accidental release or spill of these materials can be toxic to flora and fauna locally and downstream if substances are released into the aquatic environment. Runoff from construction sites has potential to carry contaminants a substantial distance downstream. Construction activities such as refuelling, storage and other activities that require oil and hazardous substances to be used are undertaken at risk of accidental release.

Invasive Species

Invasive species (flora and fauna) have the potential to be introduced or spread throughout the Project Area through increased movement of people, vehicles, machinery, vegetation and soil. Natural habitat areas are most sensitive to the introduction of invasive species. An increase in the prevalence of weeds or other pests has the potential to reduce the quality of habitat for some native flora and fauna, including conservation significant species. Invasive flora species can rapidly germinate in disturbed areas whereby affecting the ability of native vegetation communities to re-establish. Invasive animals also have the potential to be introduced or increased in abundance. These animals may adversely impact native fauna as a result of increased competition for resources, predation or habitat degradation. While this impact can be significant, the existing environment is already highly modified.

For the three (3) Critical Habitat species (Red-shanked Douc Langur, Southern White-cheeked Gibbon and Bourret's Box Turtle), impacts are not expected to be significant given that they are not heavily dependent on waterbodies (i.e. aquatic species).

10.5.3.1.4.2 Existing/ In-place Controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Strict regulations on release/disposal of chemicals into the environment will be issued in consideration of impacts on soil, water, land as well as marine ecosystem.
- Construct a rainwater storage with drainage system to prevent flooding due to deforestation within the Project Area.

The mitigation measures identified (if any) related to dust, erosion, and release of contaminants are outlined in previous sections of the environmental impact assessment.

10.5.3.1.4.3 Significance of Impacts

The nature of the impact will be negative to resident fauna within the Project Area. The impact type is likely to be indirect, as a consequence of vegetation clearing and habitat disturbance. The magnitude of impact is expected to be Small as the impacts affect a small area of the habitats, but does not result in loss of viability/function of the habitats. The sensitivity of the receptor is considered to be High, as the Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve. In addition, natural habitats are also likely to be vulnerable to mid- to long-range impacts such as dust, pollution of water sources, invasive species etc. The overall impact significance is therefore considered Moderate.

Table 10.29 Degradation of Habitat Impact Assessment

Impact Type	Direct	**Indirect**	Induced		
	These impacts are an indirect consequence of vegetation clearing and land disturbance.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	These impacts will be introduced during the construction phase and degraded areas may take time to recover.				
Impact Extent	**Local**	Regional	International		
	Impacts are localised and limited to where clearing or land disturbance is required.				
Impact Frequency	Construction will occur only once.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered small as the impacts affect a small area of the habitats (in a localised manner), but does not result in loss of viability/function of the habitats.				
Receptor Sensitivity	Low	Medium	**High**		
	Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve.				
Impact Significance	Negligible	Minor	**Moderate**	Major	

10.5.3.1.4.4 Additional Mitigation Measures

The following mitigation measures are proposed to be applied during construction and continued during operation if necessary:

- All machinery and hand held equipment used must comply with required air emission standards;
- Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a *Sediment and Erosion Control Plan*;
- Develop and implement appropriate emergency spills response procedures to avoid and manage accidental spills of any fuels, oils or other chemicals during construction activities;
- Disturbed land not required for the operation of the project will be rehabilitated using native species;
- Existing populations and the introduction of new invasive species into natural habitats are to be managed. These measures are to be outlined in an *Invasive Species Management Plan* incorporated into the BAP and include measures such as:
  - The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination;
  - Vehicle inspection and/or wash down procedures are to be used to reduce the transmission of invasive species into and from the Project Area(s);
  - Invasive species control measures are to be utilised in areas of natural habitat.

10.5.3.1.4.5 Monitoring and Audit

Monitoring will be required as part of the *Invasive Species Management Plan* and rehabilitation works.

10.5.3.1.4.6 Residual Impacts

The implementation of the mitigation measures are likely to limit the extent of these impacts, reducing the impact magnitude to negligible. The residual impact significance is therefore anticipated to be Minor/Negligible.

10.5.3.1.5 Mortality – Vehicle Strike, Hunting and Poaching

10.5.3.1.5.1 Potential Impacts and Consequences

During the construction phase, mortality of fauna may occur due to vehicle strike and hunting or poaching as a result of worker influx during construction.

The use of construction vehicles within the Project Area may increase the opportunity for strike with resident fauna during construction. There is however, a minor risk to fauna from vehicle strike during construction given that the Project Area is predominantly modified.

Furthermore, with increased human activity in the Project Area and increased access points to the neighbouring forest there is a risk of increased hunting and poaching activities leading to fauna mortality from workers and also local residents who may gain access to habitats that were previously restricted or difficult to access. Wildlife hunting and poaching, including conservation significant species is known to occur in Vietnam.

Through the installation of new roads (i.e. increased ease of access), hunting and poaching may increase. Species located within the Project EAAA and adjacent Nature Reserve include several species that are potential candidates for Critical Habitat. Some of these species are considered particularly susceptible to hunting and poaching, including the Bourret’s Box Turtle (IUCN CR).

10.5.3.1.5.2 Existing/ In-place Controls

The mitigation measures identified in the locally approved regulatory EPP include:

- Project activities are to be restricted to contractually approved area;
- Access to natural or forested areas will be restricted with clear signs and barriers;
- Restrictions on vehicle speed (maximum of 20km/h within work sites) and use of car horn will be imposed;
- The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation and hunting, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.

10.5.3.1.5.3 Significance of Impacts

The type and nature of impact on resident fauna within the Project Area will be direct and negative respectively. Impacts are restricted to the location of the transmission line and 21 wind turbines. The receptor sensitivity is considered High as the Project contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve. The impact magnitude is considered Medium as the impact may affect a sufficient proportion of a species population that it may bring about a substantial change in abundance and/or reduction in distribution over one or more generations given that the populations are already depressed for globally EN and CR species, but does not threaten the long-term viability of that population or any population dependent on it. Significance of impact is therefore considered Major.

Table 10.30 Mortality – Vehicle Strike, Hunting and Poaching Impact Assessment

Impact Type	**Direct**	Indirect	Induced		
	Mortality risks of these species are directly related to the transportation activities of construction and indirectly related to the Project in the form of worker influx and possible poaching.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	These impacts are related to the construction activities of the Project.				
Impact Extent	**Local**	Regional	International		
	Impacts are localised and limited to where construction activities are occurring at the time.				
Impact Frequency	The impact frequency (i.e. the frequency of vehicle/worker movement) cannot be determined, how it is expected to be intermittent due to possible likelihood of vehicle collision.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact may affect affect a sufficient proportion of a species population that it may bring about a substantial change in abundance and/or reduction in distribution over one or more generations given that the populations are already depressed for globally EN and CR species, but does not threaten the long-term viability of that population or any population dependent on it.				
Receptor Sensitivity	Low	Medium	**High**		
	Project EAAA contains habitat potentially of importance to globally EN and CR species, and overlaps with a nationally designated or recognised protected area – Bac Huong Hoa Nature Reserve.				
Impact Significance	Negligible	Minor	Moderate	**Major**	

10.5.3.1.5.4 Additional Mitigation Measures

No additional mitigation measures are proposed.

10.5.3.1.5.5 Monitoring and Audit

No specific monitoring measures are identified.

10.5.3.1.5.6 Residual Impacts

The implementation of the mitigation measures are likely to limit the extent of these impacts, reducing the impact magnitude to Small. The residual impact significance is Moderate.

10.5.3.2 Operation Phase

10.5.3.2.1 Mortality – Turbine and Transmission Line Strike

10.5.3.2.1.1 Potential Impacts and Consequences

Heightened risk of mortality for flying fauna during operation of the windfarm may be a risk to birds and volant mammals (bats) within the Project Area. This mortality risk arises from possible collision and electrocution with the transmission line and potential collision with the wind turbines.

Impacts to avifauna consist of direct strike to individuals flying through the Rotor Swept Zone (RSZ) of the windfarm. Bats can suffer from barotrauma, when sudden changes in air pressure when flying close to turning blades collapse the lungs of the bats.

Birds

Avifauna are most susceptible when they fly at RSZ height, either at level flight or through diving behavior. This mostly impacts raptors (hawks and eagles) diving to capture prey, flocking birds that utilize open fields for foraging, migratory birds flying in transit, or single individuals foraging or in transit between habitats. Flight times of birds at times when the windfarm is operational can also lead to increased susceptibility of strike. This includes birds that pass through the RSZ either at dawn or dusk or birds that forage at night in open spaces (such as owls).

Results from the vantage point surveys indicated that most bird species inhabiting the Project Area fly lower than the Rotor Swept Zone (RSZ) (35 – 150 m). Of the seventy-five (75) species recorded during the vantage point surveys, twenty-two (22) species were recorded to fly in the RSZ. These species are all listed as Least Concern in the IUCN Red List, and are not Critical Habitat trigger species. Flock sizes were also observed to be relatively small, ranging from 1 – 5 individuals. The pattern observed of most birds in the Project Area flying below the rotor height and small flock sizes suggests the collision risk between birds and wind turbines is relatively low.

Table 10.31 Bird Species Recorded to Fly in Band 2

S/N	Scientific Name	English Name	IUCN Category	Vietnam Red Data Book	Month (2020)
1	*Pericrocotus flammeus*	Scarlet Minivet	LC	-	Feb
2	*Lonchura punctulata*	Scaly-breasted Munia	LC	-	Feb
3	*Anthus hodgsoni*	Olive-backed Pipit	LC	-	Feb
4	*Accipiter trivirgatus*	Crested Goshawk	LC		Feb
5	*Spilornis cheela*	Crested Serpent Eagle	LC	-	Feb
6	*Nisaetus nipalensis*	Mountain Hawk Eagle	LC	-	Feb
7	*Corvus corone*	Carrion Crow	LC	-	Feb
8	*Accipiter virgatus*	Besra	LC	-	Feb
9	*Accipiter badius*	Shikra	LC	-	May
10	*Ictinaetus malaiensis*	Black Eagle	LC	-	Feb, May
11	*Pernis ptilorhynchus*	Oriental Honey-buzzard	LC	-	May
12	*Spilopelia chinensis*	Eastern Spotted Dove	LC	-	May
13	*Falco tinnunculus*	Common Kestrel	LC	-	May
14	*Artamus fuscus*	Ashy Woodswallow	LC	-	May
15	*Dicrurus macrocercus*	Black Drongo	LC	-	May
16	*Hirundo rustica*	Barn Swallow	LC	-	May

S/N	Scientific Name	English Name	IUCN Category	Vietnam Red Data Book	Month (2020)
17	*Lanius schach*	Long-tailed Shrike	LC	-	May
18	*Hypsipetes leucocephalus*	Black Bulbul	LC	-	May
19	*Acridotheres grandis*	Great Myna	LC	-	May
20	*Ardea intermedia*	Intermediate Egret	LC	-	May
21	*Psilopogon faiostrictus*	Green-eared Barbet	LC	-	May
22	*Psilopogon lagrandieri*	Red-vented Barbet	LC	-	May

Note: LC – Least Concern

Source: CIM, 2020

As a result of the low level of flight activity and no conservation significant species at risk recorded within the Project Area by the surveys, the overall risk of bird collision with turbines is considered low, and as such collision risk modelling was not warranted and has not been undertaken as part of this impact assessment. Impacts to bird species may occur from time to time, however given their relatively low densities and observations at the Project site indicating that most species fly below the RSZ, the risk of impact is considered to be smallS

Bats

Similarly for bats, flight through the RSZ may occur based on foraging or transit behavior. Flight times however increase the susceptibility of strike with most bats likely to transit the RSZ at dawn or dusk or during the night. Bats that form colonies and fly in large numbers also subject to higher strike risk.

The risk of turbine collision impact on bats has been assessed using species-based risk assessment informed by species ecology and biology. Species' distribution data from IUCN Red List suggests 55 bat species (of 7 families) might inhabit or frequent the Project Area and its vicinity. This information was collated from previous records and ecological assumptions of each species' distribution ranges, biogeographical conditions and expert opinions. Data from the GBIF database shows only 11 bat specimens found within a 25 km radius of the Project Area and 14 bat specimens recorded between 25 km and 50 km of the Project Area – belonging to four different LC species. Based on available information on the 55 bat species that may occur within the Project Area, the risk of turbine impact on each species was evaluated and presented in Table 10.32 below.

For the 14 high-risk bat species identified, of which none were identified during field surveys within the Project EAAA, these species are insectivorous bats that forage in unobstructed airspaces found in large clearings or high above the forest canopy (open-space foragers) and hence are likely to forage in nearby terrestrial agricultural areas. Individuals may, from time to time, travel in the vicinity the Project Area between habitat patches for foraging. From the field surveys, bat activity was relatively low and no roosting sites were observed. Impact magnitude on bats due to the Project is therefore considered to be small.

Table 10.32 Results of Species-Based Risk Assessment Matrix

Factor	Risk of turbine impact		
	Low risk	Medium Risk	High Risk
Habitat reference	Bats preferring cluttered habitat	Bats able to exploit background cluttered space	Bats preferring to use open habitat
Echolocation characteristics	■ Short range ■ High frequency ■ Low intensity ■ Detection distance ~15m	Intermediate – more plastic in their echolocation	■ Long range ■ Low frequency ■ High intensity ■ Detection distance ~80m
Wing shape	■ Long wing loading ■ Low aspect ratio ■ Broadest wing	Intermediate	■ High wing loading ■ High aspect ratio ■ Narrow wings
Flight speed	Slow	Intermediate	Fast
Flight behaviour and use of landscape	■ Manoeuvre well ■ Will travel in cluttered habitat ■ Keeps close to vegetation ■ Gaps may be avoided	■ Some flexibility	■ Less able to manoeuvre ■ May avoid clustered habitat ■ Aerial hawker ■ Feed in open habitat
Migration	Local or regional movements	Regional migrant in some parts of range	Long-range migrant in some parts of range
Species or taxa that match at least one criterion	■ *Hipposideros pomona* ■ *Hipposideros cineraceus* ■ *Cynopterus brachyotis* ■ *Cynopterus sphinx* ■ *Macroglossus sobrinus* ■ *Megaerops niphanae* ■ *Rousettus amplexicaudatus* ■ *Rousettus leschenaultii* ■ *Rhinolophus malayanus* ■ *Rhinolphus microglobosus* ■ *Rhinolophus pusillus* ■ *Rhinolophus shameli* ■ *Rhinolophus thomasi*	■ *Hipposideros armiger* ■ *Hipposideros larvatus* ■ *Hipposideros scutinares* ■ *Megaderma lyra* ■ *Megaderma spasma* ■ *Rhinolophus affinis* ■ *Rhinolophus luctus* ■ *Rhinolophus siamensis* ■ *Myotis horsfieldii* ■ *Myotis muricola* ■ *Myotis indochinensis* ■ *Myotis siligorensis* ■ *Glischropus bucephalus* ■ *Harpiocephalus harpia* ■ *Hesperoptenus tickelli* ■ *Phoniscus jagorii*	■ *Taphozous melanopogon* ■ *Miniopterus magnater* ■ *Miniopterus schreibersii* ■ *Miniopterus pusillus* ■ *Pipistrellus coromandra* ■ *Pipistrellus javanicus* ■ *Pipistrellus tenuis* ■ *Pipistrellus paterculus* ■ *Scotophilus kuhlii* ■ *Scotophilus heathii* ■ *Hypsugo cadornae* ■ *Hypsugo dolichodon* ■ *Ia io* ■ *Myotis annectans* ■

Factor	Risk of turbine impact		
	Low risk	Medium Risk	High Risk
	■ *Kerivoula hardwickii* ■ *Kerivoula picta* ■ *Kerivoula kachinensis* ■ *Kerivoula titania* ■ *Glischropus tylopus* ■ *Coelops frithii* ■ *Murina aurata* ■ *Murina cyclotis* ■ *Scotomanes ornatus*	■ *Pipistrellus abramus* ■ *Tylonycteris pachypus* ■ *Tylonycteris robustula*	
	Total: 22 species	**Total: 19 species**	**Total: 14 species**

10.5.3.2.1.2 Existing/ In-place Controls

No mitigation measures were identified in the locally approved regulatory EPP for this impact.

10.5.3.2.1.3 Significance of Impacts

The impacts on birds and bats relate to the collision risks with the transmission line and the turbines during wind farm operation. Impacts are restricted to the location of the transmission line and 21 wind turbines. The impact magnitude is considered Small as the impact will likely affect a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself. The receptor sensitivity is considered Low as the Project EAAA mainly plays host to species included on the IUCN Red List as LC. Significance of impact is therefore considered Negligible.

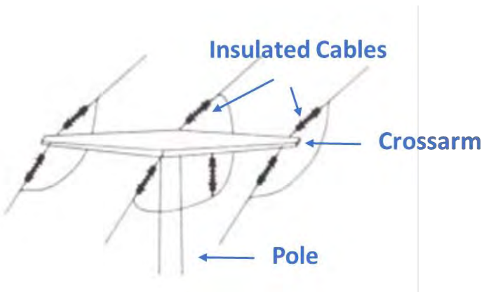
Table 10.33 Mortality – Turbine and Transmission Line Strike Impact Assessment

Impact Type	**Direct**	Indirect	Induced		
	These impacts are related to the collision risk of the transmission line and turbines.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	These impacts are related to the collision risk during the operation of the transmission line and turbines.				
Impact Extent	**Local**	Regional	International		
	Impacts are restricted to the location of the transmission line and 21 wind turbines.				
Impact Frequency	The transmission line and turbines will be operational 24hrs of the day. Impact frequency is expected to be intermittent over the operation phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Risk of collision is low. Impact may affect a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself.				
Receptor Sensitivity	**Low**	Medium	High		
	Project EAAA mainly plays host to species included on the IUCN Red List as LC.				
Impact Significance	**Negligible**	Minor	Moderate	Major	

10.5.3.2.1.4 Additional Mitigation Measures

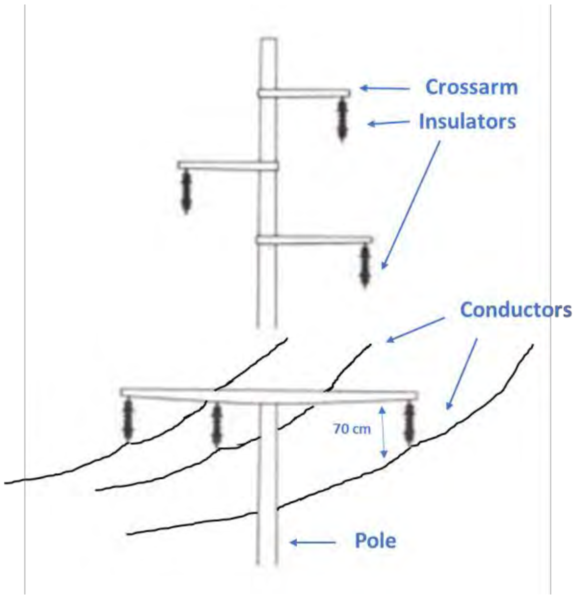
The following mitigation measures are proposed to be applied:

- The transmission line will include the following measures:
  - Use of bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna;
  - Removing the thin neutral or earth (shield) wire above the high voltage transmission lines where feasible, and where this is not possible, marking the line to make it more visible;
  - Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk;
  - Habitat manipulation to influence flight activity and bird behaviour, e.g. tree lines under the high voltage lines to increase visibility;
  - Insulating cables close to poles, at least 70 cm on both sides and around perching areas, and up to at least 140 cm in areas with large soaring birds (see Figure 10.5); and
  - Hanging insulators under cross arms and poles, provided the distance between a likely perch (mainly the transmission tower crossarm) and the energised parts (conductors) is at least 70 cm (see Figure 10.6).



Source: Haas et al., 2003

Figure 10.5 Insulated Conductors Minimum of 70 cm on Either Side of Cross Arm



Source: Haas et al., 2003

Figure 10.6 Hanging Insulators Beneath Crossarms

- All tower structures are to be free of holes that can be used for nesting. Roosting habitats (wires and ledges) are to be kept to a minimum.
- Installation of colourful or reflective components at strategic points on the turbine propellers (depend on the final design of the wind turbines) to deter birds.
- A carcass monitoring program is to be conducted on a weekly basis at the base of all turbines and along transmission line as part of the *Bird and Bat Management Plan*. All carcasses are to be identified and a database kept of the number and taxa of the species. For transmission lines it is important to distinguish between collisions and electrocutions. The former occurs all along the transmission line alignment while the latter typically occurs at the base of transmission poles.

10.5.3.2.1.5 Monitoring and Audit

Monitoring will be required as part of the *Bird and Bat Management Plan* in the BAP. Fatalities will be recorded along with information relating to the season, species and location of the fatalities to assist in determining whether management measures are required to be adjusted. The requirements for monitoring are to be outlined within the BAP prepared for the Project.

10.5.3.2.1.6 Residual Impacts

The implementation of the mitigation measures are likely to limit the extent of these impacts, reducing the impact magnitude to negligible. The residual impact significance is Negligible.

10.6 Shadow Flickering Impact Assessment

10.6.1 Scope of Assessment

The likelihood and duration of the flickering effect depends upon a number of factors, including:

- Direction of the property relative to the turbine;
- Turbine height and rotor diameter;
- Time of the day and year;
- Distance from the turbine (the further the observer is from the turbine, the less pronounced the effect will be);
- Wind direction (that affect potential wind turbine orientation); and
- Weather conditions (presence of cloud cover, fog, humidity reduces the occurrence of shadow flicker as the visibility itself of the turbine is reduced).
- Topography and presence of natural or anthropic barriers (i.e. vegetation, other buildings etc.)

In general, shadow flickering effect occurs during clear sky conditions, when the sun is low on the horizon (sunrise and sunset). As the angle of elevation from the horizon of the sun during midday changes throughout the year plus the topographical relief, each location is experienced and influenced by the shadow flickering effect phenomenally different. Hence, specific shadow receptors can be disturbed in different periods of the day or year.

The theoretical number of hours of experienced shadow flickering effect each year at a given location can be calculated by utilising modelling packages incorporating the sun path, topographical relief over the Project site, and rotor diameter and hub height details of wind turbine model.

When assessing shadow flickering impacts, the worst case and/or real case impacts are determined:

- **Worst Case Scenario:** the possibility of astronomical shadow flickering duration at maximum is defined when the sun is lastingly shining during daylight hours (i.e. the sky is always clear), the wind turbine is always operating, the rotor is always is always perpendicular to the line from the WTG to the sun; and
- **Real Case Scenario:** the expected shadow flickering duration is when average sunshine hour probabilities and wind statistics at a certain region include turning off periods (low winds and high winds) are taking into account.

10.6.2 Applicable Standards

In August 2015, the World Bank Group published the Environmental, Health and Safety (EHS) Guidelines for Wind Energy. These are technical reference documents containing examples of good industry practice.

The definition adopted in the EHS guidelines states that shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when potentially sensitive receptors (e.g., residential properties, workplaces, educational and/or healthcare spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility.

Key points identified in the guidelines include:

- Potential shadow flicker issues are **more likely occurred at higher latitudes** where the sun is lower and closer to the skyline; therefore, shadows will be casted and extended the radius in which potentially receptors will be experienced consequential shadow flicker impacts.
- In case of the possibilities of modifying the wind turbines' locations where neighbouring receptors experience no shadow flicker effects are low, it is recommended that the predicted duration of shadow flickering effects experienced at a sensitive receptor **should not exceed 30 hours per year AND 30 minutes per day on the worst affected days, based on a worst-case scenario**.
- Recommended preventative and mitigative measures to avoid substantial shadow flicker impacts include **systematising wind turbines' arrangement appropriately** to avoid shadow flicker being experienced or to meet duration limits of shadow casting continuously on the shadow sensitive receptor, as set out in the paragraph above, or scheduling wind turbines to **shut down at intervals where shadow flicker limits are exceeded**.

10.6.3 Receptors

The Project area is belonged to Huong Linh Commune and located within the residential area of Xa Bai Village. There are some sparse minor communities in Hoong Moi Village (approximately 2 km to the East-Southeast of the Project). The Project location is characterised by the presence of scattered residential houses with relatively topographically complex landscapes/ vegetation patches than surrounding areas. There are a total of 153 potential receptors that could potentially experience the shadow flickering issue within the area of influence (10 times of rotor diameter). Figure 10.7 presents the location of such receptors.

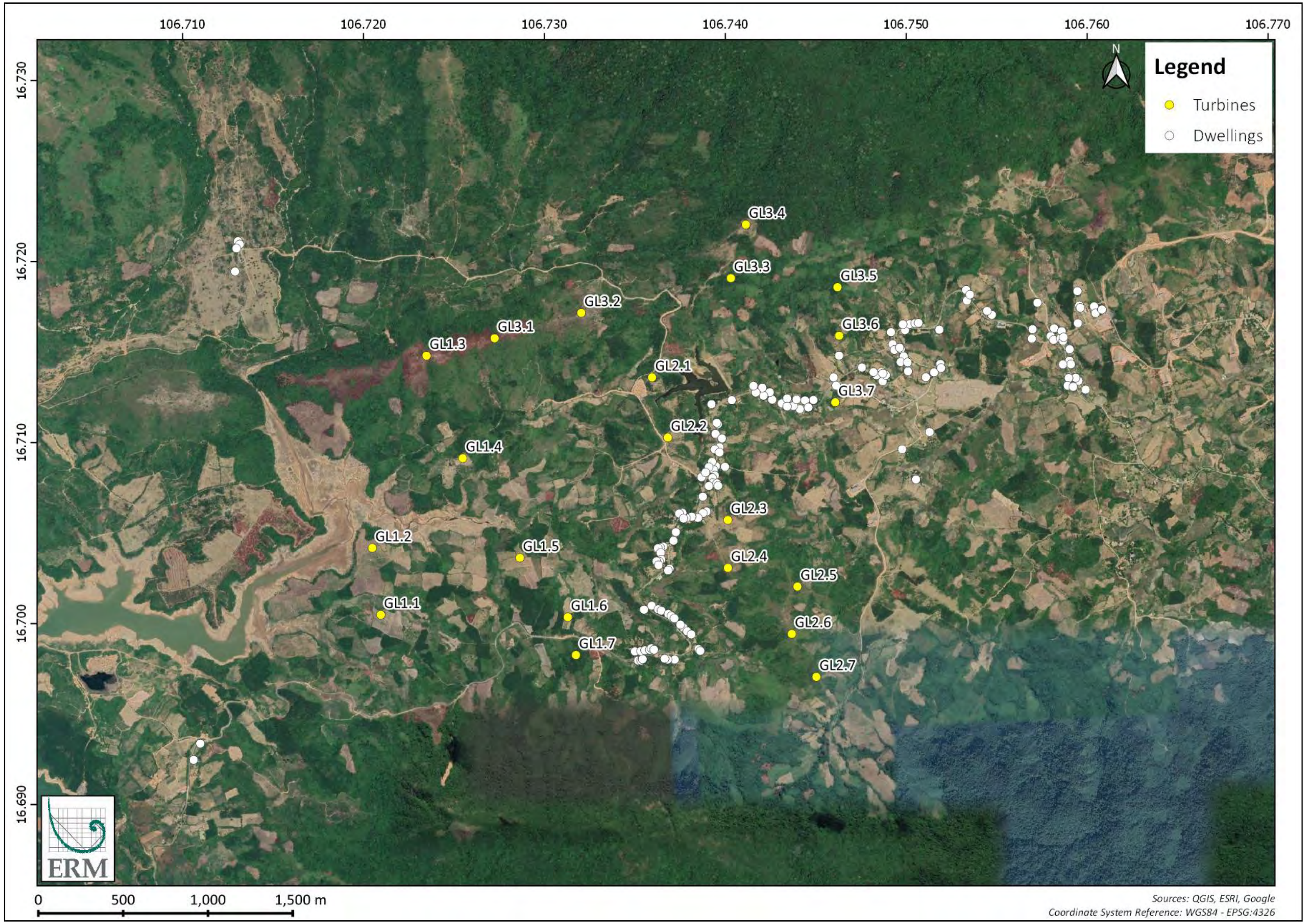


Figure 10.7 Location of main receptors

10.6.4 Shadow Flickering Analysis

10.6.4.1 windPRO Model: Scenarios and Input Criteria

This assessment has been taken advantage of windPRO 3.4©, a computer software which is widely used in the wind industry. The software package includes a Shadow Flicker Module (SHADOW) that calculates the frequencies and the intervals in which a specific neighbouring receptor or area will be affected by one or more wind turbines.

Two scenarios have been considered and modelled: Worst Case Scenario and Real Case Scenario.

- **Worst Case Scenario:** the calculation is based on the following key assumptions:
  - The presence of physical barriers is not considered;
  - Natural vegetation screening is not included;
  - Cloudiness, humidity are not considered;
  - The sun is shining all the day, from sunrise to sunset;
  - Rotor is always in operation and refrained from turning off during low winds or high winds, and
  - Shadow receptors are modelled using the "greenhouse" mode, meaning that shadow flicker effect to each receptor at all directions (visibility 360 degrees).
- **Real Case Scenario:** is designed by taking into account planned turbines, the calculations are based on a more realistic situation where publicly available dataset of sun shining probability is applied. However, it should be noted that real case scenario still ignores other relevant conditions of the local settings, which will theoretically lead to an overestimation of the shadow flickering occurrence.

All scenarios have been carried out with a chronological resolution of 1 minute (if shadow flicker is predicted to occur in any 1-minute period, the model records this as 1 minute of shadow flicker).

Independent of the selected scenario, the model calculates outputs according to the principles presented in the following Figure 10.8.

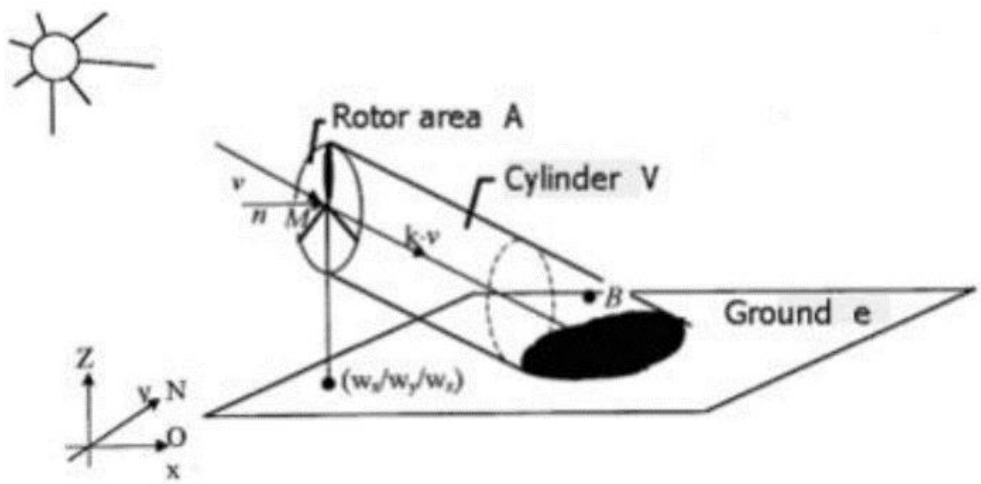


Figure 10.8 Shadow Flickering Theory

All receptors in both scenarios, assuming dwellings/groups of dwellings, within approximately 1.4 km of Project's WTGs have been modelled are taken into account the following characteristics:

- Single storey building. Therefore, shadow flicker has been calculated at a height of 1 m (equivalent to the ground floor windows);

- Slope of the window has been set to 90°;
- The identified receptors are simulated as fixed points with the 360° viewpoint, which represented an unrealistic scenario as real windows would only face a particular direction.

10.6.4.2 Worst Case Scenario

The following assumptions have been reflected in the modelling setting for the Worst Case Scenario:

- Rotors are always rotating;
- The Sun is shining all the day, from sunrise to sunset;
- Local topography has been obtained from SRTM DTM;
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and the sunlight have been assumed;
- Receptors modelled using greenhouse mode;
- No physical barriers are considered.

10.6.4.3 Real Case by Statistics Scenario

The following assumptions have been considered in the modelling setting for Real Case Scenario:

- Public data of average daily sunshine hours at Hue meteorological station (approximately 80 km from the Project):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.4	5.4	5.8	7.0	8.1	8.0	7.8	7.0	5.8	5.1	4.6	4.0

- Local topography has been obtained from SRTM DTM;
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and the sunlight have been assumed;
- Receptors modelled using greenhouse mode;
- No existing physical barriers have been considered (e.g. trees);
- Rotors are always rotating; and
- The probability distribution of wind direction according to data recorded the Project's measurement tower at the height of 60 m:

N	NE	E	SE	SE	SW	W	NW	Sum
23.35%	35.77%	0.88%	0.49%	0.83%	36.87%	1.53%	0.27%	100%
2,045	3,134	77	43	73	3,230	134	24	8,760

It should be noted that even the assessment performed with such assumptions is leading to an overestimation in terms of annual number of hours of shadow flicker at a specific location mainly because of the following local conditions have not been included:

- The occurrence of cloud cover has the potential to significantly reduce the number of shadow flickering hours that the observer can be experienced;
- The presence of fog and high humidity can reduce the visibility and consequently reduce the effects of flickering on the observer;
- The presence of aerosols in the atmosphere have the ability to influence the flickering duration as the length of the shadow cast by a WTG depends on the angle of direct sunlight hits, which is

strictly determined by the amount of fine solid particles/liquid droplets in between the observer and the rotor; and

- The analysis has not considered the presence of vegetation or any other physical barriers around a receptor that are able to block the view (at least partially) of the turbine.

10.6.4.4 Setting Summary of Scenarios

The following table is reporting the modelling settings adopted per each scenario. However, it should be noted that the performed calculations do not take into account the actual location and orientation of windows, or the screening effects associated with existing, site-specific conditions and obstacles like other buildings, leading to potential of over-estimating the duration of occurrences when shadow flicker might be experienced at a specific location.

Table 10.34 windPRO Shadow Module Inputs (in bold the differences among Worst Case and Real Case Scenario)

	Worst Case Scenario	Real Case Scenario
Wind Turbine location	See Figure 10.7	See Figure 10.7
Rotor diameter and hub height	138.25m/ 111m	138.25m/ 111m
Wind Turbine Operation	Rotors are always rotating	Rotors are always rotating
Wind Turbine Visibility	A WTG will be visible if it is visible from any part of the receiver window (greenhouse mode)	A WTG will be visible if it is visible from any part of the receiver window (greenhouse mode)
Window stories dimensions	1m height / 1m large / 1m from the ground floor	1 m height / 1m large / 1m from the ground floor
Cloudiness	Not considered	Not considered
Physical barriers (i.e. vegetation)	Not considered	Not considered
Minimum sun height over horizon for influence	3°	3°
Day step for calculation	1 day	1 day
Time step for calculation	1-minute	1-minute
Shining period	**The sun is always shining all day, from sunrise to sunset**	**The sun is shining as per available local sunshine data (Hue meteorological station)**
Height contour	SRTM DTM	SRTM DTM
Eye Height	1.5 m	1.5 m

10.6.5 Model Results

As presented above, two scenarios have been modelled using SHADOW module of windPRO software in order to identify the receptors potentially affected by the shadow flickering. The following sections are reporting the number of potentially affected receptors per each scenario.

10.6.5.1 Worst Case Scenario

As presented earlier, the modelling package was calculating the predicted shadow flickering durations at receptors. Worst case scenario had considered a fully worst case scenario with unrealistic conditions which led to a potential of 107 (around 70%) impacted receptors out of 153 mapped receptors of which a major number of receptors receives more than 100 hours of shadow flicker per year. IFC thresholds have been exceeded for both parameters: hours/year and min/day at these receivers with the most impacted receptor (63) experiences 713:55 hours per year with the maximum of 184 minutes per shadow day. The key potentially impacted area is mainly located in Moi Village of Huong Linh Commune.

The following maps present the influencing areas where shadow flickering is occurring based on the Worst Case Scenario setting (Figure 10.9 and Figure 10.10).

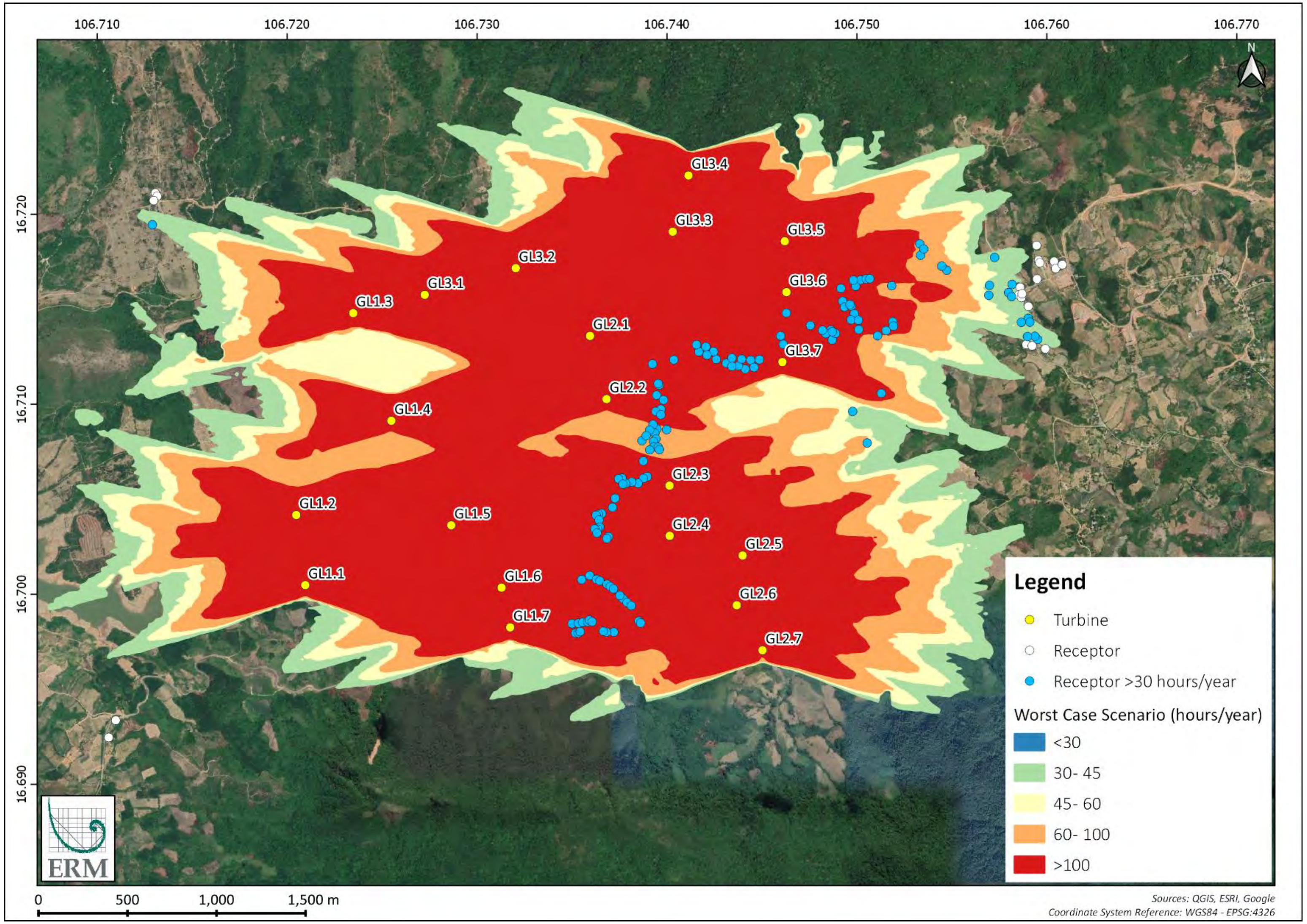


Figure 10.9 Map of Predicted shadow flicker (hours/year) – Worst Case Scenario

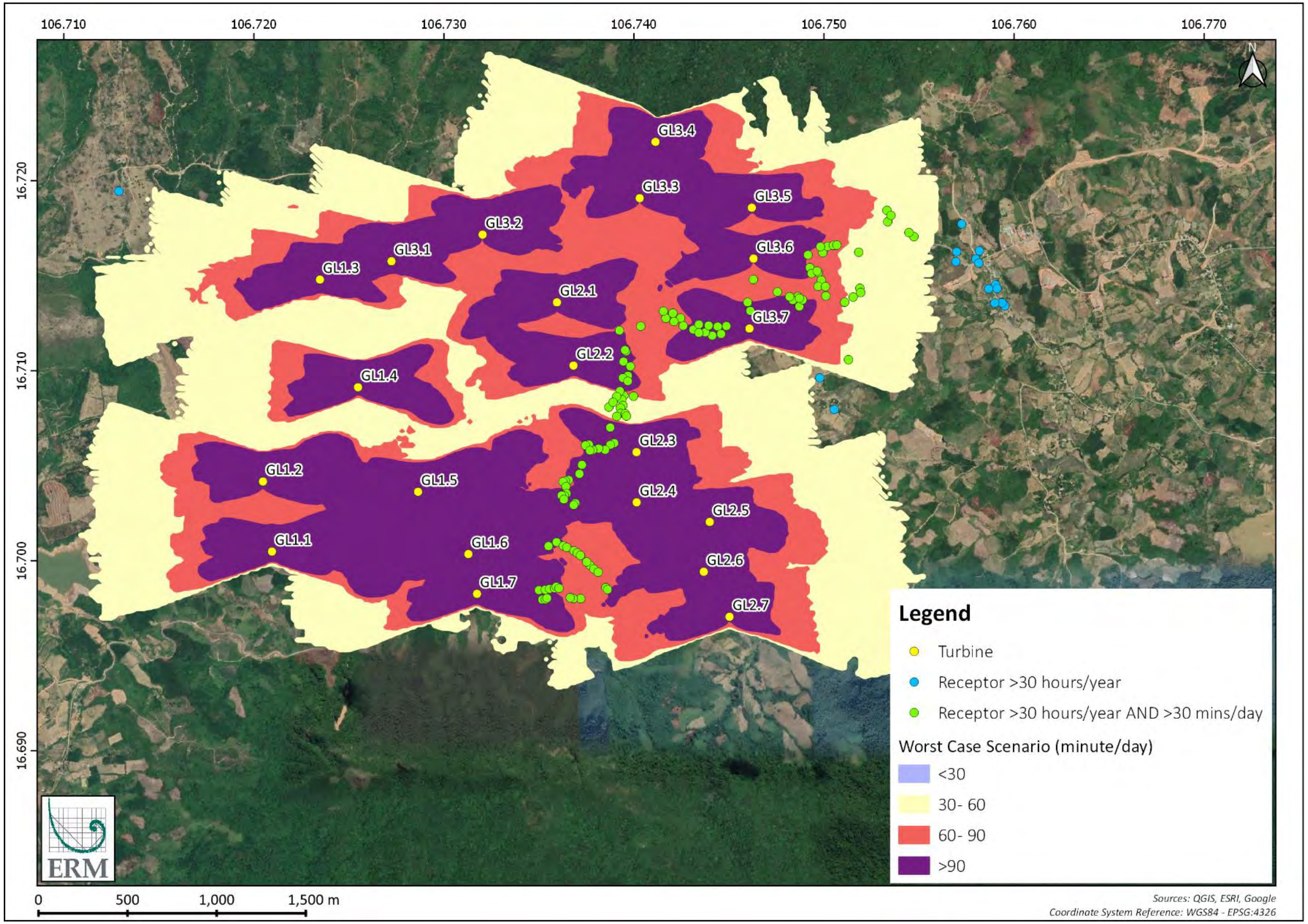


Figure 10.10 Map of Predicted shadow flicker (minutes/day) - Worst Case Scenario

10.6.5.2 Real Case by Statistic Scenario

In order to assess the shadow flickering occurrence taking into account local conditions for few parameters, a second scenario has been calculated.

The predicted shadow flicker durations at receptors are presented in Figure 10.11.

As a result, it is confirmed that with the input of local conditions (wind directions and average daily sunshine hours) on the modelling, the number of impacted receptors have been reduced to 91 instead of 118 as shown in worst-case scenario. For further detail modelling result, please refer to Appendix K.

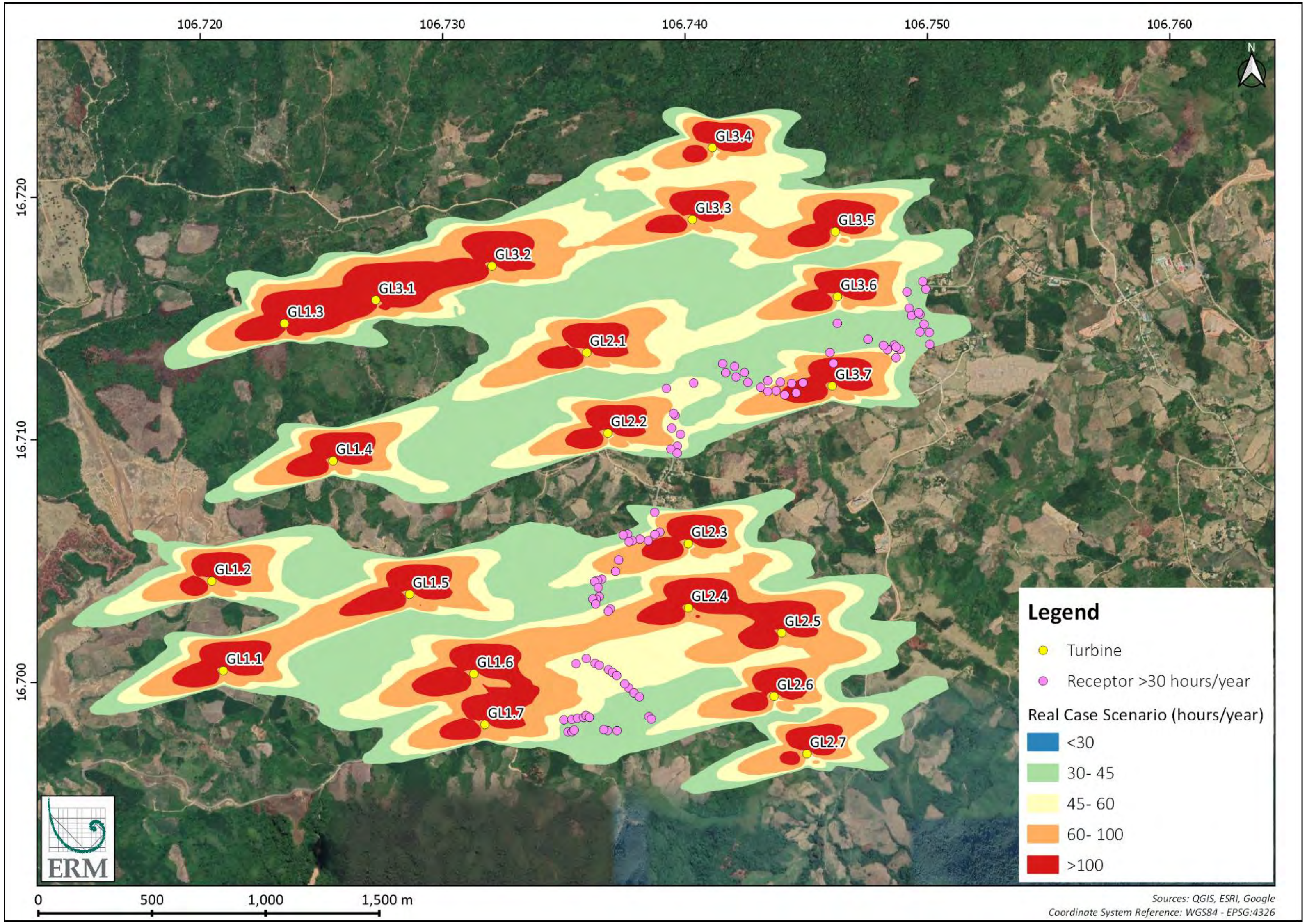


Figure 10.11 Map of Predicted shadow flicker (hours/year) – Real Case Scenario

10.6.6 Impact Assessment

10.6.6.1 Potential Impacts

The association between shadow flicker caused by wind turbines and the effects on human health is highly debated.

Certain studies suggested that flicker from turbines poses a potential risk of inducing photosensitive seizures (Harding et al, 2008; Smedley et al., 2010).

However, in 2011, the UK Department of Energy and Climate Change concluded in their Update Shadow Flicker Evidence Base report that “On health effects and nuisance of the shadow flicker effect, it is considered that the frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health”.

Despite such conclusions, other reports state that although shadow flicker from wind turbines is unlikely to lead to a risk of photo-induced epilepsy, the potential for annoyance and disturbance are still present leading to stress (Cope et al., 2009; Minnesota Department of Health, 2009; National Research Council, 2007).

10.6.6.2 Existing/ In-Place Control

There are no suggested existing controls in the local EIA report.

10.6.6.3 Significance of Impacts

The shadow flickering assessment has taken into consideration two scenarios: a worst-case scenario and a more realistic one embedding local meteorological conditions. In both scenarios, the amount of receptors in real case scenario had been insignificantly reduced comparing to worst case scenario (91 versus 107 shadow receivers). Nevertheless, these are still considered to be potentially impacted by shadow flickering that exceeding international guidance levels. It should be noted that:

- Based on available satellite imagery, the potential impacted dwellings surroundings are characterised in many cases by the presence of vegetation and/or unpredicted terrain condition. These conditions can reduce the potential to experience shadow flicker in real conditions (Figure 10.12 to Figure 10.14);
- In addition, it should be noted that receptors have been identified using satellite imagery and not confirmed through a dedicated site visit. Potentially some of them are not representing dwellings where people are permanently resided; and
- The performed calculations do not take into account the actual location and orientation of windows, or the screening effects associated with existing, site-specific conditions and obstacles like other buildings, leading to overestimate the duration of occurrences when shadow flicker might be experienced at a specific location;

Shadow flicker impacts are negative, direct and long-term during the Operation Phase of the Project. The impact scale is within 1,383 m of the WTGs on the receptors in the east of the WTGs. Impact magnitude varies based on distance of receptors from the WTGs and their orientations.

Figure 10.12 Environmental setting at shadow receptors – Group A

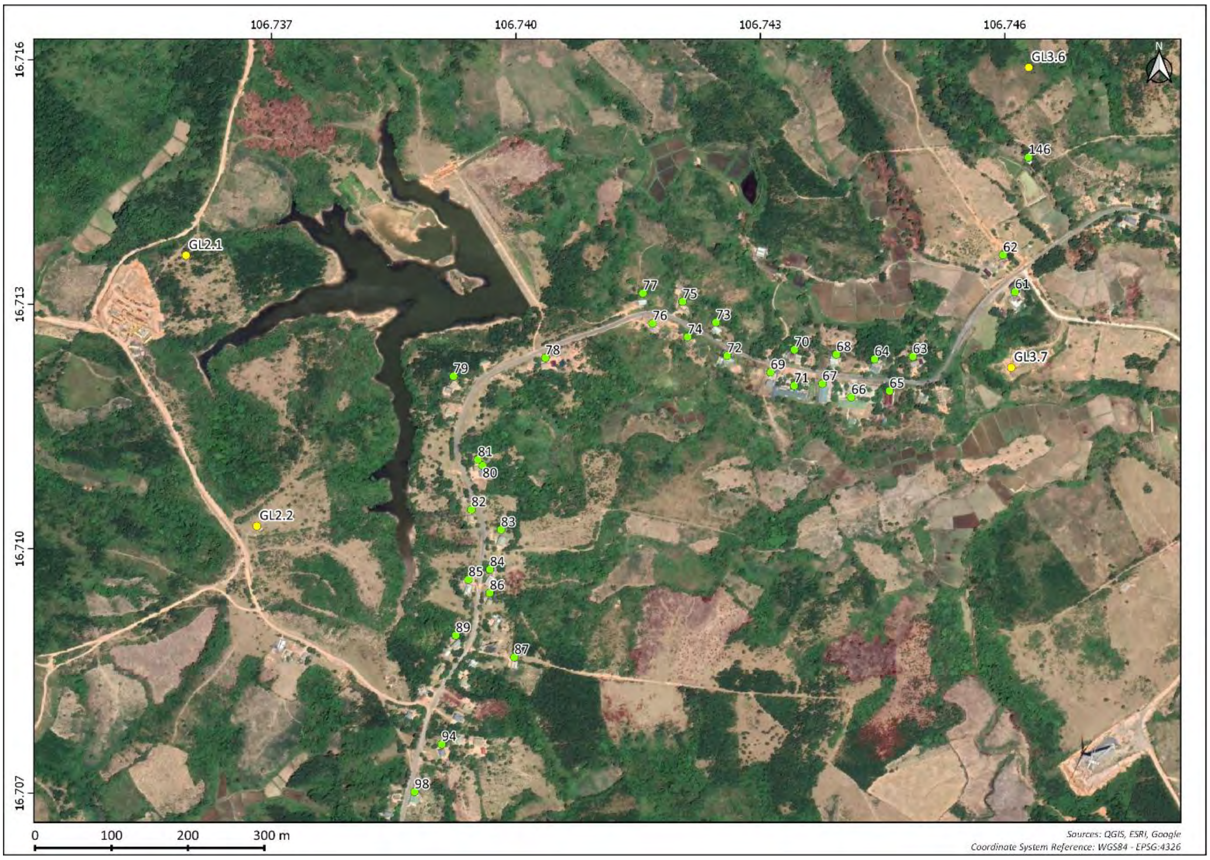


Figure 10.13 Environmental setting at shadow receptors – Group B

Figure 10.14 Environmental setting at shadow receptors – Group C

Table 10.35 Impacts of Shadow Flickering

Impact Nature	**Negative**		Positive		Neutral
Impact Type	**Direct**		Indirect		Induced
Impact Duration	Temporary	Short-term		**Long-term**	Permanent
Impact Extent	**Local**		Regional		Global
Impact Frequency	Throughout the operation phase of the Project. WTGs operate 24 hours/day				
Impact Magnitude	Positive	Negligible	Small	Medium	**Large**
Receptors Sensitivity	Low		Medium		**High**
Significance	Negligible	Minor		Moderate	**Major**
	The significance is **Major**				

10.6.6.4 Additional Mitigation Measures

As per the outcomes of the modelling, with specific regards to the residual potential impacted receptors identified by the real case scenario (nine dwellings) and in the event that on-site residents will be really affected by shadow-flickering once the turbines are under operation, it is suggested the Project proponent will assess the situation on a case-by-case basis and work according to the following mitigation scheme:

- Grievance Monitoring and Reporting – implementing a process to assess the real occurrence of the shadow flickering at local dwellings in order to eliminate the phenomena. In case of dwellings experienced shadow flickering, a detailed grievance mechanism should be available and the local community must be aware of the availability of grievance mechanism to submit their complaints regarding nuisances related to shadow flicker from turbines. Ensuring close monitoring through enagement with local stakeholders during the operational phase where there are predicted impacts from shadow flickers in case the locations have been finalised by the project proponent and earmarked for construction;
- Visual Screening (Natural) – Assess potential sensitive receptors, for which shadow flicker modelling indicates could exceed 30 hours per year, in order to ascertain the extent of existing natural visual screening in place. If not existing, the occurrence of shadow flickering during operation could be furtherly investigated, and if confirmed, natural screening could be realised to minimise the effect; and
- Visual Screening (Architectural / Structural) - If grievances will be received or if natural visual screening at potential sensitive receptors are found to be insufficient, investigations to implement architectural / structural screening such as the installation of blinds, window shades, window tinting, awnings or fences at affected receptors could be evaluated to further minimize the effect of shadow flicker.

10.6.6.5 Residual Impacts

The mitigation measures above will be implemented for identified receptors that experience shadow flicker. Residual impact following the implementation of these mitigation measures is likely to be Moderate.

10.6.6.6 Monitoring and Audits

No specific monitoring measures are identified and recommended at this stage

10.7 Visual Amenity Impact Assessment

Visual impact assessment means assessing the impacts of the Project on specific views and on the general visual amenity experienced by people. Landscapes are not static but are dynamic, not least due to the range of natural and human factors that define their characteristics, but also due to the many different pressures that have altered landscapes in the past and will continue to do so in the future. Therefore, determining the significance of visual effects identified can be particularly challenging.

This section provides methodology, an assessment of baseline conditions within Project site and surroundings in relation to landscape and visual and then assesses the anticipated impacts throughout Project's phases. Then, a set of management measures (including mitigation measures, additional requirements, etc.) and monitoring measures have been identified to eliminate or reduce the impact to acceptable levels.

10.7.1 Scope of Assessment

The scope of this assessment is limited to the proposed wind turbines design of the Project and observers as identified in Figure 10.7, including a qualitative visual aesthetics assessment and associated reporting to document the methodology, findings and any agreed mitigation measures for the proposed wind farm site/design. The assessment scope of works included:

- Reviewing existing project information and operational activities to understand site conditions pertaining to visual impacts;
- Identify the closest and/or potentially most affected receptors situated within the potential area of influence of the wind farm and discuss the existing conditions near these receptors;

10.7.2 Consideration and Assumption

Visual impacts relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's response to any changes, and the overall impacts with respect to visual amenity.

Based on the SRTM (Shuttle Radar Topography Mission) data, it is observed that the wind turbines of the Project are having site in a raised area with the elevation can be up to 100 m above sea level. It is also noted that the areas where the receptors and the wind turbines are located is distinguished by spread roughness of the terrain.

10.7.3 Assessment Methodology

Visual impacts relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's response to any changes, and the overall impacts with respect to visual amenity. The methodology followed to identify and assess the significance of and the effect of changes resulting from the project on both the landscape as an environmental resource in its own right, and on people's views and visual amenity is presented in the subsequent section. People have different responses to views and visual amenity depending on their context and purpose, with certain activities specifically associated with the enjoyment of the landscape (e.g., the use of footpaths and tourist routes and attractions) generally more susceptible to change. Residents are also considered to be particularly susceptible to change and the combined effects on a number of residents within an area may also be considered.

10.7.4 Baseline Information

The proposed assessment has been developed according to the following tasks:

- Study area definition;
- Viewshed analysis; and
- Viewpoints and sensitive receptors identification.

10.7.4.1 Study Area Definition and Viewshed

The landscape study area is defined as the area within which the Project could be discernible by the human eye and could interfere with the main sensitives identified in the local context.

To identify the landscape study area, the Zone of Theoretical Visibility (ZTV) has been determined through computer analysis of topographical mapping to establish the theoretical distance from which the wind turbines could be visible in each direction.

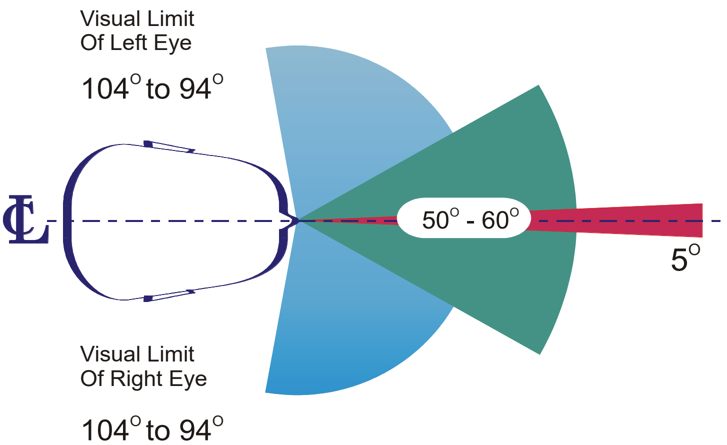
This ZTV was determined through a viewshed analysis using the software ArcMap 10.7. The viewshed analysis is based only on topography (i.e. digital elevation model), and represents the areas where the wind farm could be potentially visible. For this specific assessment SRTM (Shuttle Radar Topography Mission) 30 m Digital Elevation has been utilised.

Defining an appropriate viewshed is the starting point to understand the visual impacts of the project. The area of the viewshed will vary depending on the nature and scale of the proposed facility. The larger (and higher) the facility is, the bigger the viewshed will be, as it may be visible for a greater distance. The viewshed is therefore the area that is most likely to be visually impacted.

The following information[48] explains how a viewshed is defined and identified depending on the horizontal and vertical field of views.

A. Horizontal Field of View

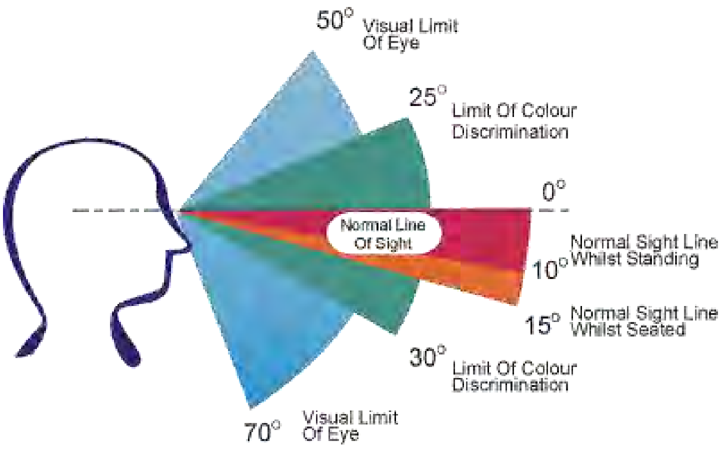
For most people, the horizontal central field of vision covers an angle of between 50° to 60°. Within this angle, both eyes observe an object simultaneously but from a slightly different angle. This creates a central field of greater magnitude than that possible by each eye separately. This central horizontal field of vision is termed the 'binocular field' (see green zone). Within this field images are sharp, depth perception occurs and colour discrimination is possible. Research suggests that the visual impact of a Project component will vary according to the proportion the binocular field it occupies. Project components which occupy 5% or 2.5° or less of the horizontal central binocular field of vision are usually perceived as insignificant objects, whereas components which occupy 30° are considered to be visually dominating.



B. Vertical Field of View

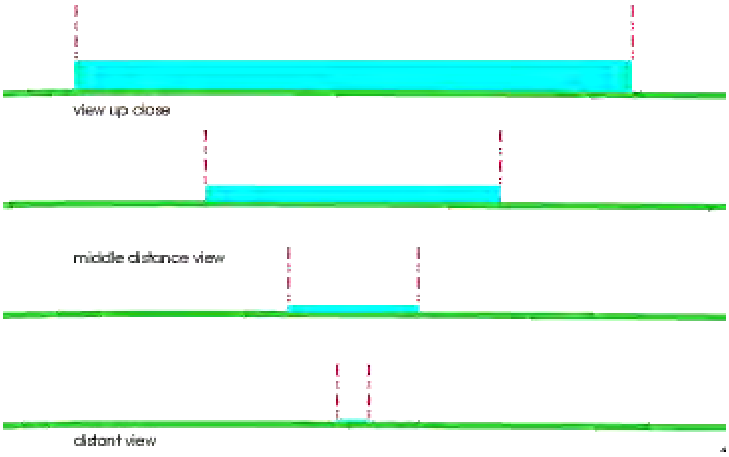
The vertical central field of vision has a similar set of parameters. The vertical binocular field is normally 25° above the vertical and 30° below the vertical. When project components exceed the 50° upper visual limit of the eye, they are considered to dominate the vertical central field of vision. When project components occupy 0.5° they are not considered dominant, nor are they usually perceived as a significant change to the existing baseline condition when they are located within an anthropogenically modified landscape.

48 Source: Human Dimension & Interior Space – A Source Book of Design Reference Standards, Julius Panero and Martin Zelnik, The Architectural Press Ltd. London, 1979



C. Horizontal versus Vertical Visibility over Distance

As a person moves further away from a project component, the visibility of the vertical dimension tends to reduce more significantly than the visibility of the horizontal dimension. This effect is illustrated below.



10.7.4.2 Visual Baseline

Visual interferences may occur when new elements are introduced into a landscape or existing elements are altered or removed leading to a change in the way that stakeholders access, perceive or experience landscape resources.

Based on the Project characteristics the main interferences could occur from:

- Erecting turbines;
- Movement of large construction vehicles;

The proposed wind turbines are the major visual element of the proposed development and may visually impact on the surrounding. As the viewer moves further away from these structures the visual impact decreases until it is no longer visible. However, before the point of non-visibility is reached, the wind turbines have reduced in scale such that they no longer have a significant visual impact.

The wind farm is comprised of a number of individual turbines of the same dimensions (180.125 m height and 138.25 m width), with relatively high separation distances between each individual turbine, more than 500 m. In assessing the visual impact of the wind turbine, it is therefore assumed that the largest horizontal component is the entire rotor, which would be a maximum of 138.25 m wide. It has been also evaluated the combined effect of multiple rotors throughout the landscape.

As shown in Table 10.36, calculations suggest that the impact of a 138.25 m wide wind turbine rotor would reduce to insignificance at about 4.1 km, as it would form less than 5% or 2.5° of the horizontal field of view.

Table 10.36 Horizontal Field of View

Horizontal Field of View	Impact	Distance from Observer to a 138.25 m Wide Turbine Rotor
<2.5° of view	The development will take up less than 5% of the central field of view. The development, unless particularly conspicuous against the background, will not intrude significantly into the view. The extent of the vertical angle will also affect the visual impact.	>4.1 km
2.5° – 30° of view	The development may will have usually a moderate impact that may be not noticeable at the greatest distance of this range.	336 m to 4.1 km
>30° of view	Developments that fill more than 50% of the central field of vision will always be noticed and only sympathetic treatments will mitigate visual effects.	< 336 m

A similar analysis can be undertaken based upon the vertical field of view for human vision (Table 10.37), shows the relationship between impact and the proportion that the development occupies within the vertical line of sight.

Table 10.37 Vertical Field of View

Vertical Line of Sight	Impact	Distance from Observer to a 180.125 m Tall Wind Turbine
< 0.5° of vertical angle	A thin line in the landscape	>20.7 km
0.5° – 2.5° of vertical angle	The degree of visual intrusion will depend on the development's ability to blend in with the surroundings	4.1 km to 20.7 km
> 2.5° of vertical angle	Usually visible, however the degree of visual intrusion will depend of the width of the object and its placement within the landscape	<4.1 km

Based on the above mentioned, it is reasonable that distances, at which the magnitude of visual impact of the wind turbine will be not significant, can be the ones greater than 21 km, where a fully visible wind turbine would be an insignificant element within the landscape.

Generally, the more conservative or worse case distances form the basis for the assessment of visual impacts. Therefore, this development the greater impacts would be associated with the vertical field of view and so it is therefore proposed to use the vertical field of view and extend the viewshed to 21 km for proposed wind farm.

ArcMap 10.7 was used to determine the ZTV for the Project. The current visibility within the ZTV will vary depending on the presence of intervening local topography, and features as vegetation and buildings. The present viewshed analysis has been based solely on topography and did not take into account the potential screening granted by the local vegetation patches, which would further reduce the actual viewshed. Moreover, it should be highlighted that a typical viewshed assessment does not take typical meteorological conditions into account that can result in changes to real visibility. For example, rainfall and other atmospheric conditions will alter the visibility of the wind farm. The diminution of visual clarity bought about by atmospheric conditions also increases with distance and cloudy days can result in a natural attenuation of the visibility of the Project.

Similar to cloud coverage, rainy days are able to reduce the visibility as the water droplets obscure vision. This varies greatly depending on the heaviness of the precipitation, but even light rain obscures distant objects greatly.

Figure 10.15 shows the ZTV mapping from any points inside the buffer area.

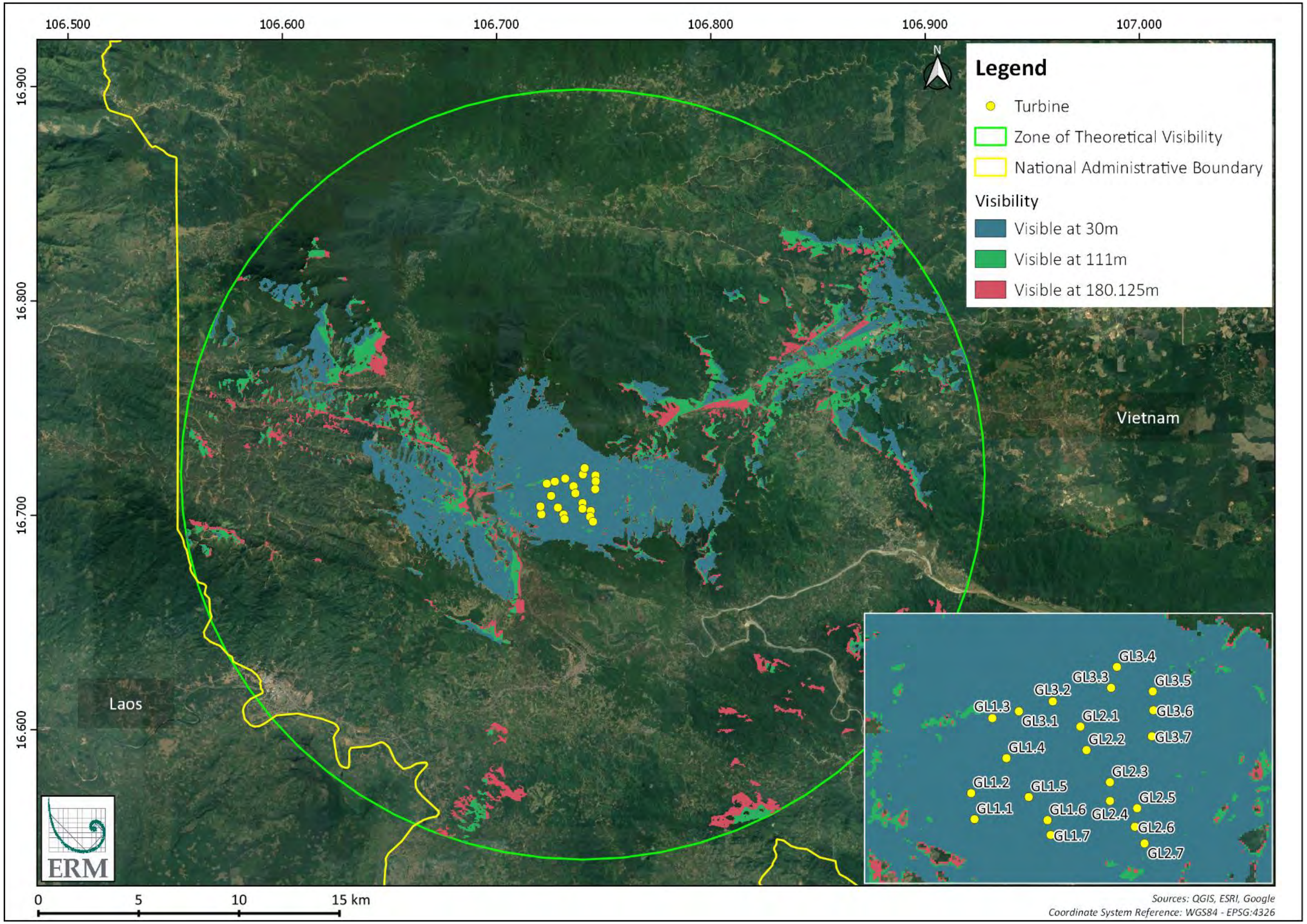


Figure 10.15 Viewshed (21 km buffer)

The results of the viewshed assessment as presented in Figure 10.15 show that the visibility is strongly influenced by the morphology of the area. In fact, the roughness of the terrain makes highly variable the chance to see the wind turbines, both in their entirety and partially.

It should be emphasized that intervening vegetation is not included in this mapping and is likely to significantly reduce the visibility of wind turbines, in whole or in part, and therefore reduce the impact identified.

Regarding the potential visibility from local communities, wind turbines, either in whole or in part, will be visible from main residential areas thereabout as Xa Bai, Cooc, Hoong Moi Villages of Huong Linh Commune. Additionally, residents in Khe Sanh Town and Lao Bao Town (approximately 8 km and 15 km respectively from the Project site) can also be able to observe the GELEX 1,2,3 wind farm.

Considering the outcomes of the viewshed analysis, five viewpoints, both among the potential receptors and the near settlement and roads, have been selected as representative locations. All of them are located within the ZTV of 21 km from the Project, from where people will be able to see the Project within the landscape and where the quality of the landscape and the visual perception of people could be affected by the presence of the Project. These viewpoints are referred to as Visual Sensitive Receptors (VSRs). Wireframes have been prepared in order to show the visual change with the development of the Project at the selected VSRs.

It should be noted that, in order to screen the potential sensitive receptors, the following criteria have been used to assess the sensitivity of the VSRs:

- Value and quality of existing views;
- Type and estimated number of receiver population;
- Duration of frequency of view; and
- Degree of visibility.

Figure 10.16 shows the locations of the VSRs selected for analysis.

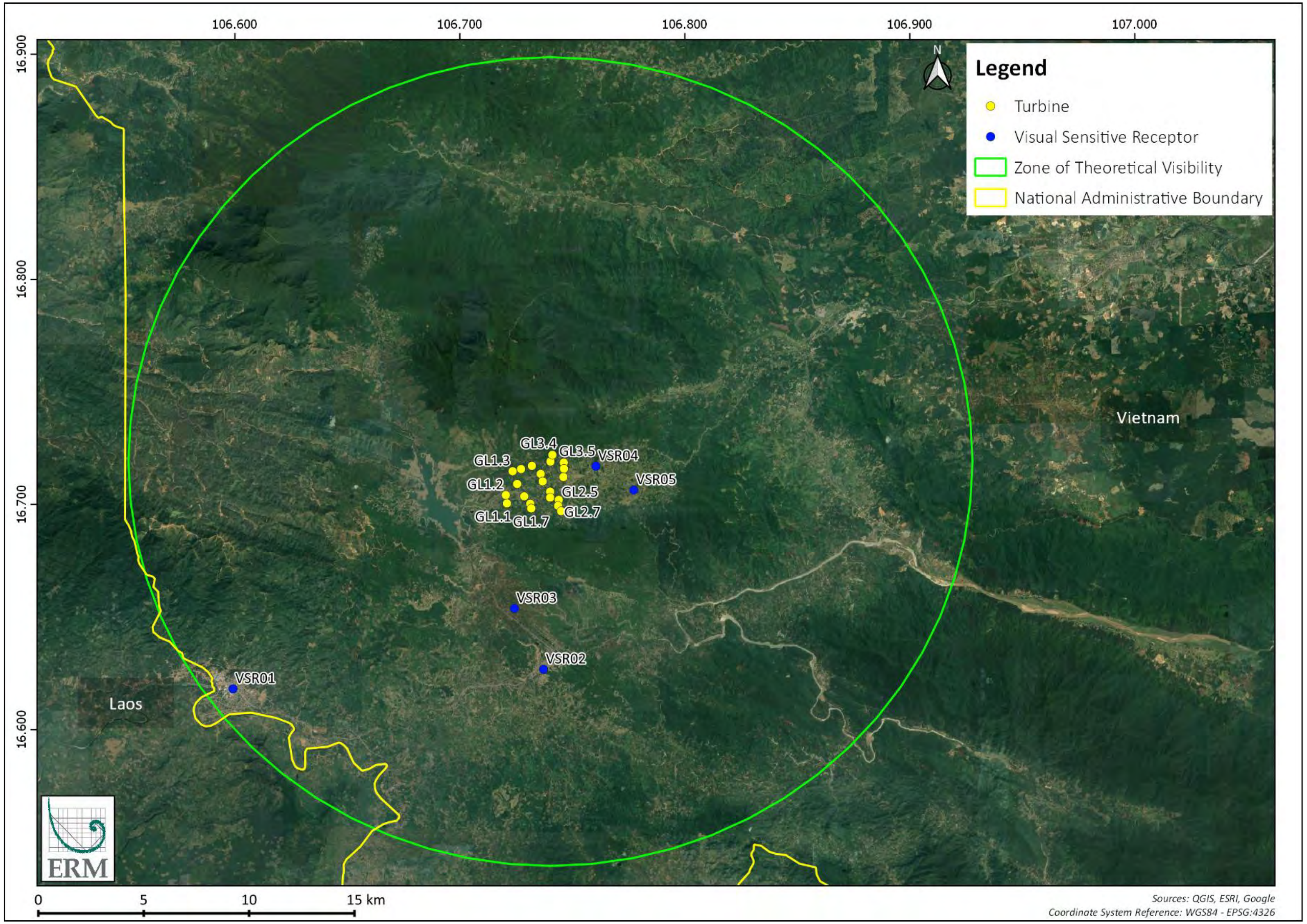


Figure 10.16 Visual Sensitive Receptors Location

10.7.5 Impact Assessment

The assessment of impacts on visual amenity was undertaken in accordance with accepted methodologies derived from best practice guidelines. Impact significance for visual amenity is generally derived on the basis of the following main factors:

- The quality/importance of the visual amenity as a resource/function that is potentially affected;
- The sensitivity of the visual amenity towards Project activities; and
- The magnitude of change to the receiving visual amenity because of the Project.

The visual impact assessment describes changes in the character of the available views to people resulting from a given Project and their visual amenity. To determine the significance of visual effects it is necessary to consider the sensitivity of the visual receptors against the magnitude of visual effects.

10.7.5.1 Methodology

10.7.5.1.1 Sensitivity of Receptors

Visual receptors are people and must be assessed in terms of their sensitivity, combining judgements on their susceptibility to the specific change proposed and the value attached to a view or their visual amenity. Susceptibility refers to the degree to which a particular visual receptor can accommodate change arising from the Project, without detrimental effects on the visual amenity, and will vary with the:

- Occupation or activity of people experiencing the view;
- Location and context of the view; and
- Extent to which their attention or interest may be focused on the view and their visual amenity.

Judgements about the sensitivity of visual receptors should be recorded on a scale (e.g., low, medium and high) with clearly stated criteria. Table 10.38 indicate the relative sensitivities of a number of visual receptors.

Table 10.38 Sensitivity of Visual Receptors

Visual Receptors	Sensitivity
Small number of visitors with interest in their surroundings. Viewers with a passing interest not specifically focussed on the landscape e.g. workers, commuters. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being low	Low
Small numbers of residents and moderate numbers of visitors with an interest in their environment. Larger numbers of recreational road users. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being medium	Medium
Larger numbers of viewers and/or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and well-used recreational facilities. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being high	High

10.7.5.1.2 Magnitude of visual effects

There is no standard methodology for the scale or magnitude of effects on views and visual amenity. However, it is generally based on the:

- Scale of change relating to the loss or additions of features in the view, including the proportion of the view occupied by the proposed development;
- Degree of contrast or integration of any new feature or changes in the composition of the view;

- Duration of the effect, whether temporary or permanent, intermittent or continuous;
- Angle of view in relation to the main activity of the receptor;
- Distance of the viewpoint from the Project; and
- Extent of the area over which the changes would be visible.

As there is likely to be a variation in the degree of visibility of the Project, it is helpful to categorize those variations:

- The extent of the view that would be occupied by the Project: full, partial, glimpse etc.;
- The distance of the viewpoint from the Project and whether the viewer would focus on the Project due to proximity or the Project would form one element in a particular view;
- The proportion of the Project or particular features that would be visible: full, most, small amount, none;
- Whether the view is transient or one of a sequence of views as from a moving vehicle or footpath.

Consideration may also be given to the time of day and seasonal differences in effects. The worst case may need to be demonstrated (i.e., during wet season, when the moisture reduces visibility). The typical criteria and thresholds in determining the magnitude of effect on visual receptors are set out in Table 10.39.

Table 10.39 Magnitude of visual effect

Typical criteria and thresholds	Visual Magnitude of effect
A change which is barely or rarely perceptible, at very long distance, or visible for a short duration, perhaps at an oblique angle, or which blends in with the existing view. The change may be short term.	Negligible
A subtle change in the view, at long distances, or visible for a short distance, perhaps at an oblique angle, or which blends in with the existing view. The change may be short term.	Small
A noticeable change in the view at an intermediate distance, affecting a substantial part of the view, part a more wide-ranging, less concentrated change across an expansive area. The change may be medium to long term and may not be reversible.	Medium
A clearly evident change in the view at a close distance, affecting a substantial part of the view, continuously visible for a long duration, or obstructing important elements of the view. The change may be medium to long term and would not be reversible.	Large

10.7.5.1.3 Significance of Visual Effect

When determining the significance of visual effects, the following is taken into account:

- Large scale changes which introduce new discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present in the view;
- Changes in views from recognized and important viewpoints or amenity routes are likely to be more significant than changes affecting less important paths and roads; and
- Changes affecting large numbers of people are generally more significant than those affecting a relatively small group of users. However, in wilderness landscapes the sensitivity of the people who use the areas may be very high and this will be reflected in the significance of effect.

The significance matrix below illustrates the relationship between the sensitivity of a visual receptor and the magnitude of the visual effect. The significance of a visual effect may be adverse or beneficial dependent upon the nature of the change. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of effects. What level of effect constitutes a significant effect will vary on a project by project basis.

Table 10.40 Significance of Visual Effect

		Sensitivity of Visual Receptor		
		Low	Medium	High
Magnitude of Visual Effect	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

10.7.5.1.4 Identification of Visual Impact

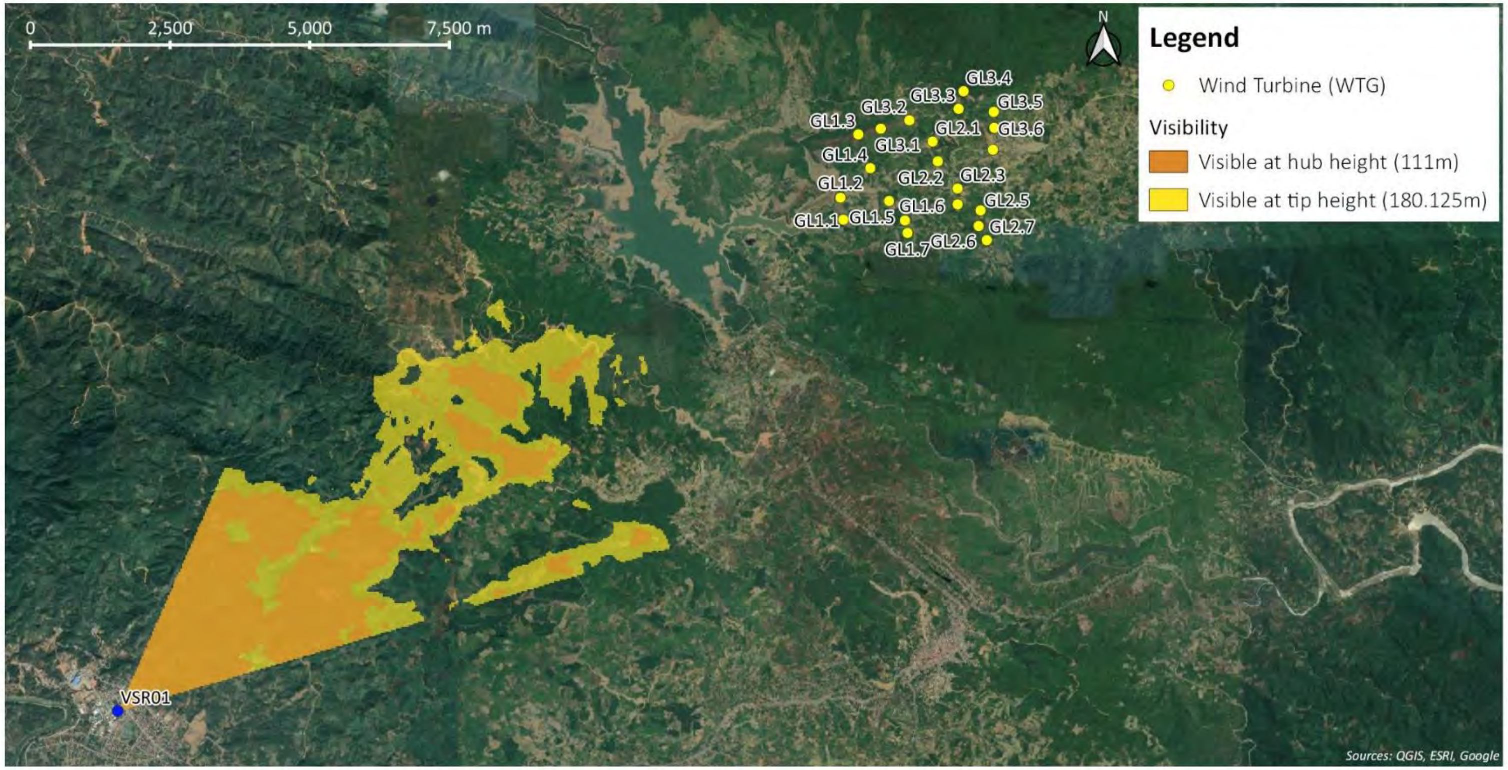
The visual impact is a product of the magnitude of change to the existing baseline conditions, the landscape context and the sensitivities of VSRs.

The viewshed analysis (Figure 10.7) shows that the proposed wind turbines have the potential to be visible in the nearby areas not continuously due to the variability of the landscape for the area surrounding the Project.

Figure 10.16 shows the location of the VSRs which have been selected for the analysis and Table 10.41 shows the summary of the visual impacts of the Project at the selected VSRs.

In the next pages are presented the wireframes for each VSR previously identified.

VIEWPOINT VSR01

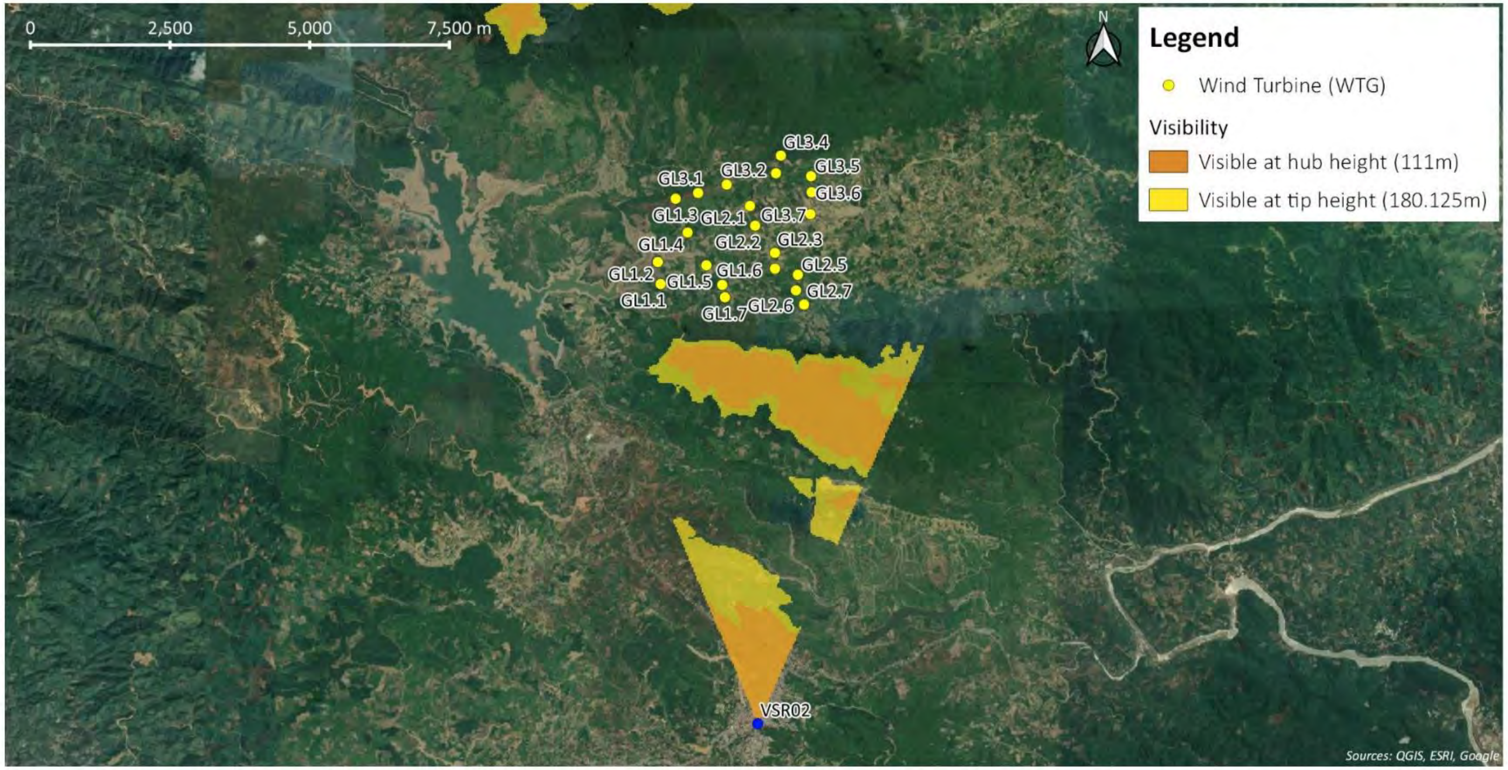


Viewpoint Location Information

Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
16.618096	106.599191	1.5	NE	50	21	0	0	15,899.84	19,229.97

Visual Sensitivity	Magnitude of Change
The present view is taken from Lao Bao Town near Laos border. Being an important residential area, large number of viewers with proprietary interest and prolonged viewing opportunities are involved. The visual sensitivity is considered to be High	Due to the topography of the land and the distance, from this point of view no wind turbines are visible. The change in the view is remained the same from Lao Bao Town to Huong Linh Commune. It is considered that the magnitude of change is Negligible

VIEWPOINT VSR02

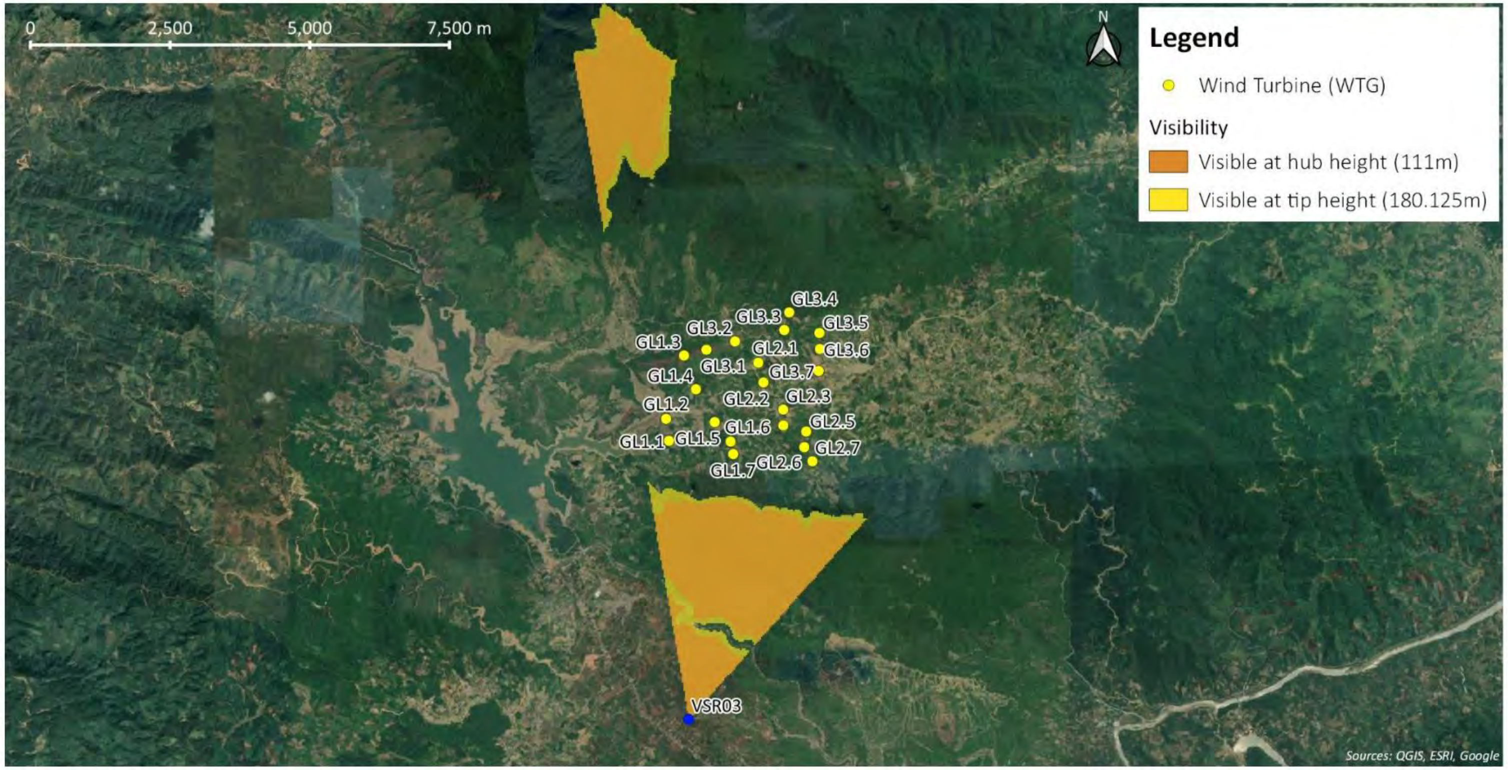


Viewpoint Location Information

Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
16.626773	106.737238	1.5	N	50	21	0	0	7.816.98	10.547.15

Visual Sensitivity	Magnitude of Change
The present view is taken from Khe Sanh Town of Huong Hoa District. Being an important residential area, large number of viewers with proprietary interest and prolonged viewing opportunities are involved. The visual sensitivity is considered to be High	Due to the topography of the land and the distance, from this point of view no wind turbines are visible. The change in the view is remained the same from Khe SanhTown to Huong Linh Commune. It is considered that the magnitude of change is Negligible

VIEWPOINT VSR03

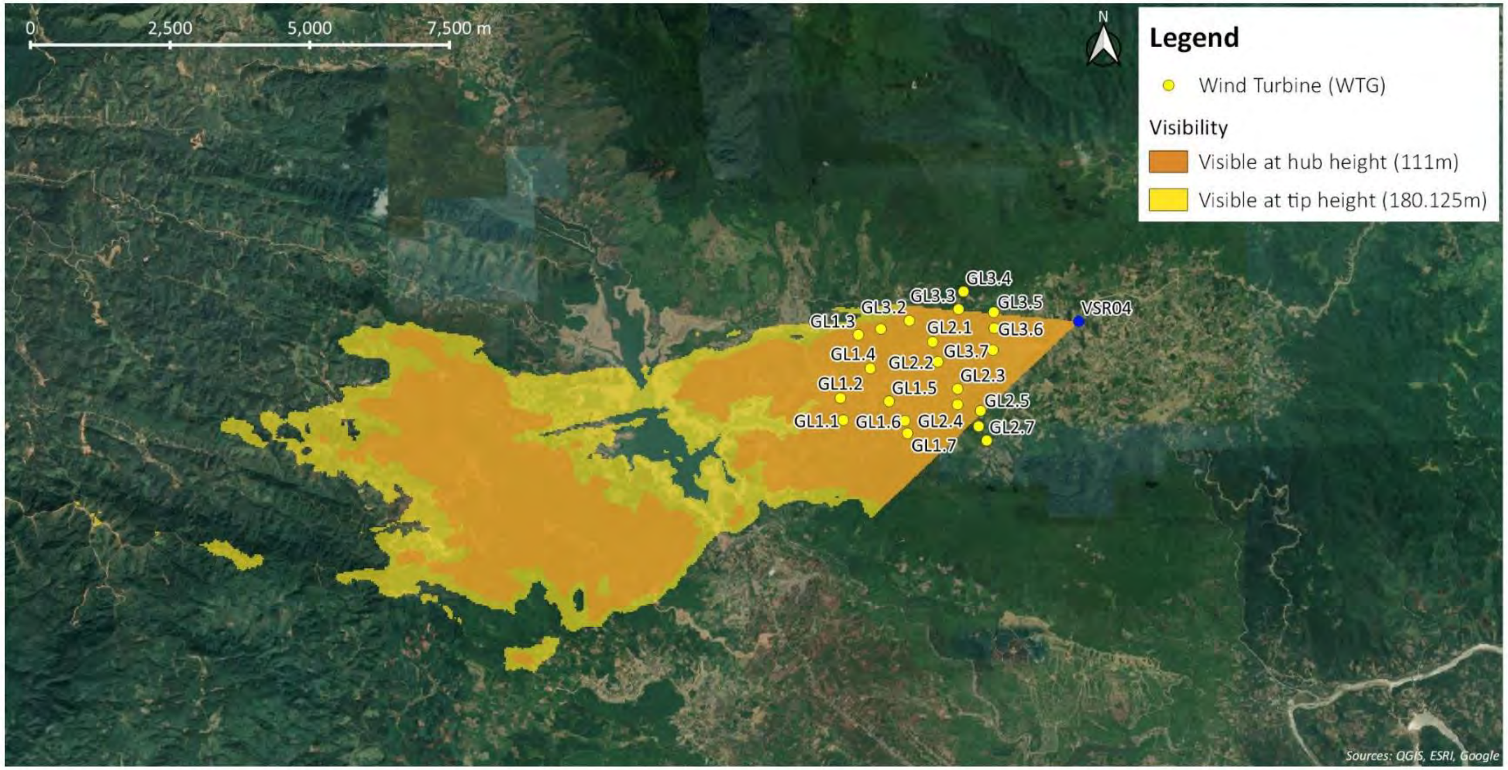


Viewpoint Location Information

Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
16.653815	106.724272	1.5	NNE	50	21	0	0	4,978.28	7.779.94

Visual Sensitivity	Magnitude of Change
The view is taken from the historical site (Ta Con airport relic) of Tan Hop Commune. Being an important point of interest, large number of visitors passes by the location with proprietary interest and brief viewing opportunities are involved. The visual sensitivity is considered to be Medium	Due to the topography of the land and the distance, from this point of view no wind turbines will be visible. It is considered that the magnitude of change is Negligible

VIEWPOINT VSR04

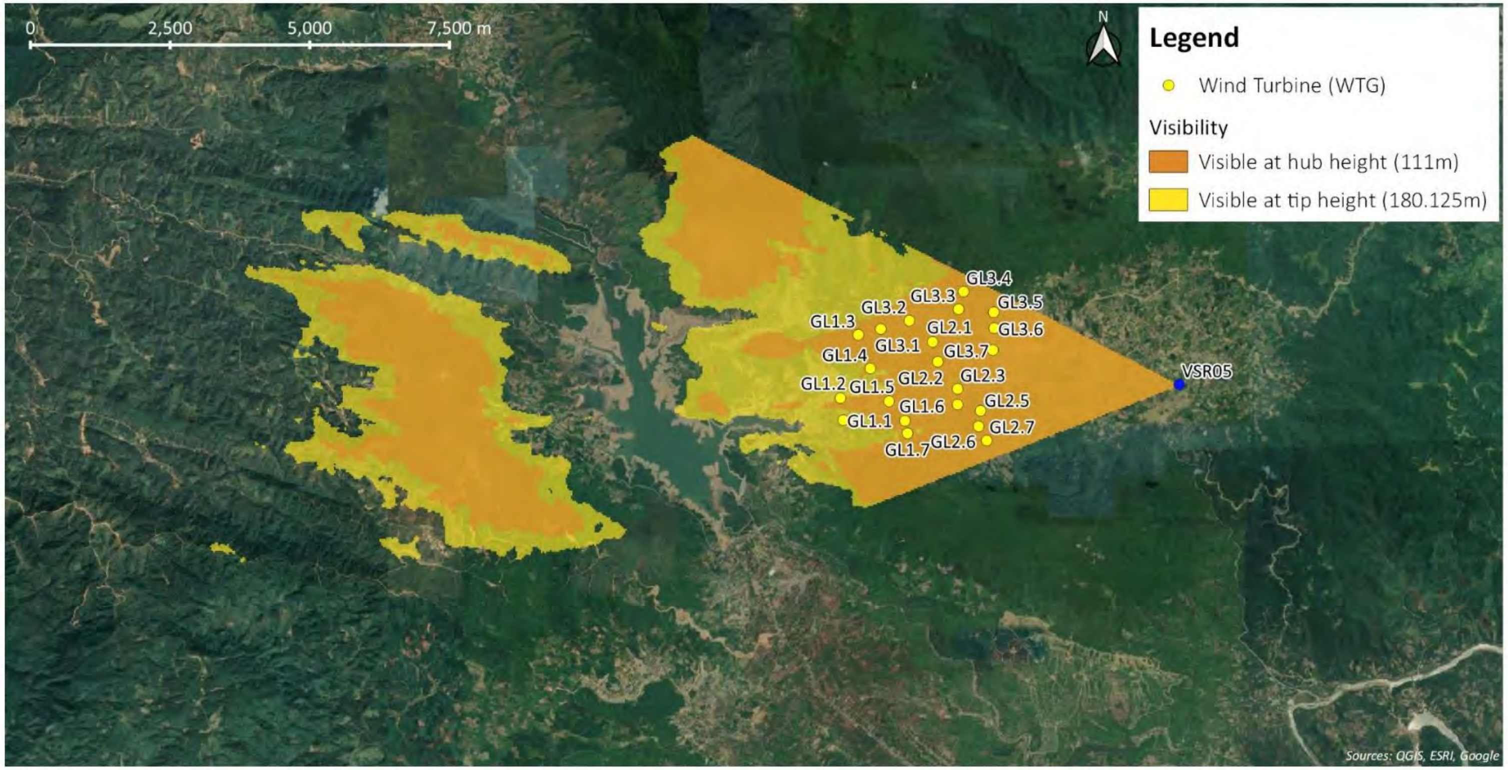


Viewpoint Location Information

Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
16.717043	106.760480	1.5	SSW	50	17	17	17	1,527.82	4,641.02

Visual Sensitivity	Magnitude of Change
The view is taken from public infrastructure of Huong Linh Commune (Healthcare Centre and People's Committee). Being an important point of interest, large number of visitors passes by the location with proprietary interest and brief viewing opportunities are involved. The visual sensitivity is considered to be Medium	The change in the view is undeniable, but mitigated by the layout of the wind farm, mainly due to the limited distance. The WTGs will become a substantial part of the view. It is considered that the magnitude of change is Large

VIEWPOINT VSR05



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
16.706445	106.777345	1.5	S	50	21	21	19	3,381.15	6,078.79

Visual Sensitivity	Magnitude of Change
The view is taken from a scattered dwellings of Huong Linh Commune. Due to the large number of viewers with proprietary interest and prolonged viewing opportunities but limited landscape value and passing interest not focused on the landscape, the visual sensitivity is considered to be Medium	The change in the view is noticeable, but mitigated by the layout of the wind farm, mainly due to the limited distance. The WTGs will become a substantial part of the view. It is considered that the magnitude of change is Large

Table 10.41 Summary of Visual Impact

VSR	Distance to nearest wind turbine	Project visibility	Sensitivity of Receptor	Magnitude of Visual Effect	Significance of Visual Effect – Combined Impact
VSR01	15.9 km	Not visible	High	Negligible	Negligible
VSR02	7.8 km	Not visible	High	Negligible	Negligible
VSR03	4.8 km	Not visible	Medium	Negligible	Negligible
VSR04	1.5 km	Visible	Medium	Large	Major
VSR05	3.4 km	Visible	Medium	Large	Major

It should be noted that views of the Project could be filtered through vegetation not included in the present analysis.

10.7.5.2 Additional Mitigation Measures

The following identifies mitigation measures to be applied by the Developer and EPC contractor during project's phase including:

- Use of materials that will minimise light reflection should be used for all Project components;
- Bright patterns and obvious logos should be avoided on WTGs;
- The replacement of wind turbines with visually different wind turbines can result in visual clutter, so replacing wind turbines with the same or a visually similar model over the lifetime of the project may be an important requirement;
- Existing vegetation should be retained to the greatest extent possible. Vegetation should be retained along roads, substations, and other Project infrastructure.

10.7.5.3 Residual Impact

Following the implementation of these mitigation measures, the significance of residual impact is considered as **Moderate**.

10.7.5.4 Monitoring and Audit

No specific monitoring measures are identified at this stage.

10.8 Electromagnetic Interference Assessment

10.8.1 Scope of Assessment

All transformers and transmission lines, especially high voltage lines, emit a type of low frequency non-ionizing radiation caused by the generation of electric fields, due to electric charges (voltage), and magnetic fields, due to the flow of electrical current through transmission lines, which collectively is referred to as Electric and Magnetic Fields (EMF). Exposure to high levels of EMF can pose a health risk for people. The strength and extent of EMF depends on three things:

- How much current is flowing;
- The voltage; and
- Configuration of the wires (e.g. size, wiring phase configuration and separation between the wires).

The key activities that are likely to negatively impact receptors during the operation phase include electromagnetic interference generated by the wind turbines transformers, transmission line and substation transformers when the wind turbines are in operation (i.e. once electrical current flows through the conductors).

Table 10.42 Scope of Electromagnetic Interference Assessment

Phases	Potential Activities	Potential Impacts	Potential Consequences	Receptor
Operation	Waste, emissions (including electromagnetic interference) and discharge generation, handling and disposal	Electromagnetic fields from transmission line and transformers in substations	Health risks	Receptors along the transmission line and near the substation

10.8.2 Relevant Guidelines and Criteria

10.8.2.1 Vietnamese Regulations

- Electricity Law dated 3rd December 2004 and the Law on amendment and supplement to the Electricity Law dated 20th November 2012;
- Decree No.14/2014/ND-CP, dated 26th February 2014 stipulating in detail the implementation of electricity law regarding electricity safety; and
- QCVN 25:2016/BYT – National Technical Regulation on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace.

10.8.2.2 International Guidelines

IFC Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution (2007) provides guidelines to manage potential environmental and community health and safety impacts from power construction facilities, including electric and magnetic fields.

As mentioned in the above section, electric fields are normally measured in kilovolts per metre (kV/m), while magnetic fields are defined by magnetic flux density, measured in micro-Tesla (μT) or milli-Gauss (mG). The World Bank Group's (WBG) Environmental, Health and Safety (EHS) Guideline[49] for Power Transmission and Distribution (WBG, 2007) refers to the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[50] [51] for health and safety standards relative to exposure to EMF. The World Health Organization (WHO)[52] refers to ICNIRP EMF standards as short-term and high level exposure limits. At present, ICNIRP limits consider the scientific evidence related to possible health effects from long-term, low level exposure to EMF fields insufficient to justify lowering these quantitative exposure limits. The ICNIRP EMF exposure limits are instantaneous and not averaging and it refers to Basic Restrictions and Reference Levels for both magnetic and electric fields under General Public and Occupational exposure conditions (Table 10.43). Basic Restrictions are the fundamental limits on exposure and are based on the internal electric currents or fields that cause established biological effects in humans. They are impractical to measure. Therefore, Reference Levels of exposure to the external fields, which are simpler to measure, are provided as an alternative means of showing compliance with the Basic Restrictions. The Reference Levels have been conservatively formulated such that the Reference Levels will ensure compliance with the Basic Restrictions. In summary, these

[49] EHS Guidelines for Power Transmission and Distribution, April 30, 2007

[50] The ICNIRP Guidelines (2010) for limiting exposure to time-varying electric, magnetic and electromagnetic field (up to 300GHz) (http://www.icnirp.de/PubEMF.htm)

[51] These values represent the ICNIRP occupational exposure limits.

[52] WHO 2007, Extremely Low Frequency Fields – Environmental Health Criteria, Monograph No. 238 March 2007

limits can be considered as chronic exposure standards and there are no health risks associated with short-term exposure to these levels.

Table 10.43 Basic Restriction and Reference Levels for Exposure to 50Hz EMF at the Edge of Right of Way (ROW)

Exposure Characteristics	Electric field (kilo volts per meter, kV/m)	Magnetic flux intensity		
		Micro-Tesla (μT)	Milli-Gauss (mG)	Ampere/m (A/m)
Occupational	10 kV/m	1,000 (500 prior to 2010)	10,000 (5,000 prior to 2010)	798 (399 prior to 2010)
General Public	5 kV/m	200 (100 prior to 2010)	2,000 (1,000 prior to 2010)	160 (80 prior to 2010)

10.8.3 Assessment Methodology

The calculation of Electro Magnetic Field (EMF) is one of the factors which must be considered during the design process especially for high voltage transmission lines to determine Right of Way (ROW) of the power line such that there will not be danger for the people and surrounding environment.

An excel based software developed by EEP Portal[53] for the calculation of electromagnetic field (EMF) around transmission and distribution overhead lines was used to calculate EMF for the 110 kV transmission line proposed for the current study. The tool can be used to calculate one or two circuit lines in which ground wires can be incorporated for the EMF calculations. In addition, the tool allows combining and creating examples of power lines where two independent power lines can interact on each other. The EMF calculations used in this tool uses the analytical approach described in EPRI Red Book “Transmission Line Reference Book”. In addition, accuracy of these EMF calculations were checked with other commercial software.

10.8.4 Impact Assessment

10.8.4.1 EMF from overhead 110 kV transmission line

Input data

As mentioned in Chapter 2, 110 kV transmission line is 110 kV double-circuit line that used support tower and angle towers, coded as D122 -26 (34; 38;42;46;50;54)B; D122 -26 (30; 34; 38; 42; 46; 50; 54)C; N122-28 (32; 37;42;47)A; N122-28 (32;37;42;47)B; N122-28 (32;37;42;47)C. The name of Tower is explained as follows:

Code	Explanation
D	Support Tower
N	Angle Tower
1	Voltage level: 110kV
2	Double-circuit
2	Two lightning rods
26 (34;38;42;46;50;54)	Height of Tower
A,B,C	Bearing Level

53 http://electrical-engineering-portal.com/download-center/electrical-ms-excel-spreadsheets/emf-td-overhead-lines

The input data used for setting up the transmission tower and circuit lines is given for Tower D122 - 30B and shown in Table 10.44 and Figure 10.17.

Table 10.44 Transmission Line Parameters of Tower D122 - 30B

			X [m]	Y [m]	Umax [kV]	I [A]	rA [mm]	d [mm]	n	Ph-seq
Line 1	Circuit 1	L1	- 2.6	27	121	1150	10.8	0	1	1
		L2	- 2.6.	23	121	1150	10.8	0	1	2
		L3	- 2.6	19	121	1150	10.8	0	1	3
		g.w.	- 2.6	30	0	0	5.4	0	1	0
		g.w.	2.6	30	0	0	5.4	0	1	0
	Circuit 2	L3	2.6	19	121	1150	10.8	0	1	3
		L2	2.6	23	121	1150	10.8	0	1	2
		L1	2.6	27	121	1150	10.8	0	1	1

X [m] – horizontal length from the middle of the line; Y [m] – height in which wires are suspended; Umax [kV] – maximum permissible line voltage; I [A] – maximum permissible line current (in case of bundle it is; determined for all wires); r_A [mm] – wire radius; d_A [mm] – distance between wires in bundle; n – number of wires in bundle; Ph-seq – phase sequence. 1 – L1, 2 – L2, 3 – L3, 0 – Ground Wire

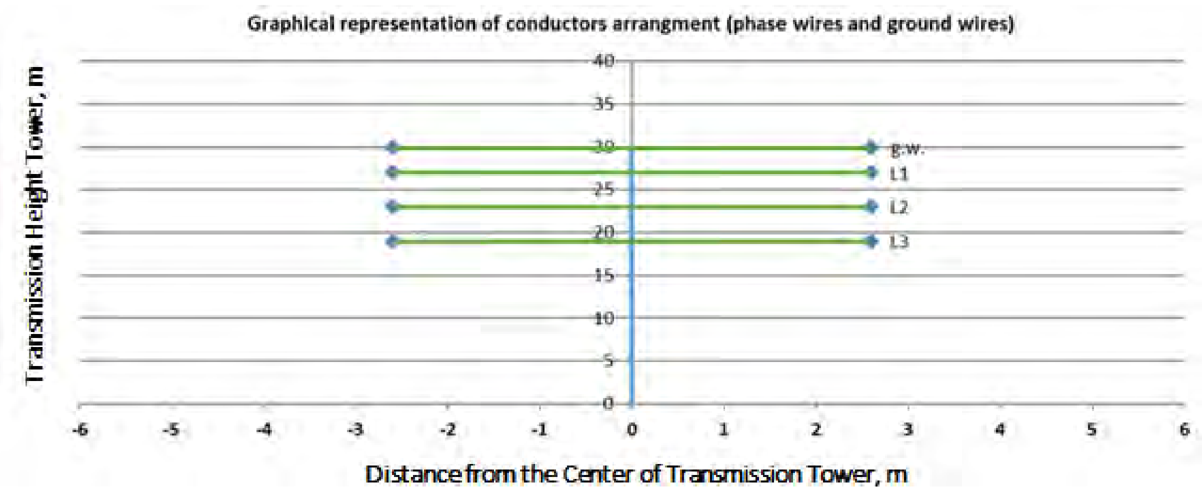


Figure 10.17 Schematic Representation of Transmission Tower with Power Line Arrangement (for Transmission Tower D122 - 30B)

The proposed minimum horizontal free space for the 110 kV double-circuit is 12 m (6 m on either side of the transmission tower). The Right of Way complied with national requirements in Decree 14/2014/ND-CP dated 26 February 2014 stipulating in detail the implementation of electricity law regarding electricity safety. The double circuits wire will be positioned between 19 – 30 m.

10.8.4.1.1 Potential Impact

EMF can affect human health directly and indirectly. Direct effects result from direct interactions of fields with the body; indirect effects involve interactions with a conduction object where the electric potential of the object is different from that of the body. Exposure to low-frequency electric fields may cause well-defined biological responses, ranging from perception to annoyance, through surface electric-charge effects due to stimulation of central and peripheral nervous tissues and the induction in the retina of phosphenes, a perception of faint flickering light in the periphery of the visual field.

10.8.4.1.2 Existing Controls

The mitigation measures identified in the EPP include:

- Design electrical equipment and transmission line in accordance with Vietnam Regulation (Decree No. 14/2014/ND-CP dated on 26 February 2014) including (1) the safety corridor of the 110 kV line should be 12 m for the double circuits; (2) the safety corridor for the 22 kV line is 4 m; (3) the distance from the lowest point of transmission lines to the ground is at least 15 m;
- Equip staffs who come in contact with electromagnetic fields (EMF), with PPE and ensure O&M staff can work in different shifts to avoid the exposure time with EMF ;
- Put up warning signs for high voltage areas;
- Shielding and Phase cancellation
- Organize periodic health check-ups for staff who work in EMF;
- Provide staff with training on electromagnetic fields (EMF); and
- Limit staff who have health problems such as cardiovascular and congenital diseases from working in areas with EMF.

10.8.4.1.3 Significance of Impacts

Operation of the Project will result in the formation of EMF along the transmission line and at the substations. Although high-voltage transmission lines do generate higher EMFs, this effect is offset by the fact that the towers are higher, the ROW is wider, and phase cancellation shielding is applied, all of which lower EMF levels, as typically measured at the edge of the ROW.

Based on the EPP model, the electric and magnetic fields calculated at the distance from the transmission line at 1 m above the ground are presented in Figure 10.18 and Figure 10.19. The maximum electric and magnetic fields are 0.67 kV/m, 5.21 A/m respectively at 1 m above the ground.

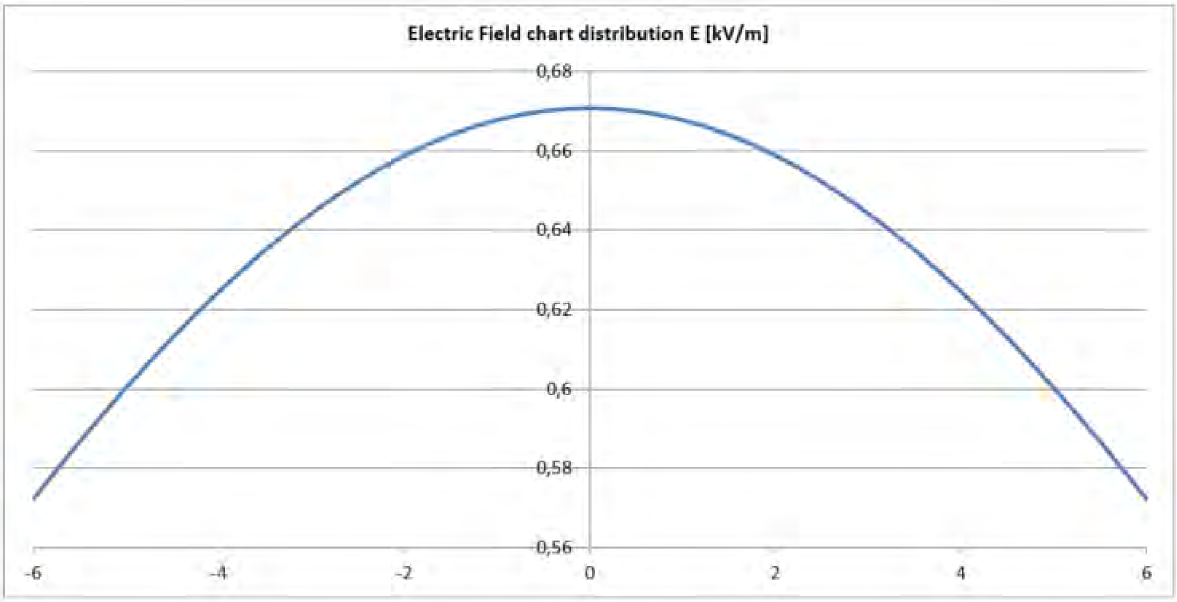


Figure 10.18 Electric Field Distribution for the Proposed Transmission Tower at 1 m above the ground

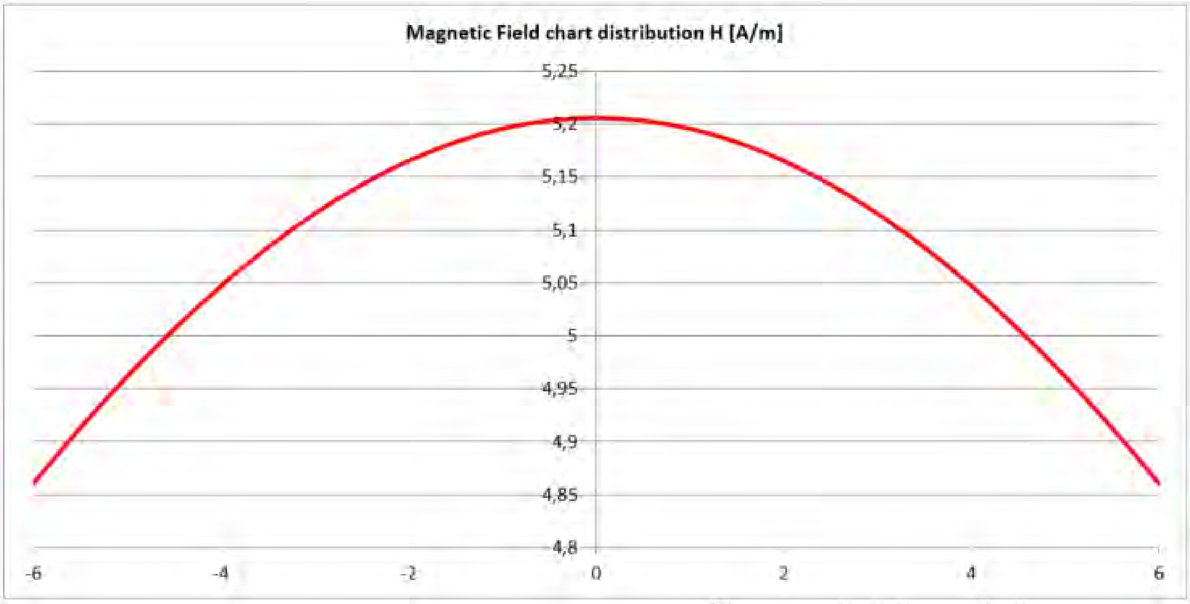


Figure 10.19 Magnetic Field Distribution for the Proposed Transmission Tower at 1m above the ground

The maximum calculated electric field inside the ROW and magnetic field for Transmission D122 - 30B does not exceed the recommended ICNIRP occupational exposure limits.

The maximum electric and magnetic fields within the ROW for various transmission towers is shown in Table 10.45. The maximum calculated electric field occurs directly under the conductors and decreases out to the edge of the ROW. The phasing of double circuit that will be used in the proposed transmission line configuration results in cancellation effects for the electric fields resulting in rapid decrease with distance. The calculated maximum electric magnetic fields for various transmission towers are below the allowable public and occupational exposure limits in accordance with ICNRP and Decree 14/2014/NĐ-CP, dated 26th February, 2014 of Government on stipulating in detail the implementation of electricity law regarding electricity safety, which requires the electricity field intensity in the areas where people regularly working must ensure the requirements not exceeding 5 kV/m.

Table 10.45 Maximum Electric and Magnetic Fields for Various Transmission Tower Types at the Edge of the ROW

Tower Type	E_{max} (kV/m)	H_{max}(A/m)
D122 - 26	0.97	7.73
D122 - 34	0.49	3.74
D122 - 38	0.38	2.81
D122 - 42	0.3	2.19
D122 - 46	0.25	1.75
D122 - 50	0.21	1.44
D122 - 54	0.18	1.20
N122 - 28	0.04	0.71
N122 - 32	0.03	0.48
N122 - 37	0.02	0.32
N122 – 42	0.02	0.22
N122 –47	0.01	0.17

The EMF calculation results of different tower configuration have shown that at the distance of 6m from the outmost transmission line, the maximum electric field reached 0.97 kV/m and magnetic field gained

7.73 A/m at the hanging height of wire of >26 m while most of human activities occurs at the height below 2m. In addition, the 110kV transmission line will be designed not to pass by any households

The EMF for the proposed 121 kV tower configuration reduce rapidly with distance from the lines. As such, the significance of EMF caused by the Project on Human Health is considered to be Negligible (See Table 10.46).

Table 10.46 EMF Impact Assessment from Overhead Transmission Line for the Operation Phase

Impact Nature	**Negative**	Positive	Neutral		
	Impact on health is considered Negative				
Impact Type	**Direct**	Indirect	Induced		
	Direct impact on health of livelihoods or residences within the ROW				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is Long-term within the ROW.				
Impact Extent	**Local**	Regional	Global		
	Impacts are localised within the ROW.				
Frequency	The impact frequency is closely related to the operation of the wind farm and substation, and is assumed to be continuous during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is Small.				
Receptor Sensitivity	**Low**	Medium	High		
	The vulnerability of receptor is Low as explained above.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is Negligible				

10.8.4.1.4 Additional Mitigation Measures

Other additional mitigation measures based on ESIA requirements to minimise impacts associated with EMF include:

- Avoid residential buildings, or acquire houses within the ROW, if possible;
- Avoid schools, hospitals, health clinics, and other similar buildings – the ETP alignment avoids these sensitive buildings and maintains at least a 20 m buffer to all schools and health clinics;
- Tower safety features – place warning signs prohibiting climbing on towers and incorporate design elements that prevent climbing of the towers;
- Implement all H&S measures as specified in the regulations including earthing of buildings that are metal clad and directly below the transmission line;
- Conduct regular clearance of the clear zone to ensure the area is safe as required by the regulation;
- Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable; and
- Emergency contact information – provide signage at each tower with emergency phone numbers.

Electric fields can be easily shielded by trees, fences, buildings and most other structures. However magnetic fields are much more difficult to shield than electric fields.

10.8.4.1.5 *Residual Impacts*

The residual impact to occupational and public health from the transmission of power through the proposed 110 kV voltage transmission line is considered to be Negligible.

10.8.4.1.6 *Monitoring and Auditing*

The electromagnetic filed should be monitored in the safety corridors of the 110 kV transmission line, at the substation and at the location of turbine.

The EMF monitoring survey should be conducted every 6 months during the operation phases.

The EMF result must comply with Decree No.14/2014/ND-CP, dated February 26th, 2014 on Stipulating in detail the implementation of electricity law regarding electricity safety and National Technical Regulation QCVN 25:2016/BYT on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace. Should thresholds be exceeded, further mitigation options should be reviewed and considered.

10.8.4.2 EMF from substation

Substations are part of the electricity supply network that enables the widespread use of electricity for public and industrial use. Inside the substation, there are switches, connections and a transformer. The transformer steps up voltage coming from wind farms and transforms them to the higher voltage of 110kV used by transmission lines. Transformer is the main unit where EMF will be of similar magnitude as the transmission lines and hence it has to be located at a height similar to the transmission line and provide sufficient buffer around it to minimize occupational and public hazards. EMF from other elements in a substation will be small and standard mitigation methods are available to reduce both electric and magnetic fields generated by them, as described below. The electric and magnetic field (EMF) levels within the fenced area of a substation depends on the number of transformers used in the substation. However, these EMF levels decrease rapidly with distance from the transformers and other electrical equipment. Most of the time, EMF levels drop to the same as surrounding background levels at a distance of 30 to 60 m from the fenced area.

10.8.4.2.1 *Potential impact*

Electromagnetic fields from transformers in substation.

10.8.4.2.2 *Existing/ in-place controls*

- Equip staffs who come in contact with electromagnetic fields (EMF), with PPE and ensure O&M staff can work in different shifts to avoid the exposure time with EMF;
- Provide EMF shielding cover in some places has high level of EMF (especially at some areas where the electric field is over 5 kV/m)

10.8.4.2.3 *Significance of impacts*

Predicting magnetic field profiles for substations is a complex exercise given the multitude of time varying sources orientated in multiple directions. As a result, the magnetic field profile is highly dependent on the particular circumstances. In order to understand the magnetic field pattern in the proposed step up substation, similar substation modelling performed elsewhere Tarmizi et al. (2016) was identified for discussion. Tarmizi et al. modelled magnetic field variability in a substation that had the 400 kV side connected to three loads, a shunt reactance and an autotransformer to step down the voltage to 220 kV. The substation considered by Tarmizi et al. was 280 m long, 140 m wide and the conductors are located at the height of 12m above the ground (on the 400 kV side). The normal operating currents at frequency of 50Hz for each load. The magnetic field distribution was calculated at the height of 1.7 m where measurements were available for comparison. The computed results for the normal operating currents are presented in Figure 10.20.

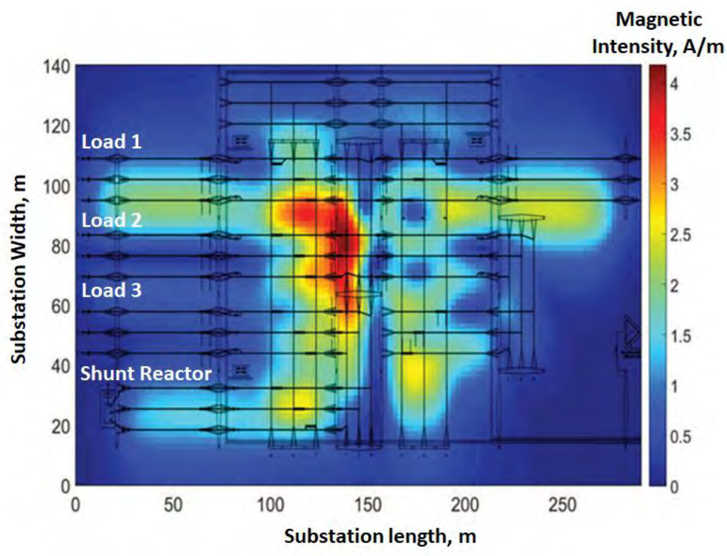


Figure 10.20 Magnetic Field Distribution in the Substation Studied by Tamrizi et al. (2016) for a 400kV substation (280m long, 140m wide)

Figure 10.20 shows that the predicted highest value of the magnetic field was 4.164A/m located along busbar 1. For the normal operation conditions of the substation, the maximum values of the magnetic field were found to be below public exposure limits proposed by ICNIRP. In addition, it clearly shows that the magnetic field decreases rapidly within the perimeter of the substation. However, for a lightning strike scenario, the magnetic field in the substation exceeded the public and the occupational exposure limit set by ICNIRP. The voltages and size of the substation used in the study by Tarmizi et al. were much higher than the proposed substation (voltage of 121 kV; and size up to 80m long by 70m wide) and hence the EMF impact is anticipated to be contained within the substation.

Additionally, another study by Grbic et al., (2017)[54] concluded that within two 110/x kV substations the measured and maximum values of electric fields are lower than the low AL (Action Levels) of 10kV/m (i.e. ICNIRP ELF exposure limits for occupational exposure); and the measured and maximum values of magnetic flux density are lower than the low AL of 1mT (796 A/m, ICNIRP ELF exposure limits for occupational exposure). ALs are action levels prescribed by Directive 2013/35/EU[55], which states the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (EMF).

Based on the analysis the assessment of impacts of EMF from substation during operation phase is shown in Table 10.47.

Table 10.47 Impacts of EMF during Operation Phase from the Substation

Impact Nature	**Negative**	Positive	Neutral
	Impacts on health is considered **Negative**		
Impact Type	**Direct**	Indirect	Induced
	Occupation health within the substation		

. [54] Levels of electric and magnetic fields inside 110/X kV substations. Maja Grbic´ ✉, Aleksandar Pavlovic´, Dejan Hrvic´, Branislav Vulevic (24th International Conference & Exhibition on Electricity Distribution (CIRED), 12-15 June 2017). IET Journal.

[55] Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/ EEC) and repealing Directive 2004/40/EC, Official Journal of the European Union, 29 June 2013 2.

Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The impact duration is **Temporary** within the substation				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the substation.				
Frequency	The impact frequency is closely related to the operation of the wind farm, and assumed to be continuous during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Receptors Sensitivity	**Low**	Medium	High		
	The vulnerability of receptor is **Low** as explained above.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible**				

10.8.4.2.4 Additional mitigation measures

Some additional mitigation measures could be applied to reduce EMF impacts from substation to human health, as follows:

- Equip staffs who come in contact with electromagnetic fields (EMF) with PPE;
- Put up warning signs for high voltage areas;
- Use ferromagnetic and conductive materials for shielding as a barrier to reduce the field strength at the source; and
- Limit staff who have health problems such as cardiovascular and congenital diseases from working in areas with EMF.

10.8.4.2.5 Residual impacts

With appropriate mitigation measures, the occupational and human exposure can be minimized to fall under ICNIRP standards, therefore the residual impact to occupational and public from the substation is considered to be Negligible.

10.8.4.2.6 Monitoring and Auditing

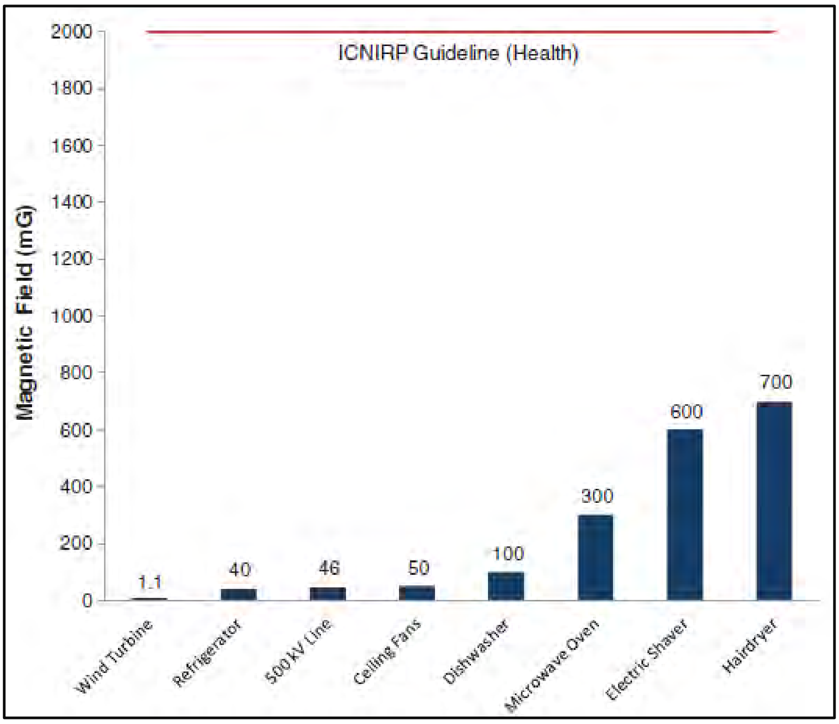
The locally approved regulatory EIA states that the electromagnetic filed should be monitored at the vicinity of the substation. The EMF monitoring survey should be conducted every 6 months during the operation phases. The EMF result must comply with Decree No.14/2014/ND-CP, dated February 26th, 2014 on Stipulating in detail the implementation of electricity law regarding electricity safety and National Technical Regulation QCVN 25:2016/BYT on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace. Should thresholds be exceeded, further mitigation options should be reviewed and considered.

10.8.4.3 EMF from wind turbine

10.8.4.3.1 Significance of impacts

EMF from the step up transformer either in the nacelle of the turbine rotor unit or at some height below it in wind turbines, which increases the voltage to 22 kV with rated capacity of 3.8 MVA, are expected to be lower than the 110 kV transmission lines. The maximum electric and magnetic fields are unlikely to be assessed quantitatively due to insufficient data of transformer.

However, referred to EMF results from empirical studies of Canadian 27MW wind farm by McCallum et al. (2014)[56], EMF were collected during three operational scenarios to characterize potential EMF exposure: “high wind” (generating power), “low wind” (drawing power from the grid, but not generating power), and “shut off” (neither drawing, nor generating power). Magnetic field levels detected at the base of the turbines under both “high wind” and “low wind” conditions were low (0.9 mG) and rapidly diminished with distance, become indistinguishable from background within 2m of the base. This source appeared to have no influence magnetic field level at nearby sensitive receptors as located over 1km from the closet turbine. The study also concluded that magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices (Figure 10.21). Furthermore, when compared to ICNIRP guidelines, the levels of EMF measured around wind turbines were all well below levels known to cause harm to public and occupational health.



Source: McCallum et al. 2011

Figure 10.21 Magnetic Fields Comparison from Wind Turbines and 500 kV Power Lines with Common Household Electrical Devices

The maximum calculated electric field occurs directly under the base of the turbine and decreases outwards does not exceed the recommended ICNIRP occupational exposure limits. The EMF impact from the wind turbines are considered Negligible**.**

10.8.4.3.2 Additional mitigation measures

Whilst no EMF specific additional mitigation and management measures are recommended; to enhance safety, it is recommended to place warning signs prohibiting climbing on wind turbines and incorporating design elements that prevent climbing of the wind turbines. It is also recommended to provide emergency contact information by placing signage at each wind turbine containing emergency phone numbers.

[56] McCallum Lindsay, Aslund M.L.W, Knopper L D, Ferguson G M and Ollson C A. 2014. Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? Environmental Health 2014, 13:9

10.8.4.3.3 Residual Impact

The residual impact to occupational and public from the substation is considered to be negligible.

10.8.4.3.4 Monitoring and Auditing

No specific monitoring and auditing is recommended

10.9 Climate Change Impact Assessment

Climate change is now widely and globally recognised as one of the most significant environmental challenges. In terms of response and adaption to climate change, a range of international and national policy and legislation has been introduced and implemented to encourage the development of renewable energy, reduce greenhouse gas emissions and combat the impacts of climate change.

Vietnam is particularly vulnerable to the effects of climate change and therefore has a strong commitment to achieve the global mitigation target. Vietnam has set its national targets for emissions mitigation in the Nationally Determined Contribution (NDC): 8% emission reduction against the “Business As Usual” (BAU) scenario by 2030 when compared with 2010 and a 25% reduction by 2030 on condition of substantial international financial and technical support.

10.9.1 Scope of Assessment

This section provides a qualitative assessment of the following Project’s activities potential impacts on climate change, including:

- Construction activities may increase greenhouse gas emissions such as operation of heavy equipment (excavator, heavy trucks, bulldozer, crane) and transportation of turbine and material and material purchasing point to the Project site; and
- Operation of wind turbine.

In addition, the physical impacts of climate change have implications for performance of wind power production, because its main resources are directly linked to climatic variables such as rainfall, wind, and temperature. This section also provides a qualitative assessment of climate change impacts to the Project development.

10.9.2 Baseline Conditions

In order to provide climate change projection information, in 2013 the Intergovernmental Panel on Climate Change (IPCC) developed and published a new set of climate change scenarios, called RCPs (Representative Concentration Pathway). The four RCPs (RCP2.6, RCP4.5, RCP6 and RCP8.5), are named after a possible range of radiative forcing values[57] in the year 2100 relative to preindustrial values (+2.6, +4.5, +6.0 and +8.5 W/m^2, respectively). Climate change for Vietnam in general and for Quang Tri Province in particular is presented in details below.

Temperature:

- For the RCP4.5 scenarios, surface temperatures would increase by 1.9 - 2.4°C in the North and 1.7 - 1.9°C in the South. For the RCP8.5 scenarios, temperature would increase by 3.3 - 4.0°C in the North and 3.0 - 3.5°C in the South (IPCC, 2013). Extreme temperatures would have an upward trend; and

[57] Radiative forcing or climate forcing is the difference between insolation (sunlight) absorbed by the Earth and energy radiated back to space. Changes to Earth's radiative equilibrium, that cause temperatures to rise or fall over decadal periods, are called climate forcings. (Source: Shindell, Drew (2013). "Radiative Forcing in the AR5" (PDF). Retrieved 17 December 2019 and Rebecca, Lindsey (14 January 2009). "Climate and Earth's Energy Budget: Feature Articles". earthobservatory.nasa.gov. Retrieved 17 Decbember 2019)

- Temperature increase for Quang Tri Province is projected to vary between 0.4 and 1.2^{0}C in the beginning of 21st Century, 1.0 and 2.0^{0}C by middle 21st Century and 1.3 and 4.6^{0}C by the end of 21st Century (MONRE, 2016).

Rainfall:

- For the RCP4.5 scenarios, annual rainfall would generally increase in a range of 5-15%. For the RCP8.5 scenarios, the greatest increase would be over 20% in most of the North, Central Coast, a part of the South and Central Highlands. Average maximum 1-day rainfall would increase all over Vietnam (10-70%) compared to the baseline period (IPCC, 2013); and
- Rainfall in Quang Tri Province is forecasted to increase by 2.9 - 22.8% in the beginning of 21st Century, 7.5 - 26.2% by middle 21st Century and by 9.8-31.3% by the end of 21st Century (MONRE, 2016).

Tropical depressions and typhoons:

- On average, approximately 12 tropical depressions and typhoons had occurred in Vietnam's East Sea on an annual basis in the period of 1959 to 2015 (MONRE, 2016). Of these, seven (07) depressions and typhoons had impacted Vietnam and five (05) of them had made their ways onto Vietnam's mainland (MONRE, 2016); and
- Tropical depressions and typhoons recorded in the same period of time show an increase in their intensity and a tendency to last longer and move southward (MONRE, 2016). The number of tropical depressions and typhoons is predicted under the RCP4.5 and RCP8.5 scenarios by MONRE to reduce slightly throughout the 21st century (MONRE, 2016). By the end of the 21st century, storm intensity is forecasted by the IPCC to increase by between 2 and 11% and rainfall within a 100 km buffer area from the storm eye is also predicted to increase by approximately 20% (IPCC, 2013).

Extreme weather events:

- The number of cold fronts had decreased gradually, yet their intensity had increased in the period of 1981 to 1990 (MONRE, 2009). Approximately 10 days of cold fronts per year are recorded for Hanoi City (MONRE, 2009). In addition, the number of droughts experienced in Vietnam, especially extreme droughts, has increased significantly since 2000 (MONRE, 2009); and
- Droughts in Vietnam are likely to become more severe in future due to the increasing temperature and decreased rainfall during the dry season (MONRE, 2016). The number of hot days (temperature $\geqslant$ 35ºC) is predicted to increase to be 35 - 45 days per year by the middle of the 21st century and exceed 100 days per year by the end of the 21st century.

10.9.3 Impact Assessment

The WTGs will be installed and designed to operate under varying meteorological conditions including temperature, rainfall, and extreme weather. As such, the impact magnitude of climate change is predicted to be Negligible and the impact significance is also considered to be Negligible.

There are no available studies on impacts of natural disasters such as storms on wind farms, but they may cause damage to turbines and affect the lifespan of wind turbines and the transmission line.

10.9.3.1 Impacts of Project's activities to Climate change

10.9.3.1.1 Impact during Construction Phase

10.9.3.1.1.1 Existing Controls

There is no existing controls.

10.9.3.1.1.2 Significance of Impact

Because climate change affects global receptors, the impact magnitude and resource/receptor sensitivity cannot be determined in the same way it can be for other impact assessment aspects such as soil, air or water resource, etc. For this reason, impact significance is only determined to be Significant or Not Significant using the IFC threshold value of 25,000 tonnes of carbon dioxide equivalent per year (tCO_{2e})[58].

Main construction activities such as construction of turbine foundation with reinforced concrete, installation of overhead and underground transmission line, wind turbines also used heavy equipment that consumes a relatively huge amount of diesel. The use diesel fuel has increased the production of greenhouse gases (GHG), especially carbon dioxide (CO_2), that contributing to climate change impacts.

The estimate of the Project GHG footprint was performed based on 2006 IPCC Guidelines for National GHG Inventories (UNFCCC, 2018b). The IPCC Guideline defined three level of methodological complexity, called “tier” for GHG accounting and reporting purposes, as shown in Table 10.48

Table 10.48 Tiers Approach for Estimation of GHG

Scope	Description
Tier 1 Approach	Calculates emissions by multiplying estimated fuel consumed with a default emission factor. For CO_2, emission factors mainly depend upon the carbon content of the fuel and therefore emissions can be estimated fairly accurately using this method. Emission factors for CH_4 and N_2O depend on the combustion technology and operating conditions and vary significantly. As such, large uncertainties are anticipated from this method.
Tier 2 Approach	The approach is the same as Tier 1 but country-specific emission factors are used in place of the Tier 1 defaults.
Tier 3 Approach	Technology-specific emission factors.

In this Project, the emission from construction activities has been accounted in the Tier 1 method. The calculation is based on the amount of fuel consumption data and emission factors for CO_2, CH_4, and N_2O which will be applied to the corresponding activity data. GHG emission from mobile combustion including bulldozer, excavators, cranes, rollers, graders, trucks are estimated using Equation 1. The value of default emission factors and energy content factors are presented in Table 10.49.

Equation 1 Fuel Combustion

$$E_j = \frac{Q_i \times EC_j \times EF_{ijoxec}}{1000}$$

where:

E_j	=	Estimated emissions of gas type j (CO_2, CH_4 or N_2O) from fuel type (i)	(t CO_2-e/year)
Q_i	=	Estimated quantity of fuel type (i)	(tonnes or GJ/year)
EC_j	=	Energy content factor of fuel (j)	(GJ/t or GJ/kL)
EF_{ijoxec}	=	Emission factor for each fuel type (j)	(kg CO_2-e/GJ or tonne)

58 IFC Greenhouse Gas Reduction Accounting Guidance for Climate Related Projects. IFC Climate Business Department, May 2017

Table 10.49 Default Emissions Factors and Energy Content Factor for Diesel Combustion in Mobile Equipment and Vehicles

Description	Value	Units
Energy content factor for diesel	43 [a]	MJ/kg or GJ/t
	35.9 [b]	GJ/kL
Diesel density [c]	0.840	kg/L or t/kL
Tier 1 CO_2 emission factor - diesel [d]	74.1	kg CO_2-e/ GJ
Tier 1 CH_4 emission factor - diesel [d]	4.15	kg CH_4/ TJ
	0.12	kg CO_2-e/ GJ
Tier 1 N_2O emission factor - diesel [d]	28.6	kg N_2O/ TJ
	7.6	kg CO_2-e/ GJ

a. (IPCC, 2006) - Table 1.2 (default net calorific values (NCVs) and lower and upper limits of the 95% confidence intervals), page 1.18, Volume 2 (Energy), Chapter 1 (Introduction).
b. Estimated by ERM based on the diesel density.
c. (STAMEQ, 2018) – TCVN 5689:2018, Table 1 (Diesel fuel oil - Specifications and test methods), Diesel density
d. (IPCC, 2006) - Table 3.3.1 (default emission factors for off-road mobile sources and machinery), page 3.36, Volume 2 (Energy), Chapter 3 (Mobile Combustion).

The estimated CO_2 emission from operation of heavy equipment with the assumption below is presented in Table 10.50. It is noted that these are estimates only, and actual emissions would vary depending on factors such as the actual construction schedule, actual material demand.

Table 10.50 Estimated CO_2 Emission from Operation of Heavy Equipment

No	Average number of heavy equipment for construction of each turbine	An average diesel consumption rate	Working hours/day	Construction period (15 months) (excluding public holidays)
1	10 pieces (2 excavators, roller, bulldozer, grader, 02 heavy trucks (12 -15T), crane, compactor, generator)	30 litters/hour[59]	8 hours/day	390 working days
Diesel quantity to complete the construction of 21 wind turbine: 1,965,600 litres				
Diesel density: 0.84 kg/litre				
Emission factor (CO2-e) : 81.82 kg CO2-e/ GJ				
Energy content factor for diesel: 43 MJ/kg				
Total estimated CO2e emission: 5,809,013,159.04 litres x 2.955 kg CO2e/litre = 17,615.63 tons CO2e				

Additionally, the estimated CO_2 emission from transportation of material and equipment is calculated as follows:

[59] Referred from Article “Evaluating the Environmental Impacts and Energy Performance of a wind farm system utilizing the Life – Cycle Assessment Method: A Practical Case Study”, Mohamed R.Gomaa and et al, 2019

Table 10.51 Estimated CO_2 Emission from Transportation of Materials and Equipment

Items	Number of heavy haul vehicle movement (one-way)/ day	Number of transportation days	Diesel use Rate60 (litre/day)	Diesel Use Demand
Wind turbine component (turbine blade, Nacelle, Hub, Tower sections) and Transmission line component were transported by specialized trailers	2	390	68	53,040 litres
Material (sand, stone, cement, steel) with a total volume of 67,733 tons [61] were transported by 10 tonne trucks	75	390	57	1,667,250 litres
Diesel quantity to complete the transportation of material and equipment: 1,720,290 litres				
Total estimated CO2e emission: 1,720,290 litres x 2.955 kg CO2e/litre = 5,083 tons CO2e				

The estimated CO_2 emission over the Project Construction is highly likely to be less than the IFC threshold value of significance of 25,000 tons of carbon dioxide equivalent (tCO_2e). Therefore the impact is considered Not Significant.

10.9.3.1.2 Impact during Operation Phase

As mentioned above, once operational, the Project will make a contribution to Vietnam renewable energy sector and climate change targets. The project plans to generate 273,300 MWh of electricity per year through wind power, which is considered as zero-emission during operation phase. Through generating electricity by harnessing the power of the wind as opposed to burning a mix of fossil fuels, the Project is expected to provide a potential saving of 249,523 tonnes of carbon dioxide emission per year over its 20 year lifetime[62].

Therefore, the Project has positive impacts to Climate Change as it helps to reduce consumption of fossil fuels to generate electricity, and as a result, reducing the emissions of GHG and air pollutants.

10.9.3.2 Impacts of Climate change to the Project

The potential impacts of climate changes affected to wind power generation and wind power infrastructure include:

- Extreme weather events, such as stronger and/or more frequent storms can reduce the output of energy, damage generation and grid infrastructure and affect security of energy supply and difficult access to offshore location for maintenance;
- Rapid change in wind speed can reduce power generation because turbines cannot operate in very high or very low winds; and
- Flooding and landslide may affect to substation and onshore components which results in loss of supply locally.

[60] Decision No 1134/QĐ-BXD of Ministry of Construction, dated October 8 2015 on Rate of fuel consumption of construction equipment.

[61] Source: Local EPP

[62] The grid emission factor of Vietnam for 2018 is 0.913 tCO2/MWh, according to the Announcement No. 263/BĐKH-TTBVOD of Department of Climate Change, Ministry of Natural Resources and Environment

10.9.3.2.1 Existing Control

There is no existing controls

10.9.3.2.2 Significance of Impact

The impact significance of Climate change to Wind power production is presented below in Table 10.52.

Table 10.52 Climate Change Impacts to Wind Power Production and Infrastructure

Impact Nature	**Negative**	Positive	Neutral		
	Impacts on health is considered **Negative**				
Impact Type	**Direct**	Indirect	Induced		
	Climate change impacts (such as changes in wind speed, flooding and inundation, storm surges) affect directly to wind turbine operation and wind power production and physical infrastructure (wind turbines, transmission line and distribution system)				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is **Long-term** within the substation				
Impact Extent	Local	**Regional**	Global		
	The impacts may occur in regional extent.				
Frequency	The impact frequency is closely related to the operation of the wind farm, and assumed to be likely to occur at some time during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Receptors Sensitivity	**Low**	Medium	High		
	The vulnerability of receptor is **Low** as explained above.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The significance is **Moderate**				

10.9.3.2.3 Adaption Measures

The following adaption measures are proposed on this ESIA to adapt impacts regarding to climate change, including:

- In case that wind speeds are likely to increase, it may be possible to select turbines and structures better able to handle higher wind speeds and gusts, to capture greater wind energy with taller towers;
- For transmission and distribution (including substation), specifying redundancy in control systems, multiple transmission and distribution routes, relocation. Where stronger winds are expected, higher design standards for distribution poles may be adopted;
- Where lightning strikes may increase, it must apply enhanced lightning protection and grounding system (earth wires, spark gaps) in the distribution network;

Ensure the presence of rapid emergency repair teams to repair damaged turbines quickly.

10.10 Summary

Significance of the impacts discussed in the above sections before and after mitigation is summarised in Table 10.53

Table 10.53 Summary of Environmental Impact Assessment

No	Impacts	Significance of Impacts		
		Impact Nature	Before Mitigation*	With Mitigation**
Pre-Construction and Construction Phase				
1	Air Quality	Negative	Negligible	Negligible
2	Water Resource Quantity	Negative	Moderate	Minor
3	Water Resource Quality	Negative	Moderate	Minor
4	Soil Compaction and Errosion	Negative	Minor	Negligible
5	Soil Contamination	Negative	Minor	Negligible
6	Noise Emissions	Negative	Minor	Negligible
7	Biodiversity			
	Loss of Habitat	Negative	Moderate	Minor
	Disturbance and/or Displacement of Fauna	Negative	Moderate	Minor
	Barrier Creation, Fragmentation and Edge Effects	Negative	Moderate	Minor
	Degradation of Habitat	Negative	Moderate	Minor
	Mortality – Vehicle Strike, Hunting and Poaching	Negative	Major	Moderate
8	Project Activities on Climate Change	Negative	Negligible	Negligible
Commissioning and Operation Phase				
9	Noise	Negative	Minor	Minor
10	Biodiversity			
	Mortality – Turbine and Transmission Line Strike	Negative	Negligible	Negligible
11	Shadow Flicker	Negative	Major	Moderate
12	Landscape & Visual Amenity	Negative	Minor	Negligible
13	Electromagnetic Interference	Negative	Negligible	Negligible
14	Project Activities on Climate Change	Positive		
15	Climate Change to the Project	Negative	Moderate	Minor

Note: *(*) without mitigation measures/management suggested from the ESIA.*
(**) with mitigation measures/management suggested from the ESIA.

11. SOCIAL IMPACT ASSESSMENT

This chapter presents the assessment of socio-economic impacts resulting from the pre-construction, construction and operation of the Gelex Wind Power Project. The assessments are based on the impact assessment methodology detailed in Chapter 4 and the social baseline data presented in Chapter 9.

This chapter aims to:

- Define the scope of the social impact assessment, including area of influence and receptors considered;
- Present the potential social impacts associated with the pre-construction, construction and operation activities of the Project;
- Identify existing controls to the potential impacts, which the Project Owner has already developed and implemented; and
- Identify appropriate management and mitigation measures and corresponding monitoring that can be implemented by the Project Owner.

11.1 Scope of Social Impact Assessment

Based on the scoping outcomes from Chapter 5, the Area of Influence for social impacts to community is defined in Figure 11.1.

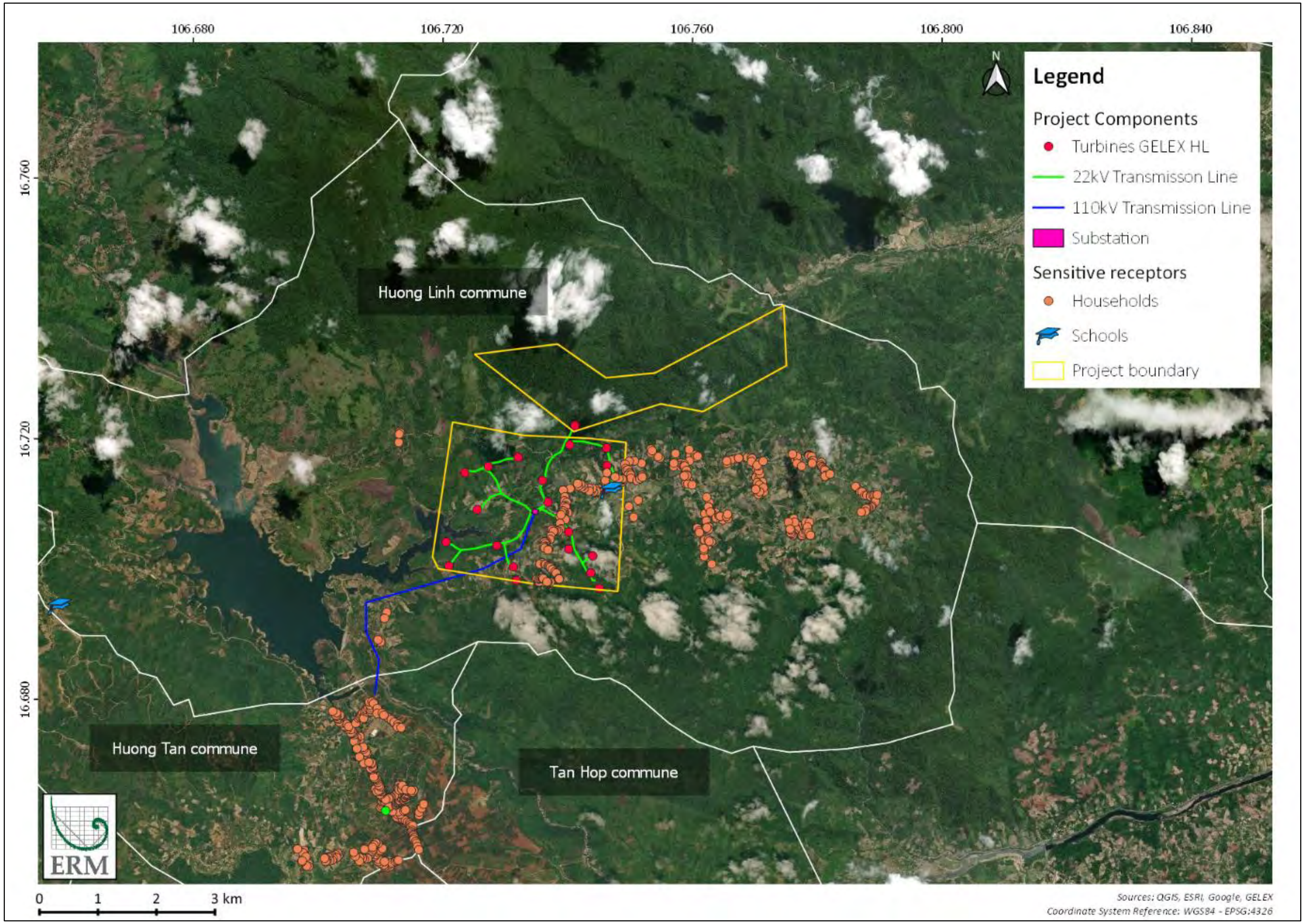
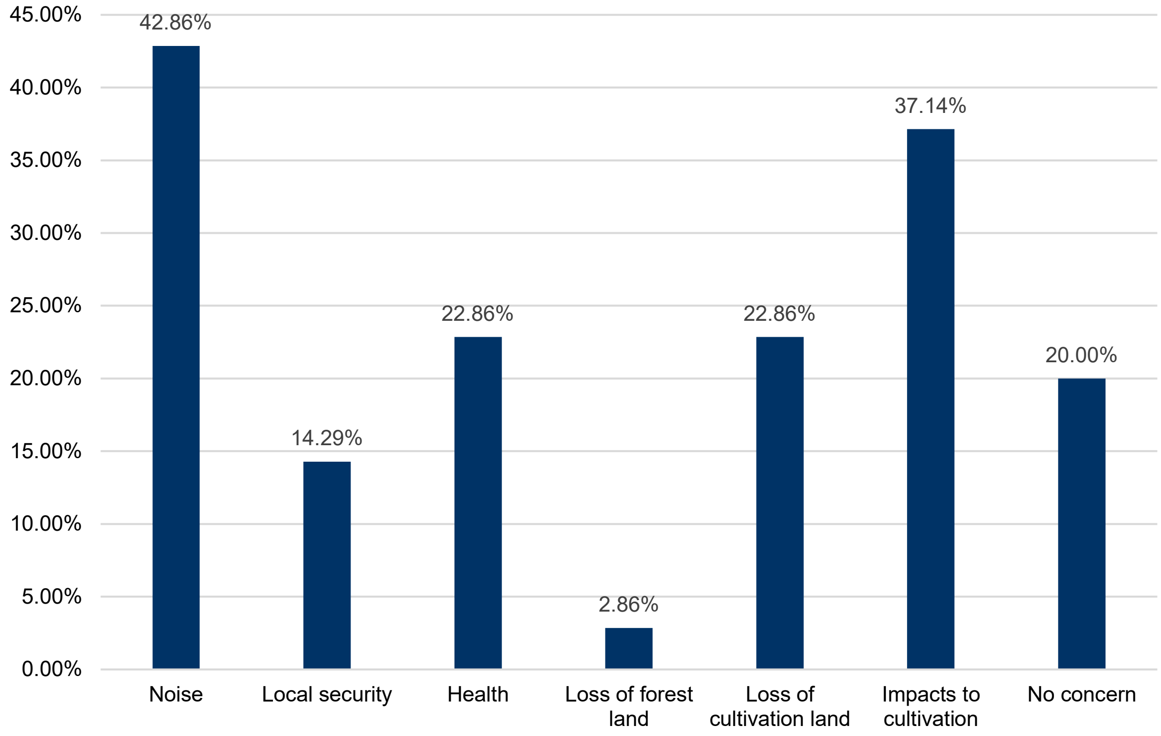


Figure 11.1 Area of Influence of Social Impacts

During the socio-economic baseline study, Project impacts perceived by local authorities and communities are defined. Locally perceived impacts of the Project generated from the household survey are summarised in Figure 11.2.



Source: Socio-economic survey conducted by ERM, 2020

Figure 11.2 Locally Perceived Impacts of the Project

Project development activities causing the potential impacts to stakeholders who are identified as receptors of the impacts are summarised in Table 11.1. In each section, the Project's area of influence for a specific resource or receptor is described in the context of the identified impacts. Apart from unplanned events which will be discussed in a separate chapter, the next sections will discuss the following impacts:

Pre-Construction and Construction Phases

- Economic displacement and livelihood impacts;
- Disturbance to agriculture production;
- Community health, safety and security impacts during construction;
- Impacts associated with construction workers; and
- Benefits to local communities (both construction and operation).

Commissioning and Operation Phases

- General disturbance on local community during operation; and
- Impacts on Indigenous People (both construction and operation).

Table 11.1 Summary of Potential Impacts, Receptors and Areas of Influence

Project Activities	Potential Impacts	Receptors	Areas of Influence
Pre-Construction Phase			
■ Land acquisition ■ Site clearance	■ Economic displacement and loss of livelihoods: ■ Loss of land and access to land owned by local people and indigenous people ■ Loss or relocation of assets on land ■ Change of land use ■ Loss of/Impact on livelihood associated with loss of land resulting in full or partial loss of income	■ Local land users who will have their production land acquired by the Projects; ■ Local agriculture and forest farmers whose livelihoods are dependent on the land area to be acquired by the Projects;	Huong Linh and Huong Tan communes
Land preparation (site clearance, excavation and levelling), fencing, and civil works	■ Potential disturbances to the nearby agriculture activities ■ General disturbances from dust, noise and vibration	Nearby land users who have land adjacent to Project area	Huong Linh and Huong Tan communes
Construction Phase			
■ Equipment and material transport and supply ■ Construction of turbine foundations, transmission line pylons , internal road, auxiliary works and turbine installation	■ General disturbances and tensions with local communities: ■ General disturbances caused by construction activities producing dust, waste and wastewater ■ Temporary occupation of farming land during construction of transmission line and substation ■ Tension with local community linked to issues of cultural conflict between local people and migrant workers ■ Tensions among different stakeholder groups due to unequal distribution of benefits and impacts	■ Local farmers who have land along the transmission lines ■ Local communities nearby Project sites ■ Local authorities at commune/district levels	■ Huong Linh and Huong Tan communes ■ Surrounding communes in Huong Hoa district

Project Activities	Potential Impacts	Receptors	Areas of Influence
■ Wastes, emissions and discharges generation, handling and disposal ■ Operation of associated facilities such as the concrete batching plant ■ Construction water usage ■ Workforce Presence	■ Potential burdens on local infrastructure and public services (health care, food and commodities, road, electricity supply, water supply and waste collection)		
	■ Potential benefits from local recruitment and local procurement: ■ Increased local employment and revenue ■ Income from compensation payment for households with land acquisition ■ Temporary direct employment for the Project and induced employment opportunities by local suppliers ■ Improved local infrastructure thanks to renovation for Project's access road ■ Support to community through community development program of the Project	■ Local authorities at commune/district level ■ Local economy, local businesses ■ Affected households ■ Local communities ■ Local contractors/suppliers	■ Huong Linh and Huong Tan communes ■ Huong Hoa district ■ Quang Tri province
	■ Community health, safety and security: ■ Health impacts associated with dust, waste management, noise generated from construction activities ■ Potential increase in the transmission of communicable diseases ■ Increased incidence of traffic accidents from construction vehicles traffic and commuting ■ Security related impacts or concerns	■ Local communities nearby Project sites ■ Local communities residing/ commuting along the transportation routes	■ Huong Linh and Huong Tan communes ■ Surrounding communes in Huong Hoa district
	■ Cultural heritage of Indigenous Peoples: ■ Potential disturbance to cultural heritage (physical cultural heritage and intangible cultural heritage) values related to the Van Kieu peoples (the Sacred Forests) if any future activities of the Project affects those areas	■ Cultural heritage values	■ Huong Linh and Huong Tan communes ■
Commissioning and Operation Phases			
■ Workforce Presence ■ WTG Operation	■ Economy and livelihood: ■ Increased local revenue and employment;	■ Local communities and suppliers	■ Huong Linh and Huong Tan communes

Project Activities	Potential Impacts	Receptors	Areas of Influence
	■ Improved local small and medium businesses and skills; improved local infrastructure (access road, school and clinics); ■ Support to local community development plans ■ Create landscapes that might attract tourism to the area	■ Local authorities ■ Vietnam Electricity Corporate (EVN)	■ Huong Hoa District ■ Quang Tri Province
■ WTG Inspection and Maintenance ■ Waste, emissions and discharge generation, handling and disposal	■ General disturbances to local communities: ■ Impacts from operation noise of turbines and transformers ■ Impacts from shadow flicker	■ Local communities	■ Huong Linh and Huong Tan communes
Unplanned Events			
■ Leakage and spill incidents ■ Fire and explosion ■ Vehicle accident ■ Blade throw ■ Transmission line snapping ■ Natural hazards (flood and landslide)	■ Community health ■ Community safety and security ■ Environmental Quality	Local communities	Huong Linh and Huong Tan communes

11.2 Impacts on Economic Displacement and Loss of Livelihoods

11.2.1 Potential Impacts

According to the Feasibility Study Report, the Project's study area will cover an area of 46.73 ha. The Project's footprint will be 26.36 ha, of which 26.6683 ha will be acquired as fixed-term use for the duration of the Project lifecycle and 20.053 ha will be temporarily acquired for construction activities and safety corridor of the 110kV transmission line.

Based on ERM's review, the total acquired area is about 33.8158 ha[63], including unused hills and mountains, production forest land, protection forest land, rural residential land, perennial tree land, and annual crop land. There are 94 households whose lands will be acquired for the Project. 86 out of 94 affected households by land acquisition are Van Kieu ethnic minorities. All of Project affected households relate to economical displacement. Besides, no cultural heritage is affected by the development of the Project components.

Potential impacts due to the land acquisition activities for the Project include:

- Economic displacement: loss of land and access to production land, resulting in loss of access, livelihood and income to the land users;
- Dissatisfaction towards the compensation price; and
- Social/ cultural tension from the unequal compensation between the affected households, especially among the Indigenous People.

11.2.1.1 Loss of Land and Livelihood Impacts

The socio-economic baseline finding indicates that most surveyed people engaging in work (83.3%) do cultivation, husbandry, and forestation. The outcomes of the three FGDs with 33 households in Hoong Moi, Xa Bai and Cooc villages indicate that the main income source for most respondents is from land-based activities. The results of KIIs with the heads of Hoong Moi, Xa Bai and Cooc villages reconfirm that cultivation and animal husbandry are main livelihoods of local households. Rice and cassava planting are common agricultural activities among participating households. While rice cultivation is for domestic use, cassava production are for sale. According to the survey interviews, 16 out of total 35 surveyed households have forest farming land with a total area of 614,179 m^2, of which Hoong Moi village has forest farming land of 42,500 m^2, Xa Bai village owning forestation area of 556,679 m^2, and Cooc village possessing forest farming land of 15,000 m^2.

Acacia is harvested within five to seven years, with an average income from 1.6 million VND to 24 million VND per year in Hoong Moi village or four million VND to 10 million VND per year in Xa Bai village. A very few households participating in the FGD in Cooc village plant acacia; but they go to forest every day to seek food such as banana, vegetable, bamboo and other food sources for daily living (FGD, vulnerable group, Cooc village, 14th February 2020).

Challenges in agricultural production as identified by surveyed households include:

- Reduced rice production due to mudslides;
- Water scarcity due to drought;
- Lack of cultivation land. The number of population in the village increases time by time while planted area is decreasing.
- Limited labour force;
- Degrading roads; and

[63] According to the Client's document sent to ERM on 20th August 2020, the total proposed land acquisition for GELEX Wind Power Project is 33.8185 ha. It is noted that this acquired land will be confirmed by the Project.

- Delayed land use right certificate (LURC) issuance for cultivation land.

A further 10.4% work in wage-based livelihoods such as public employment, working for private companies or as hired labour. A very small proportion (5.2%) relies on enterprise-based livelihoods, particularly small businesses/services. However, livelihood transformation would be a challenge as low educational background and economic development skills is low. There were 28 illiterate people in the surveyed population (18.5%). Illiteracy not only occurs among the elderly but also among young people and people within working age. Indeed, 19 of the 28 illiterate people are of working age (from 27 to 51 years old). In Hoong Moi village, thirteen out of 58 people are illiterate (22.4%) and ten out of 45 surveyed people are illiterate in Xa Bai village (22.2%).

Most of the interviewed respondents are reliant on agriculture or land-based livelihoods so they are greatly worried about land acquisition.

> We are afraid of loss of cultivation land. We do not have any business skills so we cannot do business like Kinh people. Loss of cultivation land may result in hunger (HL27, female respondent, 50 years old, Van Kieu, Cooc village, 14th February 2020).
>
> We may work as hired labour upon loss of land and may suffer many difficulties (HL25, male respondent, 45 years old, Van Kieu ethnic group, Cooc village, 14th February 2020).
>
> If land is acquired, we may receive compensation. However, we are afraid that we spend all money and do not have capital for business development (HL34, male respondent, 33 years old, Van Kieu ethnic group, Cooc village, 14th February 2020).

11.2.1.2 Dissatisfaction regarding Compensation Payment

As the compensation value is determined based on the government land price framework, it is often considered low by local people. In case of land acquisition, appropriate compensation for land acquired is of importance as for many households, land is not only a tangible asset, but also a result of their work and their hopes for a stable life for themselves (KII, male respondent, Van Kieu ethnic group, Xa Bai village, 13th February 2020). Van Kieu respondents expect the Project to bring more work opportunities and to improve local business (FGD, Van Kieu ethnic group, Hoong Moi village, 13th February 2020).

More importantly, there is a high proportion of households without a land use right certificate (LURC) for their land. Within surveyed population,

- Approximately 23% of households have no LURC for their residential land;
- Approximately 33% of households have no LURC for their agricultural land; and
- Approximately 57% of households have no LURC for their forest farming land.

11.2.1.3 Social/ Cultural Tension from the Unequal Compensation between the Affected Households, especially among the Indigenous People

Land compensation will be calculated based on different criteria (type, location and land use right) set by the State which is not often understood by local people, especially those with low educational background and social integration. Moreover, when there are several wind projects currently under development in the region, unequal compensation might be perceived due to different State-led to willing seller willing buyer arrangements.

A finding of the household survey indicates that 20% of surveyed households do not speak out any concern about the Project implementation in the locality because they lack information.

> We have not received any information about the Project so we do not have any concern until now (HP31, female respondent, 49 years old, Van Kieu ethnic group, Cop village, 12th February 2020).

Therefore, it is suggested that, regarding land acquisition and compensation resulting from Project implementation, a public consultation meeting needs to be held to officially inform local people about the Project and to get their opinions (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12 February 2020).

Although there has been no logged grievance regarding land acquisition for the Project, community dissatisfaction may lead to disturbance towards Project's future activities. Community dissatisfaction might imposes a reputational risk to the Project Owner.

11.2.2 Existing Controls

Other than the compensation payment in cash, there is no other compensation or supporting method to be applied to assist affected households.

11.2.3 Significance of Impacts

Impacts on agriculture livelihood as result of land acquisition is negative and will last permanently. It will result in approximately 83 economically displaced households. According to the socio-economic baseline chapter, the average household size in the surveyed area is 5.03 persons, therefore, it is estimated that there are around 400 PAPs belonging to those households. Given the reducing contribution of income from agriculture production into their household income, and the impact magnitude is assessed as Medium.

The land acquisition has impacted the traditional livelihood which categorised as subsistence farming for food security, especially among the Van Kieu ethnic minority. Moreover, livelihood transformation seem to be slow in consideration of current financial and human asset and vulnerability status of the affected communities. Many aaffected households expected that the compensation money would allow them invest in more effective cultivation, however the compensation as regulated by the State is often much lower than locally perceived value of the acquired land. Therefore, the receptors' vulnerability is assessed as Major.

From the above discussion, the impact of economic displacement and loss of livelihood is evaluated as being Major.

Table 11.2 Impacts on Economic Displacement and Loss of Livelihood

Impact Description	Economic Displacement and Loss of Livelihood				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptor Sensitivity	Low	Medium	**High**		
Impact Significance	Negligible	Minor	Moderate	**Major**	

11.2.4 Additional Mitigation and Management Measures

As the potential impact is identified as Moderate significance for economic displacement and livelihood, the bellowing additional mitigation measures will be implemented:

- Conduct a Land Acquisition Audit (LAA) to identify the gaps between the government-led process, the Project's practice and ADB requirements on land acquisition and resettlement. Specific actions to minimize the gaps in providing appropriate compensation should be recommended and implemented.

- Develop Stakeholder Engagement Plan (SEP) to ensure effective Project information disclosure and communication with affected households as well as relevant government stakeholder.
- Develop Grievance Mechanism to support the local authorities in receiving and addressing land acquisition-related grievances. The grievance mechanism should be disclosed to all affected communities so that they must be aware of the procedure, submission channels, and responsible person from the Project owner.
- Develop and implement a Livelihood Restoration Plan (LRP) to support the economic displaced households in restoring their livelihoods at least equal to similar level of livelihood condition before land acquisition. The LRP should take women groups and vulnerable groups into account to ensure they are not overlooked during Project implementation and left worse off.
- Assist the local community via a Community Development Plan (CDP) focusing on affected ethnic minority communities to ensure that local communities can benefit from the project.

11.2.5 Residual Impacts

As a result of the implementation of the proposed measures, the economic displacement and loss of livelihood impacts will be reduced to Minor.

11.2.6 Monitoring and Audit

- Comply with the monitoring and evaluation framework proposed in the LAA, SEP, LRP and CDP during the implementation of these plans.
- Engage a third party to undertake a Livelihood Restoration Completion audit when livelihoods of displaced people are considered being sustainably restored.

11.3 Disturbance to Agricultural Production during Construction Phase

11.3.1 Potential Impacts

A major concern raised by the local authority and local community during the social survey is that the Project activities, particularly during the land clearing and construction of all Project's component (tentatively 15 months), are anticipated to cause soil erosion around the turbine locations in rainy season. According to the environment baseline, Huong Hoa is one of the districts with highest rainfall in Quang Tri province. Rainy season with maximum rainfalls usually occur between August and November, which distribute to over 70% of the annual rainfall. In rainy season, there might be high rainfall events that cause flash flood. The Project area is mostly mountainous terrain, has an elevation from 150 – 1000 m, and slope from 20 – 30° (steep slope). As such, the water runoff with sediment would cause the accumulation of sediment and disturbance to the adjacent production land including acacia, paddy field, banana, and coffee plantations located adjacent to the turbines and the Project's Site. Similarly, there has been a concern from local authority and communities regarding the same problem during the operation phase leading to disruption of agricultural production around the Project's facilities (i.e. turbines, Project's Site Office and other related facilities such as access roads).

Many surveyed households in Cop and Phung Lam villages have expressed concerns about the impacts of the operation of the wind turbines on their crops.

> We are afraid the wind farms affect coffee production (HP34, female respondent, 66 years old, Kinh ethnic group, Cop village, 12 February 2020).
>
> We are afraid that wind turbines affect our plants (HP32, female respondent, 24 years old, Van Kieu ethnic group, Cop village, 12 February 2020).
>
> We worry that our coffee production will be negatively affected by wind turbines (HP25, female respondent, 29 years old, Kinh ethnic group, Phung Lam village, 12 February 2020).

11.3.2 Existing Controls

The local EPP provides some mitigation measures such as:

- Conduct land clearance and construction in the dry season;
- Cover the construction area during heavy rainfall events;
- Concrete the storm water drainage system;
- In case of any damage happens, compensation would be paid to the affected people in cash (by the EPC); and
- Prepare emergency response plan for flash flood events.

Besides, as reported by Project's representatives, some affected households requested to have their whole land plot to be acquired instead of a small piece in the middle of their land to avoid such disturbance on the remaining agriculture production. The request was considered by the local authority on a case-by-case basis.

11.3.3 Significance of Impacts

According to Chapter 9 on Soil Impact Assessment, the impacts from soil erosion and soil contamination were assessed as of Minor significance. In addition, given the area of agriculture production land surrounding the Project's facilities is small in comparison with other types of land (see Table 2.7), the impact magnitude is relatively Small. Although it is unlikely that the Project will have significant impact to the community incomes generated from agriculture production, the sensitivity of the receptors is assessed as Medium due to perceived concerns from local farmers surrounding the project site. As such, the disruption significance caused by the construction activity is assessed as Minor.

Table 11.3 Impacts on Disturbance to Agriculture Production due to Construction and Operation Activities

Impact Description	Disturbance to Agriculture Production due to Construction and Operation Activities				
Impact Nature	Positive	Neutral	**Negative**		
Impact Type	Induced	**Indirect**	Direct		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Intermittent (rainy seasons) during the construction and operation phase				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

11.3.4 Additional Mitigation and Management Measures

Although the assessment in this ESIA results that the impact is Minor, the Project is still expected to implement the following measures in addition to the measures provided in the local EPP report as listed above to manage the impacts within this Minor. These include:

- The Project Owner should provide and communicate detailed information about the Project's plan and schedule particularly related to land clearing and construction to the community with a special attention to farmers nearby the project locations;

- The Project's plan and schedule particularly related to land clearing and construction should avoid the rainy season and paddy rice harvesting season (i.e. according to local authority and local community, the paddy rice harvesting season is from September to February of the next year); and
- The Project Owner should establish a grievance mechanism that is understood by and accessible for all villagers. The mechanism will be simple, efficient, timely and consultative.
- Should any incident occurs and causes damage to the surrounding agriculture production, the Project ensure that such incident should be investigated to determine Project's responsibilities and compensation amount if necessary.

11.3.5 Residual Impacts

As a result of the implementation of the proposed measures, the impact on the disturbance to agriculture activities during construction and operation phases will be maintained as Negligible.

11.3.6 Monitoring and Audit

The following monitoring activities are recommended:

- Comply with the monitoring and evaluation framework proposed in the SEP, LRP and CDP during the implementation of these plans;
- Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented.

11.4 Impacts on Community Health, Safety and Security during Construction

11.4.1 Potential Impacts

General construction activities of an onshore wind project include the land preparation and civil work, transportation of materials and workers, construction and installation of turbines, and construction of associated facilities including the access road, and transmission line. These activities are likely to generate noise, dust, and risk to community's traffic safety.

11.4.1.1 Health Issues as result of Noise, Dust and Vibration

The main sources of noise and vibration in the construction phase are transportation, mobilisation of construction material and operation of heavy machineries during the construction process (main site and transmission line), include piling activities. However, these construction activities do not represent a constant source of noise that will occur on a day-to-day basis for the duration of the construction schedule. These activities are expected to occur for only portions of the works, and will not occur for entire daytime periods. Meanwhile, dust is generated during the earthworks and due to the mobilisation of construction materials to and from the Project site. Construction activities (such as soil disturbing activities, storage of materials such as concrete, and transportation of materials) without proper controls in place are likely to result in dust generation expected during the dry season.

Improper management of the dust, noise and vibration impacts will cause disturbance or certain health impacts to local communities. Potential impacts and consequences of noise, vibration and dust are also discussed in detail in the Noise Impact assessment and Air Quality impact assessment chapters accordingly.

11.4.1.2 Traffic Safety Issue during the Construction Phase

The project site can be accessed through the Western Ho Chi Minh Trail road, which is about 5.5km west and southwest of the Project site and asphalt road Highway 9, which is about 10km south of the Project site. Materials will be transported to the site by road from Hon La port via Quang Trach inter-district route to the National road 1A, along the DT71 road to the National road 15. Then passing National Road 9 to the Western Ho Chi Minh Trail road. This asphalted road has a length of 250km, a width of 12 - 20m and well-structured to ensure high traffic and high loading. The project site is located in inter-village route Cợp, Phung Lam, Huong Choa of Huong Phung Commune, which has a length of 4.6km from the Western Ho Chi Minh Trail road. The total length of transportation route from Hon La Port to the Project site is approximately 243km (see Figure 11.3):

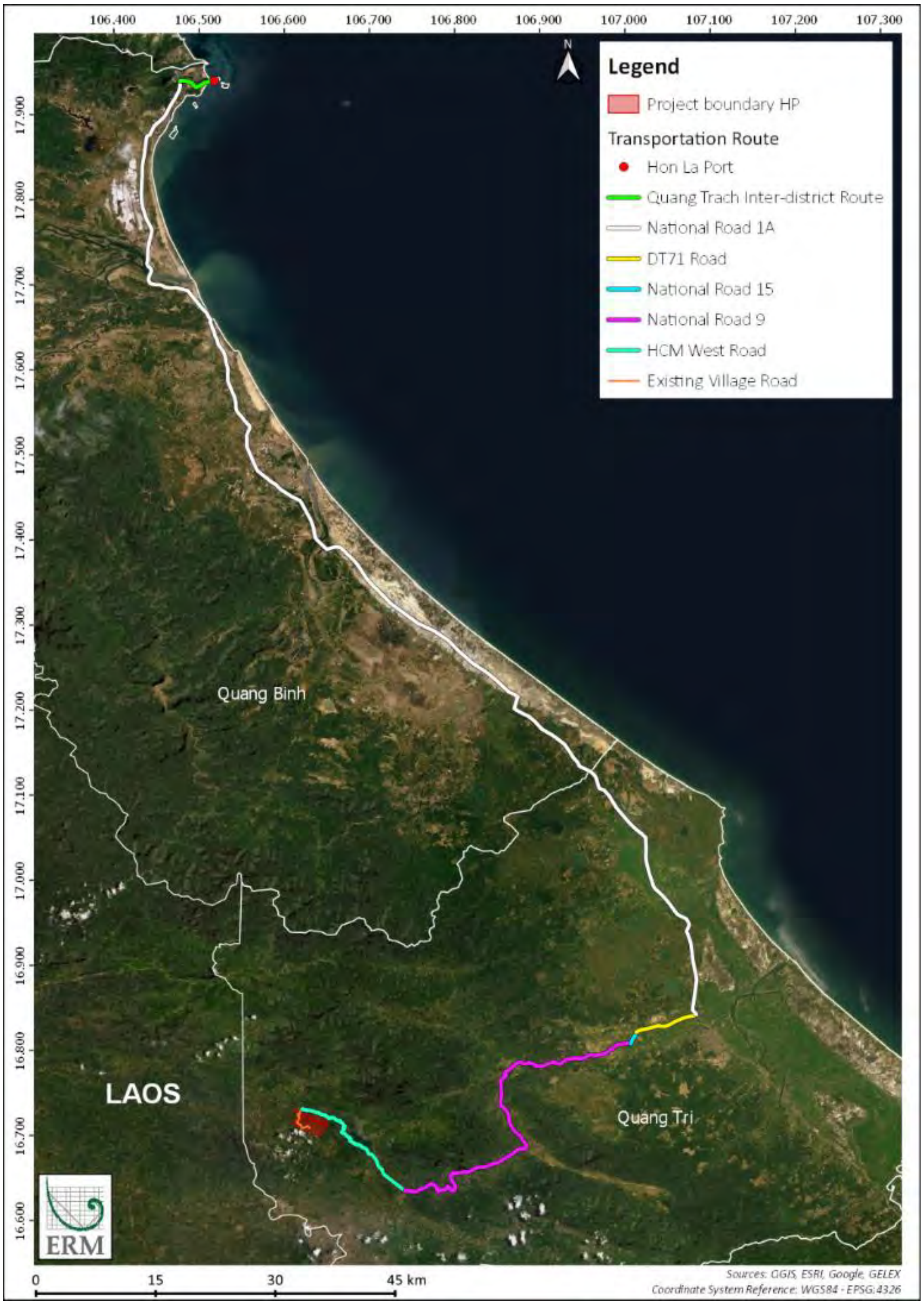


Figure 11.3 Map of Transportation Routes of Project's Equipment and Materials during Construction Phase

Based on field observation during the site visit, the traffic volume along the main road is relatively low, particularly the section from Khe Sanh to the Project site (i.e. approximately 15km). However, community activities were observed along some road segments e.g. housing, schools, and local traffic, particularly around the Project location. Meanwhile, unsafe driving practices were observed during the Survey Process and reported by local authority, particularly in terms of helmet use for motor riders. In addition, the Project location is a mountainous area with constant foggy conditions and is the main walking route for children to local schools, so traffic accidents might occur during the construction phase. Livestock from local communities were also observed roaming around the local roads that further complicate the situation. This safety issue has been raised by local people as one of their main safety concerns as experienced from current and previous projects. It is also noted that the Project area was originally a forest and agriculture area of indigenous people, which was uncrowded in terms of traffic, especially of heavy vehicle like trucks and crane trucks.

Apart from that, the transportation of raw material and heavy equipment of large volume will cause potential damages such as landslides, road and bridge deterioration along the transportation routes, especially National Highway 9 and Ho Chi Minh Road West branch (*Source: Socio-economic survey conducted by ERM, 2020*

Figure 11.4). The wind turbine equipment, cranes and their accompanying parts need to be carried out by super-length and super-heavy trucks. Road congestion might be expected due to the use of long trucks. However, the transportation of each turbine will last for 2 days and happen intermittently during the construction phase, such impact will be unlikely to cause significant disturbance to local community. Despite that, mitigation measures should be in place to minimize the negative impacts.

Moreover, the Project Owner is planned to renovate and to expand inter-village and internal road systems:

- An inter-village road of Cop village, Phung Lam village, Huong Choa village in Huong Phung Commune has existed with the length of 4.62km.This road is currently uncompleted paved with a width of 2 -3m, some parts of road is still red-earth road. This road is not in good condition due to agricultural products transportation.
- An internal road system will be buit for the construction and operation of the Project to connect all wind turbine location and the operation house. The internal road connected to turbine towers will be built as concrete road with the width of 5.5 m – 6.0m; designed speed of 30km/h and the maximum slope of 10%. The entire internal road system will be constructed within the Project footprint. The length of internal road of Huong Phung Wind power plant will be 6.867km, respectively.

The household survey has indicated that 37.1% of surveyed households are dissatisfied with inter-village and inter-commune roads, but see a need for more concrete roads between villages and communes to transport agricultural products from the fields, to easily travel, and to reduce damages related to transport vehicles. In the surveyed villages, inter-commune roads are concreted while inter-village roads are increasingly degraded due to circulation of big trucks in Cooc village. In Xa Bai village, soil inter-village roads cause a lot of difficulties for the locals when commuting.

The renovation works will occupy a large surface area, which may cause difficulties for farmers while transporting their forest products, potential landslides and stir up dust due to unpaved road surface. No road temporary closure will be expected during the access road construction. However, the renovation and upgrading of roads are also expected to bring convenience to local farmers' product transportation once they are completed.

Source: Socio-economic survey conducted by ERM, 2020

Figure 11.4 Ho Chi Minh West Road (Left) and An Inter-village road in Huong Linh Commune (Right)

11.4.1.3 Security

Consultation with the Management Board of Huong Hoa – Dakrong Protection Forest during the site survey revealed a concern that the forestry route renovation may also lead to encouragement of illegal logging. In fact, illegal logging has been a long-lasting matter of concern in Huong Hoa[64] in recent years, regardless of the government's effort in forest protection activities. New roads into the forest may create favourable conditions for loggers to be more active.

11.4.2 Existing Controls

The existing controls proposed for dust, noise and vibration impacts are presented in Chapter 10. Regarding the traffic safety issues during the Construction phase, the local EPP reports provided some mitigation measures to address the negative impacts resulting from the vehicle movement on public roads. These included planning for transportation, installing buoys, signs, signal lights and other auxiliary equipment for traffic guidance, regularly checking vehicles before travelling, and promotion of local procurement to reduce transportation. No measure was proposed to address illegal logging.

11.4.3 Significance of Impacts

From the assessment of dust, noise and vibration in Chapter 10, these impacts on local residents are predicted Minor. Meanwhile, considering the high frequency of the heavy vehicles of 9 trips every hour and carrying heavy equipment (i.e. turbines) to the Project site going through the residential area, the magnitude of impact is assessed as being Medium. Although the traffic volume is relatively low, considering the poor conditions of some road segments that will be traversed by the Project and unsafe driving behaviours, the sensitivity is assessed as Medium. Therefore, the significance impact of community health and safety risk is assessed as Moderate.

Table 11.4 Impacts on Community Health, Safety and Security during Construction Phase

Impact Description	Impacts Associated with Non-influx issues during Construction phase		
Impact Nature	**Negative**	Positive	Neutral
Impact Type	**Direct**	Indirect	Induced

[64] Source: https://baovephapluat.vn/phap-luat-ban-doc/dieu-tra-theo-don-thu/xot-xa-canh-hang-tram-cay-rung-bi-don-ha-tro-goc-o-quang-tri-74929.html

Impact Description	Impacts Associated with Non-influx issues during Construction phase				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 15 months of the construction period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.4.4 Additional Mitigation and Management Measures

In addition to measured proposed in the EPP, the Project Owner and its EPC Contractor should implement the following additional mitigation measures.

- EPC Contractor should ensure:
  - All new drivers (including contractors for construction material transportation) must be licensed with good experience, and should be required to undergo safety training;
  - Flagmen should operate at the junction between the main roads and the access road to coordinate the trucks entering and exiting;
  - Speed limits should be enforced for all Project vehicles;
- The Project Owner should:
  - Together with EPC Contractor, develop a Traffic Management Plan for the construction phase. Procedure for responding to the traffic emergency should also be included in the plan;
  - Conduct disclosure and consultation with the surroundings communities and public facility (school) on key Project traffic routes, timing of peak movements, type of vehicles and heavy equipment and provision of road safety awareness to the surrounding community, through corporation with the local police to ensure local residents be aware of increase in the level of transportation activities during the Project Construction;
  - Disclose the proposed grievance mechanism so that it is accessible for all villagers to report concerns associated with health and safety. Where complaints on accidents or near misses are submitted the Project will undertake an immediate investigation.
- Local communities should be familiarised with safety awareness and traffic management such as warning signs, limited speed and notifications of the risks of traffic accidents. This measure will need to be incorporated into the SEP.
- Project Owner should, where road conditions are poor occur as a result of Project activities, improve the road to ensure conditions meet the standard required for construction vehicle use.
- Regular road condition monitoring along the transportation route to understand road quality during construction phase.

11.4.5 Residual Impacts

As result of implementation of the proposed additional measures, the residual Project negative impact to community safety will be reduced to Minor.

11.4.6 Monitoring and Audit

The following monitoring activities are recommended:

- Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented;
- Monitoring and audit are also required to be conducted in accordance to the schedule proposed in the management plans relating to air quality, noise and traffic management.

11.5 Impacts Associated with Construction Workers

11.5.1 Potential Impacts

It is estimated that number of construction workers during the construction and turbine installation phase for Huong Phung Wind Power Plant would be 300 people in total. The number of employees during the operation phase is approximately 60 persons. The main labour source for the construction phase includes local labour supplied by domestic construction companies and Project's EPC labour resources. A temporary construction camp for the workers will be built. At the time of writing this ESIA, foreign experts is not listed in the Project's human resource, therefore accommodation arrangement for foreign experts (high-skilled employees) is not available.

Normally, risks relating to influx of construction workforce and Project-induced immigrants to the Project area have been major social concerns in many industrial projects. The risks might include potential conflict in cultural practice and living style between the migrant worker and the local people, littering and noise surrounding the worker accommodation facilities, fighting due to heavy drinking, gambling, transmission of communicable diseases, unplanned pregnancies, criminality issue and increased pressure on the local infrastructure and public services. Given the number of immigrant workers is very small and they are mostly as above-mentioned, it is almost unlikely that their presence will cause significant impact to the locality. However, mitigation measures should still be in place to ensure that minimal harm to the community.

Apart from that, there is also potential for the rights of local workers to be impacted, including workers directly employed by PCC1 as well as by the EPC contractors if appropriate safeguards are not in place. Major concerns consist of:

- Potential employment of child or forced labour;
- Accidents, injuries or other health and safety risks, which can arise from inappropriate working conditions, such as lack of safety measures, excessive working hours and insufficient breaks;
- Potential for discriminatory practices to occur in the hiring process;
- Underpaid or delayed payments to workers; and
- Risk of association with non-compliance of contractors (e.g. service contracts) or third parties (e.g. recruitment agents) adhering to relevant laws and international standards and guidance.

11.5.2 Existing Controls

Some mitigation measures were provided in the local EPP including management of workers/ staff and collaboration with local authorities for security status updates, as follow:

- Coordinating with local authorities and relevant agencies to organise programs such as education and awareness raising for workers in terms of health and safety measures, and how to minimize or avoid conflict with local people;
- Providing training to local people for them to be qualified to meet the recruitment requirements of the Project to increase local employment opportunities.
- Coordinating with local authorities to manage temporary resident registration for migrant workers and to monitor social security in the area where migrant workers will be accommodated.

No measure was proposed for the protection of local workers' right, health and safety.

11.5.3 Significance of Impacts

Based on the required labour for the Project during the construction phase, the impact magnitude of the influx-induced risks are medium. Based on consultations with key informants in Project affected villages indicated that the villages are open towards migrants. Similar wind farm development projects in Huong Linh and neighbouring communes have experienced no significant issue between locals and migrants to date. This indicates low vulnerability of the community, resulting in the impact significance of the influx worker issues is assessed as Small. In terms of local workers' rights, health and safety, given the small size of construction workforce and short-term duration of the construction work, the impact magnitude is considered Small.

According to the social baseline, there is a high proportion of affected households who are identified as vulnerable. The Project affected communes are mountainous areas with majority of the workforce are devoting for agriculture production. Only a small number of the labour force engage in wage-based works, and majority of them are day labourers, who work as masons, porters, and employees for the local bricklayer factories, carpenter workshops, mechanical workshops, coffee farms and processing factories. The workers may be unaware of their rights as well as the safety measures that should be available. This indicates high vulnerability of the community. As a result, impact significance is assessed as Moderate**.**

Table 11.5 Impacts Associated with Influx during Construction

Impact Description	Impacts Associated with Construction workers (local workers' right)				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 15 months of the construction period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.5.4 Additional Mitigation and Management Measures

The following presents the proposed mitigation measures for addressing workers' rights aspects:

- Project Owner and EPC Contractor should maximise local employment;
- Establish employment practices to check legal worker age in identification document upon recruitment to ensure no child labour or forced labour.
- Establish employment practices that ensure workers are provided an easy to understand contract that specifies working hours, overtime hours, breaks, and holidays.
- Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks.
- Establish safeguards if recruitment agents are utilised. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt).
- Establish a grievance mechanism for workers. This should include an option for grievances to be lodged anonymously. All workers, including those employed through the Project's supply chain,

should have access to a grievance mechanism to ensure that their issues and concerns are identified and addressed. Contractors should be required to inform the Project about grievances raised. Disclose the grievance mechanism to workers and local people.

- Collaborate with local/relevant authorities to organise educational or awareness-raising programs for local workers about their rights;
- EPC Contractor should register temporary residence for non-local workers to local authorities to ensure the management of Project's related workforce; Regularly engage with local authorities relevant to crime (i.e. local police) or other social problems (e.g. village leaders) for prevention of issues and for mitigation purposes when issues arise;
- EPC Contractor should conduct compulsory medical examinations (i.e. annual health check-ups) for Project workers, including contractors, as required by national regulations, to ensure they are fit for work and to monitor the prevalence of communicable diseases detected through annual medical check-ups;
- EPC Contractor should develop a Project Code of Conduct, and share the Project Code of Conduct with workers of contractors and requesting their compliance;
- Project Owner and EPC contractors should ensure that the accommodation for immigrant workers meet the standards as guidance provided in the "Workers and Accommodation: Process and Standards" – a Guidance note by IFC and ERBD.

11.5.5 Residual Impacts

As a result of the implementation of the proposed management measures, the impact on the community health and safety associated with labour influx will be reduced to Negligible.

11.5.6 Monitoring and Audit

- Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented.
- Frequency and schedule for the monitoring and audits are as proposed in the SEP and internal-external Grievance mechanism.

11.6 Benefits to Local Communities

11.6.1 Potential Impacts

The impacts to the local economy from employment and business opportunities arising during Project construction and operation include local employment and local procurement. As mentioned in the above section, construction of the Project will require approximately 300 construction workers/staff, who will be rolling from one turbine to another. As the construction work will mostly be manual and not require skilled workers, two-thirds of the workforce will be recruited from the local communities, and other nearby communes in Huong Hoa District. As such, the Project will create jobs and extra incomes for a small number of local people during the 15 months of construction phase.

In addition to employment opportunities, the Project will also require goods and services for its construction activities such as construction materials, equipment, cleaning, catering and other hospitality services. However, it is noted from the socio-economic survey that there is currently very small services are existing in Huong Linh and surrounding communes. Most of local people living close to the Project Site have very limited commercial activities, mainly with mobile traders who are from Khe Sanh town, Huong Hoa district. Therefore, the above-mentioned opportunities will probably provide additional markets for the existing small and medium local businesses of the Khe Sanh town, which is approximately 15km from the Project Site. These may include sands and rocks suppliers, excavator and bulldozer equipment suppliers, restaurants, and lodging providers. On the other hand, grocery suppliers and food provider services might be provided by local business owners.

During the operational phase, the local economy will be positively influenced by an increase in taxation revenue of the Province, demand for materials and services and tourism development. The Project expects to employ 300 employees, of which percentage of local employees is not determined at the time of this assessment. According to the local EPP report, while most of the labours during the operation phase will be the skilled labourers and will be likely recruited from outside of the area, priority will be given to the local community of Huong Hoa district and Quang Tri province to fill the required unskilled/semi-skilled positions such as security personnel and kitchen support workers.

According to the Wind Power Development Master Plan of Quang Tri province to 2020 with a vision to 2030, there are a number of wind farms to be developed in the area of Huong Hoa district. Majority of them are located in the neighbourhood of the Project site, in the communes of Huong Linh, Huong Phung, Huong Tan, Tan Thanh, Tan Lap, Tan Lien, and Tan Hop. The clusters of wind farms are expected to attract tourists and contribute to tourism development of the area. Besides, people in the area will have the opportunity to operate businesses associated with tourism services as well as obtain employment from new businesses.

11.6.2 Significance of Impacts

Based on the above analysis, the Project is expected to have a positive impact in terms of employment, procurement and induced job opportunities, and increase the economic condition of the local people.

11.6.3 Enhancement Measures

To optimise Project benefits to the local community through employment and business opportunities, the Project Owner should implement the following additional measures:

- Project Owner should hire local people for at least un-skilled positions during both construction and operation phases.
- Encourage the contractors to hire local labour by provision of a clear stipulation/commitment of using local labour, particularly in regards of economically displaced households, in the EPC contract and instruct the EPC contractors to prioritise qualified local people as construction workers in accordance with the needs of the Project;
- Communicate clear information about Project-related employment and business opportunities and prioritize local people during both construction and operation phases. Such communication should be conducted as early as possible before recruitment so that local people have enough time to prepare for the recruitment process (for example, by attending short training courses to improve their skills);
- During construction phase, the Project Owner and the EPC contractor should work closely with local government agencies, particularly in Huong Linh, Huong Phung, Huong Tan and Tan Hop communes to synchronise the Project’s needs in terms of local labour, as well as locals’ capacity;
- The Project owner should develop and implement a Community Development Plan (CDP) to invest in the community. Development of the CDP should take the potential benefits (such as tourism potentials, small business opportunities) into account, utilize community’s resources and consider the coordination with other wind farm developers in the Huong Hoa district. Disclose and conduct the monitoring of the implementation of this plan.
- At the end of construction phase, the Project Owner should consider to provide skill improvement training for those who will have worked for the Project in construction phase, so that they can be able to access to similar jobs in other projects in the country.
- Project Owner should apply local procurement during construction and operation of the Project. In particular, the Project Owner should use local foods/products and local supply to enhance benefiting to the local communities.
- Establish a clear grievance mechanism as mentioned in previous section.

11.7 Disturbance on Local Community during Operation Phase

11.7.1 Potential Impacts

During the operation phase of about 50 years, disturbance to the local communities mostly comes from the impacts from workers' presence, operation and maintenance of the turbines and substations. The number of migrant workers will be reduced to 60 staff/ workers for the operation phase. Hence, community health issues associated with workers presence such as the transmission of communicable diseases, or conflict between workforce and local communities include littering and noise surrounding the worker accommodation facilities, fighting due to heavy drinking, and gambling, are expected to be minimal. Potential cultural conflict and tension due to the difference in culture and living style between the migrant group and the local people are also not expected during this phase.

However, the community health may still be affected by air pollution, dust and water/groundwater contamination from the operation of the Project, especially during the maintenance period (mostly cleaning, checking wind turbine hubs) every six months, if not managed properly. Noise from the operation of turbines, substation and transformers of the Project is defined as another potential factor caused nuisance and disturbance to surrounding community. It is noted during the consultation with local authority and local community that as experienced from Huong Linh 1 and 2 projects, the noise from turbine operation, particularly in the windy days, cause certain disturbances and even insomnia at night to households who live close to the site. Noise impacts from the Project's WTGs operations are discussed in details in the Chapter 9 – Noise Impact Assessment. Generally, the negative impact is ranked as being of Minor significance.

Shadow flickers and visual impact to community health and safety are discussed in further details in the Section 10.6 and Section 10.7 accordingly. Generally, these impacts will be Large in the real case and worse case scenarios. Risk from blade throw will be assessed in the un-planned events chapter.

11.7.2 Existing Controls

Local EPP recommended some measures to minimise the discussed impacts above.

- Planting trees to create green space to increase the aesthetics of the Project;
- The reflected rays from the turbine blades generated by the reflection, can be minimised by optimizing the smoothness of the rotor surface as well as coating with less reflective material
- Choosing the most advanced wind turbine available, the design is compact and compact, reducing the project's visual impact.
- In order to harmonise with the general landscape of the area, wind turbine pillars are often painted light grey to create a comfortable, pleasant and gentle environment for people living around or near the wind turbine columns. The distance of each turbine is 300 - 320m to avoid causing visual disturbances.

11.7.3 Significance of Impacts

As assessed in Section 10.4 – Noise Impact Assessment, the noise screening for the Project shows that the predicted noise levels are below criteria when operating at the acoustically worst-case scenario, leading to noise impacts from the Project's WTGs operation are expected to be neutral. The impact magnitude is therefore considered Small. However, the impact magnitude of shadow flickers is Large. As such the overall impact magnitude of impacts is Medium. As the project's surrounding is currently a mountainous area and local people are quite sensitive to noise, especially at night, and other discussed impacts, the sensitivity of receptors in the area is considered Medium. Overall, the impact significance is assessed to be Moderate.

Table 11.6 Disturbance to Local Community during Operation

Impact Description	Disturbance on Community during Operation				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent throughout the operation phase				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptor Sensitivity	Low	**Medium**	High		
Impact Significance	Negligible	Minor	**Moderate**	Major	

11.7.3.1 Additional Mitigation Measures

To remain the significance of the impact as minor or reduce to negligible, the Project is required to implement the additional measures as proposed in Chapter 10 for Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment and other measures as below:

- Project Owner should keep implementing the SEP including grievance procedure during the Project's operation.
- Project Owner should keep implementing the CDP to support the local people in improvement of their socio-economic conditions. The CDP should be implemented throughout the Project's operation period and considered as Corporate Social Responsibility program of the Project Company.
- Project Owner should basic skill requirements for operation phase should be announced at least six months in advance so that local people can have appropriate training orientation for themselves.
- Project Owner should local procurement should be promoted during operation of the Project. In particular, the Project should use local foods/products and local supply to enhance benefits to the local communities.

11.7.3.2 Residual Impacts

Following the implementation of proposed additional measures, the residual impact is expected to be reduced to Negligible.

11.7.3.3 Monitoring and Audit

The following monitoring activities are recommended:

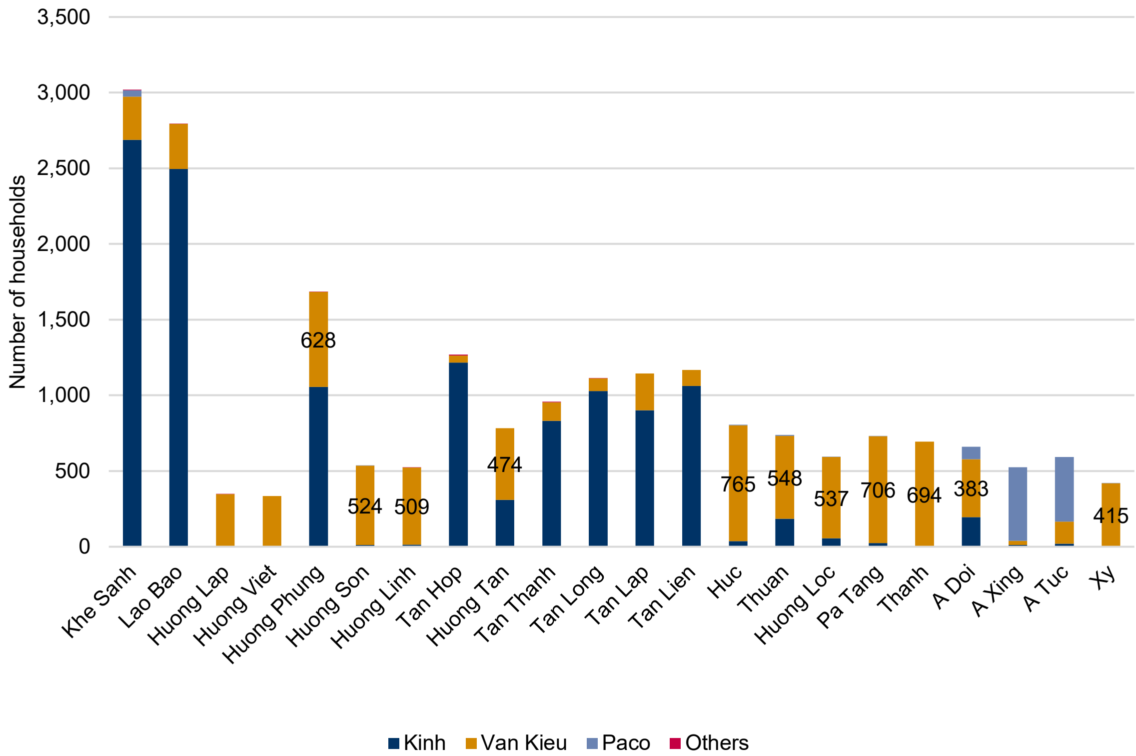
- Ongoing monitoring and periodical audit as proposed in the ESMP to ensure the above mitigation measures are in implementation;
- Monitoring and audit are also required to be conducted in accordance to the schedule proposed in Chapter 9 for Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment.

11.8 Impacts on Indigenous People

As described in the socio-economic baseline chapter, the Project area is occupied by two main ethnic groups including Kinh and Van Kieu. The Van Kieu people in the Project affected communes fulfil all four characteristics of IPs, thus the IDC PS7 provisions are applicable to them.

11.8.1 Potential Impacts

Van Kieu is one indigenous ethnic minority residing in the mountainous areas of Quang Tri and Thua Thien Hue provinces. In the past, the Van Kieu people had settled in the Central Laos. Later, due to historical changes, they had to migrate to other places, including to northwest to Thailand, some to the east to settle down in the West of Quang Tri province where they set up their villages around the mountain called Vien Kieu, which was popularly pronounced as Van Kieu. As such they are called Van Kieu or Bru-Van Kieu. According to the statistical data 2009, the Van Kieu in Viet Nam had a population of 74,506 people, residing in 39 out of 63 provinces in 2009. The Van Kieu people reside largely in Quang Tri Province, 55,079 people, accounting for nearly 74% of the total population of Van Kieu in Vietnam. Of the 55,079 Van Kieu people, there are 4,793 people living in urban areas while most of Van Kieu people (50,286 or 91.3%) are living in the rural areas. Figure 11.5 shows that a large proportion of Van Kieu live in Huong Phung, Huong Linh and Huong Tan communes.



Source: Huong Hoa Statistics Office (2019)

Figure 11.5 Households of Huong Hoa District by Ethnic Group and Commune 2018

Through the observation and interview with the local people and local authority during the site survey, it is recognised that Van Kieu people rely very much on the natural resources for subsistence, medicine and livelihoods. In fact, almost all of the surveyed Van Kieu households in Huong Choa village confirmed that land-based is the primary source of livelihood to their families, and agriculture production contributes to more than 60% of their household income. Their main economic activities are from cassava and rice cultivation, forest plantation, animal grazing and forest products collection. The outcomes of the three FGDs with 29 households in Huong Choa, Phung Lam, and Cop villages consistently indicate that the main income source for most respondents is from land-based activities. The results of KIIs with the heads of the surveyed villages confirmed that cultivation is the main form of livelihood. In Cop village, 95% of residents rely on land-based activities with an average income from agriculture of 850,000 VND per month. Approximately 94.3% of surveyed households (33 out of 35 surveyed households) are in debt. The total amount of loans for these households is 1,568,000,000 VND (the biggest is 200 million VND and the smallest loan is five million VND), and the average household loan is 50,580,645 VND. In 2019, Huong Phung commune had 301 poor households in the commune (17.6% of total households) and 145 near poor households (8.5% of total households).

There is a high level of illiteracy in surveyed areas, particularly 82.4% of surveyed households in Huong Choa village. The rest population also have low education attainment, mostly at primary or lower secondary level. Beside cultivation, they normally work as day labour/ seasonal labour for supplemental income. However, due to low skills, they work are not stable and often low paid. This indicates a marginalisation status that might lead to possible vulnerability if their land are acquired and the land-based livelihoods can no longer secure food supply and income to their family.

Additionally, interviews with village patriarchs of the Van Kieu People indicated that the local community normally access forest land which are still available surrounding the villages to collect forest-based products such as fuel wood, vegetables, timber for local traditional houses building for household consumption. Only few people (i.e. 3-5 people in each village) still practice traditional medicines (i.e. using specific forest plant's roots as medicines, mainly to cure gastrointestinal tract diseases), mostly when the cure by national medical system (i.e. having medicines from commune clinics) is unsuccessful. Essentially, there is no commercial activities conducted relating to traditional medicine practices.

Within the scope of this ESIA, though there is no internationally, nationally or provincially recognised critical cultural heritages located within the Project location, Van Kieu people have their own cultural value/ resources of Sacred Forest, which is a place to rest for their ancestors and forest-Holy. It is reported that, no one is allowed to damage the Sacred Forest, even at the very minimum activities such as cutting small trees. Should activities that cause damage to the Sacred Forest, the people who cause the damage will be punished by traditional rules of Van Kieu People, often in terms of payment equivalent to a buffalo or a pig for praying ceremony subsequently conducted to the forest-Holy, asking for apology.

Potential impacts on the Indigenous People community may include:

- Loss of livelihood and/or income from the land-based livelihood: As mentioned above, as Van Kieu People are identified as a forest/natural resource dependant community, the loss of land will potentially lead to a vulnerable status to those households;
- Social/cultural conflicts among the community: Local people may lose trust in the local authority and Project Owner when they are not able to ensure equality in terms of compensation payment;
- Lack of Project information may lead to misunderstanding and unnecessary concerns about the Project impacts, and in the worst case, rejection to the Project development;
- Potential impacts on cultural heritage (the Scared Forest) if any future activities of the Project affects those areas

Free, Prior and Informed Consent (FPIC) is not necessarily triggered for this Project. It is understood that the Project has conducted a number of engagement, including a public consultation with representatives of local authority and community for the land purchasing process. Specifically, the public consultation for land acquisition as required by regulation included the comments from local authority and representatives from community to the potential impacts from the Project as well as response from the Project to such comments. An agreement from the local authority and representatives of community for the Project to be developed in the area was provided as the results of the public consultation process. The social survey also reveals the community's perception towards the Project that they totally support the Project's development, as long as compensation for their land is paid appropriately. Future information disclosure and consultation with the Bru – Van Kieu community is required to be proper conducted through the implementation of a Stakeholder Engagement Plan, Livelihood Restoration Plan and Community Development Plan.

11.8.2 Existing Controls

There is no current existing control for this impact.

11.8.3 Significance of Impacts

Due to the high proportion of Van Kieu presence in the affected communes, the magnitude of impact on livelihood is ranked as Medium. Thanks to the awareness of Project management and local authority on the importance of the Sacred Forest of Van Kieu People, limited impacts would be expected to their traditional cultural values or practices. However, the social dissatisfaction related to land compensation price issue is assessed to be of Medium magnitude if not managed properly.

Given the fact that Van Kieu people have been living in harmony and obviously shared their support towards the Project development during the interviews, the receptors' sensitivity is assessed as High based on their poverty, natural resource dependence and vulnerability. Eventually, the impacts on livelihoods, natural resources and critical cultural heritage subject to traditional ownership or under customary use during the land clearance and construction phase and the operation phase of the Project is assessed as Major significance.

Table 11.7 Impacts on Indigenous People

Impact Description	Impacts on Indigenous People				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
Impact Extent	**Local**	Regional	International		
Frequency	Throughout the Project's life cycle				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptor Sensitivity	Low	Medium	**High**		
Impact Significance	Negligible	Minor	Moderate	**Major**	

11.8.4 Additional Mitigation and Management Measures

The Project is expected to implement the following mitigation measures:

- Establish a Stakeholder Engagement Plan during construction and operations. The SEP should include an ICP process for the Indigenous People;
- Provide and communicate detailed information about the Project's plan and schedule particularly related to land clearing and construction to the community with a special attention to farmers nearby the project locations.
- Review all public consultation process to ensure:
  - the continued access to natural resources independent of Project's land purchasing; and
  - the provision of access, usage, and transit on land that the Project is developing on (i.e. access and use of land within the Project's footprint), subject to overriding health, safety, and security considerations to the Affected Communities of Indigenous Peoples.

- In case of any future impacts to cultural heritages of Bru- Van Kieu people (i.e. the Sacred Forest), the Project Owner is required to conduct subsequent consultation with Affected Communities of Indigenous People to have a "good faith" negotiation have a mutual agreement on the compensation or additional support. The "good faith" negotiation should also be discussed during the public disclosure of ESIA or subsequently, when possible.
- Establish a grievance mechanism that is understood by and accessible for all villagers. The mechanism will be simple, efficient and timely and fully consultative. It should be disclosed in a culturally appropriate manner, with local language and easy to access
- Develop a Resettlement and Ethnic Minority Development Plan (REMDP) based on the results of socio-economic baseline survey and consultations with relevant local authorities and communities. The REMDP should propose development programs that aid the avoidance and minimization of negative impacts on IPs, ensure social and economic benefits to IPs in a culturally appropriate and gender responsive manner; and strengthen the social, legal and technical capabilities of IPs to enable them to represent the affected IPs more effectively. The document could be developed together with the LRP as recommended in Section 11.2.4 above to serve as a comprehensive guidance for the Project Owner in terms of community development actions.
- A Chance Find Procedure should be developed for the pre-construction and construction phase, given that the Project is located nearby the IP's location with probably physical cultural heritage.

11.8.5 Residual Impacts

As a result of the implementation of the proposed additional measures, the residual impact on lands, natural resources and critical cultural heritage of the Bru-Van Kieu People during construction and operation phases is expected to be Minor.

11.8.6 Monitoring and Audit

Comply with the monitoring mechanism proposed in the SEP, LAA, LRP and CDP during the implementation of these plans.

11.9 Summary

Significance of the impacts discussed in the above sections before and after mitigation is summarised in Table 11.8.

Table 11.8 Summary of Social Impact Assessment

No	Impacts	Significance of Impacts		
		Impact Nature	Before Mitigation*	With Mitigation**
Pre-Construction and Construction Phase				
1	Economic displacement and livelihood impacts	Negative	Major	Minor
2	Disturbance to agriculture production	Negative	Minor	Negligible
3	Community health, safety and security impacts during construction	Negative	Moderate	Minor
4	Impacts associated with construction workers	Negative	Moderate	Minor
5	Benefits to local communities (both construction and operation)	Positive		

No	Impacts	Significance of Impacts		
		Impact Nature	Before Mitigation*	With Mitigation**
Commissioning and Operation Phase				
6	General disturbance on local community during operation	Negative	Moderate	Minor
7	Impacts on Indigenous People (both construction and operation)	Negative	Major	Minor

Note: (*) without mitigation measures/management suggested from the ESIA.
(**) with mitigation measures/management suggested from the ESIA.

12. UNPLANNED EVENTS

This chapter presents the probable impacts of unplanned events associated with construction and operation phase of the Project. The unplanned events are those that potentially arise from technical failure, human error, or as a result of natural phenomena.

The assessment of unplanned impacts considers the probability of events occurring and an estimate of the severity of consequences. The assessment of the severity of impacts is based on the worst case scenario, where it is assumed that safety devices and associated measures fail to operate properly resulting in the incidents.

12.1 Scope of Assessment

This assessment addresses the following unplanned events:

- Spillage of fuel, oil and hazardous materials;
- Traffic accidents;
- Fire and Explosion;
- Natural Unplanned Events such as Landslide, Flood;
- Blade throw; and
- Transmission line snapping, and transmission pylon/tower collapse.

12.2 Relevant Guidelines and Regulatory Requirements

12.2.1 Vietnam Regulations

- Related to Oil Spills: Decision No. 02/2013/QD-TTG dated 14th January 2013 promulgating the regulation on oil spill response; and
- Related to Fire, Explosion, and Toxic Release:
  - Decree No. 113/2017/ND-CP dated 9th October 2017 specifying and providing guidelines for implementation of certain articles of the Law on Chemicals; and
  - Circular No. 32/2017/TT-BCT dated 28th December 2017 specifying and providing guidelines for implementation of certain articles of the Law on Chemicals and Decree No. 113/2017/ND-CP specifying and providing guidelines for implementation of certain articles of the Law on Chemicals.

12.2.2 International Standards and Requirements

IFC Performance Standards is presented in Table 12.1.

Table 12.1 Applicable IFC Performance Standards

Performance Standard	Requirements
PS1: Assessment and Management of Environmental and Social Risks and Impacts	Emergency Preparedness and Response Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, the ESMS will establish and maintain an emergency preparedness and response system so that the client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations associated to prevent and mitigate any harm to people and/or the environment.

Performance Standard	Requirements
	The preparation will include the identification of area where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially Affected communities and periodic training to ensure effective response. The emergency preparedness and response activities will be periodically reviewed and revised, as necessary, to reflect changing condition
PS4: Community Health, Safety, and Security	Emergency Preparedness and Response The client will also assist and collaborate with the affected communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations especially when their participation and collaboration are necessary to respond to such emergency situations. If local government agencies have little or no capacity to respond effectively, the client will play an active role in preparing for and responding to emergencies associated with the project. The client will document its emergency preparedness and response activities, resources, and responsibilities, and will disclose appropriate information to affected communities, relevant government agencies, or other relevant parties

12.3 Impact Assessment Methodology

12.3.1 Overview

To evaluate potential impacts from unplanned events, a risk-based approach is used to define:

1. The most likely unplanned events leading to environmental, social and/or community health impacts; and
2. Those unplanned events with the most significant potential environmental, social and/or community health impacts overall. Impact significance for unplanned events is therefore determined by evaluating the combination of likelihood and consequence.

12.3.2 Step 1: Assess the Scale of Consequence

Indicate levels of consequence for potential impacts from unplanned events can be defined for the physical, biological and social environment as provided Table 12.2.

Table 12.2 Indicative Level of Consequence for Potential Impacts from Unplanned Events

	Incidental (A)	Minor (B)	Moderate (C)	Major (D)	Severe (E)
Physical Environment	Impacts such as localised or short term effects or environmental media, meeting all environmental standards	Impacts such as widespread, short-term impacts to environmental media, meeting all environmental standards	Impacts such as widespread, long-term effects on environmental media, meeting all environmental standards	Impacts such as significant, widespread and persistent changes in environmental media OR Exceedance of environmental standards	Exceedance of environmental standards and fine/ prosecution
Biological Environment	Impacts such as localised or short term effects on habitat or species	Impacts such as localised, long term degradation of sensitive habitat or widespread, short-term impacts to habitat or species	Impacts such as localised but irreversible habitat loss or widespread, long-term effects on habitat or species	Impacts such as significant, widespread and persistent changes in habitat or species	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
Social Environment	Slight, temporary, adverse impact on a few individuals	Temporary (<1 year), adverse impacts on community which are within international health standards	Adverse specific impacts on multiple individuals that can be restored in <1 year OR One or more injuries, not severe.	Adverse long-term, multiple impacts at a community level, but restoration possible. OR One or more severe injuries to a member of the public including permanently disabling injuries.	Adverse long-term, varied and diverse impacts at a community level or higher – restoration unlikely. OR Fatalities of public.

12.3.3 Step 2: Assess the Likelihood

For the purposes of assessment, the like hood of an unplanned event occurring can be classified as follows:

1. Remote, not know in the industry
2. Very unlikely, known of in the industry
3. Unlikely, may occur once or more in life of the Project
4. Likely, may occur once or twice per year
5. Expected, may occur more than twice per year

12.3.4 Step 3: Assess the Significance

The consequences and likelihood of potential unplanned events are combined to determine the overall impact significance using the risk matrix shown in Table 12.3.

For the potential impacts that are determined to have an impact significance of Moderate or Major, risk reduction measures are identified; these can include measures that reduce the like hood of the event from occurring, those that reduce the consequences on sensitive receptors/resources if the event were to occur, and those that effect the like hood and consequence.

Table 12.3 Risk Matrix for Potential Unplanned Events

		Likelihood of Occurrence				
		1	2	3	4	5
Consequence	Incidental (A)	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor (B)	Negligible	Minor	Minor	Minor	Moderate
	Moderate (C)	Minor	Minor	Moderate	Moderate	Major
	Major (D)	Moderate	Moderate	Major	Major	Major
	Severe (E)	Major	Major	Major	Major	Major

12.4 Assessment of Potential Impacts

Based on the Project activities, the potential unplanned events that are considered to have the highest potential environmental and social risks during all phases of the Project are shown in Table 12.4. Noted that for the commissioning and operational phases, only indicative project activities are listed. A more comprehensive evaluation of potential impacts would be conducted once sufficient detailed design information is available.

Table 12.4 Unplanned Events leading to Potential Impacts

Project Phase	Unplanned Event	Potential Receptors Affected
Site Preparation and Construction	Small scale leakage and spill incidents from site-preparation/construction activities	Users of surface water and groundwater
	Traffic collisions	Users of the public roadways utilised by the Project
	Fire and explosion	■ Nearby communities

Project Phase	Unplanned Event	Potential Receptors Affected
		■ Habitats, flora, and fauna in the vicinity of the site
Commissioning and Operation	Small scale leakage and spill incidents from activities on site	Users of groundwater
	Fire and explosion	■ Nearby communities ■ Forest, habitats, flora, and fauna in the vicinity of the site
	Blade ejection failure	Nearby communities
	Accidental transmission line snapping and tower swaying/collapsing	Nearby communities
	Natural Unplanned Events - Flooding and Landslides	■ Nearby communities ■ Forest, habitats, flora, and fauna in the vicinity of the site

Potential impacts from these events are described in detail in the following section. These potential impacts had been classified using the risk-based impact assessment methodology for unplanned events included in Section 12.3. It should be noted that this methodology was different than that applied to potential impacts from planned activities, as the assessment of potential impacts from unplanned events must consider likelihood as well. Because a risk-based assessment methodology had been used, worst-case scenarios had been considered.

A summary of potential Project-related Unplanned Events, contributing causes, and consequences for the Project workforce, nearby communities and/or surrounding environment were summarised in Table 12.5. This table also provided a risk ranking for each potential impact pre-implementation of Project embedded controls.

Table 12.5 Potential Impacts from Unplanned Events and Pre-mitigation Risk Ranking

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
Site Preparation/Construction				
1	Small scale leakage and spill incidents from site-preparation/ construction activities	Corrosion, dropped objects or other damages to storage oil tanks/mobile gas stations; failure to secure valves; failure to maintain large mobile construction plant.	**Communities** – Based on the liquid fuel storage volumes the potential exists for exposure to contaminated water or soil and resulting in long-term effects on surrounding communities utilising groundwater resources if a spill was not being contained.	3C (Moderate)
			Environment – Based on the liquid fuel storage volumes potential for loss of containment of oil/chemicals into ground of surrounding area, including nearby surface water resources resulting in localised, potentially long-term, degradation.	3B (Minor)
2	Road traffic transporting personnel or materials involved in a collision	Wet/dark conditions, driver distraction, fatigue, other dangerous drivers, variable road conditions; rural areas with pedestrian road users	**Communities** – Traffic accidents that involved community members, resulting in injury or fatality. Accidents might require use of local medical emergency services in the Project area and could temporarily decrease access to these services for local residents.	4E (Major)
		As above with livestock in the road	**Communities** – Traffic accident with livestock leading to death of livestock and loss/reduction in community member's livelihood.	4C (Moderate)
3	Fire and explosion	Leakage and spill incidents of flammable materials, malfunctioning equipment and failure to operate large mobile construction vehicle,	**Communities** – Based on the liquid fuel storage volumes the potential exists for exposure to ignited due to malfunctioned equipment and resulting in potentially severe injuries to employees and spread to nearby communities' members	3D(Major)
			Environment: – Based on the liquid fuel storage volumes potential for ignition of leakage or spill of oil/chemicals due to human errors and malfunctioned short-circuit equipment, accidents might lead to uncontrollable wildfire, loss of crops and habitat, causing injury and life-threatening of local community.	3D (Major)
Commissioning and Operation				
4	Small scale spill from activities on-site	Corrosion, dropped objects or other damage to small storage vessels;	**Communities** –Based on the liquid fuel storage volumes the potential exists for exposure to contaminated water or soil and resulting in long-term effects on surrounding communities utilising groundwater resources if a spill is not contained.	3C (Moderate)

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
		failure to secure valves; failure to maintain equipment.	**Environment** - Based on the liquid fuel storage volumes potential for loss of containment of oil/chemicals into ground of surrounding area, including nearby surface water resources resulting in localised, potentially long-term, degradation.	3C (Moderate)
5	Fire and explosion	Leakage and spill incidents of flammable materials, malfunctioning equipment, short-circuit power, Damage of transmission lines or Lightning strike	**Communities** – A large-scale fire could result in injuries to people in the surrounding communities, or in the worst-case fatalities. Explosions of malfunctioned equipment could result in rapid spread of fire and projectile spread of debris. This could result in injuries to people in the surrounding communities, or in the worst-case fatalities.	2E (Major)
			Environment: – A large-scale fire could result in damage/death of local flora and fauna. Accidents might lead to uncontrollable wildfire, loss of crops and habitat given the environment settings at the Project area. Explosions could result in rapid spread of fire and projectile spread of debris. This could result in damage/death of local flora and fauna.	2D (Moderate)
6	Blade ejection failure	Root connection; catastrophic structural buckling or separation; leading edge, trailing edge, or other bond separation; lightening damage; erosion; failure at outboard aerodynamic device; reduction in stiffness of blades (up to 10%); superficial structural or delamination/laminate wrinkling that eventually become permanent damage; and over speeding due to failure of SCADA to rectify the failure or high wind/cyclonic/meteorological conditions[65]	**Communities** – Blade ejection failure could result in rapid spread of fire and projectile spread of debris given the heights of wind turbines. This could result in injuries to surrounding communities, or in the worst-case fatalities	3E (Major)
			Environment – As above with local flora and fauna.	3C (Moderate)

[65] Robinson et al. Study and development of a methodology for the estimation of the risk and harm to persons from wind turbines. 2013. Prepared by MMI Engineering Ltd for the Health and Safety Executive 2013

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
7	Accidental transmission line snapping and tower swaying/collapsing	Wind/cyclonic/meteorological conditions, catastrophic structural separation, corrosion	**Communities** –. Electrocutions that involved community members, resulting in injury or fatality, livestock leading to death of livestock and loss/reduction in community member's livelihood	3E (Major)
8	Natural Hazards	Heavy rainfall occurs that exceeds the capacity of the natural drainage system may cause flash flood event. Clearing vegetation for site preparation increases the rate of run-off and flood risks to downstream area. Landslide occurs in combination of many causes such as intense rainstorm, steep slopes (over 20^0) and vegetation removing that weakens soil bearing capacity.	**Communities:** Flood and Landslide can result in loss of human life, damage to property, destruction of crops, and loss of livestock that affects to livelihood. Flood and landslide may affects to substation and power components that lead to loss of electricity supply locally. **Environment:** A large-scale flood and landslide could result in damage/death of local flora and fauna.	4D (Major)

Notes:
'Communities' refers to all individuals not directly or indirectly employed by the Project but living and/or working in proximity to Project infrastructure or areas of Project activity such that they are at risk of potential impacts from a Project-related unplanned event

Unlike impacts from planned activities, mitigation of unplanned events should consider both Preventative actions (that reduce the likelihood of the cause of the potential impact) and mitigation actions that reduces the magnitude of the consequence.

12.4.1 During Site Preparation and Construction

12.4.1.1 Leakage and Spill Incidents

12.4.1.1.1 Background

There would be many large mobile plant items that would be powered by diesel oil and would contain relatively small reservoirs of lube oil and hydraulic oil, with the potential for environmental damage if the materials are lost to ground. Mobile plant will include:

- Cranes;
- Pipe-laying cranes and plant;
- Excavators;
- Heavy goods vehicles;
- Fork-lift trucks; and
- Fuel trucks.

During site preparation and the early stages of construction any accidental release of oils would be to unpaved areas. Hence, the oil would seep into the ground and potentially groundwater if the release was not responded to immediately. Lube oils were not expected to be readily biodegradable. However, any release was likely to be small and if there was immediate response, the residual amount released would result in negligible damage to the environment.

There might be bulk storage of fuel such as diesel oil at the construction site for mobile plant. Modern temporary storage facilities are often in the form of a plastic tank with integrated secondary containment. The main risk would be from offloading from bulk storage to mobile plant. Spillages might penetrate the soil causing groundwater contamination. Diesel oil was not readily biodegradable and was expected to bioaccumulation. However, the amount spilled in any one event was likely to be very small.

12.4.1.1.2 Significance of Impacts

The significance is provided in Table 12.5.

12.4.1.1.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental spills are summarised in table Table 12.6.

Table 12.6 Prevention and Mitigation Measures for Leakage and Spill Incidents

Type of Control	Management Control	Responsibility - Organisation	Timing
Preventative	Design the site to include good site management practices to ensure that the products are properly stored on site (e.g. secondary containment, double walled tanks, over filling alarm system).	EPC Contractor	Before site preparation
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will provide regular	The Project Owner	Before site preparation

Type of Control	Management Control	Responsibility - Organisation	Timing
	information on safety drills and guidance to residents in the event of an unplanned event.		
Preventative	Ensure good inspection and maintenance procedures for large mobile construction plant to minimise small leaks and spills.	EPC Contractor	During site preparation and construction
Mitigatitve	Prepare Emergency Response Plan and Emergency Management Plan.	The Project Owner	Planning stage (before commissioning and operations)
Mitigatitve	Implement Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	The Project Owner	During commissioning and operations

12.4.1.1.4 Residual Impacts

Because the majority of the mitigation presented was preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, if the event occurred, the consequence of the oil spills could potentially remainte same. In these cases, the mitigative measures described in the previous section would apply to minimise likelihood of impacts.

		Risk Significance
Without Control Measures	Communities	**3C Moderate**
	Environment	**3B Minor**
With Control Measures	Communities	**2C Minor**
	Environment	**2B Minor**

12.4.1.2 Traffic Accidents

12.4.1.2.1 Background

Receptors for increased road safety risks during Project site preparation and construction included drivers, passengers, and non-motorised travellers on public roads. Although existing road users were likely to be accustomed to existing safety risks associated with poor road conditions, these receptors were unlikely to have experience driving or sharing the road with heavy trucks, of the type likely to be used during Project site preparation and especially construction.

Site preparation would require a number of vehicle trips to deliver construction equipment and supplies, as well as daily trips of employee. Additionally, the Project Site is located in mountainous area, the traffic conditions is quite unfavourable. At the time of Project's construction, many wind power developments are under construction and also share the same equipment and material transportation route.

Based on this analysis, it was assumed that road safety risks increase roughly in proportion with increased vehicular traffic congestion. Road safety risks would also increase due to degraded road infrastructure conditions.

12.4.1.2.2 Significance of Impacts (Before Mitigation)

The significance is provided in Table 12.5.

12.4.1.2.3 Mitigation and Monitoring

Active mitigation measures that would be used to further mitigate potential road safety risks were provided in table below. These measures included development of a Transportation Management Plan that would address scheduling of road activity, monitoring conditions of public roads, and active traffic controls at the Project site entrance.

Table 12.7 Prevention and Mitigation Measures for Traffic Accidents

Type of Control	Management Control	Responsibility - Organisation	Timing
Preventative	Developed and implemented a Transportation Management Plan. This should include measures such as: ■ Active traffic controls (e.g. flaggers to direct traffic at the Project site entrance) ■ Schedule construction deliveries and employee shift changes to minimise traffic congestion and delay	EPC Contractor	Site preparation and construction
Preventative	Design an H&S plan and good safety practices for the transportation (e.g. alcohol policy, good driving practice).	EPC Contractor	Construction
Preventative	Upgrade the access road to the Project site	The Project owner	Site preparation
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will provide regular information on safety drills and guidance to residents in the event of an unplanned event.	The Project owner	Prior site preparation
Mitigatitve	Prepare Emergency Response Plan and Emergency Management Plan	The Project owner	Planning stage (before commissioning and operations)
Mitigatitve	Implement Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor/ The Project owner	Prior to site preparation

12.4.1.2.4 Residual Impacts

Because the majority of the mitigation presented as preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, if the event occurred, the consequence of the traffic accidents could potentially remain as severe. In these cases, the mitigation measures described in the previous section would apply to minimise the likelihood of impacts.

		Risk Significance
Without Mitigation Measures	Communities	**4E Major**
	Communities (livestock)	**4C Moderate**
With Mitigation Measures	Communities	**3E Major**
	Communities (livestock)	**3C Moderate**

12.4.1.3 Fire and Explosion

12.4.1.3.1 Background

Given the nature of construction work, the utilisation of reasonably large volumes of chemicals for machinery and equipment. Many of these are hydrocarbons (e.g. crude oil and refining products) that are also highly flammable. Whenever handling and storing these types of compounds, there is a risk of a loss of containment (i.e. large-scale spill), fires, or in some situations, explosions.

In addition to the presence of hydrocarbons on-site, the failure of malfunctioning and/or outdated machinery and equipment could be also led to the risk of fires and explosions. Explosion of Unexploded Ordnances (UXOs) left behind from the war should also need to be considered.

Large scale fires, or worst-case explosions, could potentially release smoke and fumes in the broader area generating health issues associated with inhalation of toxic substances and uncontrollable wildfire that would contribute to a loss of crops and habitats and impacts on the economics of the area (e.g. community and workers jobs and incomes).

12.4.1.3.2 Significance (Before Mitigation)

The significance is provided in Table 12.5.

12.4.1.3.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental fire and explosion are summarised in table below.

Table 12.8 Prevention and Mitigation Measures for Fire and Explosion

Type of Event	Management Control	Responsibility	Timing
Preventative	Conduct a detailed ENVID/HAZID (Environmental Identification/ Hazard Identification) process to identify key environmental and social risks associated with the Project	EPC Contractor	Site preparation
Preventative	Conduct a Quantitative Risk Assessments (QRA) for the key sources of environmental and community safety risk, as identified in the HAZID/ENVID process and ensure risks are reduced to as low as reasonably practicable	EPC Contractor	Site preparation
Preventative	Implement the recommendations of the QRA process into the design of the plant and the planned management measures	EPC Contractor/ The Project owner	Site preparation and construction
Preventative	Contact relevant authority bodies and conduct the UXO clearance	The Project owner	Site preparation
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will provide regular information on safety drills and guidance to residents in the event of an unplanned event	The Project owner	Site preparation and construction
Preventative	Implement routine inspection and maintenance procedures (in line with international best practice) for large storage vessels	EPC Contractor	Site preparation and construction
Mitigative	Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation	EPC Contractor/ The Project owner	Site preparation

Type of Event	Management Control	Responsibility	Timing
	Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor	During construction

12.4.1.3.4 Residual Impacts

Because the majority of the mitigation presented was preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, if the identified events occurred, the consequences remained the same level. In these cases, the mitigation measures described in the previous section would apply to minimise the likelihood of impacts.

		Risk Significance
Without Mitigation Measures	Communities	**3D Major**
	Environment	**3D Major**
With Mitigation Measures	Communities	**2D Moderate**
	Environment	**2D Moderate**

12.4.2 During Commissioning and Operation

12.4.2.1 Leakage and Spill Incidents

12.4.2.1.1 Background

There would be widespread use of chemicals, including hydrocarbons, across the site during both phases of the Project for operation & maintenance (O&M) services. As a result, there was a risk that small volumes of chemicals could be spilled on-site. The risk of these spills reaching the environment would be minimal in paved areas.

12.4.2.1.2 Significance (Before Mitigation)

The significance is provided in Table 12.5.

12.4.2.1.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental onshore spills are summarised in Table 12.9.

Table 12.9 Prevention and Mitigation Measures for Leakage and Spill Incidents

Type of Event	Management Control	Responsibility	Timing
Preventative	Implement good site management practices to ensure that the products are properly stored on site and in areas where spills will not easily reach the environment (e.g. in paved areas with secondary containment).	O&M Contractor/ The Project owner	Prior to commissioning
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation

Type of Event	Management Control	Responsibility	Timing
Mitigative	Prepare an Emergency Preparedness and Response Plan to cover accidental and emergency situations. This Plan will detail: ■ Planning coordination: including procedures for informing local communities about emergency response, documentation and first aid / medical treatment ■ Emergency equipment: including equipment in the project design and any additional emergency equipment ■ Training: employees and contractors will be trained in emergency response procedures ■ Auditing: audit records will be maintained on how the Plan is being implemented	O&M Contractor/ The Project owner	Before commissioning and operation
Mitigative	Implement Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation.	The Project owner	During commissioning and operation

12.4.2.1.4 Residual Impacts

Because the majority of the mitigation presented was preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, if the event occurred, the consequence of the hydrocarbon spills could potentially remain the same. In these cases, the mitigation measures described in the previous section would apply to minimise the likelihood of impacts.

		Risk Significance
Without Mitigation Measures	Communities	**3C Moderate**
	Environment	**3C Moderate**
With Mitigation Measures	Communities	**2C Minor**
	Environment	**2C Minor**

12.4.2.2 Fire and Explosion

12.4.2.2.1 Background

Damage of the wind turbine generators (WTGs) and their auxiliary components, transmission line due to lighting strikes, electrical arcs or flashovers and malfunctioned equipment which resulting fires and even explosions as WTGs materials were informatively construed as flammable materials.

Large scale fires, or worst-case explosions, could potentially release smoke and fumes in the broader area generating health issues associated with inhalation of toxic substances and uncontrollable wildfire that would contribute to a loss of crops and habitats and impacts on the economics of the area (e.g. community and workers jobs and incomes).

12.4.2.2.2 Significance (Before Mitigation)

The significance is provided in Table 12.5.

12.4.2.2.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental fire and explosion are summarised in table below.

Table 12.10 Prevention and Mitigation Measures for Fire and Explosion

Type of Event	Management Control	Responsibility	Timing
Preventative	Implement the recommendations of the QRA process into the planned management measures.	O&M Contractor/ The Project owner	During commissioning and operation
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Preventative	Implement routine inspection and maintenance procedures (in line with international best practice) for any Unplanned Eventous substances' storage vessels and WTGs.	O&M Contractor/ The Project owner	During commissioning and operation
Preventative	Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed.	The Project owner	Prior commissioning
Mitigative	Implement Emergency Preparedness and Response Plan with forest fire protection and monitor contractors to ensure consistent implementation Provide regularly safety and fire prevention & fighting drills.	The Project owner	During commissioning and operation

12.4.2.2.4 Residual Impact

Because the majority of the mitigation presented was preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, given the likelihood of the event is well-known in the industry and have been occurring sporadically, hence, the possibility of such incident still remains the same. In these cases, the mitigation measures described in the previous section would potentially apply to minimise the severity on communities and surrounding environment.

		Risk Significance
Without Mitigation Measures	Communities	**2E Major**
	Environment	**2D Moderate**
With Mitigation Measures	Communities	**2D Moderate**
	Environment	**2C Minor**

12.4.2.3 Blade Ejection Failure

12.4.2.3.1 Background

A failure of the rotor blade could result in the "throwing" of a rotor blade, which might affect public safety. Assessment of reports and case studies in the open domain had revealed an increasing trend to determine the distance at which a rotor bade could be thrown. Therefore, it became strictly necessary to define setback distances and/or buffer zones to minimise the risk of damage or injury from components failure.

12.4.2.3.1.1 National and International Existing Standards

Blade throw/ ejection incidents have been classified as the following modelling studies conducted by various research groups and blade test practices based on the IEC 61400-23 technical specifications.

They have been classified as (a) root connection failure; (b) catastrophic structural buckling or separation; (c) leading edge, trailing edge, or other bond separation; (d) lightening damage; (e) erosion; (f) failure at outboard aerodynamic device; (g) reduction in stiffness of blades (up to 10%); (h) superficial structural or delamination/ laminate wrinkling that eventually becomes permanent, leading to damage; and (h) over speeding due to failure of supervisory control and data acquisition (SCADA) to rectify the failure or high wind/ cyclonic/ meteorological conditions[66].

Considering all the above, it is difficult to attribute blade throw failure to a single attribute or a combination of attributes that result in these incidents occurring. Therefore, national regulations or recommendations are in place in some countries to define setback distances and/or buffer zones surrounding WTGs to minimise the risk of damage or injury from component failure.

In the current Vietnamese context, there exist no regulations regarding setback distances required to ensure safety of nearby settlements. However, the IFC EHS Guidelines on Wind Energy, 2015 has recommended a setback distance, based on a review of existing literature in this domain, (encompassing the rationale that WTG models have varying dimensions) which is 1.5 x turbine height (tower + rotor radius), although modelling suggests that the theoretical blade throw distance can vary with the size, shape, weight, and speed of the blades, and the height of the turbine. It is therefore recommended that the minimum setback distances required to meet noise and shadow flicker limits be maintained with respect to sensitive residential receptors to provide further protection.

12.4.2.3.1.2 Qualitative Blade Failure Assessment

The qualitative blade failure (BF) assessment encompassed the rationale that had been proposed by the IFC pertaining to setback distances which is 1.5 x turbine height (tower + rotor radius).

The project comprises 21 wind turbines. The blade throw/blade ejection (BT/BE) assessment was carried out considering the wind turbine specifications as proposed to be used in this Project. Wind turbines considered in BT/BE assessment are ENERCON.

The theoretical setback distances of the WTGs as per IFC wind guidelines have been presented Chapter 2. This information was used to independently assess the setback distances of the receptors that were identified using the latest satellite imagery of the Project area.

12.4.2.3.2 Significance (Before Mitigation)

The significance is provided in Table 12.5.

12.4.2.3.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental blade throw are summarised in table below.

Table 12.11 Prevention and Mitigation Measures for Blade Ejection Failure

Type of Event	Management Control	Responsibility	Timing
Preventative	Establish safety zone at least 270 m away from the WTGs with fences if possible. It was recommended that the minimum setback distances required to meet noise and shadow flicker limits be maintained with respect to sensitive residential receptors to provide further protection.	The Project owner	Prior commissioning
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation

[66] Robinson et al. study and development of a methodology for the estimation of the risk and harm to persons from wind turbines. 2013. Prepared by MMI Engineering Ltd for the Health and Safety Executive 2013

Type of Event	Management Control	Responsibility	Timing
Preventative	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	O&M Contractor/ The Project owner	During commissioning and operation
Preventative	Install warning system, signal boards, lighting prevention system around the 270 m radius of danger zone where the WTGs located. Equipped vibration sensors for the warning of any imbalances in rotor blades.	The Project owner	Prior commissioning
Mitigative	Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor/ The Project owner	Prior commissioning
	Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor	During commissioning and operation

12.4.2.3.4 Residual Impact

Because the majority of the mitigation presented as preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, if the event occurred, the consequence of the blade throw accidents could potentially remain as severe. In these cases, the mitigation measures described in the previous section would apply to minimise impacts on the likelihood of the events.

		Risk Significance
Without Mitigation Measures	Communities	**3E Major**
	Environment	**3C Moderate**
With Mitigation Measures	Communities	**2E Major**
	Environment	**2C Minor**

12.4.2.4 Transmission Line Snapping and Transmission Pylon Collapse

12.4.2.4.1 Background

During operation, there was a possibility of lines or transmission towers/parts snapping/swaying due to the tower failing and resulting in injuries and/or fatalities. Additionally, any contacts (both intentional and unintentional) with the exposing snapped transmission line can result in electrocution.

The risk was mainly influenced by poor foundation quality, tower member theft, material corrosion due to poor coating and poor quality or damaged fittings exposing the system to failure. The receptor sensitivity was considered high as there were households and livelihood activities within the transmission line RoWs in the Project area. Impacts on community health and wellbeing could lead in injuries and fatalities.

In the rural areas, due to the fact that the transmission line routing was mostly designed far from the existing communities the receptor sensitivity is considered low but with medium significance.

12.4.2.4.2 Significance (Before Mitigation)

The significance is provided in Table 12.5.

12.4.2.4.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental transmission line snapping and transmission pylon collapse are summarised in table below.

Table 12.12 Prevention and Mitigation Measures for Collapse

Type of Event	Management Control	Responsibility	Timing
Preventative	Establish a good practice and should comply with electricity safety related regulation or international standard, whichever, more stringent, in the design and installation of transmission line and transmission pylons.	The Project owner	Prior commissioning
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Preventative	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	O&M Contractor/ The Project owner	During commissioning and operation
Preventative	Install warning system, signal boards, lighting prevention system, anti-climbing devices on the tower.	The Project owner	Prior commissioning
Mitigative	Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor/ The Project owner	Prior commissioning
	Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor	During commissioning and operation

12.4.2.4.4 Residual Impacts

Because the majority of the mitigation presented as preventative, the primary goal of these measures was to reduce the likelihood of the unplanned event from occurring. However, if the event occurred, the consequence of the transmission line snapping and transmission pylon collapse events could potentially remain as severe. In these cases, the mitigation measures described in the previous section would apply to minimise impacts in regard to the event's likelihood.

		Risk Significance
Without Mitigation Measures	Communities	**3E Major**
With Mitigation Measures	Communities	**2E Major**

12.4.2.5 Natural Hazards (Flood and Landslide)

12.4.2.5.1 Background

The Project site is located within the area that is prone to storms which usually occur in September and October. The monthly rainfall in Khe Sanh Town and in the Project area can reach maximum rainfall of 430 mm in October. For storms which affect the Province's mainland usually last between 8 and 10 hours but their accompanied rains usually last up to 3 days[67].

Storms with strong wind intensity accompanied by heavy rains could cause flash floods, affecting agricultural production and people's safety in the area. The proposed wind farm is situated in low-hilly areas with an elevation from 450 - 520 m, which are sloping from southwest to northeast.

[67] Source: Feasibility Study Report, 2019.

The likelihood for the development to increase the flood risk is considered to be Likely.

12.4.2.5.2 Significance (Before Mitigation)

The significance is provided in Table 12.5.

12.4.2.5.3 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental flood events are summarised in table below.

Table 12.13 Prevention and Mitigation Measures for Natural Hazard

Type of Event	Management Control	Responsibility	Timing
Preventative	Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.	The Project owner	Prior commissioning
Preventative	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Preventative	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	O&M Contractor/ The Project owner	During commissioning and operation
Preventative	Install warning system, signal boards, flood prevention systems.	The Project owner	Prior commissioning
Preventative	Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	The Project owner	Prior commissioning
Mitigative	Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor/ The Project owner	During commissioning and operation

12.4.2.5.4 Residual impacts

It is noted that the likelihood of occurrence of natural hazards (Flood and Landslide) will not be increased by the Project. The Project should ensure however, that the introduction of hard surface areas does not increase the potential for flash flood etc. where possible. The Project could also provide mitigatitive measures to minimise impacts and damage caused by Flood and Landslide.

		Risk Significance
Without Mitigation Measures	Communities	**4D Major**
With Mitigation Measures	Communities	**3D Major**

13. RAPID CUMULATIVE IMPACT ASSESSMENT

13.1 Introduction

While the impacts of an individual project may be judged to be acceptable, there is also a need to consider the potential project's impacts to interact with impact associated with other developments – so called "cumulative" impacts.

The IFC Performance Standard (PS) 1 defines cumulative impacts as: "Impacts that result from incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted. Cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities".

IFC PS 1 requires that an environmental assessment should also address cumulative impacts. The objective of the Cumulative Impact Assessment (CIA) is to identify those environmental, social or health aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future Project activities or other projects/activities may result in a larger and more significant impact.

In order to gain an understanding of the Project's overall contribution to impacts within Huong Linh Commune and other communes in Huong Hoa District, a cumulative impact assessment (CIA) is required to be undertaken. Whilst total cumulative impacts due to multiple projects within a given area should be identified within government led spatial planning efforts (generally as part of a Strategic Environmental Assessment), the Project owner needs to determine the degree to which it is contributing to these overall cumulative impacts on Valued Environmental and Social Components (VEC). In this regards, the objectives of the CIA are:

- Use the outcomes of the preceding chapters of this ESIA to determine spatial and temporal boundaries, identify VEC's and all development and external natural and social stressors affecting them;
- Recognise and identify how the Project, along with other existing and future projects may contribute to cumulative impacts on the predicted future condition of the identified VEC's; and
- Develop measures to ensure these are avoided and/or minimised to the greatest extent if possible.

To achieve these objectives and gain an understanding of the complexities of cumulative impacts, this chapter presents a Rapid Cumulative Impact Assessment (RCIA), which has been undertaken largely in accordance with the IFC's Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for Private Sector in Emerging Markets (the "IFC Handbook").

13.2 Methodology

The IFC's "Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets" proposes as a useful preliminary approach to conduct a Rapid Cumulative Impact Assessment (RCIA). The RCIA provides a desk that, review in consultation with the affected communities and other stakeholders, enable the developer to determine whether its activities are likely to significantly affect the viability or sustainability of selected Valued Environmental and and Social Components (VECs).

The Figure 13.1 illustrates the RCIA logical framework, which is an iterative six-step process: scoping (step 1 and step 2), VECs baseline determination (step 3), assessment of the contribution of the development under valuation to the predicted cumulative impacts (step 4), evaluation of significance of predicted cumulative impacts to the viability or sustainability of the effected VECs (step 5), and design implementation of mitigation measures to manage the development's contribution to the cumulative impacts and risks (step 6).

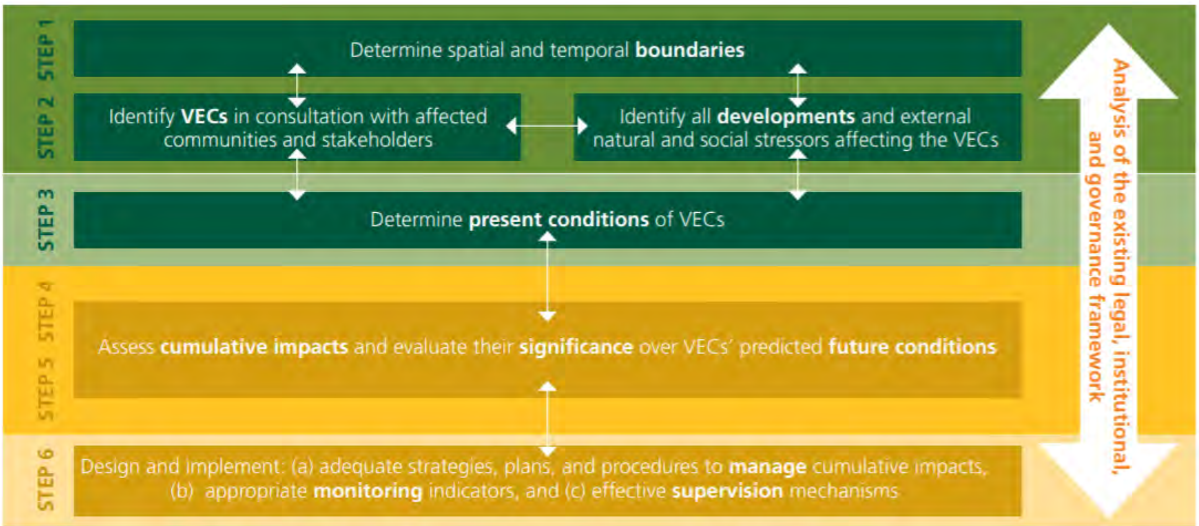


Figure 13.1 Rapid Cumulative Impact Assessment Six-Step Approach

13.2.1 Scoping Phase I – VECs, Spatial and Temporal Boundaries

Step 1 of the CIA involves identifying VECs and determining the spatial and temporal boundaries of the CIA. Based on the Handbook, the key objectives of this step include:

- Identify and agree on VECs in consultation with stakeholders;
- Determine the time frame for the analysis; and
- Establish the geographic scope of the analysis.

13.2.2 Scoping Phase II – Other Activities and Environmental Drives

Based on the Handbook, the key objectives of this step include:

- Identify other past, existing, or planned activities within the analytical boundaries; and
- Assess the potential presence of natural and social external influences and stressors (e.g., droughts, other extreme climatic events).

13.2.3 Establish Information on Baseline Status of VECs

The key objectives include:

- Define the existing condition of VECs;
- Understand its potential reaction to stress, its resilience, and its recovery time; and
- Assess trends.

13.2.4 Assess Cumulative Impacts on VECs

The key objectives include:

- Identify potential environmental and social impacts and risks;
- Assess expected impacts as the potential change in condition of the VECs (i.e., viability, sustainability); and
- Identify any potential additive, countervailing, masking, and/or synergistic effects

13.2.5 Assess Significance of Predicted Cumulative Impacts

Based on the Handbook, the key objectives of this step include:

- Define appropriate “thresholds” and indicators;
- Determine impact and risk magnitude and significance in the context of past, present, and future actions; and
- Identify trade-offs.

13.2.6 Management of Cumulative Impacts – Design and Implementation

Based on the Handbook, the key objectives of this step include:

- Use the mitigation hierarchy;
- Design management strategies to address significant cumulative impacts on selected VECs;
- Engage other parties needed for effective collaboration or coordination;
- Propose mitigation and monitoring programs; and
- Manage uncertainties with informed adaptive management.

13.3 Scoping Assessment

13.3.1 Identification of VECs

The ESIA has identified the existing conditions of a range of Sensitive Receptors, defined as VECs for the purposes of this RCIA, including:

- Noise receptors in close proximity to the Project site;
- The inhabitants of Huong Linh Commune of Huong Hoa District which occur within the projects AoI; and
- Biodiversity values and particularly bird and bats which are at risk from blade strike, and to a lesser extent habitat loss.

13.3.2 Identification of Relevant Development, External Natural and Social Stressors

According to Decision No. 6185/QD-BCT dated 19th June 2015 by the Ministry of Industry and Trade on the approval of master plan of windfarm projects in Quang Tri Province until 2020, with a vision to 2030, the Province was approved for wind power development within three areas, including

- Zone 1: including Huong Son, Huong Lap, Huong Phung Communes, Huong Hoa District with total area of 2,789 hectares.
- Zone 2: including Huong Linh, Huong Lap, Huong Hiep Communes, Huong Hoa District with total area of 2,882 hectares.
- Zone 3: including Gio Viet, Gio Hai, Gio Thanh Communes (Gio Linh District), Vinh Tan Commune and coastal area in Vinh Linh Distirct and Con Co District with total area of 1,036 hectares.
- Table 13.1 summarizes existing and proposed windfarm projects in proximity to the Project.

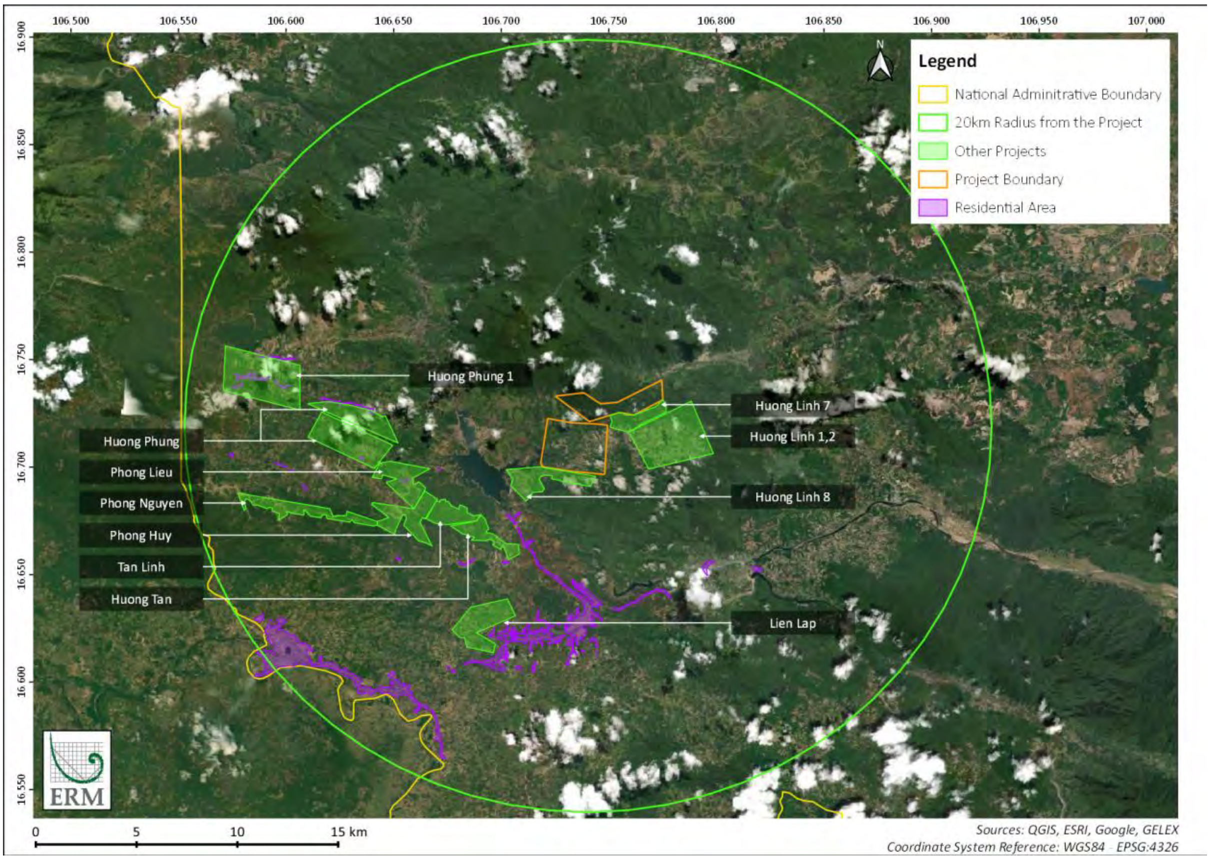


Figure 13.2 Existing and Planned Wind Power Developments in the immediate region

Table 13.1 Key Developers in the Immediate Region

No.	Project	Location	Capacity (MW)	Land Area (ha)	Development Status at the time of CIA	Tentative schedule for operation	Distance to the Project Components		
							Turbines (km)	Sub-station (km)	T-line (km)
	Key developments								
1	Huong Linh 1 & 2 Wind farm	Onshore wind farm in Huong Linh Commune	60 MW	8	Operation	-	1.4	2.7	1.3
2	Huong Linh 3 & 4 Wind farm	Onshore wind farm in Huong Linh Commune	60 MW	-	Construction	-	-	-	-
3	Huong Linh 7 Wind farm	Onshore wind farm in Huong Linh Commune			Planning	-	0.5	2	0.4
4	Huong Linh 8 Wind farm	Onshore wind farm in Huong Linh Commune			Planning	-	0.06	1.3	0.06
5	Huong Phung 1 Wind farm	Onshore wind farm in Huong Phung Commune	30 MW	30	Construction	Quarter IV 2021	12.3	13.8	12.4
6	Huong Phung 2 & 3 Wind farm	Onshore wind farm in Huong Phung Commune	50.4 MW	-	Construction	Quarter IV 2021	7.3	8.8	7.4
7	Huong Hiep Wind farm 1	Onshore wind farm in Huong Hiep Commune	30 MW	-	Construction	-	-	-	-
8	Lien Lap Wind farm	Onshore wind farm in Tan Lien Commune	48 MW	-	Construction	-	7.1	8.5	7.1
9	Tan Linh Wind farm	Onshore wind farm in Huong Linh and Huong Tan Commune	46.2	30.5	Construction	Quarter IV 2021	4.1	5.8	4.1

No.	Project	Location	Capacity (MW)	Land Area (ha)	Development Status at the time of CIA	Tentative schedule for operation	Distance to the Project Components		
							Turbines (km)	Sub-station (km)	T-line (km)
10	Huong Tan Wind farm	Onshore wind farm in Huong Tan Commune	46.2	31.2	Construction	Quarter IV 2021	4.1	5.8	4.1
11	Phong Lieu Wind farm	Onshore wind farm in Huong Phung and Huong Linh Commune	48 MW	16.51	Planning	2021	5.8	7.3	5.7
12	Phong Huy Wind farm	Onshore wind farm at Tan Lap and Tan Lien wind farm	50.4 MW	25.52	Construction	Quarter IV 2021	5.7	7.3	5.7
13	Phong Nguyen Wind farm	Onshore wind farm at Huong Phung and Tan Thanh Commune	50.4 MW	25.62	Construction	Quarter IV 2021	8.9	10.5	8.9

13.3.3 Summary of Trends, VECs and Scope Refinement

A cumulative screening assessment has been carried out to consider the interactions of impacts from various key developers on the relevant VECs, including:

- Bird and bat strike and habitat loss;
- Economy and employment;
- Community health and safety;
- Infrastructure and public services;
- Traffic; and
- Visual amenity.

Cumulative impacts that are not contributed significantly from the Project were scoped-out. Table 13.2 presents the outcomes of scoping, based upon identified VECs, assessed Project impacts, the identified external projects, and the summary of trends.

Table 13.2 Scoping Matrix

Impact Type	VEC's Likely to be Impacted	Existing Assessment in ESIA	RCIA Scope
Noise	Local communities in Huong Linh commune and other nearby communes in Huong Hoa District	Section 10 provides an assessment of noise impacts for the Project. Based on the assessed compliance of the individual operation of the Project and the cumulative operation of the nearby windfarms, predicted cumulative noise levels from these windfarms are below the compliance limits and therefore, achieves compliance at all receptors.	No further CIA is proposed.
Bird and bat strike and habitat loss.	Species of conservation significance known to habitat the local area (Chapter 10)	A detailed assessment of biodiversity impacts is provided in Section 10 and identifies impacts associated with the Huong Linh Wind Farms' development only.	Cumulative assessment to be conducted using the findings from the assessment for the Project as guidance on the extent and likely significance of impacts.
Visual Impacts	Local communities living in Huong Hoa District	A visual assessment is provided at Section 10 which indicated that the impact of the Project on visual aesthetics is assessed as Minor. Furthermore, despite the fact that the closest wind farm is located about less than one kilometre away from the Project, impacts on visual aesthetics from these projects are not considered cumulatively due to a small number of visitors with interest in their surroundings as well as viewers with a passing interest not specifically focussed on the landscape e.g. workers, commuters.	No further CIA is proposed.
Shadow Flickering Impacts	Local communities living in Huong Linh Commune.	Given that the AoI of shadow flickering issues is only within 10 times WTG's rotor diameter, residents who live in Huong Linh Commune are likely to experience shadow flickering periods during the day and throughout the year. As such, Huong Linh and adjacent windfarms (in this case Huong Linh 1 and 2)[68] can	Cumulative assessment to be conducted using the findings from the assessment for the Project as guidance on the extent and likely significance of impacts.

[68] Given Huong Linh 7 and Huong Linh 8 are under planning process, there are yet information regarding their turbine layout. Hence, Huong Linh 7 and Huong Linh 8 have been scoped out of this assessment.

Impact Type	VEC's Likely to be Impacted	Existing Assessment in ESIA	RCIA Scope
		potentially increase the cumulative experience of shadow flickering issue on such residents.	
Waste	No VEC's are likely to be impacted by waste.	Waste is not considered for the CIA as the ESMP has proposed appropriate management and mitigation measures. It is expected that any future developments will comply with Vietnamese waste storage and management regulations (as a minimum).	No further assessment required
Socio-Economic: Community Health and Safety	The VECs likely to be impacted are those people residing in Huong Hoa District.	Section 11 presents a detailed assessment of impacts relating to community health and safety during Construction and Operation Phases.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VECs, and develop appropriate mitigation strategies.
Socio-Economic: Economy and Employment	The VECs likely to be impacted are those people residing in Huong Hoa District.	Social impacts of the Project, including impacts to employment and economy during both the Construction and Operation Phases, were assessed as part of Section 11.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VECs, and develop appropriate mitigation strategies to ensure that positive impacts are maximised.
Socio-Economic: Traffic	The VECs likely to be impacted are those people residing in Huong Hoa District.	Section 11 presents a detailed assessment of impacts relating to traffic during Construction phase.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VECs, and develop appropriate mitigation strategies.
Socio-Economic: Infrastructure and Public Services	The VECs likely to be impacted are those people residing in Huong Hoa District.	Section 11 presents a detailed assessment of impacts relating to infrastructure and public services during Construction phase.	A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VECs, and develop appropriate mitigation strategies.

13.4 Cumulative Noise from Existing Wind Farms Nearby

13.4.1 THC Huong Linh 1,2

Noise has been predicted at NSRs associated with the Project but also considering noise from the THC Huong Linh 1,2 windfarm. Initial modelling suggests a noise level from the THC Huong Linh 1,2 wind farm of greater than the IFC General EHS 45 dB L_{eq} night-time guidelines at the nearest NSR. A noise contribution (from THC Huong Linh 1,2 wind farm) of up to 55 dB L_{eq} is predicted at the closest Project NSR, where a predicted noise level from the Project at this location is 35 dB L_{eq}. The additional noise contribution exceeds the predicted Project noise level at this location by approximately 20 dB addition, resulting in a cumulative noise level of 55 dB L_{eq} from both wind farms.

Given the THC Huong Linh 1,2 wind farm is already operating, and the Project does not add to the existing noise at this location significantly, it is unlikely that the Project would change the existing noise environment at this location. However, noise levels from the Project increase predicted levels to greater than 45 dB L_{eq} where predicted levels from THC Huong Linh 1,2 wind farm are marginally less than 45 dB L_{eq} at Project NSRs east of the Project WTGs, and west of the THC Huong Linh 1,2 WTGs (i.e. between the sites). Noise from wind farms at these NSRs has been predicted using worst case downwind propagation assumptions from all wind farms. However, given the layout of the Project and the neighbouring wind farm and the fact that wind can only blow in one direction, the NSRs cannot be downwind from both wind farms at the same time. Therefore, predicted cumulative noise levels of this magnitude are unlikely to be realistic. For that reason, noise from the THC Huong Linh 1,2 wind farm is not likely to be sufficiently high to result in cumulative noise levels that exceeding the IFC General EHS Guidelines of 45 dB L_{eq} at the receptors between the wind farms.

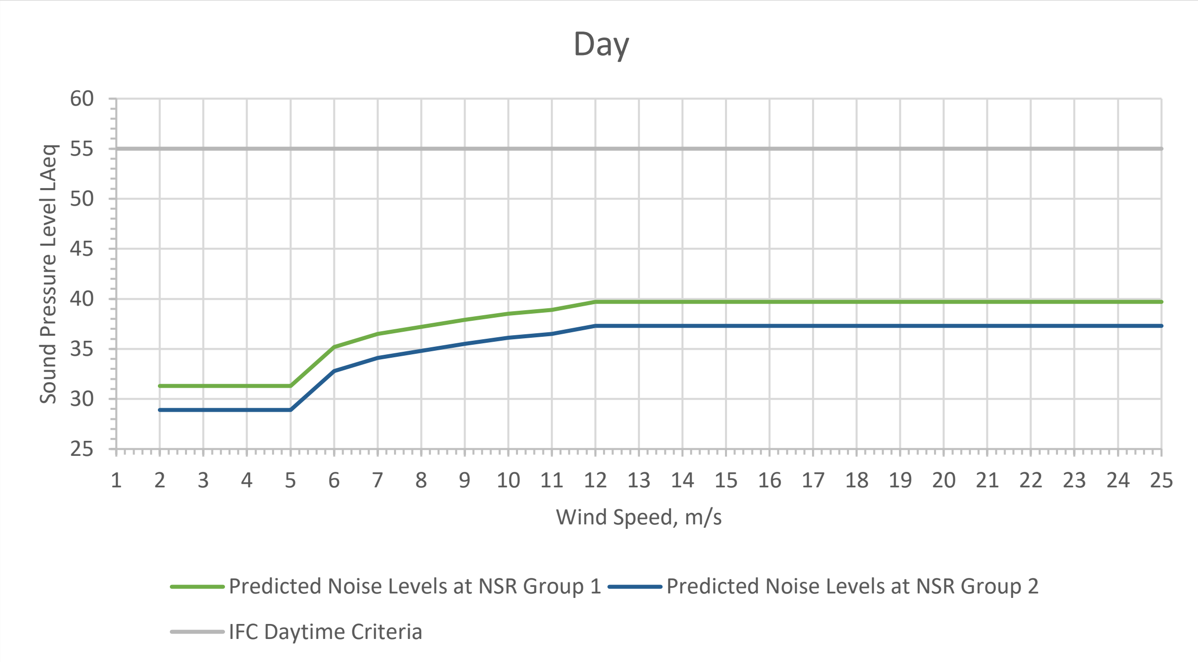
Since these results are based on predicted noise levels, it is recommended that monitoring of the existing operating wind farm should be undertaken at the most affected receptors to confirm predicted noise levels to avoid potential cumulative noise impacts.

13.4.2 Huong Tan and Tan Linh

Noise has been predicted at NSRs associated with the Project but also considering noise from the Huong Tan and Tan Linh Wind Power Project. Initial modelling suggests a noise level from the Huong Tan and Tan Linh wind farm of less than 45 dB L_{eq} at the nearest NSR. However, a noise contribution (from Huong Tan and Tan Linh wind farm) of up to 40 dB L_{eq} is predicted at the closest NSR to the GELEX Huong Linh wind farm, where a predicted noise level from the Project at this location is 34 dB L_{eq}. The additional noise contribution increases the predicted noise level at this location by approximately 7 dB addition, to 41 dB L_{eq} when considering all wind farms operating cumulatively. For that reason, noise from the Huong Tan and Tan Linh wind farm will not be sufficiently high to result in cumulative noise levels exceeding the IFC General EHS Guidelines of 45 dB L_{eq}. Furthermore, given the locality of the turbines from the Project and Huong Tan and Tan Linh wind farm, and the Project NSRs, the predicted noise levels of this magnitude are unlikely to be realistic as the wind cannot be blowing downwind towards the most affected receptors closest to the Huong Tan and Tan Linh wind farm at the same time because they are in-between Huong Tan and Tan Linh and the Project. As a result of this, it can be concluded that the Huong Tan and Tan Linh wind farm does not have potential to give rise to significant adverse cumulative impacts.

13.4.3 Huong Linh 7 & 8

As the Huong Linh 7,8 wind farm is still in planning, and specific turbine layouts have not yet been finalised, initial modelling of the wind farm could not be undertaken. However, in most cases, the noise level will be dominated by the nearest WTG and this will be either from the Huong Linh 7,8 site or the Project site, in which case significant cumulative impacts will not occur. If a receptor is separated equally from both WTG sites, the cumulative effect could be an increase of up to approximately 3 dB. This is generally considered to be the smallest noise change which is noticeable under general listening conditions and is not likely to be significant. It is noted that the Huong Linh 7,8 project, and the turbine layout, in particular, will need to consider the noise levels from the Project site in determining if mitigation is required, and this should take into account the objective of avoiding cumulative noise increases that might result in noise levels above the criteria set out in this report.



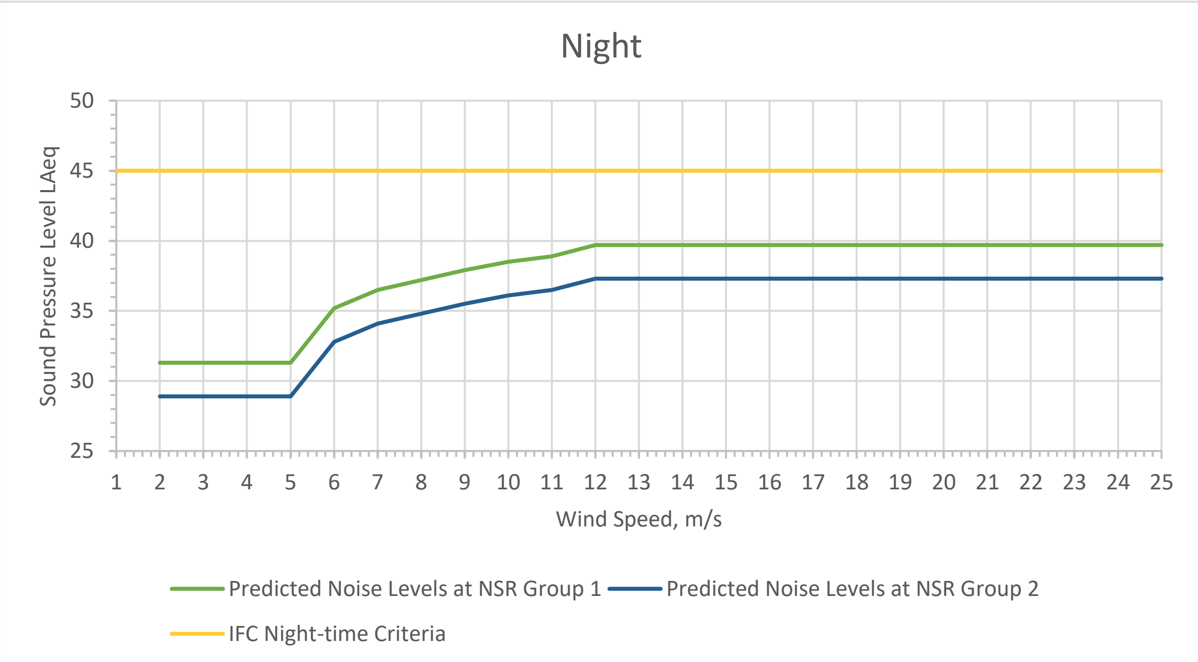


Figure 13.3 Predicted Wind Farm Noise Levels and Noise Assessment Criteria for NSR 1 and NSR 2 (which refer to IFC General EHS Guidelines)

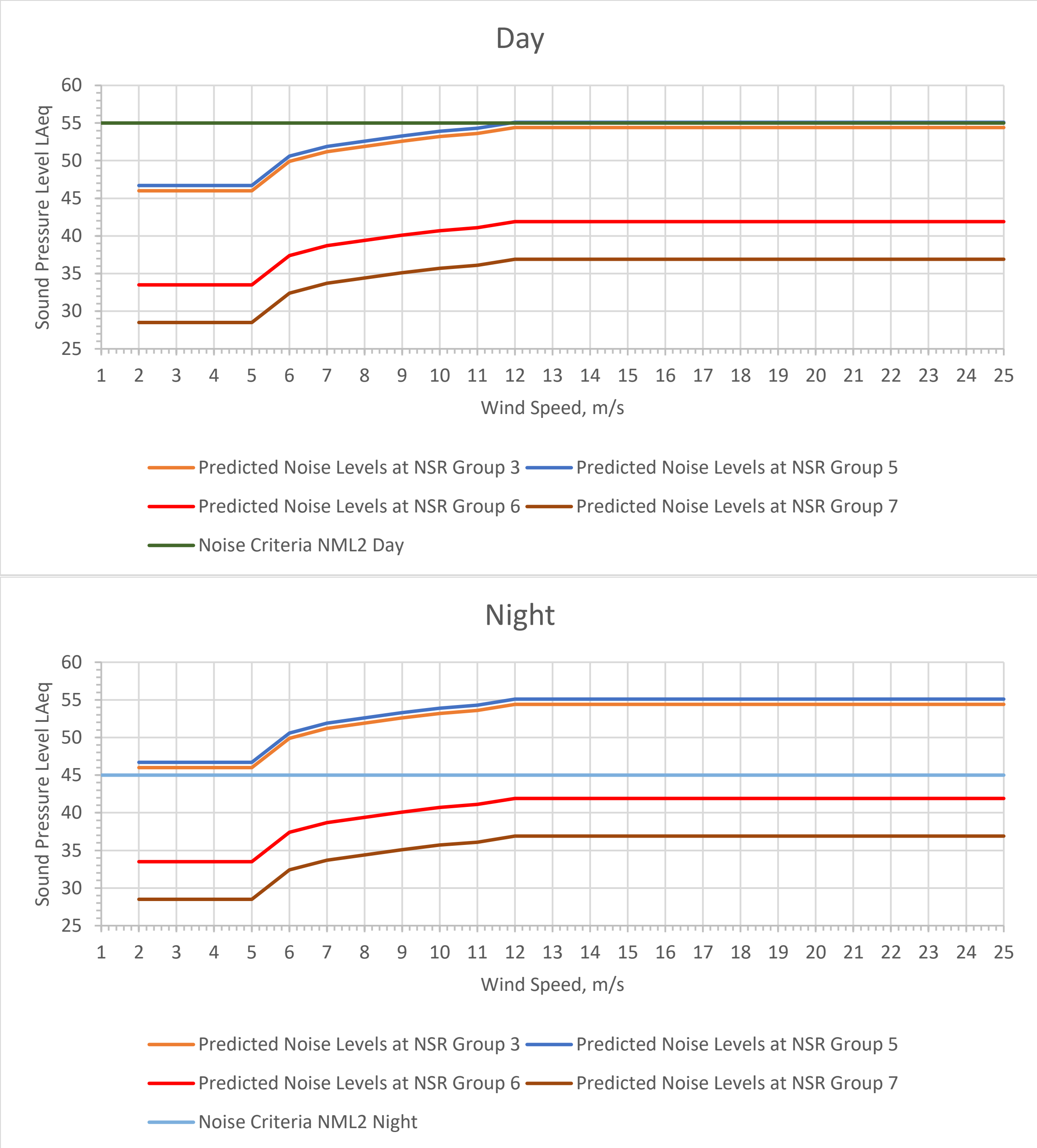


Figure 13.4 Predicted Wind Farm Noise Levels and Noise Assessment Criteria for NSR 3, NSR 5, NSR6, and NSR 7 (which refer to Baseline Location NML2)

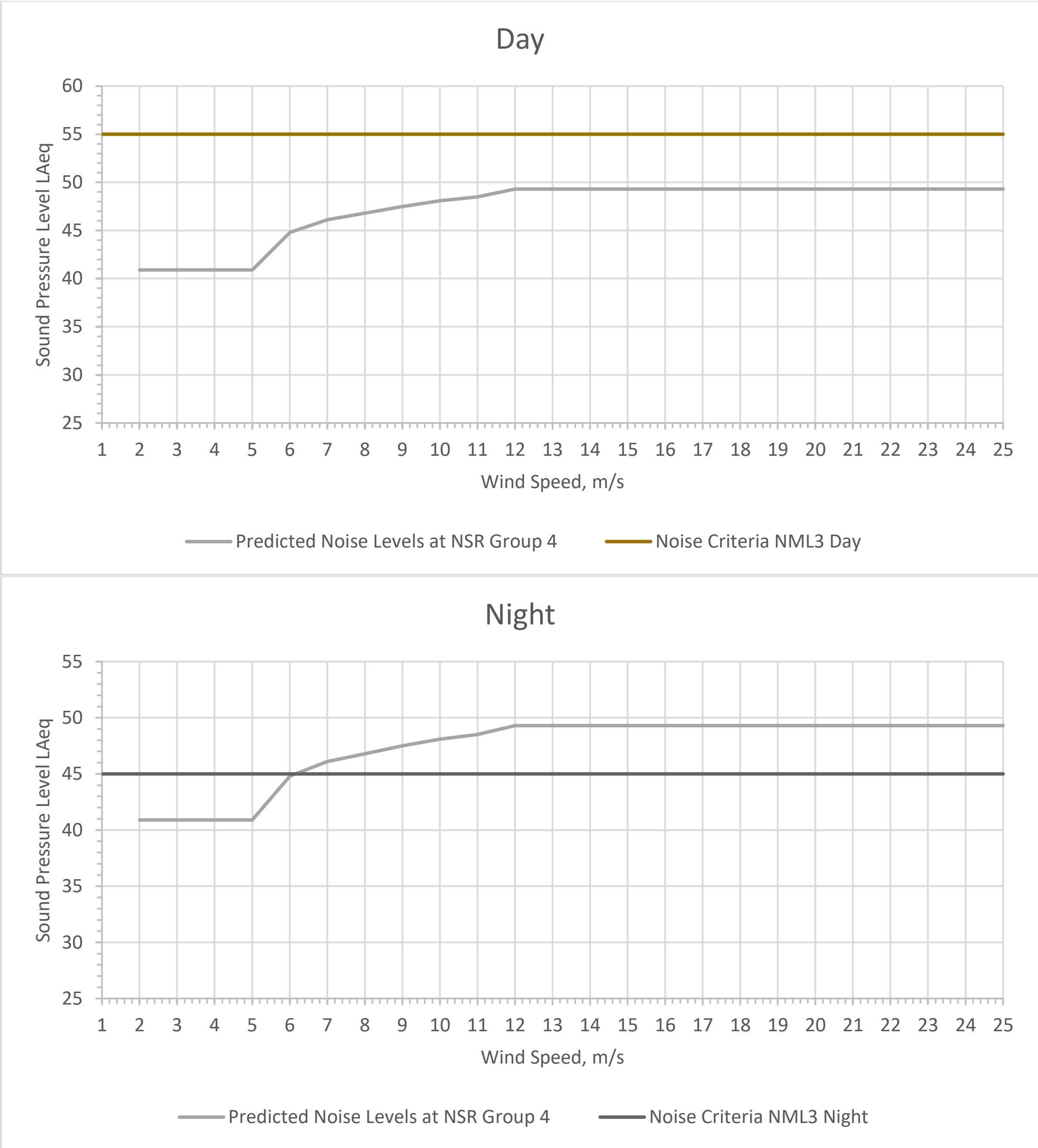


Figure 13.5 Predicted Wind Farm Noise Levels and Noise Assessment Criteria for NSR 4 (which refers to Baseline Location NML3)

Table 13.3 Predicted Operational Noise Levels Impacts at NSRs (LAeq) Night-time

Wind Speed at Hub Height (m/s)	Predicted Noise Level at NSR 1 above Assessment Criteria	Predicted Noise Level at NSR 2 above Assessment Criteria	Predicted Noise Level at NSR 3 above Assessment Criteria	Predicted Noise Level at NSR 4 above Assessment Criteria	Predicted Noise Level at NSR 5 above Assessment Criteria	Predicted Noise Level at NSR 6 above Assessment Criteria	Predicted Noise Level at NSR 7 above Assessment Criteria
2	-	-	1	-	2	-	-
3	-	-	1	-	2	-	-
4	-	-	1	-	2	-	-
5	-	-	1	-	2	-	-
6	-	-	5	-	6	-	-
7	-	-	6	1	7	-	-
8	-	-	7	2	8	-	-
9	-	-	8	3	8	-	-
10	-	-	8	3	9	-	-
11	-	-	9	4	9	-	-
12	-	-	9	4	10	-	-
13	-	-	9	4	10	-	-
14	-	-	9	4	10	-	-
15	-	-	9	4	10	-	-
16	-	-	9	4	10	-	-
17	-	-	9	4	10	-	-
18	-	-	9	4	10	-	-
19	-	-	9	4	10	-	-
20	-	-	9	4	10	-	-
21	-	-	9	4	10	-	-
22	-	-	9	4	10	-	-
23	-	-	9	4	10	-	-
24	-	-	9	4	10	-	-
25	-	-	9	4	10	-	-

No noise impacts are predicted during the day.

At night, noise impacts are predicted at NSR3, NSR4 and NSR5 with exceedances of up to 9 dB, 4 dB, and 10 dB respectively. These impacts are dependent on wind speed and there are no impacts at wind speeds at or below 6 m/s at NSR4, where there are impacts at all operating wind speeds at NSR2 and NSR5.

Significant adverse cumulative noise impacts have not been identified at six of the eight cumulative wind farms assessed. As a specific turbine layout is yet to be finalised at the Huong Linh 7,8 wind farm, initial modelling has not been possible at this stage. Given the close proximity of the proposed site to the Project's closest NSRs, it is recommended the Client should liaise with, or make the information in this study available to the developer of the Huong Linh 7,8 project, who should consider the noise levels from the Project site with the objective of avoiding cumulative noise increases. It is recommended that monitoring of the THC Huonh Linh 1,2 operating wind farm should be undertaken at the most affected receptors in Huonh Linh to confirm predicted noise levels to avoid potential cumulative noise impacts

13.5 Cumulative Impacts for Bird and Bat Strike and Habitat Loss

The Project could have potential impacts on biodiversity, including habitat loss, mortality or injury as a result of blade strike. The impact assessment indicated that the impact significances on biodiversity range from Negligible to Moderate. Of these, most impacts were considered to be Negligible and Minor, except for the mortality impact on birds which was considered to be Moderate.

The location of the the Project are within close proximity to windfarms currently under construction or sites where windfarm construction will begin in the future. Of concern is the potential for cumulative impacts to biodiversity, as a result of increases in bird flight risk throughout the Rotor Swept Zone of these additional farms. It is anticipated that the potential risk of increased mortality of avifauna is likely.

It is difficult to predict the cumulative impacts of Quang Tri Province's numerous windfarms on bird and bat populations. Species detected in the surveys conducted for this ESIA have been of lower conservation concern (generally of Least Concern or Near Threatened on the IUCN Red List). Cumulative impacts however may result in local reductions in avifauna populations that may cause impacts on ecosystem services provided by these species, such as pollination and pest control. Birds and bats can be key pollinators for flora, including for agriculture, and bats play an important role in reducing insect populations in agricultural areas.

The field survey indicated indicated that the birds that generally flew at the height of 35 m - 150 m (band 2), which coincided with the RSZ, are listed as Least Concern in IUCN Red List. There are four (04) species of Accipitriformes order including Black Eagle *Ictinaetus malaiensis* [IUCN LC], Crested Goshawk *Accipiter trivirgatus* [IUCN LC], Mountain Hawk-eagle *Nisaetus nipalensis* [IUCN LC], Crested Serpent-eagle *Spilornis cheela* [IUCN LC]. In addition, there are four (04) species belong to Passeriformes order, including Kloss's Leaf-warbler *Phylloscopus ogilviegranti* [IUCN LC], Sooty-headed Bulbul *Pycnonotus aurigaster* [IUCN LC], Large-billed Crow *Corvus macrorhynchos* [IUCN LC], Large-billed Crow *Corvus macrorhynchos* [IUCN LC], and one species of Pelecaniformes order Cattle Egret *Bubulcus ibis* [IUCN LC].

Critical Habitat has been triggered for the Project (see Chapter 8 for Critical Habitat Assessment). In addition, it is uncertain if other nearby windfarms currently under construction and the other planned windfarms would trigger Critical Habitat for their operations based on the IFC PS6 Critical Habitat Criterion. It is recommended that at the very least, the mitigation measures (which are finalised with the outcomes of the collision risk modelling) applied to the Project should be applied to all other windfarms within the area.

13.6 Cumulative Impacts on Economy and Employment

In terms of economy and employment, the cumulative impact will be Positive and this positive impact will be assessed at national, provincial and local level through analysing tax revenue, economic development and employment opportunities, respectively. As indicated in Table 13.4, the cumulative impacts will occur during both the Construction and Operation Phases of the Project. Benefits will be visible in the local employment and procurement activities of the Project as well as other local developments, both directly to the projects and indirectly via their subcontractors and suppliers. Based on ERM's experience with wind farm projects, each project requires at least 200 workers for construction and 25 workers for operations. Although not all of these workers will be recruited from the local area, some will be employed from the local communities for unskilled and semi-skilled jobs. Business and service development, including shops, restaurants and hotels, will increase in the area leading to increased incomes and induced employment for local people.

Table 13.4 Cumulative Impact Scoping for Economy and Employment

No.	Projects	Economy and Employment
1	Huong Linh 1 & 2 Wind farm	O
2	Huong Linh 3 & 4 Wind farm	O
3	Huong Linh 7 Wind farm	P
4	Huong Linh 8 Wind farm	P
5	Huong Phung 1 Wind farm	C
6	Huong Phung 2 & 3 Wind farm	C
7	Huong Hiep Wind farm 1	C
8	Lien Lap Wind farm	C
9	Tan Linh Wind farm	C
10	Huong Tan Wind farm	C
11	Phong Lieu Wind farm	P
12	Phong Huy Wind farm	C
13	Phong Nguyen Wind farm	C

P Planning
C Construction phase
O Operation phase
D Decommissioning phase
N Negligible / Managed risk
Large scale negative
Small scale negative
Positive

13.7 Cumulative Impacts on Community Health and Safety

The cumulative impacts on community health and safety are assessed for both labour influx and non-influx related issues during construction and operation of the Project, concurrently with other developments in Quang Tri Province and its surroundings, as shown in Table 13.1. As indicated in the scoping matrix (see Table 13.2), most of the cumulative impacts on community health and safety will be from the Project's construction activities interacting with the construction of the close wind farm projects. Other developments are scoped out for this CIA due to their early stage of development and distance from the Project.

Key cumulative impacts include increased risk of infectious disease, potential for increased crime and cultural impacts such as the erosion of traditional values and changes in social networks due to the influx of migrant workers and non-local people who come to Quang Tri Province. Other impacts caused by the construction and operation activities (non-influx issues) of these developments comprise of noise, dust, waste and traffic safety issues. Based on the assessment of these impacts for the Project, the cumulative impacts on community health and safety will be in the range of Moderate to Major.

In addition to the mitigation measures proposed, the Project owner should adopt a collaborative approach and work with other local projects' owners and the local authorities as part of the Project Stakeholder Engagement Plan. In particular, the Project should implement its ESMP to manage labour influx and environmental issues and to share good practices with other local project owners.

The Project owner also should collect periodic reports from local clinics at commune and district levels to understand the community health and safety status in the area prior to and during Project development. There should be a monitoring mechanism for ESMP implementation to identify its effectiveness and to allocate responsibility to certain developers in the instance where any issue arises. Where necessary, propose and conduct corrective actions in a timely manner.

Table 13.5 Cumulative Impact Scoping for Community Health and Safety

No.	Projects	Community Health and Safety
1	Huong Linh 1 & 2 Wind farm	O
2	Huong Linh 3 & 4 Wind farm	O
3	Huong Linh 7 Wind farm	P
4	Huong Linh 8 Wind farm	P
5	Huong Phung 1 Wind farm	C
6	Huong Phung 2 & 3 Wind farm	C
7	Huong Hiep Wind farm 1	C
8	Lien Lap Wind farm	C
9	Tan Linh Wind farm	C
10	Huong Tan Wind farm	C
11	Phong Lieu Wind farm	P
12	Phong Huy Wind farm	C
13	Phong Nguyen Wind farm	C

P	*Planning*
C	*Construction phase*
O	*Operation phase*
D	*Decommissioning phase*
N	*Negligible / Managed risk*
	Large scale negative
	Small scale negative
	Positive

13.8 Cumulative Impacts on Infrastructure and Public Services

The cumulative impacts on infrastructure and public services include both negative and positive impacts. Negative impacts are mostly associated with the additional strain on local services (roads, health care, electricity), rising prices for commodities, and food. Positive impacts include improvements to infrastructure and public services via the CDP or CSR programs of these developments, such as road upgrades, health facilities and health care service support, and the increase and stabilisation of electricity supply, which become significant during the Operation phase when projects begin generating revenue.

The adverse impact is expected to be Moderate overall, with the construction and operation simultaneously of these developments. The positive impact will be Minor since CDP/CSR programs may not be in place and implemented by all of these projects.

In addition to mitigation measures proposed, the Client should take a collaborative approach to working with local authorities and owners of other developments within Quang Tri Province as part of the Project Stakeholder Engagement Plan. In particular, the Client should implement its ESMP to manage impacts on infrastructure and public services and to share good practices with other development owners. The Client can also cooperate with other developers to develop and implement an infrastructure improvement project via its CDP/CSR program.

There should be a monitoring mechanism for ESMP implementation to identify its effectiveness and to allocate responsibility to certain developers in the instance where any issue arises. Where necessary, propose and conduct corrective actions in a timely manner.

Table 13.6 Cumulative Impact Scoping for Infrastructure and Public Services

No.	Projects	Infrastructure and Public Services	
1	Huong Linh 1 & 2 Wind farm	O	O
2	Huong Linh 3 & 4 Wind farm	O	O
3	Huong Linh 7 Wind farm	P	P
4	Huong Linh 8 Wind farm	P	P
5	Huong Phung 1 Wind farm	C	C
6	Huong Phung 2 & 3 Wind farm	C	C
7	Huong Hiep Wind farm 1	C	C
8	Lien Lap Wind farm	C	C
9	Tan Linh Wind farm	C	C
10	Huong Tan Wind farm	C	C
11	Phong Lieu Wind farm	P	*P*
12	Phong Huy Wind farm	C	*C*
13	Phong Nguyen Wind farm	C	*C*

C Construction phase
O Operation phase
D Decommissioning phase
N Negligible / Managed risk
Large scale negative
Small scale negative
Positive

13.9 Cumulative Impacts on Traffic

Impacts on traffic comprise of potential traffic congestion and increased traffic safety risk in the areas along the transportation routes of projects. The interactions causing these cumulative impacts occur mostly during projects' construction phase; a phase that requires a high frequency and volume of transportation activities and, taking into account the transportation activities of projects which are the neighbouring projects and may commence activities concurrently, the cumulative impacts on traffic could be moderate during operations.

Overall, this cumulative impact is predicted to be Moderate. In addition to the mitigation measures proposed, the Project owner should take a collaborative approach to working with the local authorities and owners of other developments within Quang Tri Province, as part of the Project Stakeholder Engagement Plan.

Table 13.7 Cumulative Impact Scoping for Traffic

No.	Projects	Traffic
1	Huong Linh 1 & 2 Wind farm	O
2	Huong Linh 3 & 4 Wind farm	O
3	Huong Linh 7 Wind farm	P
4	Huong Linh 8 Wind farm	P
5	Huong Phung 1 Wind farm	C
6	Huong Phung 2 & 3 Wind farm	C
7	Huong Hiep Wind farm 1	C
8	Lien Lap Wind farm	C
9	Tan Linh Wind farm	C
10	Huong Tan Wind farm	C
11	Phong Lieu Wind farm	P
12	Phong Huy Wind farm	C
13	Phong Nguyen Wind farm	C

P Planning
C Construction phase
O Operation phase
D Decommissioning phase
N Negligible / Managed risk
Large scale negative
Small scale negative
Positive

13.10 Cumulative Impacts on Shadow Flicker

Shadow flickering impact is assessed only for the Operation Phase, which is when the wind turbine plant will be fully constructed and present in the area. Since all of the aforementioned developments are and will be located within the district area, depending on the perception of receptors (who are local people living in the areas where these developments are or will be situated) the shadow flickering impact will be range from Major to Moderate given these projects locate within residential area of Huong Linh Commune. However, as the Area of Influence will be limited within 10 times of rotor diameter, only Huong Linh 1 and Huong Linh 2 which are under operation and their data is publicly available– the adjacent windfarms to GELEX 1,2,3 project can potentially create a cumulative impact to neighbouring residents of those three windfarms. According to the modelled data for worst-case scenario, there are potentially 135 receptors (Figure 13.6) who will experience the shadow flickering issues from all three wind power projects and exceed the threshold of international standard. The receptors that are experienced shadow flickering has been arranged into three groups:

- Group A (Figure 13.8): These sensitive receptors receive shadow issues mainly from GELEX 1,2,3 windfarm mainly during April to September especially turbine no. GL2.1; GL2.2; GL3.3; GL3.5; GL3.6 and GL3.7. Turbines from Huong Linh 1 windfarm will cast for mostly during January to April of the year whilst turbines from Huong Linh 2 windfarm will cumulative impact during June and July but also spread our the whole year;

- Group B and Group C (Figure 13.9 and Figure 13.10): These clustered receptors only receive shadow issues mainly from GELEX 1,2,3 windfarm and Huong Linh 1 wind project.

Therefore, the impact will be Major for those 135 potential shadow receivers and other nearby residents. Though, it should be noted that the impact can prospectively amplify further if the consideration of turbine positions of other upcoming projects (Huong Linh 7 and Huong Linh 8) are not taken into account.

Figure 13.6 and Figure 13.7 presented the affected receptors of shadow flickering issues by GELEX 1,2,3; Huong Linh 1 and Huong Linh 2 windfarms in hours per year and in minutes per day. Refer to Appendix L for further detailed information regarding the affected duration of which turbines. It is worth to mention that even though the distance of certain turbines of Huong Linh 1 (T01, T02, T03) and Huong Linh 2 (W02, W09, W13) are further from the receptors, these turbines are located at a higher altitude than the receiving area. Hence, there are higher chances for the receptors to be experienced shadow flickering issue which result in the modelling outcomes.

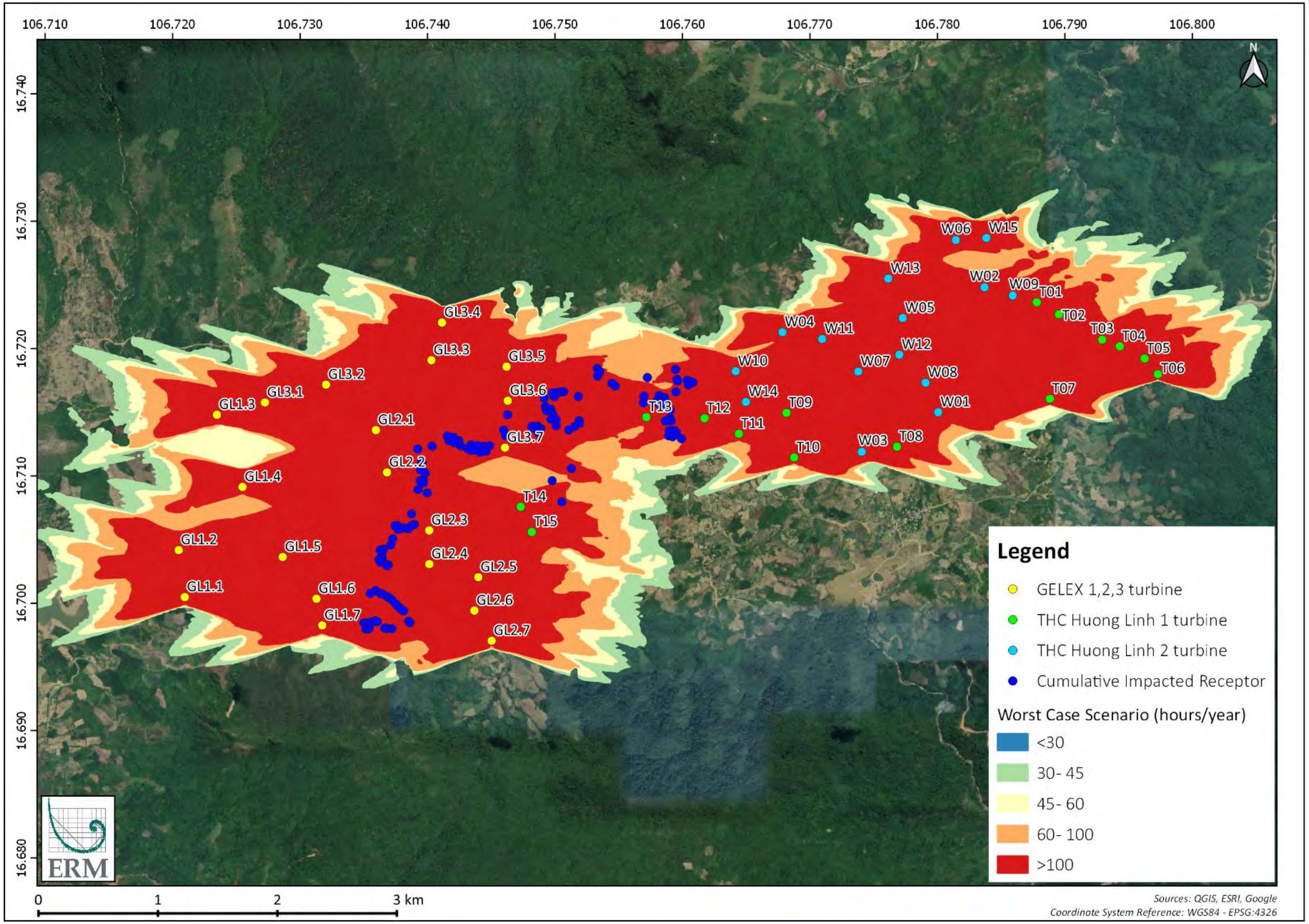


Figure 13.6 Cumulative Impact on Shadow Flicker of nearby Windfarms – hours/year (Worst Case Scenario)

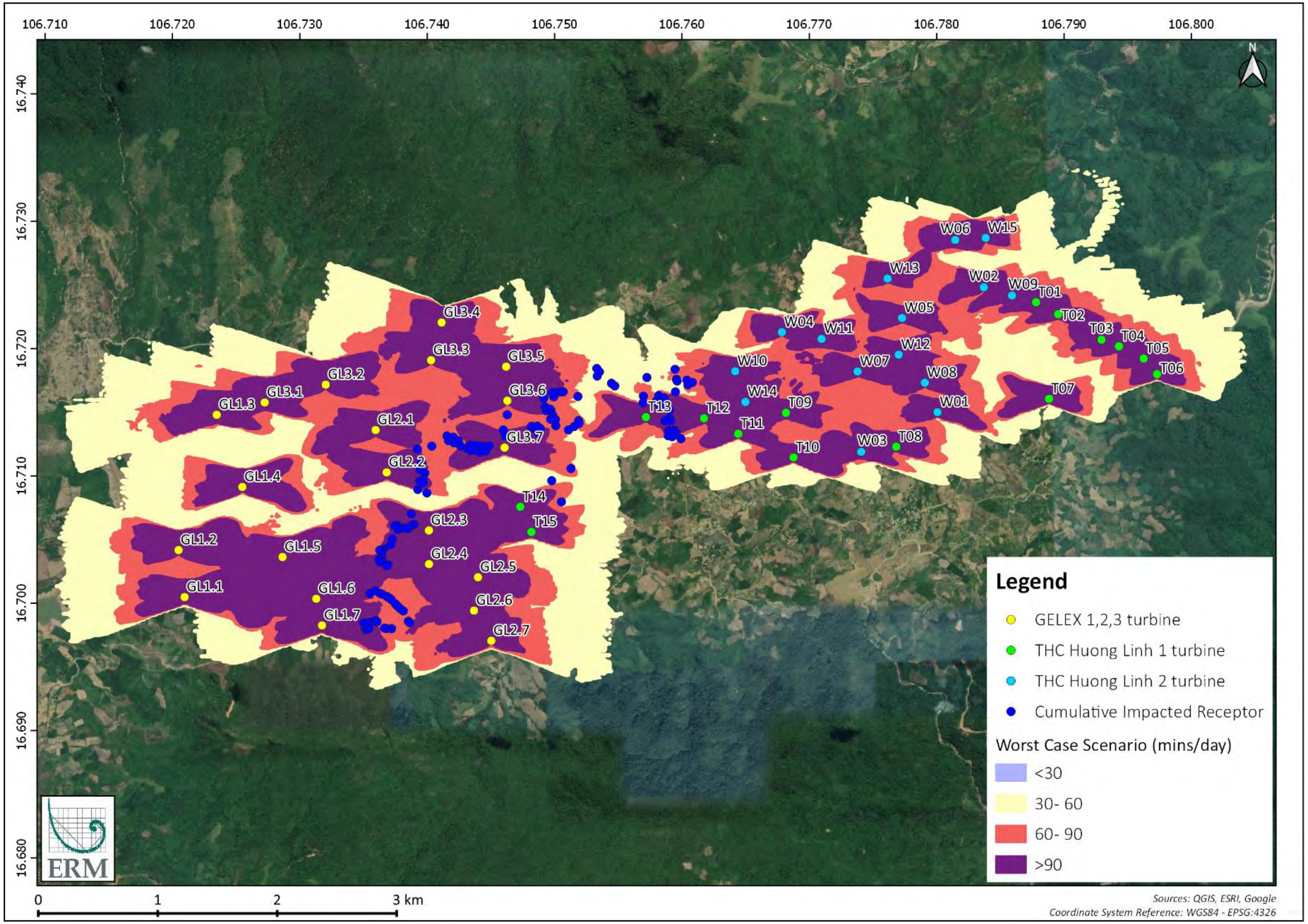


Figure 13.7 Cumulative Impact on Shadow Flicker of nearby Windfarms – minutes/day (Worst Case Scenario)

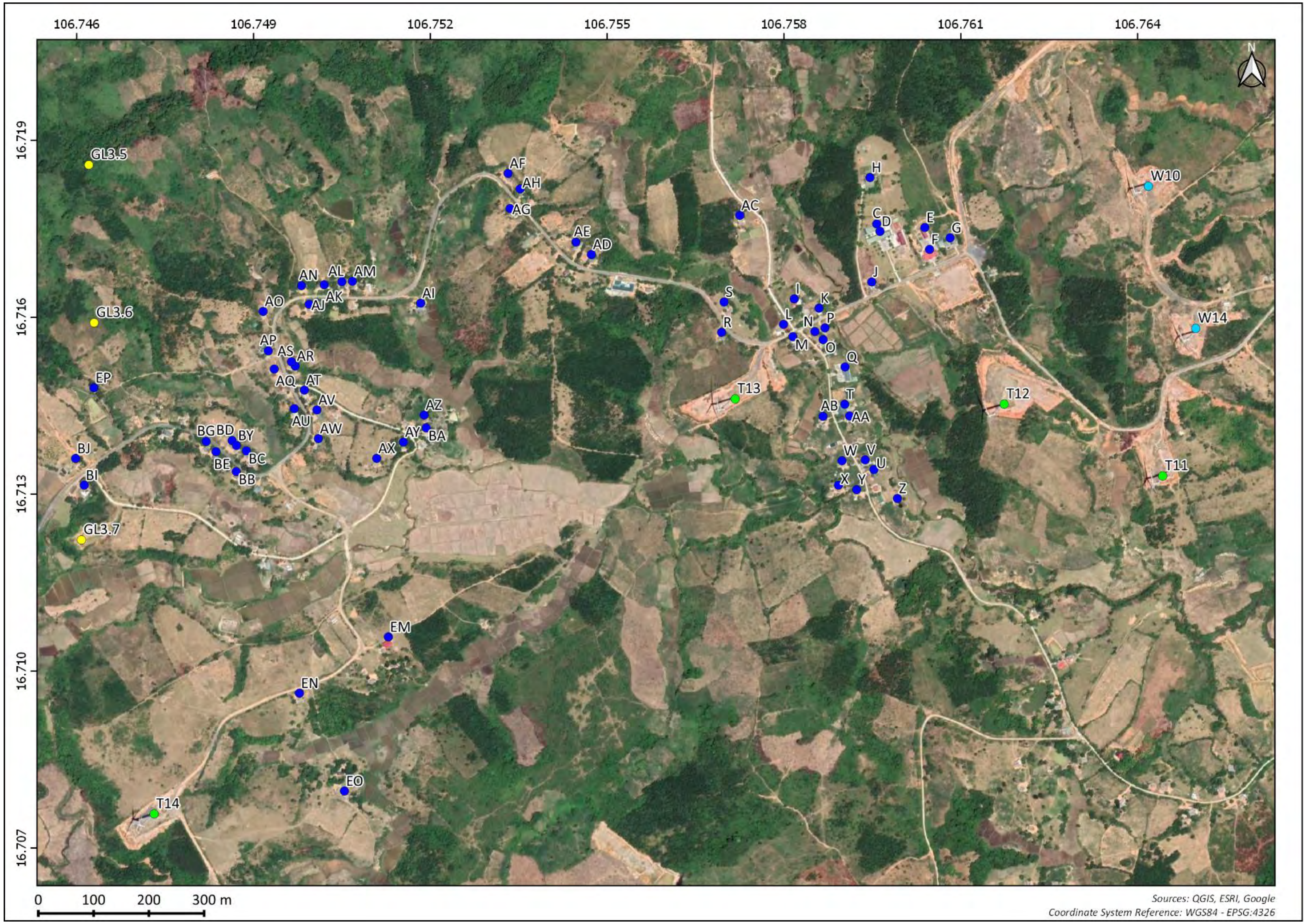


Figure 13.8 Shadow Receptors Receive nearby Windfarms' Cumulative Impact – Group A

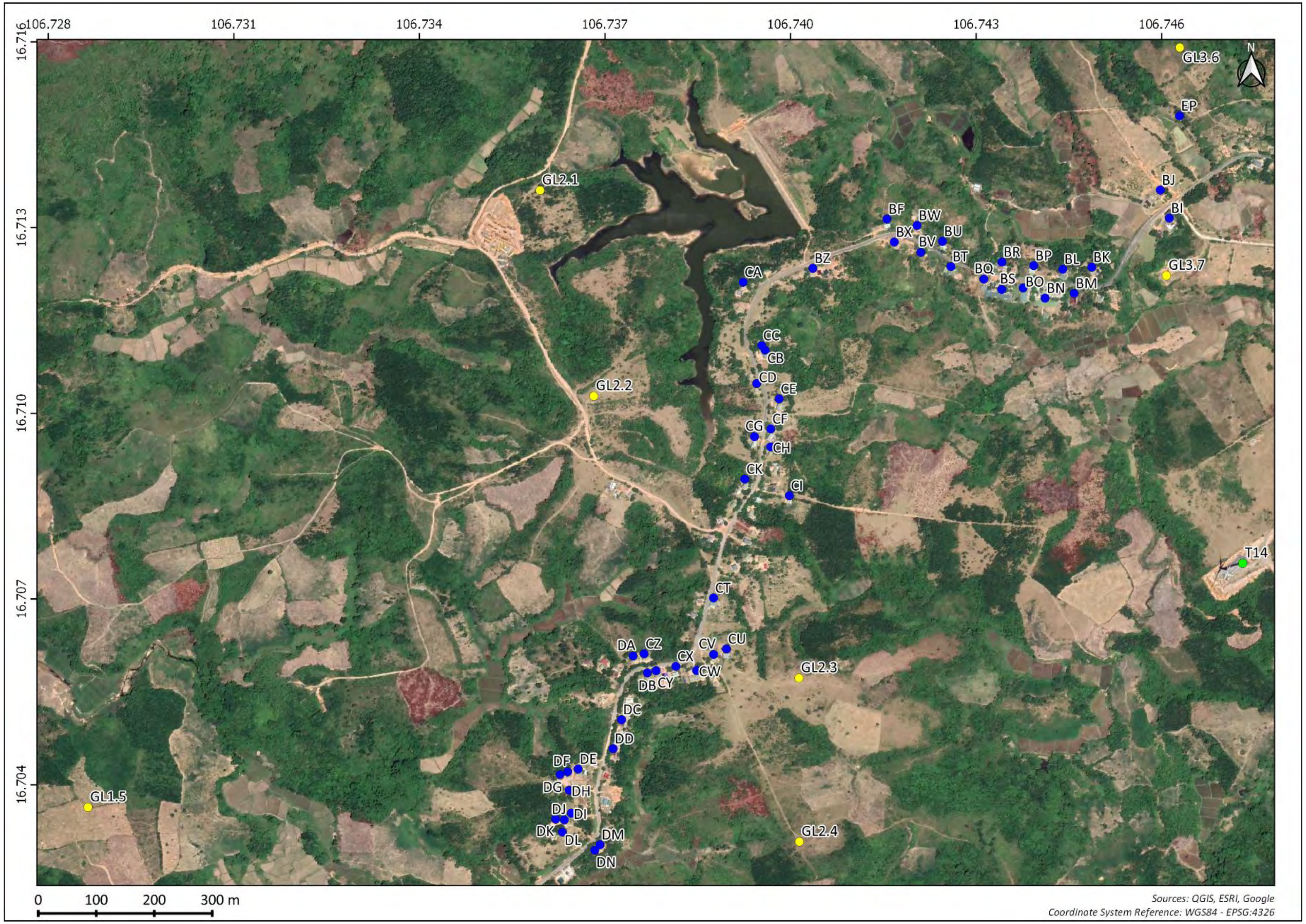


Figure 13.9 Shadow Receptors Receive nearby Windfarms' Cumulative Impact – Group B

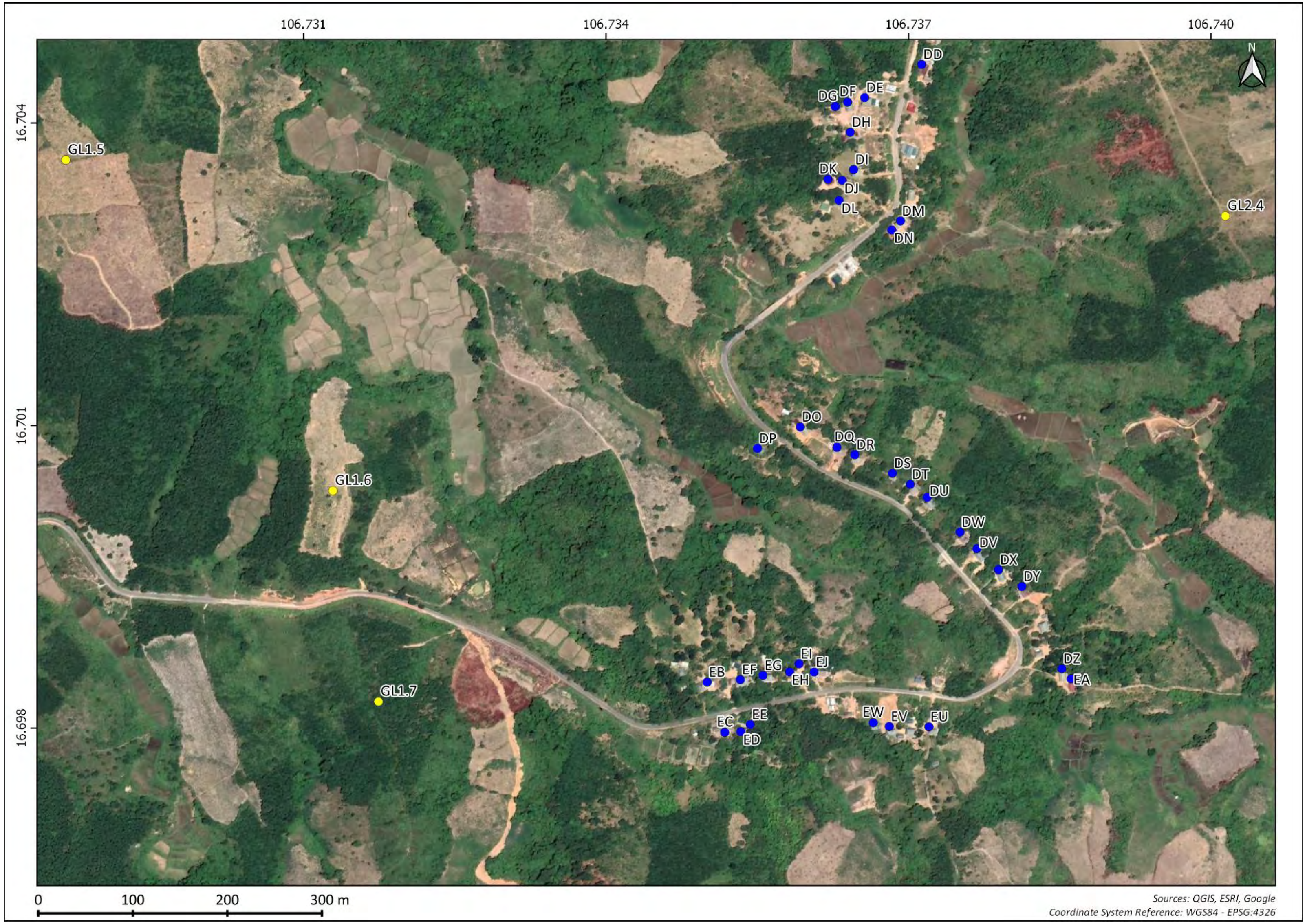


Figure 13.10 Shadow Receptors Receive nearby Windfarms' Cumulative Impact – Group C

13.11 Conclusion

Based upon a review of existing projects and potential developments within 50 km of the Project, it is concluded that cumulative impacts associated with projects that occur in Huong Hoa district will be likely experienced during the construction phase and operation phase.

The successful implementation of the various specific mitigation and management measures developed will require the inclusion of a number of stakeholders. Key stakeholders include local authorities, owners of projects and local communities. In situations such as this, where there are multiple levels of stakeholders needing to cooperate to minimise impacts, a multi-user group is vital to manage cross project impacts. To achieve this, the project owner will seek to actively collaborate with all the stakeholders identified within the SEP and surrounding project owners to exchange information for management of environmental and social impacts. The management and mitigation measures have been incorporated into the ESMP.

14. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

14.1 Introduction and Objectives

The ESIA identified a number of environmental and social impacts that may potentially result from the construction and operation of the Project. In order to manage and mitigate these impacts, a range of measures have been developed to reduce the overall residual impacts to As low As Reasonably Practicable (ALARP). This Environmental and Social Management Plan (ESMP) provides a summary of the outcomes of the ESIA and helps the Project Owner track their requirements during the implementation phase. The key objectives of this ESMP are to:

- Collate the various mitigation and management measures developed throughout the local regulatory EPP and ESIA into a single source;
- Define monitoring requirements to determine the efficacy of all mitigation and management measures;
- Provide clarity to all stakeholders as to what impacts have been identified, how they will be mitigated and managed, and through what means; and
- Provide input into the overall suite of management measures which will be incorporated and implemented through the Environmental and Social Management System (ESMS) which was developed.

14.2 Scope of this ESMP

The scope of this ESMP covers the construction and operational aspects that have the potential to affect, positively or negatively, the environment and communities in which the Project Owner or its contractors will operate. As required by this ESMP, a range of detailed management plans will be developed and implemented for each specific phase of the Project. The responsibility for the implementation of these plans will lay variously with Project Owner, contractors and sub-contractors.

Any detailed management plans developed as an outcome of this ESMP will closely reference these components of the ESMS to ensure maximum efficacy in their outcomes.

14.3 Responsibility for ESMP Implementation

The Contractor will be responsible for the implementation of most of the mitigation measures during the preparation and construction phases. Where the Contractor engages subcontractors to undertake all or part of the work scope, the Contractor should ensure that the mitigation measures are implemented by these parties. If the Project Owner directly engages other contractors (other than the Contractor), the Project Owner should ensure that the mitigation measures are implemented by these parties. The mitigation measures should be followed by all parties involved in the construction process. Once the Project approaches its operation phase, the Project Owner will generally take sole responsibility.

Detailed management plans are required to set out the detailed arrangements for implementation of certain mitigation and management measures. As identified with the summary of impacts and mitigation and management measures, the following management plans are required as part of the local regulatory EPP and to comply with the Vietnamese law.

14.3.1 Project Manager

The Project Manager is responsible for all construction activities and accountable for overall Environmental, Health, Safety and Social (EHSS) performance of the Project. Expectations for the role in terms of implementing a management system would include:

- Actively promoting and participating in the Project’s EHSS Plan;
- Ensuring that the ESMP, procedures and work practices are implemented across the Project;

- Ensuring that the ESMP reflects the requirements of the Project in terms of resources and budget;
- Ensuring that all legislative and company requirements are complied with;
- Ensuring that all scopes of work are defined in accordance with the Project's ESMP rules and regulations, work practices and procedures, as detailed in this ESMP and other associated documentation (e.g. the EPP);
- Ensuring that all contractors are made aware of their roles and responsibilities with regard to EHSS management;
- Ensuring that EHSS is regularly discussed and reported on i.e. in the weekly contractor progress meeting;
- Ensuring that all contractors are evaluated throughout the duration of the Project, as to their capabilities and performance; and
- Ensuring implementation of EHSS audit recommendations for non-compliance issues.

14.3.2 HSE Department

The Health, Safety and Environment (HSE) Department would be expected to undertake the following roles:

- Manage, review and develop the HSE program to ensure that it fulfils Project requirements, including measures observed in this ESMP, and monitor the implementation including, for example, patrolling the job site daily to ensure construction works' compliance with Project HSE Procedures and safe working practices;
- Coordinate and evaluate the effectiveness of all program elements;
- Liaise with relevant government bodies as necessary;
- Manage the Project's HSE team and supervise them to ensure that all areas of the Project are given the required level of safety support and attention;
- Ensure proper housekeeping and waste disposal in accordance with company requirements and regulations;
- Ensure that the respective control areas are given the required level of safety support and attention, for example by ensuring only safety- approved material and equipment are allowed to be brought onsite;
- Ensure that all HSE reports/ findings of any unsafe conditions/practices are brought to the attention of field management and are immediately corrected; coordinate accident/ incident investigation and report them to Project Manager; and
- Mange HSE Audits and report the results to the Project Manager.

14.3.3 Community Relations Department

- The Community Relations Department would be expected to undertake the following:
- Manage, review and develop the Social Program to ensure that it fulfils Project requirements, including measures observed in this ESMP and monitor its implementation;
- Coordinate and evaluate the effectiveness of all social management plans;
- Manage the implementation of stakeholder relations and grievance management to ensure that all social-related requirements of this ESMP are implemented;
- Manage the implementation of the community health program, including coordination with the HSE Department on OHS measures associated with the management of impacts to community health;

- Coordinate with HSE Department on implementation of the Project's vehicle safety measures associated with management of impacts to community safety;
- Coordinate with Human Resources to ensure implementation of labour-related measures required in this ESMP;
- Consult with community and liaise with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaising with related government bodies as necessary;
- Lead collaboration efforts to establish and implement the Project's Grievance Mechanism during Construction Phase, and supervise contractor's social performance as required in this ESMP; and
- Managing social monitoring and reporting the results to the Project Manager.

14.3.4 EPC's Site Representative/ HSE Department

The EPC and its contractors, depending on their scopes of work, would be expected to have an HSE Department. The contractors' site representatives or HSE Department should be assigned clear responsibilities and expectations with respect to implementing the Project's EHSS expectations and should be fully responsible for implementing any required expectations which fall under their scopes of work. More specifically, they will:

- Actively promote and implement all Project HSE Plans related to the work they are preforming. The contractor will make sure that all activities under his/her responsibility follow all safety regulation/requirements, in coordination with the Project Manager; and
- Ensure that committed resources (personnel, material, and equipment) used are consistent with achieving the objectives and requirements of the Project's EHSS Plan.

14.3.5 Employees

All employees involved in the Project will be qualified through training, experience, or knowledge. Non-supervisory personnel employed by the Project shall:

- Familiarise themselves with the concept of the Project's EHSS rules and regulations;
- Work in accordance with Project's EHSS Procedure, safe work practices, and method statements, risk assessments, permits to work and any other instructions or regulations that apply to their works;
- Use only tools/equipment and materials which have been approved for use, and employ them only for the purpose for which they were designed;
- Take an active part in the protection of themselves, fellow workers, property and the environment from accidental losses;
- Immediately report to his/her respective supervisor or HSE officer/inspector if any potential hazards (relating to unsafe conditions and/or unsafe acts) are identified which could lead to an accident;
- Report any incidents/near misses as well as injuries, regardless how minor, promptly to immediate supervisor and HSE officer/inspector; and
- Attend project safety training and drills programs as required.

14.4 Training, Awareness and Competency

It is expected that the Project would implement a training and awareness program covering EHSS expectations of the Project. As a minimum, this should be implemented during induction for all employees and contractors engaged in the Project's construction, with further training given depending on the level of responsibility for implementing HSE and social expectations and exposure to environmental and safety risks.

The Project should ensure that all personnel responsible for the implementation of this ESMP are competent on the basis of education, training and experience. All personnel shall be provided with environmental and social training appropriate to their scope of work and level of responsibility.

14.5 Monitoring, Review, Audit and Reporting

It would be expected that a monitoring, review and auditing program would be implemented during construction and operation phases to monitor implementation of the Project's HSE requirements and environment and social commitments. The inspections and audits will be done by the project identified HSE staff in coordination with O&M contractors and other external agencies identified. The entire process of monitoring and audits should being documented.

The project owner will develop and implement a programme of reporting through all stages of the project cycle. Delegated personnel shall require to fully complying with the reporting program in terms of both timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental check list, incident record register, environmental and social performance reports (weekly, monthly, and quarterly, half yearly, yearly)

14.6 Project Environmental and Social Management Plan

The development of an ESMP is considered to be good management practice for any project or activity with the potential to impact upon the physical, chemical, biological, social and health environment. In this instance, it provides guidance and a framework for ensuring that the commitments of the Client, made both within this ESIA and within the Project's EPP, are upheld and that the HSE impacts of the Project are managed to an acceptable level and in accordance with the requirements of the Project's ESIA.

Specifically, this ESMP pulls together the mitigation and management measures identified within the ESIA as necessary during the Construction and Operation Phases of the Project.

The mitigation and management measures occur throughout the Project's lifetime, from pre-construction through to construction, operation and decommissioning. In addition, there are common mitigation and monitoring requirements that apply to all phases of the Project, e.g., vehicle use/operation.

The mitigation and monitoring measures specific to the impact assessment conducted for this Project's ESIA are detailed in Section 14.9, together with information on:

- Relevant phase and activity;
- Impact summary and receptor impacted;
- Mitigation measures, responsibility and timing;
- Monitoring requirements, responsibility and timing; and
- Reporting requirements.

Where specific mitigation measures cannot be adequately defined due to lack of Project information or uncertainty regarding the environmental or social baseline, recommendations for the development of specific management plans or procedures or follow-up actions have been made.

14.7 ESMP Links to Other HSE Management Plans

Other types of plans are required to facilitate the practical implementation of the ESMP's commitments, for example, an Operational Environmental Management Plan, Social Management Plan or certain Safety Plans. These plans or studies are not substitutes for the overall ESMP, but serve to describe how the commitments will be implemented in detail (and likely at a later stage in Project development) than in the ESMP.

This ESMP will form part of future construction and operational activities, and plans for these Project phases will confirm how these commitments will be incorporated into the relevant EHSS management systems. Their implementation will fall under the responsibility of the Client. This ESMP is a live document and will be updated periodically, depending on Project progress and performance.

14.8 Plans, Policies and Procedures

The following plans and follow-up actions are identified as necessary for managing identified risks or for further understanding of potential environmental and social impacts. These plans will be developed by the Project Owner to manage specific risks or issues and to align the Project with the expectations of the IFC PS and EHS Guidelines.

Table 14.1 Specific Management Plans and Policies

Management Plan	Description
Livelihood Restoration and Indigenous People Development Plan (LREMDP)	The LREMDP will comprise of an assessment of involuntary resettlement and ethnic minorities impacts and development of measures to address the impacts of the Project as per ADB SPS 2 on Involuntary Resettlement and SPS 3 on Indigenous People. The LREMDP also include compensation and entitlement for affected households, especially those belonging to the ethnic minority group.
Occupational Health and Safety (OHS) Management Plan	An OHS Management Plan includes the mitigation measures proposed in this ESMP to manage OHS impacts to workers (e.g., compulsory medical examinations for Project workers).
Stakeholder Engagement Plan (SEP) (pre-construction and throughout the project), including Grievance Mechanism Procedure)	The SEP documents stakeholder engagement undertaken during the regulatory EPP and ESIA stages. The SEP is also an initial guide to future engagement and will need to be updated periodically to ensure on-going stakeholder engagement through various stages of the Project life cycle from construction to operation and decommissioning.
Construction Plan and a Traffic Management Plan (CTMP)	The CTMP provides measures to minimise traffic impacts that may occur during construction phase and also provides a program to monitor and report on the effectiveness of these measures.
Community Health and Safety Management Plan (CHSMP)	The CHSMP prepared potential community health, safety and security risks. The CHSMP provides commitments, programs, procedures and guidance that respond to and mitigate the identified risks; provides monitoring and training program.
Biodiversity Action Plan (BAP)	The BAP describes (i) the composite of actions and a rationale for how the project's mitigation strategy will achieve net gain (or no net loss), (ii) the approach for how the mitigation hierarchy will be followed, and (iii) the roles and responsibilities for internal staff and external partners.

14.9 Construction and Operational Environment and Social Management Plan

In order to minimize adverse impacts during different phases of project lifecycles, mitigation measures, monitoring plan and responsible for its implementation are given in this section. At the time of developing ESMP, the local regulatory EPP was approved. The ESMP will include mitigation measures proposed in local EPP. It is noted that no monitoring reporting is specified in the local EPP, other than "the competent authorities are responsible for monitoring the implementation of environmental management programs". It is proposed that the Project Owner responsibilities include supervising implementation of all proposed mitigation measures and monitoring by the Contractors.

14.9.1 Air Quality Management

Table 14.2 Air Quality Management

Activity/Aspect	Potential Impact	Source	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
Pre-Construction and Construction Phase							
■ Land preparation and civil works such as land clearance, demolition, earthworks. ■ Substation, transmission line, access road, laydown area construction ■ Operation of associated facilities such as the concrete batching plant, diesel generator for power supply ■ Transportation of equipment and materials,	■ Increased dust (e.g. PM10) from ground preparation, work sites and material / equipment transportation ■ Exhaust emissions (e.g. SOx, CO, NOx) from movement and operation of construction vehicles, machinery and other heavy equipment such as bulldozers, excavators, compactors and diesel generator.	EPP	Impacts of dust and air emission from vehicle Establish the schedule for construction phase and construction methods, choose transport route and types of vehicle approximately to reduce impacts of dust and air emission Spray water and shield at the construction area in sunny and windy days Separate lanes of vehicles at construction areas. Cleaning workers will be arrange to ensure clean the project areas The certificates of technical safety and environmental protection of road vehicles are requires for vehicles, machinery and equipment which will be used	■ Project owner ■ EPC Contractor	Temperature, humidity, wind speed, dust, CO, NOx, SO_2.	■ Monitoring locations: 03 locations: 02 location at the construction site; and 01 location at the road to access the Project area. ■ Frequency: every six months.	Environmental Monitoring Report

Activity/Aspect	Potential Impact	Source	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
workers daily movement			Install waring and traffic signs to ensure safety in transportation				
			Impacts of dust from excavation and levelling activities				
			Spray water at the construction area				
			Deploy constructions activities of each package until completion to easily control and limit pollution on a large scale				
			Arrange daily cleaning workers at the intersection with the road to the project area				
			Provide PPEs for workers				
		ESIA	Develop and implement a Traffic Management Plan to reduce the impacts of dust and emissions from transport vehicles	-	No additional specific monitoring is required.	No additional specific monitoring is required.	-
			Install fences at least 1 m height in compliance with the Circular No. 14/2014/TT-BXD around the construction sites to prevent dust dispersion to surrounding areas				

Activity/Aspect	Potential Impact	Source	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			Cover construction material trucks during the transportation				
			Control the speed limit of trucks and other vehicles, so as not to exceed 10 km/h within the Project's boundaries				
			Areas of construction, stockpile areas and other exposed soils should be designated, such as in order to minimise vehicle movements over these areas				
			Maintain all vehicles and equipment in good working order				
			No open burning on the construction site. If required, cleared vegetation should be transferred to competent non-hazardous waste disposal contractors, composed or reused for stabilisation purposes				

14.9.2 Water Resource Management

Table 14.3 Water Resource Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Pre- construction and Construction Phase							
■ Land Preparation and civil works; ■ Substation, transmission line, laydown area and operation house construction; ■ Operation of associated facilities such as concrete batching plant; ■ Waste and wastewater management from construction and worker's activities; and ■ Hazardous storage and handling.	■ Increased turbidity due to suspended sediment washed into stream and creeks ■ Increased contaminants such as heavy metals, oil and grease etc. washed into surface water bodies (such as creeks) from construction activities ■ Waste discharged from construction activities and	EPP	Domestic waste water: To build septic toilets in construction phase for workers; To manage wastewater generating during construction phase as following measurements: ■ Utilise maximum water for maintenance activities; ■ Save water during concrete mixing process; and ■ To minimise the leakage of grease from machines. Rain water ■ To check regularly to ensure no block the drainage system; ■ To build a warehouse which stores material and/or cover machine when raining; ■ Only do maintain machine and vehicles at the garage; ■ To build the synchronized drainage system; ■ To collect solid waste into trash; and ■ Do not put material nearby drainage system to prevent falling into the system.	■ Project owner ■ EPC Contractor	■ Parameters: pH, DO, BOD5, TSS, COD, NO^{3-}, $PO4^{3-}$, Oil and Grease	■ Monitoring locations: 02 locations ■ 01 location at Xa Bai stream (WGS84 Latitude: 16.70566214; Longitude: 106.73090336); and ■ 01 location at Rao Quan lake (WGS Latitude: 16.70797900; Long titude: 106.72156946). ■ Frequency: 6 month/time	Monitoring report

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	worker's activities ■ Spillage of oil, chemicals, hazardous chemical from use of vehicles and construction machines during the construction phase	ESIA	Collect and store solid waste, domestic waste and hazardous waste in containers during both construction and operation phases	-	No additional specific monitoring is required.	No additional specific monitoring is required.	-
			Solid waste will be collected, stored and processed by functional units in accordance to Circular No. 36/2015/TT-BTNMT				
			Domestic solid waste will be collected daily. The project investor will sign an agreement with functional units for transporting and handling respective wastes				
			Domestic wastewater will be collected and processed by the septic tanks				
			Hazardous waste to be collected and stored by project owners and handled by the official hazardous disposal organisation, in accordance with Circular No. 12/2011/TT-BTNMT date 21/04/2011				
			Establish internal rules and activities for environmental protection, including littering and disposal of wastes				
			Select appropriate methods and equipment to reduce disturbances to fresh water				
			Develop and establish a Soil and Erosion Management Plan				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Establish rain water / storm water drainage system to collect and remove oil prior to discharge into receiving bodies (at the operation house and the substation area)				
			The storage space where materials such as sand, machinery and equipment are stored should be covered carefully and this storage space should be on a raised platform to avoid surface runoff during rainfall				
			Equipment will be regularly checked for oil leakage				
			Prohibit discharging of waste and wastewater directly into fresh water bodies				
			Supervise implementation of proposed mitigation measures by the Contractors				

14.9.3 Soil Management

Table 14.4 Soil Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
Pre-Construction and Construction Phase - Soil Compaction and Erosion							
▪ Groundworks and construction activities: ▪ Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon ▪ Excavation for WTG foundations and electrical poles; and ▪ Construction of internal road system ▪ Accidental leaks/spills of fuel, oil and hazardous materials/waste from machine during construction phase	▪ Loss of soil stabilizing vegetation; ▪ Soil compaction and erosion; ▪ Soil contamination	EPP	N/A	-	-	-	-
		ESIA	Preparation and implementation of a soil and erosion management plan during construction to incorporate requirements such as use of dust suppression, soil stabilisation during construction and storm water and sediment management and control	▪ Project owner ▪ EPC Contractor	-	-	-
			Site clearance, piling, excavation and construction of the access roads should not be carried out during the monsoon season or during heavy winds to minimize erosion and run-off				
			Procedures for responding to emergencies/accidental spills of hazardous materials, fuel and handling, and waste management are developed and implemented				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			Maintenance works are restricted to specially designated platforms with strict control of accidental spills				
			Site should be restored at the end of the Project life-cycle to pre-Project level				
Pre-Construction and Construction Phase - Soil Contamination							
■ Groundworks and construction activities: ■ Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon ■ Excavation for WTG foundations and electrical poles; and ■ Construction of internal road system ■ Accidental leaks/spills of fuel, oil and hazardous	Soil contamination	EPP	Domestic waste ■ Provide 02 trash bin and instruct workers to keep clean; and ■ Classify wastes. Domestic waste will be collected and transported by certified agency.	-	-	-	-
			Solid waste from construction phase ■ Classify domestic solid waste and solid waste from construction phase; ■ Rock and bricks will be sued to level the ground during construction phase; ■ Metals and paper will be collected and sale to local collectors; and				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			▪ Vehicles will be covered with tarpaulins to reduce soil spillage and reduce dust generation				
			Hazardous waste ▪ Handle in accordance with Circular No. 36/2015/TT-BTNMT dated 30th June 2015 of the Ministry of Natural Resources and Environment on hazardous waste management.				
		ESIA	Contract a competent/ licensed contractor to collect, transport and treat domestic, construction and hazardous wastes from the project site	▪ Project owner ▪ EPC Contractor	Arsenic, Cadmium, Total Chromium Copper, Lead and Zinc	Monitoring locations: 02 locations ▪ 01 location at the substation area; and ▪ 01 location at the turbine area. Frequency: every six months.	Environmental Monitoring Report
			Prohibit dumping any types of solid waste to the soil or burning waste on the site				
			Ensure that hazardous materials are stored in designated areas that are designed with impermeable floor, inflammable walls and accessible to authorized personnel				
			Hazardous waste shall be properly managed in accordance with Decree No. 38/2015/ND-CP, Circular No.				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			36/2015/TT-BTNMT, QVCN 07:2009/BTNMT on Hazardous Waste as follows: ■ Hazardous waste is prohibited to be illegally disposed into the ground; ■ All workers shall be trained on hazardous and non-hazardous waste classification and their handling methods; ■ Proper facilities shall be supplied and areas for hazardous waste storage in the construction sites should be clearly determined in accordance with Circular No. 36/2015/TT-BTNMT ■ Appropriate organizations with proper license shall be contracted in order to periodically transport and dispose hazardous waste; and ■ A record of hazardous waste should be documented (using the form specified in Circular 36/2015/TT-BTNMT) to allow monitoring volume of hazardous waste generated in place and disposed by contractors of hazardous waste. The numeric				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			data in the record must be consistent in order to ensure that no improper disposal is made in the area of the Project or other locations				
			In case of accidental/ unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste.				

14.9.4 Noise Management

Table 14.5 Noise Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
Pre-Construction and Construction Phase							
■ Equipment and material transport and supply ■ Land preparation and civil works such as land clearance, demolition, earthworks ■ Substation, transmission line and laydown area construction ■ Operation of associated facilities such as the concrete batching plant	Short-term increase in noise levels	EPP	The locations of turbines must meet a safe distance from the nearest residential area ⩾ 300 according to the Circular No. 02/2019/TT-BCT dated 15/01/2019 of the Ministry of Industry and Trade to minimize the impacts of noise on people	■ Project owner ■ EPC Contractor	Noise level in compliance with QCVN 26:2010/BTNMT	■ Monitoring locations: 03 locations - 02 locations at the construction site - 01 location at the road to access the project area ■ Frequency: every six months.	Monitoring Report
			Technology selection with low noise and non-infrasound machinery to minimize the impact on people and animals				
			Develop regular maintenance schedules for all vehicles, machines and equipment to detect early problems and reduce unnecessary noise and vibration				
			Regulate the speed of vehicles when operating				
			Arrange reasonable working time in high noise areas to ensure long-term health for workers.				
			Provide PPEs if workers work in places where high noise level				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
■ Transportation of equipment, workers and materials ■ Foundation construction and Installation work of the WTGs		ESIA	Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient	-	-	-	-
			Ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed from the site				
			Ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse				
			During the construction design, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit				
			High noise generating construction works and activities should be limited to the daytime period (7AM to 10PM), and work should be avoided on Sundays or public holidays if possible				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			Any works that are required during the night time period (10PM to 7AM) should be justified and task-specific noise mitigation and management measures should be implemented to reduce noise impacts to acceptable levels. These additional measures should consider the potential for sleep disturbance impacts that could occur during the night time period due to “peak” or “maximum” noise level events e.g. metal on metal contact, or general clangs and bangs				
			Works associated with transmission line and access road construction often require activities in closer proximity to receptors that are not affected by construction works at wind turbines, or permanent facilities. In these circumstances task-specific noise mitigation and management measures should be implemented (when works are close to receptors) to reduce noise impacts to acceptable levels				
			Construction road traffic and heavy vehicle movements have the potential to generate high “peak” or “maximum” noise level events and these should be limited during the night time period, and avoided if possible. Where possible, significant noise generating vehicle movements				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			should be limited to the daytime period. Where it is not possible for this to occur drivers should be instructed to arrive and depart as quietly as possible. Whilst on-site and in close proximity to receptors the drivers should be instructed to implement good-practice noise management measures to reduce peak noise levels and minimise any impacts as far as practicable. During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night				
Operation phase							
Operational noise impacts from the WTGs and the cumulative operational noise impacts from both the Project and nearby developments	Increased noise	ESIA	As predicted operational noise levels meet the necessary criteria, there are no recommended mitigation measures for this Project	-	-	-	-

14.9.5 Electromagnetic Interference Management

Table 14.6 Electromagnetic Interference Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Operation phase							
EMF from overhead 110kV transmission line	Exposure to high levels of EMF can pose a health risk for people	EPP	Design electrical equipment and transmission line in accordance with Vietnam Regulation (Decree No. 14/2014/ND-CP dated on 26 February 2014) including (1) the safety corridor of the 110kV line should be 12m for the double circuits; (2) the safety corridor for the 22kV line is 4m; (3) the distance from the lowest point of transmission lines to the ground is at least 15 m.	Project owner	EMF	■ 02 locations: - 01 location at turbine - 01 location at the substation area ■ Frequence: 02 time/year	Environmental Monitoring report
			Equip workers who come in contact with electromagnetic fields (EMF), with PPE				
			Put up warning signs at high voltage areas				
			Using phase cancellation				
			Shielding				
			Organize periodic health check-ups for workers who work in EMF				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Provide workers with training on electromagnetic fields (EMF)				
			Limit workers who have health problems such as cardiovascular and congenital diseases from working in areas with EMF				
		ESIA	Avoid residential buildings, or acquire houses within the ROW, if possible	Project owner	EMF	No additional specific monitoring programs are required.	-
			Avoid schools, hospitals, health clinics, and other similar buildings – the ETP alignment avoids these sensitive buildings and maintains at least a 20 m buffer to all schools and health clinics				
			Tower safety features – place warning signs prohibiting climbing on towers and incorporate design elements that prevent climbing of the towers				
			Implement all H&S measures as specified in the regulations including earthing of buildings that are metal clad and directly below the transmission line				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Conduct regular clearance of the clear zone to ensure the area is safe as required by the regulation				
			Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable				
			Emergency contact information – provide signage at each tower with emergency phone numbers				
EMF from 22kV underground transmission line	Exposure to high levels of EMF can pose a health risk for people	EPP	Underground power cables are insulated	Project owner	EMF	-	-
			Place warning signs of underground power cable				
			Conduct training sessions for wind turbine operators and propagate to local community residing proximity of project area that it is prohibited to violate safety corridors				
		ESIA	For double circuit lines, it may be possible to arrange the phases to maximise the magnetic field cancellation	Project owner	EMF	EMF monitoring is carried out by using suitable magnetic and electric filed sensors within the first year	-

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Installation of a passive shielding loop can be effective in reducing the magnetic field at a particular point			of the operation on a quarterly basis.	
EMF from substation	Exposure to high levels of EMF can pose a health risk for people	EPP	There is no existing controls	Project owner	EMF	Electromagnetic filed should be monitored at the vicinity of the substation. The EMF monitoring survey should be conducted every 6 months during the operation phases.	-
		ESIA	Equip staffs who come in contact with electromagnetic fields (EMF) with PPE	Project owner	EMF	No additional specific monitoring programs are required.	-
			Put up warning signs for high voltage areas				
			Use ferromagnetic and conductive materials for shielding as a barrier to reduce the field strength at the source				
			Limit staff who have health problems such as cardiovascular and congenital diseases from working in areas with EMF				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
EMF from wind turbine	Exposure to high levels of EMF can pose a health risk for people	ESIA	Whilst no EMF specific additional mitigation and management measures are recommended; to enhance safety, it is recommended to place warning signs prohibiting climbing on wind turbines and incorporating design elements that prevent climbing of the wind turbines. It is also recommended to provide emergency contact information by placing signage at each wind turbine containing emergency phone numbers.	Project owner	No specific monitoring is recommended	-	-

14.9.6 Biodiversity Management

Table 14.7 Biodiversity Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Pre-Construction and Construction Phase							
■ Land preparation and civil works such as land clearance, demolition, earthworks ■ Substation, transmission line and laydown area construction ■ Transportation of equipment, workers and materials ■ Foundation construction and Installation work of the WTGs	Loss of Terrestrial Habitat	EPP	Project activities are to be restricted to contractually approved area.	Project Owner/ EPC Contractor	-	■ Regular check (weekly) ■ Regular inspection (quarterly) to determine plant	Quarterly report
			Access to forested areas will be restricted with clear signs.				
			Loss of forest (production forest) is anticipated – the Project will commit to conduct reforestation complying with Decree No. 23/2017/TT-BTNM. Otherwise, a sanction will be imposed by Quang Tri Province Forest Growth and Preservation Fund.				
			The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation and hunting, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.				
		ESIA	A Biodiversity Action Plan (BAP) will be prepared for the management and monitoring of natural and critical habitats				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			within the Project EAAA as required by IFC PS6;				
			Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;				
			The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing;				
			A Fauna Shepherding Protocol is to be used within the Project Area to ensure that any resident species have vacated the area prior to any clearance work;				
	Disturbance and/or Displacement of Fauna	EPP	Project activities are to be restricted to contractually approved area	Project Owner/ EPC Contractor	-	-	-
			Access to forested areas will be restricted with clear signs				
			Land clearance must follow procedures to prevent unplanned changes to natural habitat and allow fauna to move away from area safely				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Restrictions on vehicle speed (maximum of 20km/h within work sites) and use of car horn will be imposed.				
			Construction schedule will be managed to avoid high concentration of work involving heavy machinery and equipment of high noise and intensity level.				
		ESIA	Where possible, all noise-generating construction activities will be restricted to only daytime.				
			All machinery and hand held equipment used must comply with required air and noise emission standards.				
			All light sources are to be directed away from areas of natural habitat.				
			A Fauna Shepherding Protocol is to be used within the Project Area to ensure that any resident species have vacated the area prior to any clearance work.				
			Fencing is to be placed around major project sites during construction to restrict access to fauna.				
	Barrier Creation, Fragmentation and Edge Effects	EPP	Loss of forest (production forest) is anticipated – the Project will commit to conduct reforestation complying with Decree No. 23/2017/TT-BTNM. Otherwise, a sanction	Project Owner/ EPC Contractor	-	-	-

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			will be imposed by Quang Tri Province Forest Growth and Preservation Fund.				
		ESIA	Disturbed land not required for the operation of the project will be rehabilitated using native species and minimising the exposed width of the transmission line ROW.				
	Degradation of Habitat	EPP	Strict regulation and hygiene-related infrastructure will be imposed to manage chemical and municipal waste disposal to avoid further interruption and contamination of surrounding natural habitat	Project Owner/ EPC Contractor	Monitoring will be required as part of the *Invasive Species Management Plan* and rehabilitation works		
			Construct a rainwater storage with drainage system to prevent flooding due to deforestation within the Project Area.				
		ESIA	All machinery and hand held equipment used must comply with required air emission standards				
			Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a *Sediment and Erosion Control Plan*.				
			Develop and implement appropriate emergency spills response procedures to avoid and manage accidental spills of any				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			fuels, oils or other chemicals during construction activities.				
			Disturbed land not required for the operation of the project will be rehabilitated using native species.				
			Existing populations and the introduction of new invasive species into natural habitats are to be managed. These measures are to be outlined in an *Invasive Species Management Plan* incorporated into the EMMP and include measures such as: ■ The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination. ■ Vehicle inspection and/or wash down procedures are to be used to reduce the transmission of invasive species into and from the Project Area(s). ■ Invasive species control measures are to be utilised in areas of natural habitat				
	Mortality – Vehicle Strike, Hunting and Poaching	EPP	Project activities are to be restricted to contractually approved area				
			Access to natural or forested areas will be restricted with clear signs and barriers				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Restrictions on vehicle speed (maximum of 20km/h within work sites) and use of car horn will be imposed				
			The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation and hunting, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.				
		ESIA	No additional mitigation measures are proposed.				
Operation phase							
Operating activities of the Project	Mortality – Turbine and Transmission Line Strike	ESIA	The transmission line will include the following measures: ■ Use of bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna; ■ Removing the thin neutral or earth (shield) wire above the high voltage transmission lines where feasible, and where this is not possible, marking the line to make it more visible;	Project Owner/ EPC Contractor	Monitoring will be required as part of the *Bird and Bat Management Plan* in the EMMP		Fatalities will be recorded along with information relating to the season, species and location of the fatalities

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			■ Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk; ■ Habitat manipulation to influence flight activity and bird behaviour, e.g. tree lines under the high voltage lines to increase visibility; ■ Insulating cables close to poles, at least 70 cm on both sides and around perching areas, and up to at least 140 cm in areas with large soaring birds; ■ Hanging insulators under cross arms and poles, provided the distance between a likely perch (mainly the transmission tower crossarm) and the energised parts (conductors) is at least 70 cm				
			All tower structures are to be free of holes that can be used for nesting. Roosting habitats (wires and ledges) are to be kept to a minimum				
			Installation of colourful or reflective components at strategic points on the turbine propellers (depend on the final design of the wind turbines) to deter birds				
			A carcass monitoring program is to be conducted on a weekly basis at the base of all turbines and along transmission line as part of a *Bird and Bat Management Plan*. All carcasses are to be identified and a database				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			kept of the number and taxa of the species. For transmission lines it is important to distinguish between collisions and electrocutions. The former occurs all along the transmission line alignment while the latter occurs at the base of transmission poles.				

14.9.7 Shadow Flicker Management

Table 14.8 Shadow Flicker Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Operation Phase							
Operation of the turbines	The association between shadow flicker caused by wind turbines and the effects on human health is highly debated.	ESIA	Grievance Monitoring and Reporting – implementing a process to assess the real occurrence of the shadow flickering at local dwellings in order to eliminate the phenomena. In case of dwellings experienced shadow flickering, a detailed grievance mechanism should be available and the local community must be aware of the availability of grievance mechanism to submit their complaints regarding nuisances related to shadow flicker from turbines. Ensuring close monitoring through engagement with local stakeholders during the operational phase where there are predicted impacts from shadow flickers in case the locations have been finalised by the project proponent and earmarked for construction	Project Owner	-	-	-
			Visual Screening (Natural) – Assess potential sensitive receptors, for which shadow flicker modelling indicates could exceed 30 hours per year, in order to ascertain the extent of existing natural visual screening in place. If not existing, the occurrence of shadow flickering during operation could be furtherly investigated, and if confirmed, natural screening could be realised to minimise the effect				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Visual Screening (Architectural / Structural) - If grievances will be received or if natural visual screening at potential sensitive receptors are found to be insufficient, investigations to implement architectural / structural screening such as the installation of blinds, window shades, window tinting, awnings or fences at affected receptors could be evaluated to further minimize the effect of shadow flicker				

14.9.8 Visual Impact Management

Table 14.9 Visual Impact Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Pre-construction, Construction and Operation Phases							
▪ Construction and Installation of Wind turbine ▪ Operation of the turbines	Visual Impacts	ESIA	Use of materials that will minimise light reflection should be used for all Project components	Project Owner	-	-	-
			Bright patterns and obvious logos should be avoided on WTGs				
			The replacement of wind turbines with visually different wind turbines can result in visual clutter, so replacing wind turbines with the same or a visually similar model over the lifetime of the project may be an important requirement				
			Existing vegetation should be retained to the greatest extent possible. Vegetation should be retained along roads, substations, and other Project infrastructure.				

14.9.9 Unplanned Event Management

Table 14.10 Unplanned Event Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Pre-Construction and Construction Phase							
Small scale leakage and spill incidents from site-preparation/ construction activities	<u>Communities</u> – Based on the liquid fuel storage volumes the potential exists for exposure to contaminated water or soil and resulting in long-term effects on surrounding communities utilising groundwater resources if a spill was not being contained. <u>Environment</u> – Based on the liquid fuel storage volumes potential for loss of containment of oil/chemicals into ground of surrounding area,	EIA	N/A	-	-	-	-
		ESIA	Design the site to include good site management practices to ensure that the products are properly stored on site (e.g. secondary containment, double walled tanks, over filling alarm system).	■ Project Owner ■ EPC Contractor	-	-	Monitoring Report
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will provide regular information on safety drills and guidance to residents in the event of an unplanned event.				
			Ensure good inspection and maintenance procedures for large mobile construction plant to minimise small leaks and spills.				
			Prepare Emergency Response Plan and Emergency Management Plan.				
			Implement Emergency Response Plan and Emergency Management Plan and monitor				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	including nearby surface water resources resulting in localised, potentially long-term, degradation.		contractors to ensure consistent implementation				
Road traffic transporting personnel or materials involved in a collision	<u>Communities</u> – Traffic accidents that involved community members, resulting in injury or fatality. Accidents might require use of local medical emergency services in the Project area and could temporarily decrease access to these services for local residents.	EIA	N/A	-	-	-	-
		ESIA	Developed and implemented a Transportation Management Plan. This should include measures such as: ■ Active traffic controls (e.g. flaggers to direct traffic at the Project site entrance); and ■ Schedule construction deliveries and employee shift changes to minimise traffic congestion and delay ■ Design an H&S plan and good safety practices for the transportation (e.g. alcohol policy, good driving practice). ■ Upgrade the access road to the Project site	■ Project Owner ■ EPC Contractor	-	-	Monitoring Report
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will provide regular information on safety drills and guidance to residents in the event of an unplanned event.				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Prepare Emergency Response Plan and Emergency Management Plan.				
			Implement Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation				
Fire and explosion	Communities – Based on the liquid fuel storage volumes the potential exists for exposure to ignite due to malfunctioned equipment and resulting in potentially severe injuries to employees and spread to nearby communities' members. Environment: – Based on the liquid fuel storage volumes potential for ignition of leakage or spill of	EIA	The electricity technician will handle the job related connecting electricity to the project area.	■ Project Owner ■ EPC Contractor	-	-	Monitoring Report
			Establish and supervise workers to follow electricity safety regulations.				
			Check and maintain periodically machine.				
			Immediately report to line manager if any fire occur and use fire extinguisher to fight fire.				
			Install signs to show flammable area and no smoking areas.				
		ESIA	Conduct a detailed ENVID/HAZID (Environmental Identification/ Hazard Identification) process to identify key environmental and social risks associated with the Project.	■ Project Owner ■ EPC Contractor	-	-	Monitoring Report
			Conduct a Quantitative Risk Assessments (QRA) for the key sources of environmental				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	oil/chemicals due to human errors and malfunctioned short-circuit equipment, accidents might lead to uncontrollable wildfire, loss of crops and habitat, causing injury and life-threatening of local community.		and community safety risk, as identified in the HAZID/ENVID process and ensure risks are reduced to as low as reasonably practicable.				
			Implement the recommendations of the QRA process into the design of the plant and the planned management measures				
			Contact relevant authority bodies and conduct the UXO clearance.				
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will provide regular information on safety drills and guidance to residents in the event of an unplanned event.				
			Implement routine inspection and maintenance procedures (in line with international best practice) for large storage vessels.				
			Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.				
			Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Commissioning and Operation phase							
Small scale spill from activities on-site	Communities – Based on the liquid fuel storage volumes the potential exists for exposure to contaminated water or soil and resulting in long-term effects on surrounding communities utilising groundwater resources if a spill is not contained. Environment – Based on the liquid fuel storage volumes potential for loss of containment of oil/chemicals into ground of surrounding area, including nearby surface water	EIA	N/A	-	-	-	-
		ESIA	Implement good site management practices to ensure that the products are properly stored on site and in areas where spills will not easily reach the environment (e.g. in paved areas with secondary containment).	Project Owner	-	-	Monitoring Report
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.				
			Prepare an Emergency Preparedness and Response Plan to cover accidental and emergency situations. This Plan will detail:				
			Planning coordination: including procedures for informing local communities about emergency response, documentation and first aid / medical treatment				
			Emergency equipment: including equipment in the project design and any additional emergency equipment				
			Training: employees and contractors will be trained in emergency response procedures.				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	resources resulting in localised, potentially long-term, degradation.		Auditing: audit records will be maintained on how the Plan is being implemented.				
			Implement Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation				
Fire and explosion	Communities – A large-scale fire could result in injuries to people in the surrounding communities, or in the worst-case fatalities. Explosions of malfunctioned equipment could result in rapid spread of fire and projectile spread of debris. This could result in injuries to people in the surrounding communities, or in the worst-case fatalities.	EIA	Install lightning protection systems for turbines and transformer stations. Establish fire protection team.	Project Owner	-	-	Monitoring Report
		ESIA	Implement the recommendations of the QRA process into the planned management measures.				
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.				
			Implement routine inspection and maintenance procedures (in line with international best practice) for any Unplanned Eventous substances' storage vessels and WTGs.				
			Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed.				
			Implement Emergency Preparedness and Response Plan with forest fire protection and				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	Environment: – A large-scale fire could result in damage/death of local flora and fauna. Accidents might lead to uncontrollable wildfire, loss of crops and habitat given the environment settings at the Project area. Explosions could result in rapid spread of fire and projectile spread of debris. This could result in damage/death of local flora and fauna.		monitor contractors to ensure consistent implementation				
			Provide regularly safety and fire prevention & fighting drills.				
Blade ejection failure	Communities – Blade ejection failure could result in rapid spread of fire and projectile spread of debris	EIA	N/A	-	-	-	-
		ESIA	Establish safety zone at least 270 m away from the WTGs with fences if possible. It was recommended that the minimum setback distances required to meet noise and shadow flicker limits be maintained with respect to	Project Owner	-	-	Monitoring Report

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	given the heights of wind turbines. This could result in injuries to surrounding communities, or in the worst-case fatalities. Environment – As above with local flora and fauna.		sensitive residential receptors to provide further protection				
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.				
			Implement periodic routine inspection and maintenance procedures (in line with international best practice).				
			Install warning system, signal boards, lighting prevention system around the 270 m radius of danger zone where the WTGs located. Equipped vibration sensors for the warning of any imbalances in rotor blades.				
			Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.				
			Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation				
Accidental transmission line snapping and tower swaying/collapsing	Communities –. Electrocutions that involved community members, resulting	EIA	N/A	-	-	-	-
		ESIA	Establish a good practice and should comply with electricity safety related regulation or	Project Owner	-	-	Monitoring Report

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	in injury or fatality, livestock leading to death of livestock and loss/reduction in community member's livelihood.		international standard, whichever, more stringent, in the design and installation of transmission line and transmission pylons.				
Natural Hazard (Flood and Landslide)	Communities: Flood and landslide can result in loss of human life, damage to property, destruction of crops, and loss of livestock that affects to livelihood. Flood may affects to substation and power components that lead to loss of electricity supply locally. Environment: A large-scale flood and landslide could result in damage/death of local flora and fauna.	EIA	Design and construct facilities that are withstand strong winds	Project Owner	-	-	Monitoring Report
			The turbines are built to avoid landslides that damage the foundation.				
			110 kV line foundation pillar will be built with trench stone embankment and drainage system to avoid storm water overflow, causing landslide of the project.				
			Before storms and floods occur, the company will promptly notify and have a plan to respond to the incident.				
			Prepare forces, facilities and equipment to coordinate and respond to overcome before and after the incident.				
			When a flash flood incident occurs, company leaders need to evacuate workers from the dangerous area, use the equipment and on-site manpower to control the incident. Notify				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			the local authorities for flood and storm prevention and search and rescue for timely rescue				
		ESIA	Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.				
			The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.				
			Implement periodic routine inspection and maintenance procedures (in line with international best practice).				
			Install warning system, signal boards, flood prevention systems.				
			Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.				
			Implement an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.				

14.9.10 Social Management

Table 14.11 Social Management

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Pre-construction and Construction phase							
Land acquisition process	■ Economic displacement: loss of land and access to production land, resulting in loss of access, livelihood and income to the land users; ■ Dissatisfaction towards the compensation price; and ■ Social/ cultural tension from the unequal compensation between the affected households, especially among the Indigenous People	EPP	Other than the compensation payment in cash, there is no other compensation or supporting method to be applied to assist affected households	■ Project Owner ■ The Government	-	-	-
		ESIA	Conduct a Land Acquisition Audit (LAA) to identify the gaps between the government-led process, the Project's practice and ADB requirements on land acquisition and resettlement. Specific actions to minimize the gaps in providing appropriate compensation should be recommended and implemented.	■ Project Owner ■ The Government	■ Comply with the monitoring and evaluation framework proposed in the LAA, SEP, LRP and CDP during the implementation of these plans. ■ Engage a third party to undertake a Livelihood Restoration Completion audit when livelihoods of displaced people are	As defined in the LAA, SEP, LRP and CDP	As defined in the LAA, SEP, LRP and CDP
			Develop Stakeholder Engagement Plan (SEP) to ensure effective Project information disclosure and communication with affected households as well as relevant government stakeholder.				
			Develop Grievance Mechanism to support the local authorities in receiving and addressing land acquisition-related grievances. The grievance mechanism should be disclosed to all affected				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			communities so that they must be aware of the procedure, submission channels, and responsible person from the Project owner.		considered being sustainably restored.		
			Develop and implement a Livelihood Restoration Plan (LRP) to support the economic displaced households in restoring their livelihoods at least equal to similar level of livelihood condition before land acquisition. The LRP should take women groups and vulnerable groups into account to ensure they are not overlooked during Project implementation and left worse off..				
			Assist the local community via a Community Development Plan (CDP) focusing on affected ethnic minority communities to ensure that local communities can benefit from the project				
Disturbance to Agricultural Production during Construction Phase	Impacts on the agriculture production of local people	EPP	Conduct land clearance and construction in the dry season	Project Owner	-	-	-
			Cover the construction area during heavy rainfall events				
			Concrete the storm water drainage system				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			In case of any damage happens, compensation would be paid to the affected people in cash (by the EPC)				
			Prepare emergency response plan for flash flood events				
		ESIA	Provide and communicate detailed information about the Project's plan and schedule particularly related to land clearing and construction to the community with a special attention to farmers nearby the project locations	Project Owner	Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented	-	As defined in the Social Management Plans
			Avoid land clearance and construction in the rainy season and paddy rice harvesting season				
			Establish a grievance mechanism that is understood by and accessible for all villagers. The mechanism will be simple, efficient, timely and consultative				
			Should any incident occurs and causes damage to the surrounding agriculture production, the Project ensure that such incident should be investigated to determine Project's responsibilities and compensation amount if necessary.				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Impacts on Community Health, Safety and Security during Construction	■ Health Issues as result of Noise, Dust and Vibration ■ Traffic Safety Issue during the Construction Phase ■ Security issues	EPP	Measures to mitigate negative impacts from vehicle movement on public roads such as installing buoys, signs, signal lights and other auxiliary equipment for traffic guidance, regularly checking vehicles before travelling, and promotion of local procurement to reduce transportation No measure to address illegal logging	■ Project Owner ■ EPC Contractors	-	-	-
		ESIA	Ensure all new drivers are licensed with good experience, and should be required to undergo safety training Flagmen should operate at the junction between the main roads and the access road to coordinate the trucks entering and exiting Speed limits should be enforced for all Project vehicles Project Owner to develop a Traffic Management Plan for the construction phase. Procedure for responding to the traffic emergency should also be included in the plan Project Owner to conduct disclosure and consultation with the surroundings communities and public facility (school) on	■ Project Owner ■ EPC Contractors and sub-contractors ■ Local authorities ■ Local communities	■ Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented; ■ Monitoring and audit are also required to be conducted in accordance to the schedule proposed in the management plans relating to air quality, noise and traffic management	-	As defined in the Social Management Plans

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			key Project traffic routes, timing of peak movements, type of vehicles and heavy equipment and provision of road safety awareness to the surrounding community, through corporation with the local police to ensure local residents be aware of increase in the level of transportation activities during the Project Construction				
			Project Owner to disclose the proposed grievance mechanism so that it is accessible for all villagers to report concerns associated with health and safety. Where complaints on accidents or near misses are submitted the Project will undertake an immediate investigation				
			Local communities should be familiarised with safety awareness and traffic management such as warning signs, limited speed and notifications of the risks of traffic accidents. This measure will need to be incorporated into the SEP				
			Project Owner should, where road conditions are poor occur as a result of Project activities, improve the road to ensure conditions meet the standard required for construction vehicle use				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Regular road condition monitoring along the transportation route to understand road quality during construction phase				
Impacts Associated with Construction Workers	■ Potential employment of child or forced labour; ■ Accidents, injuries or other health and safety risks, which can arise from inappropriate working conditions, such as lack of safety measures, excessive working hours and insufficient breaks; ■ Potential for discriminatory practices to occur in the hiring process; ■ Underpaid or delayed payments to workers; and	EPP	Coordinating with local authorities and relevant agencies to organise programs such as education and awareness raising for workers in terms of health and safety measures, and how to minimize or avoid conflict with local people	Project Owner	-	-	-
			Providing training to local people for them to be qualified to meet the recruitment requirements of the Project to increase local employment opportunities				
			Coordinating with local authorities to manage temporary resident registration for migrant workers and to monitor social security in the area where migrant workers will be accommodated				
		ESIA	Project Owner and EPC Contractor should maximise local employment	■ Project Owner ■ EPC Contractors	Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented.	-	As defined in the Social Management Plans
			Establish employment practices to check legal worker age in identification document upon recruitment to ensure no child labour or forced labour				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	■ Risk of association with non-compliance of contractors (e.g. service contracts) or third parties (e.g. recruitment agents) adhering to relevant laws and international standards and guidance		Establish employment practices that ensure workers are provided an easy to understand contract that specifies working hours, overtime hours, breaks, and holidays		Frequency and schedule for the monitoring and audits are as proposed in the SEP and internal-external Grievance mechanism		
			Establish employment practices that ensure workers are paid appropriately and in a timely manner, informed by national standards and industry benchmarks				
			Establish safeguards if recruitment agents are utilised. This includes pre-screening of potential agents and establishment of appropriate contractual obligations with the agent to ensure appropriate oversight is in place (so that workers are not placed in debt).				
			Establish a grievance mechanism for workers. This should include an option for grievances to be lodged anonymously. All workers, including those employed through the Project's supply chain, should have access to a grievance mechanism to ensure that their issues and concerns are identified and addressed. Contractors should be required to inform the Project about grievances raised. Disclose the				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			grievance mechanism to workers and local people				
			Collaborate with local/relevant authorities to organise educational or awareness-raising programs for local workers about their rights				
			EPC Contractor should register temporary residence for non-local workers to local authorities to ensure the management of Project's related workforce; Regularly engage with local authorities relevant to crime (i.e. local police) or other social problems (e.g. village leaders) for prevention of issues and for mitigation purposes when issues arise				
			EPC Contractor should conduct compulsory medical examinations (i.e. annual health check-ups) for Project workers, including contractors, as required by national regulations, to ensure they are fit for work and to monitor the prevalence of communicable diseases detected through annual medical check-ups				
			EPC Contractor should develop a Project Code of Conduct, and share the Project Code of Conduct with workers of				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			contractors and requesting their compliance				
			Project Owner and EPC contractors should ensure that the accommodation for immigrant workers meet the standards as guidance provided in the "Workers and Accommodation: Process and Standards" – a Guidance note by IFC and ERBD				
Benefits to local communities	Positive impacts on employment and procurement opportunities	EPP	-	-	-	-	-
		ESIA	Project Owner should hire local people for at least un-skilled positions	■ Project Owner ■ EPC Contractors	-	-	As defined in the Social Management Plans
			Encourage the contractors to hire local labour by provision of a clear stipulation/commitment of using local labour, particularly in regards of economically displaced households, in the EPC contract and instruct the EPC contractors to prioritise qualified local people as construction workers in accordance with the needs of the Project				
			Communicate clear information about Project-related employment and business opportunities and prioritize local people during both construction and operation phases. Such communication should be conducted as early as possible before				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			recruitment so that local people have enough time to prepare for the recruitment process (for example, by attending short training courses to improve their skills)				
			During construction phase, the Project Owner and the EPC contractor should work closely with local government agencies, particularly in Huong Phung, Huong Linh, Huong Tan and Tan Hop communes to synchronise the Project's needs in terms of local labour, as well as locals' capacity				
			The Project owner should develop and implement a Community Development Plan (CDP) to invest in the community. Development of the CDP should take the potential benefits (such as tourism potentials, small business opportunities) into account, utilize community's resources and consider the coordination with other wind farm developers in the Huong Hoa district. Disclose and conduct the monitoring of the implementation of this plan				
			At the end of construction phase, the Project Owner should consider to provide skill improvement training for those who will have worked for the Project in				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			construction phase, so that they can be able to access to similar jobs in other projects in the country				
			Project Owner should apply local procurement during construction and operation of the Project. In particular, the Project Owner should use local foods/products and local supply to enhance benefiting to the local communities				
			Establish a clear grievance mechanism as mentioned in previous section				
Operation phase							
Benefits to local communities	Positive impacts on employment and procurement opportunities	■ EPP ■ ESIA	Similar to measures proposed in Construction phase	■ Project Owner ■ EPC Contractors	-	-	-
Disturbance on Local Community	■ Impacts from operation noise of turbines and transformers	EPP	Planting trees to create green space to increase the aesthetics of the Project	-	-	-	As defined in the Social Management Plans

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	■ Impacts from shadow flicker		The reflected rays from the turbine blades generated by the reflection, can be minimised by optimizing the smoothness of the rotor surface as well as coating with less reflective material				
			Choosing the most advanced wind turbine available, the design is compact and compact, reducing the project's visual impact.				
		ESIA	Project Owner should keep implementing the SEP including grievance procedure during the Project's operation.	■ Project Owner ■ EPC Contractors	■ Ongoing monitoring and periodical audit as proposed in the ESMP to ensure the above mitigation measures are in implementation; ■ Monitoring and audit are also required to be conducted in accordance to the schedule proposed in	-	As defined in the Social Management Plans
			Project Owner should keep implementing the CDP to support the local people in improvement of their socio-economic conditions. The CDP should be implemented throughout the Project's operation period and considered as Corporate Social Responsibility program of the Project Company.				
			Project Owner should basic skill requirements for operation phase should be announced at least six months in advance so that local people can have				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			appropriate training orientation for themselves.		Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment		
			Project Owner should local procurement should be promoted during operation of the Project. In particular, the Project should use local foods/products and local supply to enhance benefits to the local communities.				
Pre-construction, Construction and Operation phases							
Impacts on Indigenous Peoples	■ Loss of livelihood and/or income from the land-based livelihood. ■ Social/cultural conflicts among the community. ■ Lack of Project information may lead to misunderstanding and unnecessary concerns about the Project impacts, and in the worst case, rejection to the	ESIA	Establish a Stakeholder Engagement Plan during construction and operations. The SEP should include an ICP process for the Indigenous People	Project Owner	Comply with the monitoring mechanism proposed in the SEP, LAA, LRP and CDP during the implementation of these plans	As defined in the SEP, LAA, LRP and CDP	As defined in the SEP, LAA, LRP and CDP
			Develop a Resettlement and Ethnic Minority Development Plan (REMDP) based on the results of socio-economic baseline survey and consultations with relevant local authorities and communities				
			Provide and communicate detailed information about the Project's plan and schedule particularly related to land clearing and construction to the community with a special attention to farmers nearby the project locations				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	Project development; ■ Potential impacts on cultural heritage (the Scared Forest) if any future activities of the Project affects those areas		Establish a grievance mechanism that is understood by and accessible for all villagers Review all public consultation process to ensure the continued access to natural resources independent of Project's land purchasing The provision of access, usage, and transit on land that the Project is developing on (i.e. access and use of land within the Project's footprint), subject to overriding health, safety, and security considerations to the Affected Communities of Indigenous Peoples In case of any future impacts to cultural heritages of Bru- Van Kieu people (i.e. the Sacred Forest), the Project Owner is required to conduct subsequent consultation with Affected Communities of Indigenous People to have a "good faith" negotiation have a mutual agreement on the compensation or additional support. The "good faith" negotiation should also be discussed during the public disclosure of ESIA or subsequently, when possible				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			A Chance Find Procedure should be developed for the pre-construction and construction phase, given that the Project is located nearby the IP's location with probably physical cultural heritage.				

APPENDIX A NOISE BASELINE REPORT

APPENDIX B BIRD STUDY REPORT (DRY SEASON)

APPENDIX C BIRD AND PRIMATE STUDY REPORT (WET SEASON)

APPENDIX D FLORA AND FAUNA STUDY REPORT

APPENDIX E IBAT REPORT

APPENDIX F LIST OF OBSERVED BIRD SPECIES DURING SURVEY

APPENDIX G LIST OF OBSERVED FLORA SPECIES DURING SURVEY

APPENDIX H LIST OF INVASIVE SPECIES

APPENDIX I LIST OF MIGRATORY SPECIES

APPENDIX J CRITICAL HABITAT ASSESSMENT

APPENDIX K SHADOW FLICKER MODELLING RESULT

APPENDIX L CUMULATIVE SHADOW FLICKER MODELLING RESULT

APPENDIX M DIFFERENT TOWER CONFIGURATIONS

APPENDIX N MINUTES OF AUTHORITIES MEETINGS

APPENDIX O LIST OF INTERVIEWED HOUSEHOLDS

APPENDIX P HOUSEHOLD QUESTIONNAIRE

APPENDIX Q PHOTO LOGS

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