



Vietnam Electrical Equipment Joint  
Stock Corporation (GELEX)

## Environmental and Social Impact Assessment

GELEX Huong Phung Wind Power Project,  
Quang Tri Province, Vietnam

26 August 2020

Project No.: 0537794

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### Document details

Document title	Environmental and Social Impact Assessment
Document subtitle	GELEX Huong Phung Wind Power Project, Quang Tri Province, Vietnam
Project No.	0537794
Date	26 August 2020
Version	1.0
Author	ERM Vietnam
Client Name	Vietnam Electrical Equipment Joint Stock Corporation (GELEX)

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### Document history

Version	Revision	Author	Reviewed by	ERM approval to issue		Comments
				Name	Date	
Draft	1.0	HN, HP, NV, PD, JG, JM, PT	AV, SP, SM, TL, HN	HP	26.08.2020	Issue to Client

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## Signature Page

26 August 2020

# Environmental and Social Impact Assessment

GELEX Huong Phung Wind Power Project, Quang Tri Province, Vietnam

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Hai Pham  
Operations Director

## ERM Vietnam

3rd Floor, Saigon Finance Centre  
09 Dinh Tien Hoang, Dakao Ward  
District 1, Ho Chi Minh City  
Vietnam

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## Acronyms and Abbreviations

Name	Description
@	at
Aol	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 Electricity
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 <sup>2</sup>	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 50MW wind power development in Huong Linh Commune, Huong Hoa District, Quang Tri Province, Vietnam.

The Project comprises of 12 wind turbine generators (WTGs) with total installed capacity of 50 MW, in which five turbines with a capacity of 4.0MW and seven turbines with a capacity of 4.2 MW in mountainous area of central Vietnam. The Project will consist of 12 wind turbines which will all be connected to 1.5 km of 110kV transmission line and 11.8 km of 22kV transmission line. The Project is scheduled to generate electricity by the end of Quarter 2 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 Joint Venture of SCI PMC Joint Stock Company and COEE Joint Stock Company. A local Environmental Impact Assessment (EIA) for Huong Phung 2 Wind Power Project was prepared whilst Local Environmental Protection Plans (EPP) was prepared for Huong Phung 3 Wind Power Plant by Centre for Natural and Environmental Monitoring of Quang Tri Province and both 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 cash crops, agricultural land and build-up area. The area within 100m buffer from transmission line is dominated by moderately dense vegetation cover, such as agricultural land and forest. The area within a radius of 50km includes five Key Biodiversity Areas in which two are within Vietnamese territory whilst the other three are under management of Laos, three Important Bird and Biodiversity Areas and three 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 one species listed as Endangered species and one Near-Threatened species in IUCN Red List. As for

fauna species, no species have been identified based on the screening assessment that are likely triggering Critical Habitat. Avifauna species were also surveyed, notably, bats were recorded to exist and most active outside Project footprint along transmission line.

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

## Social Context

The total number of households that were directly affected by the Project is 85 households in three villages: Cop, Huong Choa and Phung Lam. No affected households were physically displaced; all affected households within the Project area were economical displaced through land acquisition process. Thirteen out of 85 affected households by land acquisition are Van Kieu ethnic minorities; however, it should be noted that the exact number of affected households will be confirmed once the final CSR plans for the Project are completed. The main livelihood of local people in the affected area were predominated 85% of the surveyed households engaging in cultivation (Rice cultivation is mainly for domestic use, while coffee and cassava are for a commercial purpose). Even when local people have a secondary occupation, a majority of them works as hired labourers. 25% of surveyed population see their work as temporary.. 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
<b>Environmental Impacts</b>				
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 Erosion	IFC PS3	Construction	Minor	Negligible
Soil Contamination	IFC PS3	Construction	Minor	Negligible
Loss of Habitat	IFC PS6	Construction	Negligible	Negligible
Disturbance and/or Displacement of Fauna	IFC PS6	Construction	Negligible	Negligible
Barrier Creation, Fragmentation and Edge Effects	IFC PS6	Construction	Negligible	Negligible
Degradation of Habitat	IFC PS6	Construction/ Operation	Negligible	Negligible
Mortality – Vehicle Strike, Hunting and Poaching	IFC PS6	Construction	Negligible	Negligible

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	Moderate	Minor
Landscape & Visual Amenity	IFC PS4	Construction	Moderate	Minor
		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	Minor	Negligible
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	Moderate
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 Negligible for both construction and operation phases due to relatively low density of species. 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 Negligible after mitigation measures were applied during construction phase given the Project area is located within heavily modified habitat.
- **Land Acquisition and Economic Displacement:** With a limited number of directly affected people (85 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 Phung 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 impact is considered Minor given adjacent projects are under planning process. Cumulative social impacts are mostly considered as Moderate.

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

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 Huong Phung 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 Huong Phung 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.

### 1.2 Project Background

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. 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. Therefore, three 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 Distirct 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, Huong Phung Wind Power Project in Quang Tri Province is 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.

Huong Phung Wind Energy Ltd, a subsidiary of GELEX, has been developing the Huong Phung Wind Power Project. The Huong Phung Wind Power Project has a designed capacity of 50MW with an investment of more than 2,196 billion VND (over 94.05 million USD).

The project is in line with Wind Power Development Plan of Quang Tri Province under Decision No. 6185/QD-BCT dated 19th June 2015 of the Ministry of Industry and Trade on Power Development Plan in Quang Tri Province up to 2020, a vision towards to 2030 which targets wind power energy in Quang Tri province to reach the capacity of 287 million kWh by 2020.

In order to comply national investment approval process, the Project proponent firstly divided the Project into 02 separate projects, named "Huong Phung 2 Wind Power Project" and "Huong Phung 3 Wind Power Project". Two projects got Approval of Adjustment of Investment Intention by the Quang Tri People's Committee under Decsion No 2939/QD-UBND, dated 17 December, 2018 for Huong Phung 2 Wind Power Project and Decision No. 1621/QD-UBND, dated 27 June, 2019 for Huong Phung 3 Wind Power Project. In order to prepare the project, GELEX had completed a Feasibility Study in 2019, which was conducted by Joint Venture of SCI PMC Joint Stock Company and COEE Joint Stock Company. A local Environmental Impact Assessment (EIA) for Huong Phung 2 Wind Power Project was approved by Quang Tri Province People's Committee under Decision No. 1617/QD-UBND dated June 10<sup>th</sup>, 2019. Consulting unit Centre for Natural and Environmental Montoring of Quang Tri Province conducted sampling and sample analysis and also involved in developing local EIA report. Meanwhile, a local Environmental Protection Plan for Huong Phung 3 Wind Power Project was prepared by same

consultant unit above and was approved by Quang Tri Province Department of Natural Resource and Environment under Document No 2005/ GXN -STNMT dated 25th June 2019.

Given that the Project proponent seeks international finance for these projects, so the ESIA is prepared for the Project named as Huong Phung Wind Power Project which including all project components of Huong Phung 2 and Huong Phung 3 Wind Power Project.

Huong Phung Wind Power Plant is located in Huong Phung Commune, Huong Hoa District in Quang Tri Province. According to the Feasibility Study Report, the Project's study area will cover an area of 350 ha. The Project's footprint will be 30.88 ha; of which 12.931 ha will be acquired as fixed-term use for the duration of the Project lifecycle; 17.949 ha will be temporarily acquired for construction activities and safety corridor of 110kV transmission line. The Project has the following key components (See Figure 1.1):

- 12 turbines with total capacity of 50.4 MW (five turbines with a capacity of 4.0MW for each and seven turbines with a capacity of 4.2 MW for each)
- A 22/110kV substation;
- Approximately 1.5 km 110kV transmission line to be connected to the 110kV transmission line of the Huong Phung 1 Wind Power; then connects to Lao Bao 110/220kV substation which is under construction.
- About 11.8 km overhead 22kV transmission line that connects all turbines;
- Upgrading the intercommunal road from the west branch of the Ho Chi Minh Road and building 6.87 km internal road within the Project area.

Huong Phung Wind Power Project started construction in Quarter 2 of 2019 and is scheduled to begin generating electricity in Quarter 2 of 2021. The Huong Phung Wind Power Project is expected to add 190 million kWh of electricity to the national power output.

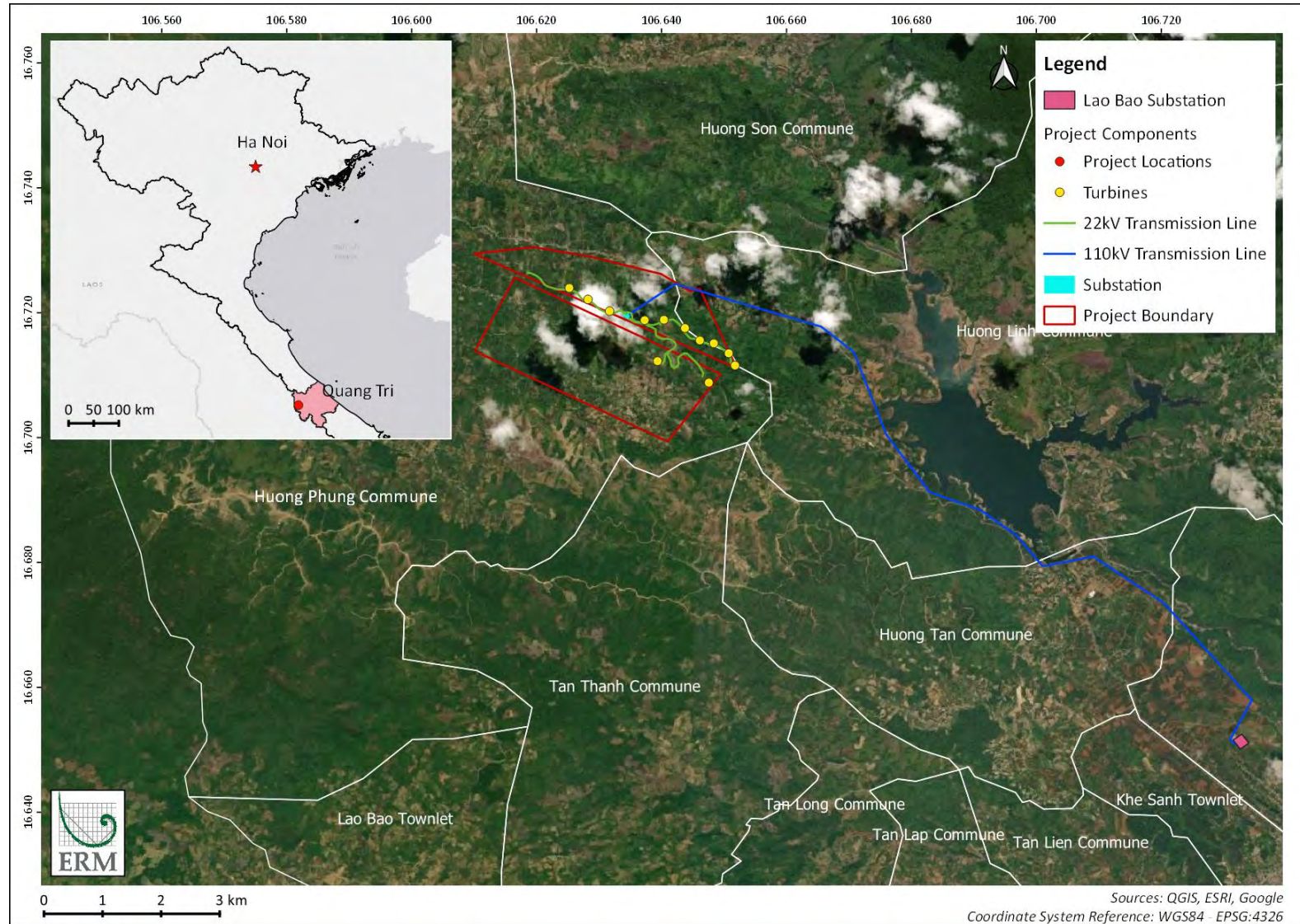


Figure 1.1 Project location

### 1.3 Environmental and Social Impact Objective

The objective of this ESIA is to assess potential impacts of the wind power project on the environment 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 Huong Phung Wind farm JSC's (GELEX) application for finance from International Lenders.

### 1.4 Scope of Baseline and Impact

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

**Table 1.1 Scope of Baseline and Impact Assessment**

Topic	Scope of Work
<b>Baseline survey</b>	
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 analysis.
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;

Topic	Scope of Work
	Determine stakeholder engagement/disclosure activities to date, including the nature of information and the medium of disclosure; 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.
<b>Impact Assessment</b>	
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 Environment	Assess impacts on Changes to physical and chemical soil properties
Air Quality	Emissions of NO <sub>x</sub> , SO <sub>x</sub> , 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
<b>Executive Summary</b>		
1	1	Introduction
	2	Project Description
	3	Administrative Framework
	4	Impact Assessment Methodology
	5	Screening and Scoping
	6	Stakeholder Engagement
2	7	Environmental Baseline
	8	Biodiversity Baseline

Volume	Chapter	Chapter Title
	9	Social Baseline
3	10	Environmental Impact Assessment
	11	Social Impact Assessment
	12	Unplanned Event
	13	Cumulative Impact Assessment
	14	Environmental and Social Management Plan
Appendices		

## 2. PROJECT DESCRIPTION

### 2.1 Introduction

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.

### 2.2 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) “no project scenario”; (ii) Project site selection alternatives, (iii) Alternatives methods of power generation and (iv) the chosen technology.

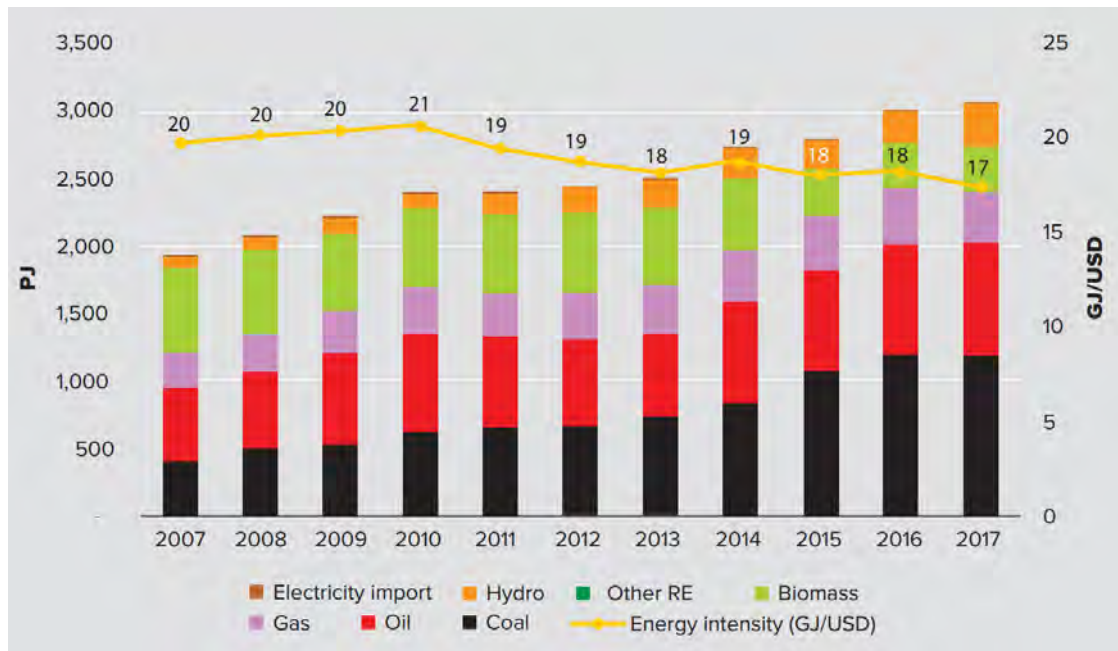
#### 2.2.1 No Project Scenario

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<sup>1</sup>) 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.

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<sup>1</sup> 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.

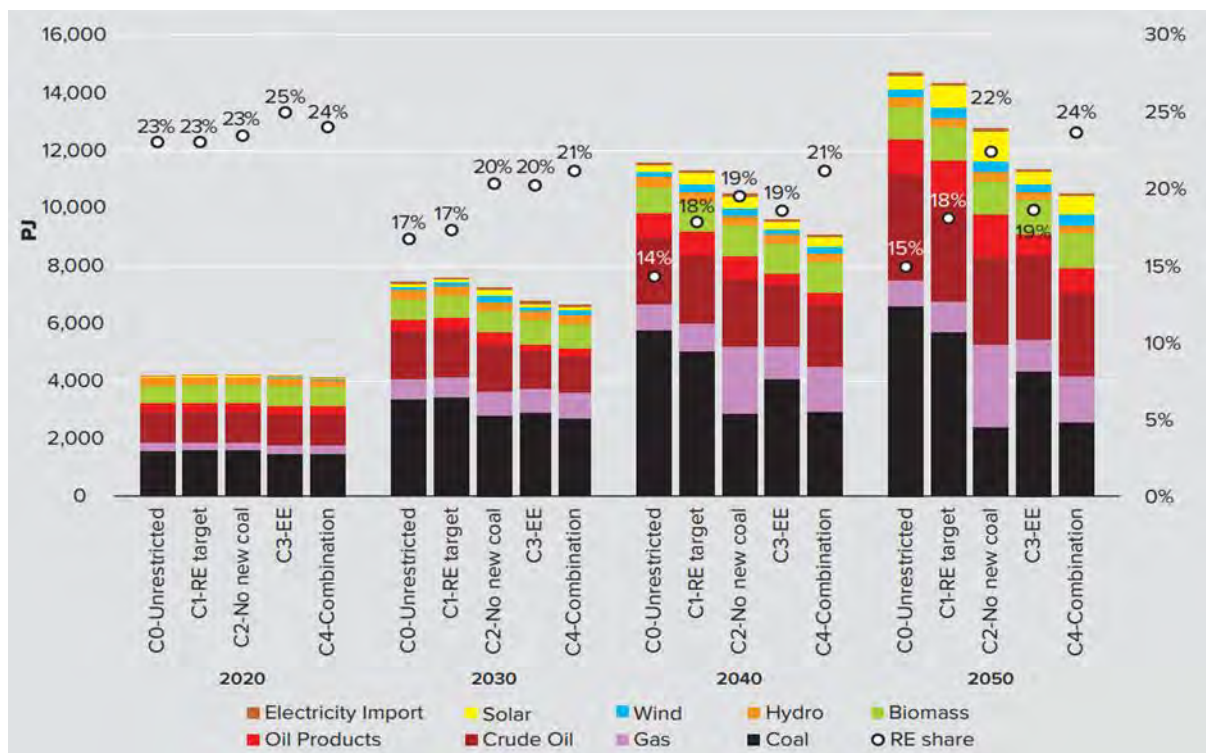




Source: Vietnam Energy Outlook Report, 2019

**Figure 2.1 Progress of Primary Energy Supply Between 2007 and 2017**

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.

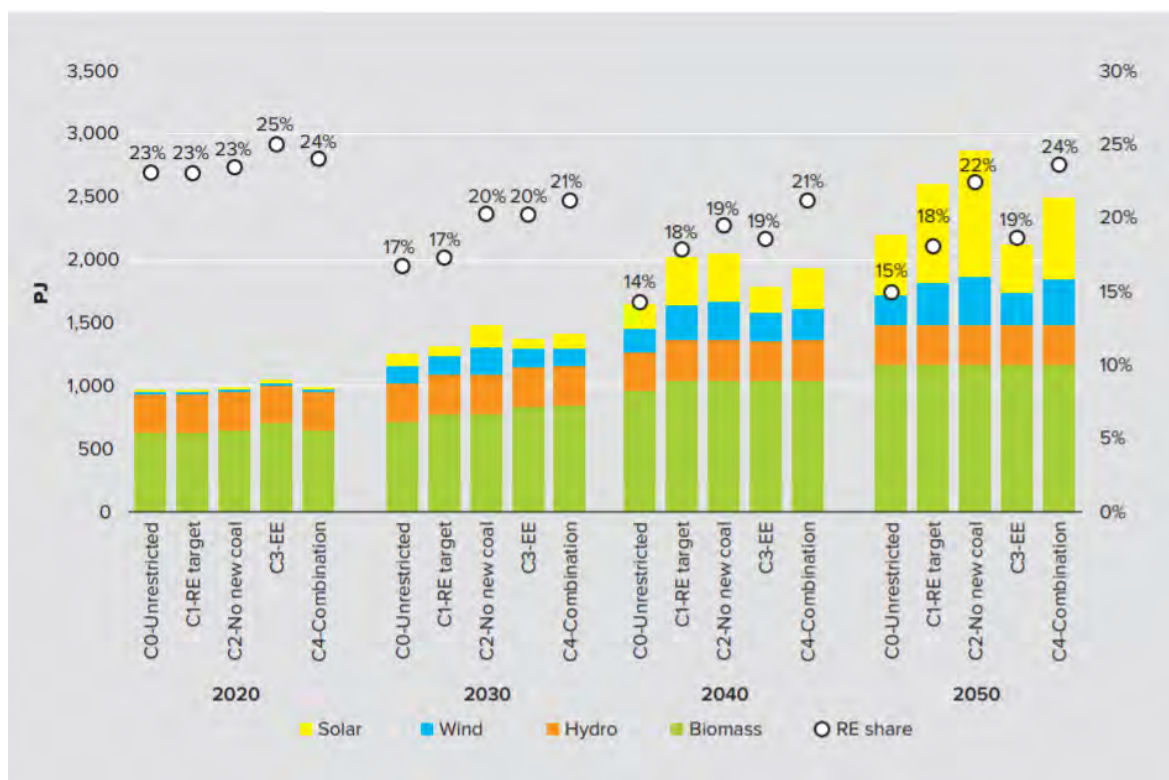


Source: Vietnam Energy Outlook Report, 2019

**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)



**Figure 2.3 Renewable energy sources and their share in TPES for all analysed scenarios<sup>2</sup>**

Source: Vietnam Energy Outlook Report, 2019

<sup>2</sup> C0- Unrestricted: A theoretical scenarios not taking policy constraints into account, such as RE targets, restriction on coal – fired generation, successful Energy Efficiency penetration.

C1 RE target: A scenario where RE power sector targets in the REDs are fulfilled, without EE penetration.

C2 No new coal – C1 scenario with the addition of the constraint of no investment in new coal power plant after 2025

C3 Energy efficiency – C1 scenario with the addition of least – cost EE technology penetration rate of 50% in 2030 and 100% in 2050.

C4 Combination – The most ambitious scenario combining the three scenarios C1, C2 and C3.

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, and not one that Vietnam is currently sharing in. 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.

## 2.2.2 Site Location Alternative

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 measurement stations set up in Huong Linh 1, 2 wind power project 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 6185/QD-BCT, dated 19 June, 2015 on “Power Development Plan of Quang Tri Province up to 2020, a vision towards to 2030” and Decision No 4946/QD- 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 sites were selected by MoIT due to some main factors as follows:

- The selected sites have relatively good meteorological, topographical and geological conditions such as superior wind speed.
- The Project boundaries do not overlap with other Projects.
- The site is located at allowable distance from any key sensitive receptors such as community settlement in accordance with national regulation (Circular 02/2019/TT-BCT, dated January 15, 2019 on Wind Power Project development and Power Purchase Agreement for Wind Power Project, which requires “the wind power work must be 300m away from the residential area”). In

reality, the closest village to the Project site is Cop village, Huong Phung commune, which is about 500 m to the turbine No.10;

- The selected sites have enough area to arrange facilities and equipment of the plant with a selected capacity scale and technologies, and conditions for possible extent in the future, and limited volume of clearance and resettlement.
- The site locations are feasible for connecting the plant to national power system;
- The sites were selected in the area with low population density; and
- The sites have been in line with local authority's development planning for the whole area and are concurred and supported by Quang Tri Province People's Committee under the Decision No. 2939/QD-UBND, dated December 17, 2018 for Huong Phung 2 Wind Power Plant and the Decision No. 332/QD-UBND, dated February 18, 2019 for Huong Phung 3 Wind Power Plant.

### 2.2.3 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 prioritised, 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 Comparison of Power Generation Methods**

System	Advantage	Disadvantage
Supercritical Thermal Power	<ul style="list-style-type: none"> <li>■ Large-scale production potential</li> <li>■ Moderate gestation period Wider distribution potential</li> <li>■ Provides cheap electricity to the consumer</li> <li>■ Provide stable output and reliable electricity on the grid</li> <li>■ Easily accessible and well established technology</li> <li>■ Requires less land per Megawatt</li> </ul>	<ul style="list-style-type: none"> <li>■ High fossil fuel consumption</li> <li>■ Large quantities of water required for cooling</li> <li>■ High volume of emission from operation</li> <li>■ Accumulation of fly ash (in case of coal powered installations)</li> <li>■ Upstream impact from mining and oil exploration</li> </ul>
Ultra Supercritical Thermal Power	<p>In addition to the above advantages:</p> <ul style="list-style-type: none"> <li>■ Improved efficiency by reaching higher pressure and temperatures compared to supercritical boilers.</li> <li>■ Reduced emissions, particularly of CO and mercury.</li> <li>■ The general rule of thumb is that each percentage point of efficiency improvement yields 2–3% less CO.</li> <li>■ Potentially lower operating costs</li> </ul>	As above.
Hydropower	<ul style="list-style-type: none"> <li>■ GHG emission estimated as low</li> <li>■ Do not create any waste by-products during conversion process</li> <li>■ 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</li> </ul>	<ul style="list-style-type: none"> <li>■ Site specific, dependent on reservoir/ river</li> <li>■ Long gestation period</li> <li>■ Alteration of river flow regime</li> <li>■ Adverse social and ecological impacts due to inundation and downstream effects</li> </ul>
Solar power	<ul style="list-style-type: none"> <li>■ Pollution levels are insignificant</li> <li>■ Inexpensive power generation</li> <li>■ Inexhaustible solar resource</li> <li>■ GHG emissions estimated as low</li> </ul>	<ul style="list-style-type: none"> <li>■ Large land requirement</li> <li>■ Site-specific, dependent on solar insolation</li> <li>■ Expensive installation</li> </ul>

System	Advantage	Disadvantage
Wind power	<ul style="list-style-type: none"> <li>■ Pollution levels are low</li> <li>■ Inexpensive power generation</li> <li>■ Inexhaustible wind resource</li> <li>■ GHG emissions estimated as low</li> </ul>	<ul style="list-style-type: none"> <li>■ Large land requirement</li> <li>■ Site-specific, dependent on wind pattern</li> <li>■ Expensive installation</li> </ul>
Nuclear power	<ul style="list-style-type: none"> <li>■ GHG emissions estimated as low</li> <li>■ Low fuel cost</li> <li>■ 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</li> <li>■ Do not emit smoke particles or gases</li> </ul>	<ul style="list-style-type: none"> <li>■ Availability of fuel source</li> <li>■ Hazards associated with radioactive material</li> <li>■ High cost of project</li> <li>■ Disposal waste is expensive, as wastes are radioactive in nature</li> <li>■ Long gestation period</li> <li>■ Risk of fallout and meltdown scenarios and its impacts on the local population and environment</li> </ul>

## 2.2.4 Technology Alternative

During the Feasibility Study, from the onset of the Project development, the Project developer approached different turbine providers as EPC contractors for the Project's development. At that time, the Project developer provided preliminary designs for the layout of the turbines and technologies selected in accordance with Project's specification. The wind turbine technologies that were considered for Huong Phung Wind Power Plant are summarized in Table 2.2.

**Table 2.2 Wind turbine technology Alternative for the Project Development**

No	Turbine Technology	Turbine capacity (MW)	Hub height (m)	Rotor Diameter (m)	IEC Classification
1	Siemens 3.3 –D132	3.3	84	132	IIIA
2	Siemens 3.4 –D132	3.4	89	132	IIIA
3	GE 3.2 –D130	3.2	85; 110	130	III
4	GE 3.4 –D137	3.4	110	137	IIIB
5	Vestas 3.45 – D136	3.45	82;112	136	IIIA/IIIB

According to Detailed Design Report, the Project Developer has provided calculation to select the optimized wind turbine technology. The result has shown that turbines shall be installed at the height ranging from 80 m to 110 m with a minimum distance between each turbines of 3 diameter and capacity ranging from 3.0 MW to 3.6 MW will generate the higher electricity. Therefore, the Project Developer selected turbine technology Siemens 3.3 MW D132 H84 for calculating basic technical and economic indicators of the Project.

During the Detailed Design, Huong Phung Wind Energy Ltd has selected the latest wind turbine technology from ENERCON with turbine type E-138-4.2MW for the following reasons:

- Turbines with high capacity can utilize to the maximum extent of project's area and wind condition in project site in order to generate high power production;
- Using high capacity turbines means the number of wind turbines will decrease, so capital cost and construction cost will reduced accordingly; and
- Less wind turbines to be used means impacts from construction phase on terrestrial habitat as well as impacts from operation phase (e.g. noise, shadow flicker, landscape, visual amenity, avifauna disturbance and mortality) can be reduced.

Hence, the environmental and social impact assessment conducted was based on the selected turbine layout and specification.

## 2.3 Project location

The Project's footprint is located within 30.88 ha in Huong Phung Commune, Huong Hoa District, Quang Tri Province (Figure 2.4). The project is located in an area with large wind power potential of Quang Tri Province which annual wind speed reaches more than 7m/s, laid in zone 1 on the map of Quang Tri Province's Wind Power Master Plan up to 2020, a vision to 2030 under Decision No. 6185/QD-BCT, dated June 19<sup>th</sup>, 2015 by Ministry of Industry and Trade. The site is located within a Northwest mountainous region and the topography is relatively flat with an altitude of 450m – 500m above the sea level. The site terrain includes low mounds with gentle hillside, lowers from Southwest to Northeast. The pattern of vegetation within project site is mostly coffee, jackfruit, *melaleuca* and cassava, etc. A small stream Pa Rong is located 530m northwest of the project area, flow from Southeast to Northwest and joint to Sen river in Phung Lam Village of Huong Phung Commune.

In addition, a number of small stream flows from East side to West side are located in turbine area, then discharge to Sen river, is being used for domestic activities, agricultural irrigation and aquatic production. A Rao Quan lake is also positioned 2.5 km of the project area in Huong Linh Commune, Huong Hoa District and is being used for water supply for Quang Tri hydro power plant.

The physical surrounds of the Project are described below:

- To the North: the project is adjacent to Huong Son, Huong Hiep, Huong Lap Communes, Huong Hoa District;
- To the South: the project is adjacent to Tan Thanh and Tan Long Communes and Lao Bao Town, Huong Hoa District;
- To the West: the project is adjacent to Lao People’s Democratic Republic;
- To the East: the project is adjacent to Huong Hiep Commune, Dakrong District.

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

**Table 2.3 Locations of Project area**

Landmark	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
1	16.72557875	106.6166433
2	16.71015518	106.6494348
3	16.69932702	106.6409731
4	16.71384229	106.6100565
5	16.72557875	106.6166433
6	16.72384618	106.6461169
7	16.72343991	106.6445916
8	16.72620496	106.6398696
9	16.72904294	106.6282816
10	16.73048143	106.6194998
11	16.72944937	106.6099015
12	16.71112276	106.6520057
13	16.72384618	106.6461169

**Table 2.4 Locations of Project’s wind turbines**

Turbines	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
W01	16.71154	106.6518
W02	16.71349	106.6507
W03	16.71508	106.6484



Turbines	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
W04	16.71555	106.6461
W05	16.71753	106.6437
W06	16.71886	106.6404
W07	16.71879	106.6373
W08	16.72024	106.6317
W09	16.72212	106.6282
W10	16.72395	106.6252
W11	16.70879	106.6476
W12	16.71223	106.6393

### 2.3.1 Wind Turbine Layout

The entire wind power project, including twelve (12) wind turbines, is expected to be built within a northwest mountainous region and the topography is relatively flat with an altitude of 450m – 500m above the sea level.

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;
- Shielding performance of 90% or more;
- 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

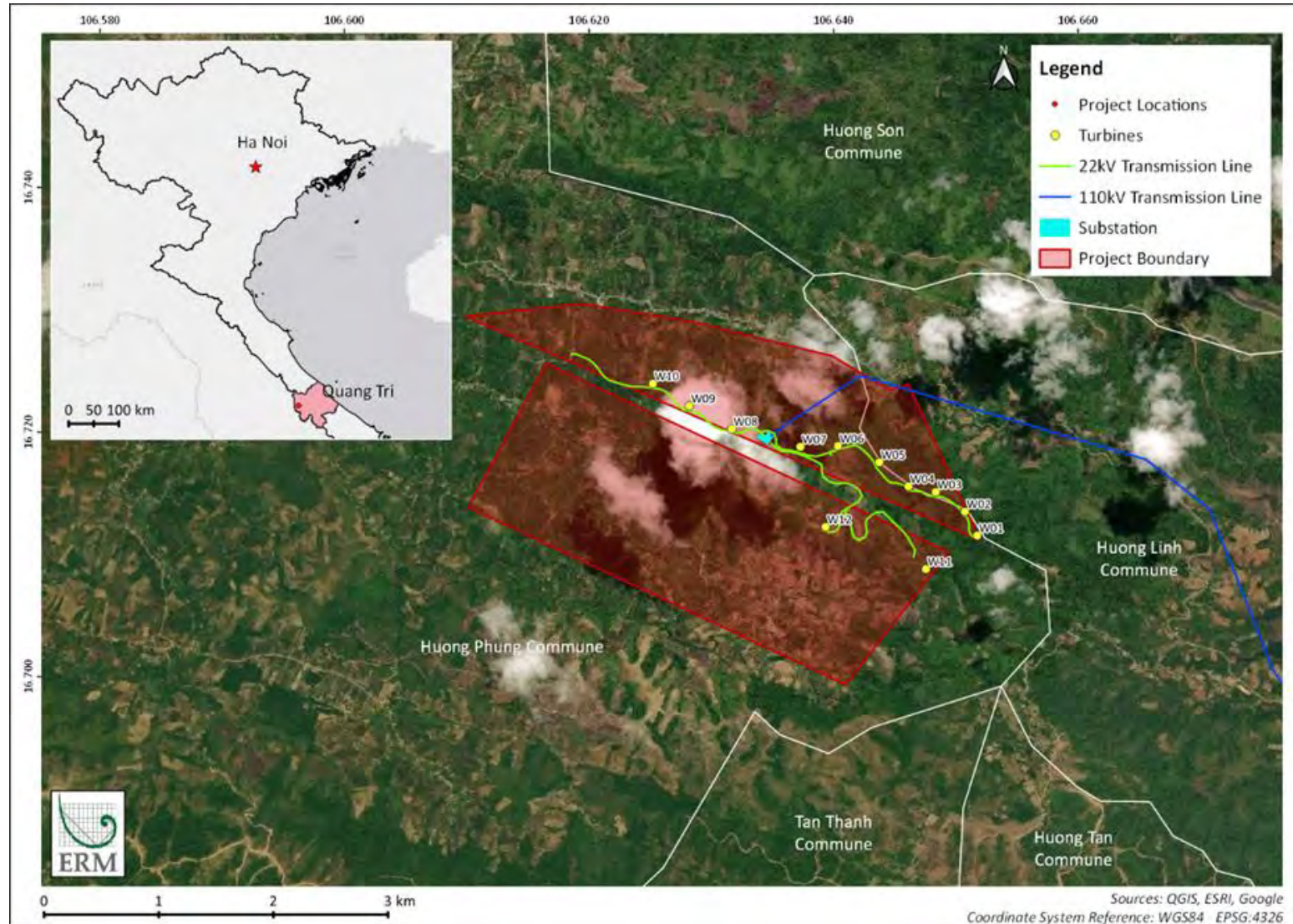


Figure 2.4 Project's wind turbine layout

### 2.3.2 Substation

The 22/110kV lift transformer station with a capacity of 63MVA is being built in Huong Phung Commune within the Project area. The substation takes up about 1.33 ha and is located between turbine No. 7 and turbine No 8. The substation is approximately 800m from the nearest residential area. Table 2.5 and Figure 2.4 illustrate the location of project substation.

**Table 2.5 Location of substation**

Landmark	Coordinates (WGS84)	
	Latitude (m)	Longitude (m)
1	16.71973	106.6333
2	16.72014	106.6336
3	16.71975	106.6342
4	16.71997	106.6344
5	16.71942	106.6352

### 2.3.3 110kV overhead transmission line

According to Power Development Master Plan of Quang Tri Province, an overhead 110kV transmission line with a length of 1.56 km will be constructed to connect to the 110kV transmission line of the Huong Phung 1 Wind Power Plant, then connects to Lao Bao 110/220kV substation. It is noted that Huong Phung 1 Wind Power Plant and Lao Bao 110/220kV substation are under construction. The 110kV transmission line will pass through mainly land for perennial crops and vacant and unused land.

### 2.3.4 22kV overhead transmission line

The 11.8 km overhead 22kV transmission line will be built that connects all turbines to collect electricity output from 0.69/22kV transformers and then connect to 22/110kV project's substation.

The layout of 22kV transmission line is presented in Figure 2.4.

## 2.4 Project Schedule

The schedule for Project Implementation is shown in detail in the following Table 2.6.

**Table 2.6 Huong Phung Wind Power Project Schedule**

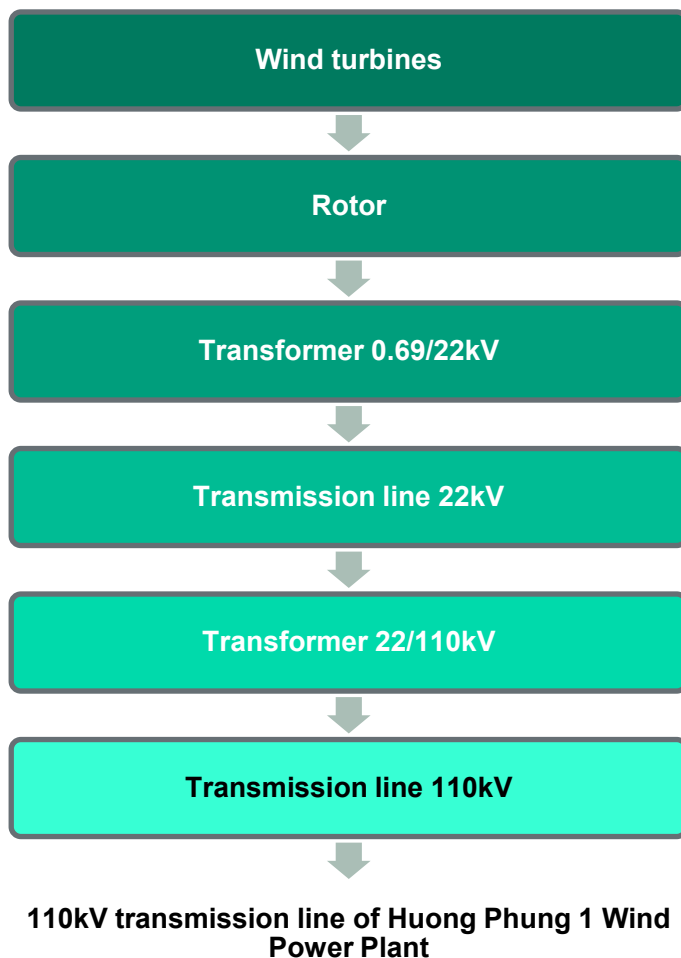
No.	Timeframe	Duration	Milestone	Activity
1	January 2019 – June 2019	6 months		<ul style="list-style-type: none"> <li>■ Seek approval of Intention Investment Decision and legal procedures</li> <li>■ Survey, prepare Feasibility Study report</li> <li>■ Seek approval of the Feasibility Study report</li> </ul>
2	June 2019 – December 2019	6 months		<ul style="list-style-type: none"> <li>■ Conduct Inventory of Loss; Land Clearance</li> <li>■ Bidding, Negotiating and signing EPC contract</li> </ul>
3	March 2020– May 2020	4 month	5/2020	Prepare Detailed Design, Detailed Design for Wind farm and substation

No.	Timeframe	Duration	Milestone	Activity
4	June 2019 – July 2020	14 months		Receive Site and Construct the infrastructure
5	May 2020 – January 2021	9 months	1/2021	Sign Equipment purchasing contract and receive equipment,
6	May 2020 – May 2021	13 months	5/2021	<ul style="list-style-type: none"> <li>■ Construct the foundations of the wind turbines.</li> <li>■ Construct the 22/110 kV substation, 22kV transmission line.</li> </ul>
7	November 2020 – May 2021	7 months	5/2021	Transport turbines to site and Install wind turbines.
8	June 2021	1 months	6/2021	Trial for operation, and begin operation.
Estimated project duration				29 months

The project is expected to be operational for a period of 50 years.

## 2.5 Project Facilities and Components

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



**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 dual circuit of 110kV transmission line of Huong Phung 1 Wind Power Plant.

## 2.5.1 Wind turbines

### 2.5.1.1 Rotors

According to Feasibility Study Report 2020 of Huong Phung Wind Power Project, there are twelve (12) wind turbine towers to be built, one for each turbines. The key specification of chosen turbine is presented in Table 2.7 below:

**Table 2.7 Huong Phung 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.

### 2.5.1.2 Transformer 0.69/22kV

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

Source: Feasibility Study Report, 2019.

## 2.5.2 110 kV Transmission line

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

Specifications	
Length	1.56 km
Type	Overhead
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 HP 1 Wind Power Plant (at the km 5.0)
Cable	ACSR 240/32
Lightning rod	01 GSW-50 lightning protection cable, 01 lightning protection cable with OPGW-57 optical cable (12 fiber-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 galvanized steel

### 2.5.3 22kV transmission line

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

Specifications	
Length	11.8 km, of which 6.4 km of 01-circuit cable and 5.4 km of 02-circuit cable
Type	overhead
No. of circuits	1 and 2 circuits
Cable	ACSR – 185/29mm <sup>2</sup>
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

### 2.5.4 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.

### 2.5.5 Access and Internal Road System

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. 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.

An internal road system will be built 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 6.867 km, respectively.

### 2.5.6 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.

## 2.6 Project Activities

### 2.6.1 Pre-construction phase

The Pre-construction phase will include two main activities:

- Preparation of the detailed design and layout of wind turbines within the Project site and other infrastructure (substation, transmission lines, operation and maintenance facility, auxiliary works, etc.);

- 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; 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 2.8 Area of Land for the Project**

No.	Items	Area (ha)					Total (ha)
		Protection Forest Land	Land for Perennial crops	Land for Annual crops	Vacant land for forestry	Other land <sup>3</sup>	
<b>Fixed-term used land</b>		<b>0.987</b>	<b>7.820</b>	<b>0.136</b>	<b>5.604</b>	<b>1.344</b>	<b>15.891</b>
1	Turbine foundation and safety corridor	0.317	1.099	0.013	1.106		<b>2.534</b>
2	Substation 22/110 kV and operation house,		0.415	0.035	1.027		<b>1.478</b>
3	Pylon and 22kV transmission line		0.710	0.057	0.937		<b>1.704</b>
4	Pylon and 110kV transmission line		0.258	0.017	0.533		<b>0.807</b>
	Warehouse and auxiliary works		1.320		0.510		<b>1.830</b>
5	Traffic road system (Upgraded inter-village road and build new internal road)	0.670	4.018	0.015	1.491	1.344	<b>7.538</b>
<b>Temporarily-used land</b>		<b>0.400</b>	<b>6.834</b>	<b>0.074</b>	<b>7.315</b>	<b>0.373</b>	<b>14.995</b>
6	Temporary excavated soil site		1.580		1.500		<b>3.080</b>
7	Laydown area	0.400	0.802		1.126	0.123	<b>2.452</b>
8	Crane Installation Site area		1.675		1.500	0.125	<b>3.300</b>
9	Concrete batching plant		0.5		1.500		<b>2.000</b>
	EPC office house				0.015		<b>0.015</b>
	Worker camp				0.054		<b>0.054</b>
10	Safety corridor of 110kV transmission line		0.827		0.556		<b>2.638</b>
11	Safety corridor of 22kV transmission line		1.450	0.074	1.063	0.126	<b>1.457</b>
<b>TOTAL AREA</b>		<b>1.387</b>	<b>14.654</b>	<b>0.21</b>	<b>12.919</b>	<b>1.717</b>	<b>30.887</b>

<sup>3</sup> Other land includes residential land in rural area, public land for transport purpose, land for infrastructure construction.



## 2.6.2 Construction Phase

Key activities of the Construction Phase will include:

- Construction/establishment of the cement batching plant;
- Construction of turbine foundations, 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;
- Construction of temporary worker camp, warehouse, auxiliary works; and
- Commissioning.

### 2.6.2.1 Wind turbine layout construction

#### 2.6.2.1.1 *Turbine foundation*

The turbine foundation is a high-strength reinforced concrete foundation on the pile foundation. It 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 M500; stones of 1x2 and bearing steels. Round shaped turbine foundation will be built with diameter of 4m, depth of 3.7m. Bolt round links are extensively used to connect the foundation and the turbine. Figure 2.6 and Figure 2.7 illustrate the basic structure of turbine foundation.

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

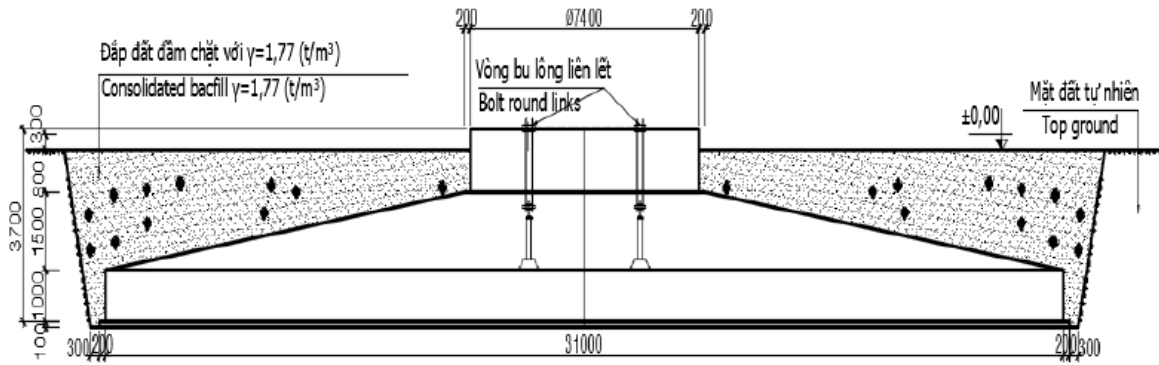


Figure 2.6 Cross-section layout of round-shaped turbine foundation

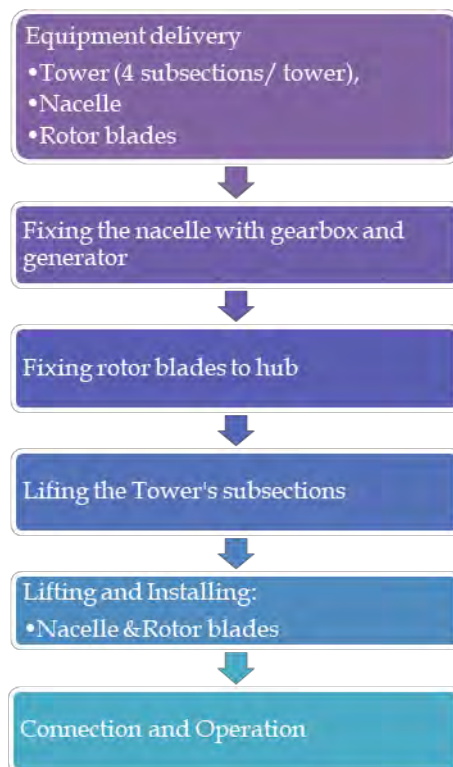


Figure 2.7 Round-shaped turbine foundation

### 2.6.2.1.2 Turbine installation

After completing construction of the wind turbine foundation, the next steps will be to assemble 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 2.8.



**Figure 2.8** Flow Chart of Turbine Installation Process

### 2.6.2.2 Substation and operation house

A substation 22kV/110kV will be developed with a total estimated capacity of 63 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.

### 2.6.2.3 Transmission line

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 20m of height.

- Installation of insulation and accessories;
- Straining of rope to measure deflection;
- String power lines; and
- Grounding installation work.

#### 2.6.2.4 Power Supply

According to the regulatory EIA 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.

#### 2.6.2.5 Water Supply

According to Construction Plan provided by Client, water for the construction activities, domestic usage will be estimated about 262.5 m<sup>3</sup> daily, which is to be stored in temporary 100m<sup>3</sup> water storage tank with the size of 5 x10 x 2m.

Source of water use should be taken from natural streams within the Project footprint and ground water from 03 predefined wells. Water supply for concrete batching area and worker's camp area will be pumped from water storage tank by diesel D18 pump and will transverse through D34 pipeline. Due to small volume of wastewater from domestic use and construction use, the Project owner will install several mobile toilets on site which have septic tank for wastewater collection and treatment.

#### 2.6.2.6 Transportation of major equipment and material

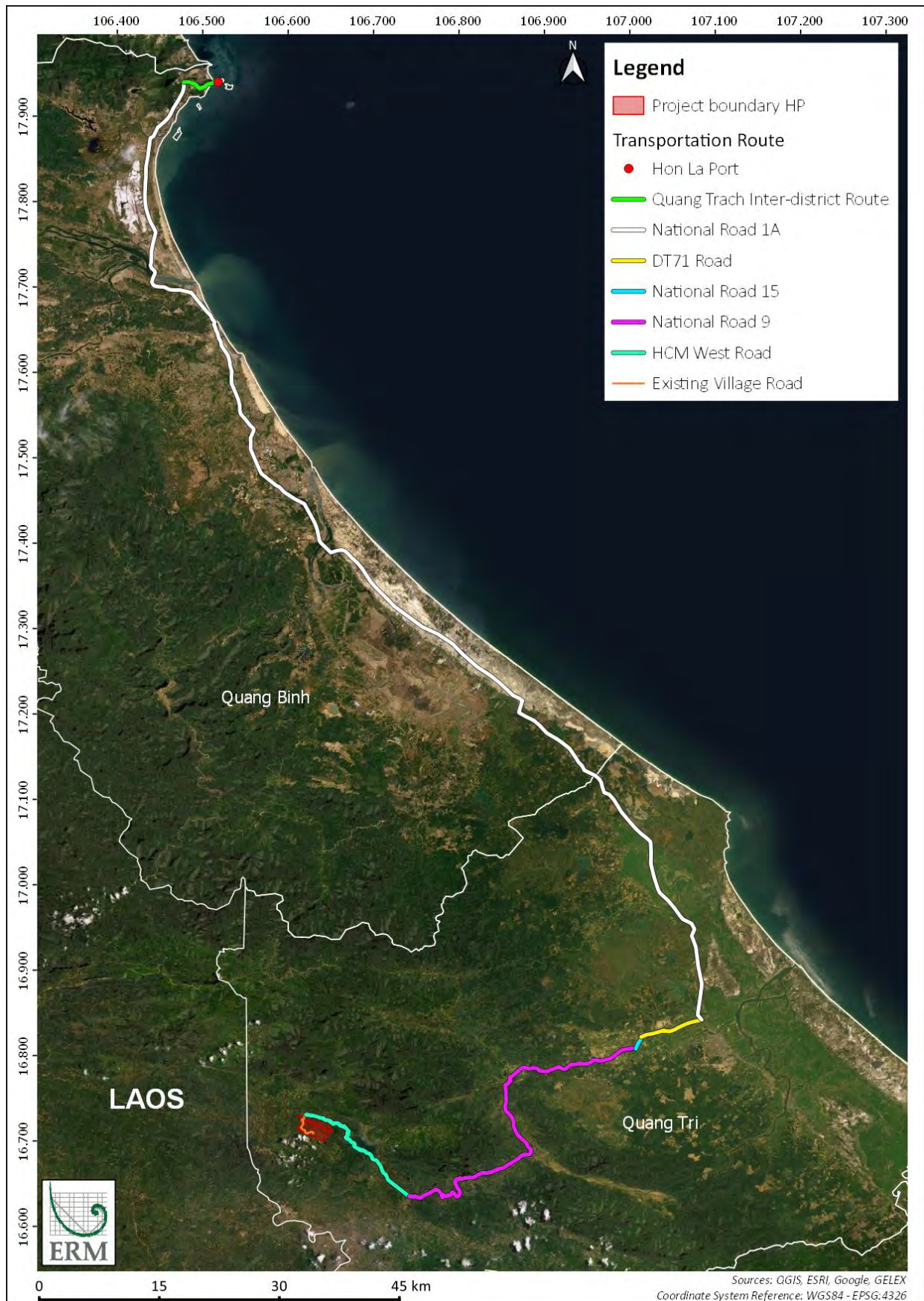
Main major equipments (wind turbines, propeller, transformer...) are usually imported from foreign firms, as are high-strength bolts with fatigue design which are used to connect the columns. These equipment will be transported by sea and then unloaded to Hon La port, Quang Dong Commune, Quang Trach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

Special trailer crane will be used to unload these equipment and then use specialized vehicle to 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 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 Cõp, Phung Lam, Huong Choa of Huong Phung Commune, which has a length of 4.6km from the Western Ho Chi Minh Trail road. This road is uncompleted paved with a width of 2 -3m and covered with red dirt and currently being used by local forest farmers for transporting plantation timber and agricultural products.

The total length of transportation route from Hon La Port to the Project site is approximately 243km.

In term of sourcing 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 2.9** Equipment transportation route

### 2.6.3 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.;
- Scheduled maintenance activities at each WTG location as per the supplier's guidance of Operation and Maintenance (except for the first maintenance will be conducted after 01 month operation);
- Routine inspection of all WTGs as per supplier's specifications;
- 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.

### 2.6.4 Decommissioning phase

According to Feasibility report 2019 of Huong Phung 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.

## 2.7 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;

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

## 2.8 Project Management

Some key agencies involve in project management, including:

- Project owner: Huong Phung Wind Power Joint Stock Company;
- Equipment Supplier: ENERCON;
- Construction unit: To be confirmed;
- Operation and Maintenance: To be confirmed.

## 2.9 Employment and Accommodation

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

### 2.9.1 Construction

The main labour source for the construction phase includes (i) local labour supplied by domestic construction company; (ii) Project's EPC labour resources (approximately 20 employees).

At the time of writing this ESIA, the number of foreign experts has not been available, therefore accommodation arrangement for foreign experts (high-skilled employees) is not available.

It is estimated that number of construction workers during the construction and turbine installation phase for Huong Phung Wind Power Plant would be 90 people totally.

A temporary construction camp for the workers will be built to facilitate worker accommodation, save the time and cost of daily transport of workers.

### 2.9.2 Operation

The Client plans to prioritise the recruitment of local workers who can take care of their own accommodation to operate Huong Phung Wind Power Plant.

- No. of working days/year: 365 days;
- No. of working hours/day: 24 hours;
- No. of shifts/day: three shifts/day, each shifts last 8 hours.

No. of employees during the operation phase: 40 persons.

## 3. ADMINISTRATIVE FRAMEWORK

### 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 regulatory Environmental Impact Assessment (EIA) and its regulatory Environmental Protection Plan (EPP) in 2019. However, the local EIA and EPP does not address some environmental and social aspects that meet international standards and expectations. This ESIA contributes to fullfill the gaps between Vietnamese regulatory EIA and IFC PS and EHS standards.

The regulatory EIA and ESIA process and their relevance to the Project are described in detail below

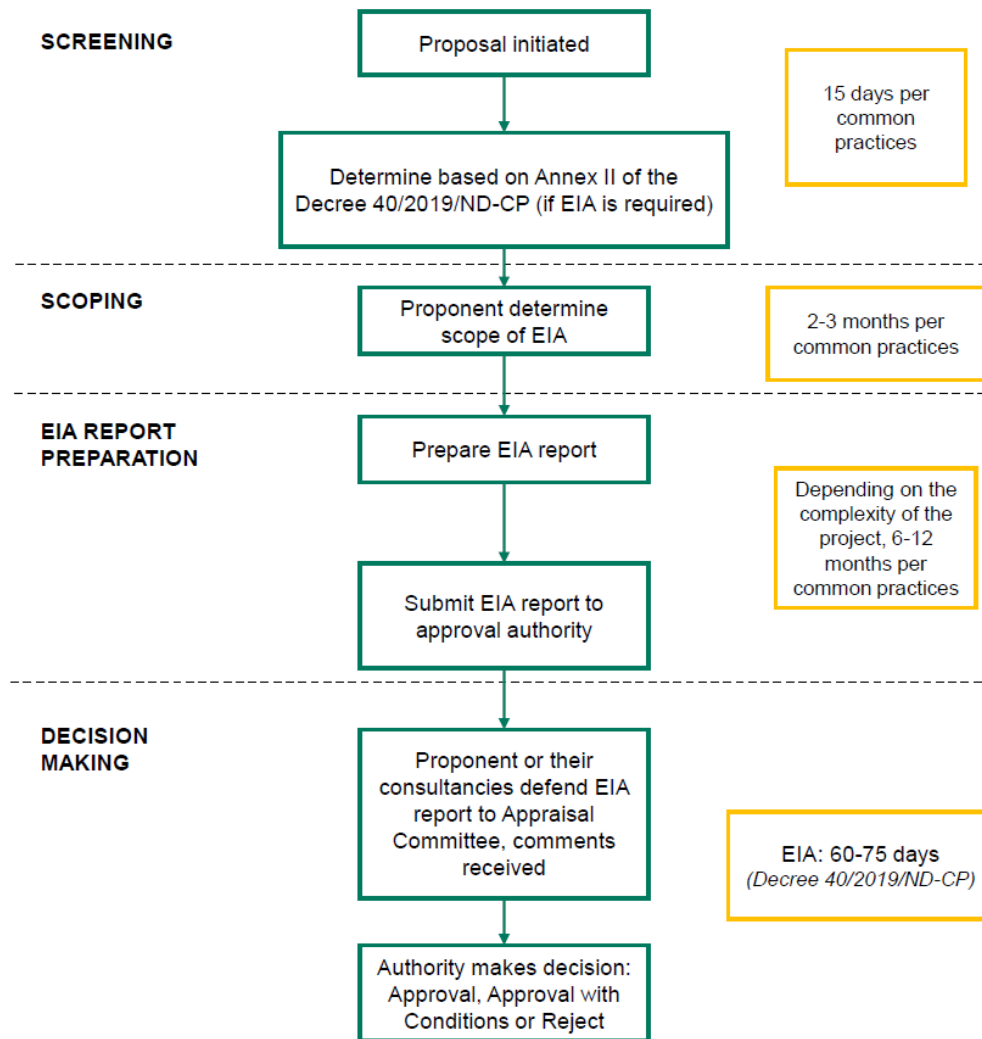
#### 3.1.1 Environmental Impact Assessment Process

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 EIA process has followed the regulations as given below:

- Law No. 55/2014/QH13 on Environmental Protection dated 23th June 2014 ;
- Decree No. 40/2019/ND-CP dated 13th May 2019 amending a number of articles of decrees that guiding the implementation of the Law on Environmental Protection;
- Decree No. 18/2015/ND-CP dated 14th February 2015 on environmental protection planning, SEA, EIA and EPP;
- Decree No. 19/2015/ND-CP dated 14th February 2015 detailing the implementation of a number of articles of the law on environmental protection;
- Circular No. 25/2019/TT-BTNMT dated 31st 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 Vietnam’s regulatory EIA process**

### 3.1.1.1 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 organisation and the communities directly affected by the project. Community feedbacks must be 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 developed and organizations under direct impact of the project shall be consulted as per the following procedures:

- The Project Owner shall send EIA report to the PC and organizations 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 that directly affected by the project shall be carried out in the form of public consultation 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.

### 3.1.1.2 Information Disclosure

As required by the Decree No. 40/2019/ND-CP dated 13th 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.

## 3.1.2 National Regulatory Provisions

### 3.1.2.1 Law on Environmental Protection

The Law on Environmental Protection (LEP) No. 55/2014/QH13 dated 23rd 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).

### 3.1.2.2 Environmental regulations/ standards

- Decree No. 38/2015/ND-CP dated 24th April 2015 on waste and scrap management;
- Decree No. 80/2014/ND-CP dated 6th August 2014 on the drainage and treatment of wastewater;
- Circular No. 36/2015/TT-BTNMT dated 30th June 2015 on hazardous waste management;
- Circular No. 04/2015/TT-BXD dated 3rd April 2015 on providing guidance on a number of articles of the government;
- Circular No. 08/2017/TT-BXD dated 16th 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.

### 3.1.2.3 National regulations on land acquisition, compensation, support and resettlement

The Land Law No. 45/2013/QH13, dated 29th 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.

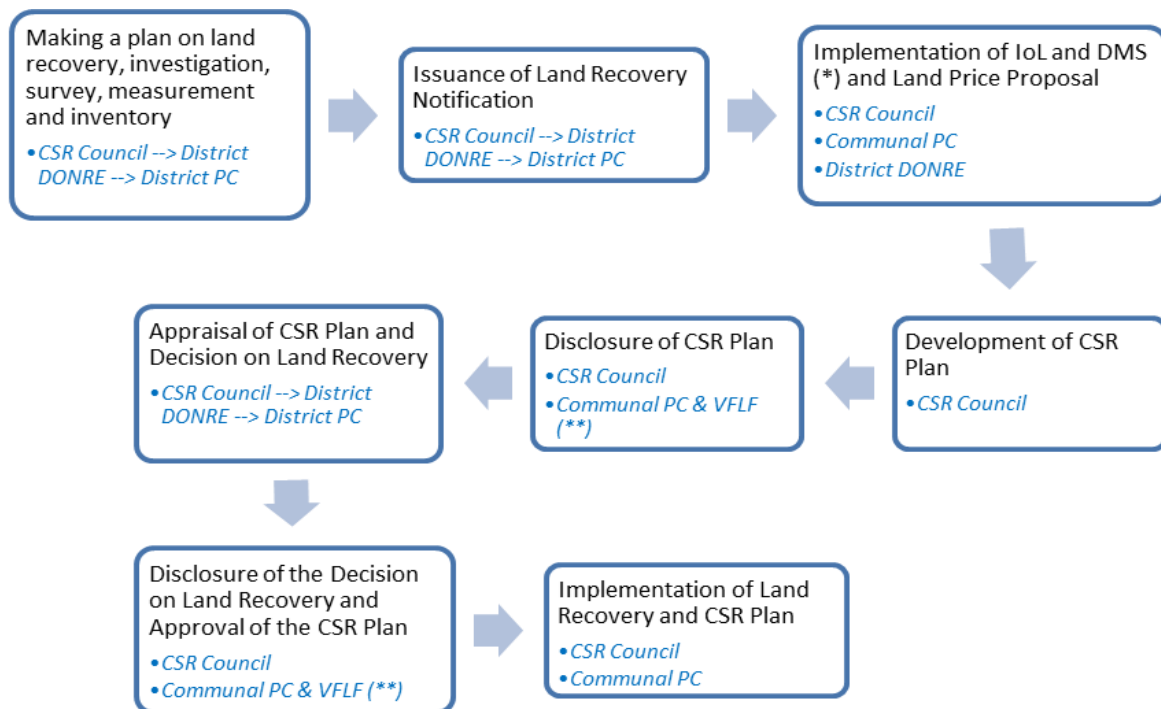
#### 3.1.2.3.1 National level regulations

- Law on Land No. 45/2013/QH13 (Land Law 2013);
- Decree No. 47/2014/ND-CP dated 15th May 2014 of the Government on regulating CSR Policies when land is acquired by the government;
- Decree No. 06/2020/ND-CP dated 1st January 2020 of the Government on amending Article 17 of Decree No. 47/2014/ND-CP;
- Decree No. 43/2014/ND-CP dated 15th May 2014 of the Government detailing a number of articles of the Land Law 2013;
- Decree No. 136/2018/ND-CP dated 5th October 2018 of the Government on amending certain Decree providing for regulatory requirements for trade and investment in the environment and natural resource sector;
- Decree No. 01/2017/ND-CP dated 6th January 2017 of the Government on amendments to the Decrees on the implementation of the Land Law;
- Decree No. 44/2014/ND-CP dated 15th May 2014 of the Government prescribing Land Prices;
- Circular No. 30/2014/TT-BTNMT dated 2nd June 2014 of MoNRE regulating documents on land allocation, land lease, land use change and land acquisition;
- Circular No. 37/2014/TT-BTNMT dated 30th June 2014 of MoNRE detailing regulations on compensation, support, and resettlement upon land expropriation by the state; and
- Circular No. 33/2017/TT-BTNMT dated 29th September 2017 of MoNRE detailing Decree 01/2017/ND-CP dated 6th January, 2017 and amending and supplementing the Circulars guiding the implementation of the Law on land.

#### 3.1.2.3.2 Provincial level regulations

- Decision No. 31/2017/QD-UBND dated 20th 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.16/2018/QD-UBND dated 28th August 2018 of Quang Tri Province People's Committee on amending and supplementing regulations on Compensation, Support and Resettlement Policies upon land acquisition by the State in Quang Tri Province, issued with Decision No. 31/2017/QD-UBND;
- Decision No. 49/2019/QD-UBND dated 20th 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/QD-UBND, dated 11th October 2017 of Huong Hoa District People's Committee on adjusting Land Use Plan towards 2020 of Huong Hoa District;
- Decision No. 2181/QD-UBND, dated 2nd August 2019 of Huong Hoa District People's Committee on approving Compensation, Support and Resettlement Plan for Huong Phung 2 and Huong Phung 3 Wind Power Project.

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



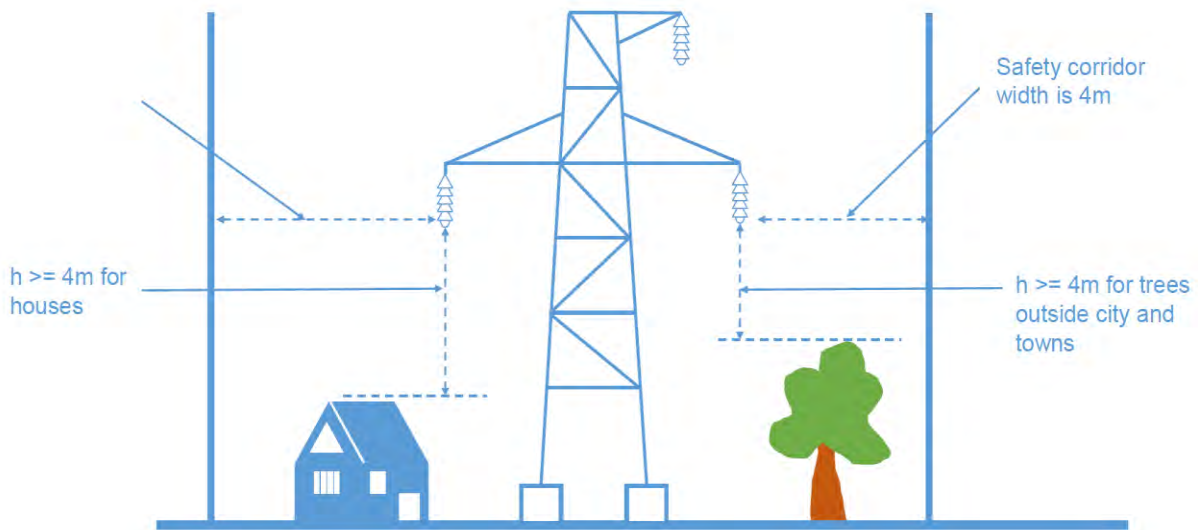
Note: Inventory of Loss (IoL) and Detailed Measurement Survey (DMS) are conducted under the presence of members of the CSR Council and affected household's representative(s). IoL and DMS results will be disclosed to the Project affected persons (PAPs) for review and signature. All DMS results will be 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**

### 3.1.2.3.3 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 3rd December 2004, and Decree No. 14/2014/ND-CP dated 26th 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 or towns, 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 2nd 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.

#### **3.1.2.3.4 National regulations on Occupational Health and Safety (OHS)**

Law No. 84/2015/QH13 on occupational safety and hygiene dated 25th 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 10th 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.

#### **3.1.2.3.5 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, dated 1st July 2016 and Decree No. 113/2017/ND-CP, dated 9th October 2017. 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 22nd May 2001 and entered into force on 17th 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 22nd 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/QĐ-TTg dated 10th 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.

### **3.1.2.3.6 National regulations on fire safety and fire fighting**

Law No. 40/2013/QH13 dated 22nd November, 2013 on amending and supplementing some articles of Law No27/2001/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 31st 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.

### **3.1.2.3.7 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 18th 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.

## **3.2 International Standards and Guidelines**

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

### **3.2.1 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<sup>4</sup>.

**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.

**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.

### 3.2.2 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 1st January 2012. The complete list of IFC PS is provided in Figure 3.4 and more details can be found on the IFC website<sup>5</sup>.

<sup>4</sup> <https://equator-principles.com/wp-content/uploads/2019/11/The-Equator-Principles-November-2019.pdf>

<sup>5</sup> [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/](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/)



Source: IFC, 2019

**Figure 3.4 IFC Performance Standards**

### 3.2.3 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.

#### 3.2.3.1 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

#### 3.2.3.2 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.



### 3.3 International Conventions

#### 3.3.1 The Kyoto Protocol on Climate Change (UNFCCC)

Vietnam became a signatory to the UNFCCC 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.

#### 3.3.2 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.

#### 3.3.3 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.

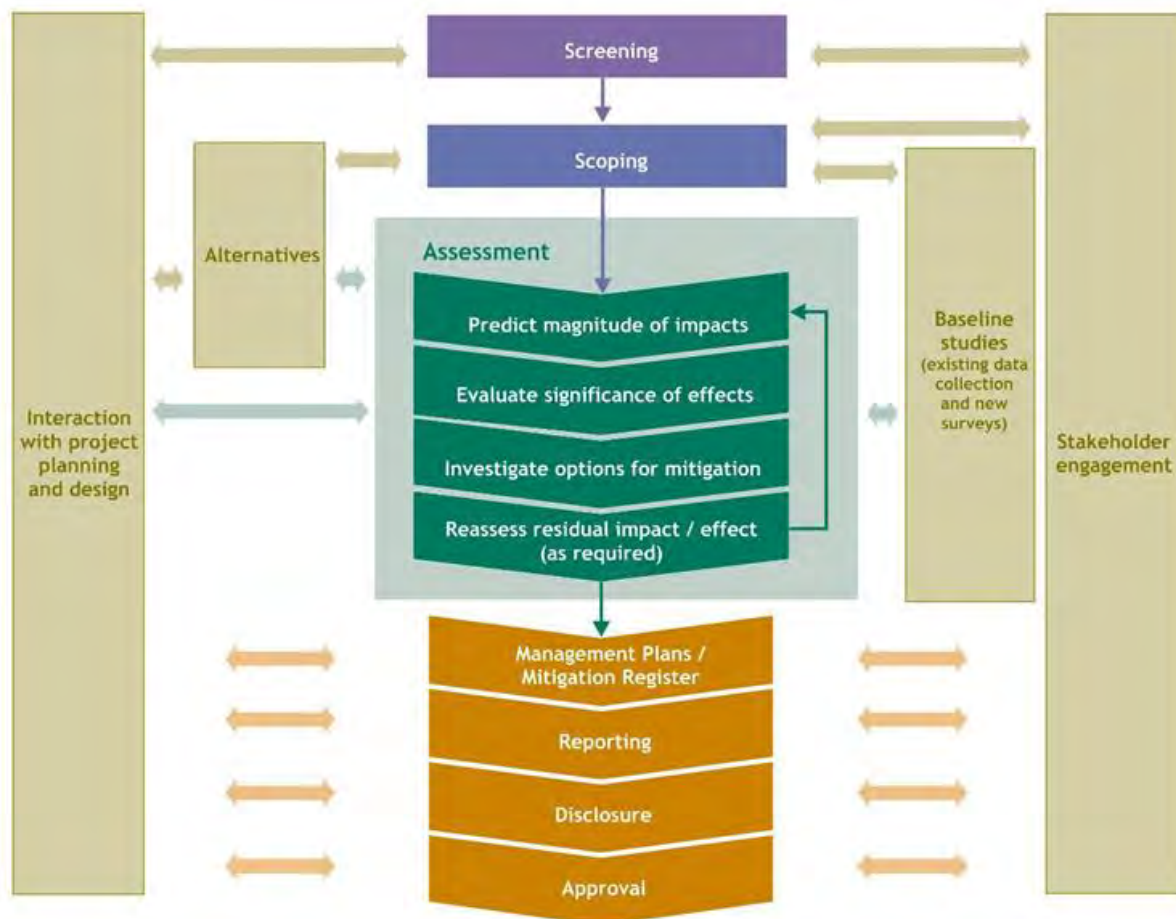
#### 3.3.4 International Union for Conservation of Natural and Natural Resources Red List of Threatened Species

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 IUSCN 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 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 Report.

### 4.7 Impact Assessment (IA)

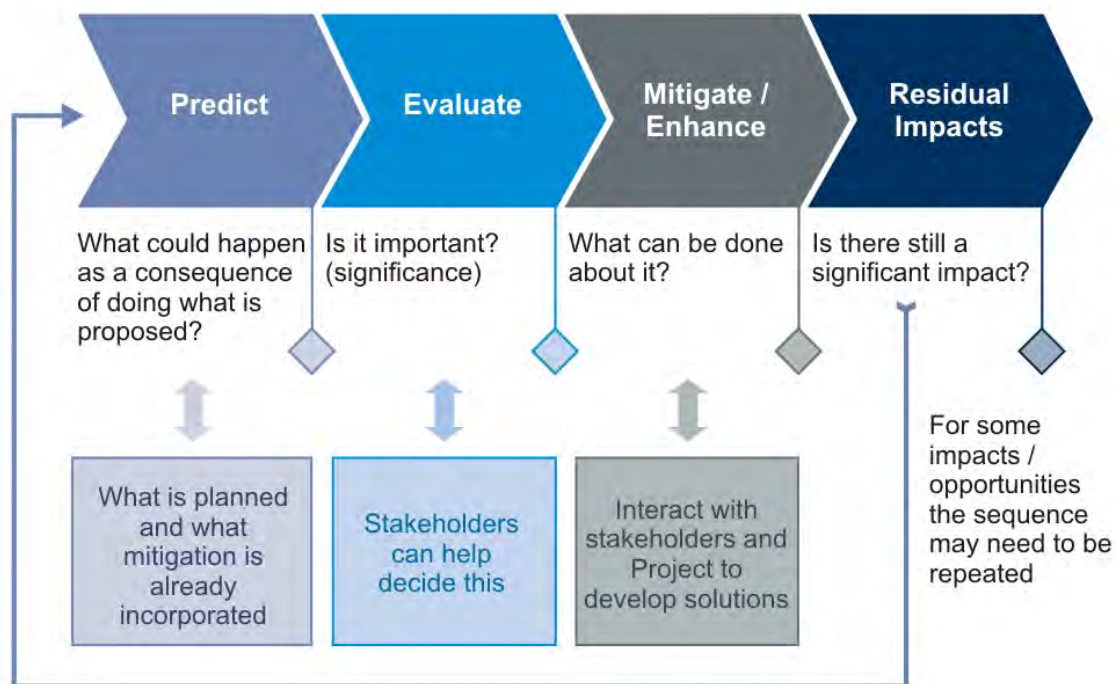
Impact identification and assessment starts with scoping and continues throughout the remainder of the ESIA Process. The main ESIA steps are summarised below and comprise of:

**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 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
<b>Type</b>	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).	<ul style="list-style-type: none"> <li>■ Direct</li> <li>■ Indirect</li> <li>■ Induced</li> </ul>
<b>Extent</b>	The “reach” of the potential impact (e.g., confined to a small area around the Project footprint, projected for several kilometres, etc.).	<ul style="list-style-type: none"> <li>■ Local</li> <li>■ Regional</li> <li>■ International</li> </ul>
<b>Duration</b>	The time period over which a resource / receptor is potentially affected.	<ul style="list-style-type: none"> <li>■ Temporary</li> <li>■ Short-term</li> </ul>

Characteristic	Definition	Designations
		<ul style="list-style-type: none"> <li>■ Long-term</li> </ul>
<b>Scale</b>	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”]
<b>Frequency</b>	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
<b>Direct</b>	Potential impacts that result from a direct interaction between the Project and a resource/receptor (e.g. between occupation of a plot of land and the habitats which are affected)
<b>Indirect</b>	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)
<b>Induced</b>	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
<b>Unlikely</b>	The event is unlikely but may occur at some time during normal operating conditions
<b>Possible</b>	The event is likely to occur at some time during normal operating conditions
<b>Likely</b>	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 from “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:

- **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; and
- **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).

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 4.3). 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 4.4. 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:

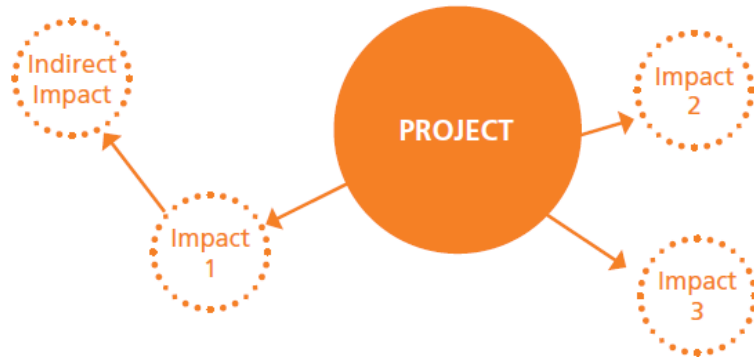
- Incomplete information about other projects and activities (e.g. the information is not available in the public domain);



- 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

ESIA: Project-Centred Perspective



CIA: VEC-Centred Perspective

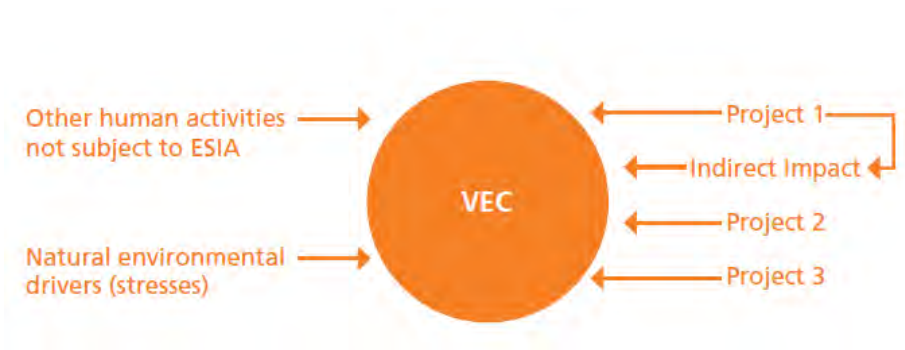


Figure 4.3 ESIA and CIA Analysis (IFC 2013)

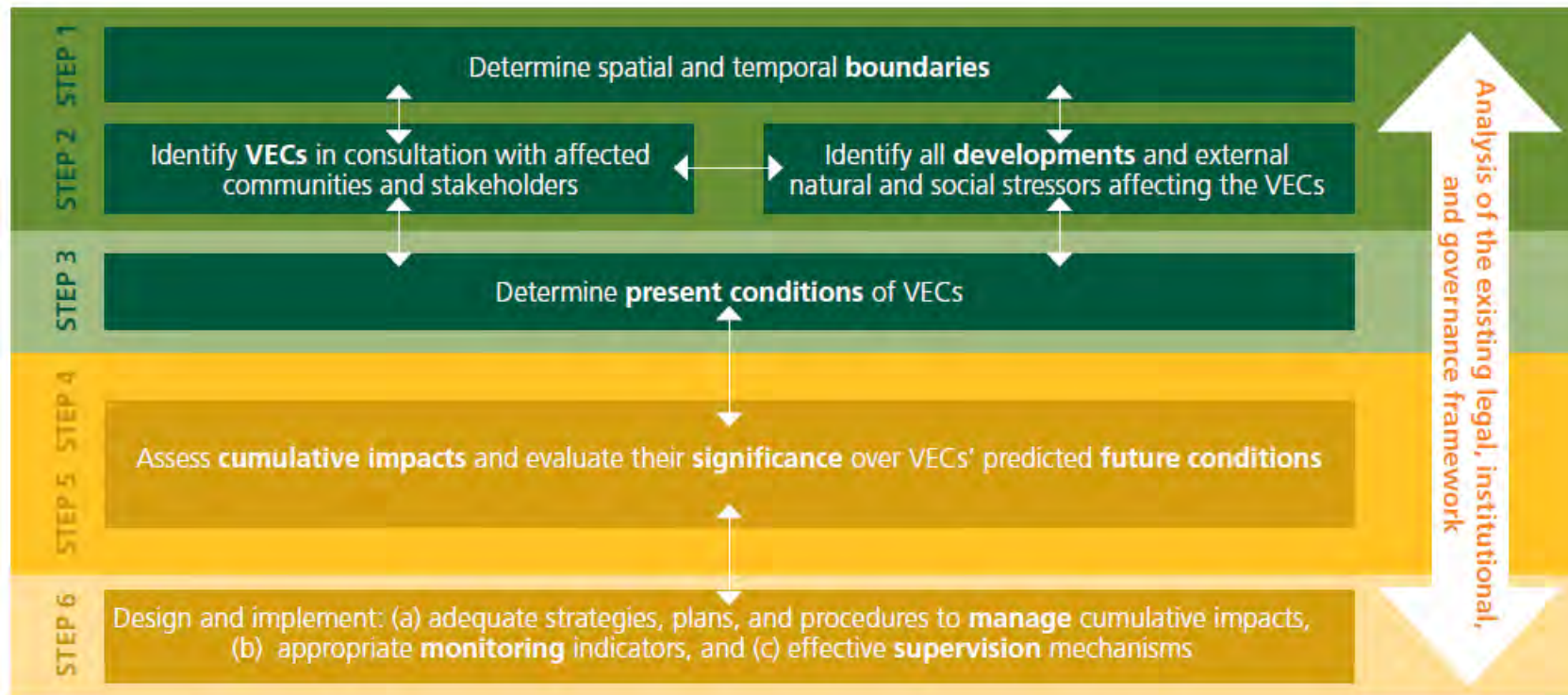


Figure 4.4 Six-Step Approach for CIA (IFC 2013)

## 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
<b>Consequence</b>	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

## 5. SCREENING AND SCOPING

This Chapter forms a basis 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
- 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 Categorization, the Project is categorized 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;
- 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.

No	Characteristics	The Van Kieu People <sup>6</sup>	Determined (Yes/No)
1	Self-identification	The project affected villages are Cop village, Huong Choa village in Huong Phung commune, which are 100% and 70% of commune population are of Van Kieu ethnic minority group in the two affected village. 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

### 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 Huong Phung Ltd. (e.g. EPP

<sup>6</sup> 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.

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 Huong Phung Ltd 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 5.1 presents the resources/receptors considered during scoping.

**Table 5.1 Resources/receptors considered during scoping**

Resources/Receptors	Impacts
<b>Environmental</b>	
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.
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.



Resources/Receptors	Impacts
	Effluent discharge. Contamination of shallow or deep groundwater resources. Change in groundwater resource Change in water resources availability, impacts on demands of surface water uses.
Soil	Changes to physical and chemical properties and soil ecology
Noise	Changes in noise level
Visual Amenity	Changes in landscape and visual amenity
<b>Social / Socio-economic</b>	
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
<b>Community Health and Safety</b>	
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.
<b>Indigenous People</b>	
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 (Aol)

The Aol varies depending on the nature of Project and its receptors. Under the IFC PS1, an Aol 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.

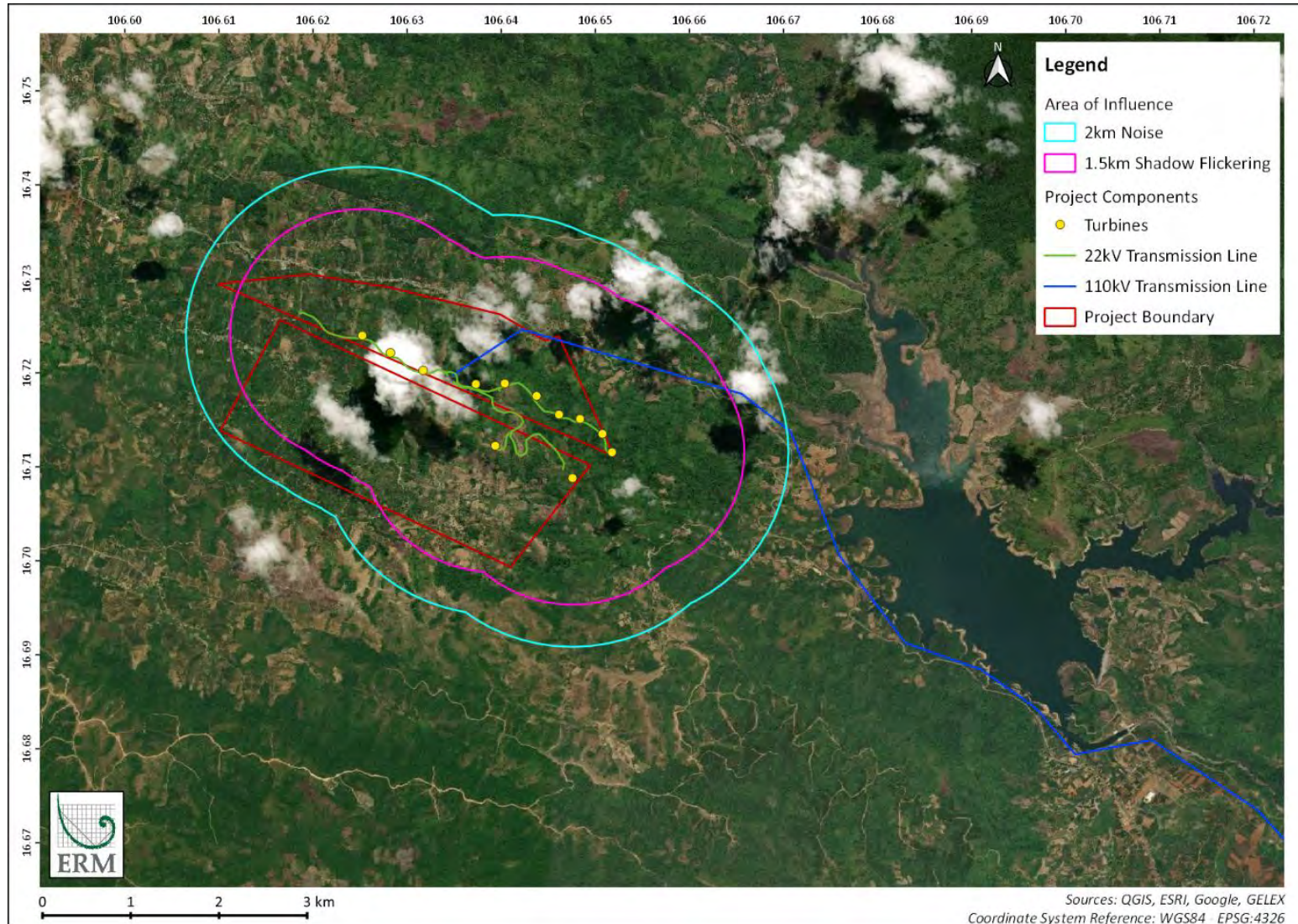


Figure 5.1 Area of Influence of Noise and Shadow Flicker

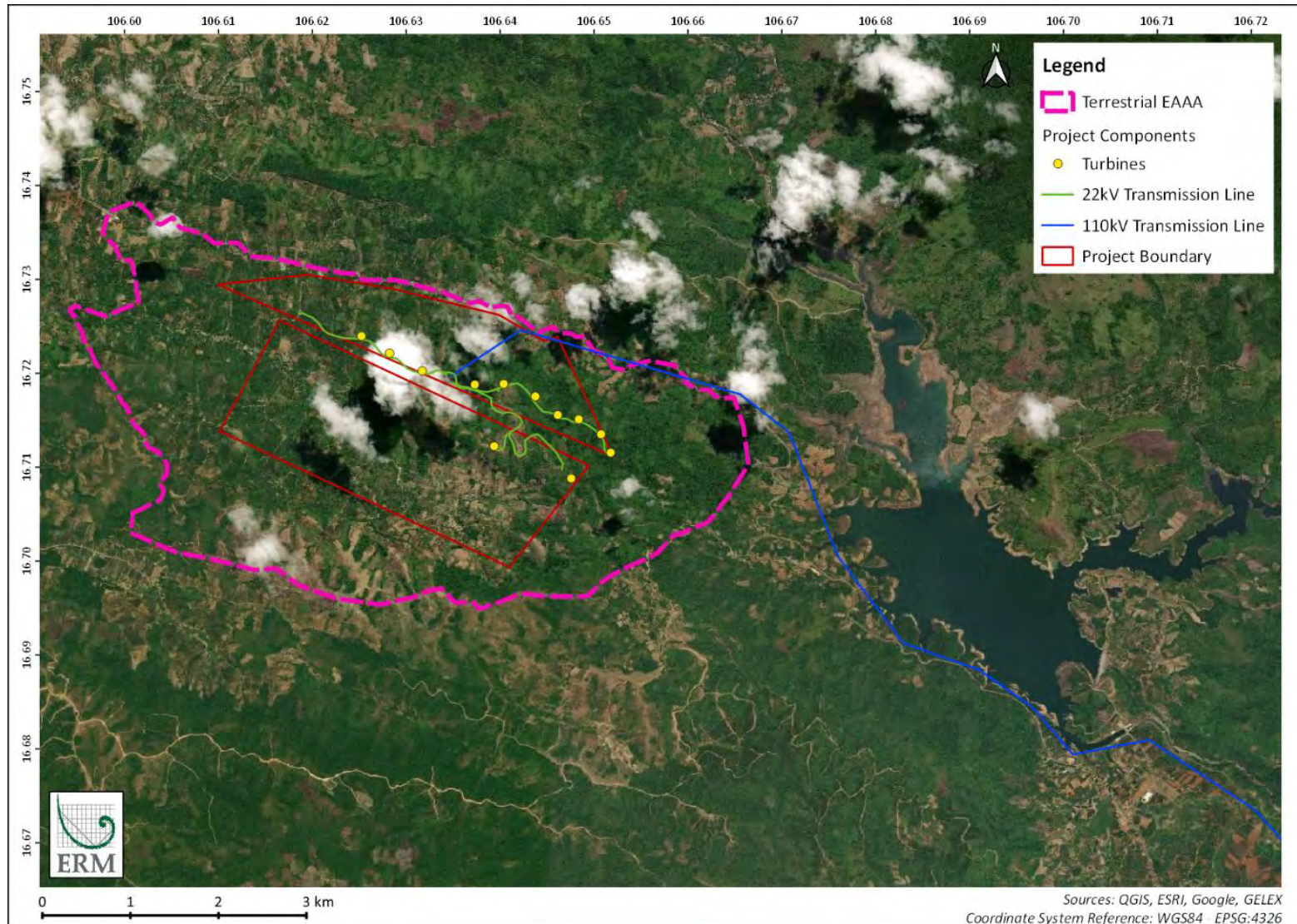


Figure 5.2 Area of Influence of Ecological Habitat

- Nearby sensitive receptors have been identified at the initial site visit, including:
- Livelihood sites: agricultural fields, grazing areas, coffee farms and planted forests have been identified to be within and surround the Project' area. Huong Phung Wind Farm will cover an area of 0.987 ha of the protected forests and 7.956 ha of agricultural land.
- Residential areas:

The nearest residential area which is approximately 200m from the turbine to the southwest is Cop Village in Huong Phung Commune. This village is resided by Van Kieu ethnic minority.

- Water bodies: About 530m to the Northwest of the project area is a small stream (Pa Rong), which the width is relatively narrow. The stream originates from small creeks in the mountainous area, flowing in Southeast – Northwest direction to Sen River in Phung Lam village, Huong Phung Commune.

About 2.5 km from the project area is Rao Quan Lake in Huong Linh Commune, Huong Hoa District. This is a reservoir project serving the generation of Quang Tri hydropower plant.

- Protection forests:
  - Huong Phung Wind Farm will require 1.387 ha of protection forest permanently and temporarily, which taking up 4.49% 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

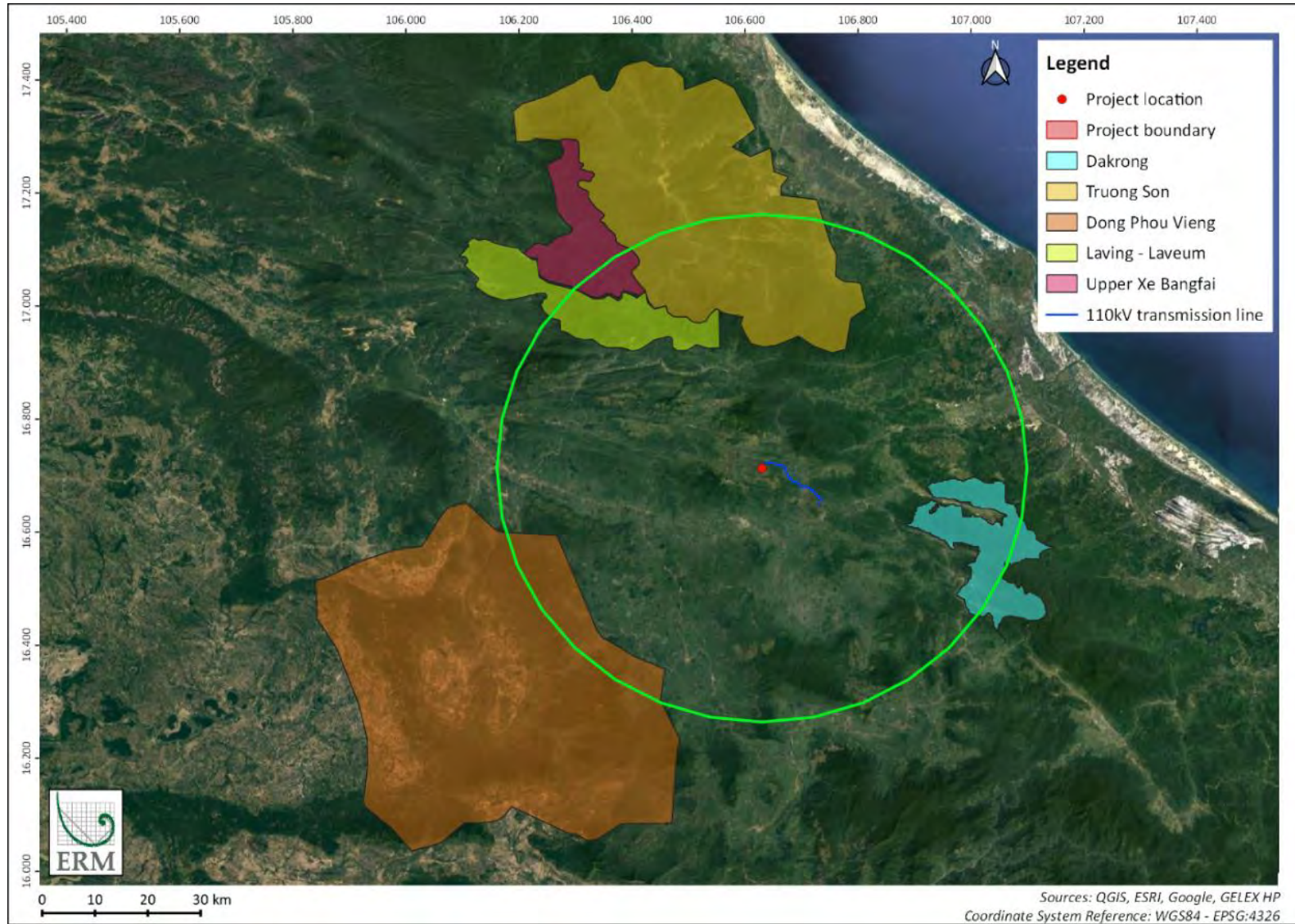


Figure 5.3 Key Biodiversity Area

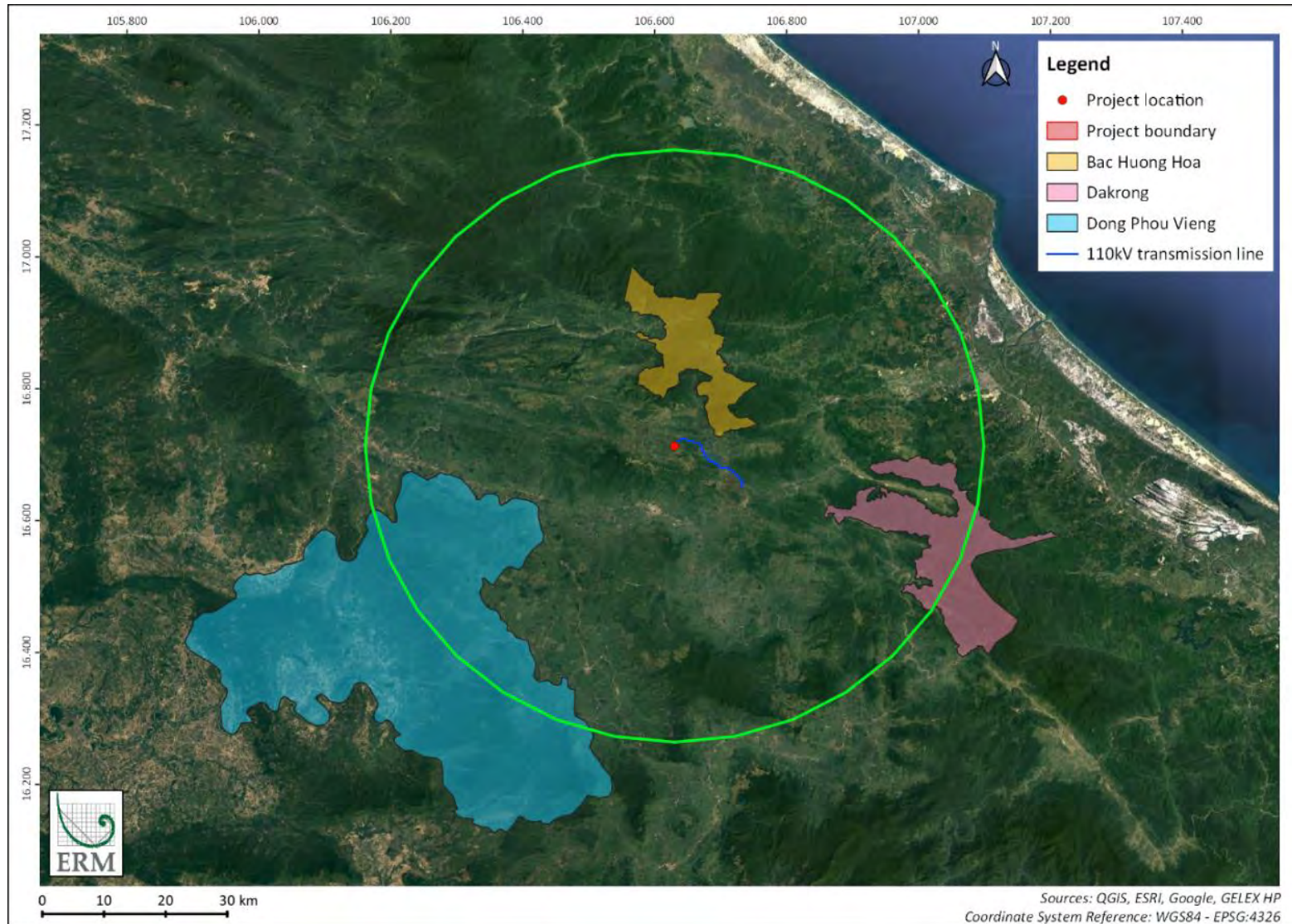
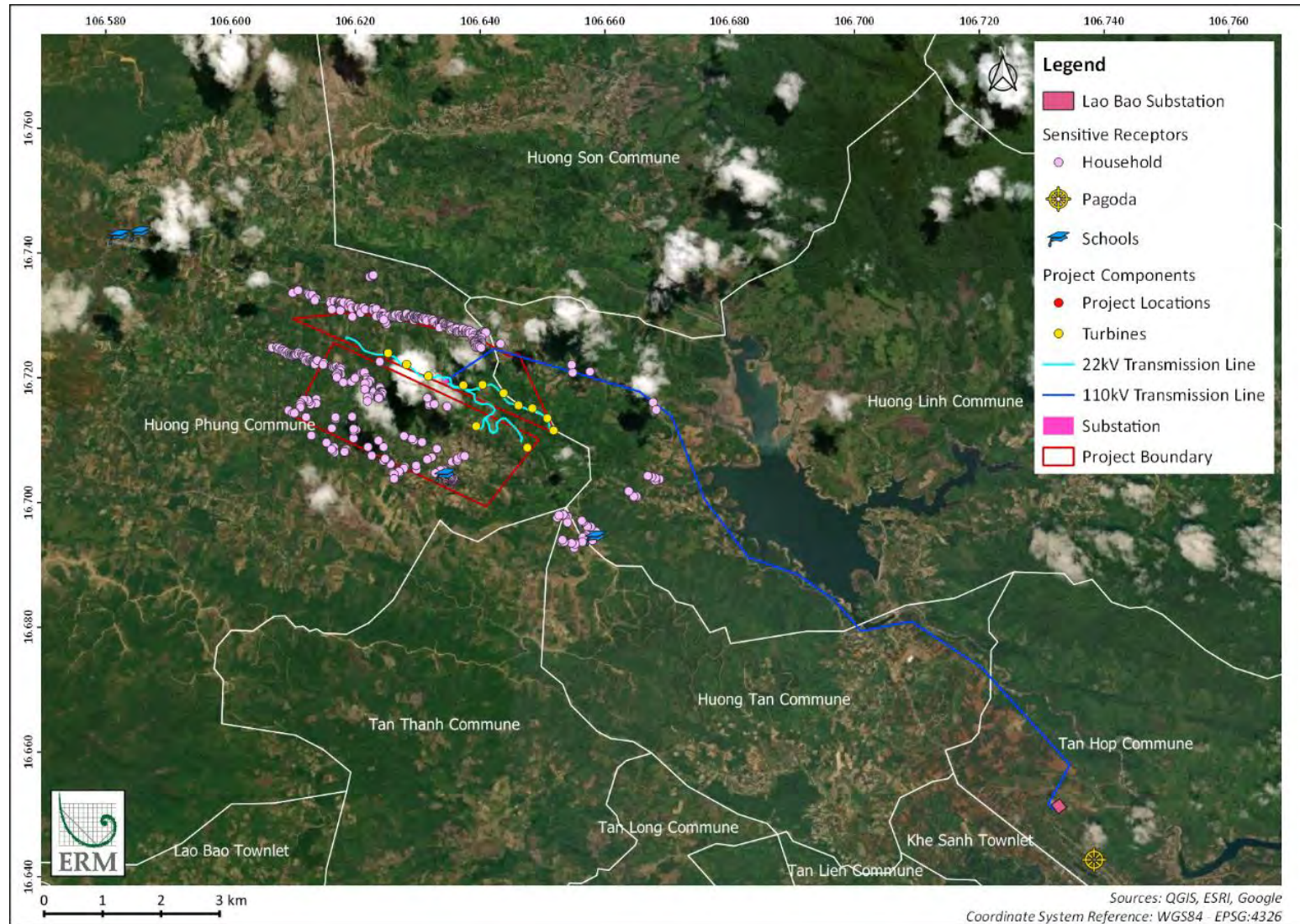


Figure 5.4 Key Protected Area



**Figure 5.5** Key receptors within and around Project area



## 5.6 Scoping Matrix

Following the determination of Aol, 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 Aol. 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 Aol that they have the potential to interact with.

Entries in the matrix cells are coloured to indicate whether:

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 5.2 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
<b>Pre-Construction</b>															
Land Acquisition															
Workforce Mobilisation and Presence															
Land Preparation (site clearance, excavation and levelling), fencing, and civil works															
<b>Construction</b>															
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
<b>Commissioning and Operation</b>															
Workforce Presence								High				Medium		High	High
WTG Operation		High				High	High		Medium	High			High	High	
WTG Inspection and Maintenance		High											High		
Waste, emissions and discharge generation, handling and disposal	Medium	Medium			Medium	Medium								Medium	
<b>Unplanned Events</b>															
Leakage and spill incident			High	High	High						High		High		
Fire and explosion	Medium	Medium				High							High	High	
Vehicle collision													High	High	
Blade throw													High	High	
Transmission line snapping						High					Medium		High	High	
Natural Hazards (Flood, Storm, etc.)			High	High	Medium	High		High	High			High	High	High	Medium

## 6. STAKEHOLDER ENGAGEMENT

### 6.1 Stakeholder Engagement during EIA process

Due to the total project site area of Huong Phung 3<sup>7</sup> is less than 200 hectare, the project is required to conduct the Environment Protection Plan (EPP) instead of the local EIA as per legal framework. Thus, there is no requirement for conducting the public consultation according to the Decree 40/2019 ND-CP dated 13 May 2019 by the Government on guidelines for the Law on environment protection.

Nevertheless, Huong Phung 2 project's boundary is larger than 200 hectare, the local EIA has been prepared by the Project as required by Vietnam EIA regulations. In April and May 2019, the Project Owner organized multiple public consultation sessions for the draft local EIA report at affected areas where the Project is located following the below approach:

- Sending letters soliciting opinions regarding Project's potential environmental impacts from Huong Phung commune PC; and
- Arranging a public consultation meeting at the Huong Phung PC's office with participation of local authorities, socio-political professional organizations and directly affected residential communities in the Project area;

The purposes of these public consultation sessions were to obtain gain (i) opinions on negative impacts by the Project to natural environment, socio-economy and community health, (ii) opinions on mitigation measures to reduce these impacts, (iii) recommendations of the community to Project Owner.

Detailed comments of local community and authorities together with feedback from the Project Owner are provided in Table 6.1 and Table 6.2.

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<sup>7</sup> The Project includes Huong Phung 2 Project and Huong Phung 3 Project, which were separated during the EIA process.

**Table 6.1 Comments of Engaged Stakeholders on the Draft EIA**

No	Comments of Stakeholders	Issues and Concerns			
		Environmental	Health	Socio-Economic, Cultural	Technical
<b>Huong Phung Commune People's Committee</b>					
1	The People's Committee of Huong Phung commune agreed to the proposed Project location in Huong Phung commune, Huong Hoa district, Quang Tri province.				✓
2	The People's Committee of Huong Phung commune concurred with the identified negative impacts on environment, socio – economic and community health of the Project in the EIA.	✓	✓	✓	
3	The People's Committee of Huong Phung commune agreed with mitigation measures proposed in the local EIA to minimize impacts on the environmental and socio-economic condition in the EIA.	✓	✓	✓	
4	Project Owner was required to comply with the commitments stated in the EIA in order to minimize the environment impacts.	✓			
5	Project Owner and its EPC contractors was required to comply with construction schedule.				✓
6	Project Owner and its EPC contractors was required to compensate, repair and upgrade any community facilities (i.e. roads, house, fence, agricultural establishment) which are subjected to damage during and after transport of tools, materials and equipment.			✓	
7	Project Owner was required to compensate the losses related to the environment and public health due to the Project's operation, if any.		✓		
8	Project Owner was required to closely coordinate with related stakeholders, especially the local communities to inventory, compensate and support of assets that may be damaged before the construction.			✓	

No	Comments of Stakeholders	Issues and Concerns			
		Environ-mental	Health	Socio-Economic, Cultural	Technical
9	Project Owner was required to notify the authorities of the project implementation status, official project name, investor and telephone number of person in charge for the authorities and people promptly contact with any concerns that may occur.				✓

**Local Communities in Huong Phung Commune**

10	The affected people required the Project Owner to clarify the impact on residential areas, the impact on their assets and incidents that may occur during construction and operation.			✓	
11	Project Owner was recommended to coordinate closely with the competent local authorities to conduct inventory of loss, detailed measurement survey and prepare land compensation and support plan for the affected people.			✓	
12	For the Project Owner's temporary shelter for i.e., equipment, tools, machinery, Project Owner and its EPC contractors were obliged to perform site clean-up, and provide compensation for the affected people to facilitate their resumption of agricultural activities.	✓		✓	✓
13	Project Owner and its EPC contractors in collaboration with the competent local authorities was requested to take measures to ensure transport and site safety, especially during the transport of heavy equipment i.e. wind pillars, turbines and wind rotors.				✓
14	The Project Owner was recommended to have a plan to adjust the construction time and limit the construction in the rainy season. If unexpected incidents occur, the Project Owner needs to coordinate with local authorities for damage remediation solutions.	✓			

**Table 6.2 Feedback from Project Owner to Comments during Draft EIA Public Consultation**

Feedback to Comments from Huong Phung People's Committee and Local communities

The Project Owner has committed to the following measures:

- Coordinate with local authorities for asset inventory in accordance with the process and regulations and compensate and support for Project affected people in accordance with local regulations;
- Minimise negative environmental impacts during the construction and operation phases of the Project;
- Comply with the provisions of the law on environmental protection in construction work of the Project;
- Prioritise the affected people and local people have jobs as well as training local human resources in service during construction and operation.

## 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 Phung 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 6.3. 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 six to eight 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 forestry famers, ethnic minorities and vulnerable people currently living in Huong Phung Commune were selected.

#### Key informant interviews (KIIs)

The KIIs were conducted with village head of the three communes i.e. Cop, Phung Lam and Huong Choa villages. 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 Phung 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 6.3.



**Table 6.3 Summary of Stakeholder Engagement Activities during ESIA Process**

Interviewed Group	Organisations	Topics covered in the interview meetings
Commune authority	PC of Huong Phung Commune	<ul style="list-style-type: none"> <li>■ Update the authority with Project development;</li> <li>■ 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;</li> <li>■ Gain feedback/perceptions on the Project development; and</li> <li>■ Ask for acceptance and support from the People’s Committee to conduct the household survey in the area.</li> </ul>
Focused group	Groups of project affected fisher folks, women, aquaculture farmers, agriculture farmers and vulnerable people	<ul style="list-style-type: none"> <li>■ Each group will have different question design, in general, the following information was collected from the interviewed groups of FGD:</li> <li>■ Demographic information of the affected villages;</li> <li>■ Main livelihoods in this community area;</li> <li>■ Investment cost for and income from their main livelihoods;</li> <li>■ 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</li> <li>■ Awareness of the Project and any concern about the Project development.</li> </ul>
Key informant interviews	Key informant interviews of: Cop Village Huong Choa Village Phung Lam Village	<ul style="list-style-type: none"> <li>■ The questionnaire of the KII interview was designed to collect the following:</li> <li>■ The history and organizational structure;</li> <li>■ Housing and land (i.e. land use and land tenure);</li> <li>■ Main livelihoods in this community area;</li> <li>■ Infrastructure status;</li> <li>■ Access to and availability of public facilities (i.e. electricity, water supply, etc.);</li> <li>■ Financial situation;</li> <li>■ Future-oriented development; and</li> <li>■ Awareness on the development of the Project and its engagement activities.</li> </ul>
Household	35 households living in Huong Phung Commune	<ul style="list-style-type: none"> <li>■ The questionnaire of the household interview was designed to collect the following:</li> <li>■ Family status and demographics;</li> <li>■ 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);</li> <li>■ Livelihoods and employment (i.e. their livelihoods/employment);</li> <li>■ Household income and expenditure;</li> <li>■ Housing and land (i.e. land use and land tenure);</li> </ul>

Interviewed Group	Organisations	Topics covered in the interview meetings
		<ul style="list-style-type: none"> <li>■ Education background (i.e. education level of members in the surveyed households);</li> <li>■ Health status/profile and health care practice;</li> <li>■ Access to and availability of public facilities (i.e. electricity, water supply, etc.); and</li> <li>■ Awareness on the development of the Project and its engagement activities.</li> </ul>

### 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 6.4 and Table 6.5.

#### 6.2.3.1 Authority

**Table 6.4 Concerns from Huong Phung Commune PC during ESIA engagement**

Areas	Concerns
Environmental	<ul style="list-style-type: none"> <li>■ Noise</li> <li>■ Impacts on climate in the surrounding area</li> </ul>
Health	No concern
Socio-economic and Cultural	<ul style="list-style-type: none"> <li>■ Impacts on agricultural production (cultivation and husbandry)</li> <li>■ Land acquisition</li> </ul>
Technical issues	No concern

#### 6.2.3.2 Community

**Table 6.5 Concerns from Community during ESIA engagement**

Areas	Concerns
Environmental	<ul style="list-style-type: none"> <li>■ Polluted environment and biodiversity during the Project implementation process</li> <li>■ Impacts on climate in the surrounding area</li> </ul>
Health	Impacts on health in the surrounding area
Socio-economic and Cultural	<ul style="list-style-type: none"> <li>■ Concern on land acquisition and compensation</li> <li>■ Affecting cultivation season and animal husbandry</li> <li>■ Impacts on local livelihoods (farming and husbandry)</li> <li>■ Affecting local route and traffic safety situation due to the project's heavy transportation</li> <li>■ Concern on the order security situation and the social evils of the immigrant workforce</li> </ul>
Technical issues	No concern

## 6.2.4 Local Perception and Understanding about the Project

### 6.2.4.1 Local Understanding about the Project

The household survey suggests that 74.3% of surveyed respondents have heard about the Project, but that 25.7% of respondents do not know about it (see Table 6.6). Of the 26 respondents who are informed about the Project, the corresponding figures are 14 households in Huong Choa village, seven households in Phung Lam village, and five households in Cop village.

**Table 6.6 Project Acknowledgement by Village**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village(N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Yes	14	77.78	7	77.78	5	62.50	26	74.29
No	4	22.22	2	22.22	3	37.50	9	25.71
Total	18	100.00	9	100.00	8	100.00	35	100.00

Source: Socio-economic survey conducted by ERM, 2020

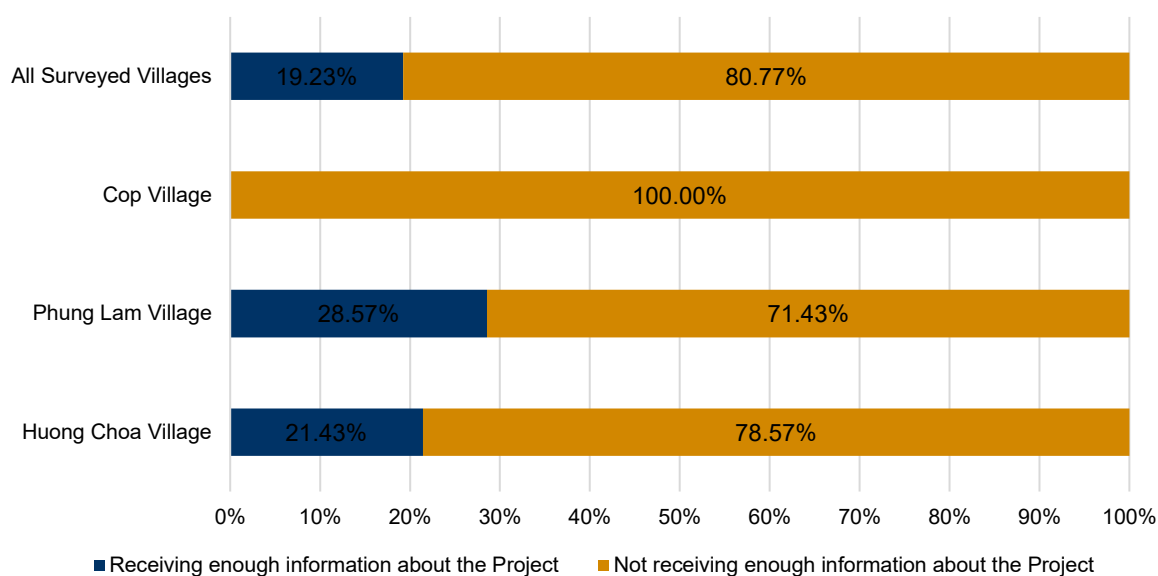
The highest share of the 26 households who know about the Project get information from the local authorities (53.9%) (see Table 6.7). Eight households (30.8%) know about the Project from relatives and neighbours, and another one households approach to Project's information by the Project owners during the environment impact assessment process (3.9%). Three households (11.6 %) hear about the Project from another source such as word of mouth. In addition, some representatives of Cop village know about the Project through the meeting between the Project and commune authorities in 2019 (KII, male respondent, Van Kieu people, Cop village, 12th February 2020). The Village head, village deputy head, and village patriarch in Huong Choa village were invited to the Project commencement ceremony in Cop village at the end 2019 (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12th February 2020).

**Table 6.7 Project Information Channels**

	Huong Choa Village (N=14)		Phung Lam Village (N=7)		Cop Village (N=5)		All Surveyed Villages (N=26)	
	N	%	N	%	N	%	N	%
Local authorities	11	78.57	1	14.29	2	40.00	14	53.85
Relatives and neighbors	1	7.14	4	57.14	3	60.00	8	30.77
Project owners during the environment impact assessment process	1	7.14	0	0.00	0	0.00	1	3.85
Others	1	7.14	2	28.57	0	0.00	3	11.54

Source: Socio-economic survey conducted by ERM, 2020

Of the 26 surveyed respondents who have Project information, only five households (19.2%) say they have sufficient information, while most (80.8% or 21 households) want to know more about the Project. Twenty-one out of 26 households (80.8%) want to get information about the Project content, impact, operation plan, mitigation strategies, and livelihood support program (see Figure 6.1) and the remaining are not sure about the specific information they want to receive or they have no concerns.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 6.1 Local Responses to Project Information Efficiency**

### 6.2.4.2 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 in Table 6.8 below; further details are provided in Appendix N.

**Table 6.8 Recommendations from Stakeholder Engagement during ESIA Process**

	Commune Authorities	Local Communities
<b>Environmental</b>		
Comply with all relevant regulatory requirements on environmental protection to minimize potential environmental issues during Project's construction and operations phases	✓	
<b>Health</b>		
No recommendation	✓	✓
<b>Socio-Economic and Cultural</b>		
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		✓
<b>Technical</b>		
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 and geology conditions, climate and meteorology, hydrology, water quality, noise and biodiversity.

The objective of this chapter is to outline the existing environmental conditions in the Project area. This information is used to assess potential impacts caused by the Project in both construction and operation phases and provide mitigation measures and/or monitoring programs to reduce adverse impacts.

Information in this chapter is primarily based on studies undertaken for the locally approved regulatory EIA (Huong Phung 2, EIA, 2019) and EPP (Huong Phung 3, EPP, 2019), the Feasibility Study Report for Huong Phung 2 & 3 and a desktop review of reliable information sources as well as the additional baseline surveys for noise, biodiversity including bird and bat surveys which were conducted by ERM. The noise survey was conducted from 10 to 14 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-western mountainous region, in Huong Phung 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 250 – 2000 m above sea level. The topography of the Project area is lower from southwest to northeast. The terrain has an average slope ranging from 20° – 30° (very steep), and could up to 40° – 50°. The Project areas are mainly crops and coffee hills, unused bare land and forest land.

Along valley stream, the flow is mainly horizontal erosion, the terrain is created mainly from layers of floods and sediments. Both sides of the streams 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 March 2019 for Huong Phung Wind Farm by SCI Join Stock Company. The results of the geological survey are presented Table 7.1.

**Table 7.1 Geotechnical Conditions**

Geotechnical conditions	Huong Phung Wind Power Project
Geotechnical conditions of the project site area	Geological conditions of the project site area are presented as below:  1st layer – Ruin layer (edQ): loam mixed 10 – 30% gravel. The soil is semi-hard, little moisture to moisture. At the expected location of wind turbines, the resistivity value is 460 – 650 m. The class has low load capacity and can lay foundations for substation, 110 kV transmission line and auxiliary structures.  2nd layer – Intense weathering (IA1): loam mixed 10 -25% gravel. The soil is semi-hard, little moisture to moisture. At the expected location of wind turbines, the resistivity value is 650 – 920 m. The class has low load capacity and can lay foundations for wind turbines, substation, 110 kV transmission lines and auxiliary structures.

Geotechnical conditions	Huong Phung Wind Power Project
	<p>3rd layer – Strong weathering (IA2): The shale and granodiorite is strongly weathered and soft. The class has average load-bearing capacity, can lay the foundations for wind turbines and substation.</p> <p>4th layer – Weathered (IB): Shale-base rocks and granodiorite are cracked strong, medium to firm. Medium-strength rocks, capable of bearing average load, can lay the foundations of main works such as wind turbines and substation.</p>
Geotechnical conditions of substation area	<p>Geological conditions of the project site area are presented as below:</p> <p>1st layer – Ruin layer (edQ): loam mixed 10 – 30% gravel. The soil is semi-hard, little moisture to moisture. At the expected location of substation, the resistivity value is 580 – 650 m. The class has low load capacity and can lay foundations for substation items and auxiliary structures.</p> <p>2nd layer – Intense weathering (IA1): loam mixed 20 – 30% gravel. The soil is semi-hard, little moisture to moisture. At the expected location of substation, the resistivity value is 650 – 820 m. The layer with low stable load capacity is not suitable for laying foundations for works items.</p>
Geotechnical conditions of 110 kV transmission line	<p>Geological conditions of the project site area are presented as below:</p> <p>1st layer – Ruin layer (edQ): loam mixed 15 – 15% gravel. The soil is semi-hard, little moisture to moisture. At the expected location of 110 kV transmission lines, the resistivity value is 590 – 650 m. The class has low load capacity and can lay foundations for transformer station items, 110 kV line and auxiliary structures.</p> <p>2nd layer – Fully weathering (IA1): loam mixed 10 – 15% gravel. The soil is semi-hard, little moisture to moisture. At the expected location of turbines and 110 kV lines, the resistivity value is 650 – 840 m. The layer with low stable load capacity is not suitable for laying foundations for works items.</p>

## 7.3 Climate and Meteorology

Data on climate and meteorology are primarily obtained from:

- The Environmental Impact Assessment (EIA) report of Huong Phung 2 and Environmental Protection Plan (EPP) report of Huong Phung 3;
- Khe Sanh, Ga Wong, Dong Ha, Thanh Hai and Con Co meteorological Station; and
- The Website of Quang Tri Province (Quang Tri Province Portal, 2019).

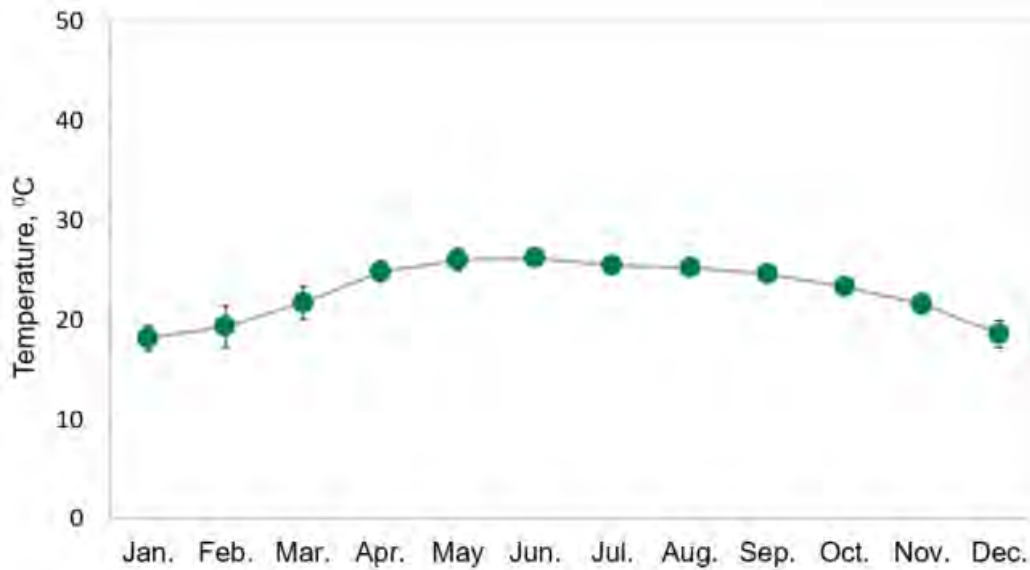
### 7.3.1 Temperature

Quang Tri Province has a tropical monsoon climate, with annual average temperature between 24 – 25°C in low terrains and between 22 – 23°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°C in low plains or 20°C at high attitudes of over 500 m (Quang Tri Province Portal 2019);
- Summer season is between May and August with a high average temperature of 28°C. Temperatures are highest between June and July and they can go up to 42°C (Quang Tri Province Portal 2019). 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°C and 26.3°C (Figure 7.1). Temperatures differ between winter and summer seasons, including:

- Winter season: average monthly temperatures are between 18°C and 19.3°C; and
- Summer season: average monthly temperatures can go up to above 26°C.



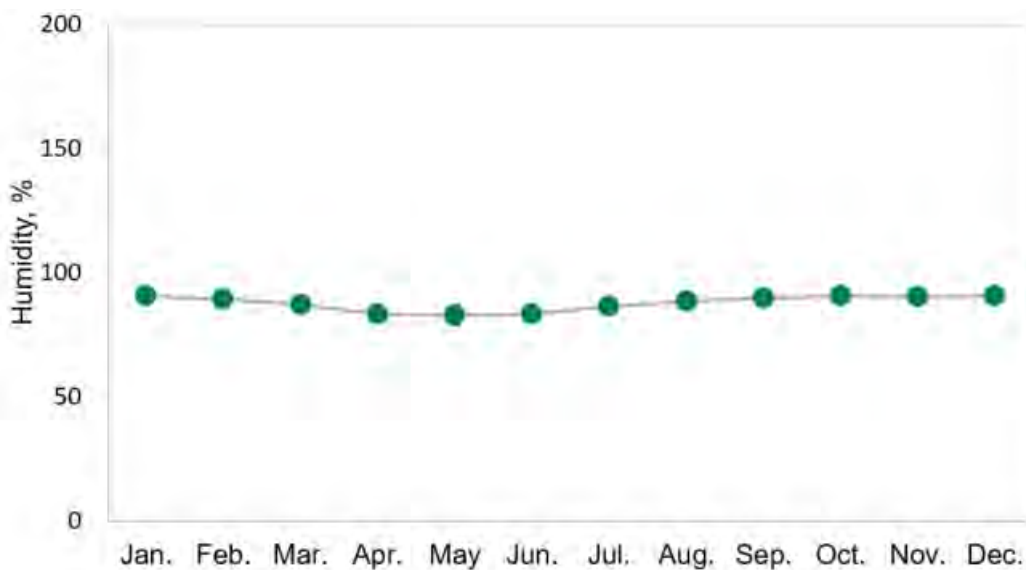
Source: Khe Sanh Meteorology Station

**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 drop 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% (Figure 7.2). Minimum monthly humidity usually occurs during the summer season (April through July) and it could go down to 83% in May.



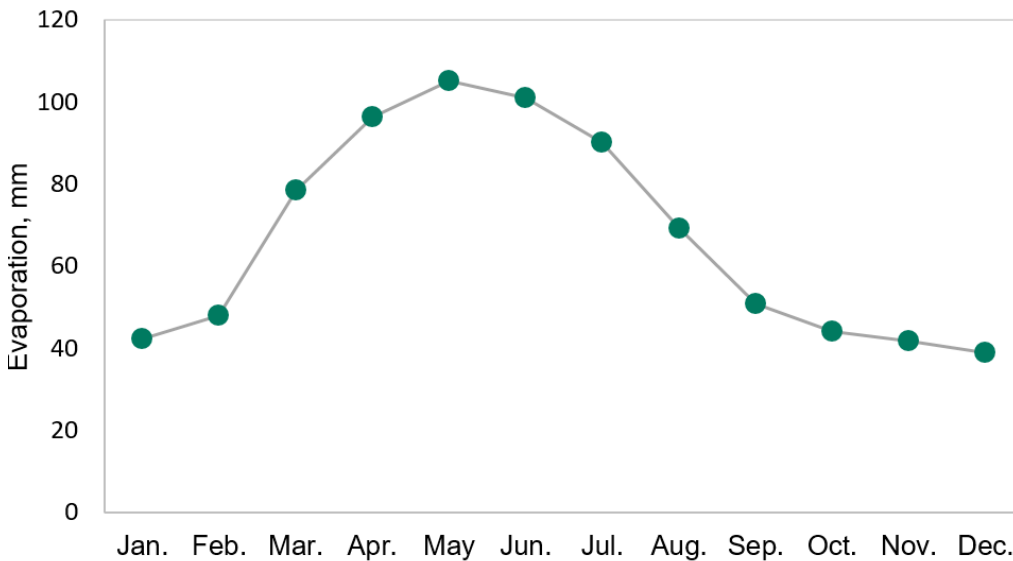
Source: Khe Sanh Meteorology Station

**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).

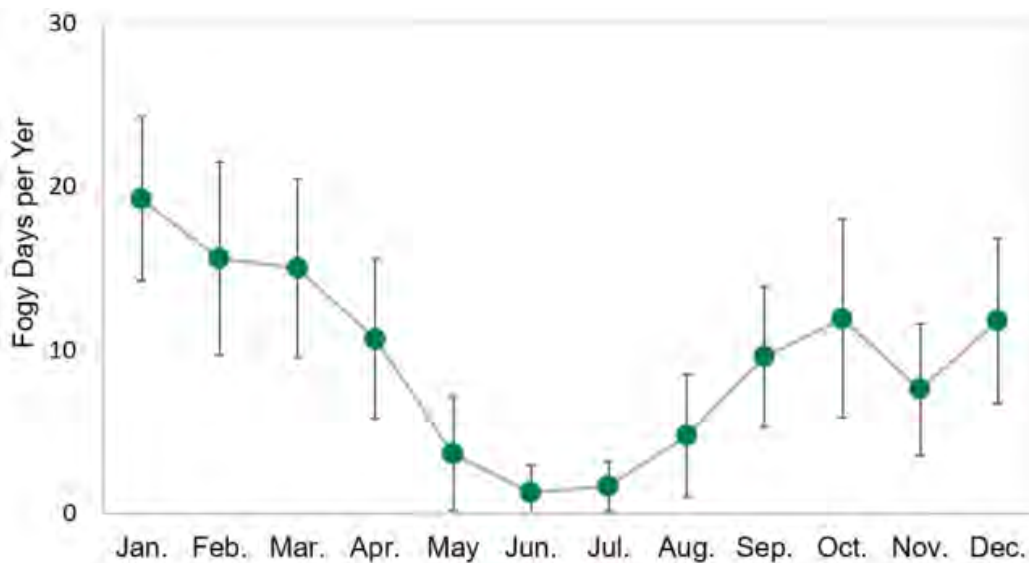


Source: Khe Sanh Meteorology Station

**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 Meteorological 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).

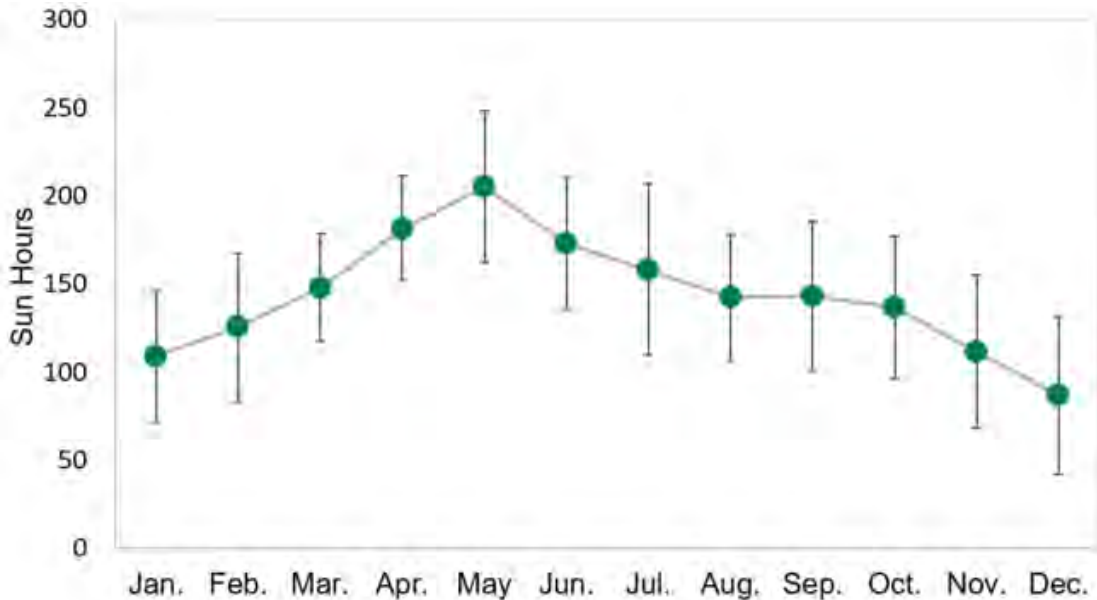


Source: Khe Sanh Meteorology Station

**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).



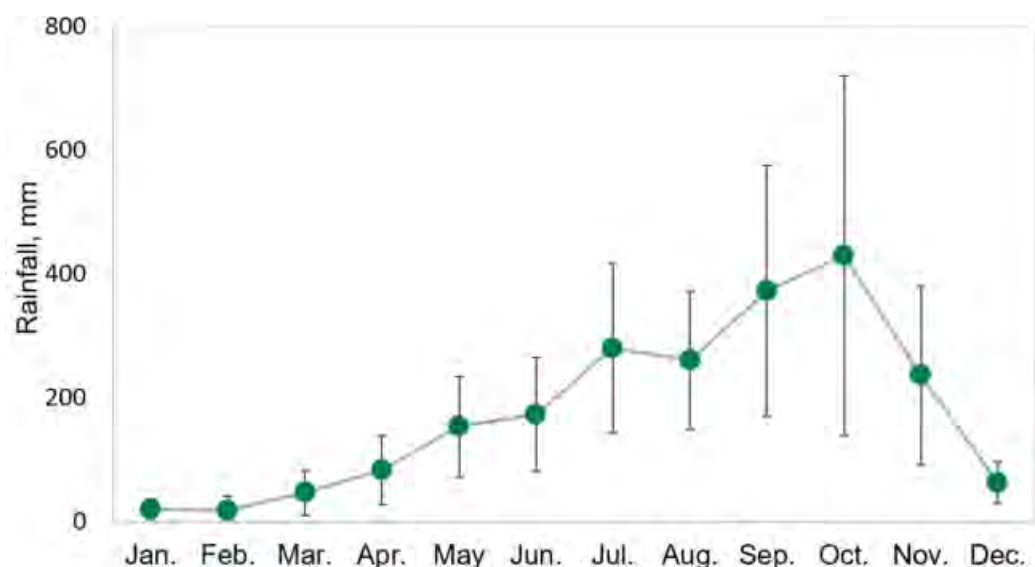
Source: Khe Sanh Meterology Station

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

### 7.3.6 Rainfall

According to Quang Tri Portal, the average annual rainfall in Quang Tri Province is between 2,200 mm and 2,500 mm. Maximum rainfalls usually occur from September through December and they distribute to over 70% of the annual rainfall. The number of rainy days in the Province is between 154 and 190 days per year (Quang Tri Province Portal, 2019).

The monthly rainfall in Khe Sanh Town greatly varies throughout the year to be between 18.1mm 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 Meteorological Stations

**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**

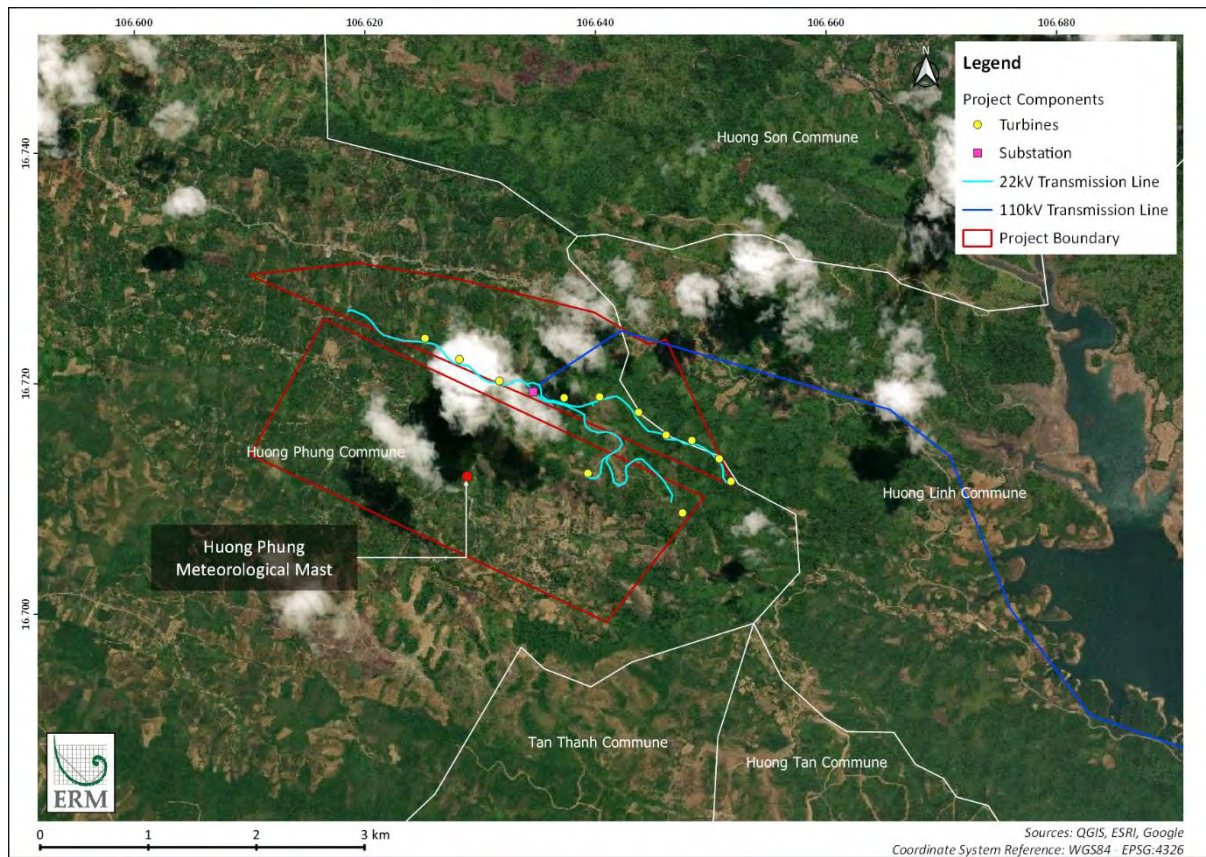
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Dong Ha	2.29	2.25	2.10	1.95	2.29	3.53	3.78	3.40	1.87	2.18	2.58	2.56	2.57
Khe Sanh	3.00	2.85	2.68	2.20	2.24	2.83	2.96	2.62	1.63	2.35	3.13	3.03	2.62

**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

The wind data were recored at the Meteoroglogical mast which is located in the project area (Figure 7.7).



**Figure 7.7** Huong Phung Meteorological Mast

The Project area belongs to the strong speed areas. The wind speed data which were recorded at the project’s wind measuring tower are shown in Table 7.4. The average wind speed is similar among the measurement heights of the wind measuring tower. From morning to noon, the wind speed tends to increase and peak in the afternoon (9 – 10 AM) then gradually decreases until the next morning and reaches a minimum from 19 to 21 PM.

Table 7.5 shows the data of monthly average wind speed at the wind measuring tower of the Project. While in the transition seasons (September and May) has minimum variance, the maximum variance was recorded in the period of winter monsoon (December and January).

**Table 7.4** Variation of hourly average wind speed

Hour	Huong Phung Station, Unit: m/s			
	80m (Ch1)	80m (Ch2)	60m	40m
0	6.7	6.6	6.6	5.8
1	6.8	6.8	6.7	5.9
2	6.9	6.9	6.8	6.0
3	7.1	7.0	7.0	6.2
4	7.2	7.1	7.1	6.3
5	7.3	7.2	7.1	6.4
6	7.4	7.3	7.3	6.7

Hour	Huong Phung Station, Unit: m/s			
	80m (Ch1)	80m (Ch2)	60m	40m
7	7.5	7.4	7.4	6.8
8	7.5	7.5	7.4	6.9
9	7.7	7.6	7.6	7.1
10	7.6	7.5	7.6	7.0
11	7.5	7.5	7.5	7.0
12	7.4	7.5	7.4	6.9
13	7.3	7.3	7.3	6.8
14	7.2	7.3	7.3	6.5
15	7.0	7.0	7.0	6.4
16	6.8	7.0	6.7	6.0
17	6.5	6.7	6.4	5.7
18	6.3	6.4	6.2	5.4
19	6.1	6.0	6.0	5.3
20	6.1	6.0	6.0	5.3
21	6.1	6.0	6.0	5.3
22	6.3	6.2	6.2	5.5
23	6.4	6.4	6.3	5.7
Average	6.95	6.88	6.86	6.2

Note: Ch1 (Chanel 1): Wind direction with the height of 80mA, Ch2 (Chanel 2): Wind direction with the height of 80mB

**Table 7.5 Monthly average wind speed measured (m/s) at the wind measuring tower of the Project**

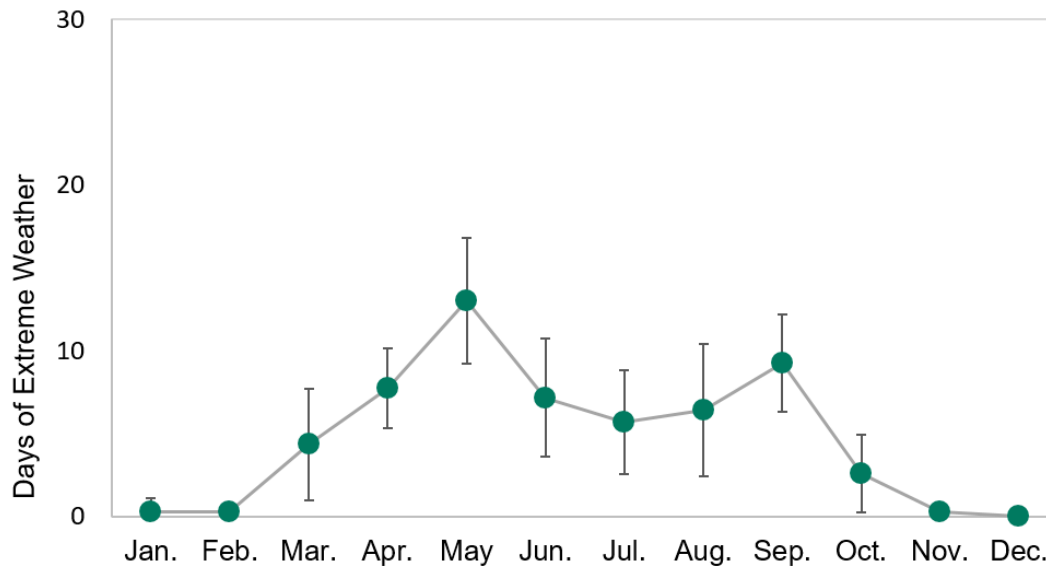
Height	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Average
80m (Ch1)	7.11	8.36	7.24	6.94	5.84	5.24	3.30	5.55	6.23	6.37	4.00	6.02
80m (Ch2)	6.73	8.06	7.26	6.99	5.92	5.20	3.53	5.46	6.32	6.41	4.12	5.98
60m	6.66	7.93	6.74	6.53	5.60	4.92	3.27	5.28	5.97	6.11	4.04	5.74
50m	5.89	7.20	6.33	6.08	5.11	4.45	2.91	4.72	5.35	5.48	3.67	5.20

### 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 rivers and streams, 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 (EIAs, 2019); 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 (Figure 7.8).



Source: Khe Sanh Meteorology Station

**Figure 7.8 Days of Extreme Weather in Huong Hoa District (2007 - 2018)**

## 7.4 Hydrography

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 Brances), 13 branches at level 2 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 156km, measured based on its longest river. The basin is 36.8 km wide at average and has a total area of approximately 2660 km<sup>2</sup>;
- Ben Hai River System has a basin capacity of approximately 809 km<sup>2</sup> 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<sup>2</sup> and is approximately 65 km long. The upper River is running through Thua Thien - Hue Province.

### 7.4.1 Surface water

The Pa Rong stream is located about 530 m to the northwest of the Project. This stream flows into the Sen River. The hydrological regime of streams and rivers in Quang Tri province has two distinct seasons including flood season and dry season. Flood season comes late and lasts a short time. Flood season usually starts from September and ends in December. Although it only lasts for 4 months, the

concentration level of flood season is quite large, accounting for 60-80% of the total annual flow. The dry season on the streams lasts 9 months, starting in January and ending in August.

Rao Quan Lake, which is located in Huong Linh Commune, Huong Hoa District, is about 2.5 km from the project area. This is a reservoir project serving the generation of Quang Tri hydropower plant. The reservoir is designed to provide water for more than 1,600 hectares of rice and crops in Huong Hoa District.

### 7.4.2 Groundwater

Based on the EIA of Huong Phung 2, the groundwater in the area has been being exploited and used by local residential. However, the groundwater level in the area is quite low, the depth of exploitation starts from  $\geq 4$  m, so it easily has microbiological contamination from animal husbandry activities households. The current form of exploitation is mainly small-scale household wells to use for domestic water supply.

A baseline of groundwater quality was collected on 22 April 2019 showed that all analysed parameters fell below thresholds' of QCVN 09-MT:2015/BTNMT – National technical regulation on ground water quality (Table 7.11).

## 7.5 Air Quality

A baseline of air quality and noise was collected on 22 April 2019 to support the regulatory EIA by Center for Natural Resources and Environment Monitoring of Quang Tri province. Four samples were taken in the Project area for analysing based on 05:2013/BTNMT – National Technical Regulation on Ambient Air Quality.

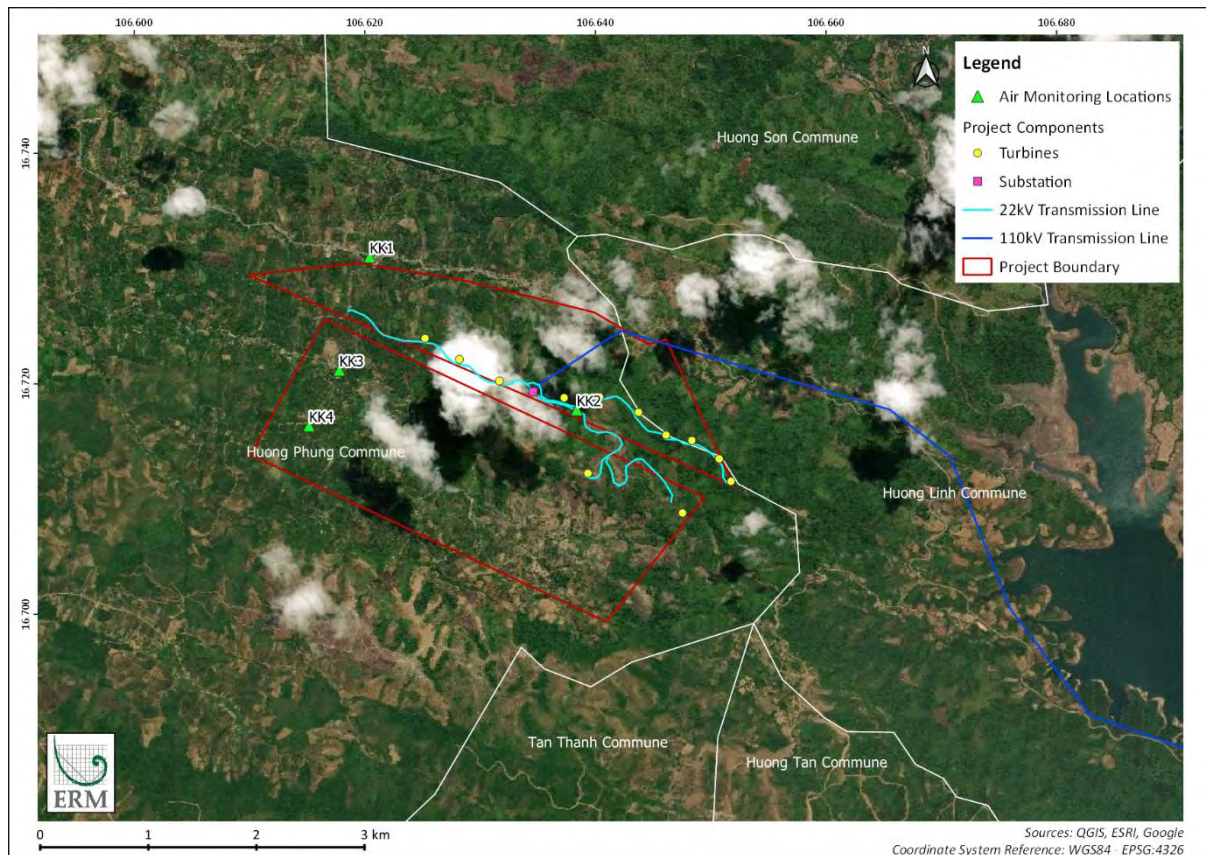
The results showed that at the sampling time, all analysed parameters fell below thresholds' value of the QCVN 05:2013/BTNMT. Therefore the air quality is generally in good conditions.

The monitoring locations are described in Table 7.6.

**Table 7.6 Air Monitoring Location**

Sampling Location	Coordinate (WGS84)	
	X (m)	Y (m)
KK1	106.620414	16.7310123
KK2	106.638375	16.7177492
KK3	106.617781	16.7212029
KK4	106.615153	16.7163637

Four monitoring locations are illustrated in Figure 7.9.



**Figure 7.9 Air Quality Monitoring Locations**

The air quality results are summarised in Table 7.7.

**Table 7.7 Air quality results**

No.	Parameters	Unit	Results				QCVN 05:2013/BTNMT (Average 01 hour)
			KK1	KK2	KK3	KK4	
1	Temperature	°C	29.9	30.6	33.3	34.6	-
2	Humidity	%	67	66	65	64	-
3	Wind speed	m/s	2.8	3.3	3.5	4.0	-
4	Dust	µg/m <sup>3</sup>	166	222	167	194	<b>300</b>
5	SO <sub>2</sub>	µg/m <sup>3</sup>	23	20	26	24	<b>50</b>
6	NO <sub>2</sub>	µg/m <sup>3</sup>	17	20	19	21	<b>200</b>
7	CO	µg/m <sup>3</sup>	KPH (2000*)	KPH (2000*)	KPH (2000*)	KPH (2000*)	<b>30,000</b>

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



## 7.6 Water Quality

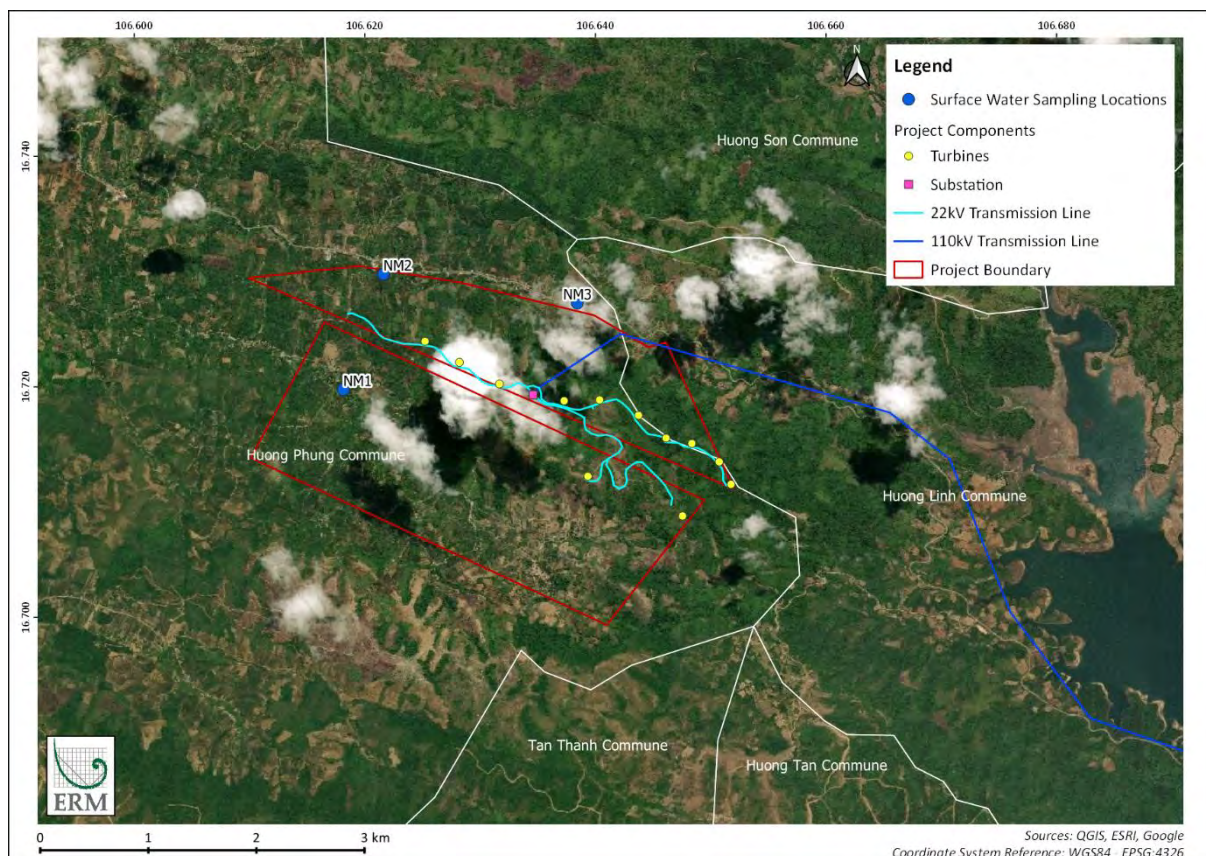
### 7.6.1 Surface water

A baseline of surface water quality was collected on 22 April by Center for Natural Resources and Environment monitoring of Quang Tri province to support the regulatory EIA. Three samples were taken in the Project area for analysing ten parameters of water quality, based on QCVN 08-MT:2013/BTNMT – National Technical Regulation on Surface Quality.

**Table 7.8 Surface Water Sampling Locations**

Sampling Location	Description	Coordinate (WGS84)	
		X (m)	Y (m)
NM1	Pa Rong stream, Phung Lam village, Huong Phung commune	106.618123	16.7197563
NM2	A small stream at proposed road to access the Project	106.621603	16.7297721
NM3	Co Nhoi stream, nearby Military Post 337	106.638423	16.7272650

Three monitoring locations are illustrated in Figure 7.10.



**Figure 7.10 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. The results are summarised in Table 7.9.

**Table 7.9 Surface water quality results**

No.	Criteria	Unit	Analysis result			QCVN 08-MT:2015/BTNMT
			NM1	NM2	NM3	B1
1	pH	-	5.9	5.8	6.0	<b>5.5 - 9</b>
2	DO	mg/L	7.2	7.2	6.9	<b>≥ 4</b>
3	TSS	mg/L	7.0	7.8	9.6	<b>50</b>
4	BOD <sub>5</sub>	mg/L	1.7	1.9	1.6	<b>15</b>
5	COD	mg/L	7	5	8	<b>30</b>
6	NH <sub>4</sub> -N	mg/L	0.05	KPH (0.02*)	KPH (0.02*)	<b>0.3</b>
7	NO <sub>3</sub> -N	mg/L	0.07	0.09	KPH (0.04*)	<b>10</b>
8	PO <sub>4</sub> -P	mg/L	KPH (0.04*)	KPH (0.04*)	KPH (0.04*)	<b>0.3</b>
9	Fe	mg/L	0.026	0.046	0.08	<b>1.5</b>
10	Coliform	NPN/100mL	240	2,100	1,100	<b>7,500</b>

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

KPH: not detected

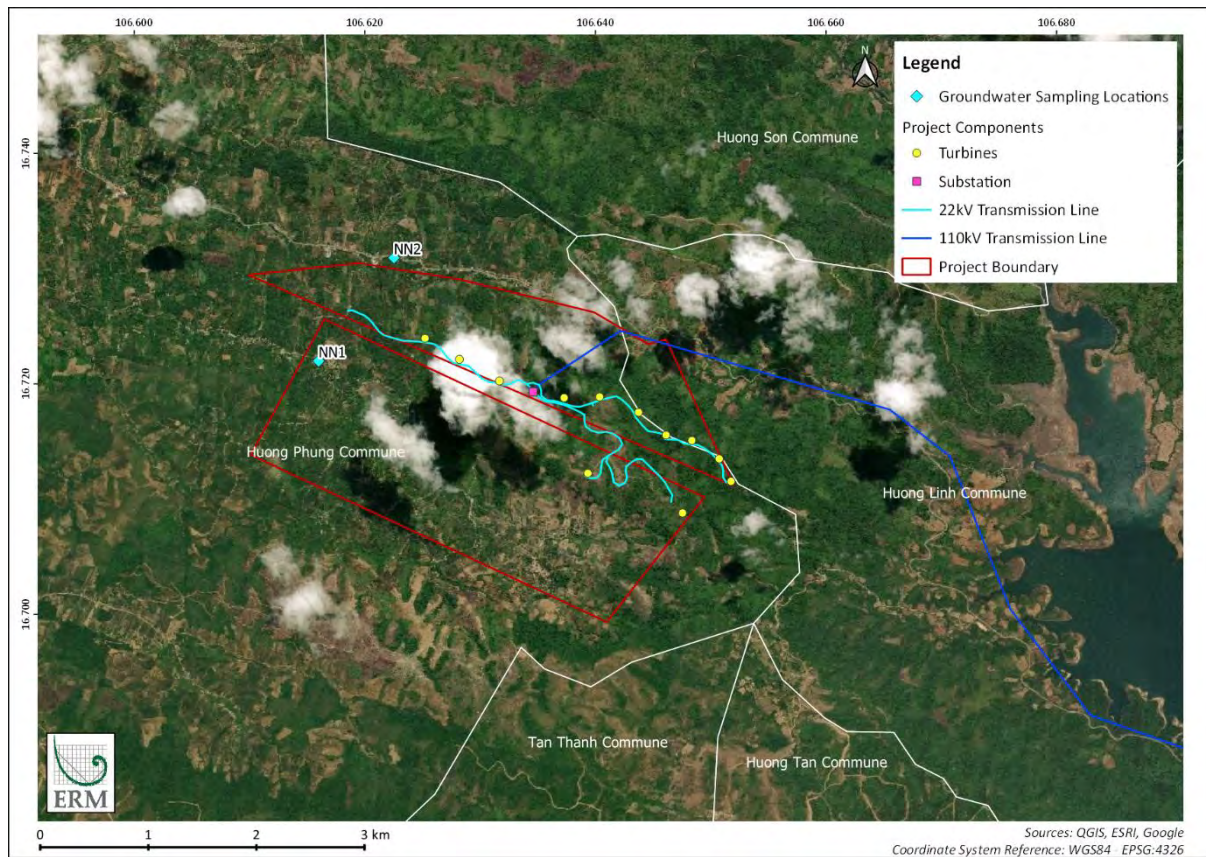
## 7.6.2 Groundwater

A baseline of groundwater quality was collected on 22 April by Center for Natural Resources and Environment monitoring of Quang Tri province to support the regulatory EIA. Two samples were taken in the Project area for analysing ten parameters, based on QCVN 09-MT:2015/BTNMT – National technical regulation on ground water quality.

Two monitoring locations are illustrated in Table 7.10 and Figure 7.11.

**Table 7.10 Groundwater Sampling Locations**

Sampling Location	Description	Coordinate (WGS84)	
		X (m)	Y (m)
NN1	At Nguyen Van Toan household, Phung Lam village, Huong Phung commune	106.615980	16.7219832
NN2	At Ho La Hon household, Cop village, Huong Phung commune	106.622515	16.7309362



**Figure 7.11 Groundwater Monitoring Locations**

The results showed that all analysed parameters fell below thresholds' of QCVN 09-MT:2015/BTNMT – National technical regulation on ground water quality.

**Table 7.11 Groundwater quality results**

No.	Criteria	Unit	Analysis result		QCVN 09-MT:2015/BTNMT
			NN1	NN2	
1	pH	-	6.5	6.5	<b>5.5 – 8.5</b>
2	TDS	mg/L	518	523	<b>1.500</b>
3	Hardness	mgCaCO <sub>3</sub> /L	228	238	<b>500</b>
4	Chloride	mg/L	11	10	<b>250</b>
5	NH <sub>4</sub> -N	mg/L	0.04	KPH (0.02*)	<b>1</b>
6	NO <sub>3</sub> -N	mg/L	0.63	0.66	<b>15</b>
7	Fe	mg/L	KPH (0.021*)	KPH (0.021*)	<b>5</b>
8	Sulphate	mg/L	20	17	<b>400</b>
9	Coliform	NPN/100mL	KPH	KPH	<b>3</b>
10	E.coli	NPN/100mL	KPH	KPH	<b>KPH</b>

Note:  
 QCVN 09-MT:2015/BTNMT - National technical regulation on groundwater  
 (-) Non-specified standards

## 7.7 Noise

A noise monitoring was conducted at two (02) locations in Huong Phung Commune to collect the noise baseline condition for the Project between 10 and 14 February 2020. These monitoring locations were presentative of noise sensitive receptors around the Project site and related type of Residential, institutional and educational receptors in the Table 7.12. The selection of the monitoring locations and monitoring procedure were implemented based on the IFC noise management Guidance. Detailed information of the noise survey can be found in Appendix A.

**Table 7.12 IFC Noise Level Guidelines**

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

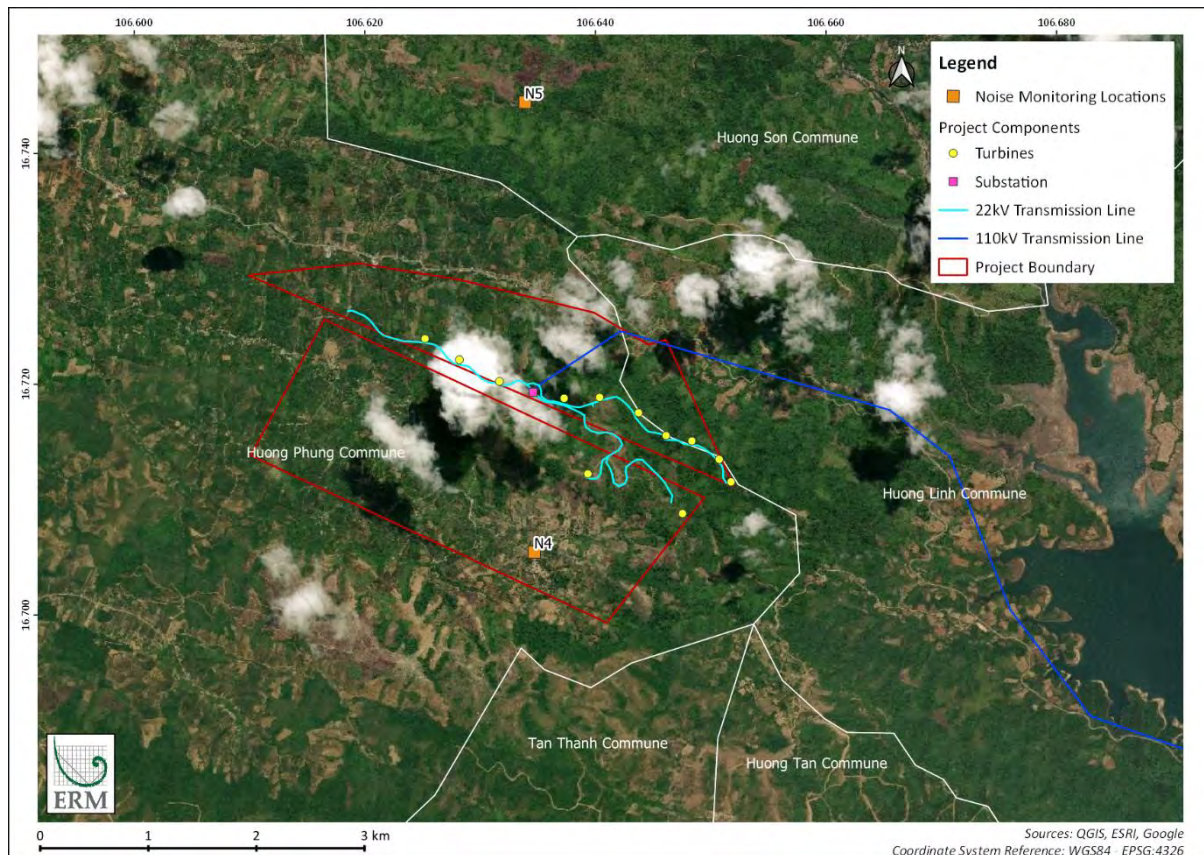
Source: IFC General EHS Guidelines – Noise Management, 2007

### 7.7.1 Noise Monitoring Locations

Noise monitoring was conducted at two (02) locations in Huong Phung Commune (Table 7.13). These monitoring locations were representative of noise sensitive receptors around the Project site. The noise monitoring locations are described in Table 7.13.

**Table 7.13 Noise Monitoring Locations**

Sampling locations	Description	Coordinate	
		16.705444	106.634694
N4	Huong Choa village, Huong Phung commune	16.705444	106.634694
N5	Cop village, Huong Phung commune	16.744444	106.633889



**Figure 7.12 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. LAeq, LA90 and LA10 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 LAeq, LA90 and LA10 are listed in the Noise survey report in the Appendix A.

### 7.7.3 Noise Monitoring Results

Noise monitoring results for each monitoring location are showed in Figure 7.13 and Figure 7.14 and discussed below:

Location N4:

- The 1-hour equivalent sound level at the N2 was the least fluctuating (range from 42.7 to 56.1 dBA). Leq,1h noise level met the IFC standard, accounting for 100% in daytime, but only 27.8% in night time;
- The main sources of noise are frog insects, motorbikes, dogs, roosters and cows.

Location N5:

- Noise level at N5 was highest and fluctuated in a wide range (from 41.8 to 75.2dBA), mainly due to the influence of many sources such as motorbike, car horns, truck horns, the barking of dogs, loudspeakers and most notably the sound of frogs and insects from evening until 4am The equivalent sound level one hour (Leq,1h) exceeded the IFC standard, accounting for 26.3% in daytime, and 86.1% in night time;

- The 24-hour average Leq level between the two days measured at N5 varies significantly, especially at night, because the second day was heavily influenced by frogs and insects with higher intensity and longer duration).

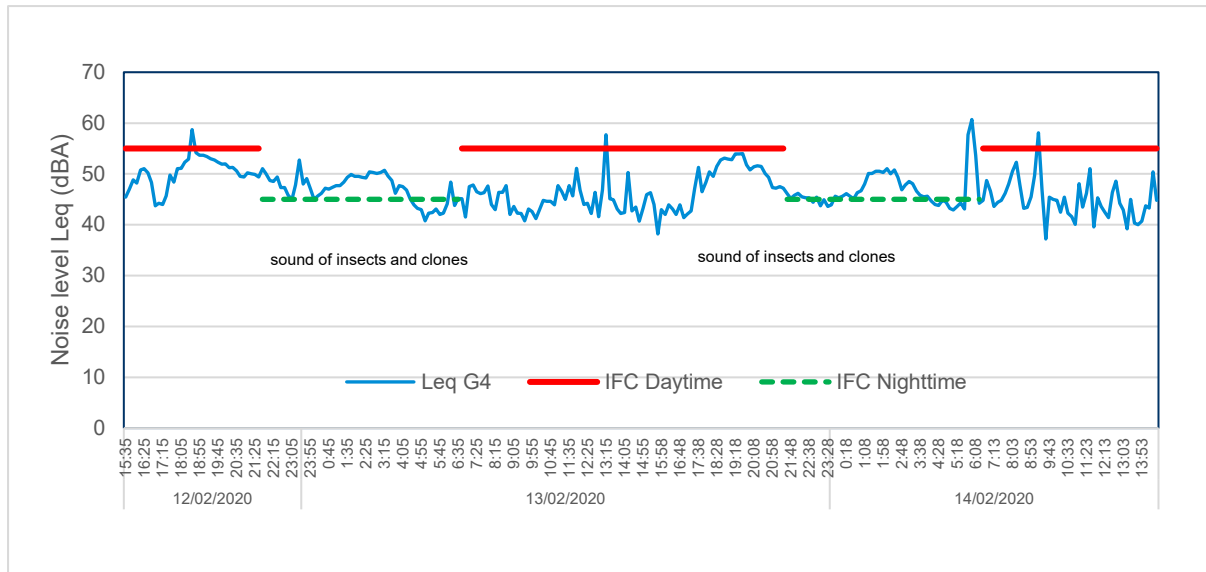


Figure 7.13 Leq, 10min (dBA) at Noise Monitoring Location N4

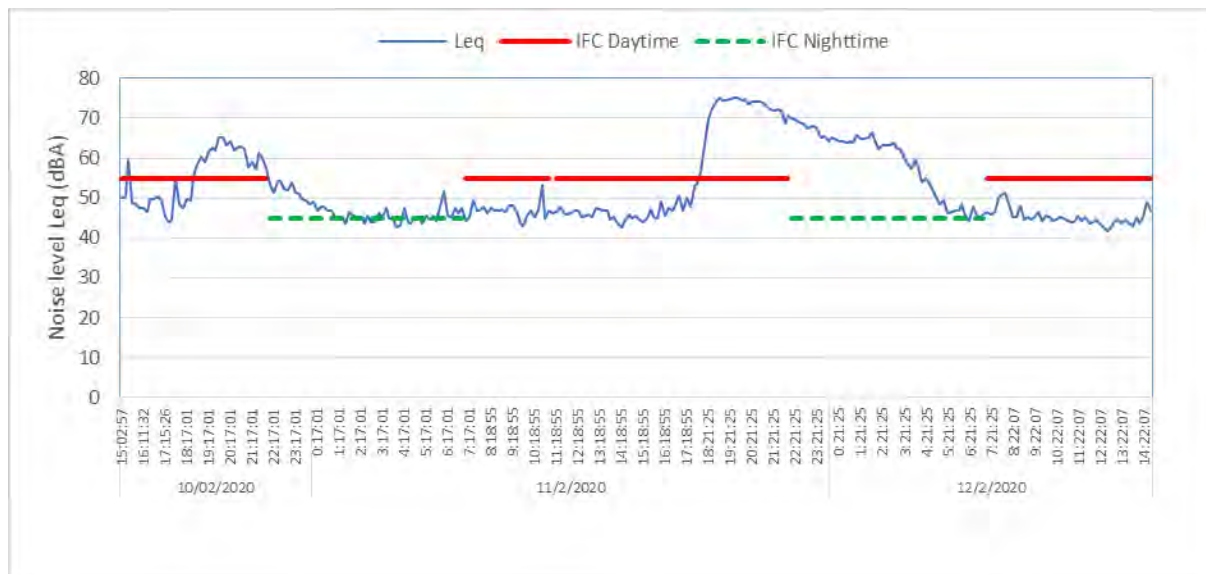


Figure 7.14 Leq, 10min (dBA) at Noise Monitoring Location N5

## 8. BIODIVERSITY BASELINE

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 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 8.4).

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 World Wildlife Fund (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 8.1.11.

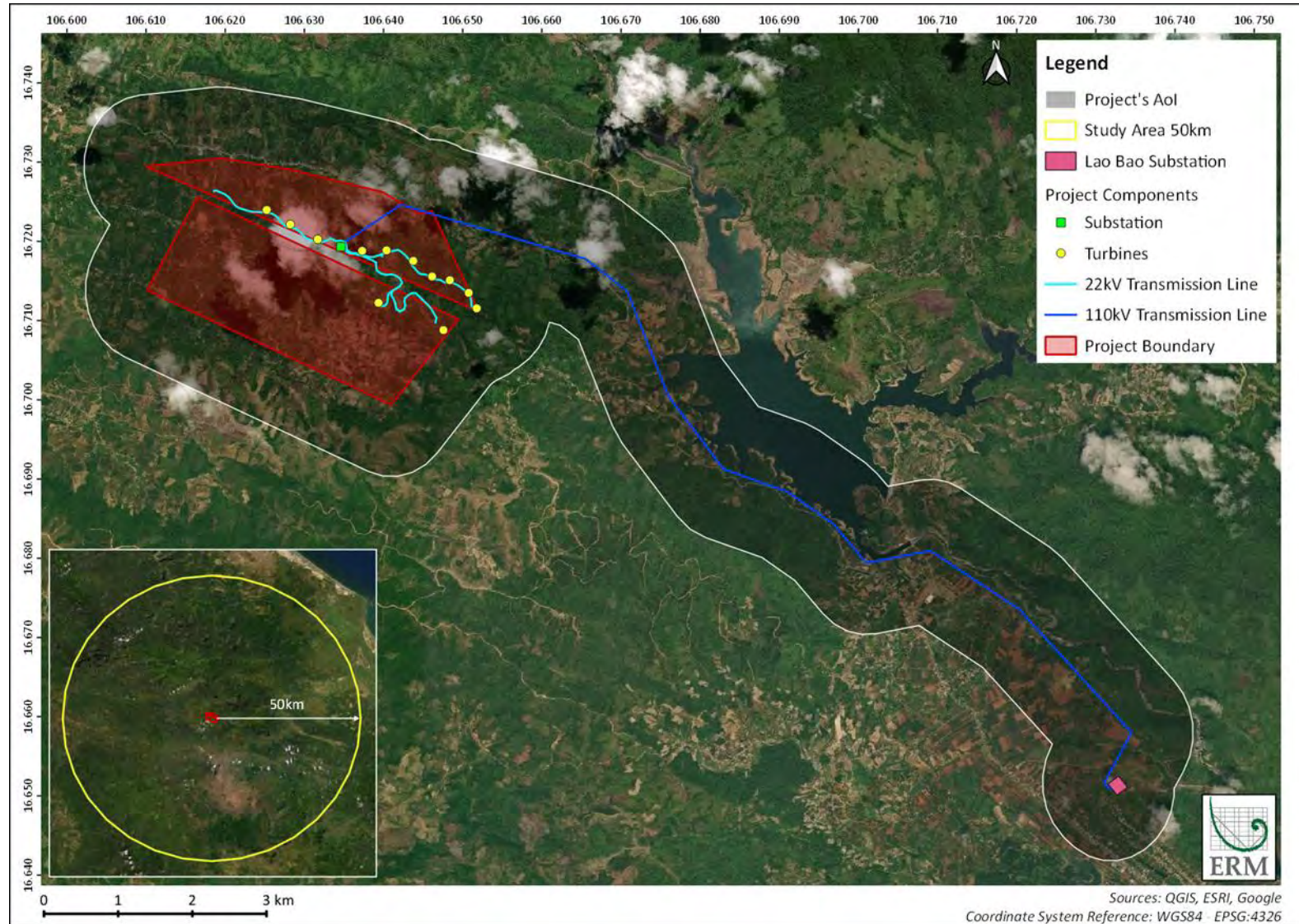


Figure 8.1 Biodiversity Assessment Areas within Study Area



## 8.1.1 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 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 truongsongensis*; 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 Edwards' Pheasant (*Lophura edwardsi*), Crested Argus (*Rheinardia ocellata*) and Short-tailed Scimitar-babbler (*Jabouilleia danjoui*). The Imperial Pheasant (*L. imperialis*) and Edwards' 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<sup>2</sup>, 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.

#### 8.1.1.1.1 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 species. Endemic species include the Annam Partridge (*Arborophila merlini*), while the near-endemic species include the Edwards' 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<sup>2</sup>. However, less than 10% of the native vegetation remains and is protected due to Vietnam's high human population density and illegal wildlife trade.

## 8.1.2 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 8.1.2.1 and 8.1.2.2.

### 8.1.2.1 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.

### 8.1.2.2 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.

## 8.1.3 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.

## 8.1.4 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<sup>2</sup>, 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).

### 8.1.5 Key Biodiversity Areas

Key Biodiversity Areas (KBAs) are defined by the Key Biodiversity Areas Partnership<sup>8</sup> 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 9.2.

**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	30 km southeast of Project Area
2	Laving-Laveun	38,103	Laos	No	30 km north of Project Area
3	Dong Phou Vieng	306,624	Laos	No	40 km southwest of Project Area
4	Truong Son	191,094	Vietnam	Yes	25 km north of Project Area
5	Upper Xe Bangfai	30,481	Laos	Yes	40 km northwest of Project Area

Source: IBAT, 2020

<sup>8</sup> 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.

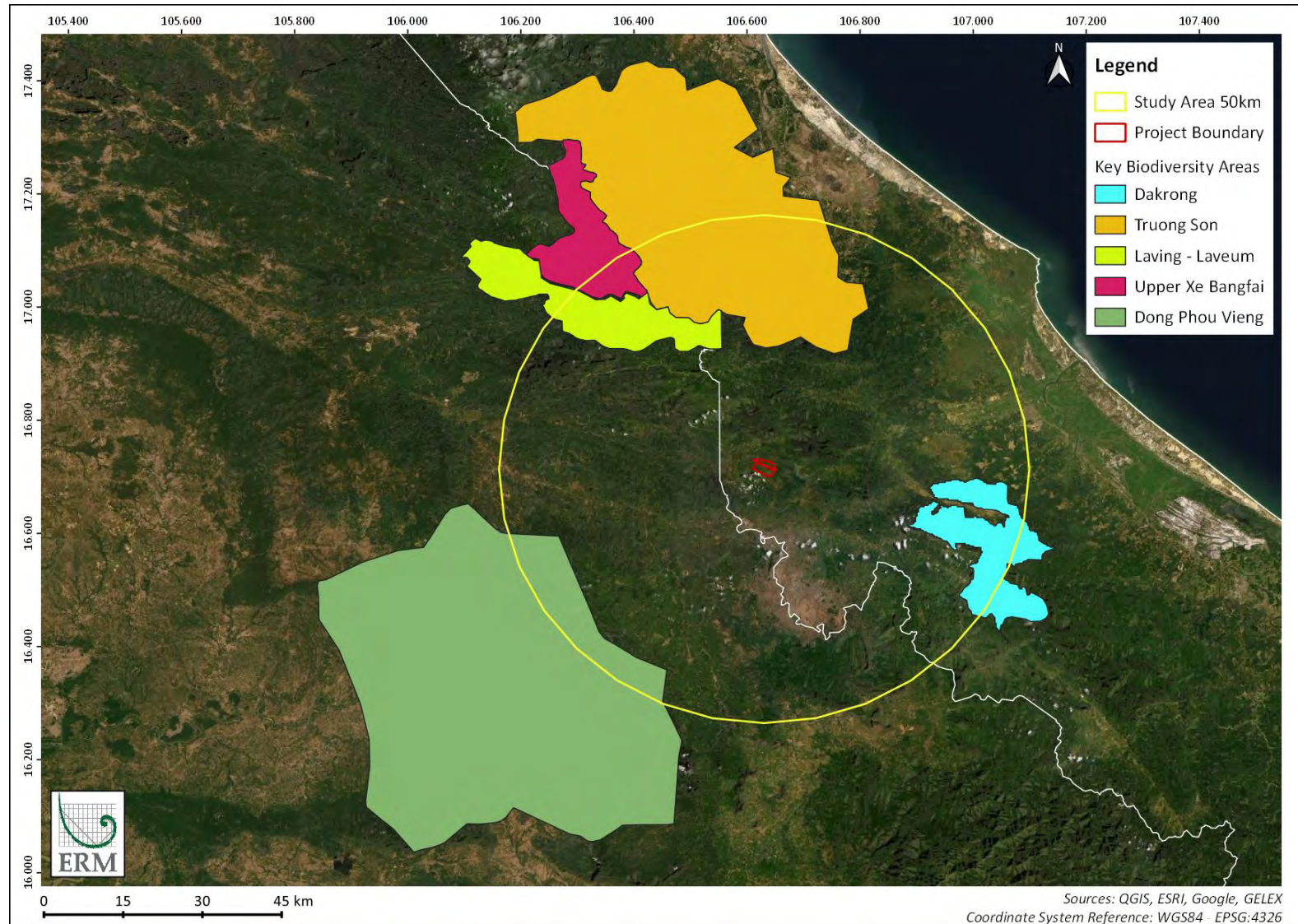


Figure 8.2 KBAs in proximity to the Project Area

### 8.1.5.1 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. All the IBAs identified are also within the Annamese Lowlands Endemic Bird Area (EBA).

**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 30 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 Edwards' Pheasant ( <i>Lophura edwardsi</i> ) and Imperial Pheasant ( <i>Lophura imperialis</i> ) (BirdLife International, 2020a).
2	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 ( <i>Rheinardia ocellata</i> ) (BirdLife International, 2020b).
3	Upper Xe Bangfai	Upper Xe Bangfai is classified as an IBA approximately 31,300 ha in size, located approximately 40 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 ( <i>Rheinardia ocellata</i> ), Grey-headed Parakeet ( <i>Psittacula finschii</i> ), Siamese Fireback ( <i>Lophura diardi</i> ), Lesser Fish Eagle ( <i>Ichthyophaga humilis</i> ), Bar-backed Partridge ( <i>Arborophila brunneopectus</i> ), Ashy Woodswallow ( <i>Artamus fuscus</i> ), Lesser Necklaced Laughingthrush ( <i>Garrulax monileger</i> ), and Black-collared Starling ( <i>Gracupica nigricollis</i> ) (BirdLife International, 2020c).

Source: BirdLife International, 2020.

### 8.1.5.2 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 (*Leptobranchium xanthops*).

### 8.1.6 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  $\leq 50,000$  km<sup>2</sup>) are entirely confined (BirdLife International, 2020d). 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<sup>2</sup> (BirdLife International, 2020e). The Annamese Lowlands EBA also contains all the IBAs identified within the Study Area.

### 8.1.7 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.

#### 8.1.7.1 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.

#### 8.1.7.2 Nationally Protected Areas

Three 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 30 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).
2	Dong Phou Vieng	299,000	VI	Dong Phou Vieng National Biodiversity Conservation Area is located in central Laos, approximately 25 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 ( <i>Trachypithecus germaini</i> ) (Protected Planet, 2020a; Timmins et al., 2013).

S/N	Name	Area (ha)	IUCN Category	Summary
3	Bac Huong Hoa	23,486	Not Reported	Bac Huong Hoa Nature Reserve is located in central Vietnam, approximately 10 km from the 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 Douc Langur, as well as four of seven restricted-range bird species which define the Annamese Lowlands EBA. 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 Tran, 2008; Protected Planet, 2020b).

Source: iBAT, 2020.

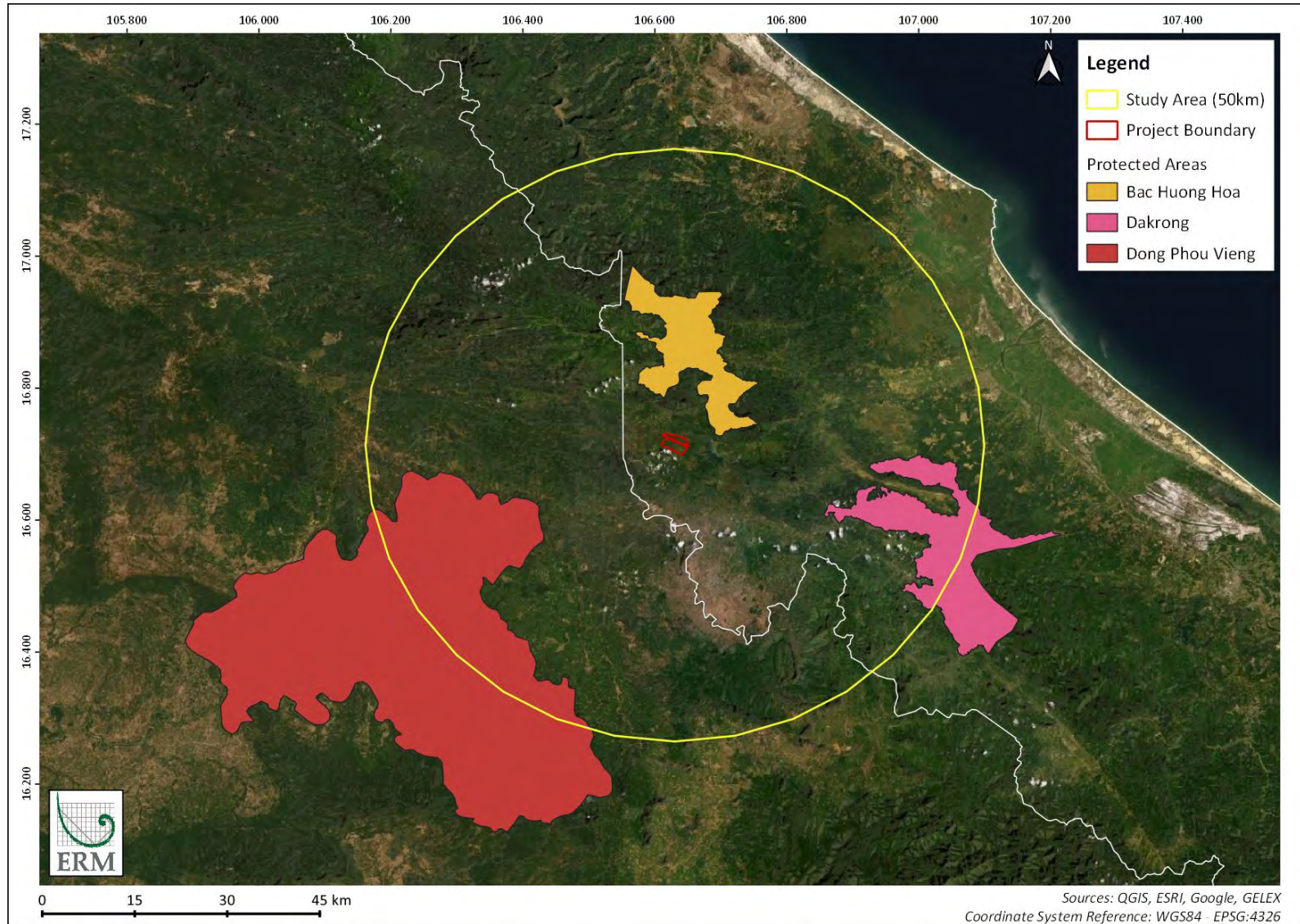


Figure 8.3 Protected Area within the Study Area



### 8.1.8 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.

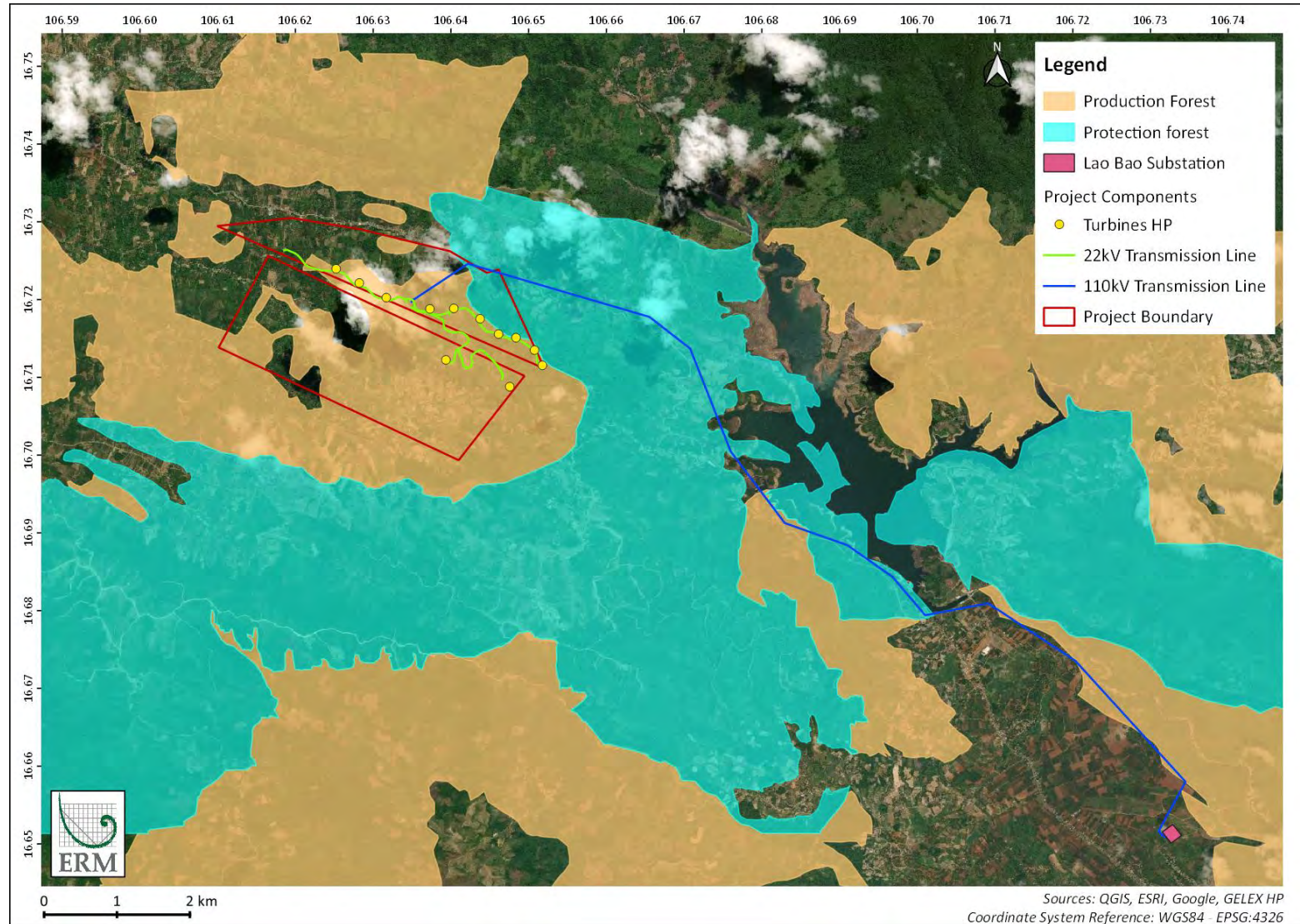


Figure 8.4 Vietnam Forest Classifications

## 8.1.9 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 Table 8.4.

### 8.1.9.1 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.

75 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	<i>Crocodylus siamensis</i>	Siamese Crocodile	CR	Reptile
2	<i>Indotestudo elongata</i>	Elongated Tortoise	CR	Reptile
3	<i>Manis javanica</i>	Sunda Pangolin	CR	Mammal
4	<i>Manis pentadactyla</i>	Chinese Pangolin	CR	Mammal
5	<i>Pangasius sanitwongsei</i>	Giant Pangasius	CR	Ray-finned fish
6	<i>Pseudoryx nghetinhensis</i>	Saola	CR	Mammal
7	<i>Muntiacus vuquangensis</i>	Large-antlered Muntjac	CR	Mammal
8	<i>Cuora bourreti</i>	Bourret's Box Turtle	CR	Reptile
9	<i>Catlocarpio siamensis</i>	Giant Carp	CR	Ray-finned fish
10	<i>Gyps bengalensis</i>	White-rumped Vulture	CR	Bird
11	<i>Sarcogyps calvus</i>	Red-headed Vulture	CR	Bird
12	<i>Emberiza aureola</i>	Yellow-breasted Bunting	CR	Bird
13	<i>Gyps tenuirostris</i>	Slender-billed Vulture	CR	Bird
14	<i>Lophura edwardsi</i>	Vietnam Pheasant	CR	Bird
15	<i>Panthera pardus ssp. delacouri</i>	Indochinese Leopard	CR	Mammal
16	<i>Pygathrix nemaeus</i>	Red-shanked Douc Langur	CR	Mammal
17	<i>Nomascus siki</i>	Southern White-cheeked Gibbon	CR	Mammal

S/N	Scientific Name	Common Name	IUCN Category	Class
18	<i>Laubuka caeruleostigmata</i>	Flying Minnow	EN	Ray-finned fish
19	<i>Chrotogale owstoni</i>	Owston's Civet	EN	Mammal
20	<i>Cuon alpinus</i>	Dhole	EN	Mammal
21	<i>Elephas maximus</i>	Asian Elephant	EN	Mammal
22	<i>Panthera tigris</i>	Tiger	EN	Mammal
23	<i>Hemitygon laosensis</i>	Mekong Freshwater Stingray	EN	Cartilaginous fish
24	<i>Nomascus gabriellae</i>	Red-cheeked Gibbon	EN	Mammal
25	<i>Trachypithecus germaini</i>	Indochinese Lutung	EN	Mammal
26	<i>Trachypithecus hatinhensis</i>	Hatinh Langur	EN	Mammal
27	<i>Nesolagus timminsi</i>	Annamite Striped Rabbit	EN	Mammal
28	<i>Viverra megaspila</i>	Large-spotted Civet	EN	Mammal
29	<i>Nycticebus pygmaeus</i>	Pygmy Slow Loris	EN	Mammal
30	<i>Cuora mouhotii</i>	Keeled Box Turtle	EN	Reptile
31	<i>Protobothrops sieversorum</i>	Three Horned-scaled Pitviper	EN	Reptile
32	<i>Pangasianodon hypophthalmus</i>	Striped Catfish	EN	Ray-finned fish
33	<i>Schistura nudidorsum</i>	-	EN	Ray-finned fish
34	<i>Poropuntius deauratus</i>	Yellow Tail Brook Barb	EN	Ray-finned fish
35	<i>Terateleotris aspro</i>	-	EN	Ray-finned fish
36	<i>Rheinardia ocellata</i>	Crested Argus	EN	Bird
37	<i>Pavo muticus</i>	Green Peafowl	EN	Bird
38	<i>Sterna acuticauda</i>	Black-bellied Tern	EN	Bird
39	<i>Lonchura oryzivora</i>	Java Sparrow	EN	Bird
40	<i>Calostoma insigne</i>	-	EN	Fungi
41	<i>Bos gaurus</i>	Gaur	VU	Mammal
42	<i>Helarctos malayanus</i>	Sun Bear	VU	Mammal
43	<i>Macaca arctoides</i>	Stump-tailed Macaque	VU	Mammal
44	<i>Myotis pilosus</i>	Rickett's Big-footed Myotis	VU	Mammal
45	<i>Panthera pardus</i>	Leopard	VU	Mammal
46	<i>Ursus thibetanus</i>	Asiatic Black Bear	VU	Mammal
47	<i>Nycticebus bengalensis</i>	Bengal Slow Loris	VU	Mammal
48	<i>Macaca leonina</i>	Northern Pig-tailed Macaque	VU	Mammal

S/N	Scientific Name	Common Name	IUCN Category	Class
49	<i>Arctictis binturong</i>	Binturong	VU	Mammal
50	<i>Rusa unicolor</i>	Sambar	VU	Mammal
51	<i>Hipposideros scutinares</i>	Shield-nosed Leaf-nosed Bat	VU	Mammal
52	<i>Wallago attu</i>	-	VU	Ray-finned fish
53	<i>Pseudohemiculter dispar</i>	-	VU	Ray-finned fish
54	<i>Osphronemus exodon</i>	Elephant Ear Gourami	VU	Ray-finned fish
55	<i>Oxygaster pointoni</i>	-	VU	Ray-finned fish
56	<i>Epalzeorhynchus munense</i>	Red Fin Shark	VU	Ray-finned fish
57	<i>Lycodon paucifasciatus</i>	Rendahl's Wolf Snake	VU	Reptile
58	<i>Naja siamensis</i>	Black And White Spitting Cobra	VU	Reptile
59	<i>Ophiophagus hannah</i>	King Cobra	VU	Reptile
60	<i>Bangana behri</i>	-	VU	Ray-finned fish
61	<i>Schistura kaysoni</i>	Laotian Cave Loach	VU	Ray-finned fish
62	<i>Tor sinensis</i>	Red Mahseer	VU	Ray-finned fish
63	<i>Yasuhikotakia nigrolineata</i>	Black-Lined Loach	VU	Ray-finned fish
64	<i>Bungarus slowinskii</i>	Red River Krait	VU	Reptile
65	<i>Python bivittatus</i>	Burmese Python	VU	Reptile
66	<i>Bangana musaei</i>	-	VU	Ray-finned fish
67	<i>Mulleripicus pulverulentus</i>	Great Slaty Woodpecker	VU	Bird
68	<i>Buceros bicornis</i>	Great Hornbill	VU	Bird
69	<i>Rhyticeros undulatus</i>	Wreathed Hornbill	VU	Bird
70	<i>Carpococcyx renauldi</i>	Coral-billed Ground-cuckoo	VU	Bird
71	<i>Clanga clanga</i>	Greater Spotted Eagle	VU	Bird
72	<i>Aquila heliaca</i>	Eastern Imperial Eagle	VU	Bird
73	<i>Garrulax konkakinhensis</i>	Chestnut-eared Laughingthrush	VU	Bird
74	<i>Arctonyx collaris</i>	Greater Hog Badger	VU	Mammal
75	<i>Physignathus cocincinus</i>	Chinese Water Dragon	VU	Reptile

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

Source: IBAT, 2020.

### 8.1.9.2 Restricted Range Species

According to IFC PS6, restricted range species are defined as species with an estimated extent of occurrence (EOO) of  $\leq 50,000 \text{ km}^2$  for terrestrial vertebrates and  $\leq 100,000 \text{ km}^2$  for marine species. These species are candidates for screening against Critical Habitat Criterion 2. 10 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 <sup>2</sup> )	Class
1	<i>Pseudoryx nghetinhensis</i>	Saola	CR	<10,000	Mammal
2	<i>Lophura edwardsi</i>	Vietnam Pheasant	CR	18,000	Bird
3	<i>Garrulax konkakhensis</i>	Chestnut-eared Laughingthrush	VU	19,400	Bird
4	<i>Cutia legalleni</i>	Vietnamese Cutia	NT or LR/NT	98,300	Bird
5	<i>Fregata minor</i>	Great Frigatebird	LC or LR/LC	126,000,000	Bird
6	<i>Stachyris herberti</i>	Sooty Babbler	LC or LR/LC	28,500	Bird
7	<i>Psilopogon auricularis</i>	Necklaced Barbet	LC or LR/LC	94,100	Bird
8	<i>Nok hualon</i>	Bare-faced Bulbul	LC or LR/LC	34,000	Bird
9	<i>Theلودerma truongsoneuse</i>	-	DD	-	Amphibian
10	<i>Hylomys megalotis</i>	Long-eared Gymnure	DD	-	Mammal

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

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

Although the Vietnamese Cutia, Great Frigatebird and Necklaced Barbet are identified as restricted range species in the IBAT report, they have EOOs above 50,000 km<sup>2</sup> and this does not meet the threshold definition for Criterion 2 under IFC PS6. For *Theلودerma truongsoneuse* 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. truongsoneuse* has been recorded in the mountains of central Vietnam and is expected to be present in Laos (Stuart, 2008).

### 8.1.9.3 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). 202 migratory birds were identified as candidates, as shown in Appendix I.

### 8.1.10 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 H. The invasive species recorded during field surveys are listed in Section 8.3.1.

### 8.1.11 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, which 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 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.

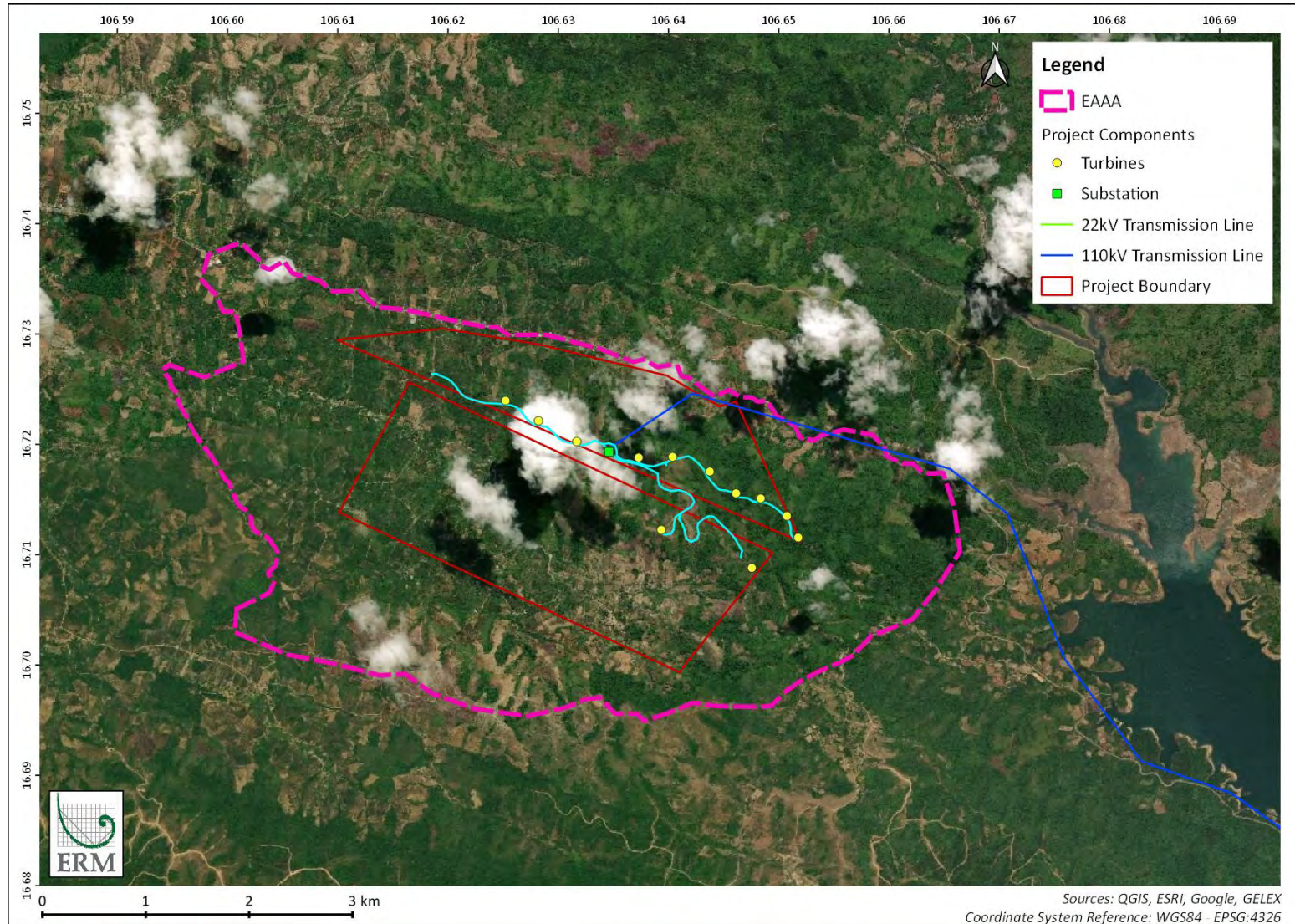


Figure 8.5 Project EAAA



## 8.1.12 Natural Habitat and Modified Habitat Assessment

### 8.1.12.1 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 together with publicly available data from the government. 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 *Cyperus cyperoides*, *Kyllinga brevifolia*, *Ageratum conyzoides*, *Cyrtococcum patens*, *Bidens pilosa*, *Solanum torvum* 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

- Natural forest: Natural 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**

### 8.1.12.2 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.”*

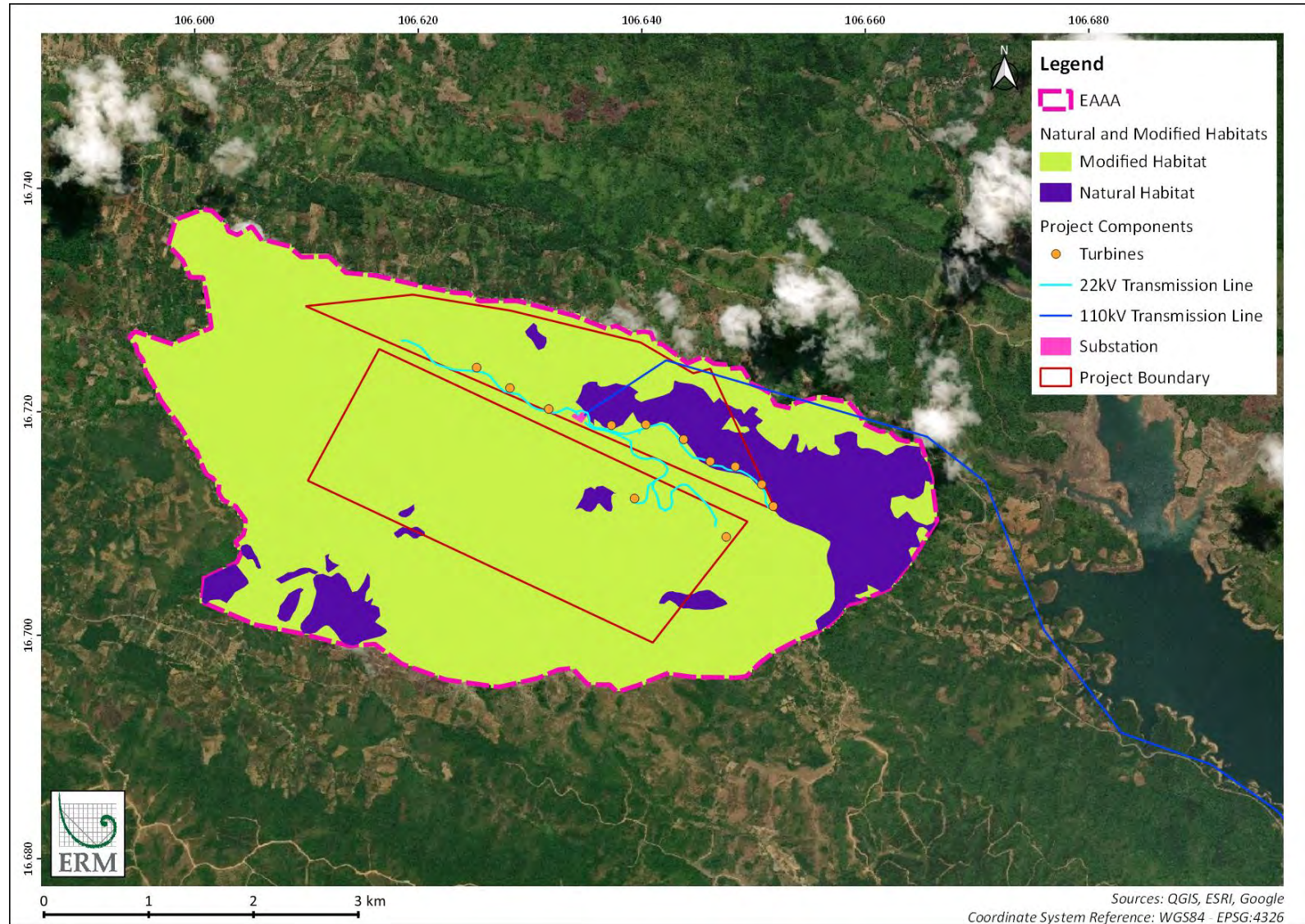
There is currently no methodology within IFC PS6 and the associated Guidance Note (GN) on the approach to assess the distribution of these habitat types. ERM has utilised methods used previously in consultation with the IFC to complete this assessment using remote sensing techniques for the Study Area.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

Figure 8.11 shows the natural and modified habitat areas within the EAAA. The approximate area of each type of habitat is summarised in Table 8.7.

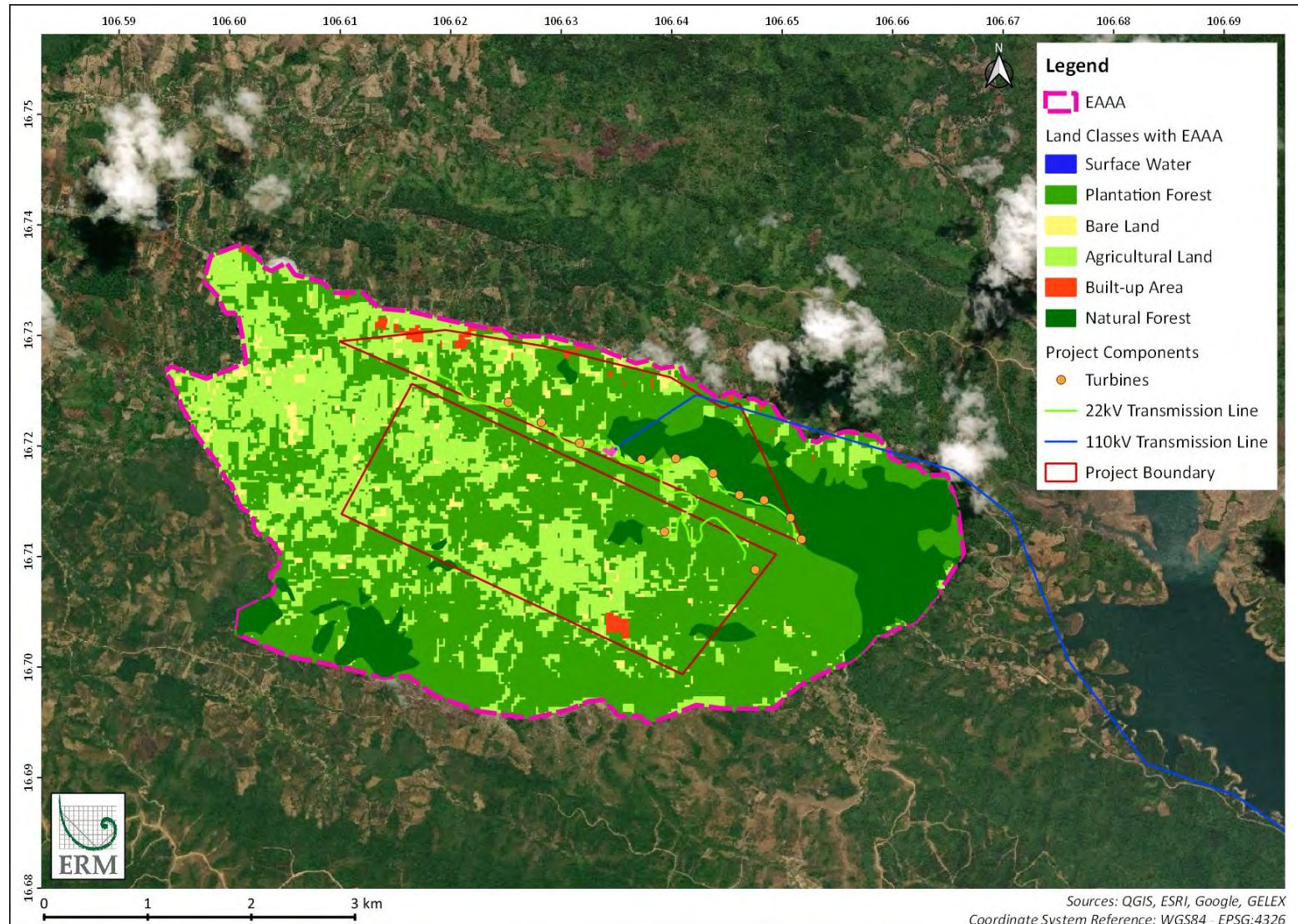
**Table 8.7 Natural and Modified Habitat areas within the Study Area**

Area	Natural Habitat (ha)	Modified Habitat (ha)	Total (ha)
EAAA	326.29	1926.21	2252.50
Project Area	85.42	786.69	872.11

Natural habitats within the EAAA consist of forest while modified habitats consist of plantation, agricultural land, bare land and built-up area, shown in Figure 8.12.



**Figure 8.11** Natural and Modified Habitat Classification within EAAA



**Figure 8.12 Land Classification within EAAA**

## 8.2 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.

### 8.2.1 Field Survey Program

Multidisciplinary 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 8.2.1.1.1	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)				
3	6 January 2020 (First survey)	Avifauna	Line Transect Survey	See Section 8.2.1.1.2	1 line transect (12 km) surveyed for 5 hours by 2 surveyors
4	16 May 2020 (Second survey)				2 line transects (8.6 km, 4.8 km) surveyed for 10 hours by 2 surveyors for each transect
5	14 February – 16 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 8.2.1.2	9 points surveyed across 3 days
6		Terrestrial Fauna (Birds, Amphibian, Reptiles and Non-	Line Transect Survey	See Section 8.2.1.4	9 hours (7:00 – 16:00) and 2.5 hours (18:30 – 21:00) per day

S/N	Dates	Target	Survey Technique	Survey Methods	Survey Effort
		volant Mammals)			
7		Bat	Acoustic Line Transect Survey	See Section 8.2.1.3.1	3 different transects on 3 days (3 hours per day)
			Acoustic Monitoring Station	See Section 8.2.1.3.2	3 stations deployed over 3 days, 5 hours per day (17:30 – 22:30)
			Mist-net Sampling	See Section 8.2.1.3.3	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	<p>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.</p> <p>Locals were shown a photo catalogue and asked if they had encountered any of the above species.</p> <p>Information on time, location, situation of each encounter was recorded.</p> <p>Questions regarding potentially important habitats for taxa of conservation concern (e.g. feeding sites for Red-shanked Douc Langur) and any visible changes in the species' populations (e.g. more common, less common compared to 5 years ago) were also asked.</p>	2 interviewers conducted interviews with 88 locals (90% farmers) living near the Project Area



S/N	Dates	Target	Survey Technique	Survey Methods	Survey Effort
9	13 May – 16 May 2020	Terrestrial Fauna (Gibbons)	Acoustic Auditory Point Count Survey	See Section 8.2.1.4.2.	3 listening posts surveyed for 3.5 hours per day for 4 days
10		Terrestrial Fauna (Primates)	Line Transect Survey	See Section 8.2.1.4.1	4 different transects of lengths ranging from 4 – 8 km surveyed by 2 surveyors for 9 hours each

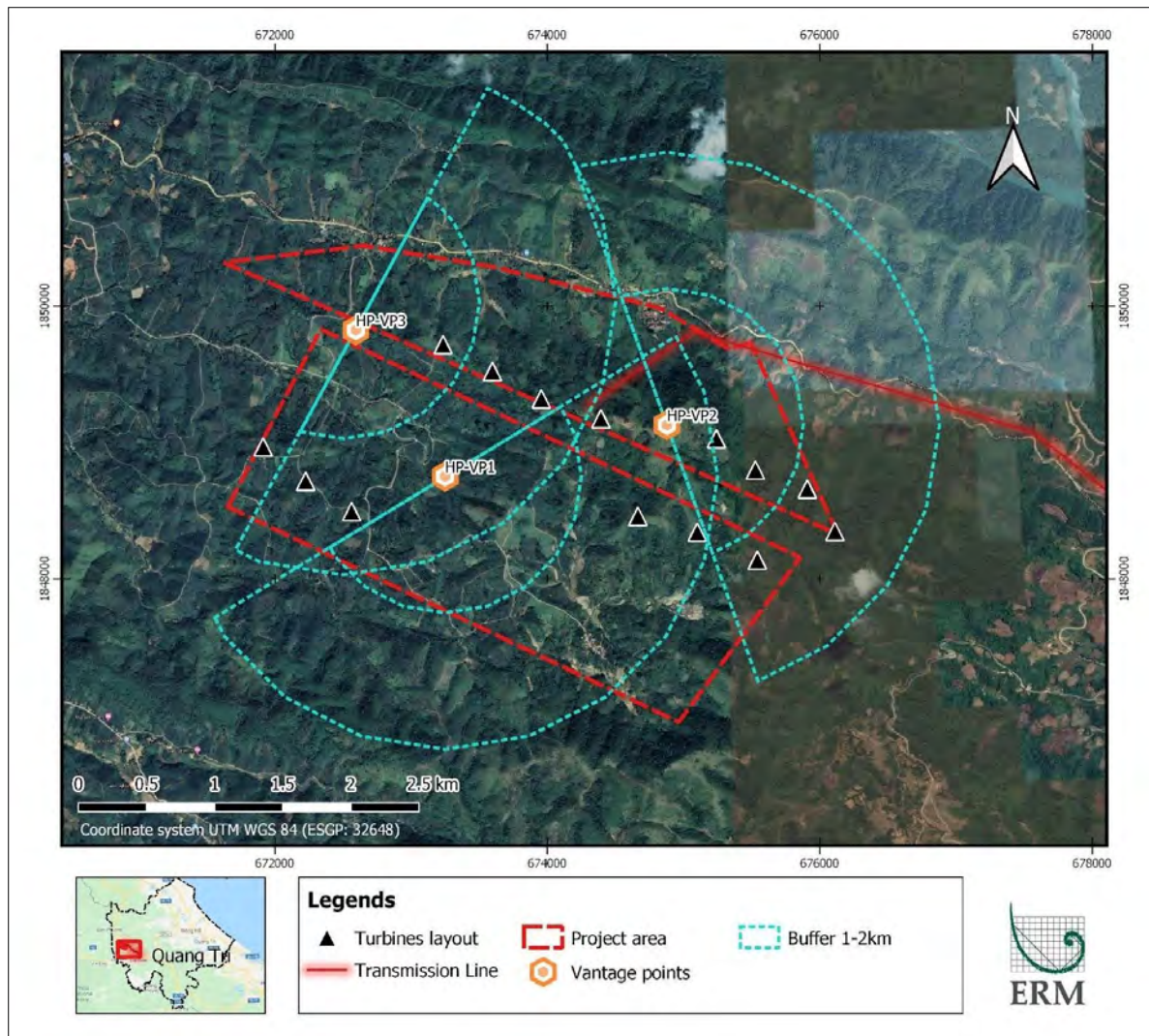
### 8.2.1.1 Birds

#### 8.2.1.1.1 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, namely VP1, VP2 and VP3 were located within the vicinity of the Project Area (Figure 8.13). 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° 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.



**Figure 8.13** Locations of three vantage points used for avifauna survey

### 8.2.1.1.2 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 transect. Attempts were made to ensure that the survey transect covered different habitats of the Project Area and its vicinity. During the survey, two surveyors recorded and identified any sightings of birds along the transects of approximately 12-13 km in length (Figure 8.14; Figure 8.15).

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 8.2.1.4 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.

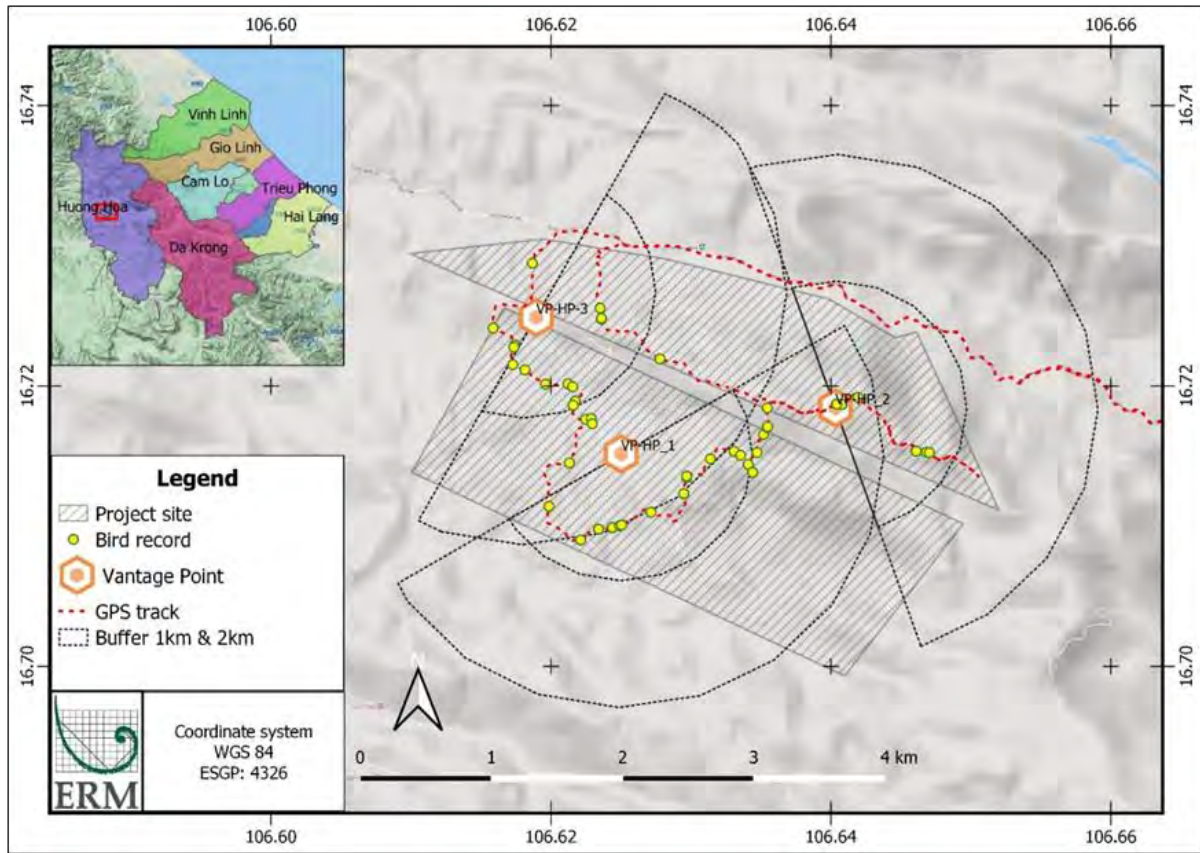
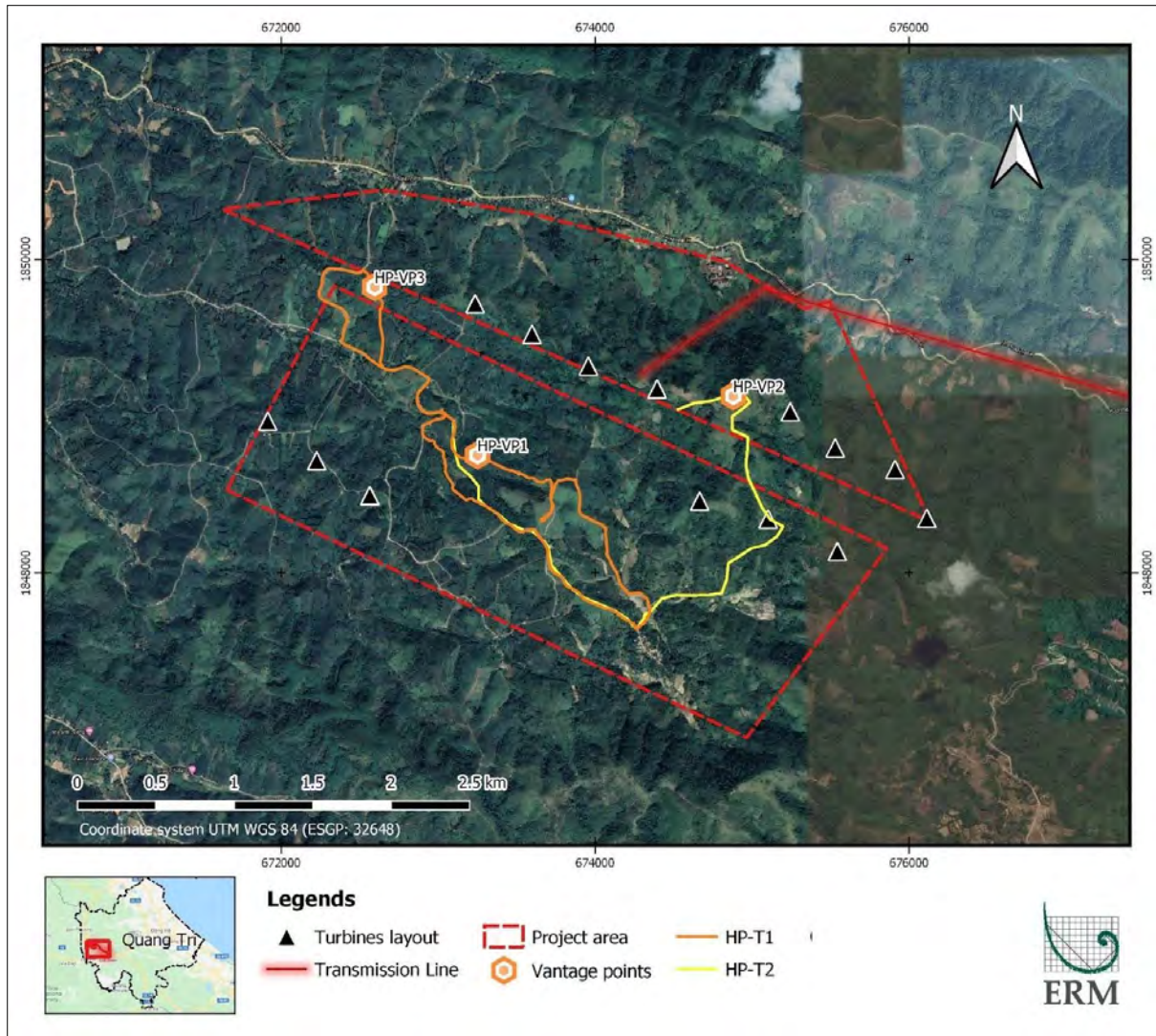


Figure 8.14 Locations of terrestrial transects used for avifauna survey in January 2020



**Figure 8.15** Locations of terrestrial transects used for avifauna survey in May 2020

## 8.2.1.2 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 nine 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).

## 8.2.1.3 Bats

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

### 8.2.1.3.1 Acoustic Line Transect Survey

Four line transects with a total length of 14.29 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).

### 8.2.1.3.2 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).

### 8.2.1.3.3 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.

## 8.2.1.4 Other Terrestrial Fauna (Herpetofauna and Non-Volant Mammal)

### 8.2.1.4.1 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-HP1	26,071	14 Feb 2020	07:00 to 16:00	9
T-HP2	55,380	15 Feb 2020	07:00 to 16:00	9
T-HP3	67,482	16 Feb 2020	07:00 to 16:00	9
Tn-HP1	2,208	14 Feb 2020	18:30 to 21:00	2.5
Tn-HP2	1,082	15 Feb 2020	18:30 to 21:00	2.5
Tn-HP3	5,473	16 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 Phung 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 8.16.

**Table 8.10 Summary of primate-focused transect surveys in May 2020**

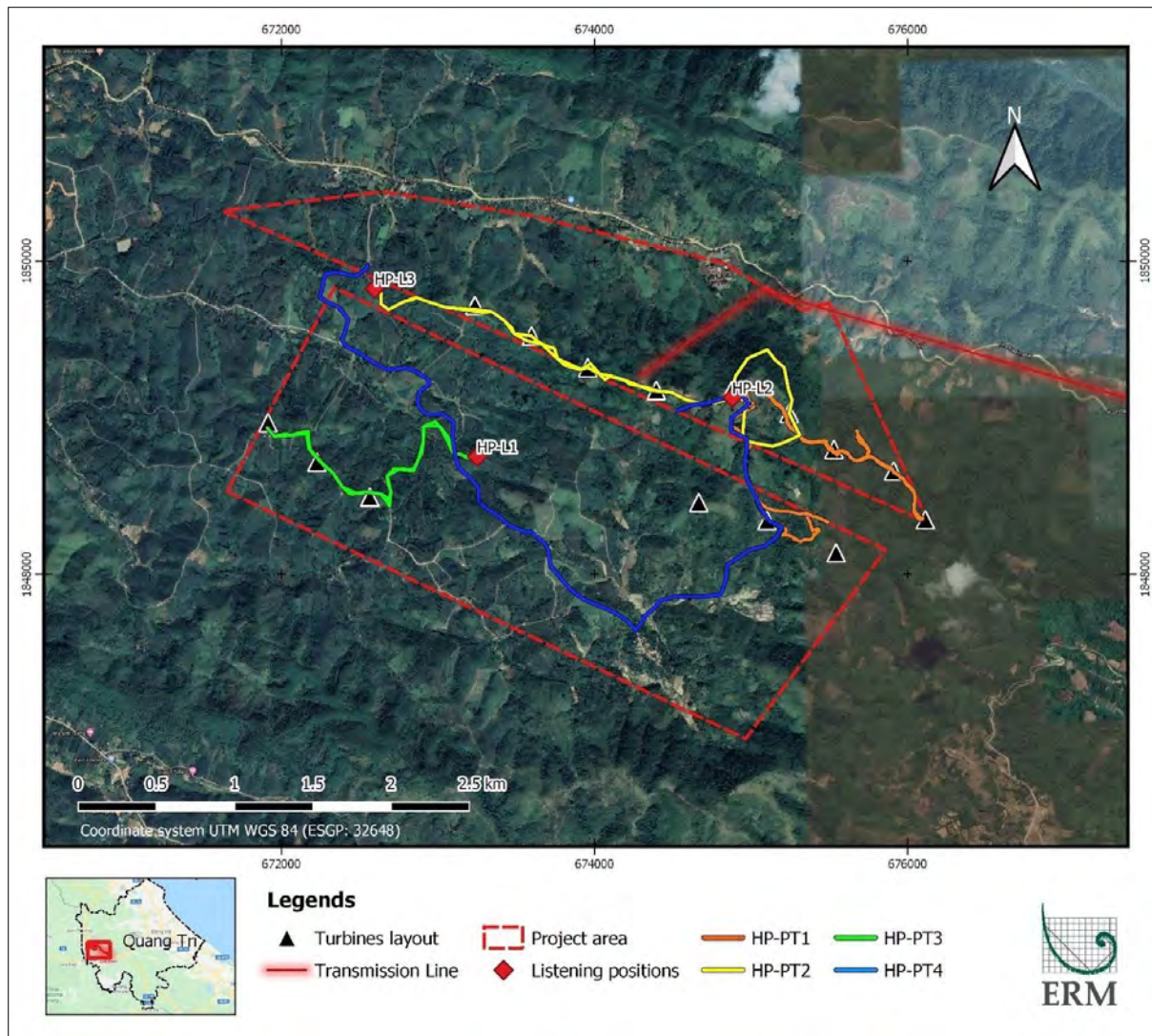
Transect	Transect length (km)	Survey date	Time of survey	Survey effort (hours)
HP-PT1	8.2	13 May 2020	9:00 to 15:00	6
HP-PT2	7.2	14 May 2020	9:00 to 15:00	6

Transect	Transect length (km)	Survey date	Time of survey	Survey effort (hours)
HP-PT3	4.3	15 May 2020	9:00 to 15:00	6
HP-PT4	6.6	16 May 2020	9:00 to 15:00	6

#### 8.2.1.4.2 Acoustic Auditory Point Count Survey

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 behaviour. 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, three 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 (HP-L1, HP-L2, HP-L3) are shown in Figure 8.16.



**Figure 8.16** Locations of primate-focused transects and gibbon listening posts in May 2020

### 8.3 Biodiversity Field Survey Results

#### 8.3.1 Flora

##### 8.3.1.1 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 agricultural land and 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	1557.9	1422.63	2654.82



S/N	Habitat/Vegetation Type	Project Area with 1000m buffer (ha)	T-line with 1000m buffer (ha)	Total Area (ha)
2	Water surface	0.09	370.98	371.07
3	Forest	888.57	1171.26	1737.81
4	Urban and Built Up	57.78	183.96	221.94
5	Barren	98.01	145.35	214.74
6	Total	2602.35	3294.18	5200.38

### 8.3.1.2 Rapid Field Survey

The field survey recorded 109 plant taxa (95 species, 7 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, 28 species are listed in the IUCN Red List: 1 Endangered (*Coffea arabica* L.); 1 Near-Threatened NT (*Pinus latteri* Mason); and 26 species are Least Concern LC) (Table 8.12). *Lithocarpus vestitus* (Hickel & A.Camus). None of 95 plant species (excluding 14 unidentified species) are recorded in Vietnam Red Data Book. The *Coffea arabica* L. (IUCN EN) found within the Project Area were planted.

There were also 2 endemic species recorded during this rapid survey: *Alocasia decumbens* Buchet and *Semecarpus anacardiopsis* Evrard & Tardieu. Additionally, a total of 10 plant species were also identified as invasive species (Table 8.13).

Rarefaction curves generated indicated that there were many more undetected plant species within the Project Area and under the transmission line. Calculated from the observed 109 taxa at 9 survey points, the estimator Chao for this study was rounded at 174 species with 95% confidence interval from 143 to 235 plant species. Besides the 109 observed taxa, results of Chao suggests that at least 65 (95% CI from 34 to 126) 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	Vietnamese Name	Scientific Name	IUCN Red List
1	Cà phê arabica	<i>Coffea arabica</i> L.	EN
2	Thông hai lá	<i>Pinus latteri</i> Mason	NT
3	Bọ nét	<i>Alchornea rugosa</i> (Lour.) Müll. Arg.	LC
4	Mán đĩa	<i>Archidendron clypearia</i> (Jack) I.C.Nielsen	LC
5	Bích hợp	<i>Bischofia javanica</i> Blume	LC
6	Bồ cu vè	<i>Breynia fruticosa</i> (L.) Müll. Arg.	LC
7	Cù đề	<i>Breynia vitis-idaea</i> (Burm.f.) C.E.C.Fisch.	LC
8	Dương	<i>Broussonetia papyrifera</i> (L.) L'Hér. ex Vent.	LC
9	Kha thụ ấn	<i>Castanopsis indica</i> (Roxb. ex Lindl.) A.DC.	LC
10	Rau má	<i>Centella asiatica</i> (L.) Urb.	LC

S/N	Vietnamese Name	Scientific Name	IUCN Red List
11	Lác đuôi chồn	<i>Cyperus cyperoides</i> (L.) Kuntze	LC
12	Thập tử mảnh	<i>Decaspermum gracilentum</i> (Hance) Merr. & L.M.Perry	LC
13	Ráng tây sơn ngay	<i>Dicranopteris linearis</i> (Burm. f.) Underw.	LC
14	Ngái vàng	<i>Ficus fulva</i> Reinw. ex Blume	LC
15	Bạc đầu lá ngắn	<i>Kyllinga brevifolia</i> Rottb.	LC
16	Sâu trắng	<i>Liquidambar formosana</i> Hance	LC
17	Bời lời nhót	<i>Litsea glutinosa</i> (Lour.) C.B.Rob.	LC
18	Mã rặng răng	<i>Macaranga denticulata</i> (Blume) Müll.Arg.	LC
19	Ba bét nam	<i>Mallotus paniculatus</i> (Lam.) Müll.Arg.	LC
20	Dấu dầu ba lá	<i>Melicope pteleifolia</i> (Champ. ex Benth.) T.G. Hartley	LC
21	Trinh nữ	<i>Mimosa pudica</i> L.	LC
22	San cạp	<i>Paspalum conjugatum</i> P.J.Bergius	LC
23	Thông ba lá	<i>Pinus kesiya</i> Royle ex Gordon	LC
24	Sở dĩ nepal	<i>Saurauia napaulensis</i> DC.	LC
25	Chò xót	<i>Schima crenata</i> Korth.	LC
26	Cương đất	<i>Scleria terrestris</i> (L.) Fassett	LC
27	Sòi tía	<i>Triadica cochinchinensis</i> Lour.	LC
28	Huân lang chùm tụ tán	<i>Wendlandia paniculata</i> (Roxb.) DC.	LC

Note: LC – Least Concern  
 NT – Near-Threatened  
 EN – Endangered

**Table 8.13 Invasive plant species recorded in field survey**

S/N	Vietnamese Name	Scientific Name	Family	Invasive species
1	Cỏ hôi	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Compositae	Invasive weed
2	Sậy khô nhỏ	<i>Neyraudia arundinacea</i> (L.) Henrard	Poaceae	Invasive weed
3	Me đất nhỏ	<i>Oxalis corniculata</i> L.	Oxalidaceae	Invasive weed
4	Cứt lợn	<i>Ageratum conyzoides</i> (L.) L.	Compositae	Weed
5	Quỳ chàm, Xuyên chi	<i>Bidens pilosa</i> L.	Compositae	Weed
6	Chân voi mềm	<i>Elephantopus mollis</i> Kunth	Compositae	Weed
7	Trinh nữ	<i>Mimosa pudica</i> L.	Leguminosae	Weed
8	Dụm	<i>Rubus moluccanus</i> L.	Rosaceae	Weed
9	Cà pháo	<i>Solanum torvum</i> Sw.	Solanaceae	Weed
10	Cỏ mỹ	<i>Pennisetum polystachion</i> Schult.	Poaceae	Weed

## 8.3.2 Birds

### 8.3.2.1 Vantage Point Survey

#### January 2020

For the first survey, thirty-one (31) bird species were identified. A total of fourteen (14), sixteen (16) 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 8,700 seconds of bird flying was observed from the three vantage points. Most observed flights (8,130 seconds) observed occurred in band 1 (<35 m), below the RSZ, while little flying time was observed to occur in band 2 (35-150 m) (570 seconds). No observed flights occurred in band 3 (>150 m). Busier avian traffic was observed at VP2 and VP3 as compared to VP1, and this was also reflected in the disparity between the numbers of species recorded at each vantage point. Flock sizes were generally larger at VP3, ranging from 3 to 7 individuals as compared to those at VP1 and VP2 which ranges from 1 to 2 individuals. This explains the heavier avian traffic observed at VP3. Overall, the Black Bulbul (IUCN LC) was the most active species at the three vantage points. Flying activity appeared to vary within a day. At all three vantage points, birds appeared to be more active in the afternoon from 15:00 – 16:00. For VP2 and VP3, flying activity also peaked in the morning, at approximately 7:00.

Four (4) species flew in band 2, including the Little Egret (IUCN LC), Large-billed Crow (IUCN LC), Black Eagle (IUCN LC) and Crested Serpent Eagle (IUCN LC). Most of these flights occurred at VP1, with up to 60 seconds for each flight at different times of the day.

#### May 2020

For the second survey, forty-six (46) species were identified. A total of twenty-six (26), fifteen (15), and thirty-two (32) 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 8,055 seconds of bird flying was observed from the three vantage points. Most observed flights observed occurred in band 1 (<35 m), below the RSZ, while little flying time was observed to occur in band 2 (35-150 m) and band 3 (>150 m). Busier avian traffic was observed at VP2 which could be explained by the larger flock sizes observed, although longer duration of flights were observed at VP1 and VP3. Bird activity appears to be highest in the morning (6:00 – 8:00) and there was another peak in the late afternoon/evening (17:00) for all three vantage points.

Five (5) species flew in band 2, including the Lesser Whistling Duck (IUCN LC), Edible-nest Swiftlet (IUCN LC), Eastern Spotted Dove (IUCN LC), Black Drongo (IUCN LC) and Black-collared Starling (IUCN LC). All of these flights occurred at VP3, with up to 120 seconds for each flight at different times of the day.

### 8.3.2.2 Line Transect Survey

#### January 2020

In January 2020, fifteen (15) bird species were identified along the terrestrial transects. Many species were recorded only once during the survey. The most frequently sighted species was the Sooty-headed Bulbul (IUCN LC).

The occurrence data input into MAXENT model included 1 record of order Accipitriformes, 1 record of order *Coraciiformes*, 1 record of order Columbiformes, 1 record of order Galiformes, 40 records of order Passeriformes, and 1 record of order Piciformes. Due to the paucity of data, MAXENT modelling could only predict the suitable habitat of one out of six bird orders that were included into the model – Passeriformes. Results of the model suggest that the Project Area contains suitable but scattered habitat for bush and forest birds of order Passeriformes. Among members of Passeriformes order, only birds belonging to the Corvidae family (e.g. Large-billed Crow) could fly high and long distance enough

to potentially occur within the RSZ. This is also supported by the findings of the vantage point survey, where the Large-billed Crow (IUCN LC) was recorded flying in band 2 (i.e. within the RSZ).

### February 2020

In February 2020, thirty-three (33 species) were identified along the terrestrial transects. Eighteen (18) 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 2 records of order Accipitriformes, 3 records of order Columbiformes, 4 records of order Cuculiformes, 75 records of order Passeriformes, 2 records of order Pelecaniformes and 1 record of order Piciformes. MAXENT modelling could only predict the suitable habitat of five out of six bird orders that were included into the model – all except Piciformes. The Project Area appears to contain suitable habitat for Accipitriformes, as cliffs and mountains in the Project Area provide suitable foraging and nesting places for these birds. Suitable habitat for Columbiformes and Cuculiformes was patchy in the Project Area, with some overlap between the Project footprint and the suitable habitats for species of these orders. Suitable habitat for Passeriformes was found in the Northwest of the Project Area, where there is higher vegetation cover although it was also relatively patchy. 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-four (24) species were identified along the transects. Similarly, many species were recorded only once during the survey and the most frequently sighted species was the Sooty-headed Bulbul (IUCN LC) again.

The occurrence data input into MAXENT model included 1 record of order of order Caprimulgiformes, 7 records of order Columbiformes, 7 records of order Cuculiformes, 42 records of order Passeriformes, and 2 records of order Piciformes. MAXENT modelling could only predict the suitable habitat of three out of five included. Results were similar to those from the earlier MAXENT models ran in the previous surveys.

All species recorded in the bird surveys have not been listed as species of conservation significance nationally or internationally. The full list of species recorded in all bird surveys in both seasons is shown in Appendix F

## 8.3.2.3 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.

## 8.3.3 Bats

### 8.3.3.1 Acoustic Line Transect Survey

A total of 1,025 bat calls were recorded from transects (14.29 km). A spatial variation in bat activity was detected from the transect survey in the Huong Phung 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' vocalization per second) was calculated. According to the results, bats were most active along transect BT3 (outside Project footprint along transmission line).

Three (3) bat species, none of which are of conservation significance, were identified from the bat calls (summarized in Table 8.14):

- *Rhinolophus sinicus* – Call length was about  $40 \pm 3.2$  ms, with start frequency around  $60.1 \pm 2.1$  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);
- An unidentified *Rhinolophus* – Call length of  $19.6 \pm 1.2$  ms, start frequency  $80.5 \pm 1.2$  kHz, and peak frequency (Frequency at Maximum Energy) at  $97.3 \pm 1.5$  kHz (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) / cave-dwelling bat species (Kruskop, 2013), which may sometimes utilize old building and man-made structures;
- *Myotis muricola* – Start frequency around  $96.1 \pm 18.1$  kHz, peak frequency around  $62.1 \pm 16.3$  kHz, call length around  $6.1 \pm 1.3$ ms. The *Myotis muricolar* is an insectivorous bat that forage in semi-cluttered spaces or just above canopy (Kruskop, 2013).

### 8.3.3.2 Acoustic Monitoring Stations

A total of 1,657 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 at the edge of the Project footprint, especially during the evening time at 20:00. Bat activity was comparatively lower and more spread out at the other two monitoring stations (one located inside the Project footprint and the other outside the footprint, near the lake). The same three (3) bat species were identified for the acoustic monitoring stations as for the acoustic line transects (Table 8.14).

### 8.3.3.3 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 8.14 Bat species identified during field surveys**

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Survey
1	<i>Rhinolophus sinicus</i>	Chinese Horseshoe Bat	LC	-	Acoustic Line Transect, Acoustic Monitoring Station
2	Unidentified <i>Rhinolophus</i>	Horseshoe Bat	LC	-	Acoustic Line Transect, Acoustic Monitoring Station
3	<i>Myotis muricola</i>	Nepalese Whiskered Bat	LC	-	Acoustic Line Transect, Acoustic Monitoring Station

Note: LC – Least Concern

## 8.3.4 Non-volant Mammals

### 8.3.4.1 Line Transect Survey

No live non-volant mammal (especially primates) was recorded during the transect surveys in both the first (February 2020) and second (May 2020) surveys. However, one carcass of an Indochinese Chiromyscus *Chiromyscus chiropus* (IUCN LC) was found in the transect line near the Project’s T-line in February 2020. The species is not listed as conservation significant by any documents. Lack of solid

evidence on the occurrence of primates in the Project Area in both surveys suggests very small numbers of non-human primates occur in this area to be impacted by the Project. The habitat in the survey area has been heavily modified by humans (mostly converted into plantations), thus it has become unsuitable for the majority of non-human primates.



**Figure 8.17** Photograph of a carcass of Indochinese Chiromyscus *Chiromyscus chiropus* found along the transect

#### 8.3.4.2 Acoustic Auditory Point Count Survey

No gibbon vocalization was detected over four days of survey effort at three listening posts in May 2020. Previous surveys conducted earlier, where recent evidence of gibbon's presence in the study area was not detected, suggests that gibbon species may not be occurring in the Project footprint and its vicinity anymore.

#### 8.3.4.3 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 summarized 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.

### 8.3.5 Herpetofauna

#### 8.3.5.1 Line Transect Survey

A total of ten (10) herpetofauna species were recorded during the line transect survey. All of the recorded species are common species that have not been listed by any conservation organization.

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 8.15.

**Table 8.15 Herpetofauna species identified during field surveys**

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Class
1	<i>Duttaphrynus melanostictus</i>	Black-spectacled Toad	LC	-	Amphibian
2	<i>Limnonectes bannaensis</i>	Banna Large-Head Frog	-	-	Amphibian
3	<i>Occidozyga martensii</i>	Marten's Oriental Frog	LC	-	Amphibian
4	<i>Polypedates megacephalus</i>	Hong Kong Whipping Frog	LC	-	Amphibian
5	<i>Microhyla heymonsi</i>	Black-sided Narrow-mouthed Frog	LC	-	Amphibian

S/N	Scientific Name	Common Name	IUCN Category	Vietnam Red Data Book	Class
6	<i>Sylvirana nigrovittata</i>	Black-striped Frog	LC	-	Amphibian
7	<i>Acanthosaura lepidogaster</i>	Brown Pricklenape	LC	-	Reptile
8	<i>Calotes versicolor</i>	Changeable Lizard	-	-	Reptile
9	<i>Cyrtodactylus irregularis</i>	Irregular Bow-fingered Gecko	DD	-	Reptile
10	<i>Hebius leucomystax</i>	White-lipped Keelback	LC	-	Reptile

Note: DD – Data-Deficient  
 LC – Least Concern

## 8.4 Critical Habitat Assessment

### 8.4.1 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 8.16 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 8.16 Critical Habitat Criteria**

Criteria	Thresholds
Criterion 1: Critically Endangered (CR) / Endangered (EN) species:	<p>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);</p> <p>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).</p> <p>As appropriate, areas containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species.</p>
Criterion 2: Habitat of significant importance to endemic and/or restricted-range species;	<p>Areas that regularly hold <math>\geq 10\%</math> of the global population size AND <math>\geq 10</math> reproductive units of a species.</p>
Criterion 3: Habitat supporting globally significant concentrations of migratory species and/or congregatory species;	<p>Areas known to sustain, on a cyclical or otherwise regular basis, <math>\geq 1\%</math> of the global population of a migratory or congregatory species at any point of the species' lifecycle.</p> <p>Areas that predictably support <math>\geq 10\%</math> of the global population of a species during periods of environmental stress.</p>
Criterion 4: Highly threatened and/or unique ecosystems; and/or	<p>Areas representing <math>\geq 5\%</math> of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.</p> <p>Other areas, not yet assessed by IUCN, but determined to be of high priority for conservation by regional or national systematic conservation planning.</p>
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<sup>2</sup>; 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.

## 8.4.2 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 8.4.1. 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, 245 species are considered conservation significant species, and are candidate species for the Critical Habitat Screening Assessment. Conservation significant species include 40 critically endangered species and endangered species (in accordance with the IUCN Red List and/or Vietnam Red Data Book), 7 restricted-range species and 201 migratory

and/or congregatory species. The following sections determine if the candidate species assessed trigger critical habitat within the EAAA.

#### 8.4.2.1 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 9 bird, 8 fish, 17 mammal, 5 reptile and 1 fungi species. While suitable habitats might be present within the Project EAAA, it is considered unlikely the highly modified environment within the Project EAAA is important habitat for these species. Given there is an absence of preferred habitat and no or few records of the species within the EAAA (from field surveys conducted and online databases/literature) it is considered unlikely the EAAA is an area:

- a. That supports 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);
- b. That supports 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);
- c. Containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species. **Based on the screening assessment, no species have been identified as likely triggering critical habitat within the EAAA under Criterion 1.**

#### 8.4.2.2 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 1 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  $\geq 10$  % of the global population size and  $\geq 10$  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.**

#### 8.4.2.3 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. Whereas congregatory species are defined as species that meet in 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 201 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,  $\geq 1$  % of the global population of a migratory or congregatory species at any point of the species' lifecycle or support  $\geq 10$  % 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.**

#### 8.4.2.4 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 progress 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.**

#### 8.4.2.5 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 highly 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 section describes the baseline of social and economic conditions for the potentially community affected by the Huong Phung Wind Farm Project (the Project) in Huong Phung commune, Huong Hoa district, Quang Tri province. The economic and social analyses 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 about socio-economic conditions in the Project area to help identify potential impacts; and
- Identify and understand the perceptions/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 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 mainly based on a review of socio-economic conditions collected during site visits on 11th and 12th 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, and in enough detail to detect 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 published 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 local authorities at the provincial, district, and commune levels. Secondary sources were used to build a socio-economic baseline at national and local levels including 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
- Archaeology, cultural heritage, and religious sites.

Sources were also identified 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, including:

- Semi-structured interviews with local authorities;
- Key informant interviews (KIIs);
- Focus group discussions (FGDs);
- Household interviews; and
- 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 such as age cohorts, education backgrounds, livelihoods, gender, and social groups. Table 9.1 shows the target population, sample size, and sample populations in the study.

**Table 9.1 Research Sample by Method and Location**

Province	District	Commune	Village	Number of Interviews with Local Authorities	Number of KIIs	Number of FGDs	Number of Household Interviews
Quang Tri							
	Huong Hoa						
		Huong Phung		1			
			Huong Choa		1	1	18
			Phung Lam		1	1	9
			Cop		1	1	8
<b>Total</b>				<b>1</b>	<b>3</b>	<b>3</b>	<b>35</b>

Source: Socio-economic survey conducted by ERM, 2020

#### 9.1.2.1.2.2 Consultation with Local Authorities

Using semi-structured interviews, ERM collected updated information on the socio-economic conditions of the area as well as the key concerns and perceptions of local authorities and other organisations about the Project. Suggestions were also presented to the Project for environmental and social

performance management and impact mitigation. This consultation assisted the team in confirming development trends and any changes in socio-economic conditions, infrastructure, and public services.

The consultation process also aimed to inform stakeholders about Project progress, while assessing awareness at different levels and 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 Phung commune	<ul style="list-style-type: none"> <li>■ Update about Project progress and current status of the ESIA;</li> <li>■ Obtain up-to-date socio-economic data about infrastructure and public services, health, livelihoods and employment of people in the commune;</li> <li>■ Gain feedback/perceptions about the Project development; and</li> <li>■ Obtain acceptance and support from the People’s Committee to conduct the household survey in the area.</li> </ul>

#### 9.1.2.1.2.3 Key Informant Interviews (KIIs)

Village head was identified as a key informant. 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 O.

Three village heads were involved in KIIs. The questions for the village heads 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)

A focus group discussion approach was used since it enables ERM to observe interactions between group members and to listen to their 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 the Van Kieu ethnic minority group, one with an agriculture and forestry group, and one with a vulnerable group. Each focus group involved a heterogeneous group of eight to eleven people with distinctive backgrounds in terms of age, gender, and 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 access to public services, and their opinions or concerns about the Project (see Table 9.3).

**Table 9.3 Focus Group Discussions by Surveyed Villages**

Commune	Village	Group	Number of FGD Participants		
			Female	Male	Total
Huong Phung	Huong Choa	Van Kieu ethnic minority group	2	9	11
	Phung Lam	Agriculture and forestry group	2	8	10
	Cop	Vulnerable group	5	3	8
<b>Total</b>			<b>9</b>	<b>20</b>	<b>29</b>

Source: FGDs conducted by ERM, 2020

All FGDs began with an introduction about objectives and methods. The focus groups were structured around 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 organisations (NGOs). Based on a list of stakeholders, participants were invited to rank them in terms of 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.

#### 9.1.2.1.2.5 Household Interviews

The survey was conducted in Huong Phung commune where the Project components will be located and/or impact on local communities. At the community level, a sample of 35 households (HHs) was selected for interview, including 18 households from Huong Choa village, nine from Phung Lam village, and eight from Cop 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 interviewed households and household survey photos are provided in Appendix O and Appendix Q.

**Table 9.4 Household Interviews by Surveyed Villages**

Province	District	Commune	Village	Number of Surveyed Households	Total Surveyed Population
Quang Tri	Huong Hoa	Huong Phung	Huong Choa	18	94
			Phung Lam	9	32
			Cop	8	38
<b>Total</b>				<b>35</b>	<b>164</b>

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 for the household interview 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. people who may be more adversely affected by the Project by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status);
- 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 access 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 survey, at the village and commune level covering the following aspects (see Appendix Q):

- 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 of the consistency of 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. Efforts were made to cross-check and triangulate information from different sources to confirm their accuracy.

The majority of surveyed respondents were from the Van Kieu ethnic minority group, and some could not communicate fluently in Vietnamese with the interviewers. Some detailed household information was not obtained, but the survey team double-checked information with the village heads and re-contacted 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

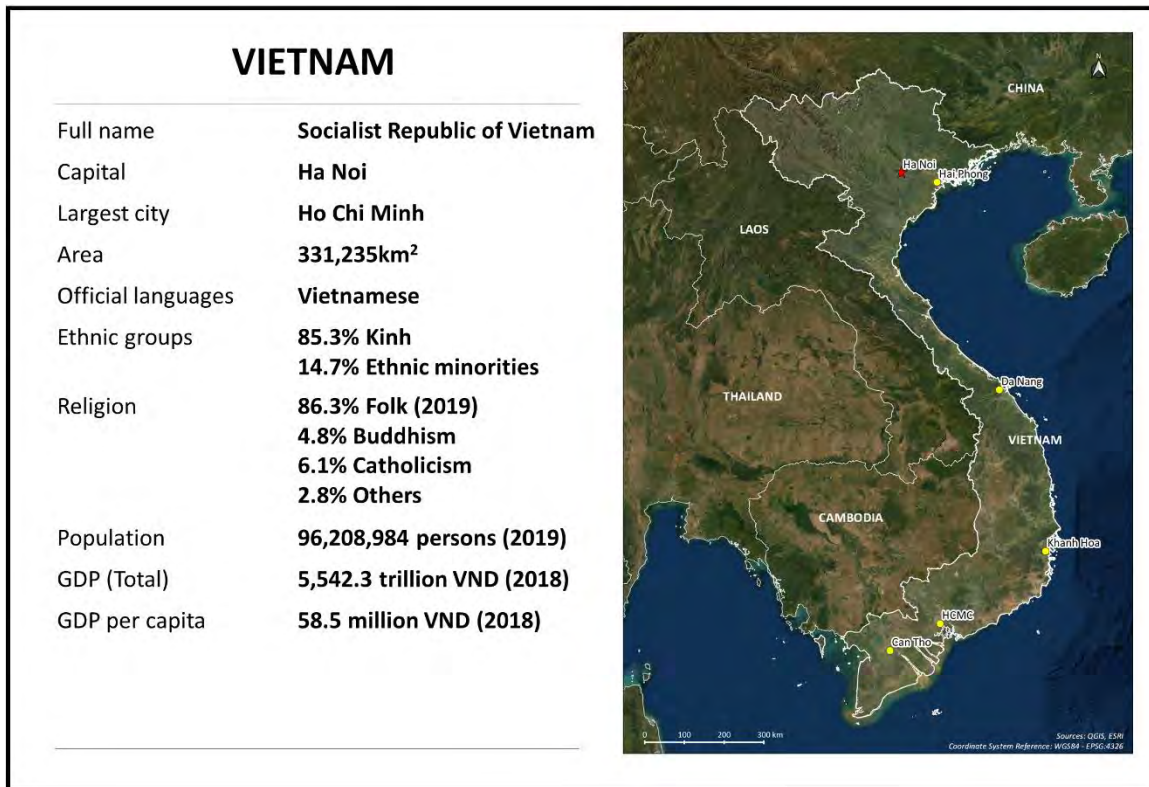
The Socialist Republic of Vietnam is located on the Indochina peninsula in Southeast Asia. It is bordered by China to the North, Laos, and Cambodia to the West, the Gulf of Thailand to the Southwest, and the East Sea to the East and South, and has a mainland area of 331,230 km<sup>2</sup> and more than 4,000 islands. It has a population of 96.2 million (2019), an increase of 1.6% over 2018, of which the urban population is 33.1 million people (34.4%), and the rural population is 63.1 million people (65.6%). The male and female populations were 47.9 million people and 48.3 million respectively with a corresponding share of 49.8% and 50.2% (Central Population and Housing Census Steering Committee 2019; also see Figure 9.1). With the population density of 290 people/km<sup>2</sup> in 2019, Vietnam has the population density ranked third in the Southeast Asia (Philippines with 363 people/km<sup>2</sup> and Singapore with 8,292 people/km<sup>2</sup>). The country had a total of 26,870,079 households with the average family size of 3.6 people/household (Central Population and Housing Census Steering Committee 2019).

Vietnam has a total of 54 ethnic groups. According to the statistical data 2019, the Kinh ethnic group makes up the largest proportion with approximately 85.3% of the population (82.1 million people), 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). Of the 53 ethnic minority groups, there are six ethnic groups with over one million people: Tay, Thai, Muong, Mong, Khmer, and Nung, in which Tay has the highest population of 1.85 million. Eleven ethnic groups with the population of under 5,000, in which O Du ethnic group has the lowest population of 428 people (Central Population and Housing Census Steering Committee 2019).

Vietnamese is the official language and is spoken by around 90% of the population. Minority groups have 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 are still trapped in poverty. According to the World Bank (2013), ethnic minorities account for 14% of the total population but up to 50% of the total poor population.

In 2019, there were 16 religions in Vietnam with 13.2 religious adherents, accounting for 13.7% of total population. Of the 13.2 religious adherents, 5.9 million people practiced Catholics, accounting for 44.6% (6.1% of total national population); and 4.6 million people were identified as Buddhists, accounting for 35% (4.8% of total national population). The number of people following other religions such as Caodaiism, Muslim, and Hoahaoism took a small proportion of total religious adherents.

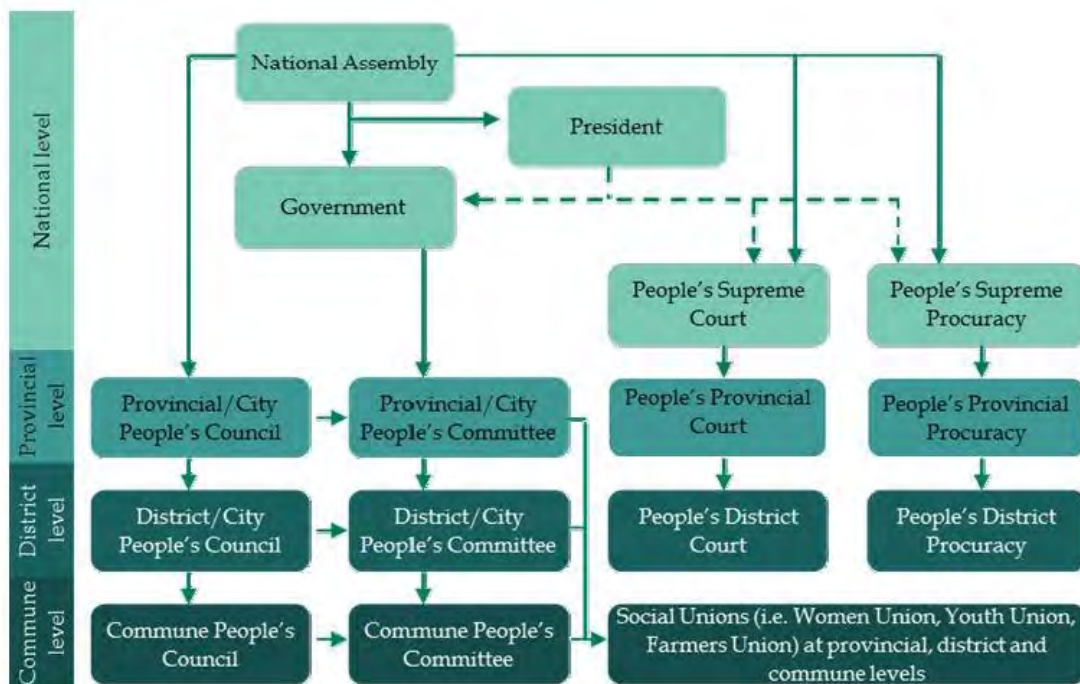


Source: GSO (2019); Central Population and Housing Census Steering Committee (2019)

**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.



Source: ERM

**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 the 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, to initiate or conclude wars, and to assume other duties and powers it deems necessary.
- The President represents Vietnam both domestically and internationally, 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 and the highest body of state administration of the Socialist Republic of Vietnam. It carries out the 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.

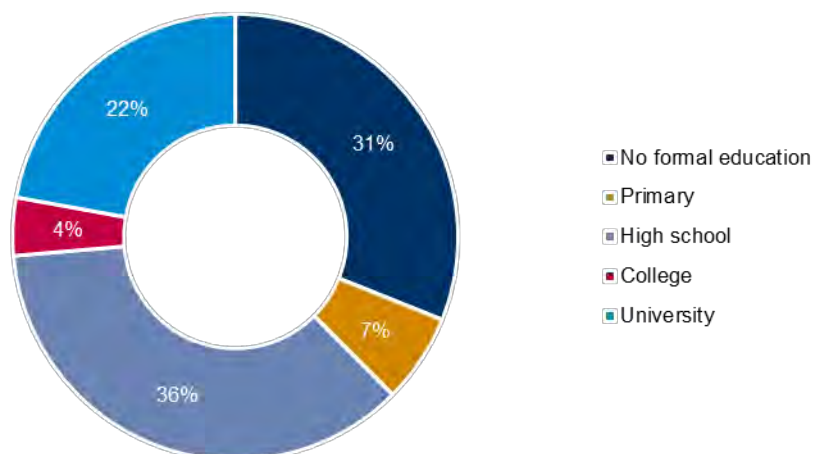
Organisation of institutional governance from the provincial/city level to the commune level consists of:

- The People's Council at provincial, district, and commune levels<sup>9</sup>: 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 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 townships and 9,064 communes<sup>10</sup>. The capacity of the rural commune's human resources needs to be strengthened to meet increasing demands of national development. Of 145,112 permanent staff at the commune level, 31% are reported to have no formal education (see Figure 9.3).

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<sup>9</sup> Provincial level includes cities under the central governance (*thành phố trực thuộc trung ương*) and provinces (*tỉnh*). District level includes cities under the provincial governance (*thành phố trực thuộc tỉnh*), quarters (*quận*), town (*thị xã*), and districts (*huyện*). Commune level includes township (*thị trấn*), wards (*phường*) and communes (*xã*).

<sup>10</sup> Source: Mai Duc Ngoc. 2015. Key Communal Human Resources in Contemporary Rural Vietnam (*Cán bộ lãnh đạo chủ chốt cấp xã ở nông thôn Việt Nam hiện nay*). *Khoa học Xã hội Việt Nam* 12(2015): 19-27.



Source: Mai Duc Ngoc (2015)

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

While they are not recognised under the State’s local administration system, village level institutions are the basic unit of Vietnamese society and their interactions with the State are vital to understanding Vietnamese socio-political characteristics and citizen behaviour<sup>11</sup>. Under the New Rural Development Program, village leadership and participation is becoming more important for village development planning and grassroots democracy, and thus community development.

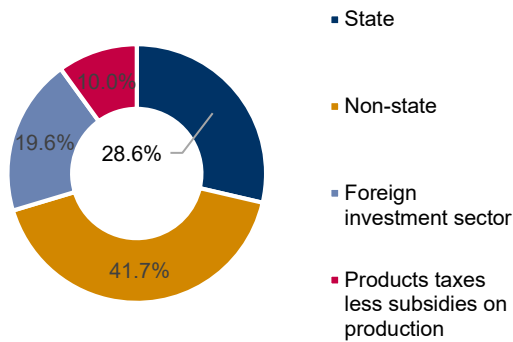
### 9.2.3 Economy and Industry

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

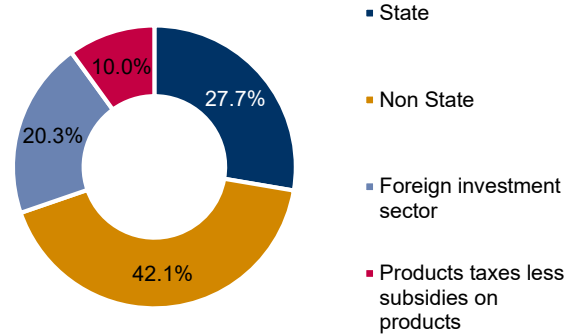
Gross domestic product (GDP) in 2018 increased by 7.08% from 2017 with the agriculture, forestry and fishery sector increasing by 3.76%; industry and construction by 8.85%; and the service sector by 7.03%. In 2018, GDP at current prices was 5,542 trillion VND. In terms of ownership, the non-state economy 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 in 2017 while the state economy in 2018 was slightly lower. 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 are the Republic of Korea, Japan, and Singapore (see Figure 9.5).

<sup>11</sup> 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.

**GDP by types of ownership 2017**

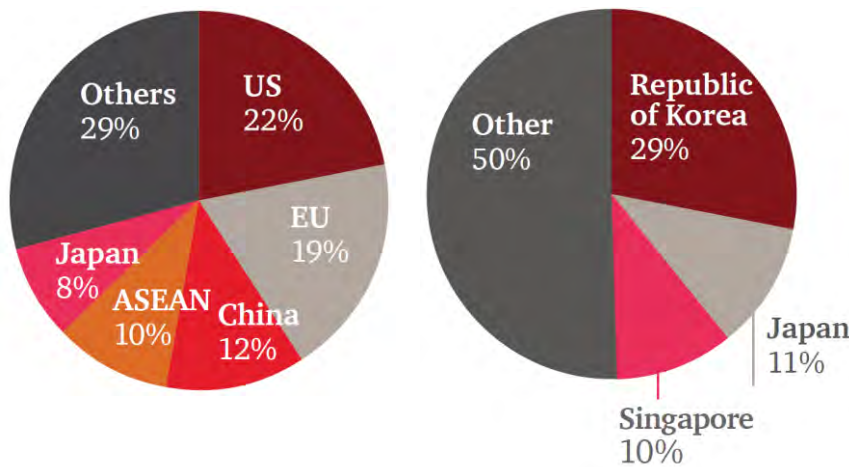


**GDP by types of ownership 2018**



Source: GSO (2018, 2019)

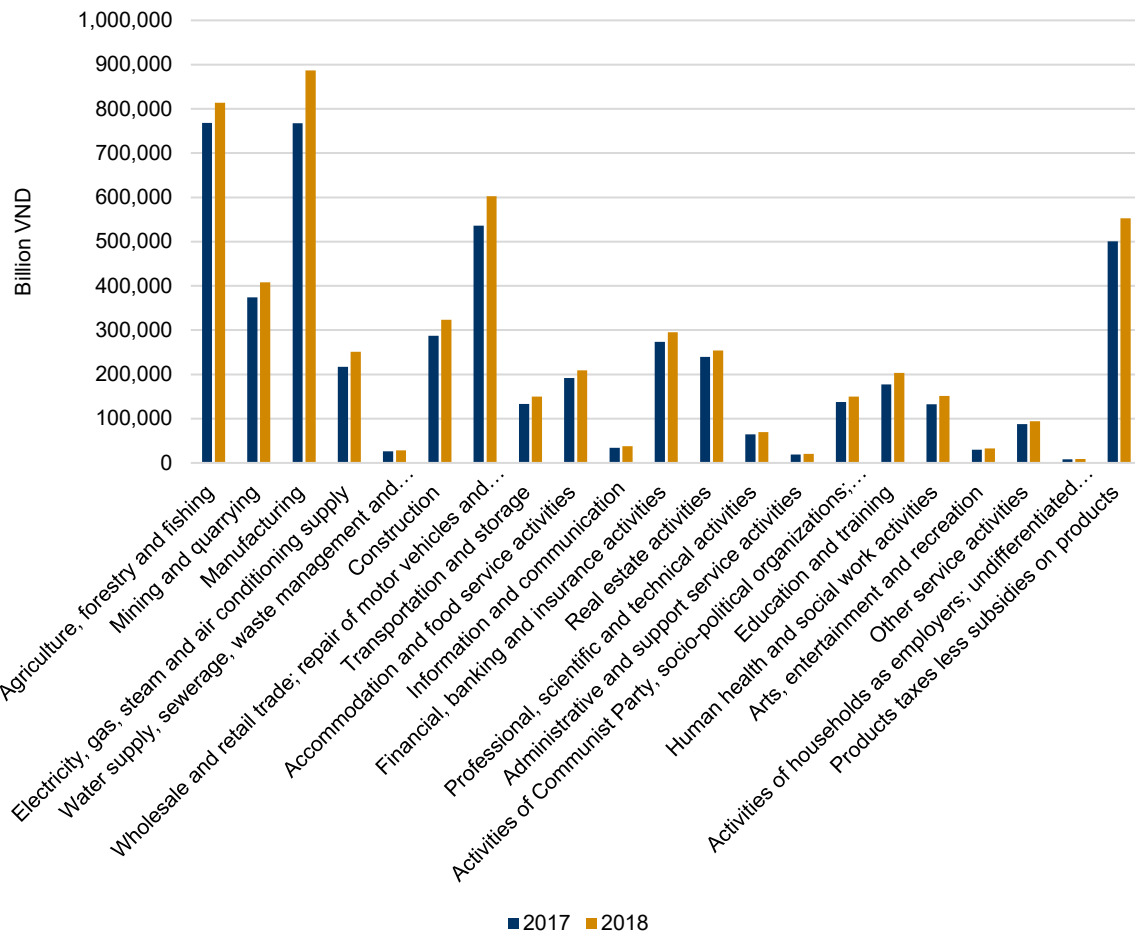
**Figure 9.4 GDP at Current Prices by Types of Ownership in 2017 and 2018**



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 with the share of agriculture gradually reducing, and the share of industry and services increasing. 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% (corresponding figures for 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 as shown in Figure 9.6.



Source: GSO (2019)

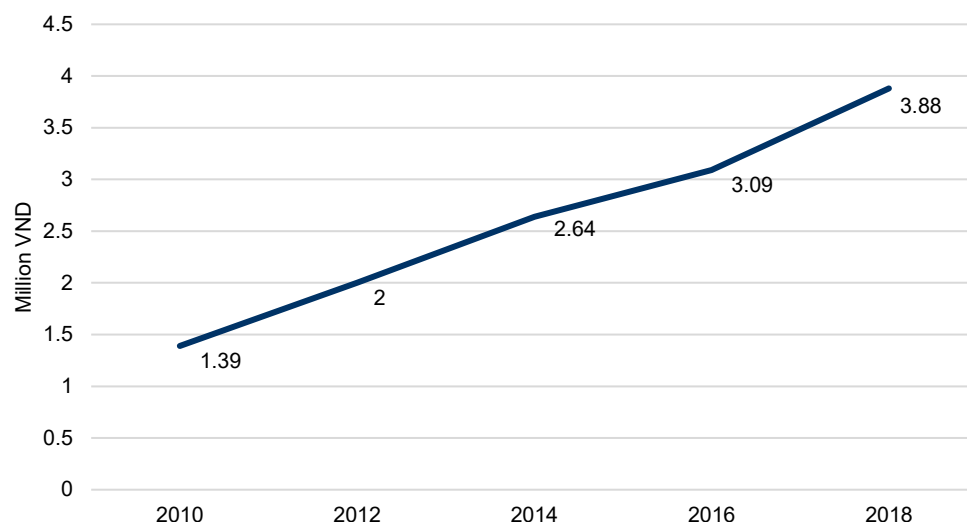
**Figure 9.6 GDP at Current Prices by Kinds of Economic Activity in 2017-2018**

In 2018, there were 55.4 million people in the labour force (people aged 15 years and over). This was an increase of 530,500 people over the previous year, and of these 52.2% were male and 47.8% were female. The employed population aged 15 years and above working in economic activities was 54.2 million people in 2018, an increase of 546,100 people compared to 2017.

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

The living standards of the population have been improved but 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 decreased slightly to 0.693 in 2018 and 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 was 3.88 million VND with the monthly income per capita at current prices of urban and rural areas at 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<sup>12</sup> was 6.8% in 2018, a decrease of 1.1 percentage points from 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). 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 saw a remarkable reduction in the percentage of multi-dimensional poor households (by 2.6, 3.2 and 1.5 percentage points from 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.

<sup>12</sup> 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 the minimum living standard and deprives from at least three indices for measuring deprivation of access to basic social services. The multi-dimensional poverty line is defined from two criteria, including income-based criteria and basic-social-service-based criteria as follows:

**Income-based criteria:**

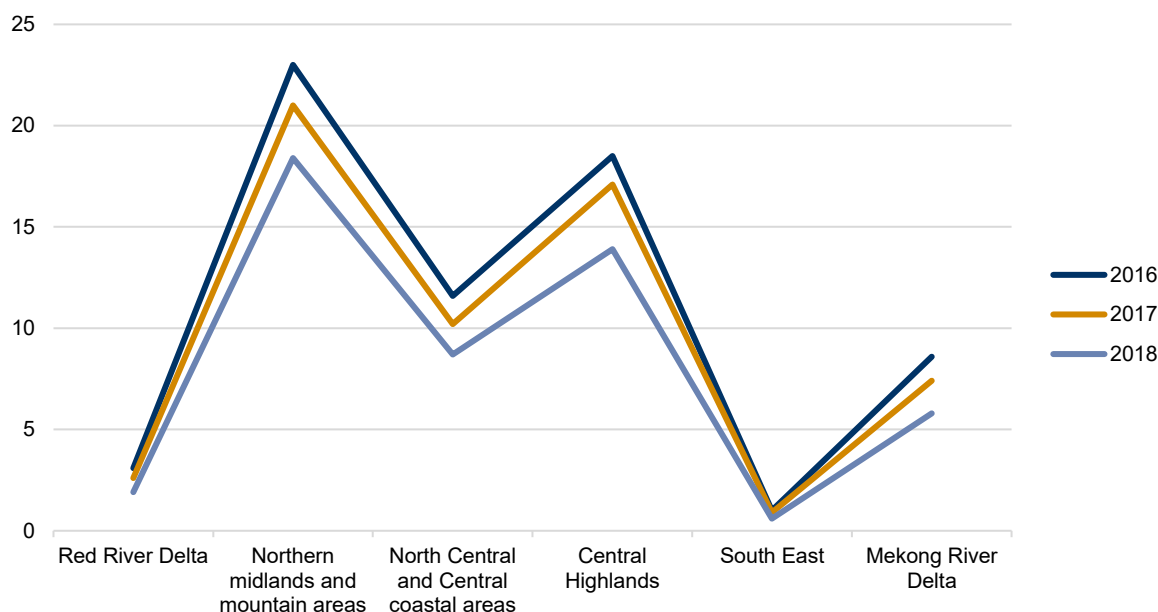
- Income-based minimum living standard is the income level that guarantees to afford basic minimum needs for a person to survive, including food, foodstuff demands and non-food consumption suitable with socio-economic situation of the province/city directly under central management in each period.
- 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 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 with economic restructuring as well as a more transparent administration<sup>13</sup>. It is expected that together with the EU-Vietnam Partnership and Cooperation Agreement, the EU-Vietnam Free Trade Agreement which was ratified by the European Parliament in February 2020, will serve “as the foundation for the

<sup>13</sup> Source: European Chamber of Commerce in Vietnam. 2019. White Book: Trade & Investment Issues and Recommendations. Hanoi: EuroCham Vietnam.

commitment from both sides to the principles of sustainable development, human rights, and labour rights”<sup>14</sup>.

The past decades have witnessed significant 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 equality has been established<sup>15</sup>. 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<sup>16</sup>, 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. The report’s recommendations stress 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 as well as harnessing economic benefits for social ends - should be encouraged to directly advance human rights<sup>17</sup>.

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<sup>14</sup> Source: Tran Ngoc Diep. 2019. The EU-Vietnam Free Trade Agreement: Reflecting on the Issue of Child Labour. Brussels: European Institute for Asian Studies.

<sup>15</sup> Source: JICA. 2011. Country Gender Profile: Vietnam. Japan International Cooperation Agency.

<sup>16</sup> Source: World Bank. 2011. Vietnam Country Gender Assessment.

<sup>17</sup> 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.

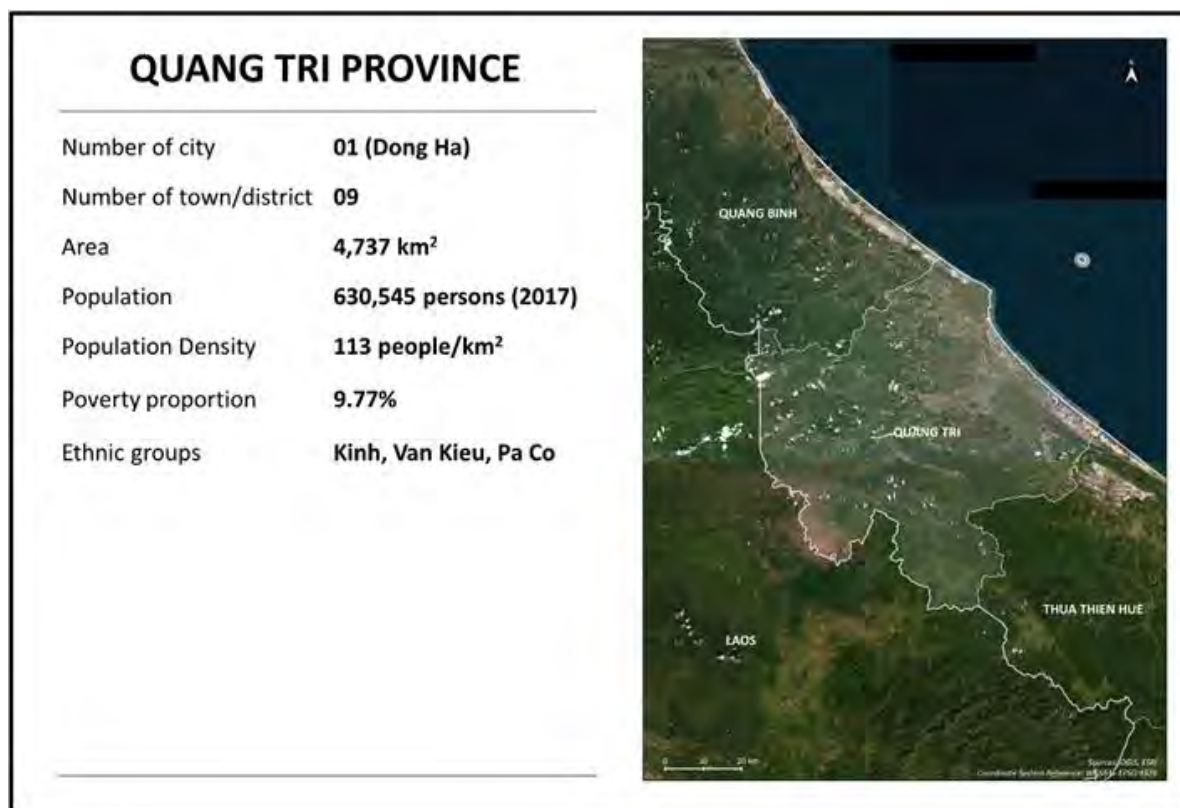
### 9.3 Local Context

This section provides details about the locality 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 Phung commune) levels.

#### 9.3.1 Provincial Level: Quang Tri

##### 9.3.1.1 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; Savanakheth 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 593 km away from Ha Noi city to the north. The province has a total of 4,737 km<sup>2</sup> 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)<sup>18</sup>.



Source: Quang Tri Statistics Office (2019)

**Figure 9.9** Quang Tri at a Glance

<sup>18</sup> Source: Quang Tri Province Portal. 2019. Introduction about Quang Tri. <https://www.quangtri.gov.vn/xem-chi-tiet-gioi-thieu-tong-quan/-/view-article/1/3500113539863336577/1573630224087> (Accessed 22 March 2020).

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 districts) (see Table 9.5). There are 141 communes, wards, and townships in the province. Dong Ha city is the political, economic, and cultural center of the province.

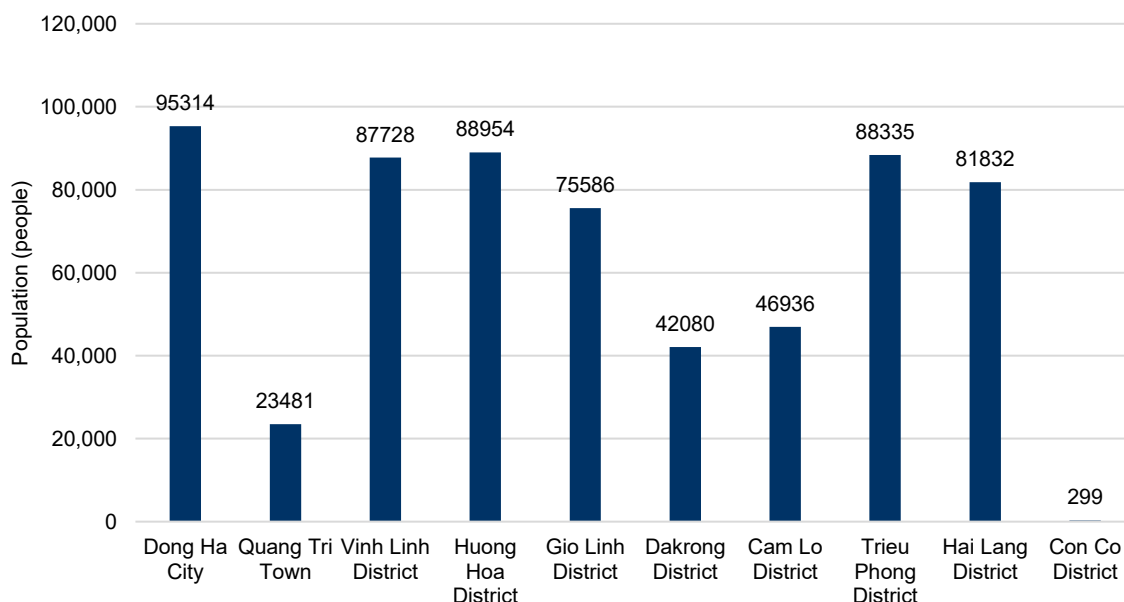
**Table 9.5 Administrative Units in Quang Tri Province**

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	-	-	-	-
<b>Total</b>	<b>13</b>	<b>11</b>	<b>117</b>	<b>141</b>

Source: Quang Tri Statistics Office (2019)

### 9.3.1.2 Population

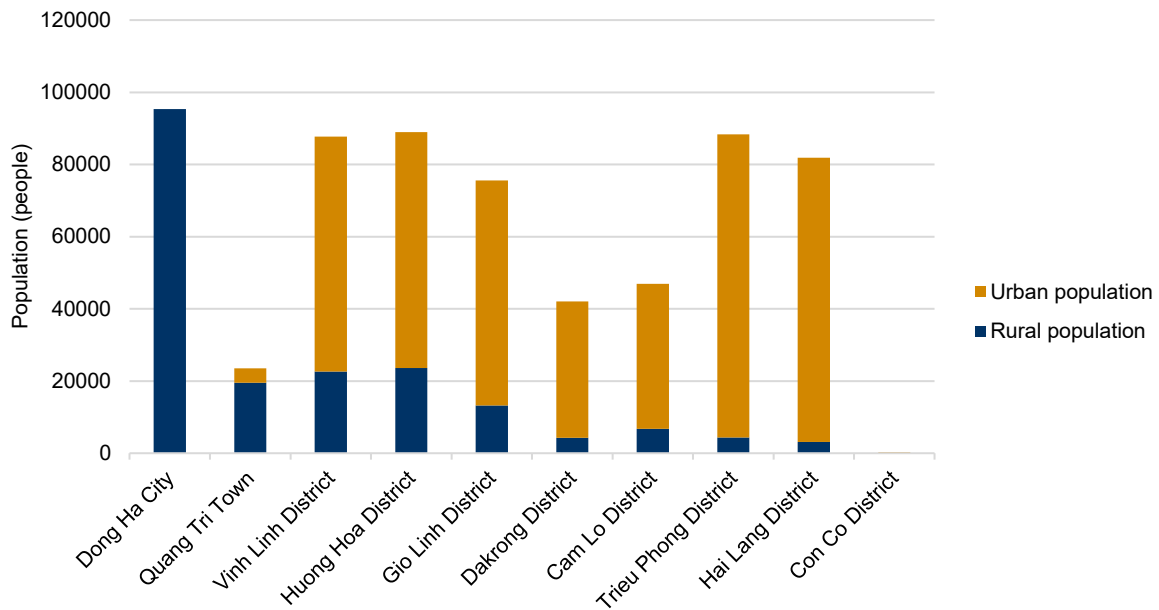
According to the Quang Tri Statistics Office (2019), the province has a total area of 4,737 km<sup>2</sup> and its population of 630,545 people (in 2018) (see Figure 9.10). The population is mainly concentrated in Dong Ha city with 95,314 persons and next in line are the two districts Huong Hoa and Trieu 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 9.6, 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<sup>2</sup>. The highest population density is in Dong Ha city with 1,304 person/km<sup>2</sup> while Dakrong has the lowest with 34 person/km<sup>2</sup> and Huong Hoa has 77 person/km<sup>2</sup> (the second lowest).

**Table 9.6 Natural Area, Population, and Population Density of Quang Tri Province by District in 2018**

Administrative Units	Natural Area (km <sup>2</sup> )	Number of Communes and Wards	Population (people)	Population Density (person/km <sup>2</sup> )
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	1,152.35	22	88,954	77
Gio Linh district	470.68	21	75,586	161
Dakrong district	1,224.67	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
<b>Total</b>	<b>4,737.44</b>	<b>141</b>	<b>630,545</b>	<b>133</b>

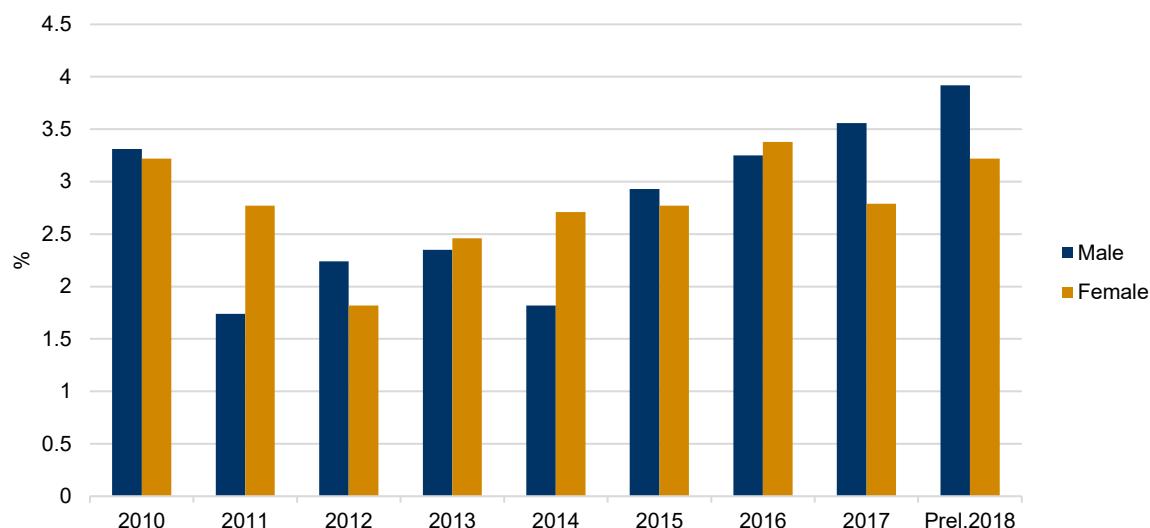
Source: Quang Tri Statistics Office (2019)

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 2.14 and 2.83 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**

### 9.3.1.3 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<sup>19</sup>. Main features of the two main ethnic minority groups are discussed in the below sections.

#### 9.3.1.3.1 Van Kieu Ethnic Minority Group

Van Kieu is one indigenous ethnic minority residing in the mountainous areas of Quang Tri and Thua Thien Hue provinces<sup>20</sup>. 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<sup>21</sup>, 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<sup>22</sup>. 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<sup>23</sup>.

#### 9.3.1.3.2 Pa Co Ethnic Minority Group

The Pa Co, whose name means “the people of the mountains”, has over 50,000 people in Vietnam. Pa Co people reside mainly in mountainous districts including A Luoi district of Thua Thien Hue province and Dakrong and Huong Hoa districts of Quang Tri province. As Pa Co people live closely with other

<sup>19</sup> 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).

<sup>20</sup> Source: Thua Thien Hue Portal

<sup>21</sup> Source: Central Population and Housing Census Steering Committee (2010)

<sup>22</sup> Source: Central Population and Housing Census Steering Committee (2010)

<sup>23</sup> Source: Central Population and Housing Census Steering Committee (2010)

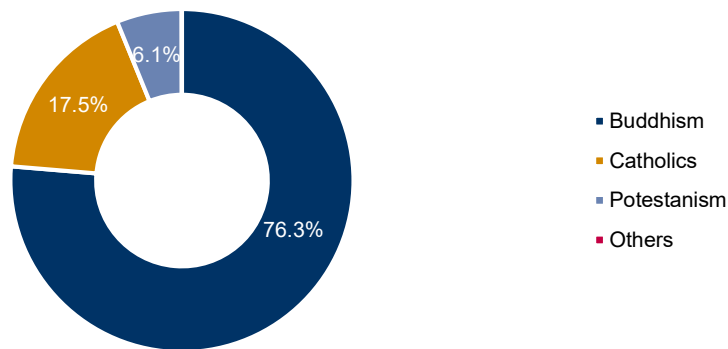


ethnic minority communities such as Co Tu, Ta Oi, and Van Kieu ethnic groups, they share similarities in farming methods and costumes. However, they use their own language.

Pa Co people live in hamlets of five to 10 stilt houses made of wood, bamboo, and leaves. People in a hamlet belong to the same clan. Elephants are of symbolic value to the Pa Co, showing the strength and prosperity of a family or clan. Maintaining a strong community solidarity, Pa Co people retain many customs, unique folk dances (Cha Chap, A Den, Ka Loi, Oat and Ta Oi), and festivals including Pul Boh (field ceremony), Ada (crop festival), and Arieu Ping (grave exhumation ceremony)<sup>24</sup>.

### 9.3.1.4 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) practiced 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 2009**

### 9.3.1.5 Infrastructure and Public Facilities

#### 9.3.1.5.1 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).

#### 9.3.1.5.2 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

<sup>24</sup> Source: To Tuan (2017)

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<sup>25</sup>.

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

### 9.3.1.5.3 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<sup>26</sup>.

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<sup>27</sup> in 2018.

### 9.3.1.5.4 Irrigation System

Quang Tri has a dense river network with an average density of 0.8-1 kilometre/km<sup>2</sup>. The Ben Hai River system starts at a height of 1,257m with a length of 65km, and an average annual flow of 43.4 m<sup>3</sup>/s. The Thach Han River has a length of 155km with the largest basin area of 2.660 km<sup>2</sup>. 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).

### 9.3.1.5.5 Domestic Waste Management and Drainage

In 2018, the average amount of solid waste collected per day in Quang Tri was 363 tons, but 269 tons were treated in accordance with corresponding defined national criteria<sup>28</sup>. The province has no waste treatment factory. It is reported that waste landfills have not been properly managed and operated, causing pollution especially during hot weather days. Particularly, Huong Hoa and Vinh Linh districts have not meet requirements on waste treatment at concentrated landfills<sup>29</sup>.

On 8th December 2018, the provincial People's Council issued Resolution No. 30/2018/NQ-HDND, which approved for a project to address the environment pollution issues, focusing on pollution treatment, improvement and restoration of environmental quality in some seriously polluted areas in Quang Tri province. The resolution sets out target of, from 2019 to 2025, treating the environment

<sup>25</sup> 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).

<sup>26</sup> 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).

<sup>27</sup> 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).

<sup>28</sup> Source: GSO (2019)

<sup>29</sup> Source: Ho Chien and Trong Hoang (2019)

issues in 100% of areas and establishments that causes serious 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 township landfill site, and completing stage 2 investment for four landfill sites in the townships (Hai Lang, Ai Tu, Gio Linh, and Cam Lo). Dealing with pollution in five markets including Khe Sanh, Bo Ban, My Chanh, Cam Lo, and Cau markets. Handling pollution treatment from cattle slaughter at the abattoirs in Ward 1 (Dong Ha city) and Ward 2 (Quang Tri town) and Khe Sanh Abattoir Cooperative.

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<sup>30</sup>. According to the statistical data 2019<sup>31</sup>, the rate of solid waste in urban areas collected was 99%.

#### 9.3.1.5.6 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.

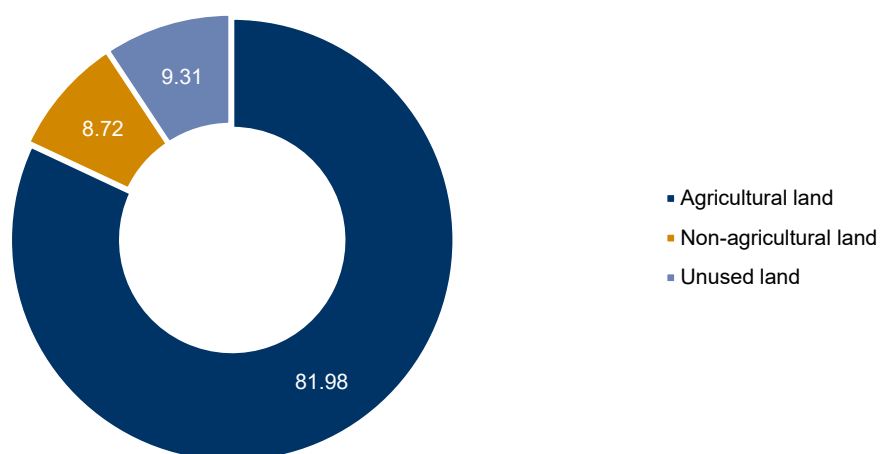
Telecommunication and information technology revenue was 1,462 billion VND in 2019, up by 8.6% over 2018. The province had 178 postal service stations and 2,310 base transceiver stations (Quang Tri People's Committee 2019).

#### 9.3.1.6 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.

<sup>30</sup> Source: Phuong Tam (2019)

<sup>31</sup> Source: Quang Tri People's Committee (2019)



Source: Quang Tri Statistics Office (2019)

**Figure 9.14 Land Use Structure in Quang Tri Province 2018**

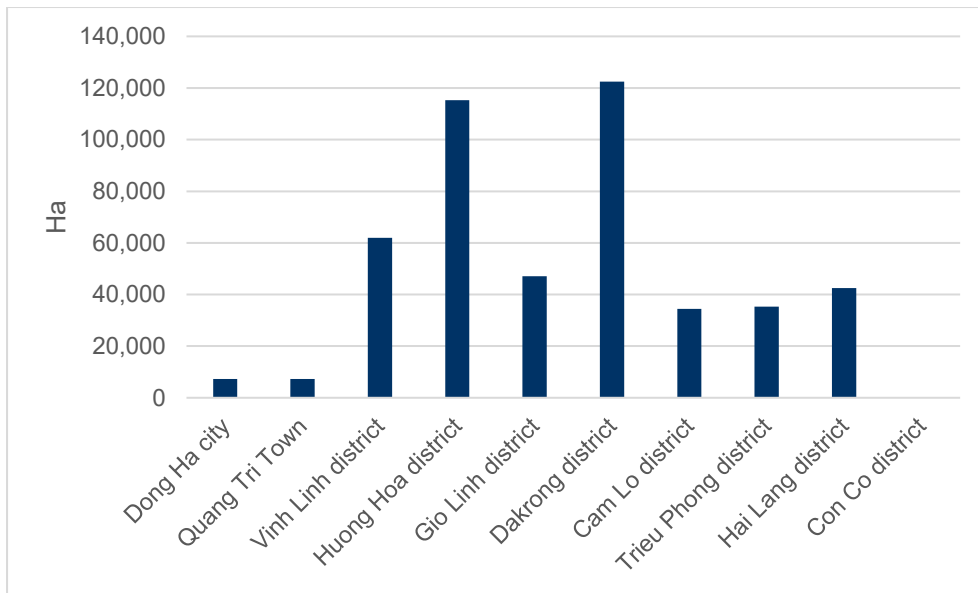
As shown in Table 9.7, forestry recorded the greatest share of land use (55.6% or 263,450 ha), while housing land had the lowest share of land use in the province (0.9% or 4,356 ha).

**Table 9.7 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).

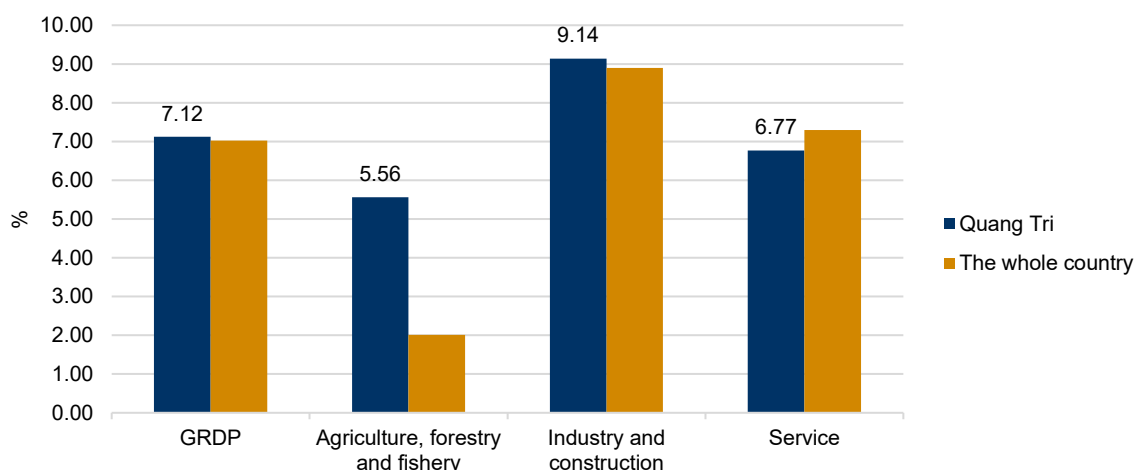


Source: Quang Tri Statistics Office (2019)

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

### 9.3.1.7 Economy and Industry

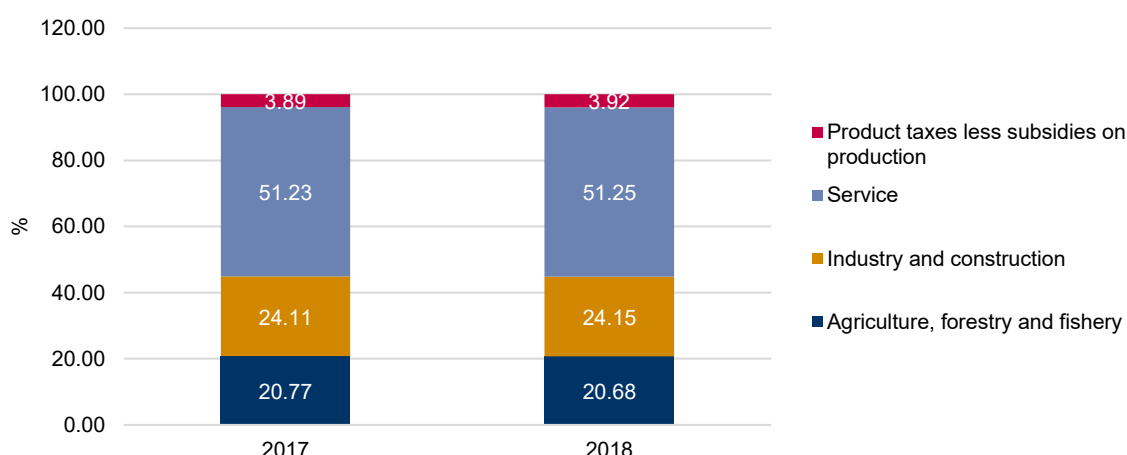
Gross regional domestic production (GRDP) at current prices was 27,503 billion VND, increasing 7.1% compared to 2017. Of this, the agriculture, forestry and fishery sector is estimated at 5,687 billion VND (increasing 5.6%), the industry and construction sector is 6,642 billion VND (growing by 9.1%), 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<sup>32</sup>) (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).



Source: Quang Tri Statistics Office (2019)

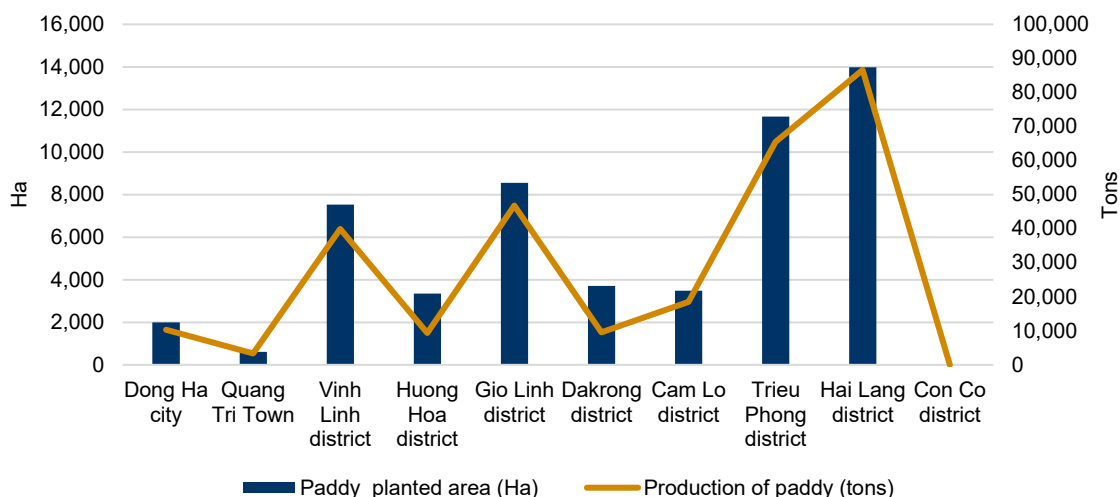
**Figure 9.17 Economic Structure in Quang Tri Province 2017-2018**

<sup>32</sup> Source: <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=19454>

### 9.3.1.7.1 Agriculture, Forestry and Fishery

#### 9.3.1.7.1.1 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.

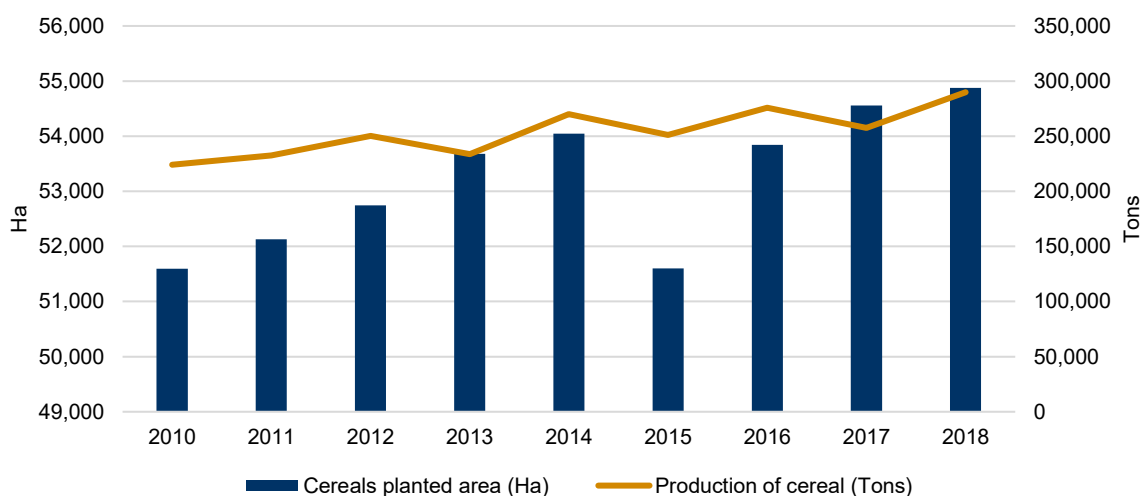


Source: Quang Tri Statistics Office (2019)

**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).

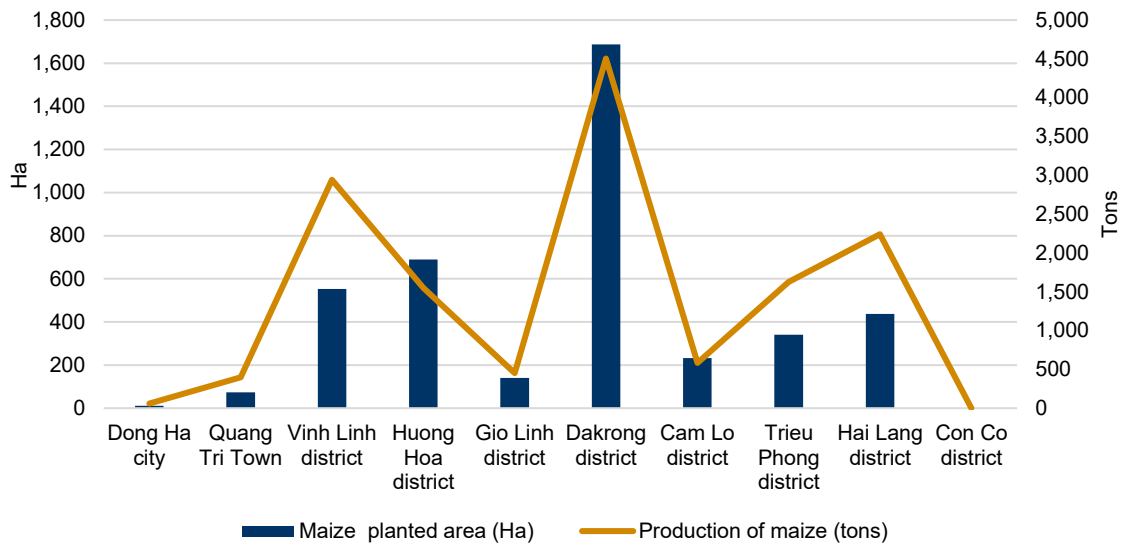
**Cereals:** Overall, the planted area and productions for cereals rose during 2010-2018, increasing from 224,094 tons in 2010 (51,593 ha) to 289,867 tons in 2018 (54,876 ha). During this period, the production area dropped dramatically in 2015 and increased sharply again in 2016-2018 (see Figure 9.19). 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**

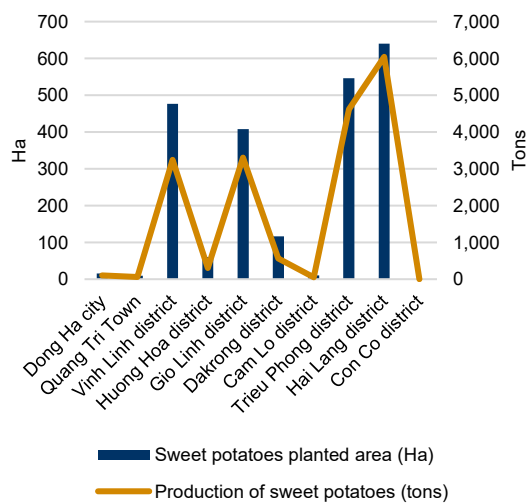
**Maize:** The province had a total of 4,165 ha under maize cultivation and production was 14,356 tons in 2018 (see Figure 9.20). Dakrong district has the largest area with 1,687 ha and also the top production with 4,505 tons. In contrast, Dong Ha city has the smallest cultivation area and production 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)

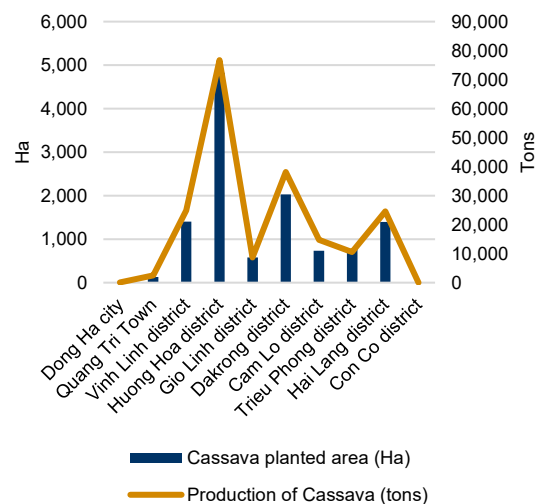
**Figure 9.20 Maize Planted Area and Production in Quang Tri Province 2018**

**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)

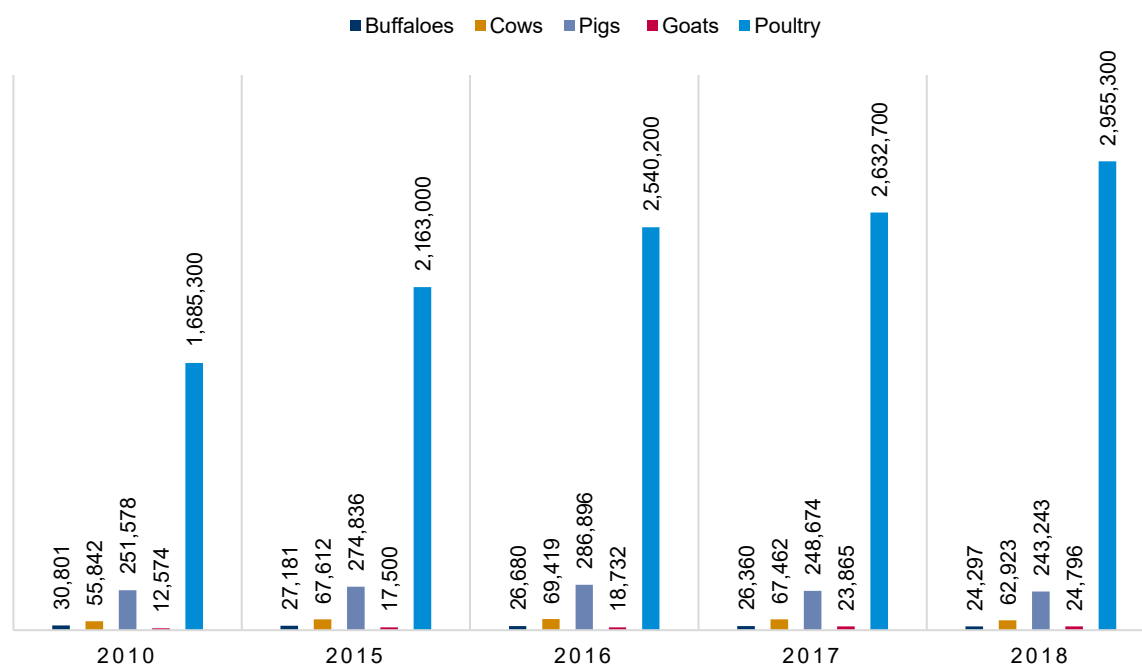
**Figure 9.22 Cassava Planted Area and Production in Quang Tri Province 2018**

9.3.1.7.1.2 *Animal Husbandry*

- Animal husbandry output decreased in 2018 in terms of buffaloes, cows 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).



Source: Quang Tri Statistics Office (2019)

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

### Forestry

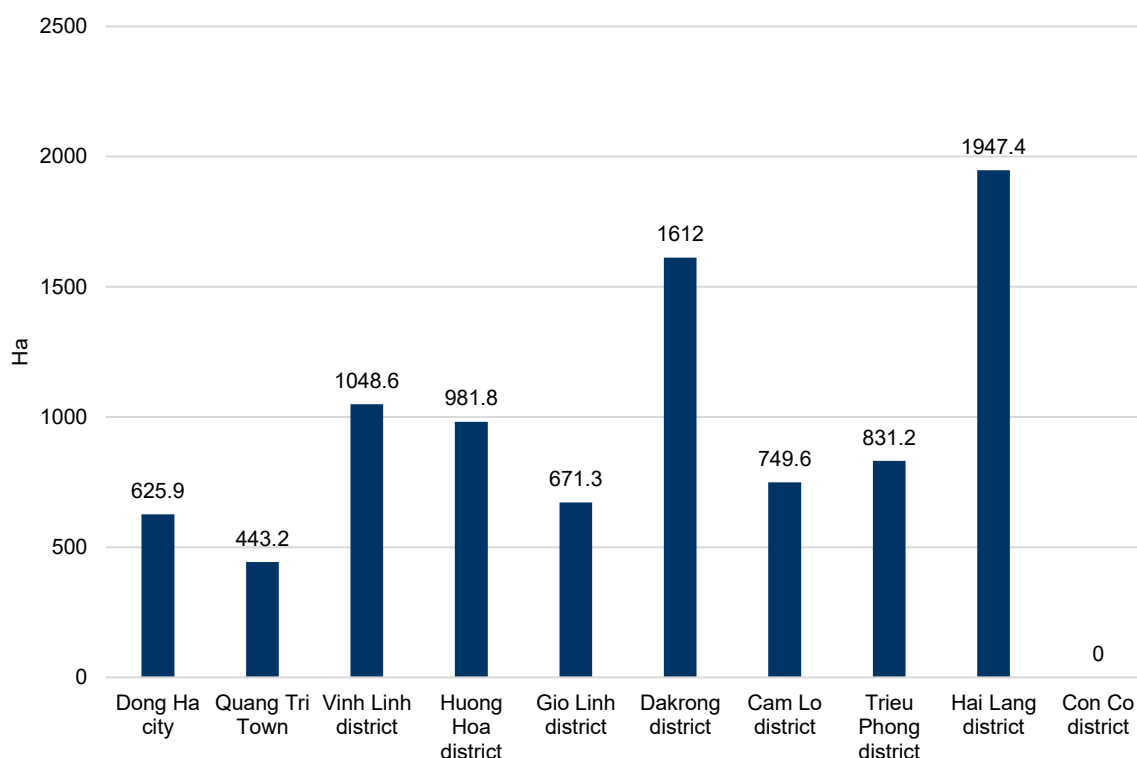
The province had a total of 8,911 ha forest land, including 8,719 ha of production forest and 191.7 ha of protected forest. No land has been used for specialised forest since 2014 (see Table 9.8).

**Table 9.8** Area of Forest Land by Type of Forest

Year	Production Forest	Protection Forest	Specialised Forest	Total
2010	6,023	1,415	-	7,439
2011	5,870	225	-	6,095
2012	6,445	596	50	7,91.8
2013	6,595	647	150	7,392
2014	5,448	1,556	-	7,004
2015	5,739	1,386	-	7,125
2016	7,678	775	-	8,453
2017	8,799	156	-	8,956
2018	8,719	191	-	8,911

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 9.24). 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 9.24 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<sup>2</sup>, an increase of 14.8%. The rate of forest cover remained stable, above 50% (Quang Tri People’s Committee 2019).

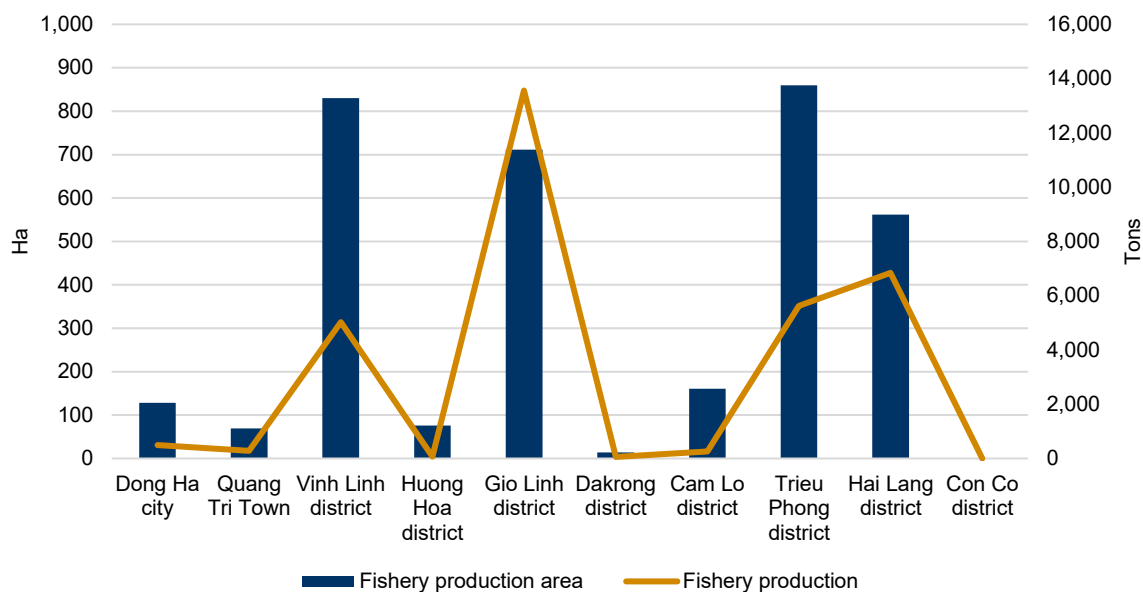
### Aquaculture

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 9.9). 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 9.25).

**Table 9.9 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
<b>Total</b>	<b>24,668.2</b>	<b>33,896.2</b>	<b>23,794.9</b>	<b>30,780.0</b>	<b>32,216.0</b>

Source: Quang Tri Statistics Office (2019)



Source: Quang Tri Statistics Office (2019)

**Figure 9.25 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).

### 9.3.1.7.2 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 9.26), 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 9.26 Huong Linh Wind Farm under Operation Phase**

*Wind Power Development and Planning:* As described in the Decision 6185/QD-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 9.10). 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 9.10 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 19/6/2015 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/QĐ-TTg on January 16<sup>th</sup>, 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<sup>3</sup>/ year (Quang Tri Statistics Office 2019).

### 9.3.1.7.3 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%<sup>33</sup>.

### 9.3.1.8 Education

In the school year 2018-2019, Quang Tri had 168 kindergartens, 154 primary schools (including 67 primary and lower schools and one private primary school), 65 lower secondary schools (including five lower and upper secondary schools), and 25 upper secondary schools. There were 195 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 9.27.

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<sup>33</sup> 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).

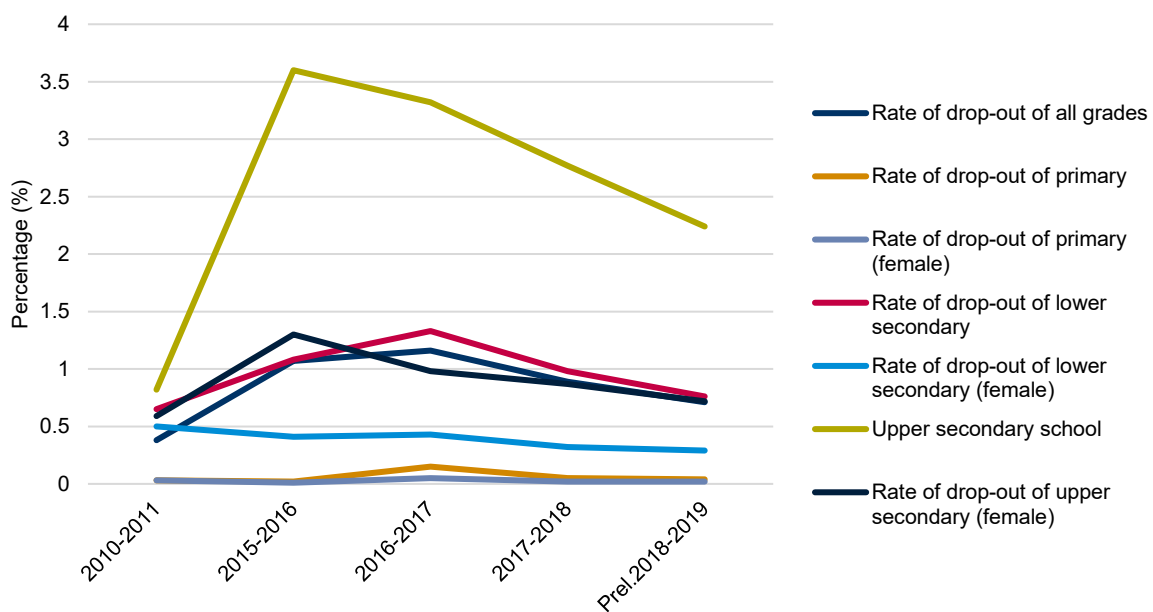


Source: Quang Tri Statistics Office (2019)

**Figure 9.27** 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 2010-2011 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 9.28).



Source: Quang Tri Statistics Office (2019)

**Figure 9.28** 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).

### 9.3.1.9 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 (see Table 9.11). 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 9.11 Statistics on Health Services in Quang Tri Province 2018**

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

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.

### 9.3.1.10 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).

### 9.3.1.11 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 Table 9.12).

**Table 9.12 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 <sup>34</sup>	26	184
<b>Total</b>	<b>47</b>	<b>213</b>

Source: Decision 582/QD-TTg dated 28 April 2017 by the Prime Minister

According to the Quang Tri Statistics Office (2018)<sup>35</sup>, 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

<sup>34</sup> 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 labourer 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.

<sup>35</sup> 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%).

### 9.3.1.12 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 9.29). 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 9.29** Pilgrimage Center of Our Lady of La Vang<sup>36</sup> and Quang Tri Ancient Citadel<sup>37</sup> (Left to Right)

## 9.3.2 District Level: Huong Hoa

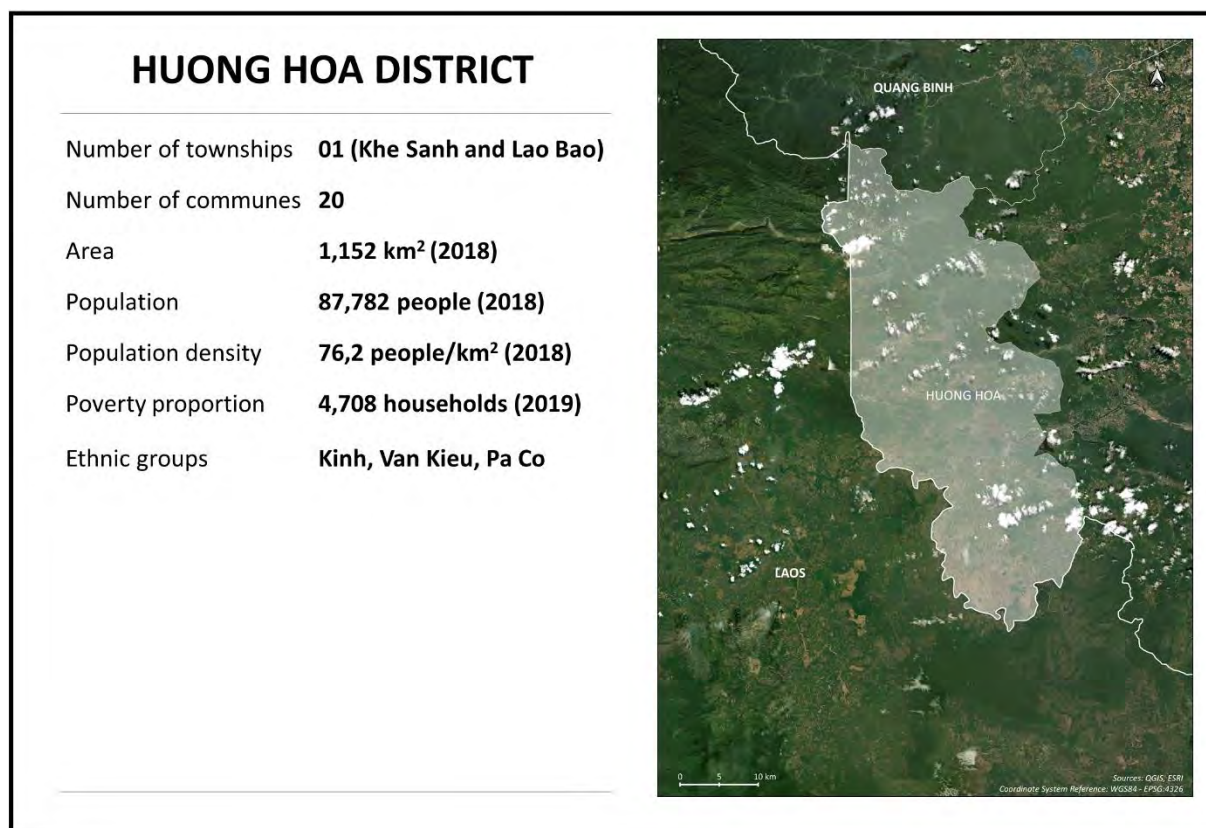
### 9.3.2.1 Overview of Huong Hoa District

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 9.30). The district is about 65 kilometres from Khe Sanh township, 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<sup>38</sup>.

<sup>36</sup> Source: <https://medium.com/@infoexplorevietnam/quang-tri-ancient-citadel-the-great-evidence-for-vietnam-war-c62c44865618>

<sup>37</sup> Source: <https://huesmiletravel.com.vn/blog/779-thanh-dia-la-vang>

<sup>38</sup> Source: [https://vi.wikipedia.org/wiki/H%C6%B0%E1%BB%9Bng\\_H%C3%B3a](https://vi.wikipedia.org/wiki/H%C6%B0%E1%BB%9Bng_H%C3%B3a)



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

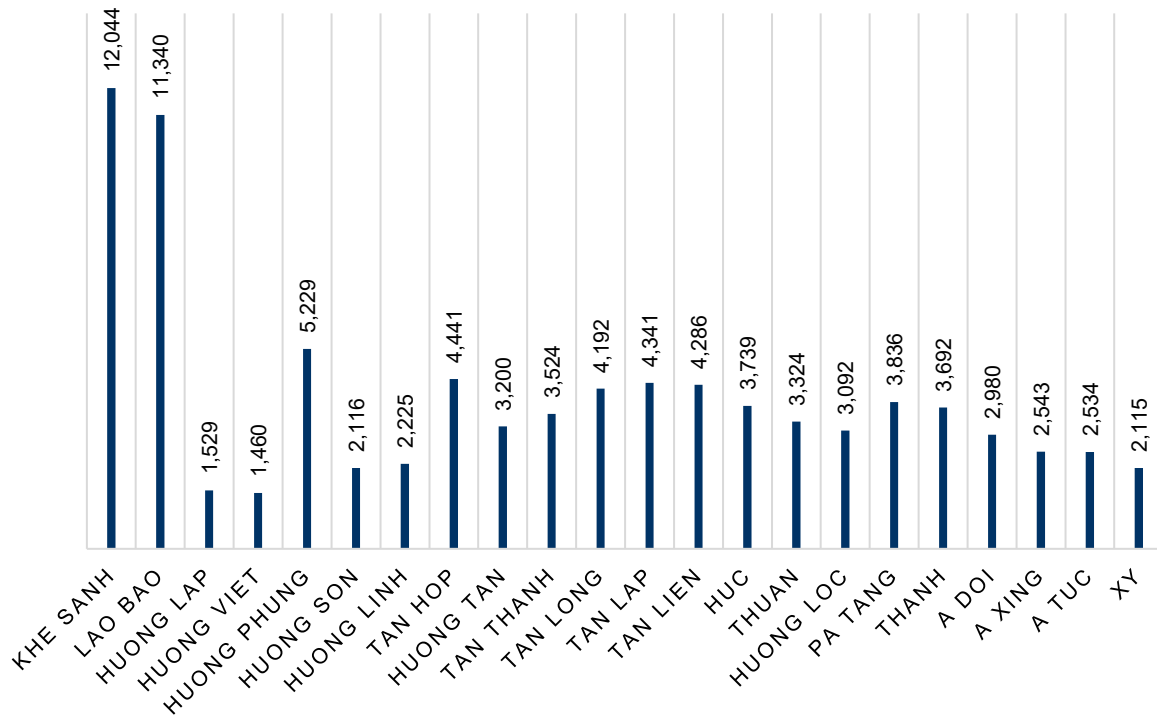
### Figure 9.30 Huong Hoa District at a Glance

The whole district has 22 administrative units including two townships (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).

#### 9.3.2.2 Population, Ethnicity and Religion

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

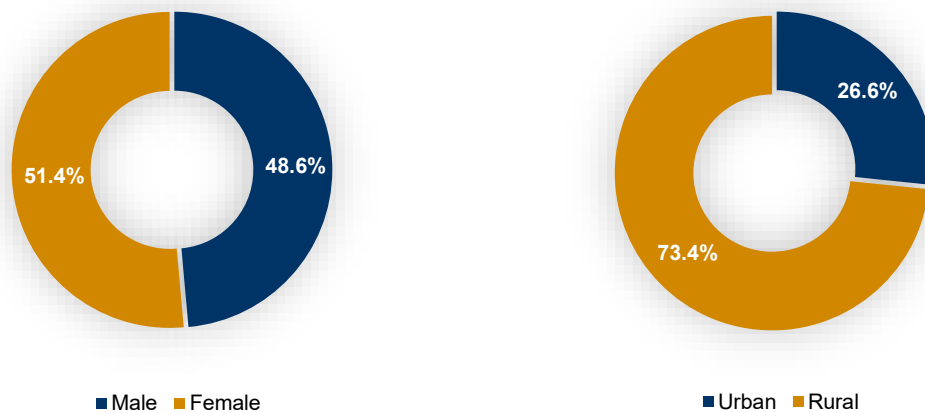
As shown in Figure 9.31, the majority of the population is concentrated in two townships (Khe Sanh and Lao Bao) with 12,044 people and 11,340 people respectively. Next in line are Huong Phung commune (5,229 people) and Tan Hop commune (4,441 people). Huong Lap and Huong Viet communes have the lowest populations with 1,529 people and 1,460 people respectively (Huong Hoa Statistics Office 2019).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.31 Average Population of Huong Hoa District by Township/Commune in 2018**

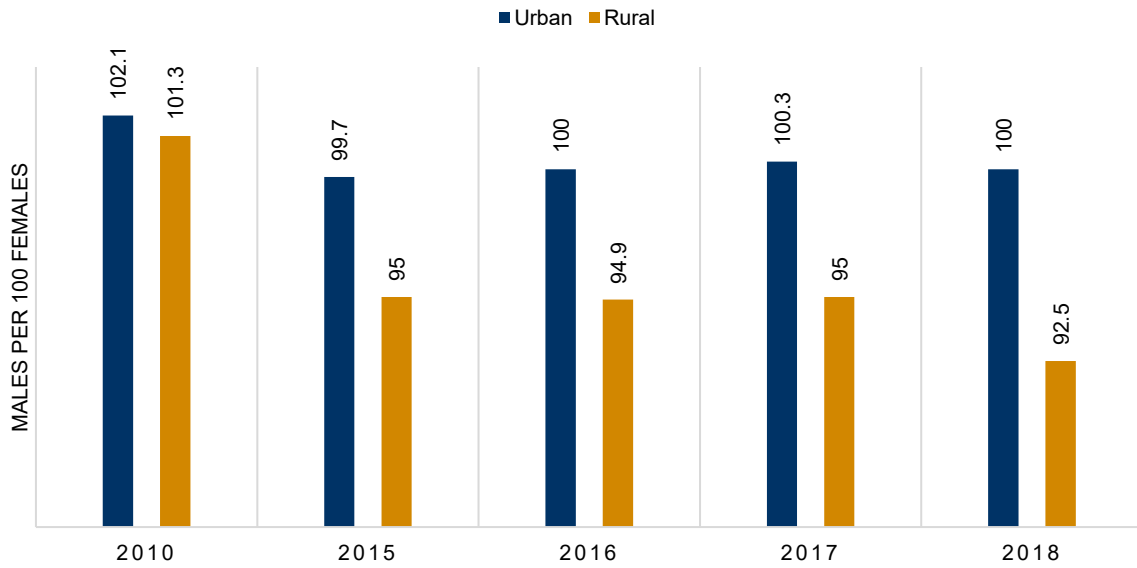
The whole district has 87,782 people, with 45,144 females and 42,638 males (51.4% and 48.6% respectively). As shown in Figure 9.32, the majority of the population is rural with 64,397 persons (73.4%), while the remainder are urban with 23,385 persons (26.6%).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.32 Population of Huong Hoa District by Gender and Residence in 2018**

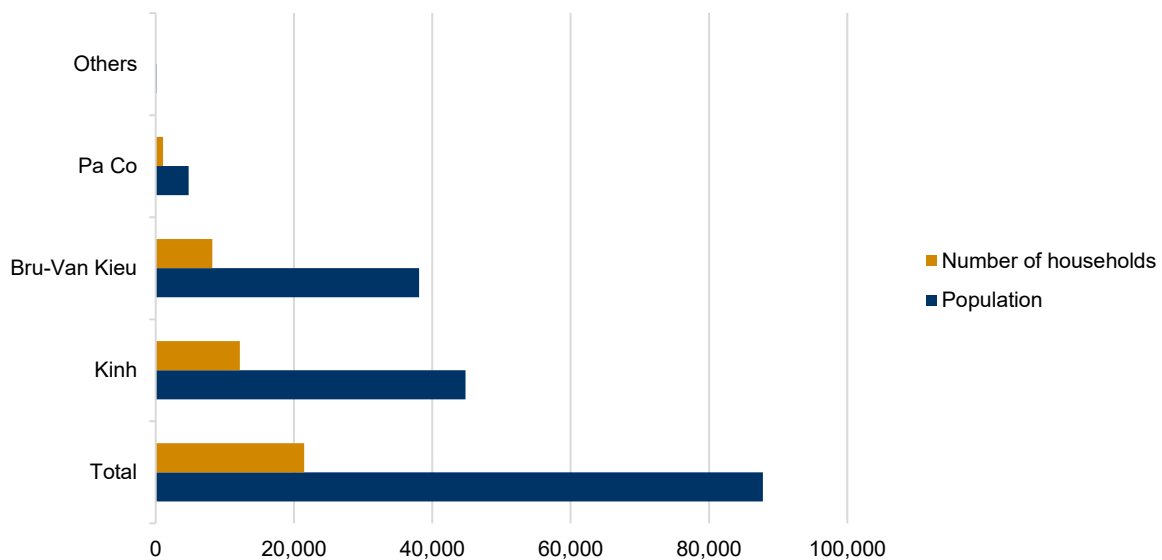
Figure 9.33 shows the gender difference between rural and urban areas in Huong Hoa district during 2010-2018. In 2010, the proportion of males in both regions was similar with 102.1 males in rural areas and 101.3 males in urban areas, but there was a wider gap by 2015-2018 with figures of 100 males in rural areas and 92.5 males in urban areas at the end of the period.



Source: Huong Hoa Statistics Office (2019)

**Figure 9.33 Population Sex Ratio of Huong Hoa District by Residence in 2010-2018**

As Figure 9.34 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 townships 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 9.34 Population and Number of Households by Ethnic Group in Huong Hoa District 2018**

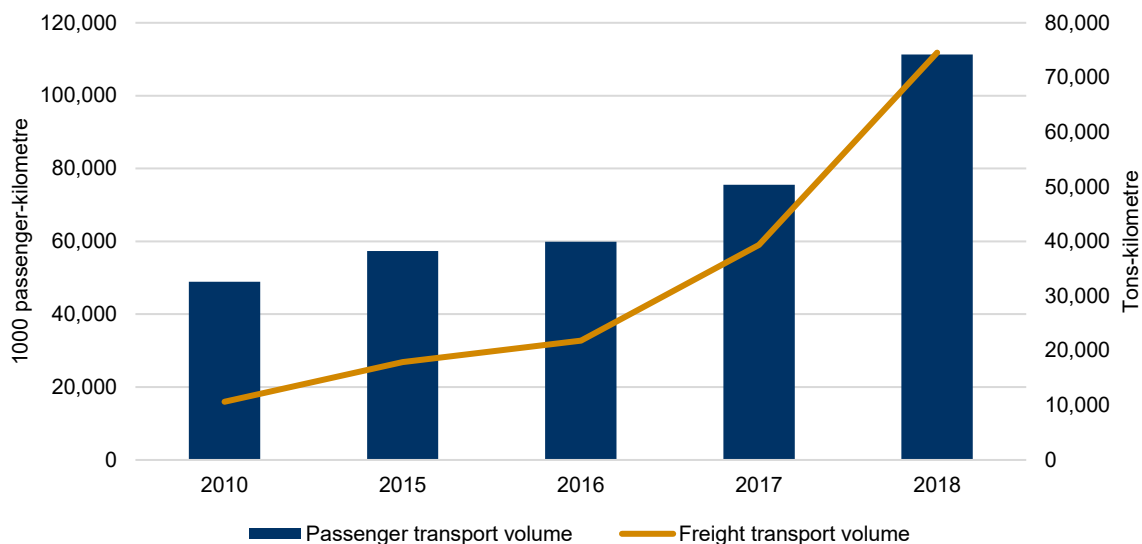
### 9.3.2.3 Infrastructure and Public Facilities

#### 9.3.2.3.1 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 9.35 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 9.35 Passenger Transport and Freight Transport Volume in Huong Hoa District 2010-2018**

#### 9.3.2.3.2 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<sup>39</sup>. Wind power is considered as a good option for developing clean energy while minimising impacts on

<sup>39</sup> Source: Nguyen Tuan. 2020. Quang Tri starts three wind power projects with total investment of nearly 5,000 billion VND (*Quang Tri khai cong ba du an dien gio voi tong muc dau tu gan 5000 ty dong*) <https://congthuong.vn/quang-tri-khai-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<sup>40</sup>.

### 9.3.2.3.3 Water Supply and Irrigation System

The district has 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 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<sup>41</sup>.

According to the statistics of Huong Hoa District People's Committee<sup>42</sup>, seven out of the 22 communes and townships in the district are using pipe water provided by Khe Sanh and Lao Bao Water Plants. Those communes are mostly located along the National Highway 9. Currently, demand for domestic water in those areas are basically met. Meanwhile, six communes located in the north and eight communes in the south mainly use water from the gravity water supply schemes. Lack of water for domestic use often occurs in those communes, and some households have to use water from rivers and streams for their daily activities.

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.

In 2018, Huong Hoa had a total of 50 irrigation works distributed in 22 communes and townships<sup>43</sup>. Of which, 20 works built in in the 1980s, 1990s and 2000s for serving agricultural production irrigation in remote and isolated communes were evaluated to be degraded, including Cu Bai irrigation work (Huong Lap commune), Xa Nghet and Hoong irrigation systems (Huong Linh commune), Moi irrigation work (Huong Son commune), and Khe Sanh lake (Khe Sanh township). They are prioritised to be upgraded within the local government plan.

### 9.3.2.3.4 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 townships 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 townships 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.

### 9.3.2.4 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 Figure 9.36). Agricultural land includes land for

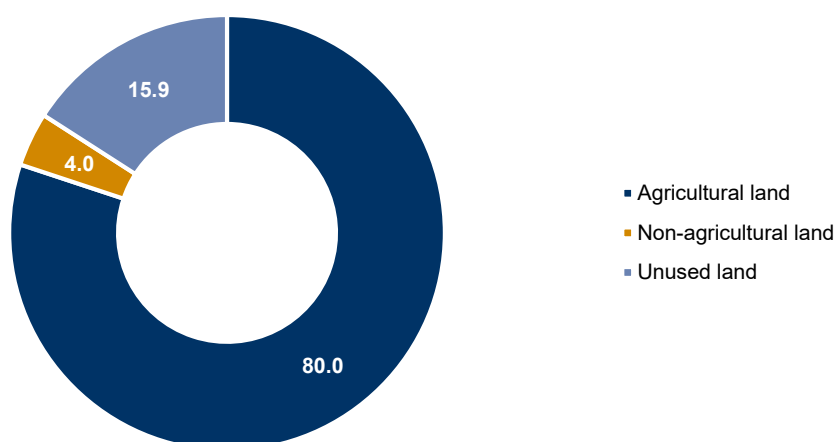
<sup>40</sup> Source: Bich Lien and Khanh Hung. 2019. Huong Hoa focuses on attracting investment in wind power farms (*Huong Hoa: Chu trong keu goi dau tu vao nang luong dien gio*). <http://huonghoa.quangtri.gov.vn/Kinh-te-Thi-truong/huong-hoa-chu-trong-keu-goi-dau-tu-vao-nang-luong-dien-gio-945.html> (Accessed 22 March 2020).

<sup>41</sup> 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).

<sup>42</sup> Source: <https://tinhuyluongtri.vn/-huong-hoa-14-xa-thieu-nuoc-va-co-nguy-co-thieu-nuoc-sinh-hoat> (Accessed 25 August 2020)

<sup>43</sup> Source: Cong Dien (2018)

agriculture, forestry, aquaculture and other agricultural activities, while non-agricultural land includes land for housing, religion, special uses and other uses.



Source: Huong Hoa Statistics Office (2019)

**Figure 9.36 Land Use Structure in Huong Hoa District 2018**

As shown in Table 9.13, 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 9.13 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

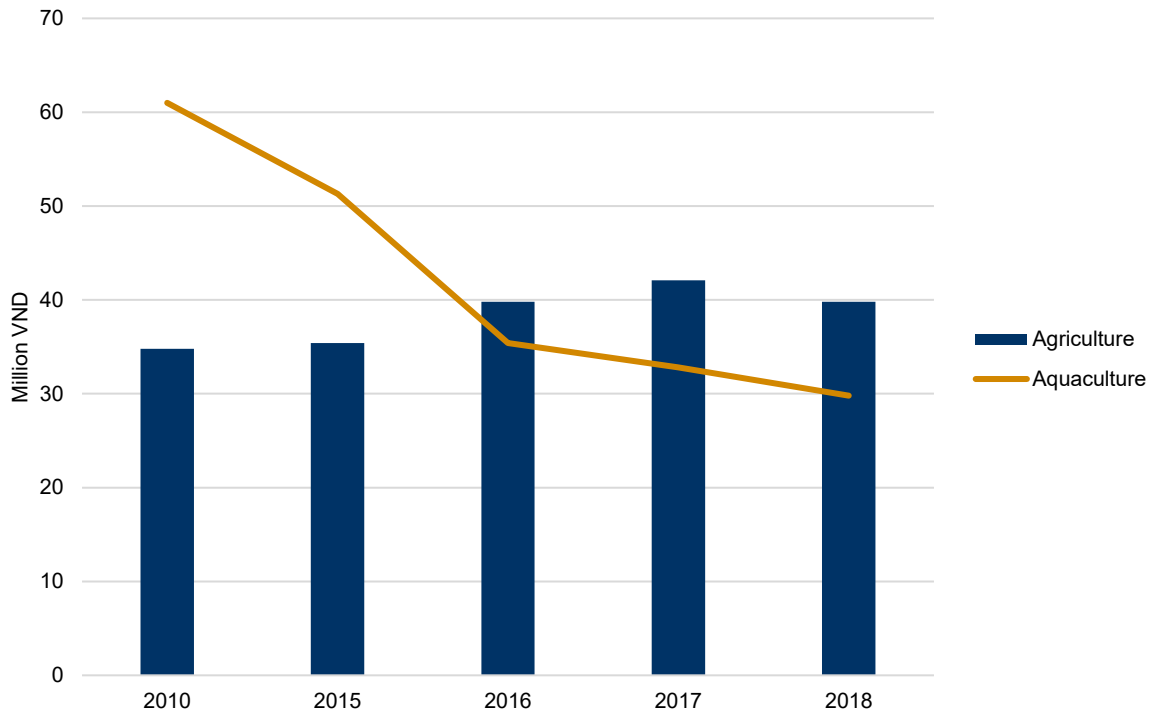
Source: Huong Hoa Statistics Office (2019)

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 township with 64.2 ha (Huong Hoa Statistics Office 2019).

### 9.3.2.5 Economy and Industry

#### 9.3.2.5.1 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 9.37).

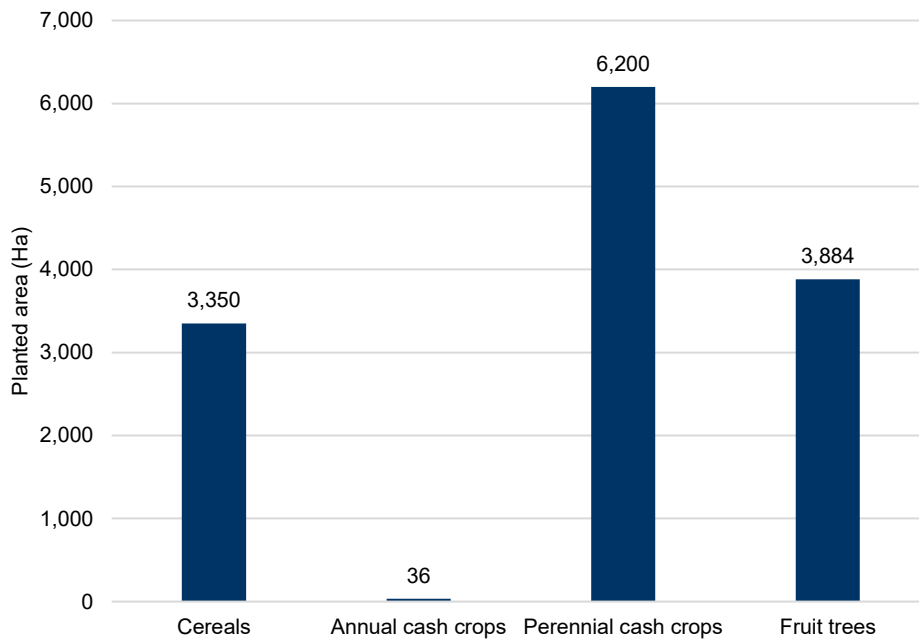


Source: Huong Hoa Statistics Office (2019)

**Figure 9.37** Production Value per Hectare of Agriculture and Aquaculture Land in Huong Hoa District 2018

9.3.2.5.1.1 *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 9.38).



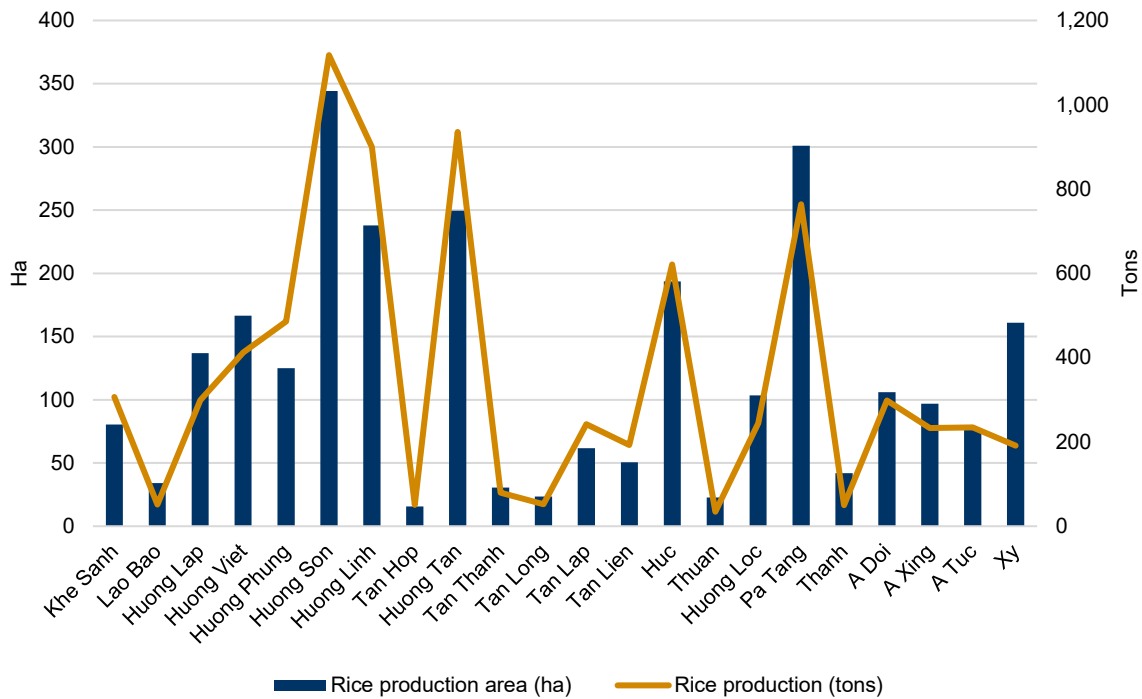
Source: Huong Hoa Statistics Office (2019)

**Figure 9.38** 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).

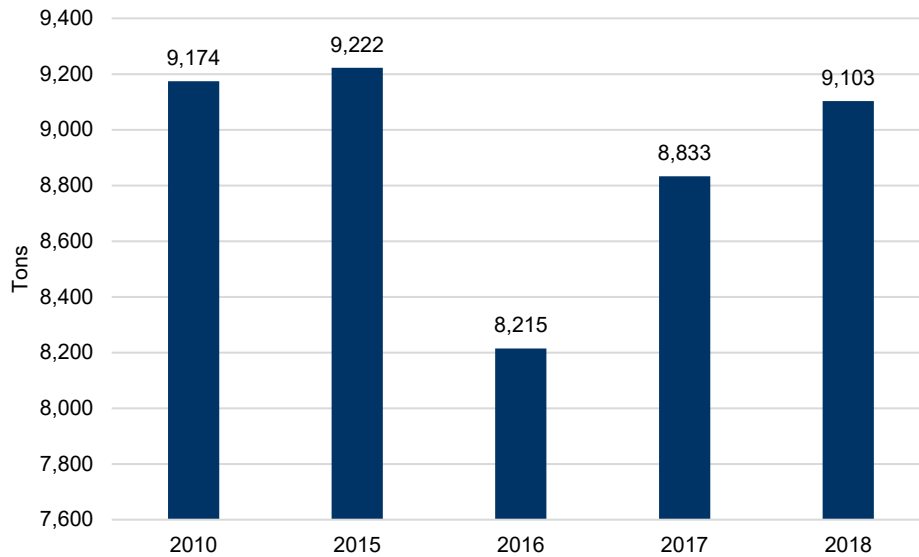
Huong Son and Huong Tan communes were the biggest rice producers in the district, with production going up 1,118 tons and 936 tons respectively in 2018. The main planted areas were at Huong Son and Ba Tang communes with 250 ha and 301 ha respectively, while Tan Hop commune had the lowest planted area with only 15.6 ha and production of 51 tons in 2018 (see Figure 9.39).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.39 Rice Planted Area and Production in Huong Hoa District by Commune 2018**

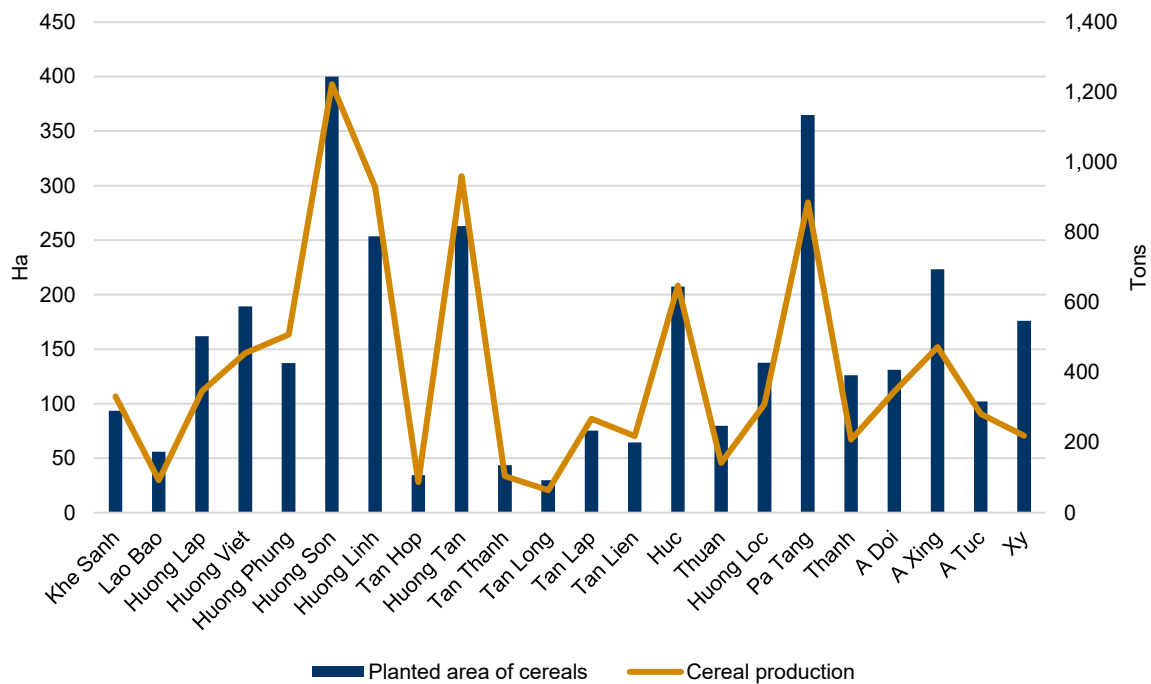
*Cereals:* District cereals production varied during 2010-2018, with the highest production of 9,222 tons in 2015 but dropping to 8,215 tons in 2016. However, production increased during 2017-2018 with 8,833 tons and 9,103 respectively (see Figure 9.40).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.40 Cereal Production in Huong Hoa District 2010-2018**

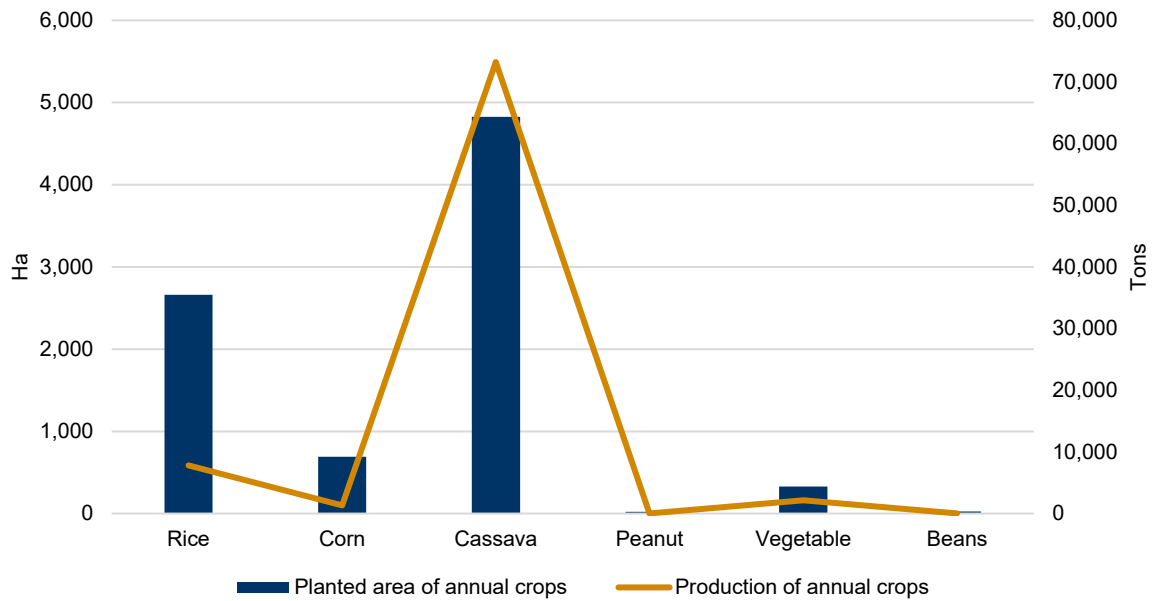
According to the Huong Hoa Statistics Office (2019), the whole district harvested 9,103 tons of cereals in 2018. Huong Son and Huong Tan communes were the highest producers with 1,223 tons and 961 tons, respectively in 2018. Lowest cereal production was at Tan Long and Tan Hop communes with 64.1 tons and 87 tons, respectively (see Figure 9.41).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.41 Planted Area and Production of Cereals in Huong Hoa District by Commune 2018**

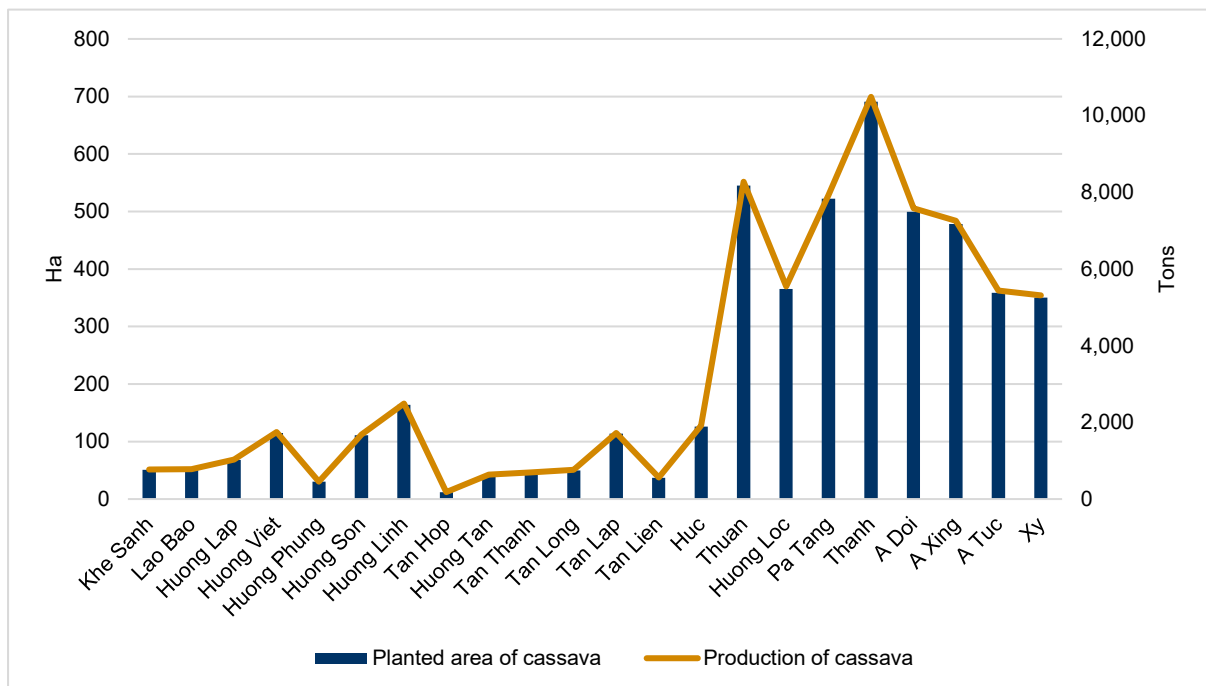
Cassava: Cassava is the main agricultural product, followed by rice while peanut and bean production had the lowest production with 18.6 tons and 20.9 tons respectively. Cassava and rice produced 73,246 tons and 7,796 tons respectively in 2018, and these crops also occupied the largest planted areas with 4,826 ha and 2,660 ha respectively (refer to Figure 9.42).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.42 Planted Area and Production of Annual Crops in Huong Hoa District 2018**

As shown in Figure 9.43, 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)

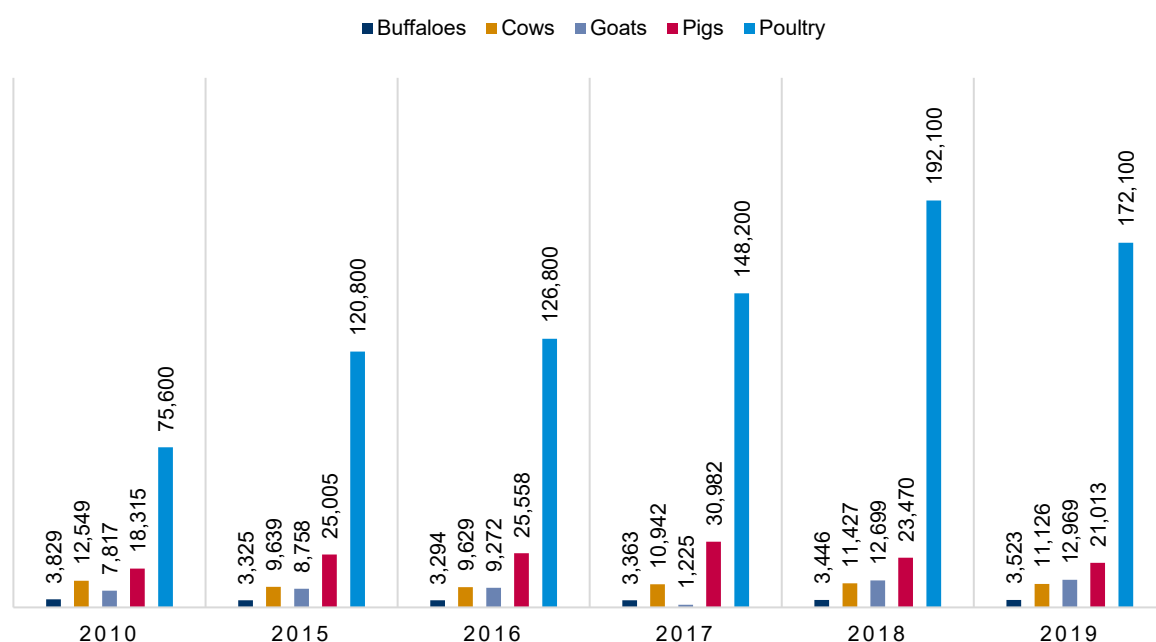
**Figure 9.43 Planted Area and Production of Cassava in Huong Hoa District by Commune 2018**

*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 longans and 108 tons of rambutans and lychees (Huong Hoa Statistics Office 2019).

### 9.3.2.5.1.2 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 9.44). 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).

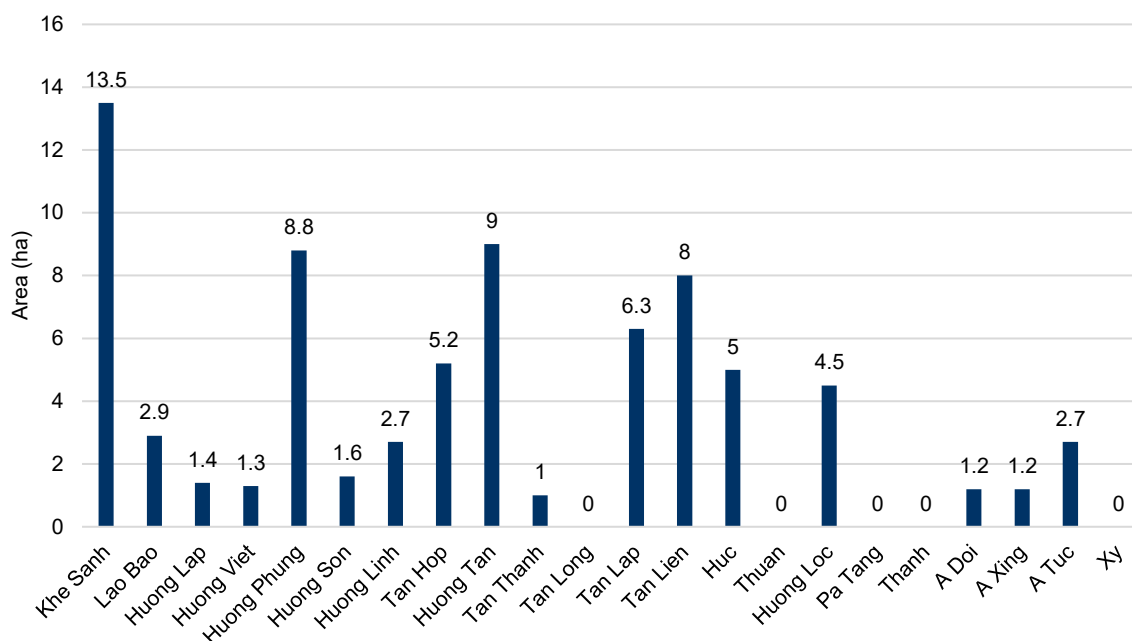


Source: Huong Hoa Statistics Office (2019)

**Figure 9.44** Number of Buffaloes, Cows, Goats, Pigs and Poultry in Huong Hoa District 2010-2018

### 9.3.2.5.1.3 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 township with 13.5 ha, while 16 other townships/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 9.45) (Huong Hoa Statistics Office 2019).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.45 Aquaculture Area in Huong Hoa District by Commune in 2018**

#### 9.3.2.5.1.4 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 9.14).

**Table 9.14 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)

#### 9.3.2.5.2 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<sup>3</sup> (up 4.5% over 2018), 22.5 million bricks (up 0.5%), 594.8 million kW/h electricity (up 8%), 18.8 m<sup>3</sup> piped water (up 2.7%) and 368,500 clothes (up 0.1% over 2018) (Huong Hoa People's Committee 2019).

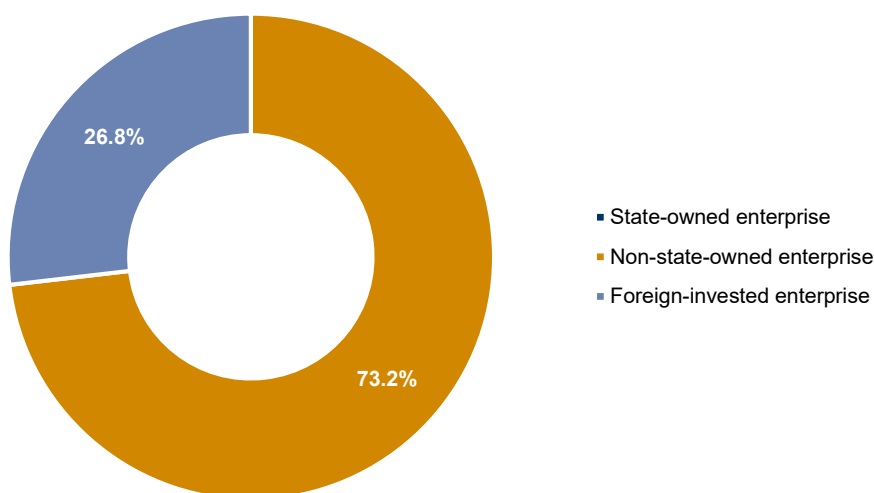
### 9.3.2.5.3 Local Enterprises

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 9.46). 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 9.46).

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).

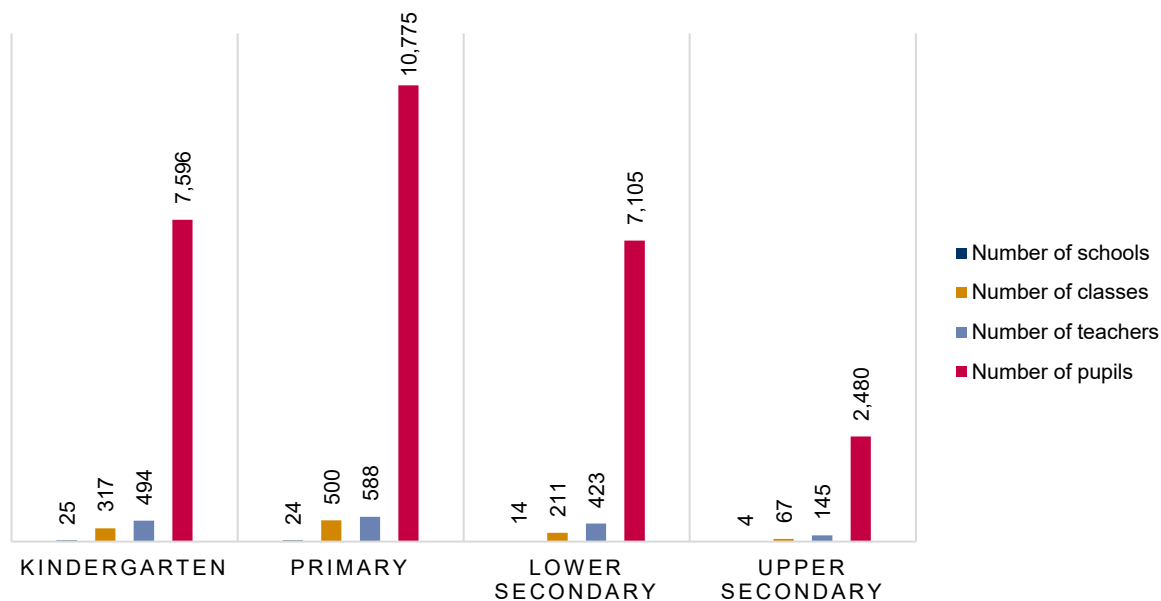


Source: Huong Hoa Statistics Office (2019)

**Figure 9.46 Structure of the Labour Force of Huong Hoa District by Enterprise Type in 2018**

### 9.3.2.6 Education

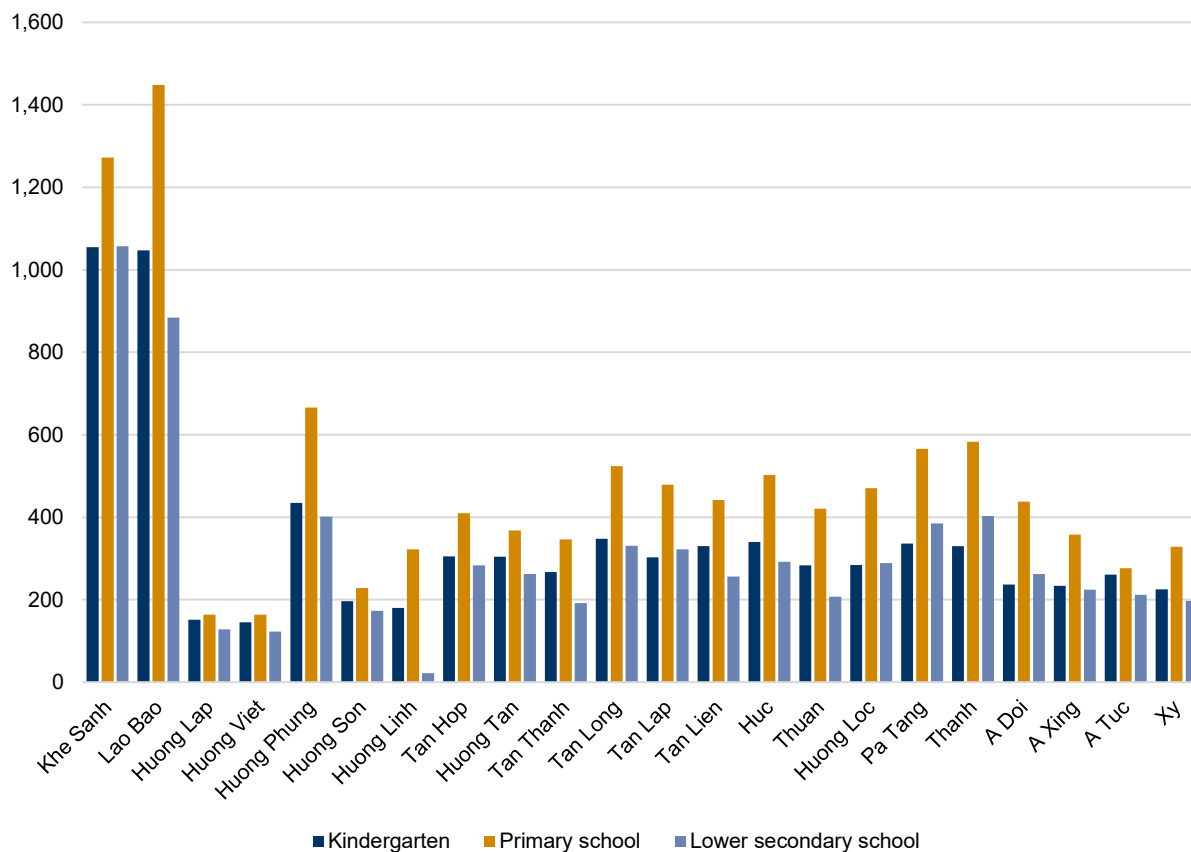
In the 2018-2019 school year, the district had 25 kindergartens, 24 primary schools (including nine primary and lower secondary), 14 lower secondary schools, and four upper secondary schools. The number of schools, classes, teachers, and pupils for the school year 2018-2019 are shown in Figure 9.47.



Source: Quang Tri Statistics Office (2019); Huong Hoa Statistics Office (2019)

**Figure 9.47** Number of Schools, Classes, Teachers, and Pupils in Huong Hoa District for the 2018-2019 School Year

In the 2018-2019 school year, Huong Hoa district had 7,596 pupils in kindergarten, 10,775 pupils in primary schools, 7,105 pupils in lower secondary schools, and 2,480 pupils in upper secondary schools. At kindergarten, primary, and lower secondary levels, the majority of pupils in the district are in Khe Sanh and Lao Bao townships 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 township with 1,055 pupils, and the least number was in Huong Viet commune with 145 pupils. Lao Bao township 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 township 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 townships 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.

### 9.3.2.7 Health

As shown in Table 9.15, 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/townships achieved 100% vaccination rates.



**Table 9.15 Statistics on Health Services in Huong Hoa District 2018**

	Number
<b>Total health care establishments, including:</b>	<b>25</b>
District hospital	1
Regional polyclinics	2
Medical service units in communes, precincts, offices and enterprises	22
<b>Total personnel, including:</b>	<b>244</b>
Doctors	60
Physicians	29
Nurses	57
Midwives	39
Medical technicians	14
Other	45
<b>Pharmaceutical staff</b>	<b>22</b>

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/township.

The rate of height for age malnutrition in communes reduced in 2019, but there was a big difference between ethnic minority communes and communes/townships 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).

### 9.3.2.8 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.

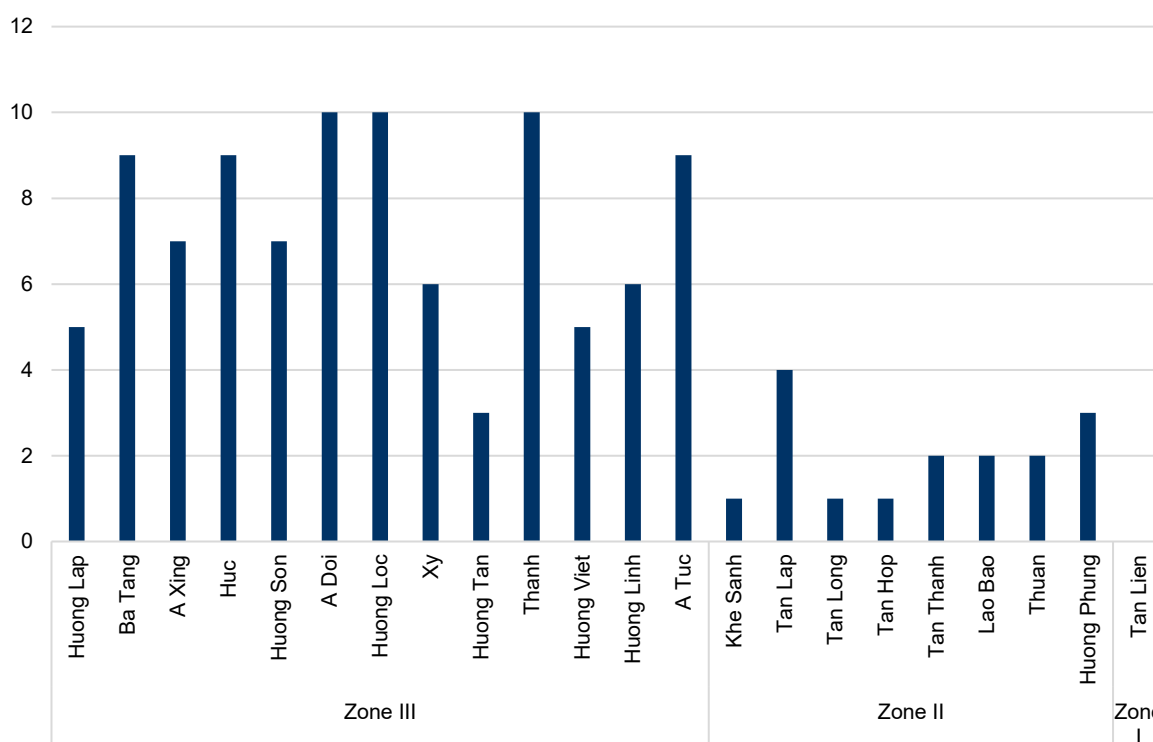
With regard to judicial activities, there were 62 prosecution cases in 2018 with 85 defendants, and 45 of these with 69 defendants were prosecuted. Some 39 cases involving 62 criminals were sentenced (Huong Hoa Statistics Office 2019).

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.

### 9.3.2.9 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 9.49). 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).

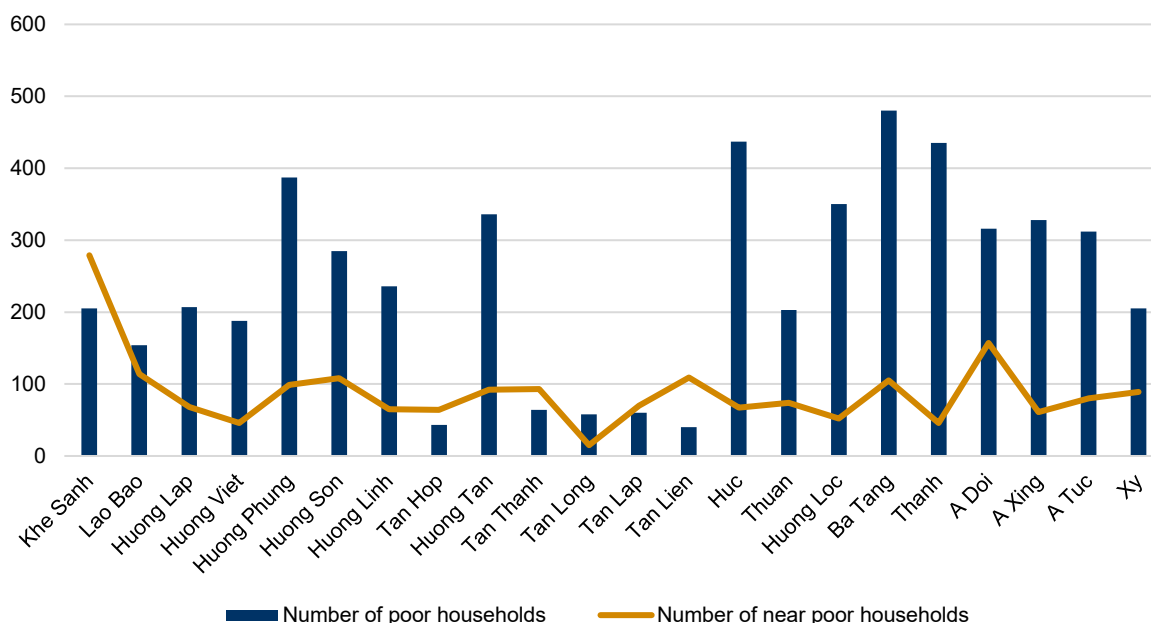


Source: Decision 582/QD-TTg dated 28 April 2017 by the Prime Minister

**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 township having the greatest number (279 households) and Tan Long commune having the least with 15 households.

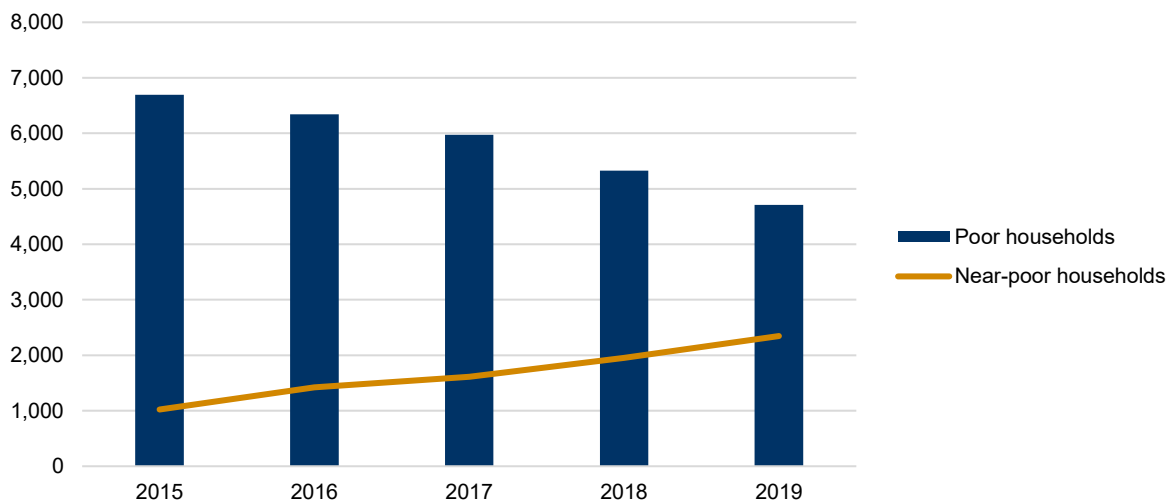
According to the report on multi-dimensional poverty rate by Huong Hoa People’s Committee (2019), at the end of 2018, the district had 21,678 households including 11,862 ethnic minority households. There were 5,329 poor households, accounting for 24.6% of total households. Among 5,329 poor households, 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).

### 9.3.2.10 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)<sup>44</sup>**

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 township 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.

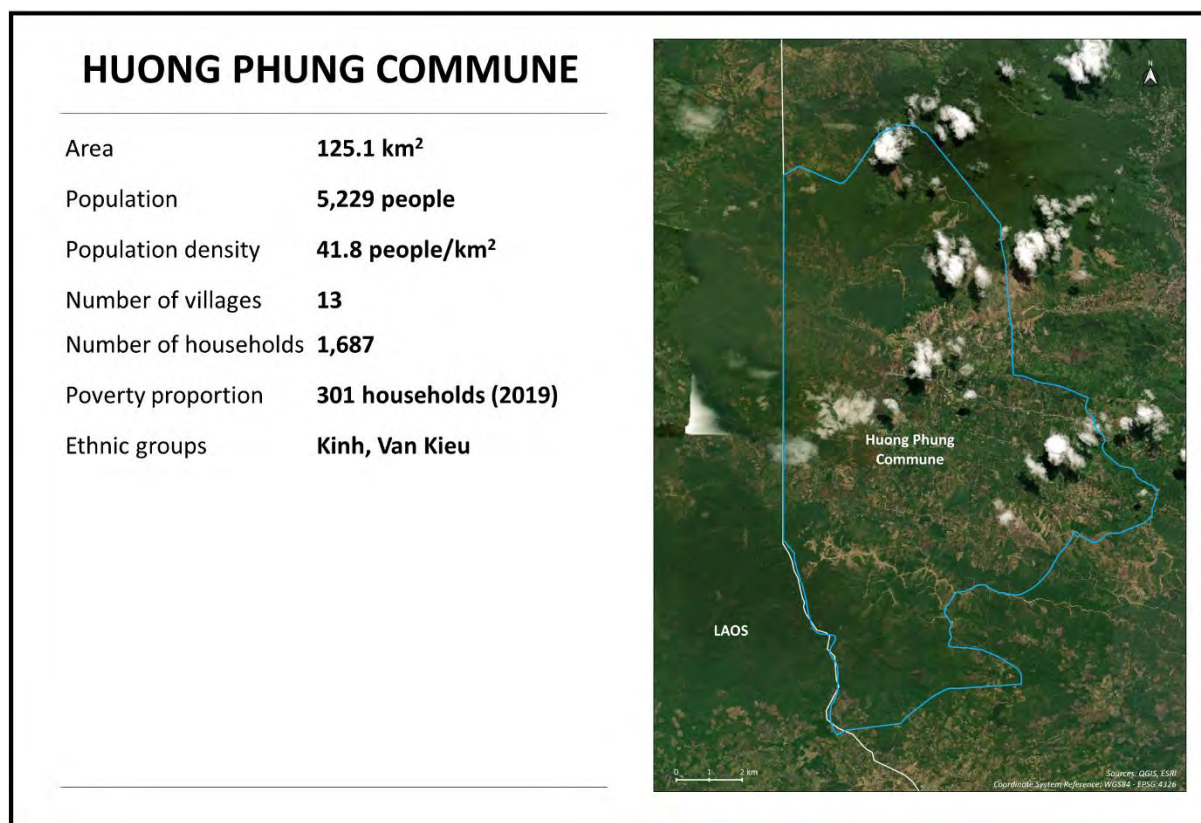
Thac Ta Puong (Ta Puong Waterfall) is 30-35 metres high, with a huge flow and majestic flowing water all year round like white silk in the forest, creating a pristine and charming beauty for the district.

## 9.3.3 Communal Level: Huong Phung

### 9.3.3.1 Demographics

Huong Phung has an area of 125.1 km<sup>2</sup> with thirteen villages including Huong Choa, Huong Lam, Cop, Huong Phu, But Viet, Ma Lai Pun, Dai Do, Cheng, Huong Hai, Xa Ry, Chenh Venh, Doa Cu, and Co Nhoi (see Figure 9.53). The population of the commune in 2018 was 5,229 people with 1,687 households, and population density was 41.8 people per km<sup>2</sup>. The male population is relatively equal to the female population (2,639 and 2,590 respectively). Of the 5,229 people, the majority are Van Kieu (2,719 people) and Kinh (2,501) with one Pa Co person and eight from other ethnic minority groups. 59% of total population are of working age - 3,074 people including 1,630 males and 1,444 females (Huong Hoa Statistics Office 2019). The majority of villagers practice Buddhism while some Van Kieu people are Protestants and Catholics (ERM's meeting with Huong Phung People's Committee, 11th February 2020).

<sup>44</sup> Source: Internet



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

**Figure 9.53 Huong Phung Commune at a Glance**

### 9.3.3.2 Infrastructure and Public Facilities

Over 50% of commune roads are sandy and dirty and many village roads need to be upgraded for easier commuting (ERM's meeting with Huong Phung People's Committee, 11th February 2020). Field observations shows that the roads to Huong Choa and Phung Lam villages are particularly difficult as they are rocky, rough and steep. From the main commune road, it takes around ten minutes to go to Phung Lam village and more 20-25 minutes to go further 6-7km to Huong Choa village - only 1.1 kilometre of this road is concreted.

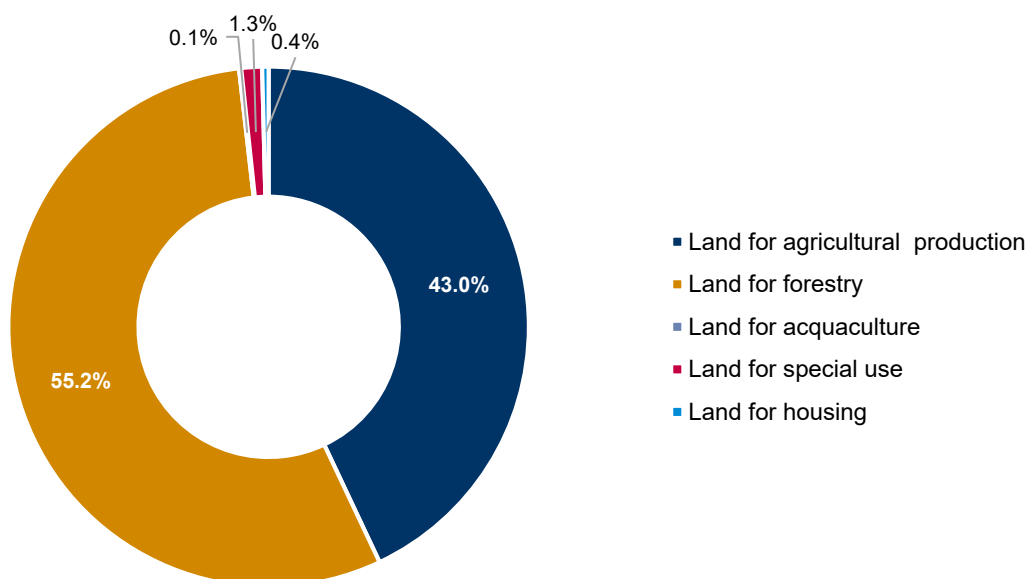
In 2019, the Huong Phung People's Committee budgeted to improve local infrastructure with over five billion VND to achieve New Rural Development program objectives and sustainable poverty reduction. A total of 5,879 m of rural roads were completed, including the Huong Choa - Phung Lam inter-village road (932m); 13 intra-village traffic routes in Huong Hai, Chenh Venh, Ma Lai Pun, Cheng, Huong Phu, Dai Do, Huong Choa, Phung Lam, Doa Cu, Cop, Co Nhoi, and But Viet villages (3,133m); two traffic routes to production areas in Dai Do village (241m); the Huong Phu intra-village traffic road (241m), the But Viet inter-village traffic road (400m); and the Ma Lai Pun intra-village road (960m).

Transport routes in the commune basically meet travel needs of the locals and freight transport. There were four bus routes, 25 trucks, and 15 household cars in the commune in 2019.

There is one village with a community house meeting the national standards, three villages with degrading community houses, and the remaining villages normally organising meetings or community activities in local houses. Local people mainly use boreholes and gravity water source for domestic use. The rate of households using hygienic water is 99.8%, while 98% of households are connected to the electricity grid in 2019. Solid waste collection services are available for 10% of households but most just burn their waste. Solid waste collection services at public areas such as markets and the commune center are maintained with twice per week.

### 9.3.3.3 Land Tenure and Land Use

The total land area of the Huong Phung commune is 11,042 ha, of which the largest proportion is used for forestry (55.2%) (see Figure 9.54). A further 43% is used for agricultural production, and very small proportions are used for special purposes (1.3%), residential (0.4%), and aquaculture (0.1%).



Source: Huong Hoa Statistics Office (2019)

**Figure 9.54 Land Use Structure in Huong Phung Commune 2018**

### 9.3.3.4 Economic Development

#### 9.3.3.4.1 Farming

In 2019, due to the long-term sunny climate in the first months and floods in the final months, agricultural production activities of the commune was affected. According to the socio-economic report by Huong Phung People’s Committee (2019), the commune’s total planted area of annual crops in 2019 was 282 ha, increased by 8 ha from 2018. Of the 282 ha planted area, 106.5 ha was for winter-spring wet rice cultivation (down 1.5 ha over 2018), 1.5 ha for summer-autumn wet rice (down 5.5 ha over 2018), 4.5 ha for winter-spring maize cultivation (up 0.5 ha over 2018), 35 ha for cassava planting (up 10 ha over 2018), 10 ha for all kinds of potatoes, 10 ha for beans, sesame and vegetables, 100 ha for turmeric (down five ha from 2018), two ha for ginger (down five ha from 2018), and 7.5 ha for passion fruit. Total wet rice production in 2019 was 511.2 tons, a reduction of 7.2 tons over 2018.

The commune had 1,689 ha of perennial crops (down 10 ha from 2018) of which 1,649 ha were for coffee planting (a fall of eight ha over 2018), 20 ha for pepper (a reduction of five ha over 2018), seven ha for rubber, and 13 ha for fruit trees (a rise of three ha). Fresh coffee yield in 2019 was 5 tons/ha and total production was 7,875 tons, up 499 tons from 2018. The price of one kg of fresh coffee beans was 4,500 VND in 2019.

#### 9.3.3.4.2 Animal Husbandry

The commune had 294 buffaloes, 932 cows, 319 pigs, 1,045 goats, and 9,450 poultry (Huong Phung People’s Committee 2019). Because of the African swine fever epidemic, by October 2019 the commune had to destroy 89 pigs in six villages (But Viet, Xa Ry, Cop, Chenh Venh, Dai Do, and Doa Cu) with a total weight of 3,432 kg. To deal with the epidemic, the commune established five groups to implement disease preventive measures. 84 litres of chemicals and 2,000 kg of lime were used to

disinfect animal houses, markets, and the surrounding areas and prevent the spread of African swine fever epidemic in the locality.

#### 9.3.3.4.3 Aquaculture

In 2010-2019, there is an increase in aquaculture area, from 5.3 ha in 2010 to 15 ha in 2019. The commune had 18 ponds with a total area of 15 ha (up eight ha over 2018) for raising carp, tilapia, and grass carp in 2019.

#### 9.3.3.4.4 Forestry

According to the report of Huong Phung People's Committee (2019), the commune developed a forest fire prevention plan. The commune in coordination with Huong Phung Border Guard Station, Police Security, and the commune Military organised monitoring activities to detect illegal forest exploitation activities. In 2019, 404.9 ha of natural forest were allocated to 57 households in Xa Ry and Chenh Venh villages (Huong Phung People's Committee 2019).

Huong Phung is now focusing on economic development based on four key points: maintaining the existing coffee area of over 1,650 hectares, raising buffaloes, increasing the afforestation area, and creating areas for growing passion fruit for export from agricultural processing factories. This is a new direction for the Huong Phung commune<sup>45</sup>.

#### 9.3.3.4.5 Trade and Tourism

In 2019, the whole commune had 176 business households, of which 18 households do business at local markets. In 2019, the construction commencement ceremonies for three wind farm projects - Huong Phung 1, 2, 3 were organised in the commune. In addition, the project of extending basin for supplying water to irrigation and hydropower works with total investment of 4,000 billion VND was implemented. The commune supported the agreement of connecting Gelex wind power source to the national electricity grid (Huong Phung People's Committee 2019).

### 9.3.3.5 Community Development

As updated in the Socio-Economic Development report of Huong Phung in 2019, there are four main community development programs in the commune, including:

- National Target Program for New Rural Development: The program aims to improve the economy and living standards of Vietnam's rural areas. To be recognized as a "new rural commune", there are 19 main criteria to be compulsory met, including planning and planning implementation, communication information, irrigation, electricity, school, cultural facilities and infrastructure, rural market, post, residential houses, income, household poverty, labor force structure, type of production organisations, education, health care, cultural lives, environment, system of social organization, security and social order. After ten years of the program implementation, Huong Phung commune completed 13 out of 19 criteria. In 2019, the commune achieved the criterion of education.
- Ethnic Minority Economic Empowerment (EMEE): The project implemented by World Vision in Vietnam (WVV) under the funding of the New Zealand Government aims to improve the economic well-being of poor ethnic minority households over a five year period (2015-2020). In 2019, the project carried out trainings on coffee planting, loans programs, and delivery of machinery and agricultural materials for 11 clean coffee planting groups with total funding of two billion VND.
- World Vision International's Area Development Program (ADP): The project aims to child focused development, emphasising the process of community participation, sustainability, and integrating

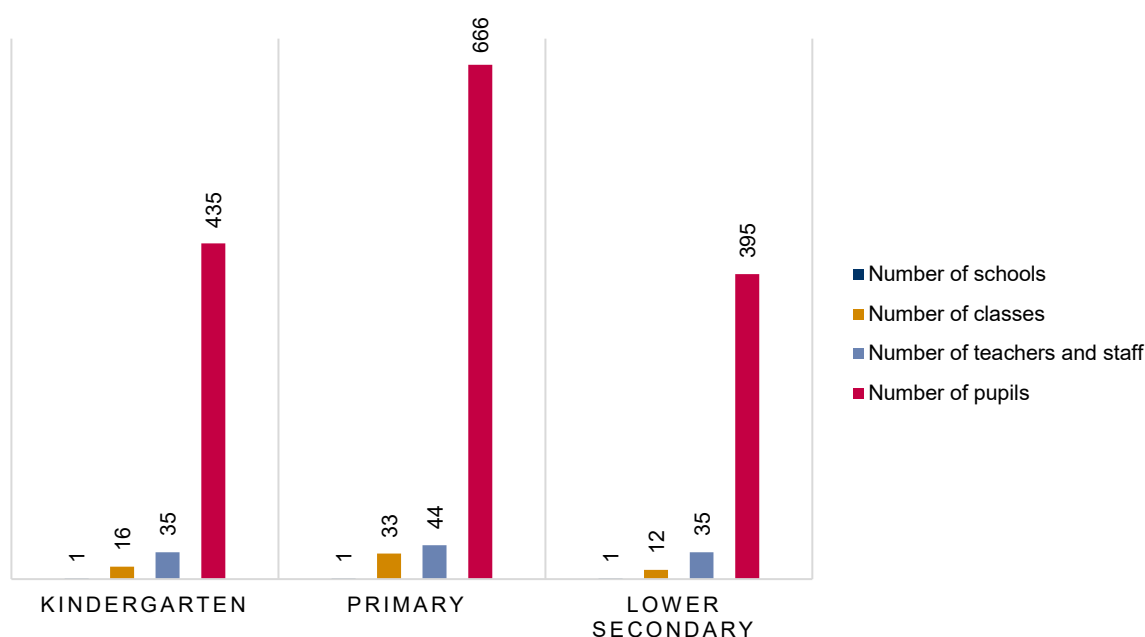
<sup>45</sup> Source: Quang Tri Science and Technology Department. 2019. Developing passion fruit in Huong Phung. <http://www.dostquangtri.gov.vn/Home/Tintuc?details=9219&Ngonngu=1&CongID=1> (Accessed on 3 March 2020)

activities in the areas of food security, agriculture, micro-enterprise, health, nutrition, education, water, and sanitation with total funding of over 800 million VND/year.

- Greater Mekong Sub-region Biodiversity Conservation Corridors Project - Phase 2 (BCC project): The project aims to restore and plant forest and provide livelihood creation solutions to improve living conditions for ethnic minority people in the poor mountainous areas.

### 9.3.3.6 Education

There is a kindergarten, a primary school, and a lower secondary school in Huong Phung commune. The schools are under the management of the local authority and 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 the kindergarten, primary and secondary levels is shown in Figure 9.55.



Source: Huong Hoa Statistics Office (2019)

**Figure 9.55 Number of Schools, Classes, Teachers and Staff, and Pupils in Huong Phung Commune for the 2018-2019 School Year**

According to the report of Huong Phung People’s Committee (2019), there were positive changes in the education quality in 2019. The rate of enrolment was 19.3% for preschool, 98.7% for kindergarten, 100% for primary education, and 97.3% for lower secondary education in 2019. Huong Phung commune has achieved preschool education universalisation for five-year-old children and primary education universalisation. In 2019, the illiteracy rate was 1% and most illiterate people are elderly.

The commune has one kindergarten with nine village branches with 16 classes, and 435 children, and there are 35 teachers and staff. In the school year 2018-2019, the kindergarten had one teacher recognised as an ‘excellent’ teacher at the provincial level.

Huong Phung primary school has five branches with 33 classes, 666 pupils, and 44 teachers and staff (see Figure 9.56). Thirty primary teachers were recognised as ‘excellent’ teachers at the school level, and five teachers as ‘excellent’ teachers at the district level in the school year 2018-2019.

At the lower secondary level, there are 12 classes, 395 pupils, and 35 teachers and staff, 85.5% of pupils of study age attend the school. In the school year 2018-2019, ten lower secondary teachers were



recognised as ‘excellent’ teachers at the district level and five teachers as ‘excellent’ at the provincial level.



Huong Phung Primary School - Huong Choa Branch



Huong Phung Primary School - Cop Branch



Huong Phung Primary School Located in the Commune Center

Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.56** Huong Phung Primary School in Different Locations

### 9.3.3.7 Health

Huong Phung commune has a health station and which meets the basic medical needs of local people (see Figure 9.57), and residents reportedly travel to the station for vaccinations, vitamins, and treatment

for common diseases such as colds and headaches. In addition, local people visit the Military 337 health station (*Bệnh xá quân y 337*) in the commune. For medical complications, local people visit the General Hospital of Huong Hoa district.

In 2019, the commune health station provided health treatment and check-up services to 2,214 patients, down 53 patients from 2018. There was no epidemic recorded in the commune. The commune organised 180 information dissemination sessions about dengue fever prevention for 2,688 local participants. 97.1% of children received full vaccination in 2019, up 6.5% over 2018. The rate of weight-for-age malnutrition for under-five children was 17.8% (down 0.63% from 2018) and the rate of height-for-age malnutrition was 19.5% - down 5.6% from 2018. 86.9% of people had medical insurance in 2019. Only ethnic minority people, and poor and near poor households are entitled to free medical insurance. Some main health programs have been implemented in the locality, including immunization, health check-up for the poor, and malnutrition prevention programs (Huong Phung People's Committee 2019).



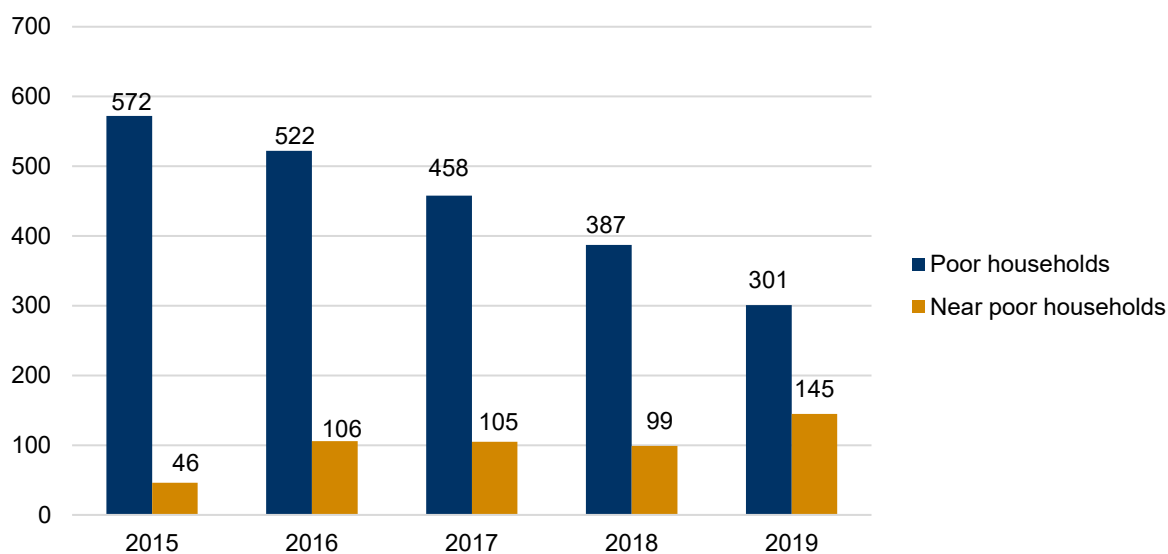
Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.57 Health Station in Huong Phung Commune**

### 9.3.3.8 Vulnerable Group

According to Decision 582/QĐ-TTg dated 28/4/2017 by the Prime Minister, Huong Phung is classed as a Zone II commune that has difficulties but temporarily stable socio-economic conditions. There are three villages with special difficulties in Huong Phung including Chenh Venh, Huong Choa, and But Viet villages. There are 387 households and 99 households classified as poor and near poor respectively in Huong Phung commune in 2018 (Huong Hoa Statistics Office 2019). According to the report by the Huong Phung People's Committee (2019), the rate of poor households reduced by 5% from 2018. In 2019, the commune had 301 poor households in the commune (17.6% of total households) and 145

near poor households (8.5% of total households) - up by 46 households from 2018. As shown in Figure 9.58, the number of poor households significantly decreased in 2015-2019.



Source: Huong Hoa Statistics Office (2019)

**Figure 9.58** Number of Poor and Near Poor Households in Huong Phung Commune 2015-2019

Table 9.16 shows the number of poor and near poor households in the three surveyed villages in Huong Phung commune.

**Table 9.16** The Current Number of Poor and Near Poor Households in the Three Surveyed Villages in Huong Phung Commune

	Huong Choa Village	Phung Lam Village	Cop Village
Total number of households in the village	66	300	245
Number of poor households	47	5	61
Number of near poor households	4	5	20

Source: Socio-economic survey conducted by ERM, 2020

### 9.3.3.9 Archaeological, Cultural Heritage and Religious Sites

All villages in Huong Phung commune have “ghost” forests. For Van Kieu people, “ghost” forests are the holy cemeteries for their family lines in villages of Huong Phung commune. Like the stilt houses for the living Van Kieu indigenous people, ghost forests are the 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 temple forests where village patriarch and local villagers celebrate worshipping every year. Local people worship a buffalo every ten years in the temple forest (see Figure 9.59 and Figure 9.62).

There is one Buddhist temple and two memorial steles situated in the commune. No cultural establishments or historical relics are identified in the Project area (ERM’s meeting with Huong Phung People’s Committee, 11th February 2020).



Source: FGD conducted by ERM, 2020

**Figure 9.59** Ghost Forest and Temple Forest in Cop Village as Identified by Local Villagers

## 9.4 Household Level Analysis

This section analyses the results of the household survey undertaken in Huong Choa, Phung Lam, and Cop villages of Huong Phung commune, Huong Hoa district. A total of 35 household surveys were randomly selected and interviewed from the 11th to 12th February 2020. The interviews were often conducted at the respondent's house; however based on 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 9.1.2. Table 9.17 presents the number of households engaging in the survey.

**Table 9.17** Surveyed Households by Village

Province	District	Commune	Village	Number of Surveyed Households	%
Quang Tri	Huong Hoa	Huong Phung	Huong Choa	18	51.43
			Phung Lam	9	25.71
			Cop	8	22.86
<b>Total</b>				<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

## 9.4.1 Demographic Information

### 9.4.1.1 Population

The socio-economic baseline survey includes 35 households from Huong Choa, Phung Lam, and Cop villages, Huong Phung commune, Huong Hoa district, Quang Tri province. The population of the 35 surveyed households is 164 people including (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 9.18).

In presenting the data, it should be noted that people whose names are recorded in the formal household registration book (which has to be kept and continually updated in Vietnam) but who are not living with the family, are included in the demographics statistics but are not included in household expenditure and income statistics. This includes for example, females who have married recently and moved into a separate dwelling with their husbands, or those who are working in other cities and provinces and are not contributing to household income or expenditure.

**Table 9.18** Surveyed Households and Population by Village

Province	District	Commune	Village	Surveyed Households		Surveyed Population	
				N	%	N	%
Quang Tri	Huong Hoa	Huong Phung	Huong Choa	18	51.43	94	57.32
			Phung Lam	9	25.71	32	19.51
			Cop	8	22.86	38	23.17
<b>Total</b>				<b>35</b>	<b>100.00</b>	<b>164</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

The average household size is 4.7 people per household with the highest number of household members at eight people. As shown in Table 9.19, for household size, the households in Huong Choa village have the largest average family size at 5.2. The average number of children per household in Huong Choa is four as local people want to have both boys and girls (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12th February 2020).

**Table 9.19** Household Size by Village

Village	Average Family Size	Minimum Family Size	Maximum Family Size
Huong Choa (N=18)	5.22	3	8
Phung Lam (N=9)	3.56	2	5
Cop (N=8)	4.75	2	7
<b>All Surveyed Villages (N=35)</b>	<b>4.69</b>	<b>2</b>	<b>8</b>

Source: Socio-economic survey conducted by ERM, 2020

There are 164 people living in the 35 households with a relatively gap of gender ratio (i.e. 76 males versus 88 females or 46.3% versus 53.7%). The majority of people are between 15 and 60 years old (working age) accounting for about 60.9% of the total sample. Some 32.9% are below 15 years old and the other 6.1% are elderly people over 60 years old (see Table 9.20). In each age group, there is no

significant ratio difference for male and female, except for the people above 60 years old age group where the number of males to females is 1:9. Table 9.21 outlines the composition of the households by gender.

**Table 9.20 Population of the Surveyed Households by Age Group**

Village	<15 years old		15-60 years old		>60 years old		Total	
	N	%	N	%	N	%	N	%
Huong Choa	36	38.30	53	56.38	5	5.32	94	100.00
Phung Lam	9	28.13	22	68.75	1	3.13	32	100.00
Cop	9	23.68	25	65.79	4	10.53	38	100.00
<b>All Surveyed Villages</b>	<b>54</b>	<b>32.93</b>	<b>100</b>	<b>60.98</b>	<b>10</b>	<b>6.10</b>	<b>164</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

**Table 9.21 Population of the Surveyed Households by Gender**

Age Cohorts	Gender				Total	
	Male		Female		N	%
	N	%	N	%		
Below 15 years old	24	44.44	30	55.56	54	100.00
15-60 years old	51	51.00	49	49.00	100	100.00
Above 60 years old	1	10.00	9	90.00	10	100.00
<b>Total</b>	<b>76</b>	<b>46.34</b>	<b>88</b>	<b>53.66</b>	<b>164</b>	<b>100.00</b>

#### 9.4.1.2 Source: Socio-economic survey conducted by ERM, 2020 Ethnicity

Among three surveyed villages, Huong Choa and Cop villages have high levels of ethnic minority people. The rate of Van Kieu people in Huong Choa and Cop villages are 100% and 70% respectively (ERM's meeting with Huong Phung People's Committee, 11th February 2020). Phung Lam village has nearly 100% of Kinh people with three Van Kieu people (KII, male respondent, Phung Lam village, 12th February 2020).

Van Kieu ethnic minority people were maintained an adequate representation in the surveyed population. Of 35 households surveyed, 21 households identify themselves as Van Kieu ethnic minority people and 14 households are of Kinh ethnic group. Of 29 FGD participants, 55.2% are Van Kieu people and 44.8% are Kinh.

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. 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. The village patriarch is responsible for organising worshipping activities of the village.

### 9.4.1.3 Religion

Nearly all households (94.3%) identify as non-religious. In the survey, only two households from Huong Choa and Cop villages (5.7%) identify as Protestants. Table 9.22 presents the religious status of the participating households.

**Table 9.22 Religion Reported by Surveyed Households**

Village	Protestantism		No Religion		Total	
	N	%	N	%	N	%
Huong Choa (N=18)	1	5.56	17	94.44	18	100.00
Phung Lam (N=9)	0	0.00	9	100.00	9	100.00
Cop (N=8)	1	12.50	7	87.50	8	100.00
<b>All Surveyed Villages (N=35)</b>	<b>2</b>	<b>5.71</b>	<b>33</b>	<b>94.29</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

### 9.4.1.4 Residence Length at the Current Village

The average number of years of residence for surveyed households is 16.2 years. There is one Van Kieu household who has lived there for 40 years while another Van Kieu household has the shortest period of four years – both households are from Cop village. Notably, 89% of the surveyed households in Huong Choa village have the same length of local residence of 14 years. They previously lived in Pa Cong village of Huong Linh commune, but were relocated to Huong Choa village in 2006 when the Rao Quan hydropower project was constructed. Some 25 households moved to the village at the time and the current number of households is 66 in Huong Choa village (FGD, male respondent, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Nine surveyed households in Phung Lam village have lived there for 10-22 years. According to the FGD with local people in the village, the majority of households moved there since 1988, in responding to the new economic policy of the State (FGD, agriculture and forestry group, Phung Lam village, 12th February 2020). Many of them have come at the village for farming purposes and stay here during the production season. They maintain rotating stays at their old residence for better education conditions for their children (KII, male respondent, Kinh ethnic group, Phung Lam village, 12th February 2020).

### 9.4.1.5 Marital Status

Seventy-two out of the 164 surveyed population are married, accounting for 43.9% (see Table 9.23). Some 64 out of 164 surveyed people are under the marriage age<sup>46</sup> which is equivalent to 39%, and 17 people are single (10.4%). One male in Phung Lam is divorced (0.6%). Ten people are widowed (6.1%) including six people in Huong Choa village, two people in Phung Lam village, and two people in Cop village.

**Table 9.23 Marital Status by Surveyed Population**

	Huong Choa Village		Phung Lam Village		Cop Village		All Surveyed Villages	
	N	%	N	%	N	%	N	%
Married	38	40.43	17	53.13	17	44.74	72	43.90
Single	8	8.51	1	3.13	8	21.05	17	10.37

<sup>46</sup> 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.

	Huong Choa Village		Phung Lam Village		Cop Village		All Surveyed Villages	
	N	%	N	%	N	%	N	%
Divorced	0	0.00	1	3.13	0	0.00	1	0.61
Widowed	6	6.38	2	6.25	2	5.26	10	6.10
Under marriage age	42	44.68	11	34.38	11	28.95	64	39.02
<b>Total</b>	<b>94</b>	<b>100.00</b>	<b>32</b>	<b>100.00</b>	<b>38</b>	<b>100.00</b>	<b>164</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

In the surveyed areas, despite a recent reduction, underage marriages often occur when teenagers get married at their age of 15 years. Through the FGD with a vulnerable group in Cop village, three female respondents shared that they got marriage at an early age - one got married when she was at 15 years old, one at 16 years old, and one at 17 years old. Two of them later obtained a marriage certificate but one still does not have a marriage certificate (FGD, vulnerable group, Cop village, 12th February 2020). In Huong Choa village, the rate of underage marriages reduces by 10% compared from previous years as a result of information broadcast through the village's speaker system (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12th February 2020).

#### 9.4.1.6 Labour Force

The survey data indicates that 100 people (60.9% of surveyed people) are of working age, defined as between 15 and 60<sup>47</sup> (see Table 9.24). However, only 81 of these 100 people are engaged in work, accounting for 81%. As well as the 81 people of working age engaged in work, there are four people over the working age who are engaged in work. The remaining 19 people (19% of working age people) are unemployed (four people); mentally or physically disabled and unable to work (three people), or are engaged in unpaid activities (12 people, in housework, military service, or studentship).

**Table 9.24 Ratio of Labour Resources of the Surveyed Households**

	Huong Choa Village (N=94)		Phung Lam Village (N=32)		Cop Village (N=38)		All Surveyed Villages (N=164)	
	N	%	N	%	N	%	N	%
15-60 years old (N=164)	53	32.32	22	13.41	25	15.24	100	60.98
15-60 years old engaging in work (N=100)	44	44.00	19	19.00	18	18.00	81	81.00

Source: Socio-economic survey conducted by ERM, 2020

#### 9.4.2 Educational Attainment

Education levels were calculated for household members who were six years old<sup>48</sup> and older. Twenty-two people under six years old were excluded from the education level analysis. Information about the educational attainment of the 142 surveyed people is included in the analysis.

There were 17 illiterate people in the surveyed population (11.9%). Illiteracy not only occurs among the elderly but also among young people and people within working age. More particularly, 11 of the 17 illiterate people are of working age (from 15 to 59 years old) and the remainder are over 60 years old.

<sup>47</sup> 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.

<sup>48</sup> At the time of the survey (January 2020), six years old kid have entered the 1<sup>st</sup> grade class.



The youngest illiterate person is 29 years old and the oldest illiterate one is 89 years old in Huong Choa village. While reasons for this were not investigated in the survey, they may be related to difficult living conditions and their ability to study.

Among the 17 illiterate people of Van Kieu ethnic group, 14 people are in Huong Choa (82.4%) and three people are in Cop village (17.6%). There are no illiterate people among the 32 surveyed people in Phung Lam village. Table 9.25 shows illiteracy and literacy in the surveyed households by village.

**Table 9.25 Illiteracy and Literacy of People over School Age in the Surveyed Villages**

Education Level	Huong Choa Village		Phung Lam Village		Cop Village		All Surveyed Villages	
	N	%	N	%	N	%	N	%
Illiterate	14	17.28	0	0.00	3	8.82	17	11.97
Literate	67	82.72	27	100.00	31	91.80	125	88.03
<b>Total</b>	<b>81</b>	<b>100.00</b>	<b>27</b>	<b>100.00</b>	<b>34</b>	<b>100.00</b>	<b>142</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Of the 142 surveyed population, 43 persons (30.3%) have completed their primary school education (see Table 9.26). 35.2% and 17.6% of the surveyed population has gained secondary and high school education respectively. Two people (1.4%) have completed vocational training education, in which, one is in military duty while the other one is doing cultivation as main occupation. Only one people (0.7%) have attended college and is pursuing her study in Da Nang city (Table 9.26). Two people have attended university (1.4%) and all of them have finished their undergraduate studies. Of these two graduate students, one is work for a company based Ho Chi Minh city and one is working abroad for a private company based in Japan. Two people in Huong Choa village have not attended school but they can read and write (1.4%).

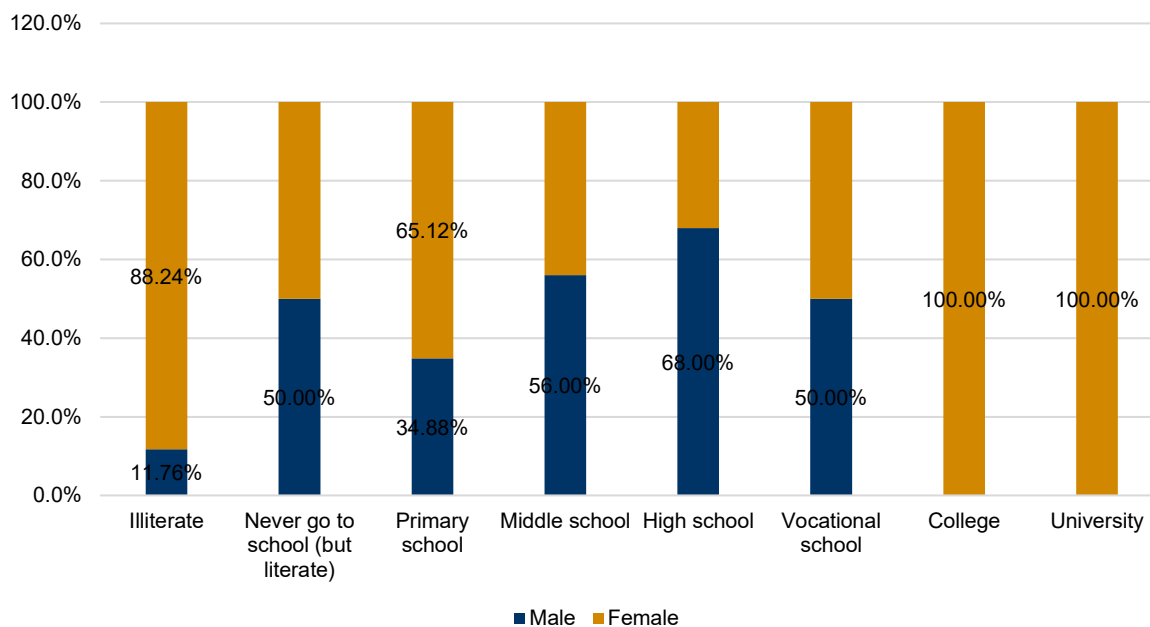
**Table 9.26 Education Level of People over School Age in the Surveyed Households**

Educational Attainment	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Illiterate	2	11.76	15	88.24	17	11.97
Never go to school (but literate)	1	50.00	1	50.00	2	1.41
Primary level	15	34.88	28	65.12	43	30.28
Secondary level	28	56.00	22	44.00	50	35.21
High school level	17	68.00	8	32.00	25	17.61
Vocational training level <sup>49</sup>	1	50.00	1	50.00	2	1.41
College	0	0.00	1	100.00	1	0.70
University level	0	0.00	2	100.00	2	1.41
<b>Total</b>	<b>64</b>	<b>45.07</b>	<b>78</b>	<b>54.93</b>	<b>142</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

<sup>49</sup> 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.

With regard to gender, males outnumber females at secondary and high school education levels. The rates are 28 males versus 22 females for secondary level and 17 males versus eight females for high school level. Three surveyed people at the college and university levels are females. Figure 9.60 shows that the number of male and female completed vocational training is the same. Notably, among 17 illiterate people, more females are illiterate with 88.2% compared to 11.7% (15 females versus two males).



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.60 Education Level of Males and Females over Six Years Old in the Surveyed Households**

### 9.4.3 Employment and Livelihoods

#### 9.4.3.1 Livelihood Engagement

As discussed earlier, 81 people of working age are engaged in work. In addition, four people over 60 years old are identified as having occupations, making a total of 85 people engaged in work. These people are engaged in three main livelihood categories including land-based, wage-based, and enterprise-based activities.

Households in each of the surveyed villages show a similar livelihood structure in terms of land-based, enterprise-based, and wage-based categories. Land-based livelihoods dominate as shown in Table 9.27, with 84.7% of the sample engaged in this type of livelihood, including cultivation and husbandry. A further 12.9% work in wage-based livelihoods such as public employment, working for private companies, or as day labour, and a very small proportion (2.4%) relies on enterprise-based livelihoods, particularly small businesses/services.

**Table 9.27 Primary Livelihoods of the Surveyed Households**

Livelihoods		Huong Choa Village		Phung Lam Village		Cop Village		All Surveyed Villages		Total by Livelihoods	
		N	%	N	%	N	%	N	%	N	%
Land-based livelihoods	Cultivation	41	93.18	18	90.00	12	57.14	71	83.53	<b>72</b>	<b>84.71</b>
	Husbandry	0	0.00	0	0.00	1	4.76	1	1.18		
Enterprise-based livelihoods	Small business/ service	0	0.00	0	0.00	2	9.52	2	2.35	<b>2</b>	<b>2.35</b>
Wage-based livelihoods	Public employment	1	2.27	0	0.00	0	0.00	1	1.18	<b>11</b>	<b>12.94</b>
	Private staff	2	4.55	2	10.00	4	19.05	8	9.41		
	Day labour	0	0.00	0	0.00	2	9.52	2	2.35		
<b>Total</b>		<b>44</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>	<b>21</b>	<b>100.00</b>	<b>85</b>	<b>100.00</b>	<b>85</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Of the 85 working people, 64 people described their work as stable (75.3%) while 21 people see their work as temporary - 24.7% (see Table 9.28). The largest share with temporary occupation status is in Huong Choa village (13 out of 21 people).

**Table 9.28 Work Status of Surveyed Population Engaging in Work**

	Huong Choa Village		Phung Lam Village		Cop Village		All Surveyed Villages	
	N	%	N	%	N	%	N	%
Stable	31	70.45	18	90.00	15	71.43	64	75.29
Temporary	13	29.55	2	10.00	6	28.57	21	24.71
<b>Total</b>	<b>44</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>	<b>21</b>	<b>100.00</b>	<b>85</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Of the 85 working people, the male: female ratio is 49.4% and 50.6% (42 males and 43 females) (see Table 9.29). Gender disaggregated data shows that the number of men and women in cultivation is relatively similar (34 men versus 37 women or 47.9% versus 52.1%). Male and female share the same rate in enterprise-based livelihood, in particular, small business or services (50%). However, males outnumber females in husbandry, public employment, and day labour. Females make up a higher proportion in private companies (62.5% female versus 37.5% male).

**Table 9.29 Livelihoods of the Surveyed Households by Gender**

Livelihoods		Male		Female		Total	
		N	%	N	%	N	%
Land-based livelihood	Cultivation	34	47.89	37	52.11	71	100.00
	Husbandry	1	100.00	0	0.00	1	100.00

Livelihoods		Male		Female		Total		
		N	%	N	%	N	%	
Enterprise-based livelihood	Small business/ service	1	50.00	1	50.00	2	100.00	
	Wage-based livelihood	Public employment	1	100.00	0	0.00	1	100.00
		Private staff	3	37.50	5	62.50	8	100.00
		Day labour	2	100.00	0	0.00	2	100.00
<b>Total</b>		<b>42</b>	<b>49.41</b>	<b>43</b>	<b>50.59</b>	<b>85</b>	<b>100.00</b>	

Source: Socio-economic survey conducted by ERM, 2020

Of the 85 working people (15 years old and over), 51 people have a secondary occupation of which two people carry out cultivation, six people with forestation, seven people with husbandry, three people with small business/services, 33 people as day labourers. Of these, seven people have two secondary occupations for their income generation. Among the seven people, three people do husbandry and day labour and four people do forestation and day labour. Notably, all seven surveyed people with two secondary occupations are living in Huong Choa village.

**Table 9.30 Surveyed Working People with Secondary Occupation**

Number of Surveyed Working People with Secondary Occupation (N=51)		Description of Secondary and Main Occupations	
N	%	Secondary occupation	Main occupation
2	3.92	Cultivation	Public cadre (1), Day labour (1)
6	11.76	Forestation	Cultivation (6)
7	13.73	Husbandry	Cultivation (7)
3	5.88	Small business/ service	Cultivation (3)
33	64.71	Day labour	Cultivation (33)
51	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, nine out of 35 surveyed households rely on single livelihood, equivalent 25.7% including seven households with land-based livelihoods and two households with wage-based livelihoods. Another 25 households have two types of livelihoods (71.4%). Of these 25 households, 22 households (62.9%) combine both land-based and wage-based livelihoods to ensure their income security. In addition, one household has an income from more than two livelihoods (2.8%) (see Table 9.31).

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, disadvantage group, disabled people, and financial support from children).

**Table 9.31 Livelihood Diversification of the Surveyed Households**

Category	Livelihoods	Surveyed Households		Surveyed Households by Livelihood	
		N	%	N	%
Single livelihood	Land-based	7	20.00	9	25.71
	Wage-based	2	5.71		
	Enterprise-based	0	0.00		
	Other sources	0	0.00		
Two livelihoods	Land-based and wage-based	22	62.86	25	71.43
	Wage-based and enterprise-based	0	0.00		
	Enterprise-based and land-based	3	8.57		
Three livelihoods	Land-based, wage-based, enterprise-based	1	2.86	1	2.86
<b>Total</b>		<b>35</b>	<b>100.00</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

#### 9.4.3.2 Land-based Livelihoods

As mentioned above, most surveyed people engage in work (84.7%) through cultivation and husbandry (see Figure 9.61). 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 per capita from agriculture of 850,000 VND per month (KII, male respondent, Van Kieu ethnic group, Cop village, 12th February 2020).



Drying coffee bean in Cop village



Planting turmeric in Phung Lam village



Corn dried naturally in Phung Lam village



Goat husbandry in Phung Lam village



Planting coffee in Phung Lam village



Planting coffee in Huong Choa village

Source: Socio-economic survey conducted by ERM, 2020

## Figure 9.61 Land-based Livelihoods in Surveyed Villages

### 9.4.3.2.1 Cultivation

Rice and coffee planting are common agricultural activities for surveyed households. Rice and coffee planting are also main crops for the 29 households participating in the FGDs in Huong Choa, Phung Lam, and Cop villages, with rice cultivation mainly for domestic use, and coffee, cassava, and other crops for sale.

#### 9.4.3.2.1.1 Cultivation Area

From the survey interviews, the majority of surveyed households have their own land for agriculture. For instance, 100% of surveyed households in Huong Choa village have their own agricultural land with a total area of 186,050 m<sup>2</sup>; 88.9% in Phung Lam village (127,950 m<sup>2</sup>), and 87.5% in Cop village (101,200 m<sup>2</sup>) (see Table 9.32).

**Table 9.32 Agricultural Cultivation Area by Village**

Agricultural Land Area	Huong Choa Village	Phung Lam Village	Cop Village
Number of households with agricultural land	18	8	7
Total agricultural land area of surveyed households (m <sup>2</sup> )	186,050	127,950	101,200
Average agricultural land area per household (m <sup>2</sup> )	10,336	15,993	14,457
Minimum agricultural land area (m <sup>2</sup> )	800	0	0
Maximum agricultural land area (m <sup>2</sup> )	25,000	36,730	40,000

Source: Socio-economic survey conducted by ERM, 2020

Figure 9.62 is a drawing of the agricultural production area by Van Kieu ethnic minority households in Huong Choa village. They were resettled in the village because of the Rao Quan Hydropower Project in 2006 and their households rely on farming. There are 40 ha of agricultural land for 66 households - the State allocates cultivation land for households depending on their financial and human resource, but all land is issued with a LURC (KII, male respondent, Van Kieu ethnic group, 12th February 2020).

Figure 9.63 shows the agricultural production area in Phung Lam village. The drawing was developed by ten Kinh respondents aged 37 to 54 years old including two females and eight males and they all rely on farming. Their cultivation area is quite large, with the smallest at one ha and the largest at over 25 ha. The distance from their house to their cultivation land is around one km but some households have a field right next to their houses. Most of them travel to their land by motorbike.

#### 9.4.3.2.1.2 Coffee Planting

32 out of 35 surveyed households plant coffee for their income generation and 25 out of 29 households participating in the FGDs in Huong Choa, Phung Lam, and Cop villages are engaged in coffee planting. The Catimor coffee variety is mainly planted in Phung Lam village. Catimor trees are small in size, allowing for more dense plantings, and fruit is quick to ripen guaranteeing high productivity if well maintained. Coffee planting does not require water and is fertilized with NPK<sup>50</sup>.

Some households plant coffee trees in their garden area while some households take to travel one km to their coffee fields. In Huong Choa, coffee is harvested every September with an average production of 3.2 tons per year. At harvest time, traders come to the village to buy the products.

During the harvesting season, farmers in Phung Lam village hire labourers from Dakrong district to harvest coffee beans for 2,000 VND per one kg of coffee beans. During the FGDs, households in Phung Lam shared that they do not earn much from coffee farming as the price for one kg of coffee beans is 3,800 VND while they spend 2,000 VND for the hired labourers. If the coffee price is above 5,000 VND/kg then they can get a profit; but if the price is under 5,000 VND/kg, they suffer a loss. The coffee price fluctuates with the coffee price on the world market, with traders, and with the State. Coffee production is around 10-12 tons per hectare (FGD, agriculture and forestry, Phung Lam village, 12th February 2020).

Households in Huong Choa village shared during the interview survey that they usually do not have money to buy fertilizers and that they buy them with loans from local agricultural agents. These agents purchase coffee when the households harvest their beans, but selling coffee is lower than selling to other traders (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

<sup>50</sup> NPK stands for "nitrogen, phosphorus, and potassium," the three nutrients that compose complete fertilizers.

To support their local livelihoods, the EMEE project carry out effective activities to support households planting coffee. In Cop village, there are two coffee planting groups organised by the EMEE project with around 32-38 households per group. As member of these group, they receive technical and seedling support (FGD, vulnerable group, Cop village, 12th February 2020). In recent years, household finances have gone down because of lower coffee prices, and many households have left cultivation to find other jobs or have let others use their land for cultivation (KII, male respondent, Kinh ethnic group, Phung Lam village, 12th February 2020).

#### 9.4.3.2.1.3 *Rice Cultivation*

Rice is planted along the springs in Huong Choa and Cop villages for domestic use (see Figure 9.62 and Figure 9.63). In Huong Choa, most participating households work on one winter-spring terraced rice crop, while three out of eight households in Cop village carry out rice farming. Households in Huong Choa village use rice seedlings provided by the communal agricultural extension center (six quintals of seedlings for each village). Rice production is three to six quintals per 1,000m<sup>2</sup> as reported by households in Cop village through the FGD.

#### 9.4.3.2.1.4 *Other Crops*

In addition, surveyed households plant cassava, turmeric, corn, sweet potato, pepper, jack fruit, and passion fruit. In 2019, the Nafood Company supported local households in Phung Lam in planting passion fruit but only one household registered for planting (another household registered in 2019). Most of local households were concerned that passion fruit would not provide a stable income due to high costs of transport, product quality, and the cultivation process (KII, male respondent, Kinh ethnic group, Phung Lam village, 12th February 2020).





Source: FGD conducted by ERM, 2020

**Figure 9.62 Agriculture Production Area Map of Huong Choa Village**



Source: FGD conducted by ERM, 2020

**Figure 9.63** Agriculture Production Area Map of Phung Lam Village

### 9.4.3.2.2 Animal Husbandry

Of the 72 surveyed people who rely on land-based livelihoods, only one person (1.4%) sees animal husbandry as the main occupation, and it is more often a secondary occupation to increase their household income (seven people). Households raise cows, ducks, calves and goats for domestic use and for income generation. Of the 85 surveyed people engaged in work, eight people carry out husbandry activities, of which seven raise cows and one raises goats. Two out of the eight people raise two kinds of animals.

### 9.4.3.2.3 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. Crop diversification is a significant change and was identified by a Van Kieu ethnic group in Huong Choa village. They explained that previously they used to carry out only rice farming, but now they plant many crops such as cassava, coffee, and rice (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Farmers in Phung Lam village have seen changes in agriculture in recent years, especially lower coffee price (KII, male respondent, Kinh people, Phung Lam village, 12th February 2020). As a result, many households have given up cultivation to find another livelihood or to lease their land for other purposes. The situation requires new opportunities to keep them in cultivation for a living, and the establishment of State-Scientist-Enterprise-Farmer network should support farmers and promote agricultural production in the locality (FGD, agriculture and forestry group, Phung Lam village, 12th February 2020).

Agricultural production in Cop village is supported by fertile land, favourable weather condition, and abundant labour force, but many households face challenges with product selling (KII, male respondent, Van Kieu ethnic group, Cop village, 12th February 2020) (see Table 9.33).

**Table 9.33 Changes in Agricultural Production Activities over the Last Five Years from FGDs**

Village	Positive Changes	Negative Changes
Huong Choa	<ul style="list-style-type: none"> <li>■ Crop diversification (cassava, coffee, and rice)</li> <li>■ Improved income due to increased coffee price.</li> </ul>	<ul style="list-style-type: none"> <li>■ Bad road conditions.</li> <li>■ Low price of some agriculture products, except coffee</li> </ul>
Phung Lam		Reduction in coffee price and low income from coffee production due to high crop investment
Cop	<ul style="list-style-type: none"> <li>■ Fertile land and favourable weather for cultivation.</li> <li>■ Huge labour force in working age.</li> </ul>	Difficulties in selling agricultural products

Source: Socio-economic survey conducted by ERM, 2020

### 9.4.3.3 Wage-based Livelihoods

Eleven (12.9%) of surveyed people engaged in work rely on wage-based livelihood. Of these, eight work for companies or corporations, two work as day labourers, and one works for a governmental organisation.

Of the eight people who work in private companies or corporations, two work in Ho Chi Minh city for around 5 million VND per month, two work in Da Nang city for an average 6.5 million VND per month,

two work in Japan for 20 million VND per month, and two people provided no detailed information about their work places.

One of the two day labourers is working in Dong Ha city and one is working seasonally in the locality. Day labour is the most common secondary occupation, with 33 nominating day labour as their second job (out of 52 people with a secondary occupation). Local job opportunities for day labour remain limited and relate mainly to farming activities such as picking coffee beans. During the coffee harvesting season, farmers hire labourers to harvest coffee with a wage of 2,000 VND per one kg of coffee, and on average, they can earn 300,000 to 400,000 VND per day (FGD, agriculture and forestry group, Phung Lam village, 12th February 2020).

In Huong Choa village, there are around 38 young people in the 18-35 age group, in which around 25 people find employment elsewhere, for instance in Binh Duong, Ho Chi Minh city, and Da Nang city. Finding stable employment is very challenging as most work requires qualification or educational at least to completion of grade 9 (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12th February 2020).

One person work in public security locally for 700,000 VND per month and he sees the job as his main occupation. The income in public security is low and does not cover daily expenditure for his household, and so he engages in cultivation as a secondary occupation for extra income.

#### 9.4.3.4 Enterprise-based Livelihoods

Enterprise-based work is the least common livelihood with only two out of 85 people working in small business in Cop village (2.4%), although there are another three people in small business as their secondary occupation. Local small businesses include retailing, carpenter service, and trading in farm products (see Figure 9.64).



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.64 A Retailer is Selling Petrol in Cop Village**

#### 9.4.4 Income and Expenditure

Household income and expenditure is calculated from data from 35 surveyed households with 155 people. Data from some nine people (three in Huong Choa village and six in Cop village) is not included

as they are currently not living with the household and do not contribute to household expenditure and income.

#### 9.4.4.1 Income

The average monthly household income of the 35 surveyed households is 3,290,571 VND, and the monthly per capita income was 743,032 VND (see Table 9.34). The highest monthly average income per household and per capita are 5,524,167 VND and 1,381,042 VND respectively recorded in Cop village. In contrast, the average monthly income per household and per capita in Huong Choa village are the lowest, 1,862,083 VND and 368,324 VND respectively.

**Table 9.34 Average Monthly Income per Household and per Capita by Surveyed Villages**

	Huong Choa Village (N=18)	Phung Lam Village (N=9)	Cop Village (N=8)	All Surveyed Villages (N=35)
Monthly average income per household (VND)	1,862,083	4,162,130	5,524,167	3,290,571
Monthly average income per capita (VND)	368,324	1,170,599	1,381,042	743,032
Minimum monthly household income (VND)	125,000	1,417,000	925,000	125,000
Maximum monthly household income (VND)	5,675,000	7,167,000	24,250,000	24,250,000

Source: Socio-economic survey conducted by ERM, 2020

Notable, among 18 surveyed households in Huong Choa village, there are two households with very low monthly income of 125,000 VND and 188,000 VND. Their monthly income is much lower than their expenditure and they get loans to afford their daily living. The data collected from the FGD with Van Kieu ethnic minority people in Huong Choa village shows that the average monthly household income of this group remains low, around 490,000 VND.

According to Government Decision 59/2015/QĐ-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 shows that the monthly income per capita of the surveyed communities (743,032 VND) is very close to the rural national poverty level for poor households.

Of 35 households, 28 have monthly per capita incomes below the poverty level. In particular, 22 households having monthly income per capita below 700,000VND and six households having monthly income per capita between 700,000 - 1,000,000n VND. Of these, 20 households are classified as poor or near-poor as they are not eligible for at least three basic social services under the multi-dimensional poverty level<sup>51</sup>. Another eight households have monthly per capita incomes below the poverty level but

<sup>51</sup> 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/QĐ-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 3 indicators measuring deprivation of access to basic social services.

Norms on deprivation of accessing to basic social services:

- (c) Basic social services (5 services): health; education; housing; clean water and sanitation; and information;

they are not classified as near-poor or poor because they can access more than three basic social services.

When disaggregated by livelihood type, Table 9.35 shows that land-based livelihood is the largest contributor to annual household income (35.4%). Its overall contribution is very high in Phung Lam village (65.5%). 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 (32.4%) is the significant contributor to household income, with the corresponding figures for Huong Choa village, Phung Lam village, and Cop village at 63.3%, 23.7%, and 16.3% respectively. The labour force in land-based livelihoods is seven times higher than wage-based livelihoods, but income from this livelihood approximately equals to income from wage-based categories. The FGD with a vulnerable group in Cop village reveals that agriculture-based households do day labour for extra income. They mainly harvest coffee for other agricultural households in the locality with a wage of 150,000 - 300,000 VND per day. Some work as day labourers in the Central Highlands or other provinces.

Enterprise-based income contributes 7.9% to income of surveyed households, with the corresponding figures for Phung Lam and Cop villages at 8.2% and 13.6%. There is no household in Huong Choa village having income from this livelihood.

**Table 9.35 Household Income by Livelihood Types**

Livelihoods	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	Annual Income (VND '000)	%	Annual Income (VND '000)	%	Annual Income (VND '000)	%	Annual Income (VND '000)	%
Land-based	114,550	28.48	294,550	65.53	80,000	15.09	<b>489,100</b>	<b>35.39</b>
Enterprise-based	0	0.00	37,000	8.23	72,000	13.58	<b>109,000</b>	<b>7.89</b>
Wage-based	254,540	63.29	106,500	23.69	86,600	16.33	<b>447,640</b>	<b>32.39</b>
Other	33,120	8.23	11,460	2.55	291,720	55.01	<b>336,300</b>	<b>24.33</b>
<b>Total</b>	<b>402,210</b>	<b>100.00</b>	<b>449,510</b>	<b>100.00</b>	<b>530,320</b>	<b>100.00</b>	<b>1,382,040</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Apart from the three main livelihoods of land-based, wage-based, and enterprise-based livelihood, surveyed households get other income from social allowances, bank interest, and financial support from children which contribute 24.3% of annual income. In detail, one household in Cop village has received financial support from a family member who working abroad in Japan. This type of financial support provides a significant surplus income for surveyed households apart from another livelihoods. Households in Huong Choa have main income from land-based and wage-based livelihoods while households in Phung Lam and Cop village report a range of livelihood types which suggest that diversified strategies are one way of coping with fluctuating income levels in these villages.

- (d) 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.

### 9.4.4.2 Expenditure

Average monthly expenditure per household is 3,923,943 VND which is slightly above average monthly income (3,290,571 VND). Over the past 12 months, many households had unexpected expenditures. Six out of 35 households spent a total of 168,500,000 VND on housing repairs or construction, 19 households paid 147,450,000 VND for serious medical conditions such as serious medical treatment or surgery, and three households had costs of 438,000,000 VND for other purposes such as paying debt or organising weddings for family members. Since these expenditures are unexpected, they are not included in the calculations for average monthly household expenditure. Table 9.36 presents average monthly expenditure per household against average monthly household income.

**Table 9.36 Average Monthly Expenditure of the Surveyed Households**

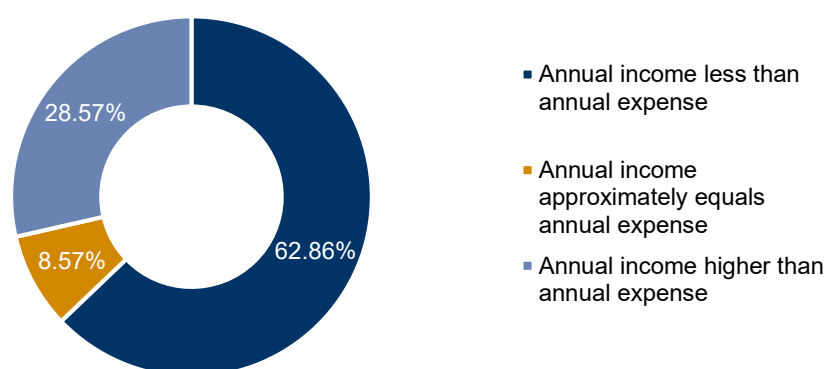
	Surveyed Households (N=35)	
	N	%
Food and daily commodities	1,274,952	32.49%
Clothing, entertainment and community activities	950,833	24.23%
Financial expenditure (debt interest payment)	579,148	14.76%
Daily expenses (Electricity/ Energy/Transportation/Communications)	546,212	13.92%
Education	200,679	5.11%
Health care	195,929	4.99%
Support for household members living away	176,190	4.49%
<b>Total monthly expenditure per household</b>	<b>3,923,943</b>	<b>100%</b>
<b>Total monthly income per household</b>	<b>3,290,571</b>	

Source: Socio-economic survey conducted by ERM, 2020

'Food and daily commodities' and 'Clothing, entertainment and community activities' are the dominant expenditure items accounting for 32.5% and 24.2% of household expenses respectively. In addition, expenditure for financial expenditure (debt interest payment) and daily expenses (electricity/ energy/ transportation/ communications) are also significant (14.8% and 13.9% respectively). Whereas, households also spend their finance for education, health care, and support for other members living away with the corresponding figures of 5.1%, 5% and 4.5%.

### 9.4.4.3 Income and Expenditure Balance

A large number of households (62.9%) have expenditure higher than their annual income (Figure 9.65), and they have to borrow money (with or without interest) from various sources, sell assets, or spend savings to make up for the difference. Many households earn income which exceeds their annual expenditure (28.6%), and three household (8.6%) has 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 Expenditure and Income Balance of Surveyed Households**

Balancing income and expenditure is an evitable concern - 97.1% of households had to get financial support (34 out of 35 surveyed households), as their monthly income over the preceding three years did not cover their household expenditure. Only one household in Phung Lam have not sought other financial support during the last three years (see Table 9.37).

**Table 9.37 Financial Support to Cover Expenditure during Last Three Years**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Yes	18	100.00	8	88.89	8	100.00	34	97.14
No	0	0.00	1	11.11	0	0.00	1	2.86
<b>Total</b>	<b>18</b>	<b>100.00</b>	<b>9</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Table 9.38 shows how households obtained financial support to cover their expenditure over the last three years. Of 34 households seeking financial support, 58.8% borrowed money from relatives, 47.1% got financial support from banks, 5.9% used savings to cover shortcomings, and 5.9% used other financial support such as borrowing money from Elderly's Association or coffee traders.

**Table 9.38 Sources of Financial Support**

	Huong Choa Village (N=18)		Phung Lam Village (N=8)		Cop Village (N=8)		All Surveyed Villages (N=34)	
	N	%	N	%	N	%	N	%
Relatives	8	44.44	5	62.50	7	87.50	20	58.82
Banks	9	50.00	4	50.00	3	37.50	16	47.06
Savings	1	5.56	0	0.00	1	12.50	2	5.88
Others	2	11.11	0	0.00	0	0.00	2	5.88

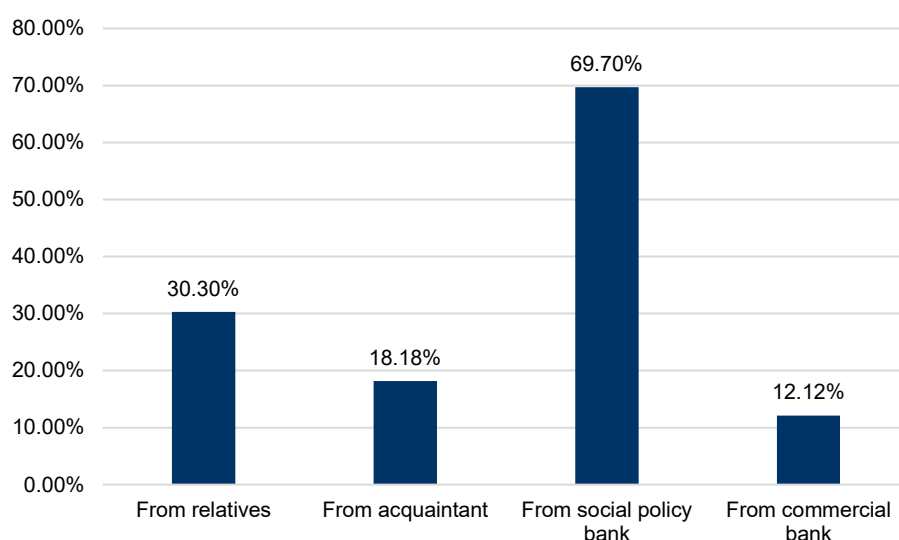
Source: Socio-economic survey conducted by ERM, 2020



### 9.4.4.4 Debts

Approximately 94.3% of surveyed households (33 out of 35 surveyed households) are in debt while 5.7% are not. The households with debts including 18 households in Huong Choa village, eight households in Phung Lam village, and seven households in Cop village have provided detailed information about their debts, except two households who do not remember the exactly amount of their debts. 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.

Of the 33 households with debts, the highest number of households (69.7%) had loans from social policy banks with preferential interest rates, or through various loan programs such as poor household loans. Some households (12.1%) had loans from the commercial banks such as Vietnam Bank for Agriculture and Rural Development (Agribank) (see Figure 9.66). There is also a number of households receiving loans from relatives and acquaintant (30.3% and 18.2% respectively). 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**

## 9.4.5 Health Issues

### 9.4.5.1 Place of Birth

Some 35 households responded about the year of birth of their youngest household member. There were six households with their youngest member born before 2000, six households with their youngest born in the 2000s, and 23 born from 2010 to 2019, with corresponding shares of 17.1%, 17.1% and 65.7% (see Table 9.39).

It is noted that before the year of 2000, of the six surveyed households, there were three youngest members born at the communal health station (50%), two at home (33.3%), and one at the district/town health center (16.7%). During the 2000s, 50% of households again had their youngest members born at the communal health station, but 50% were also born at home. In 2010-2019, the majority of surveyed households select health establishments at the district and commune levels as the place of birth of their youngest members (47.8% and 34.8% respectively).

No baby was born at home in Phung Lam and Cop villages during 2010-2019, but there were two Van Kieu households in Huong Choa village with their youngest members born at home in 2013 and 2018. It might be that difficulties in commuting in Huong Choa prevented village women from accessing the

communal health station as the distance to the local health station is very far and the road is unpaved, steep, rugged, and quite dangerous to travel. Previously, local villagers in Huong Choa used a hand-made stretcher to carry women in pregnant to the local health station for an emergent delivery. But now with better information about maternal health, local pregnant women have a regular check-up at the communal health station and they are hospitalised a couple of days before their confinement (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

**Table 9.39 Timeframe of when the Youngest Members were Born in the Surveyed Villages**

Health Establishment	Before 2000		2000-2009		2010-2019		Total	
	N	%	N	%	N	%	N	%
Communal health station	3	50.00	3	50.00	8	34.78	14	40.00
District/town health centre	1	16.67	0	0.00	11	47.83	12	34.29
Provincial/city hospital	0	0.00	0	0.00	2	8.70	2	5.71
At home	2	33.33	3	50.00	2	8.70	7	20.00
<b>Total</b>	<b>6</b>	<b>17.14</b>	<b>6</b>	<b>17.14</b>	<b>23</b>	<b>65.71</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

#### 9.4.5.2 Common Diseases

Over the last 12 months, many common diseases were reported by the 164 surveyed respondents including gastritis (11 people or 6.7%), hypertension (seven people or 4.3%), and anaemia (four people or 2.4%) (see Table 9.40). Some surveyed people suffer from helminthiasis, hepatitis B, rickets, heart disease, cancer, pneumonia, malaria, dengue fever, lack of micro elements, labour accident in construction, and psychological diseases. Apart from the diseases listed, other health issues such as spondylosis, arthritis, backache, brain shrinkage, oesophagus virus, migraine, deaf, myositis, degenerative spine, and sore throat are recorded among the surveyed people during the survey.

**Table 9.40 Common Diseases in Surveyed Households over the 12 Months**

	Huong Choa Village (N=94)		Phung Lam Village (N=32)		Cop Village (N=38)		All Surveyed Villages (N=164)	
	N	%	N	%	N	%	N	%
Gatritis	9	9.57	1	3.13	1	2.63	11	6.71
Hypertension	0	0.00	4	12.50	3	7.89	7	4.27
Anaemia	3	3.19	0	0.00	1	2.63	4	2.44
Helminthiasis	3	3.19	0	0.00	0	0.00	3	1.83
Hepatitis B	1	1.06	0	0.00	2	5.26	3	1.83
Rickets	2	2.13	0	0.00	0	0.00	2	1.22
Heart diseases	0	0.00	2	6.25	0	0.00	2	1.22

	Huong Choa Village (N=94)		Phung Lam Village (N=32)		Cop Village (N=38)		All Surveyed Villages (N=164)	
	N	%	N	%	N	%	N	%
Cancer	0	0.00	2	6.25	0	0.00	2	1.22
Pneumonia	1	1.06	0	0.00	1	2.63	2	1.22
Malaria	1	1.06	0	0.00	0	0.00	1	0.61
Dengue fever	1	1.06	0	0.00	0	0.00	1	0.61
Lack of micro elements	1	1.06	0	0.00	0	0.00	1	0.61
Labour accident in construction	1	1.06	0	0.00	0	0.00	1	0.61
Psychological diseases	0	0.00	1	3.13	0	0.00	1	0.61

Source: Socio-economic survey conducted by ERM, 2020

Of the 35 surveyed households, 12 households (34.3%) did not have any health issues over the past 12 months (see Table 9.41). Nine households (25.7%) had at least one health issues, five households (14.3%) had two health issues, eight households (22.9%) had three health issues, and one households (2.9%) had more than three health issues over the last 12 months.

**Table 9.41 Health Issues by Surveyed Households over the Last 12 Months**

	N	%
Households without any health issues	12	34.29
Households with one health issue	9	25.71
Households with two health issues	5	14.29
Households with three health issues	8	22.86
Households with more than three health issues	1	2.86
<b>Total</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Among the 164 surveyed population, 19 people are addicted to tobacco (11.6%) and 10 people abuse alcohol<sup>52</sup> (6.1%) (see Table 9.42). The highest number of cigarettes smoked per day is 20 and one Van

<sup>52</sup> 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.

Kieu woman is addicted to tobacco. No case of drug addiction is recorded among the surveyed households.

**Table 9.42 Number of Household with Members having Alcohol and Tobacco Use Habits**

	Huong Choa Village (N=94)		Phung Lam Village (N=32)		Cop Village (N=38)		All Surveyed Villages (N=164)	
	N	%	N	%	N	%	N	%
Alcohol abuse	5	5.32	2	6.25	3	7.89	10	6.10
Tobacco addiction	9	9.57	5	15.63	5	13.16	19	11.59

Source: Socio-economic survey conducted by ERM, 2020

### 9.4.6 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, internet service, 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.

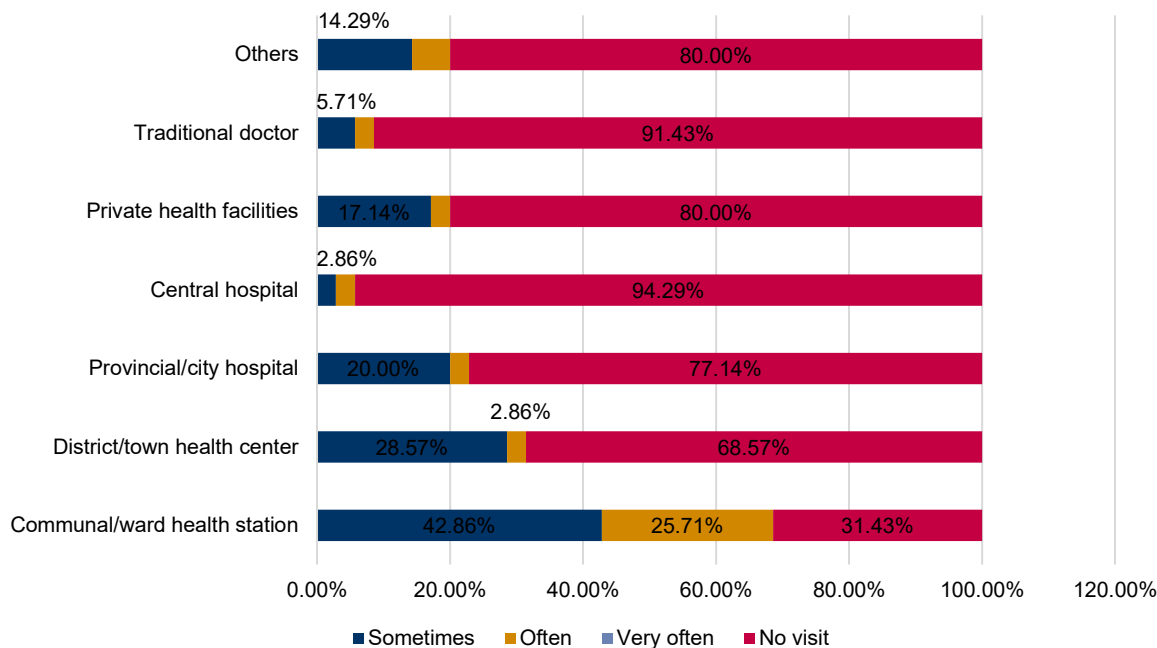
#### 9.4.6.1 Commune Health Station

Huong Hoa district has 22 medical service units in communes, wards, offices and enterprises. In Huong Phung commune, the communal health station and Military 337 health station (*Bệnh xá quân y 337*) only provide first aid and basic treatments such as vaccinations, vitamins, maternal healthcare, and medical treatment for common diseases (i.e. colds, headaches, and common flu). However, households tend to prefer the hospitals at provincial and district level or private healthcare facilities when they get sick or have a serious health issue.

All surveyed households visited health establishments over the last 12 months. Survey results shows that local households tend to visit the communal health station rather than the other health care establishments in the district. To be specific, the communal health station is visited the most (68.6%) with 42.9% of households visiting it sometimes and 25.7% visiting often (see Figure 9.67). Other healthcare establishments such as the district/town health care center, provincial/city hospital, and private health facilities have a lower visiting frequency - 31.4%, 22.9%, and 20% respectively. Seven (20%) out of 35 surveyed households have their health treatment or check up at Military 337 health station. Very few households visited the central hospital and traditional doctors over the last 12 months, with 5.7% and 8.6% respectively.

In Phung Lam village, local people can visit either the commune health station (about 25 minutes from the village by motorbike) or the health station at Military Division 337. For emergency cases, local people use a small tractor owned by a local villager or hand-made stretchers to take patients to the local health station, or to the main road where cars can reach them (KII, male respondent, Kinh ethnic group, Phung Lam village, 12th February 2020).

In Cop village, Van Kieu people are treated for health issues in traditional ways by worship, or by visiting the communal health station (KII, male respondent, Van Kieu ethnic group, Cop village, 12th February 2020).



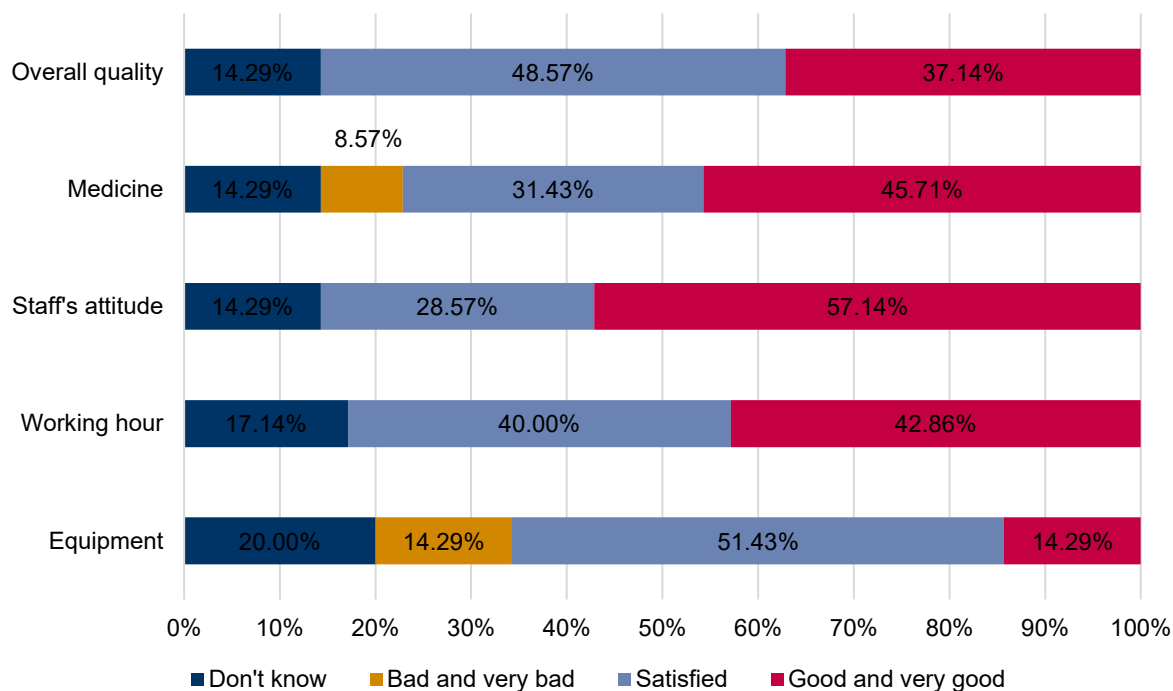
Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.67 Frequency of Health Facilities Use over 12 Months**

Overall, surveyed respondents are satisfied with the quality of the local health station. Staff attitudes have the highest satisfaction levels (over 85%), but some households are not satisfied with the medical equipment (14.3%) or medicine (8.6%) (see Figure 9.68). Some households in Phung Lam and Cop villages prefer to go to the health station of Military Division 337 rather than the communal health station, even if they have to pay additional costs. This is probably because the local health check-up and treatment facilities are limited and the local health services do not meet their needs. They want better medical equipment, medicine, and more rooms for patients at the communal health station. In addition, qualified doctors for better health treatment are also mentioned by local people. Some surveyed respondents cannot give an evaluation of the communal health station because they have not often used the facilities.

The local health station does not meet local needs due to its low capacity for a large number of patients (HP01, male respondent, 32 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

The communal health station needs high-quality medicines, health facilities such as ultrasound and X-ray machine, and professional doctors (HP12, male respondent, 40 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.68 Level of Satisfaction of Surveyed Households with the Local Health Station**

### 9.4.6.2 Local Schools

Huong Phung commune has one kindergarten, one primary school, and one lower secondary school. There are kindergarten branches in all surveyed villages and two campuses of Huong Phung primary schools in Huong Choa and Cop villages. For secondary education, pupils in all three villages study at a lower secondary school in the commune which is about seven km away from Phung Lam and Cop villages and very far from Huong Choa village.

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). However, some surveyed households are dissatisfied with the rooms (17.1%), facilities (14.3%), teacher quality (8.6%), and school surrounding (8.6%). Suggestions were made for a safer environment such as rebuilding the school walls, upgrading the school yard, and cleaner classrooms. People also wanted more school equipment and furniture, better quality of daily meals, new teachers, and more leisure facilities in the school yards. Because of their difficult living conditions, households wanted local authorities to develop education support programs for their children.

The school should be equipped with fence, toilet, more classes, learning and teaching facilities (HP01, male respondent, 32 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Teachers should be more patient when working with pupils and more devoted in teaching (HP02, male respondent, 26 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

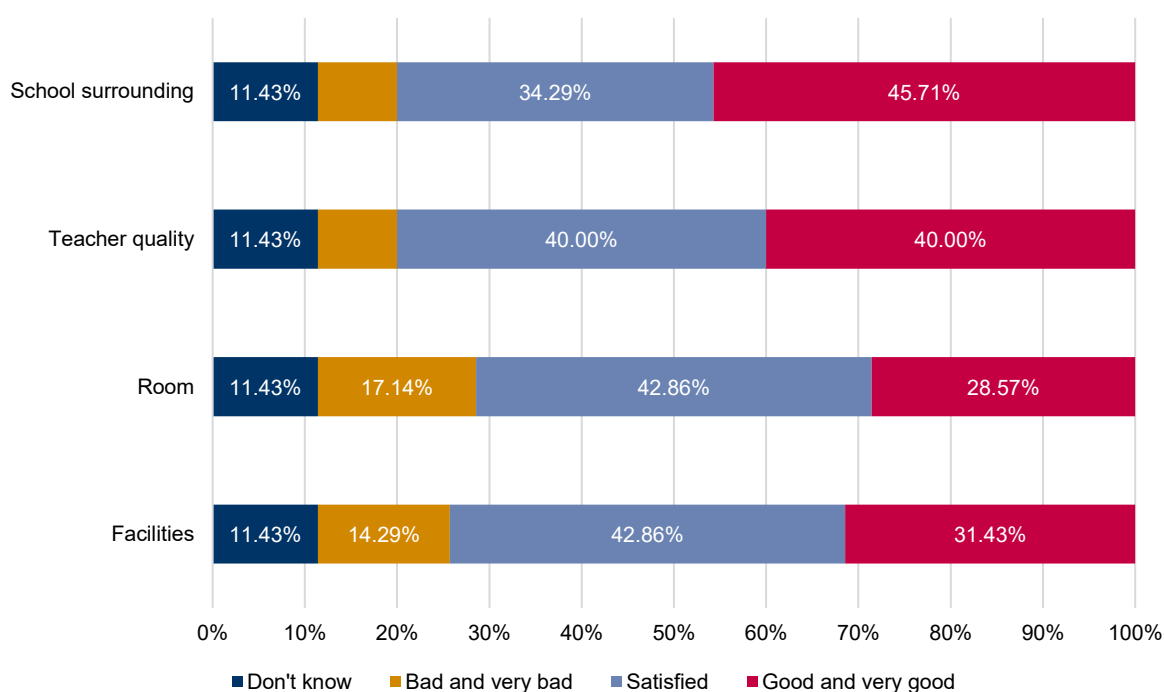
Huong Choa primary school and kindergarten need to be upgraded with schoolyards (HP05, male respondent, 27 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Schools should be upgraded with teaching and learning facilities, a concreted schoolyard, and water supply. The school toilet is in use without water (HP07, male respondent, 30 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

There is one kindergarten and one primary school in Huong Choa village funded by local authorities, World Vision, and Gyeong Nam Branch Office (Korea). 100% of children under school age attend schools. The primary school is a village meeting place as there is no community house. Huong Choa primary school has a shortage of teachers with only three teachers in charge of teaching for all the primary classes from grade 1 to grade 5 (HP12, male respondent, 40 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020). The teachers are Kinh people and they come to the village school every day. At lower secondary education level, pupils go to study at a boarding school in the commune and only come home once a week. Boarding school tuition is free for all village pupils as Huong Choa is categorised as an extremely difficult village (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

In Phung Lam village, 100% of school-age children attend schools despite of difficulties of commuting. It takes parents around 25 minutes to take their children to school at the commune and another 25 minutes to pick their children up after school every day. The road to schools is extremely difficult, especially in rainy season when pupils have to wear boots and bring clothes to change into when coming to schools as the road is so rough, dirty, and muddy. Due to the challenges of schooling in Phung Lam village, many households in Phung Lam keep their children at their home village for schooling (KII, male respondent, Kinh ethnic group, Phung Lam village, 12th February 2020).

Cop village has a primary school and a kindergarten. According to the local people, the kindergarten does not have a toilet so it is very hard for young children to study there. The kindergarten is also in need of a playground (FGD, vulnerable group, Cop village, 12th February 2020).

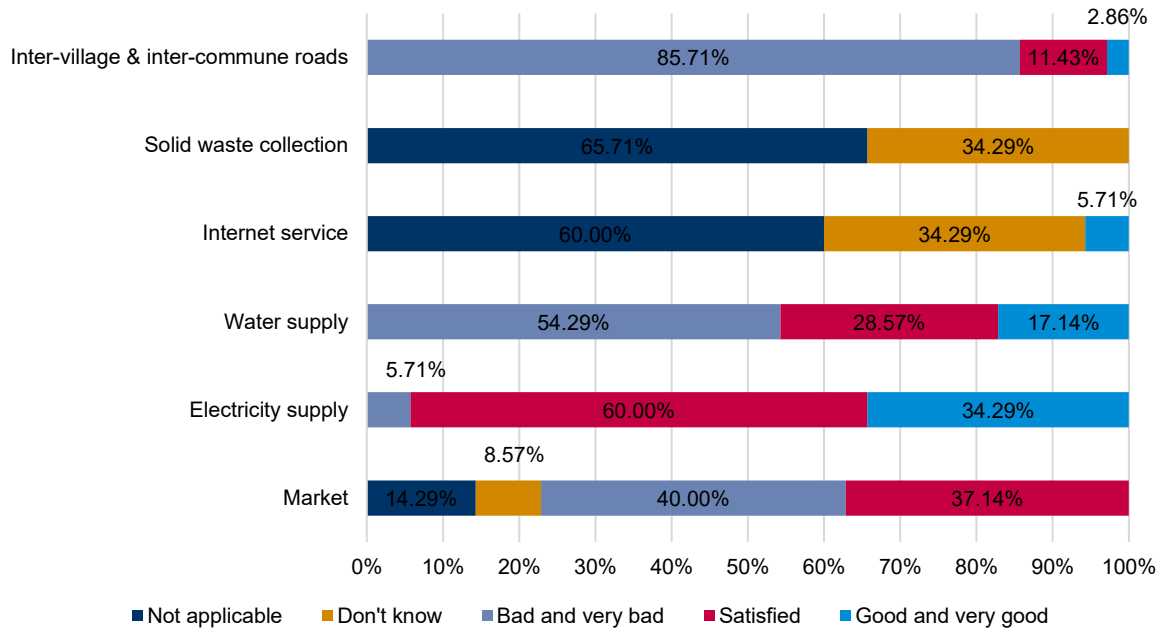


Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.69 Level of Satisfaction of Surveyed Households with the Local Schools**

### 9.4.6.3 Infrastructure and Public Services

Surveyed respondents show satisfaction with local infrastructure and public services in terms of electricity supply and market (Figure 9.70). However, inter-village and inter-commune roads, solid waste collection, internet service, and water supply were not evaluated highly by surveyed respondents.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.70 Evaluation of Satisfaction of Surveyed Households with Local Infrastructure and Public Facilities/Services**



### 9.4.6.3.1 Market

No official market is available in three surveyed villages of Huong Phung commune, but there is one market in the Huong Phung commune center. Trading in goods from motorbikes is popular in the surveyed villages (see Figure 9.71), and local people in Cop and Phung Lam buy food from mobile sellers who come daily to the village. They also buy daily necessities from local groceries (see Figure 9.72). They visit the commune market seven kilometres away for higher level goods (KII, male respondent, Kinh ethnic group, Phung Lam village, 12th February 2020 and KII, male respondent, Van Kieu ethnic group, Cop village, 12th February 2020). Huong Phung market is quite dirty and small and goods are expensive (HP32, female respondent, 24 years old, Van Kieu ethnic group, Cop village, 12th February 2020). In Huong Choa, Kinh traders carry goods, daily necessities, and food to the village every day and local people only go to the market in Khe Sanh township once a year when coffee is harvested (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Twenty-seven respondents evaluated the market with 13 people expressing satisfaction with it. During field interviews, some households express their need for a market for daily goods.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.71** Trading in Goods on Motorbike in Cop village



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.72 A Grocery in Cop Village**

#### 9.4.6.3.2 Electricity Supply

100% of surveyed households are connected to the National Electricity Grid, including all households in the three surveyed villages (KII, male respondents, Huong Choa, Phung Lam, and Cop villages, 11th - 12th February 2020). 94.3% of respondents were satisfied with the power supply although some are not satisfied with power losses and lack of street lighting (5.7%).

Electricity supply should be maintained as power failure occurs one or two days per month (HP08, male respondent, 34 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

#### 9.4.6.3.3 Local Roads

85.7% of surveyed respondents in the surveyed areas are not satisfied with the condition of local roads and they expect an improvement in the future. But five out of 35 households are satisfied or highly satisfied with the inter-village and inter-commune roads - mainly from Cop village where houses are located on the main commune road.

The biggest problem for Huong Choa villagers is the route to the village from the main road. From the main commune road (Ho Chi Minh road), it takes around 15 minutes to go to Phung Lam village and more than 30 minutes to go the extra six km to Huong Choa village. The road has a 1.1 km section which was concreted in 2019 but the remainder is extremely difficult for travel. All 18 surveyed households in Huong Choa evaluate the village road as really bad. They say that the current road condition makes difficulties for local people for transporting agriculture products, accessing public services, higher vehicle maintenance costs, travel time expenses, and limiting education opportunities for their children.

Van Kieu people during the FGD further explained that they are always at a disadvantage when negotiating agricultural prices with traders due to transport difficulties (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020). If a villager faces an emergency, the villagers carry him/her to the local health station and it takes around one hour to get there. They have to carry the patient on a stretcher for this long trip (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Similarly, local people in Phung Lam had several complains about the road to the village. It is difficult for travel and transport, especially in bad weather (see Figure 9.73). To describe all difficulties when traveling on this road, a male respondent composed the following poem:

It's a short road to Phung Lam village,  
But local complaints are so long.  
Only serviceable in the dry season,  
With no reason, a path of mud it becomes in the rain.  
He who wants to visit his friend in Phung Lam,  
When thinking of the road, quickly postpones his plan.  
Wishing the dream of a new road to comes true;  
So he can see his friends in Phung Lam in one move.  
Oh my Lord, that's what we all cry,  
But no reply 'cause his throne is so high.  
Looking back on our road to Phung Lam,  
Nothing is left but mud and long complaints.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.73 Road from Phung Lam to the Commune**

#### 9.4.6.3.4 Water Supply

In all three surveyed villages, local people use water from wells. In Cop village, 40% of the households in the village use water from their neighbours (KII, male respondent, Van Kieu ethnic group, Cop village,

12th February 2020), while in Huong Choa village, World Vision in Vietnam (WVV) supports the construction of wells down to 5m for local use. All seven households share the same well. In the dry season, people use water from springs due to the shortage of water (see Figure 9.74) (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Some households are dissatisfied with their current water source, and a majority (54.3%) are dissatisfied with their supply. They say that water sourced from the spring is increasingly polluted by fertilizers and pesticides from coffee farms (HP18, male respondent, 54 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020), and that the wells funded by WVV are no longer operating after two years (HP18, male respondent, 54 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020). One respondent insists that wells are essential in the locality (HP14, male respondent, 28 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.74** A Stream in Huong Choa Village

#### 9.4.6.3.5 Internet Service

Most of surveyed households do not use internet services and they cannot give an evaluation of the service. The two surveyed households with an internet service are satisfied with its quality and some surveyed households rank it as 'good and very good' (5.7%) (see Figure 9.70).

#### 9.4.6.3.6 Solid Waste Collection

As shown in Figure 9.70, 65.7% of respondents cannot give an evaluation of the solid waste collection as there is no official waste management system in the surveyed villages. Households mainly dump or throw garbage into surrounding areas or burn their domestic waste. The local community burn their waste in different ways. Mostly households dig holes for domestic waste or take it to their fields to burn.

## 9.4.7 Land, Housing and Household Assets

### 9.4.7.1 Land

#### 9.4.7.1.1 Residential Land (Including Garden Area)

Table 9.43 shows that 30 households own residential and garden land, accounting for 85.7%; but five households do not own any residential land and most of these households have their house built on agricultural land. The average residential and garden land area per household is 1,032 m<sup>2</sup>. Of the 30 households with residential and garden land, only eight households (26.7%) have land use right certificates (LURC), with figures of 25% for Phung Lam village and 87.5% for Cop village. All 18 households (100%) in Huong Choa village, three (75%) in Phung Lam village, and one (12.5%) in Cop village do not have a LURC for their residential land.

**Table 9.43 Residential and Garden Land by Surveyed Households**

	Residential and (including Garden Area)		Total Area (m <sup>2</sup> )	Average Area per Household (m <sup>2</sup> )	Total Residential and Garden Land Plots	LURC among Surveyed Households with Residential Land (including Garden Area)	
	N	%				N	%
Huong Choa village (N=18)	18	100.00	26,320	1,462	18	0	0.00
Phung Lam village (N=9)	4	44.44	1,500	375.00	4	1	25.00
Cop village (N=8)	8	100.00	3,136	392.00	8	7	87.50
All surveyed villages (N=35)	30	85.71	30,956	1,032	30	8	26.67

Source: Socio-economic survey conducted by ERM, 2020

#### 9.4.7.1.2 Agricultural Land

Thirty-three out of 35 surveyed households own agricultural land with a total of 66 land plots and a total area of 415,200 m<sup>2</sup> (Table 9.44). Of the 33 households with agricultural land, 25 households have two agricultural land plots and four households have three agricultural land plots (including two in Huong Choa village and two in Cop village). These land plots are around 0.05-3 km away from their residence. These households with agricultural land plots currently carry out cultivation activities. The average area of agricultural land per household is 12,582 m<sup>2</sup>. The households mainly plant rice, coffee, turmeric, sweet potato, pepper, and fruit trees.

Of the 33 households with agricultural land, only eight households have LURCs, accounting for 24.2%, in which the corresponding figures are 37.5% and 71.4% in Phung Lam village and Cop village. Notably, 100% households in Huong Choa with agriculture land do not have LURCs for their land plots.

**Table 9.44 Agricultural Land by Surveyed Households**

	Agricultural Land		Total Area (m <sup>2</sup> )	Average Area per Household (m <sup>2</sup> )	Total Agricultural Land Plots	LURC among Households with Agricultural Land Plots	
	N	%				N	%
Huong Choa village (N=18)	18	100.00	186,050	10,336	37	0	0.00
Phung Lam village (N=9)	8	88.89	127,950	15,993	16	3	37.50
Cop village (N=8)	7	87.50	101,200	14,457	13	5	71.43
All surveyed villages (N=35)	33	94.29	415,200	12,582	66	8	24.24

Source: Socio-economic survey conducted by ERM, 2020

### 9.4.7.1.3 Forest Farming Land

Seven out of 35 surveyed households (20%) own forest farming land with the total area of 78,000 m<sup>2</sup> and all the seven land plots are in Huong Choa village. These land plots are about 1-10 km away from their residence. The average area per household is 11,143 m<sup>2</sup>. No forest farming land plots are granted with LURCs. Six out of seven forest farming land plots directly carry out cultivation activities on land and the remaining household has their land cultivated by relatives.

In addition, ten out of 35 surveyed households have 13 other land plots with the total area of 75,150m<sup>2</sup>, including five households in Huong Choa village, two in Phung Lam village, and three in Cop village. Among two households in Phung Lam village, one household has other lands rented and without LURC. The average area per household is 8,350m<sup>2</sup>. All the ten households cannot identify the type of their land as they reclaimed their land plots previously and all the land plots are not granted with LURCs. Eight out of the 13 land plots are currently in use, four are abandoned, and the remaining land plot is not identified in terms of land status.

### 9.4.7.2 Housing

100% surveyed households own their current house privately. Twenty-nine households have houses built on residential land, while five household have houses on agriculture land and one house is built in a land area without identified origin. On average, households in the surveyed villages have been living in their house for nearly 11 years.

As shown in Table 9.45, the majority of surveyed households own at least one house (97.1% or 34 households) and only one Van Kieu household in Huong Choa has two houses (2.9%). No household is recorded as having more than two houses in the surveyed villages.

**Table 9.45 Number of Houses Owned by the Surveyed Households**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
One house	17	94.44	9	100.00	8	100.00	34	97.14
Two houses	1	5.56	0	0.00	0	0.00	1	2.86
Total	18	100.00	9	100.00	8	100.00	35	100.00

Source: Socio-economic survey conducted by ERM, 2020

The survey suggests that most houses are semi-permanent (see Table 9.46). The typical house design in the surveyed area is a semi-permanent house<sup>53</sup> (mainly in the form of a stilt house), and this design was noted 26 times. Five surveyed households (14.3%) live in permanent one-storey houses and four non-permanent houses including three houses in Huong Choa village and one in Cop village are recorded during the survey, accounting for 11.4% (see Table 9.46).

**Table 9.46 Number of Different Types of Houses Owned by the Surveyed Households**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Non-permanent house	3	16.67	0	0.00	1	12.50	4	11.43
Semi-permanent house	15	83.33	7	77.78	4	50.00	26	74.29
Permanent house with one storey	0	0.00	2	22.22	3	37.50	5	14.29
Total	18	100.00	9	100.00	8	100.00	35	100.00

Source: Socio-economic survey conducted by ERM, 2020

During field observation, it is noted that households in Huong Choa village live in semi-permanent stilt houses that are clusteredly arranged around the center of the village and very close to the village kindergarten and primary school, which are often used for village meeting or community activities. In addition, the population in the village is rather small and everyone knows each other well so the spirit of solidarity and support is always maintained.



Permanent house with one storey in Cop village



Semi-permanent house in Phung Lam village

<sup>53</sup> 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.



Semi-permanent house in Huong Choa village



Non-permanent house in Huong Choa village

Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.75 House Types in the Surveyed Villages**

### 9.4.7.3 Toilets

The survey indicates that 22 out of 35 households (62.8%) do not have a toilet, and there is outside defecation in fields or in the forest. The remaining eight households (22.9%) have toilets with a septic tank, one households (2.9%) use a toilet with no septic tank, and four households use latrines (11.4%) (see Table 9.47). Field observation indicates that the construction style and sanitation conditions of toilets is not hygienic.

**Table 9.47 Toilet Conditions by Surveyed Households**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Toilet with septic tank	0	0.00	4	44.44	4	50.00	8	22.86
Toilet with no septic tank	0	0.00	1	11.11	0	0.00	1	2.86
Latrine	0	0.00	3	33.33	1	12.50	4	11.43
No toilet	18	100.00	1	11.11	3	37.50	22	62.86
Total	18	100.00	9	100.00	8	100.00	35	100.00

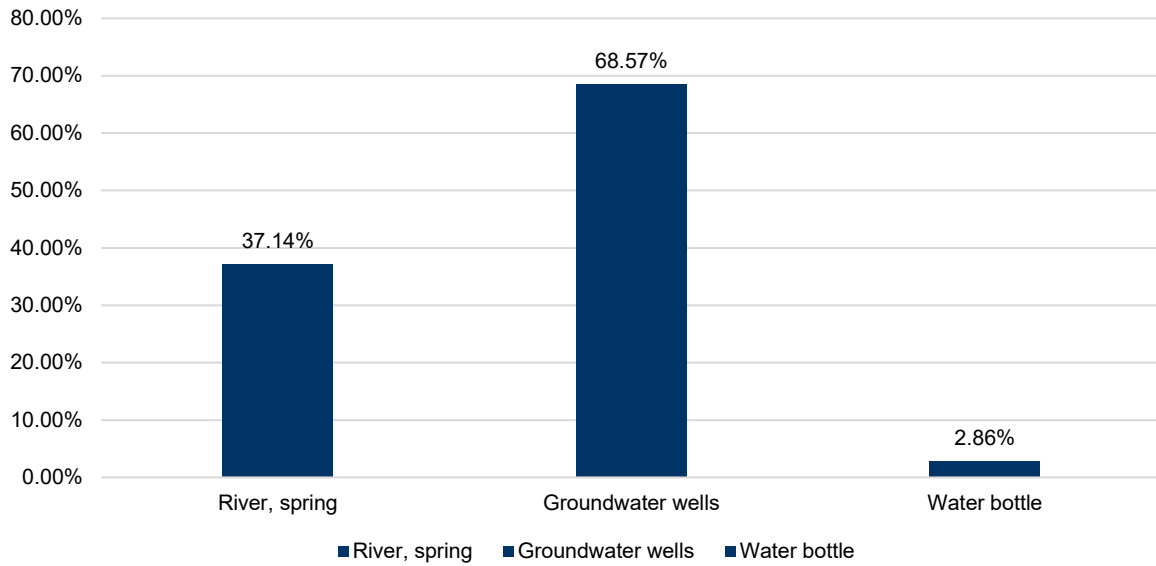
Source: Socio-economic survey conducted by ERM, 2020

### 9.4.7.4 Sources of Drinking Water

The survey data shows that most households (24 households or 68.6%) use groundwater wells for their drinking water. As shown in Figure 9.76, of 35 surveyed households, 13 households (37.1%) use drinking water from rivers and springs. One household in Phung Lam village use water bottles (2.9%) due to water pollution in springs and the household buys a 20 litre water bottle with the price of 15,000 VND per bottle that is only enough for two days.

In 2014, WVV supported the village to build two drilled wells and water filtration tanks, with a pipe line system for each house but it is no longer in use after two operation years, and people had to switch to use hand-dug wells for drinking. Water for domestic use is taken from two streams flowing around the village. Women are normally responsible for taking water from streams.





Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.76 Sources of Drinking Water of the Surveyed Households**

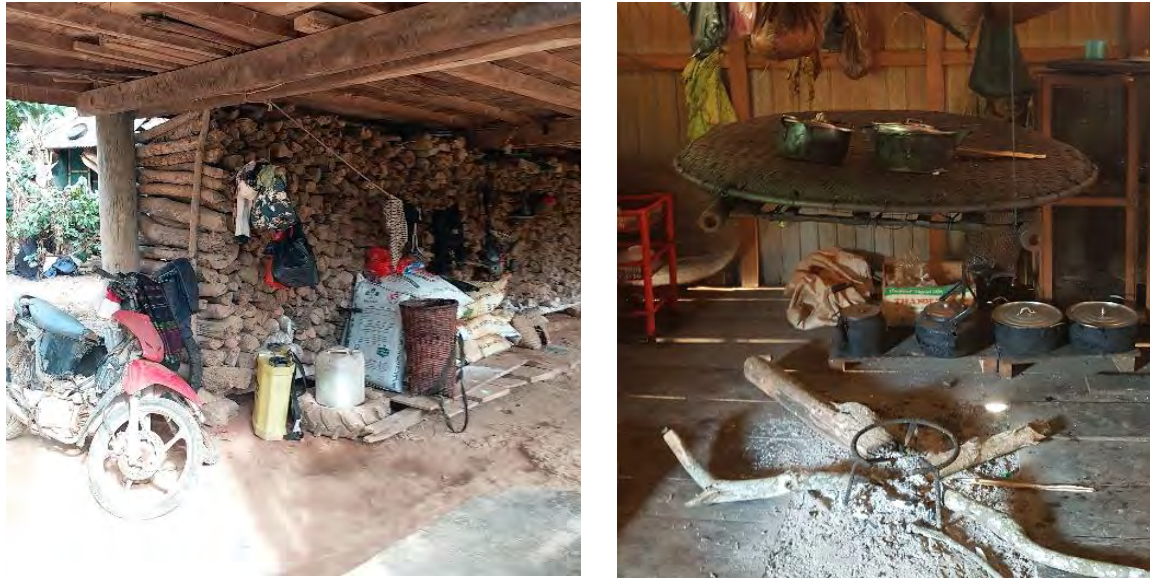


Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.77 Groundwater Wells in Phung Lam Village**

### 9.4.7.5 Sources of Cooking Energy

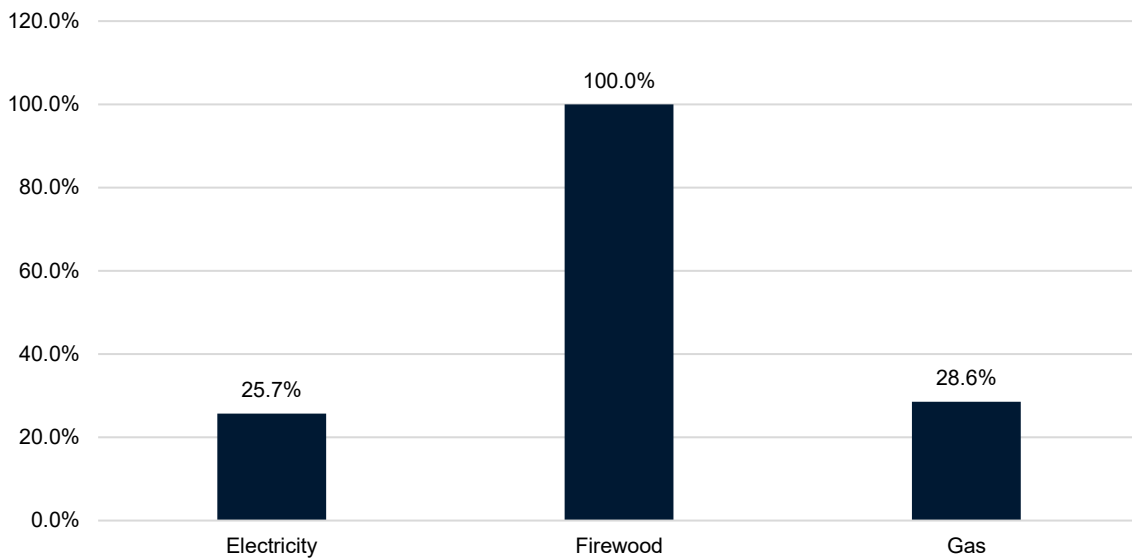
Firewood (100%) is the most popular cooking fuel among the surveyed households (Figure 9.78). The households in Huong Phung commune collect trees or wood from forests or their land and use it for domestic use.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.78 Firewood as a Main Cooking Fuel among the Surveyed Households**

Many households also use gas for cooking (28.6%). Nine households (25.7%) use electricity for appliances such as rice cookers and kettles. No household uses solar power, charcoal, or biogas for cooking.



Source: Socio-economic survey conducted by ERM, 2020

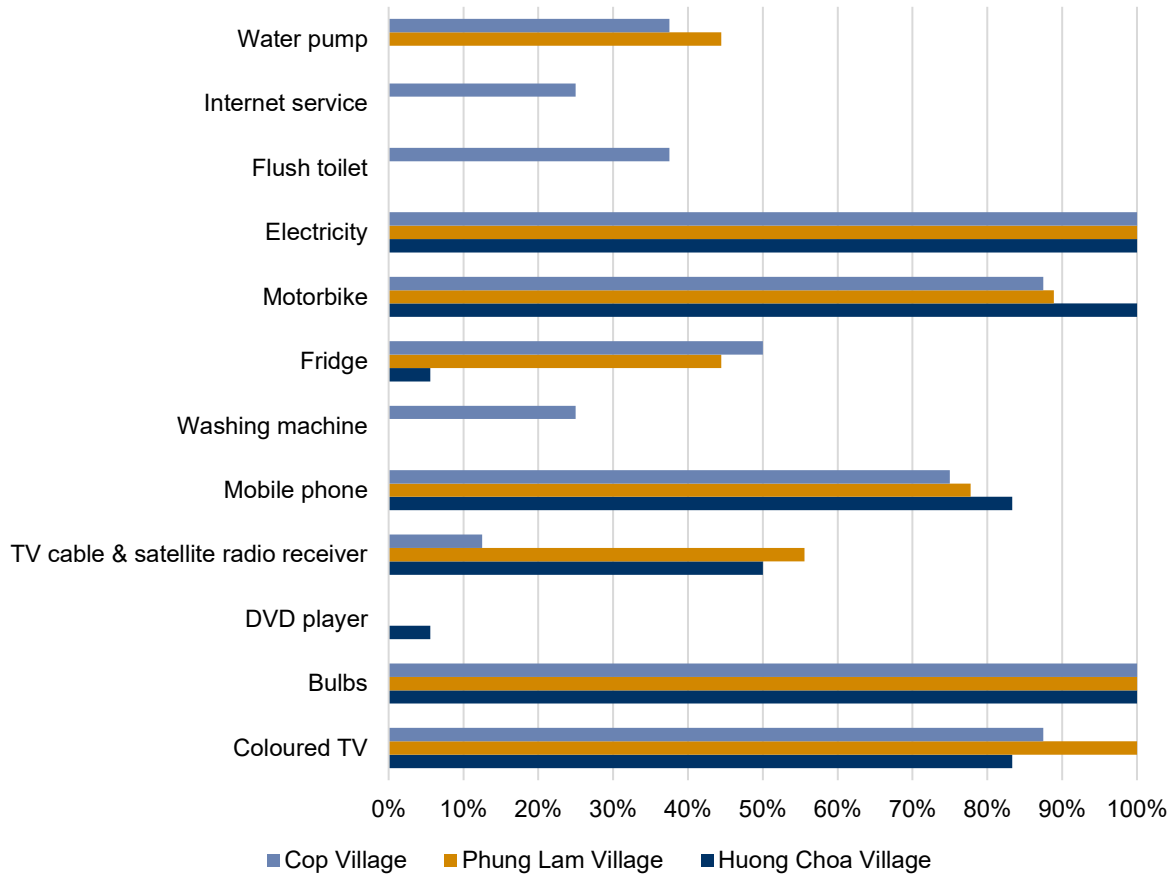
**Figure 9.79 Sources of Cooking Energy by Surveyed Households**

### 9.4.7.6 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 9.80). Apart from basic home equipment, a small number of households have a DVD player (one household or 2.9%), a TV cable and satellite radio receiver (15 households or 42.9%), a washing machine (two households or 5.7%), a fridge (nine households or 25.7%), and a water pump (seven households or 20%).

All surveyed households are currently connected to the national electricity grid. Three out of 35 households have flush toilets (8.6%), and two households (5.7%) access internet services.

Other facilities recorded included rice cooker, electric fan, lawn mower, and agri-motor (see Figure 9.81). There is no households owning an air conditioner, sewing machine, car, or solar energy equipment. No household accesses centralised piped water system as the service is not available in the surveyed villages.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.80 Household Asset Items of the Surveyed Households**



Source: Socio-economic survey conducted by ERM, 2020

### Figure 9.81 Household Facilities in Surveyed Villages

The Van Kieu respondents through FGD in Huong Choa village identify 'access to electricity' as a positive change in their living since resettlement as they previously used oil lamp in their old village. In addition, with the State support, Van Kieu households access preferential loans program for purchasing vehicles serving for commuting and production activities (FGD, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

## 9.4.8 Gender and Vulnerability Description

### 9.4.8.1 Gender Relations

Based on household interviews and field observations in Huong Choa village, women seem to do most of the household work such as farming, water carrying, taking care of children, and cooking. Both men and women engage in income generation, but men have the voice in the family and make decisions on household affairs (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12th February 2020).

In Phung Lam, both men and women are engaged in cultivation (see Figure 9.82). Men mainly do the heavy work such as fertilizing and spraying while women do pruning and cutting tree branches (FGD, agriculture and forestry group, Kinh ethnic group, Phung Lam village, 12th February 2020).

The FGD with a vulnerable group in Cop village shows that there is a shared responsibility between men and women in income generation and household work, although men's involvement in family work is limited. One female respondent said that women and men take responsibilities for care of children and household work, and that they have discussions before making decisions about their family, although the final decisions are usually made by the man (FGD, vulnerable group, Cop village, 12th February 2020).



A woman is taking care of coffee plants in Phung Lam village



Women are going to home after working in fields in Huong Choa village

Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.82 Female Engagement in Livelihood Activities**

**9.4.8.2 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 unable to 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 25 households (71.4%) have been identified as vulnerable (see Table 9.48).

**Table 9.48 Number of Vulnerable Households in the Surveyed Villages**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Vulnerable households	14	77.78	5	55.56%	6	75.00	25	71.43
Non-vulnerable households	4	22.22	4	44.44%	2	25.00	10	28.57
<b>Total</b>	<b>18</b>	<b>100.00</b>	<b>9</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

Table 9.48 shows that among the 35 surveyed households, 13 are recognised as poor households, and this is the highest category (37.1%). Eight households (22.9%) are classified as near poor, four (11.4%) as female-headed households, and two (5.7%) with an illiterate main bread-winner. There is one household with orphans/abandoned children and one household including an elderly person above the age of 60 living alone (2.9% for each category). There is one household with a single mother under the poor household category and raising children under the age of 16 or children aged 16-18 and attending school (2.9%).

Three out of 35 vulnerable households (8.6%) have family members who are physically disabled. Of these, two households are entitled to a social allowance around 400,000VND per month. There are three household (8.6%) with a family member who is mentally disabled and not engaged in work; but only one households receive a monthly social allowance of 405,000 VND.

The FGD results with eight vulnerable households in Cop village shows that among eight participating households, two households have family members with physical disability, one household is as female-headed, and the others have extreme difficulties in living. The two households with physically disabled

members are entitled to receive social allowance from the State. All eight households have received enough information about any plans, programs, or activities of the locality. They have a close relationship with the community (FGD, vulnerable group, Cop village, 12th February 2020).

**Table 9.49 Vulnerable Household Cases by Category**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village (N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Poor household	9	50.00	1	11.11	3	37.50	13	37.14
Near poor household	5	27.78	2	22.22	1	12.50	8	22.86
Female-headed household	1	5.56	2	22.22	1	12.50	4	11.43
Household with physically disabled people	0	0.00	1	11.11	2	25.00	3	8.57
Household with illiterate main labour	2	11.11	0	0.00	0	0.00	2	5.71
Household with orphans/ abandoned children	0	0.00	1	11.11	0	0.00	1	2.86
Household with elderly person above the age of 60 living alone	0	0.00	0	0.00	1	12.50	1	2.86
Household with mental disabled people not working	0	0.00	1	11.11	2	25.00	3	8.57
Single parent under the poor household category and raising children under the age of 16 or children aged 16-18 and attending school, without SA	1	5.56	0	0.00	0	0.00	1	2.86
Not under these categories	4	22.22	4	44.44	2	25.00	10	28.57

Source: Socio-economic survey conducted by ERM, 2020

A vulnerable household can have more than one vulnerability criteria. Of the 25 vulnerable households, 17 households (68%) have one vulnerable criteria (see Table 9.50). Six households have these double vulnerabilities (24%). One household in Phung Lam (4%) have triple vulnerabilities (female-headed, household with orphans/abandoned children, and physically disabled people) and one household (4%) in Huong Choa village has four vulnerabilities (poor, female-headed, single parent raising children attending to school, and illiterate main labour).

**Table 9.50 Vulnerability Criteria**

	Huong Choa Village (N=14)		Phung Lam Village (N=5)		Cop Village (N=6)		All Surveyed Villages (N=25)	
	N	%	N	%	N	%	N	%
Households with one vulnerability	12	85.71	3	60.00	2	33.33	17	68.00
Households with two vulnerabilities	1	7.14	1	20.00	4	66.67	6	24.00
Households with three vulnerabilities	0	0.00	1	20.00	0	0.00	1	4.00
Households with four vulnerabilities	1	7.14	0	0.00	0	0.00	1	4.00
Total vulnerable Households	14	100.00	5	100.00	6	100.00	25	100.00

Source: Socio-economic survey conducted by ERM, 2020

Table 9.51 shows how satisfied vulnerable participants feel about 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 community cohesion, personal relationships, and time allocation for favourite work. Their favourite work include going out with friends for coffee or spending time at home for children. The most serious aspects of their well-being are living quality and achievement in life. Most of them share that they are always in deprivation situation and have to pay much money for food as buying foods from mobile goods vendors is expensive. They compare 15 kg of coffee beans harvested only equal to one kg of fish (FGD, vulnerable group, Cop village, 12th February 2020).

Well-being ranking by vulnerable groups is relatively similar to the Van Kieu group. All respondents show high satisfaction towards community cohesion and time allocation for favourite work. The most serious aspects of their well-being are health issues, local environment, and achievement in life (FGD, Van Kieu ethnic group, Huong Choa village, 12th February 2020). Meanwhile, through the FGD with the agriculture and forestry group in Phung Lam village, respondents show high satisfaction towards local security, community cohesion, and health situation. They are concerned about time allocation for favourite work, achievement in life, and local environment (FGD, agriculture and forestry group, Phung Lam village, 12th February 2020).

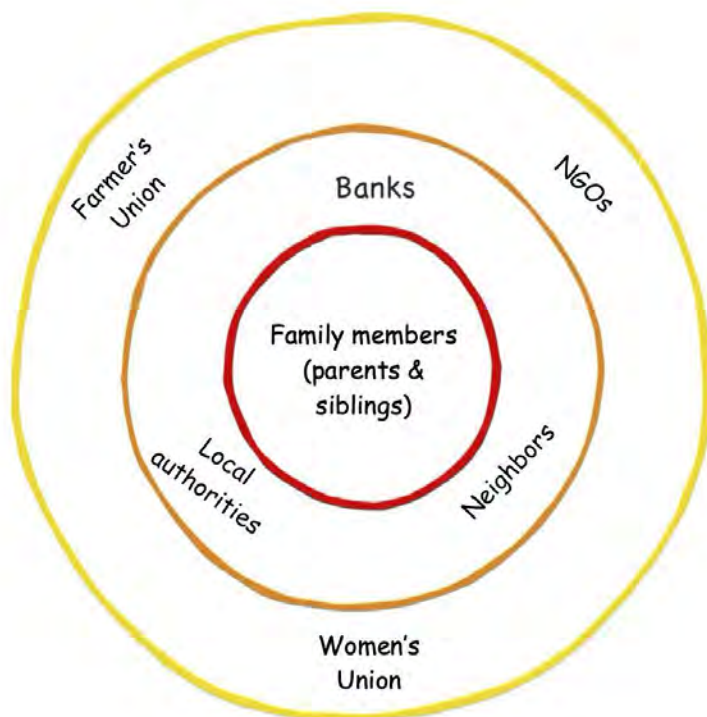
**Table 9.51 Well-Being Ranking by Vulnerable Groups**

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?	3.5	8.1	7.2
2	How satisfied are your with your health?	6	7.5	8.0
3	How satisfied are you with what you are achieving in life?	3.8	7	6.9
4	How satisfied are you with your personal relationships?	9.6	8	7.6
5	How satisfied are you with how safe you feel?	8.5	9	8.1

No.	Aspects of Well-being	Ranking Score		
		Vulnerable Group	Van Kieu Group	Agriculture and Forestry Group
6	How satisfied are you with feeling part of your community?	10	10	8.0
7	How satisfied are you with the quality of your local environment?	6.8	7.4	6.9
8	How satisfied are you with time allocation for a hobby?	9.0	8.9	6.6

Source: Socio-economic survey conducted by ERM, 2020

In terms of circles of support, the most important groups for vulnerable group are family members including parents and siblings. Neighbours, local authorities, and banks are identified as a second order circle of support. People can get loans from bank when needed, receive support from neighbours in difficult time, and update with information, programs and plans from village head or local authorities. The Women’s Union, Farmer’s Union, and NGOs are their third support circle as the surveyed people rarely receive support from these organisations (FGD, vulnerable group, Cop village, 12th February 2020).



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.83** Circles of Support Defined by Vulnerable Group

## 9.4.9 Local Perception and Understanding about the Project and Impacts

### 9.4.9.1 Local Understanding about the Project

The survey suggests that 74.3% of surveyed respondents have heard about the Project, but that 25.7% of respondents do not know about it (see Table 9.52). Of the 26 respondents who are informed about the Project, the corresponding figures are 14 households in Huong Choa village, seven households in Phung Lam village, and five households in Cop village.



**Table 9.52 Project Acknowledgement by Village**

	Huong Choa Village (N=18)		Phung Lam Village (N=9)		Cop Village(N=8)		All Surveyed Villages (N=35)	
	N	%	N	%	N	%	N	%
Yes	14	77.78	7	77.78	5	62.50	26	74.29
No	4	22.22	2	22.22	3	37.50	9	25.71
<b>Total</b>	<b>18</b>	<b>100.00</b>	<b>9</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>35</b>	<b>100.00</b>

Source: Socio-economic survey conducted by ERM, 2020

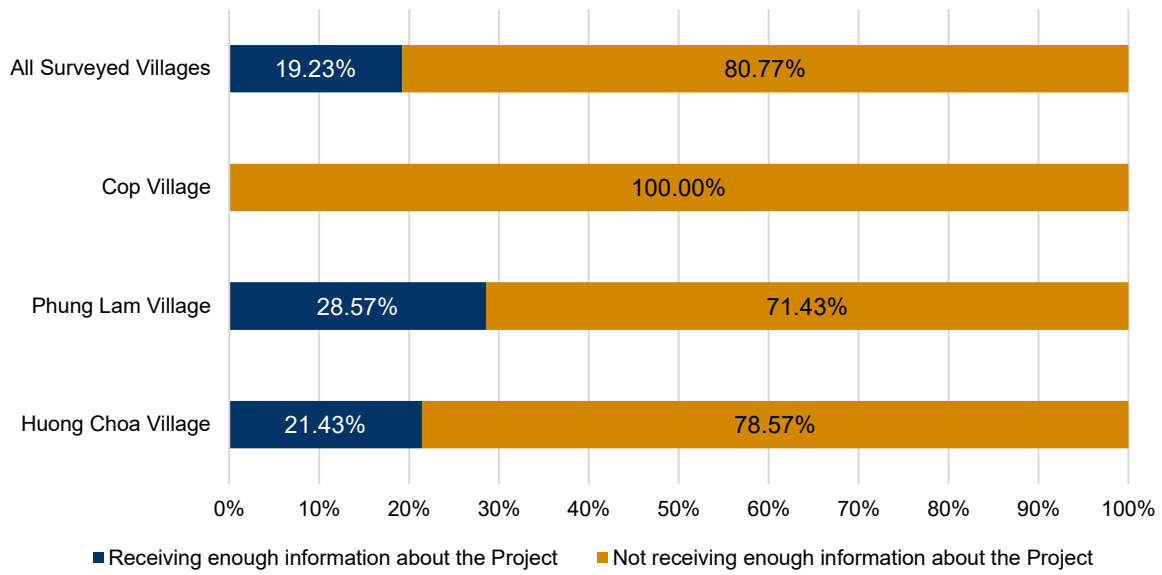
The highest share of the 26 households who know about the Project get information from the local authorities (53.9%) (see Table 9.53). Eight households (30.8%) know about the Project from relatives and neighbours, and another one households approach to Project's information by the Project owners during the environment impact assessment process (3.9%). Three households (11.5 %) hear about the Project from another source such as word of mouth. In addition, some representatives of Cop village know about the Project through the meeting between the Project and commune authorities in 2019 (KII, male respondent, Van Kieu people, Cop village, 12th February 2020). Village head, village deputy head, and village patriarch in Huong Choa village were invited to the Project commencement ceremony in Cop village at the end 2019 (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12th February 2020).

**Table 9.53 Project Information Channels**

	Huong Choa Village (N=14)		Phung Lam Village (N=7)		Cop Village (N=5)		All Surveyed Villages (N=26)	
	N	%	N	%	N	%	N	%
Local authorities	11	78.57	1	14.29	2	40.00	14	53.85
Relatives and neighbors	1	7.14	4	57.14	3	60.00	8	30.77
Project owners during the environment impact assessment process	1	7.14	0	0.00	0	0.00	1	3.85
Others	1	7.14	2	28.57	0	0.00	3	11.54

Source: Socio-economic survey conducted by ERM, 2020

Of the 26 surveyed respondents who have Project information, only five households (19.2%) say they have sufficient information, while most (80.8% or 21 respondents) want to know more about the Project (see Figure 9.84). Seventeen out of 21 respondents want to get information about the Project content, impact, operation plan, mitigation strategies, and livelihood support program and the remaining four respondents are not sure about the specific information they want to receive or they have no concerns.

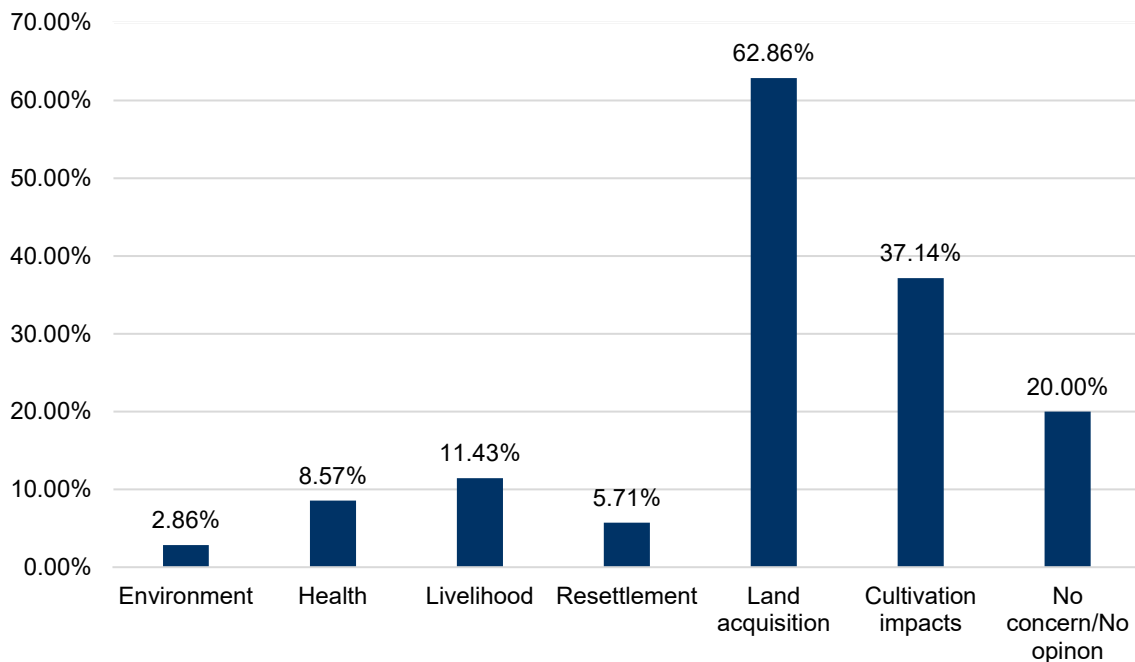


Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.84 Local Responses to Project Information Efficiency**

### 9.4.9.2 Local Perception about the Project Impacts

Households shared their concerns about the Project through household interviews (see Figure 9.85). Most of the interviewed households practice agriculture or rely on land-based livelihoods so they are extremely worried about land acquisition (62.9%) and cultivation impacts (37.1%) when the Project is implemented in the locality.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 9.85 Local Concerns about the Project Implementation**

A number of surveyed households (20%) do not have any concern about the Project implementation in the locality because they lack information.

We do not have any concern. We hope our land is acquired so we can get compensation (HP33, female respondent, 61 years old, Kinh ethnic group, Cop village, 12th February 2020).

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).

#### 9.4.9.2.1 *Land Acquisition*

This is the biggest concern of the surveyed households about the Project implementation. For most of surveyed households, land is not only a valuable asset, but also a result of their work and their hopes for a stable life for themselves and their descendants. Land-based livelihood is also important as it ensures domestic food security. Many households in Huong Choa village expressed their fears about loss of cultivation land as a result of the Project implementation. Their worries may be greater than others because they have gradually established their lives in the village after resettlement as a result of the hydropower development in 2006.

I am afraid that the Project affects cultivation land and local living (HP02, male respondent, 26 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Land acquisition may result in loss of cultivation land, residential land, and land-based livelihood (HP12, male respondent, 40 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

We concern that our future generation will not have land for living and cultivating if our land is acquired for the Project implementation (HP11, male respondent, 49 years old, Van Kieu people, Huong Choa village, 11th February 2020).

In case of land acquisition, appropriate land compensation is as important as restoring their livelihoods. Some households are concerned that they may not be eligible for land compensation as they do not have LURCs for their land.

Land acquisition and compensation price are our concern (HP06, male respondent, 41 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

We do hope the Project provides reasonable compensation for affected households (HP07, male respondent, 30 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

We are afraid that we cannot get money for our affected land as our land has not been granted with a LURC (HP09, male respondent, 30 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

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, 12th February 2020).

#### 9.4.9.2.2 *Impacts to Cultivation*

Many surveyed households in Cop and Phung Lam villages had concerns about the impacts of the Project on their crops.

We are afraid the wind farms affect coffee production (HP34, female respondent, 66 years old, Kinh ethnic group, Cop village, 12th February 2020).

We are afraid that wind turbines affect our plants (HP32, female respondent, 24 years old, Van Kieu ethnic group, Cop village, 12th 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, 12th February 2020).

Our concerns include loss of cultivation land, unreasonable compensation, and negative impacts of the Project on our plants and health (HP23, male respondent, 34 years old, Kinh ethnic group, Phung Lam village, 12th February 2020).

### 9.4.9.2.3 Other Impacts

Apart from the concerns above, there are fears about potential impacts on local livelihood (11.4%), health (8.6%), resettlement (5.7%), and the environment (2.9%). One household in Huong Choa does not want the Project to have any impact on graves in the area (HP07, male respondent, 30 years old, Van Kieu ethnic group, Huong Choa village, 11th February 2020).

Local responses to the Project from the household survey, FGDs, and through consultation with local authorities and KIIs are summarised below (see Table 9.54).

**Table 9.54 Main Concerns about the Project Impacts**

Group	Main Concerns through Consultation with Local Authorities and KIIs	Main Concerns through Household Interviews and FGDs
Commune authorities	<ul style="list-style-type: none"> <li>■ Noise</li> <li>■ Impacts on climate in the surrounding area</li> <li>■ Impacts on agricultural production (cultivation and husbandry)</li> <li>■ Land acquisition</li> </ul>	
Huong Choa village	<ul style="list-style-type: none"> <li>■ Impacts on living environment</li> <li>■ Impacts on local livelihoods (farming and husbandry)</li> <li>■ Impacts on cultivation land</li> <li>■ Compensation for land acquisition</li> </ul>	<ul style="list-style-type: none"> <li>■ Negative impacts on livelihoods including loss of land, loss of trees, and loss of pastures for husbandry</li> <li>■ Unfair compensation in case of land acquisition</li> <li>■ Impacts on living environment (noise pollution)</li> </ul>
Phung Lam village	Compensation price in case of land acquisition	<ul style="list-style-type: none"> <li>■ Loss of cultivation land</li> <li>■ Impacts on trees, environment, health, and climate</li> <li>■ Unfair compensation in case of land acquisition</li> </ul>
Cop village	<ul style="list-style-type: none"> <li>■ Community safety due to an increase of social evils</li> <li>■ Overloaded traffic in the locality</li> <li>■ Polluted environment during the Project implementation process</li> </ul>	Impacts on cultivation activities, crop yield and production

Source: Socio-economic survey conducted by ERM, 2020

### 9.4.10 Local Needs for Community Development

Apart from the concerns related to the Project implementation, local needs for community development or the benefits that the Project might bring to the locality were identified during the field survey, FGDs, and consultation with local authorities and KIIs (see Table 9.55).

**Table 9.55 Local Needs for Community Development**

Group	Local Needs through Consultation with Local Authorities and KIIs	Local Needs through Household Interviews and FGDs
Commune authorities	<ul style="list-style-type: none"> <li>■ Upgrading road system</li> <li>■ Construction of community houses</li> <li>■ Developing high value crops (passion fruit, avocado, durian, guava, mango, and rambutan)</li> <li>■ Coffee replanting</li> <li>■ Development of agricultural farm models</li> </ul>	
Huong Choa village	<ul style="list-style-type: none"> <li>■ Reasonable compensation</li> <li>■ Implementation of community development programs such as upgrading road system, constructing community houses, and improving water supply</li> </ul>	<ul style="list-style-type: none"> <li>■ Improving a road to the village</li> <li>■ Construction of a community house</li> <li>■ Supply of domestic water</li> </ul>
Phung Lam village	Upgrading the village roads	<ul style="list-style-type: none"> <li>■ Road improvement</li> <li>■ Clean water</li> <li>■ Community learning center</li> </ul>
Cop village	<ul style="list-style-type: none"> <li>■ Construction of community house</li> <li>■ Three boreholes for household groups</li> <li>■ Employment opportunities for the locals during the Project implementation</li> </ul>	<ul style="list-style-type: none"> <li>■ Employment opportunities</li> <li>■ Renovation of village community house</li> <li>■ Well construction for local water supply</li> <li>■ Upgrading local kindergarten school</li> </ul>

Source: Socio-economic survey conducted by ERM, 2020

## 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 5.2). 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	<ul style="list-style-type: none"> <li>Increased dust (e.g. PM10) from ground preparation, work sites and material / equipment transportation</li> </ul>	<ul style="list-style-type: none"> <li>Annoyance and nuisance to the general public as a result of dust deposition on properties, dwellings, cultural heritage sites and places of business</li> <li>Increased effects of morbidity/ reduced health due to exposure to dust and exhaust emissions</li> </ul>	Nearby residents Construction workers
	Substation, transmission line, access road, laydown area construction	<ul style="list-style-type: none"> <li>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</li> </ul>		
	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

A baseline of air quality and noise was collected on 22nd April 2019 to support the regulatory EIA by Center for Natural Resources and Environment Monitoring of Quang Tri Province. Four samples were taken in the Project area for analysing based on QCVN 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:

- Increased dust and particulate matter emission (TSP, PM<sub>2.5</sub>, and PM<sub>10</sub>) from earthworks, site preparation activities (land clearing, levelling, excavation, etc.) and construction activities of project components such as substation, operation house, transmission towers;
- Elevated 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<sub>2</sub>, CO, NO<sub>2</sub>, NH<sub>3</sub>) from road transport of equipment and material;
- Smoke from burning cleared vegetation, should this occur; and
- Strengthening and maintenance of access roads.

#### 10.1.4.2 Existing controls

The mitigation measures identified in the locally approved regulatory EIA and EPP include:

- The Project Owner will upgrade in priority roads which will use to transport materials and machines such as the road through Cop, Huong Choa and Phung Lam Villages, Huong Phung Commune;
- Trucks will be covered with tarpaulins to avoid spillage of materials on the way of transportation;
- Do not use vehicles and machines which are too old and high potential cause pollution;
- Water spraying should be conducted at least twice a day during the dry season at communal roads and roads to access Cop and Phung Lam Villages, Huong Phung Commune;
- Ensure transport vehicles are not over-capacity and restrict transportation during rush hour and night time; and
- PPEs must be provided adequately for all 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 of the project will likely bring some impacts to the communities living along the transportation routes. 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<sup>54</sup>, earthworks<sup>55</sup>, construction<sup>56</sup> and track-out<sup>57</sup> as per the IAQM guidance note is presented in Table 10.2 and is used to inform the impact assessment.

**Table 10.2 Dust Emission Magnitude**

Activity	Impact Magnitude		
	Small	Medium	Large
Demolition	Total building volume <20,000 m <sup>3</sup> , 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 m <sup>3</sup> – 50,000 m <sup>3</sup> , potentially dusty construction material, demolition activities 10-20 m above ground level.	Total building volume >50,000 m <sup>3</sup> , 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 m <sup>2</sup> , soil type with large grain size (e.g. sand), <5 heavy earth moving	Total site area 2,500 m <sup>2</sup> – 10,000 m <sup>2</sup> , moderately dusty soil type (e.g. silt), 5-10 heavy	Total site area >10,000 m <sup>2</sup> , potentially dusty soil type (e.g. clay, which will be prone to

<sup>54</sup> 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.

<sup>55</sup> Earthworks covers the processes of soil-stripping, ground-levelling, excavation and landscaping.

<sup>56</sup> 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.

<sup>57</sup> 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.



Activity	Impact Magnitude		
	Small	Medium	Large
	vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.	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.	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 m <sup>3</sup> , construction material with low potential for dust release (e.g. metal cladding or timber).	Total building volume 25,000 m <sup>3</sup> – 100,000 m <sup>3</sup> , potentially dusty construction material (e.g. concrete), on site concrete batching.	Total building volume >100,000 m <sup>3</sup> , 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 30.8 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 (and, 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. 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. 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 <sub>10</sub> concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m <sup>3</sup>	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m <sup>3</sup>	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m <sup>3</sup>	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m <sup>3</sup>	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m <sup>3</sup>	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m <sup>3</sup>	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m <sup>3</sup>	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low

Receptor Sensitivity	Annual Mean PM <sub>10</sub> concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
	<24 µg/m <sup>3</sup>	>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 300m, 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**

Impact Nature	<b>Negative</b>	Positive	Neutral		
	Increased dust and gaseous pollutants are considered <b>Negative</b>				
Impact Type	<b>Direct</b>	Indirect	Induced		
	Nearby residential areas are <b>directly</b> impacted by increased dust and gaseous pollutants				
Impact Duration	<b>Temporary</b>	Short-term	Long-term	Permanent	
	Impacts are <b>temporary</b> and only present when stated activities are ongoing during the construction phase				
Impact Extent	<b>Local</b>	Regional	Global		
	Impacts are within the Project area and the immediate surroundings				
Impact Frequency	Intermittent over the construction period				
Impact Magnitude	Positive	Negligible	<b>Small</b>	Medium	Large
	The impact magnitude is <b>Small</b>				
Receptor Sensitivity	<b>Low</b>	Medium	High		
	Residential areas, construction workers and farm houses near the project area may be inadvertently affected				
Impact Significance	<b>Negligible</b>	Minor	Moderate	Major	
	The significance is <b>Negligible</b>				

#### 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;
- 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; 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 EIA recommended for air monitoring program in construction phase:

- Parameters: Temperature, humidity, wind speed, dust, CO, NOx, SO<sub>2</sub>.
- Monitoring locations: 03 locations
  - 01 location at the Project site (WGS84 – Latitude: 16.71608541; Longitude: 106.61410253);

- 01 location at the gate of the construction site (WGS84 – Latitude: 16.73101226; Longitude: 106.62041442); and
- 01 location at the turbine area (WGS84 – Latitude: 16.72024685; Longitude: 106.63167526);
- 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**

Phase	Potential Activities	Potential Impacts	Potential consequences	Receptors
Construction phase	Land preparation and civil works	<ul style="list-style-type: none"> <li>■ Increased turbidity due to suspended sediment washed into stream and creeks;</li> <li>■ Increased contaminants such as heavy metals, oil and grease etc. washed into surface water bodies (such as creeks) from construction activities;</li> </ul>	<ul style="list-style-type: none"> <li>■ Aquatic ecology is affected due to increased turbidity and pollution;</li> <li>■ Decreased quality of surface water which is used for domestic lives of local people</li> </ul>	Nearby surface water bodies
	Substation, transmission line, access road, laydown area construction			
	Operation of associated facilities such as the concrete batching plant	<ul style="list-style-type: none"> <li>■ Waste discharged from construction activities and worker's activities;</li> <li>■ Spillage of oil, chemicals, hazardous chemical from use of vehicles and construction machines during the construction phase.</li> <li>■ Reduction</li> </ul>		
	Waste and wastewater management from construction activities and worker's activities			
	Hazardous waste storage and handling			

## 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 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 Conservation 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 was collected on 22nd April 2019 by Center for Natural Resources and Environment monitoring of Quang Tri province to support the regulatory EIA. Three samples were taken in the Project area for analysing ten parameters of water quality. 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.

A baseline of groundwater quality was collected on 22nd April 2019 showed that all analysed parameters fell below thresholds' of QCVN 09-MT: 2015/BTNMT – National technical regulation on ground water quality.

In conclusion, the water quality within and 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:

- Increased turbidity due to sediment washed into freshwater water bodies;
- Increased 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 EIA and EPP include:

- 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 build the synchronised drainage system;
  - To check regularly to ensure no block the drainage system;
  - To collect solid waste into trash;
  - To build a warehouse which stores material and/or cover machine when raining;
  - Do not put material nearby drainage system to prevent falling into the system;
  - Only do maintain machine and vehicles at the garage; and

### 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	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic



Sensitivity Criteria	Contributing Criteria	
	indirectly, particularly with respect to dependent ecosystems.	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.	<p>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.</p> <p>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).</p>
Medium	The water resource supports diverse populations of flora and fauna but available in the surface water bodies in the region.	<p>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.</p> <p>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.</p>
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species.	<p>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.</p> <p>The groundwater resources is wholly relied upon locally, with no suitable technically or economically feasible alternatives.</p> <p>The development stage of groundwater is critical or over exploited.</p>

**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 give rise to indirect ecological and/or socio – economic impacts.

The project obtains water for construction from surface water body (Pa Rong stream) that is seasonal flow and groundwater from 03 predefined wells with a capacity of 90m<sup>3</sup> per day. It is estimated that total water requirements during construction phase will be about 262.5m<sup>3</sup> per day. According to Construction

Plan provided by Project owner, the water taken from surface water for construction of 72 transmission line pylons is taking up 38% of total water requirements.

Given the Project commenced its construction of turbine foundation in Quarter 3 of 2020 and the monthly rainfall in the region at this time (from August to December) is high, which is up to 430mm, it can be stated that the amount of water extracted is likely to be relatively small in comparison to the water resource availability at the time of use, and at the same time, water from streams is sufficient to support project demand without disrupting the current water use of the local community. As such, the impact magnitude can be assessed as Small.

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 68.6% 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 10.8 and Table 10.9 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	<b>Negative</b>	Positive	Neutral
	Decrease of water resources in term of surface water and ground water is considered <b>Negative</b>		
Impact Type	<b>Direct</b>	Indirect	Induced
	Decrease of water sources <b>directly</b> affects locals that are dependent on the ground water and surface water body.		
Impact Duration	Temporary	<b>Short-term</b>	Long-term
	The impact duration is <b>Short-term</b> and only present when stated activities are ongoing during the construction phase		
Impact Extent	<b>Local</b>	Regional	Global
	Impacts are within the Project area and the immediate surroundings.		
Impact Frequency	Intermittent over the construction period.		
Impact Magnitude	Positive	Negligible	Small
	The impact magnitude is <b>Medium</b>		
Receptor Sensitivity	Low	Medium	<b>High</b>
	The vulnerability of receptors is <b>High</b> taking into account the chances of an overexploited source of groundwater, causing scarcity of water in the region.		
Impact Significance	Negligible	Minor	<b>Moderate</b>
	The significance is <b>Moderate</b> .		

**Table 10.10 Impact on Water Quality for the Construction Phase**

Impact Nature	<b>Negative</b>	Positive	Neutral
	Increased pollution of freshwater quality is considered <b>Negative</b>		
Impact Type	<b>Direct</b>	Indirect	Induced
	Pollution in freshwater sources <b>directly</b> affect locals that are dependent on the fresh water body.		
Impact Duration	Temporary	<b>Short-term</b>	Long-term
	The impact duration is <b>Short-term</b> and only present when stated activities are ongoing during the construction phase		
Impact Extent	<b>Local</b>	Regional	Global
	Impacts are within the Project area and the immediate surroundings.		
Impact Frequency	Intermittent over the construction period.		
Impact Magnitude	Positive	Negligible	Small
	The impact magnitude is <b>Medium</b>		
Receptor Sensitivity	Low	<b>Medium</b>	High
	The vulnerability of receptors is <b>Medium</b> as pollution of water resources will affect those locals that use fresh water bodies for domestic uses and agricultural activities.		
Impact Significance	Negligible	Minor	<b>Moderate</b>
	The significance is <b>Moderate</b> .		

#### 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, BOD5, TSS, COD, NO<sup>3-</sup>, PO<sup>4</sup><sup>3-</sup>, Oil and Grease for surface water;
- Monitoring locations: 02 locations
  - 01 location at Pa Rong stream, Phung Lam Village, Huong Phung Commune (WGS84 – Latitude: 16.72123314; Longitude: 106.61598789); and
  - 01 location at streams at Cop Village, Huong Phung Commune (WGS84 – Latitude: 16.73006907; Longitude: 106.62227890).
- 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 Negligible.

## 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	<p>Groundworks and construction activities:</p> <ul style="list-style-type: none"> <li>■ Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon</li> <li>■ Excavation for WTG foundations and electrical poles</li> <li>■ Construction of internal road system</li> </ul> <p>Accidental leaks/spills of fuel, oil and hazardous materials/waste from machine during construction phase</p>	<ul style="list-style-type: none"> <li>■ Loss of soil stabilizing vegetation;</li> <li>■ Soil compaction and erosion;</li> <li>■ Soil contamination.</li> </ul>	<ul style="list-style-type: none"> <li>■ Loss of top soil quality would affect cultivation productivity.</li> <li>■ Loss of forest for WTG foundation construction by removal of stabilized top soil might potentially result in increased sediment in surface runoff and localized soil erosion.</li> </ul>	Soil quality in the Project area
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	<b>Negative</b>	Positive	Neutral		
	Increased pollution of freshwater quality is considered <b>Negative</b>				
Impact Type	<b>Direct</b>	Indirect	Induced		
	Soil compaction and erosion <b>directly</b> affect local community's livelihood as cultivation activities is their main livelihood.				
Impact Duration	Temporary	<b>Short-term</b>	Long-term	Permanent	
	The impact duration is <b>Short-term</b> during the construction phase				
Impact Extent	<b>Local</b>	Regional	Global		
	Impacts are within the Project area and the immediate surroundings.				
Impact Frequency	Intermittent over the construction period.				
Impact Magnitude	Positive	<b>Negligible</b>	Small	Medium	Large
	The impact magnitude is <b>Negligible</b> .				
Receptor Sensitivity	Low	<b>Medium</b>	High		
	The sensitivity of receptors is <b>Medium</b> as soil erosion will affect local community's livelihood in minor level.				
Impact Significance	Negligible	<b>Minor</b>	Moderate	Major	
	The significance is <b>Minor</b> .				

#### 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 EIA and EPP include:

- Do not clear all the area of the safety corridor that goes through the annual crop land of the people, do clear only enough the area which serves for construction activity;
- Undertakes to occupy only the right area;
- Activities of site clearance and vegetation clearance are carried out in phases;
- Control wastes released into the environment and take appropriate measures to treat wastes that may cause harm to the environment;
- Take measures to manage and strictly control workers to avoid hunting and deforestation
- Train and educate workers to raise awareness of environmental protection; and
- In order to minimize the occurrence of forest fires caused by biomass burning, the project will arrange burning areas in isolation from surrounding areas.

#### 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	<b>Negative</b>	Positive	Neutral	
Impact Type	<b>Direct</b>	Indirect	Induced	
	Soil compaction and erosion <b>directly</b> affect local community's livelihood as cultivation activities is their main livelihood.			
Impact Duration	Temporary	<b>Short-term</b>	Long-term	Permanent
	The impact duration is <b>Short-term</b> during the construction phase			
Impact Extent	<b>Local</b>	Regional		Global
	Impacts are within the Project area and the immediate surroundings.			
Impact Frequency	Intermittent over the construction period.			
Impact Magnitude	Positive	<b>Negligible</b>	Small	Medium
	The impact magnitude is <b>Negligible</b> .			
Receptors Sensitivity	Low	<b>Medium</b>		High
	The sensitivity of receptors is <b>Medium</b> as soil erosion will affect local community's livelihood in minor level.			
Impact Significance	Negligible	<b>Minor</b>	Moderate	Major
	The significance is <b>Minor</b> .			

#### 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, 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.
  - 01 location at the turbine area (WGS84 – Latitude: 16.72024685; Longitude: 106.63167526);
- Frequency: every six months.
- Regulation: QCVN 03-MT:2015/BTNMT - National technical regulation on the allowable limits of heavy metals in soil.

#### 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.

Background noise measurements have been carried out by the University of Ho Chi Minh City Institute of Environment and Resources at two representative monitoring locations in the vicinity of the GELEX Huong Phung Project site (NML4–5). Details of the noise measurement methodology and measurement equipment can be found in the Appendix A.

The background noise measurements at the two monitoring locations were conducted for a period of 48 hours at 10-minute intervals.

Regression analyses of the background noise data and the hub height wind speed data were carried out to determine a line of 'best fit' from the baseline noise measurements, from which the noise impact assessment criteria have been established as a function of wind speed. Measured noise levels were generally lower than both day and night-time 55 dB LAeq and 45 dB LAeq criteria respectively. At both NML4 and NML5, it was observed that high levels of noise from motorbikes and insects at NML4, and insects at NML5 were present intermittently indicating that noise levels were influenced by non-wind affected sources.

### 10.4.2.1 Measurement Locations

Details of the noise measurement locations are presented in Table 10.15

**Table 10.15 Background Noise Measurement Locations**

NML ID	Geographical Coordinates		Comment
	Latitude	Longitude	
4	16°42'19.6"N	106°38'04.9"E	Huong Choa Village, Huong Phung Huong Hoa, Quang Tri
5	16°43'40"N	106°38'2"E	Cop Village, Huong Phung Huong Hoa, Quang Tri

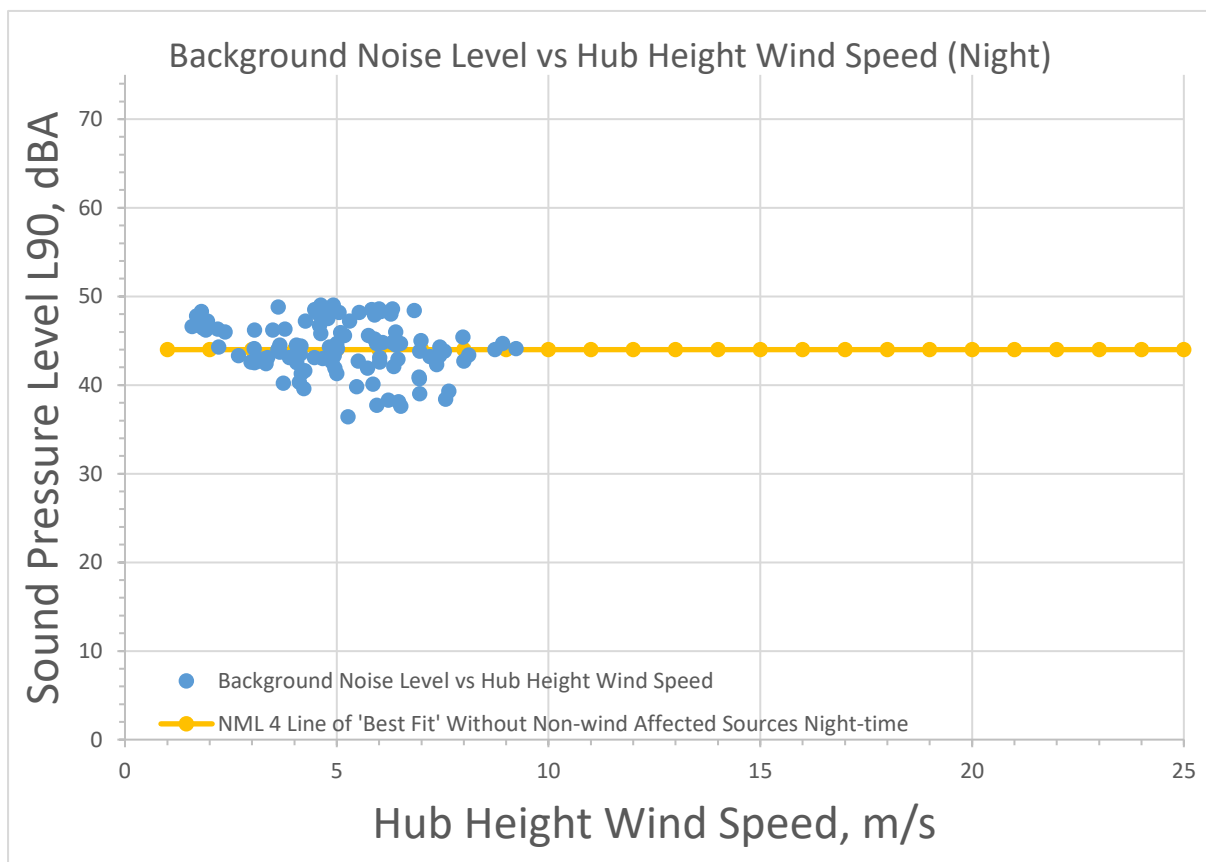
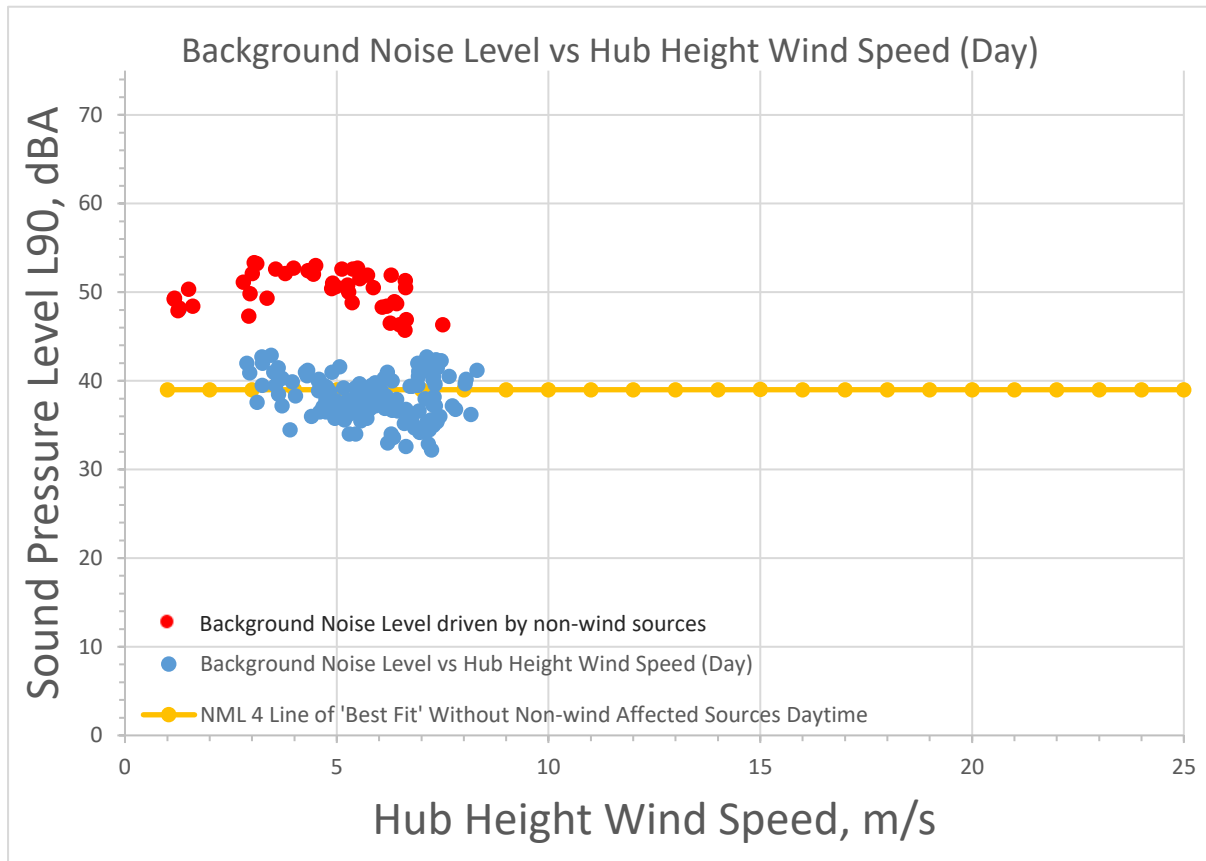
*Note 1: Universal Transverse Mercator coordinate system*

### 10.4.2.2 Background Noise Plot and Regression Analysis

Background noise is typically expected to increase as wind speed increases, as a result of wind-induced noise generated around objects or vegetation. The measured background noise levels (LA90) for the daytime are plotted against the wind speed at a hub height of 111 metres to obtain a background versus wind speed characteristic.

The line of best fit for the data set is determined using a linear trend line. It provided the most realistic correlation between wind speed and background noise level. As discussed above, however, at both NMLs, a clear correlation between wind speed and measured noise level was not apparent, as measured levels were driven by noise from motorbikes and insects for some periods of the measurement. Therefore the trend of background noise data and the hub height wind speed has been considered for values of the 10-minute noise measurements where noise was not present as a conservative approach for the assessment, and a line of 'best fit' has been introduced for those discrete measurements only.

The results of the background noise monitoring and analysis showing the measured noise data points are shown in Figure 10.1 and Figure 10.2 below for NMLs 4–5. The day and night-time plots show the line of 'best fit' introduced for measurement data without non-wind affected sources present.



**Figure 10.1 NML4 Background Noise Curve**



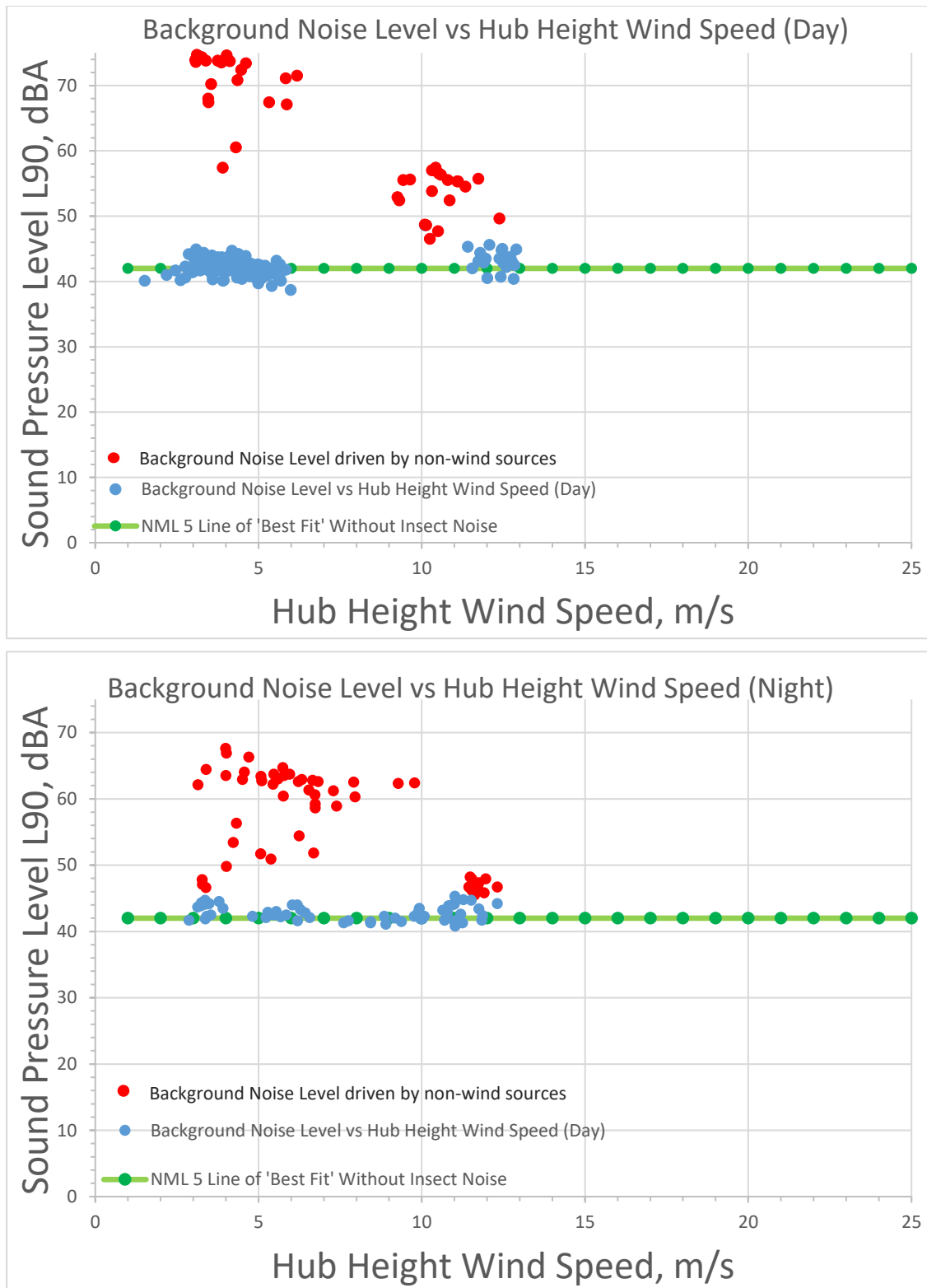


Figure 10.2 NML5 Background Noise Curve

### 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  $\geq 300$  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;
- 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 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 <b>Negative</b>				
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 <b>Short-term</b>				
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 <b>Small</b> .				
Receptors Sensitivity	Low	Medium	High		
	Overall vulnerability is <b>Medium</b>				
Impact Significance	Negligible	Minor	Moderate	Major	
	The significance is <b>Minor</b>				

### 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 (7AM to 10PM), and work should be avoided on Sundays or public holidays if possible.
  - 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 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

The local EIA recommended for the monitoring program in the construction phase:

- Parameters: Noise;

- Monitoring locations: 03 locations
  - 01 location at the Project site (WGS84 - Latitude: 16.71608541; Longitude: 106.61410253);
  - 01 location at the gate of the construction site (WGS84 - Latitude: 16.73101226; Longitude: 106.62041442); and
  - 01 location at the turbine area (WGS84 - Latitude: 16.72024685; Longitude: 106.63167526)
- Frequency: every six months
- Regulation:
  - QCVN 24:2016/BYT – National Technical Regulation on Noise – Permissible Exposure Levels of Noise in the Workplace; and
  - QCVN 26:2016/BTNMT – National Technical Regulation on Noise.
- No additional specific monitoring or auditing is recommended.

## 10.4.4 Impact Assessment in Operation Phase

### 10.4.4.1 Impact Assessment Criteria

Wind farm noise assessment criteria for receptors were based on the background noise plot against wind speed and the limits defined 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 limits are also referenced in the IFC wind energy guidance, which are 55 dB  $L_{Aeq,1 \text{ hour}}$  during the day (07.00 to 22.00) and 45 dB  $L_{Aeq,1 \text{ hour}}$  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. Based on this methodology, the plots showing the impact assessment criteria against hub height wind speed for each noise survey location are presented in Figure 10.4 and Figure 10.5.

### 10.4.4.2 Noise Prediction Method

The noise emission 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  $L_{eq}$  noise levels were calculated based upon sound power levels determined in accordance with the recognised standard IEC-61400-11:2002 “*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.

**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 $2 \times 10^{-5}$ 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 $\pm 3$ dBA 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	<p>Sound Power Level (LW, dBA) data (overall LW 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 LW, dBA value of:</p> <p>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</p> <p>One main operational mode (Mode 0s), with additional power mode (4000 kW s) modelled for 5 of the 12 turbines</p> <p>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).</p> <p>Spectral data (dBA per frequency band in 1/1 octaves).</p> <p>Hub height of 111 metres has been adopted for all ENERCON E-138 EP3 E2 turbines.</p> <p>Potential cumulative wind farm noise impacts:</p> <p>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 4, given their potential to contribute to noise levels at NSRs associated with the Huong Phung Project.</p> <p>Sound power level data was assumed in this report, adopting a worst-case approach for the candidate turbines.</p> <p>A conservative hub height was adopted for all WTGs where data supplied by the client were unavailable.</p>

### 10.4.4.3 Noise Emission Sources

The noise specifications adopted for the purpose of this assessment are presented in Table 10.18. 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 spectrums (noise level in dBA for each 1/1 octave band between 31.5 Hz and 8000 Hz), were taken from the ENERCON 4.2 MW wind turbine corrected to 106 dB(A) and 105.9 dB(A) respectively 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 and 105.9 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 E-138 EP3 Sound Power Levels**

Wind Speed at Hub Height (m/s)	Sound Power Level at Hub Height (dBA) Standard Power Operation Mode	Sound Power Level at Hub Height (dBA) 4000 kW s Power Operation Mode
2	96.6	96.6
3	96.6	96.6
4	96.6	96.6
5	96.6	96.6
6	100.5	100.5
7	102.9	102.9
8	103.6	103.6
9	104.3	104.3
10	104.9	104.9
11	105.4	105.5
12	106.0	105.9
13	106.0	105.9
14	106.0	105.9
15	106.0	105.9
16	106.0	105.9
17	106.0	105.9
18	106.0	105.9
19	106.0	105.9
20	106.0	105.9

**Table 10.19 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
ENERCON 4.2 MW Mode 4000 kW s	80.5	89	94.6	98.2	100.2	100.1	97.3	93.6	81.6	105.9

#### 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 10.21. Noise contour map for the Project operating in the acoustically worst-case mode is provided in Figure 10.3.

**Table 10.20 Representative Sensitive Receptors**

Receptor ID	UTM <sup>1</sup> WGS84 North Zone 48 (metres)		Comments
	Northing	Easting	
NSR 1	16°43'42.91"N	106°37'29.96"E	Representative of closest residential properties in Cop Village. NSR 1 is located approximately 150 metres south from the Ho Chi Minh Highway, and 500 metres north of the nearest wind turbine W10. Associated noise monitoring location is NML5.
NSR 2	16°43'20.74"N	106°37'27.00"E	Representative of closest residential properties in Phung Lam Village. NSR 2 is located approximately 200 metres southwest of the nearest wind turbine W10. Associated noise monitoring location is NML5.
NSR 3	16°42'55.42"N	106°38'4.84"E	Representative of closest residential properties south of Cop Village. NSR 3 is located approximately 1300 metres southwest from the Ho Chi Minh Highway, and 450 metres southwest of the nearest wind turbine W07. Associated noise monitoring location is NML4.
NSR 4	16°42'24.12"N	106°38'10.85"E	Representative of closest residential properties in Huong Choa Village. NSR 4 is located approximately 250 metres northeast from the main road in Huong Choa Village, and 680 metres southwest of the nearest wind turbine W12. Associated noise monitoring location is NML4.
NSR 5	16°43'14.98"N	106°39'17.31"E	Representative of closest residential properties east of Cop Village. NSR 5 is located along the Ho Chi Minh Highway, 900m north-north-east of the nearest wind turbine W02. Associated noise monitoring location is NML5.
NSR 6	16°41'52.64"N	106°39'9.42"E	Representative of closest residential properties north of Tan Thanh Commune. NSR 6 is located approximately 2000m metres west of

Receptor ID	UTM <sup>1</sup> WGS84 North Zone 48 (metres)		Comments
	Northing	Easting	
			the Ho Chi Minh Highway, and 1200 metres southeast of the nearest wind turbine W11. Associated noise monitoring location is NML4.

Note 1: Universal Transverse Mercator coordinate system

**Table 10.21 Predicted Operational Noise Levels at NSRs (L<sub>Aeq</sub>)**

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
2	34	41	38	35	32	33
3	34	41	38	35	32	33
4	34	41	38	35	32	33
5	34	41	38	35	32	33
6	38	45	42	39	36	36
7	41	47	44	41	39	39
8	41	48	45	42	39	40
9	42	48	45	42	40	40
10	43	49	46	43	41	41
11	43	50	47	44	41	41
12	44	50	47	44	42	42
13	44	50	47	44	42	42
14	44	50	47	44	42	42
15	44	50	47	44	42	42
16	44	50	47	44	42	42
17	44	50	47	44	42	42
18	44	50	47	44	42	42
19	44	50	47	44	42	42
20	44	50	47	44	42	42
21	44	50	47	44	42	42
22	44	50	47	44	42	42
23	44	50	47	44	42	42
24	44	50	47	44	42	42



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
<b>25</b>	44	50	47	44	42	42

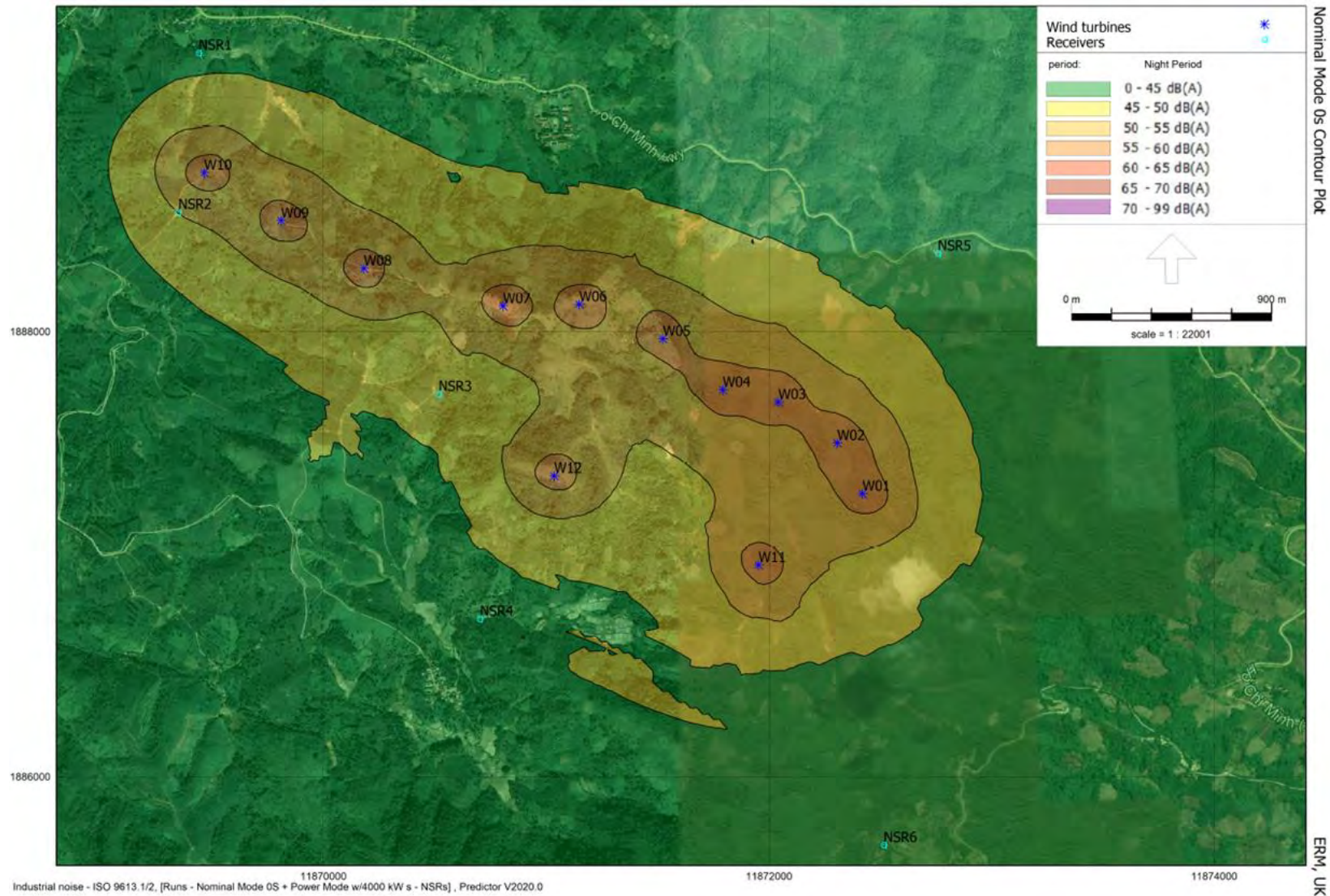
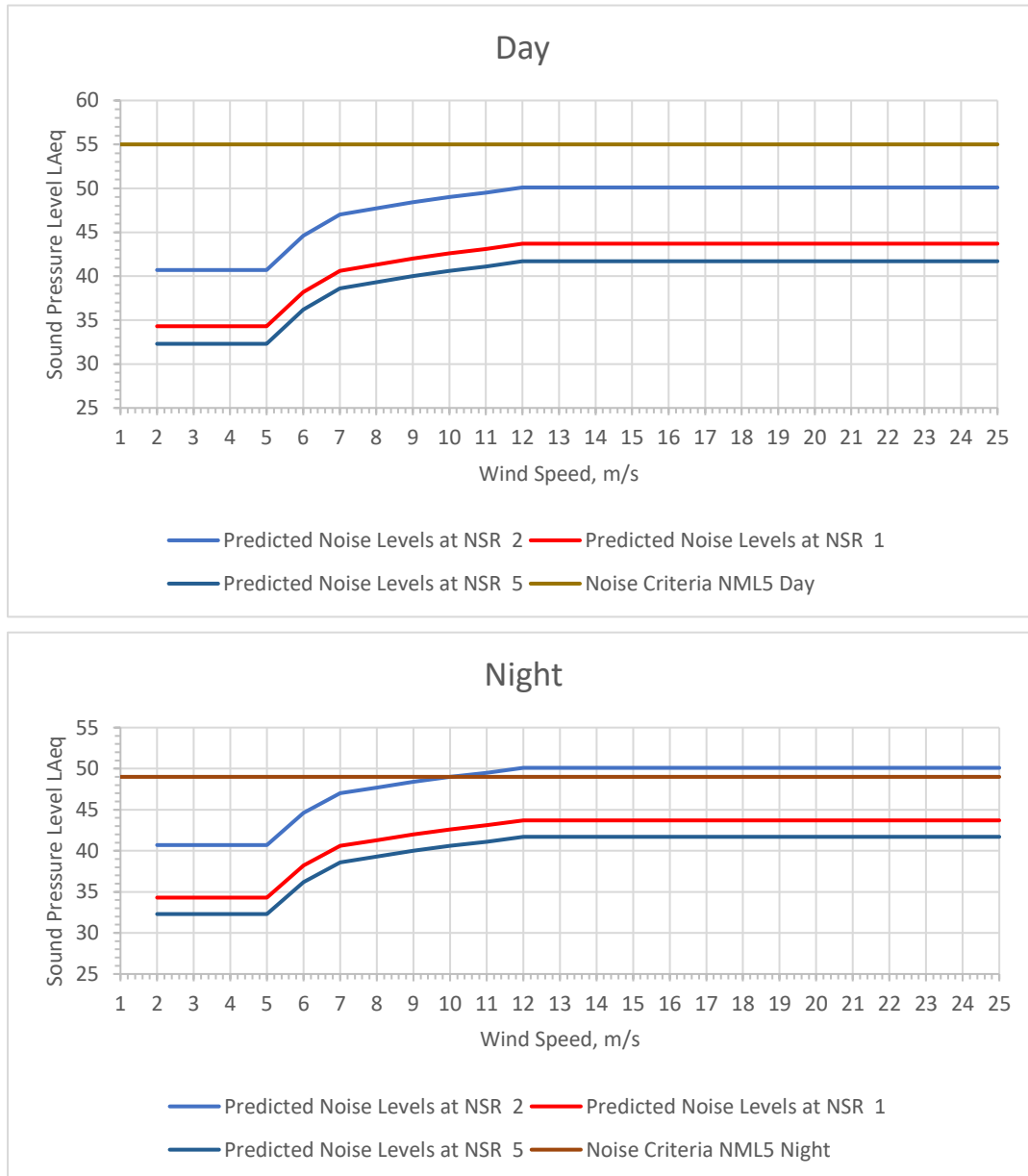


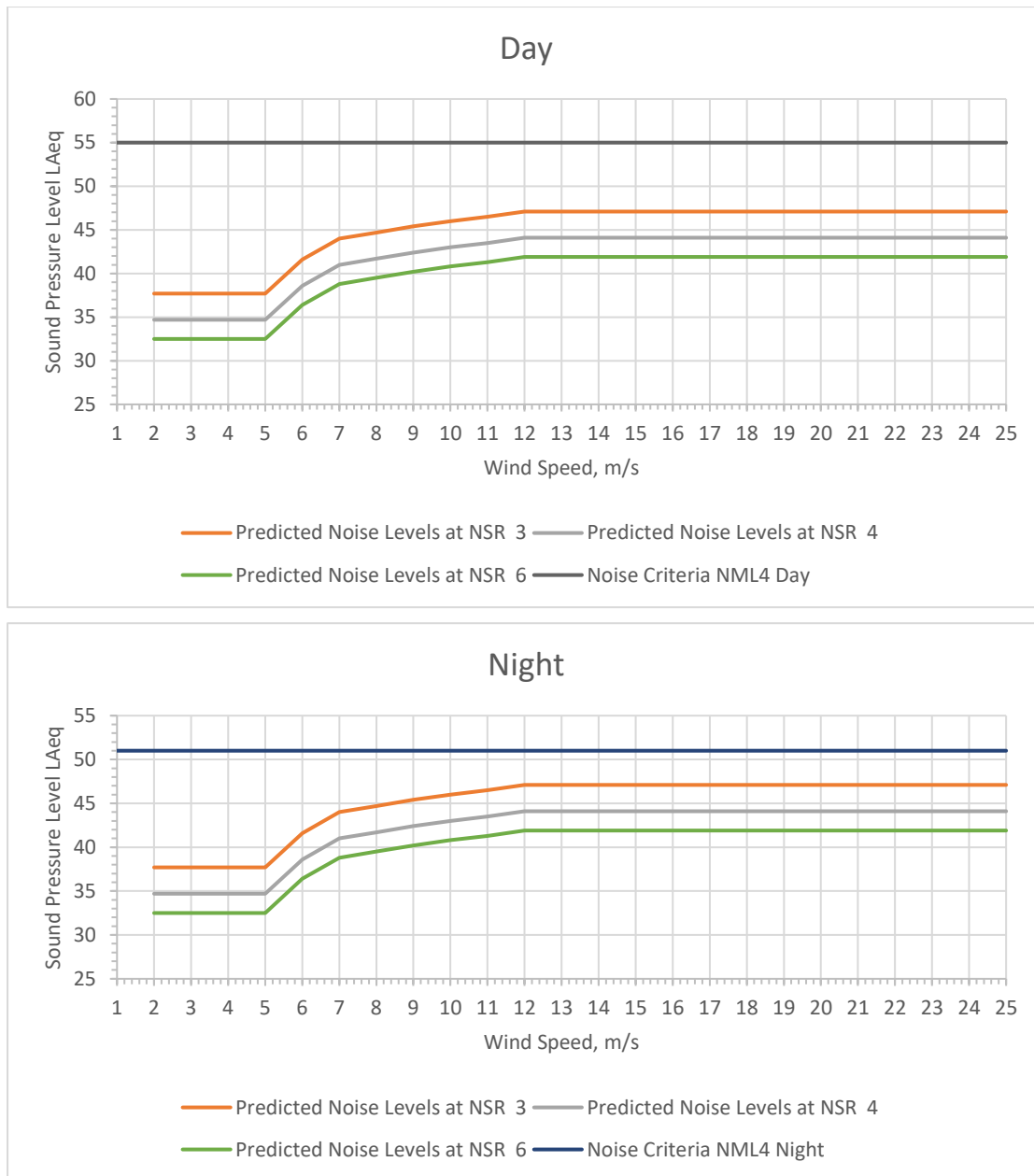
Figure 10.3 Worst-case and Operational Noise Contours of Huong Phung Project

### 10.4.4.5 Discussion of Predicted Wind Farm Noise

Wind farm noise predictions have been undertaken at each of the representative receptors (NSRs) for operations. Figure 10.4 and Figure 10.5 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.



**Figure 10.4 Predicted Wind Farm Noise Levels and Noise Assessment Criteria against (Hub Height) Wind Speed for NSR 1, NSR 2 and NSR 5**



**Figure 10.5 Predicted Wind Farm Noise levels and Noise Assessment Criteria against (Hub Height) Wind Speed for NSR 3, NSR 4 and NSR 6**

### 10.4.4.6 Significance of Impacts

The significance of impacts is presented in Table 10.22.

**Table 10.22 Noise Impact Significance during Operation Phase**

Impact Nature	Negative	Positive	Neutral
	Disturbance and potential health impacts are considered <b>Negative</b>		
Impact Type	Direct	Indirect	Induced
	Exposure to noise causes direct disturbance and potential health impacts.		
Impact Duration	Temporary	Short-term	Long-term
	The impact duration is <b>Long-term</b>		

Impact Extent	<b>Local</b>	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	<b>Small</b>	Medium	Large
	The impact magnitude is <b>Small</b> .				
Receptors Sensitivity	Low	<b>Medium</b>	High		
	Overall vulnerability is <b>Medium</b>				
Impact Significance	Negligible	<b>Minor</b>	Moderate	Major	
	The significance is <b>Minor</b>				

#### 10.4.4.7 Additional Mitigation Measures

As predicted operational noise levels meet the necessary criteria, there are no recommended mitigation measures for this Project.

#### 10.4.4.8 Residual Impacts

The residual impacts to be considered to be Minor.

#### 10.4.4.9 Monitoring and Auditing

The local EIA recommended for the monitoring program in the operation phase:

- Parameters: Noise;
- Monitoring locations: 03 locations
  - 01 location at Turbine No.2 (WGS84 – Latitude: 16.71015518; Longitude: 106.64943476);
  - 01 location at Turbine No.4 (WGS84 – Latitude: 16.71384229; Longitude: 106.61005653); and
  - 01 location at Turbine No.5 (WGS84 – Latitude: 16.71885718; Longitude: 106.6402719).
- Frequency: 03 times/year
- Regulation:
  - QCVN 24:2016/BYT – National Technical Regulation on Noise – Permissible Exposure Levels of Noise in the Workplace; and
  - QCVN 26:2016/BYT – National Technical Regulation on Microclimate – Permissible Value of Microclimate in the Workplace.

No additional specific monitoring or auditing is recommended.

### 10.4.5 Mitigation

Noise impacts from WTG emissions are predicted at one of the closest NSRs assessed, NSR 2 during the night above 10 m/s. Modelling indicates noise levels may need to be reduced by up to 1 dB during operation. NSR 2 in Phung Lam Village has a cluster of dwellings located approximately 200m southwest of W10. At the stage of the ESIA, it is not clear if these dwellings will remain when the wind farm is completed.

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. These have been reviewed and Sound

Optimised Modes I s and II s, and Power Optimised Modes 2500 kW s 2000 kW s, 1500 kW s 1000 kW s and 500 kW s would all give sufficient noise reduction at NSR 2 at the worst affected location for wind turbine W10. 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 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 Section 8. 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 10.23 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 10.23 Potential Threats to Biodiversity Values**

Term	Description
Loss of terrestrial and marine habitat at footprint of the transmission line infrastructure and turbines	<ul style="list-style-type: none"> <li>■ Temporary and permanent loss of habitat or species due to permanent or temporary site activities. Temporary and permanent impacts to marine habitat from turbine anchoring to the seabed.</li> </ul>
Disturbance or displacement of individuals from light; noise and/or vibration impacts	<ul style="list-style-type: none"> <li>■ Disturbance to, or displacement/exclusion of a species from foraging habitat due to construction activities, and operation and maintenance activities.</li> <li>■ Impacts from light, noise and vibration sources on surrounding habitats causing disturbance and displacement and changes in behaviour.</li> </ul>
Barrier creation, fragmentation and edge effects	<ul style="list-style-type: none"> <li>■ 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 and/or subsea cable.</li> <li>■ Fragmentation of habitat, or permanent/temporary severance of wildlife corridors between isolated habitats of importance for biodiversity due to the transmission line and/or subsea cable.</li> <li>■ 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.</li> </ul>
Degradation of habitat from dust; water pollution; or invasive species	<ul style="list-style-type: none"> <li>■ 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 flora and fauna. This can include increased exposure to noise, light and dust.</li> <li>■ Introduction or spreading of alien species during the construction works.</li> </ul>
Mortality – vehicle/vessel strike, hunting and poaching, transmission line, turbine strike	<ul style="list-style-type: none"> <li>■ Mortality of individual fauna species as a result of vehicle/vessel or machinery strike or falling debris during clearing activities.</li> <li>■ Mortality to individual fauna species as a result of worker influx and hunting/poaching of extant fauna.</li> <li>■ Mortality due to collision and electrocution with transmission line.</li> <li>■ Mortality due to potential flight of avifauna and bats through the Rotor Swept Zone (RSZ) of the wind turbines.</li> </ul>

Table 10.24 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 10.24 Scoping of Potential Impacts during Project Phases**

Impact	Construction Phase	Operation Phase
Loss of habitat	Yes	Continuing from construction phase
Disturbance or displacement of fauna	Yes	Continuing from construction phase
Barrier creation, fragmentation and edge effects	Yes	Continuing from construction phase
Degradation of habitat	Yes	Continuing from construction phase
Mortality – vehicle strike, hunting and poaching, transmission line strike, turbine strike	Yes	Reassessed for operation 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 10.25, while Table 10.26 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 10.25 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
	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	Negligible	Moderate	Major	Critical



migratory species and/ or congregatory species; highly threatened and/or unique ecosystems, areas associated with key evolutionary species.				
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**Magnitude of Effect Definition**

<b>Negligible</b>	Effect is within the normal range of variation
<b>Small</b>	Affects a small area of habitat, but without the loss of viability/function of the habitat
<b>Medium</b>	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.
<b>Large</b>	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 10.26 Species Impact Assessment – Significance Criteria**

Species Sensitivity/Value		Magnitude of Effect			
		Negligible	Small	Medium	Large
<b>Low</b>	Species which are included on the IUCN Red List of Threatened Species as Least Concern (LC).	Negligible	Negligible	Minor	Moderate
<b>Medium</b>	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
<b>High</b>	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 km <sup>2</sup> . Internationally important numbers of migratory or congregatory species. Key evolutionary species.	Negligible	Moderate	Major	Critical

**Magnitude of Effect Definition**

<b>Negligible</b>	Effect is within the normal range of variation.
<b>Small</b>	Affects a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself
<b>Medium</b>	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.
<b>Large</b>	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

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species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.
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### 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 Horseshoe Bat (IUCN LC) detected within the Project Area. The natural habitat areas within the Project Area are patchy. They consist mainly of natural forests. Flora species present are common to the region and 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)).

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 10.27 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 10.27 Land Area occupied by Project Components**

Project components	Duration	Estimated land area (ha)	Habitat type	
			Modified Habitat	Natural Habitat
Wind turbines (15)	Permanent	2.534	Perennial cropland, annual cropland, vacant land (2.218)	Protection forest land (0.317)
110 kV transmission line (1.56 km)	Permanent	0.807	Perennial cropland, annual cropland, vacant land (0.807)	-
22 kV transmission line (11.8 km)	Permanent	1.704	Perennial cropland, annual cropland, vacant land (1.704)	-
Substation and operation house	Permanent	1.478	Perennial cropland, annual cropland, vacant land (1.478)	-
Warehouse and auxiliary works	Permanent	1.830	Perennial cropland, vacant land (1.830)	-
Traffic road system (Upgraded inter-village road and new internal road)	Permanent	7.538	Perennial cropland, annual cropland, vacant land, other land <sup>58</sup> (6.868)	Protection forest land (0.670)
Excavated soil site	Temporary	3.080	Perennial cropland, vacant land (3.080)	-
Laydown area	Temporary	2.452	Perennial cropland, vacant land, other land (2.051)	Protection forest land (0.400)
Crane installation area	Temporary	3.300	Perennial cropland, vacant land, other land (3.300)	-
Concrete batching plant	Temporary	2.000	Perennial cropland, vacant land (2.000)	-
EPC office house	Temporary	0.015	Vacant land (0.015)	-

<sup>58</sup> Other land includes residential land in rural area, public land for transport purpose, land for construction of infrastructure

Project components	Duration	Estimated land area (ha)	Habitat type	
			Modified Habitat	Natural Habitat
Worker camp	Temporary	0.054	Vacant land (0.054)	-
Safety corridor of 110 kV transmission line	Temporary	2.638	Perennial cropland, vacant land (2.638)	-
Safety corridor of 22kV transmission line	Temporary	1.457	Perennial cropland, annual cropland, vacant land, other land <sup>59</sup> (1.457)	-
<b>Total</b>		<b>Permanent: 12.931</b> <b>Temporary: 17.949</b>	<b>Permanent: 14.904</b> <b>Temporary: 14.595</b>	<b>Permanent: 0.987</b> <b>Temporary: 0.400</b>

<sup>59</sup> Other land includes residential land in rural area, public land for transport purpose, land for construction of infrastructure

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 EIA include:

- Project activities are to be restricted to contractually approved area.
- 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.
- The Project owner shall provide training to staff, workers and visitors on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can be 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*

The area of natural habitat potentially lost is considered to be minimal (permanent loss of 0.99 ha, temporary loss of 0.40 ha), representing a loss of 0.30% and 0.12% of natural habitat in the EAAA. The area of modified habitat lost will consist mainly of existing vacant, perennial cropland, annual cropland, and other 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, however the Study Area 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 Low as the habitats in the Project Area plays host to IUCN listed LC species and are common and widespread within the region. The overall significance is therefore considered Negligible.

**Table 10.28 Loss of Habitat Impact Assessment**

Impact Type	<b>Direct</b>	Indirect		Induced	
	The footprint of habitat loss is approximately 12.93 ha (permanent) and 17.95 ha (temporary) for the project components. The area of natural habitat lost is estimated to be 0.99 ha (permanent) and 0.40 ha (temporary).				
Impact Duration	<b>Temporary</b>	Short-term	Long-term	<b>Permanent</b>	
	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	<b>Local</b>	Regional		International	
	Impacts on terrestrial habitat are localised.				
Impact Frequency	The impact is considered a one-off event.				
Impact Magnitude	Positive	Negligible	<b>Small</b>	Medium	Large
	Impact magnitude is considered small. Representing a loss of 0.30% (permanent project components) and temporary loss of 0.12% (temporary construction areas) of natural habitat in the EAAA which is a small area of habitat, long term viability/function of the habitat is unlikely to be lost.				
Receptor Sensitivity	<b>Low</b>	Medium		High	
	Project EAAA contains habitats for LC species, which are also common and widespread within the region.				
Impact Significance	<b>Negligible</b>	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:

- 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.
- Once construction is complete the temporary construction areas will be rehabilitated to pre-construction land type.
- All land rehabilitation 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*

The application of the mitigation measures is likely to retain the impact due to loss of habitat within the project area as Negligible during construction and operation.

#### 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.

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 EIA include:

- Project activities are to be restricted to contractually approved area.
- 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.
- Construction schedule will be managed to avoid high concentration of work load 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 Low as the habitats in the Project Area play host to IUCN listed LC species and are common and widespread within the region. The overall impact significance is therefore considered Negligible.

**Table 10.29 Disturbance and/or Displacement of Fauna Impact Assessment**

Impact Type	<b>Direct</b>		Indirect	Induced	
	Disturbance and/or displacement impacts will occur largely during the construction phase.				
Impact Duration	<b>Temporary</b>	Short-term	Long-term	Permanent	
	These impacts are associated with the construction (temporary) phase.				
Impact Extent	<b>Local</b>		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 fauna being in the Project Area is anticipated to be possible given that the Project Area contains suitable habitat.				
Impact Magnitude	Positive	Negligible	<b>Small</b>	Medium	Large
	Impact magnitude is considered <b>small</b> 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	<b>Low</b>		Medium	High	
	Project EAAA contains habitats for LC species, which are also common and widespread within the region				
Impact Significance	<b>Negligible</b>	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 remain 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 EIA include:

- Land clearance must follow procedures to prevent unplanned changes to natural habitat and allow fauna to move away from area safely.

#### *10.5.3.1.3.3 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 during construction and ongoing during operation. The magnitude of impact is expected to be Negligible as the impacts are likely within the normal range of variation. The sensitivity of the receptor is considered to be Low, as the Project EAAA plays host to IUCN listed LC species and are common and widespread within the region. The overall impact significance is therefore considered Negligible.

**Table 10.30 Barrier Creation, Fragmentation and Edge Effects Impact Assessment**

Impact Type	Direct	<b>Indirect</b>			Induced
	These impacts are an indirect consequence of vegetation clearing and land disturbance.				
Impact Duration	Temporary	Short-term	Long-term	<b>Permanent</b>	
	These impacts will be introduced during the construction phase and will be maintained throughout the operation of the project.				
Impact Extent	<b>Local</b>		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	<b>Negligible</b>	Small	Medium	Large
	Impact magnitude is considered <b>negligible</b> as the effects are within the normal range of variation.				
Receptor Sensitivity	<b>Low</b>		Medium	High	
	Project EAAA plays host to IUCN listed LC species and are common and widespread within the region				
Impact Significance	<b>Negligible</b>	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

With the implementation of the mitigation measures, the residual impact significance is expected to be 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.

### 10.5.3.1.4.2 Existing/ In-place Controls

The mitigation measures identified in the locally approved regulatory EIA include:

- 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.
- Drainage system will be constructed to avoid erosion.

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 Low, as the Project EAAA plays host to IUCN listed LC species and are common and widespread within the region. The overall impact significance is therefore considered Negligible.

**Table 10.31 Degradation of Habitat Impact Assessment**

Impact Type	Direct	<b>Indirect</b>		Induced	
	These impacts are an indirect consequence of vegetation clearing and land disturbance.				
Impact Duration	Temporary	Short-term	<b>Long-term</b>	Permanent	
	These impacts will be introduced during the construction phase and degraded areas may take time to recover.				
Impact Extent	<b>Local</b>		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	<b>Small</b>	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	<b>Low</b>		Medium	High	
	Project EAAA contains habitats for LC species, which are also common and widespread within the region.				
Impact Significance	<b>Negligible</b>	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 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.

#### 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 retain residual impact significance as 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.

#### 10.5.3.1.5.2 *Existing/ In-place Controls*

No existing controls were identified to mitigate this impact.

#### 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 15 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 sensitivity of the receptor is considered to be Low as the habitats in the Project Area plays host to IUCN listed LC species and are common and widespread within the region. Significance of impact is therefore considered Negligible.

**Table 10.32 Mortality – Vehicle Strike, Hunting and Poaching Impact Assessment**

Impact Type	<b>Direct</b>	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	<b>Temporary</b>	Short-term	Long-term	Permanent	
	These impacts are related to the construction activities of the Project.				
Impact Extent	<b>Local</b>	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	<b>Small</b>	Medium	Large
	The impact may affect a small proportion of the population, but does not substantially affect other species dependent on it, or the populations of the species itself.				
Receptor Sensitivity	<b>Low</b>		Medium	High	
	Project EAAA contains habitats for LC species, which are also common and widespread within the region.				
Impact Significance	<b>Negligible</b>	Minor	Moderate	Major	

#### 10.5.3.1.5.4 Additional Mitigation Measures

The following mitigation measures are proposed be applied:

- Hunting and poaching 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.
- All vehicles are to maintain a speed of a maximum of 20 km/h within work sites to reduce the risk of fauna strike.

#### 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 retain the residual impact significance as Negligible.

### 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 sixty (60) species recorded during the vantage point surveys, only nine (9) 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 – 7 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 10.33 Bird species recorded to fly in band 2**

S / N	Scientific Name	English Name	IUCN Category	Vietnam Red Data Book	Month (2020)
	<i>Egretta garzetta</i>	Little Egret	LC	-	Feb
	<i>Spilornis cheela</i>	Crested Serpent Eagle	LC	-	Feb
	<i>Corvus macrorhynchos</i>	Large-billed Crow	LC	-	Feb
	<i>Ictinaetus malaiensis</i>	Black Eagle	LC	-	Feb
	<i>Dendrocygna javanica</i>	Lesser Whistling-duck	LC	-	May
	<i>Aerodramus fuciphagus</i>	Edible-nest Swiftlet	LC	-	May
	<i>Spilopelia chinensis</i>	Eastern Spotted Dove	LC	-	May
	<i>Dicrurus macrocercus</i>	Black Drongo	LC	-	May
	<i>Gracupica nigricollis</i>	Black-collared Starling	LC	-	May

Note: LC – Least Concern

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 low.

## 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 10.34 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 10.34 Results of species-based risk assessment matrix**

	Risk of turbine impact		
Factor	Low risk	Medium Risk	High Risk
<b>Habitat reference</b>	Bats preferring cluttered habitat	Bats able to exploit background cluttered space	Bats preferring to use open habitat
<b>Echolocation characteristics</b>	Short range High frequency Low intensity Detection distance ~15m	Intermediate – more plastic in their echolocation	Long range Low frequency High intensity Detection distance ~80m
<b>Wing shape</b>	Long wing loading Low aspect ratio Broadest wing	Intermediate	High wing loading High aspect ratio Narrow wings
<b>Flight speed</b>	Slow	Intermediate	Fast
<b>Flight behaviour and use of landscape</b>	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 hawkler Feed in open habitat
<b>Migration</b>	Local or regional movements	Regional migrant in some parts of range	Long-range migrant in some parts of range



	Risk of turbine impact		
<b>Species or taxa that match at least one criterion</b>	<i>Hipposideros pomona</i>	<i>Hipposideros armiger</i>	<i>Taphozous melanopogon</i>
	<i>Hipposideros cineraceus</i>	<i>Hipposideros larvatus</i>	<i>Miniopterus magnater</i>
	<i>Cynopterus brachyotis</i>	<i>Hipposideros scutinares</i>	<i>Miniopterus schreibersii</i>
	<i>Cynopterus sphinx</i>	<i>Megaderma lyra</i>	<i>Miniopterus pusillus</i>
	<i>Macroglossus sobrinus</i>	<i>Megaderma spasma</i>	<i>Pipistrellus coromandra</i>
	<i>Megaerops niphanae</i>	<i>Rhinolophus affinis</i>	<i>Pipistrellus javanicus</i>
	<i>Rousettus amplexicaudatus</i>	<i>Rhinolophus luctus</i>	<i>Pipistrellus tenuis</i>
	<i>Rousettus leschenaultii</i>	<i>Rhinolophus siamensis</i>	<i>Pipistrellus paterculus</i>
	<i>Rhinolophus malayanus</i>	<i>Myotis horsfieldii</i>	<i>Scotophilus kuhlii</i>
	<i>Rhinolophus microglobosus</i>	<i>Myotis muricola</i>	<i>Scotophilus heathii</i>
	<i>Rhinolophus pusillus</i>	<i>Myotis indochinensis</i>	<i>Hypsugo cadornae</i>
	<i>Rhinolophus shameli</i>	<i>Myotis siligorensis</i>	<i>Hypsugo dolichodon</i>
	<i>Rhinolophus thomasi</i>	<i>Glischropus bucephalus</i>	<i>la io</i>
	<i>Kerivoula hardwickii</i>	<i>Harpiocephalus harpia</i>	<i>Myotis annectans</i>
	<i>Kerivoula picta</i>	<i>Hesperoptenus tickelli</i>	
	<i>Kerivoula kachinensis</i>	<i>Phoniscus jagorii</i>	
	<i>Kerivoula titania</i>	<i>Pipistrellus abramus</i>	
	<i>Glischropus tylopus</i>	<i>Tylonycteris pachypus</i>	
	<i>Coelops frithii</i>	<i>Tylonycteris robustula</i>	
	<i>Murina aurata</i>		
	<i>Murina cyclotis</i>		
	<i>Scotomanes ornatus</i>		
	<b>Total: 22 species</b>	<b>Total: 19 species</b>	<b>Total: 14 species</b>

#### 10.5.3.2.1.2 Existing/ In-place Controls

No mitigation measures were identified in the locally approved regulatory EIA to mitigate 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 15 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 10.35 Mortality – Turbine and Transmission Line Strike Impact Assessment**

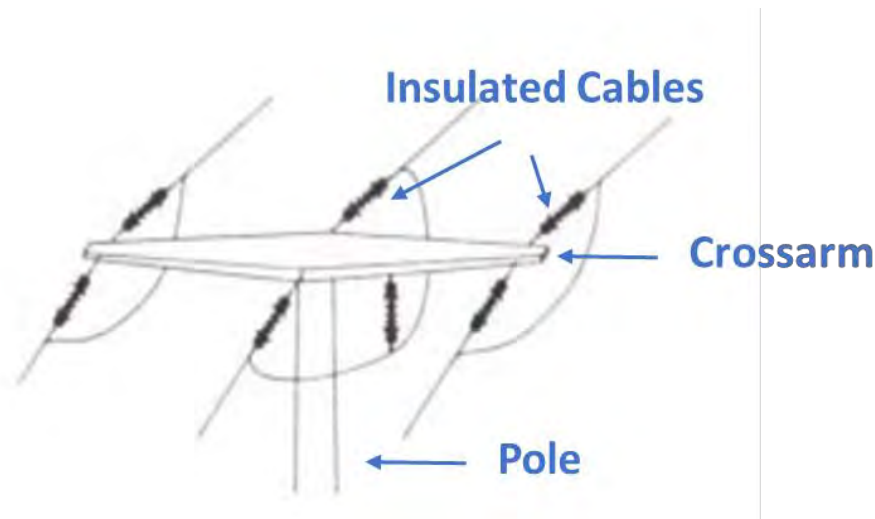
Impact Type	Direct		Indirect	Induced
	These impacts are related to the collision risk of the transmission line and turbines.			
Impact Duration	Temporary	Short-term	<b>Long-term</b>	Permanent

	These impacts are related to the collision risk during the operation of the transmission line and turbines.				
Impact Extent	<b>Local</b>	Regional		International	
	Impacts are restricted to the location of the transmission line and 15 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	<b>Small</b>	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	<b>Low</b>		Medium	High	
	Project EAAA mainly plays host to species included on the IUCN Red List as LC.				
Impact Significance	<b>Negligible</b>	Minor	Moderate	Major	

10.5.3.2.1.4 Additional Mitigation Measures

The following mitigation measures are proposed to be applied:

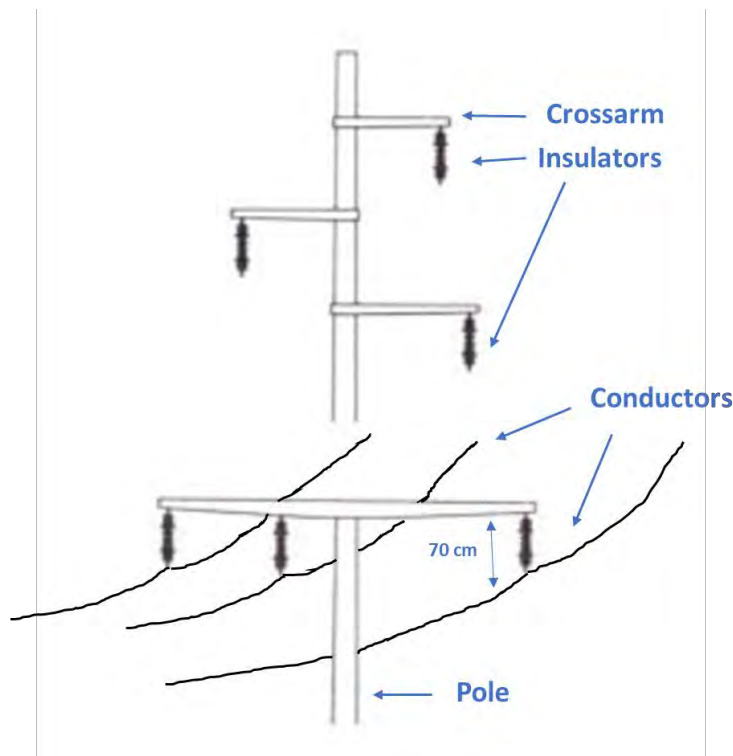
- The transmission line will include the following measures:
  - Use of bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna;
  - Removing the thin neutral or earth (shield) wire above the 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 10.6); and



Source: Haas et al., 2003

**Figure 10.6 Insulated Conductors Minimum of 70 cm on Either Side of Cross Arm**

- 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 10.7).



Source: Haas et al., 2003

**Figure 10.7 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 a *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 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 EMMP. 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 EMMP 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 locates within Huong Phung Commune and the main dense residential area is Cop Village (approximately 3 km to the Northwest of the Project). There are some sparse minor communities in Phung Lam Village (approximately 2 km to the West-Southwest of the Project). The Project location is characterised by the presence of relatively dense vegetation with topographically complex landscapes than surrounding areas. There are a total of 429 potential receptors that could potentially experience the shadow flickering issue within the area of influence (10 times of rotor diameter). Figure 10.8 presents the location of such receptors.



Figure 10.8 Location of main receptors

## 10.6.4 Shadow Flickering Analysis

### 10.6.4.1 windPRO Model: Scenarios and Input Criteria

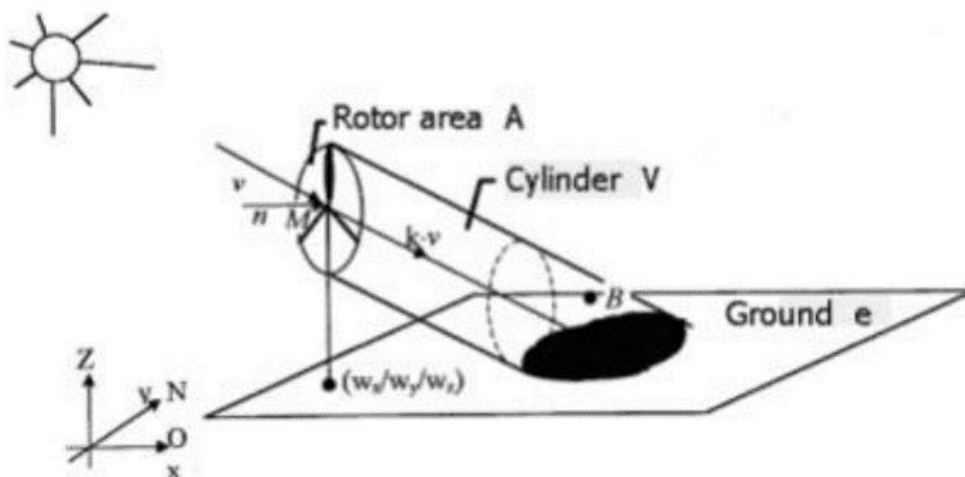
This assessment has been taken advantage of windPRO 3.4<sup>®</sup>, a computer software which is widely used in the wind industry. The software package includes a Shadow Flicker Module (SHADOW) that calculates the frequencies and the intervals in which a specific neighbouring receptor or area will be 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 10.9.



**Figure 10.9 Shadow Flickering Theory**

All receptors in both scenarios, assuming dwellings/groups of dwellings, within 1.5 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 86 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 80 m from June 1st, 2019 to June 1st, 2020:

N	NE	E	SE	SE	SW	W	NW	Sum
3.72%	25.48%	32.19%	2.39%	3.18%	18.37%	12.69%	1.97%	100%
326	2232	2819	209	279	1610	1112	173	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 10.36 windPRO Shadow Module Inputs (in bold the differences among Worst Case and Real Case Scenario)**

	<b>Worst Case Scenario</b>	<b>Real Case Scenario</b>
Wind Turbine location	See Figure 10.8	See Figure 10.8
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	<b>The sun is always shining all day, from sunrise to sunset</b>	<b>The sun is shining as per available local sunshine data (Hue meteorological station)</b>
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 62 (around 15%) impacted receptors out of 429 mapped receptors of which three receptors receive more than 100 hours of shadow flicker per year (272, 273 and 422). The key potentially impacted area is mainly located in Cop and Phung Lam Villages of Huong Phung Commune. IFC thresholds have been exceeded for both parameters: hours/year and min/day at these receivers

with the most impacted receptor (273) experiences 104:23 hours per year with the maximum of 49 minutes per shadow day.

The following maps present the influencing areas where shadow flickering is occurring based on the Worst Case Scenario setting (Figure 10.10 to Figure 10.16).

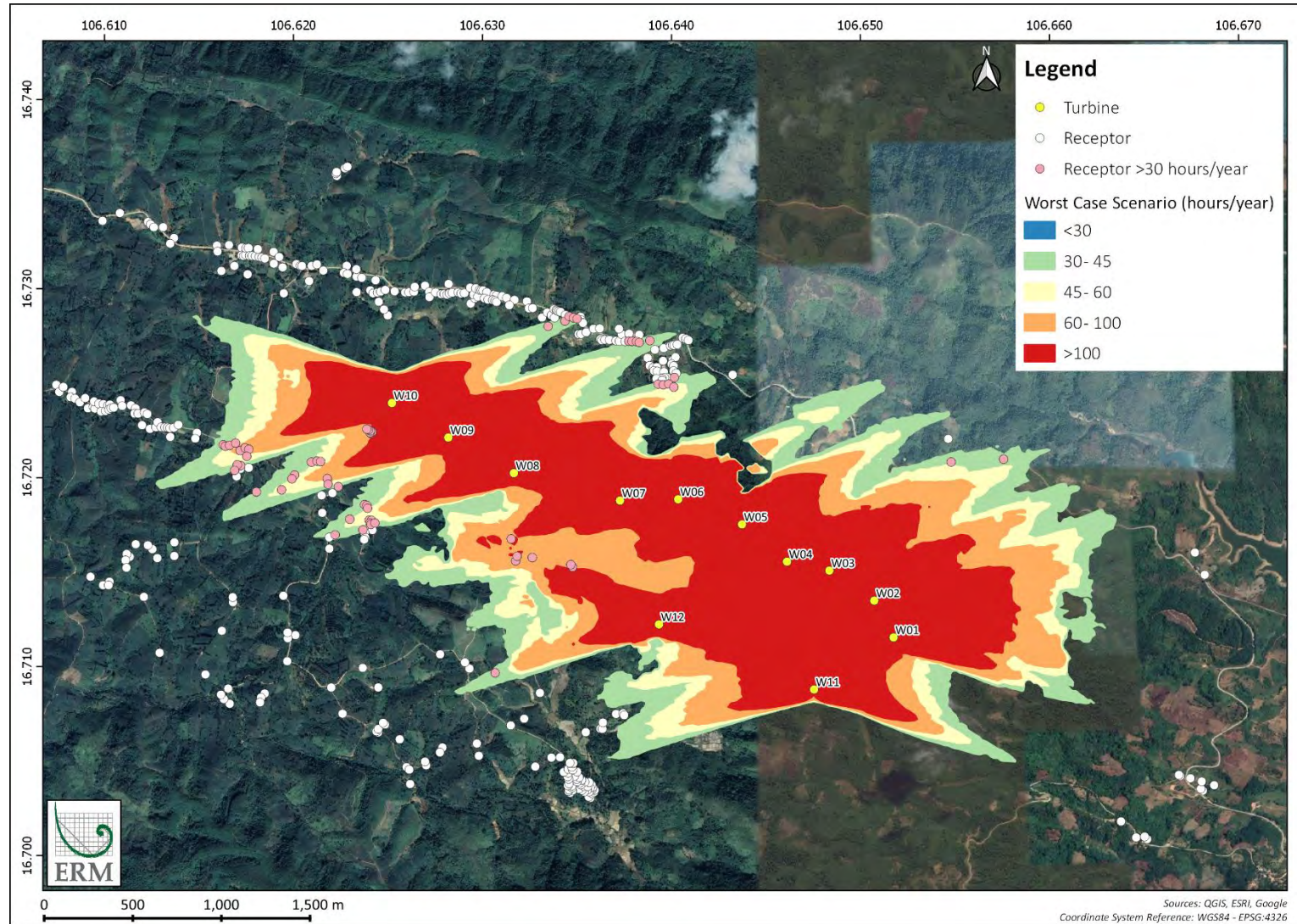


Figure 10.10 Map of Predicted shadow flicker (hours/year) – Worst Case Scenario

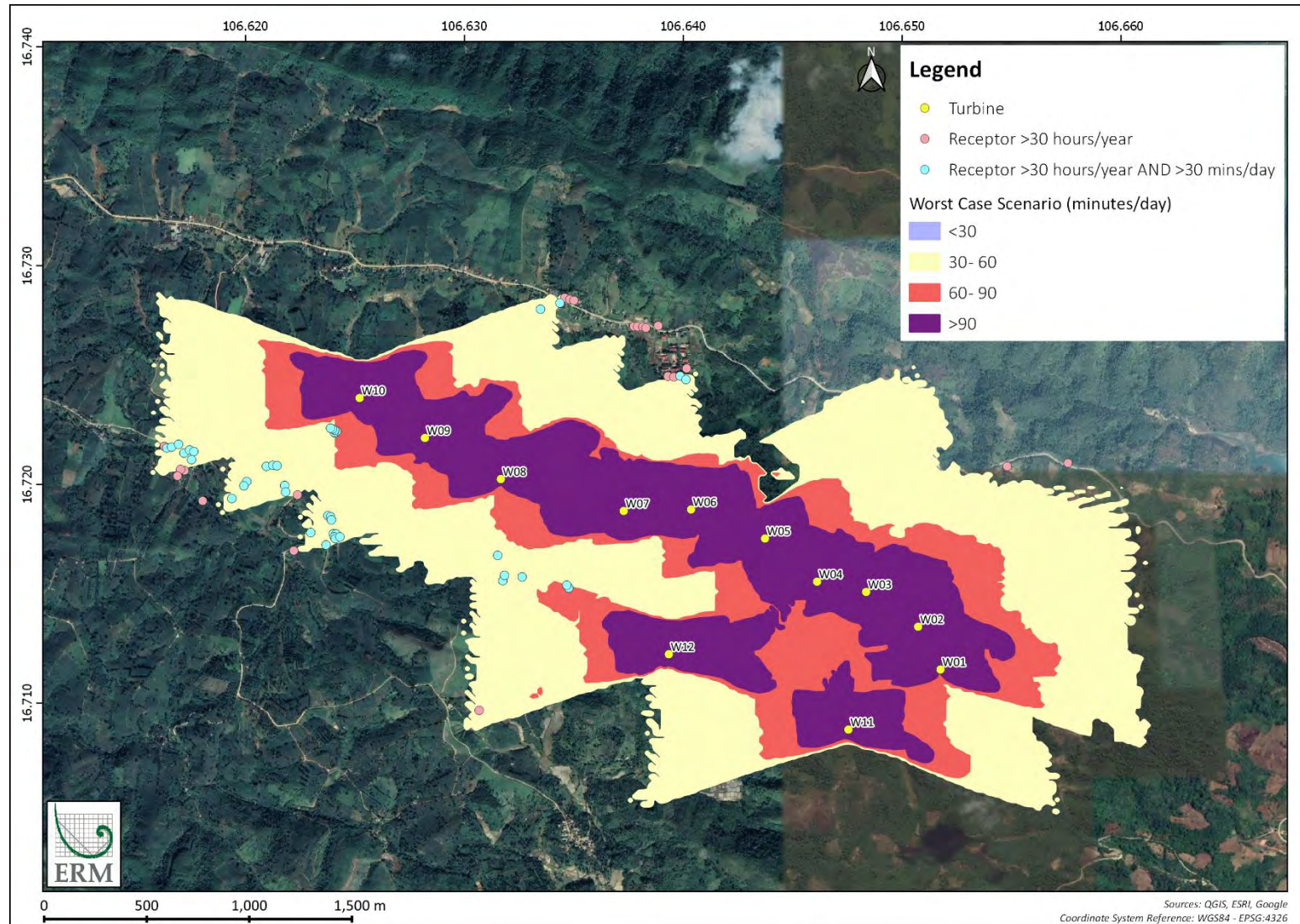
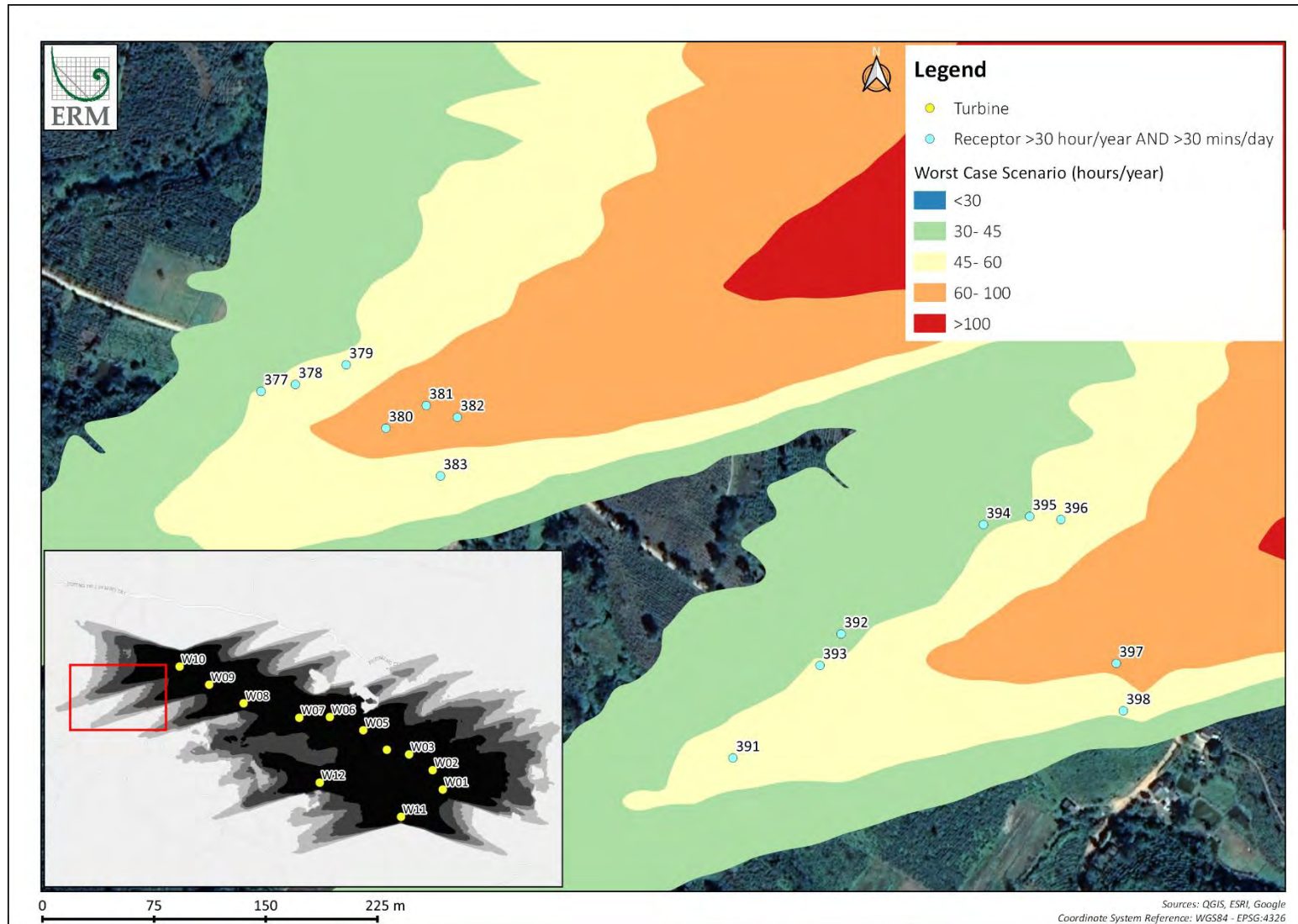


Figure 10.11 Map of Predicted shadow flicker (minutes/day) - Worst Case Scenario



**Figure 10.12 Map of Predicted shadow flicker at receivers no. 377 to 383 and 391 to 398 (hours/year) – Worst Case Scenario**



Figure 10.13 Map of Predicted shadow flicker at receivers no. 421 to 423, 425 and 426 (hours/year) – Worst Case Scenario

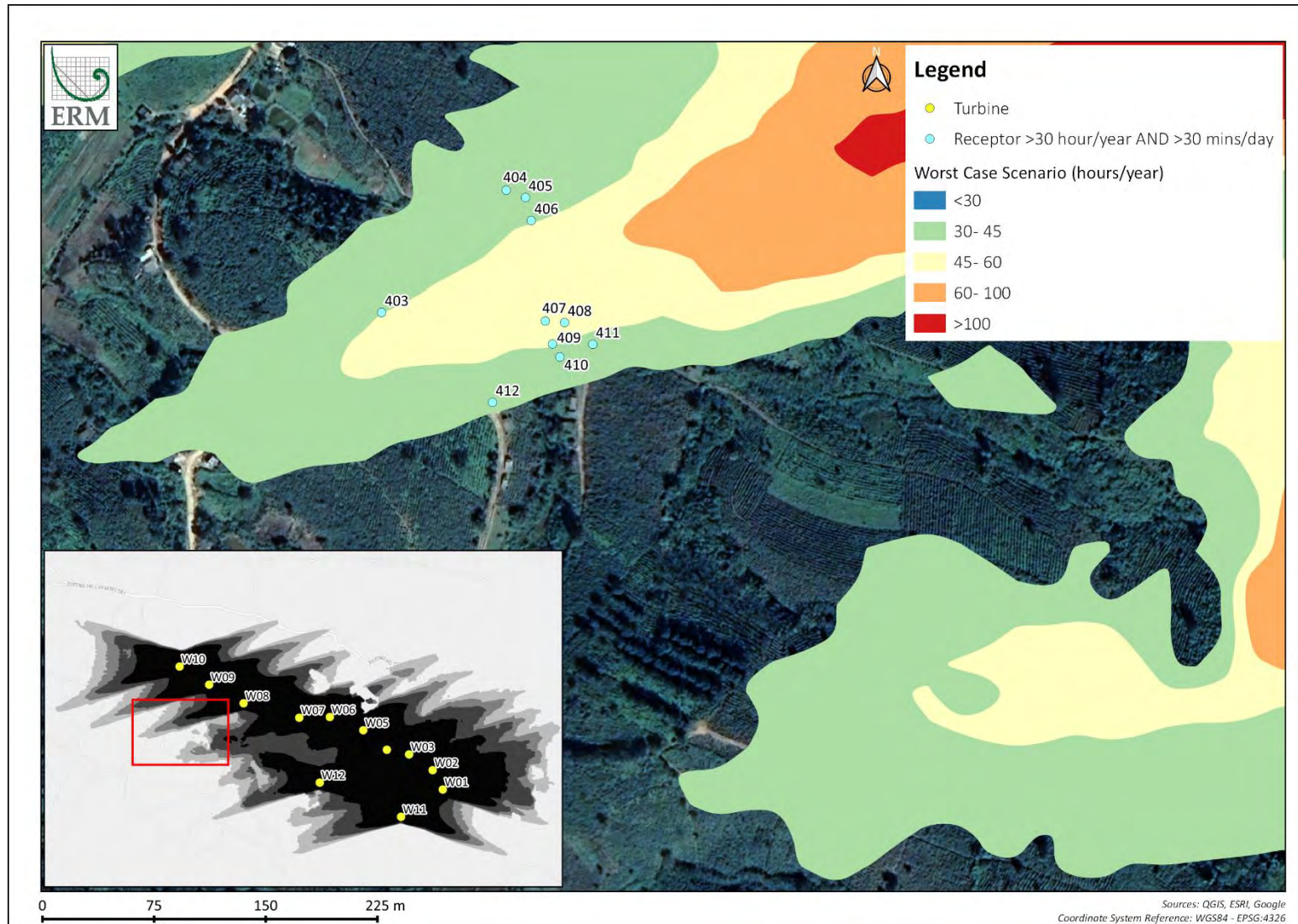
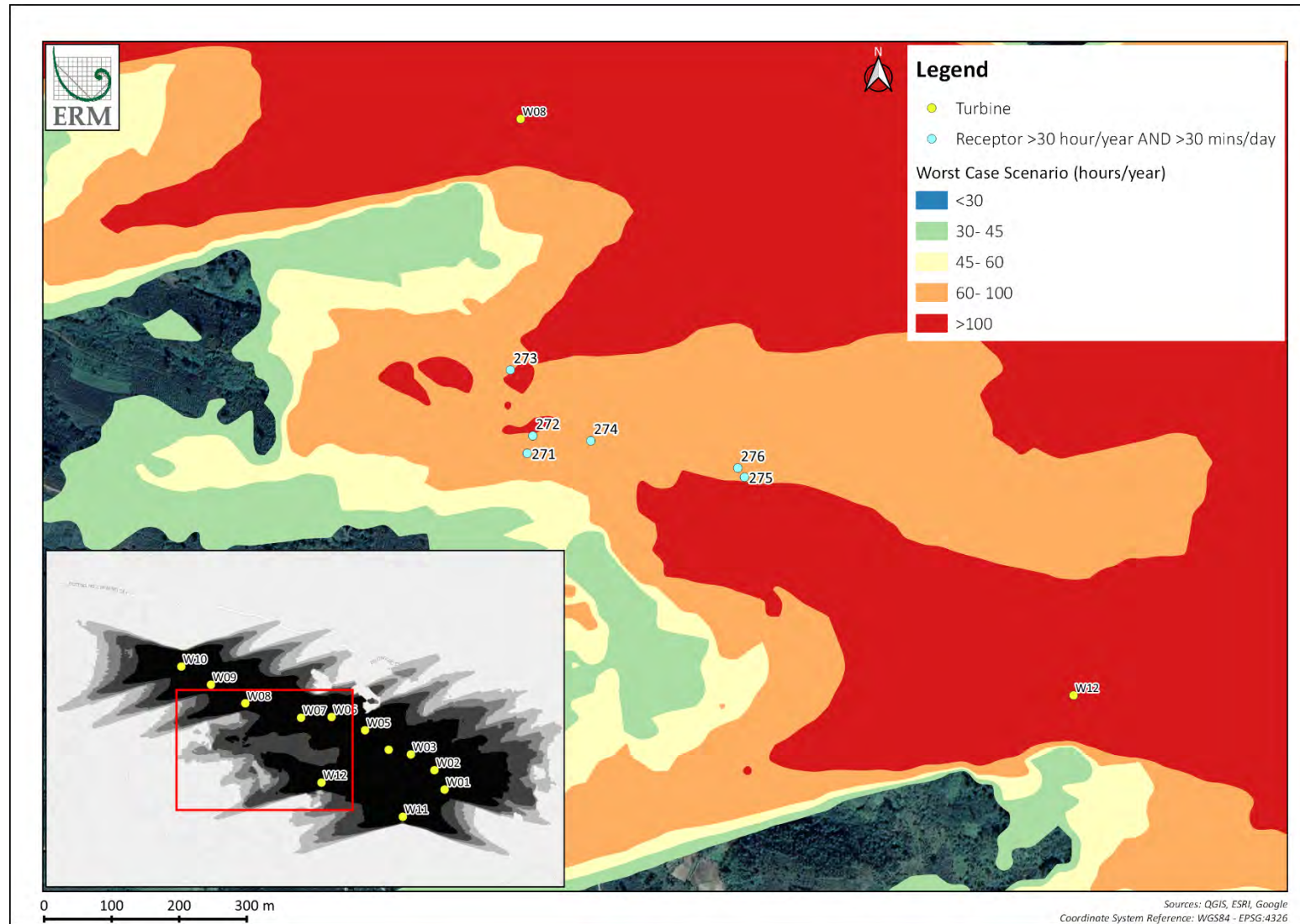


Figure 10.14 Map of Predicted shadow flicker at receivers no. 403 to 412 (hours/year) – Worst Case Scenario



**Figure 10.15** Map of Predicted shadow flicker at receivers no. 271 to 276 (hours/year) – Worst Case Scenario



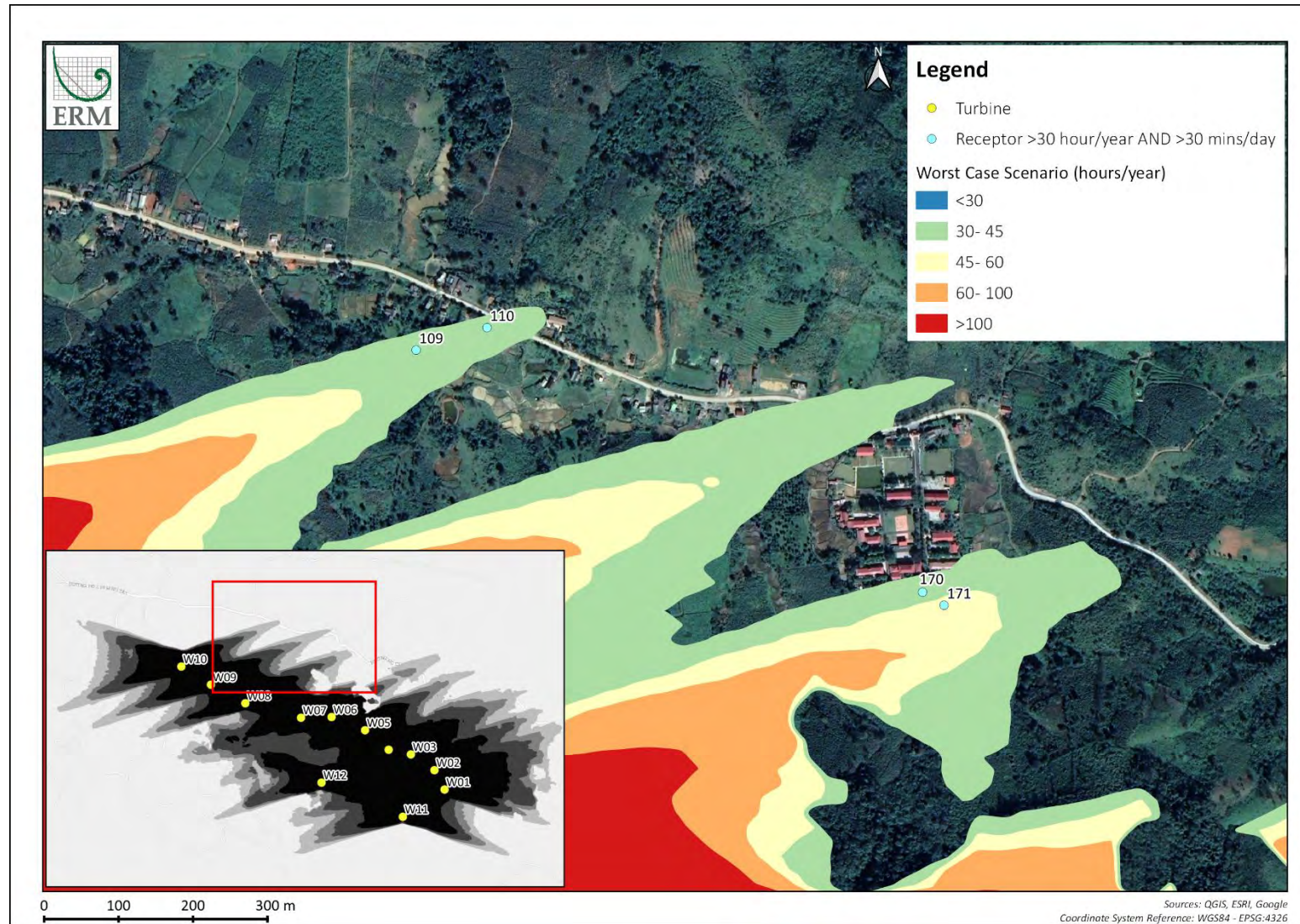


Figure 10.16 Map of Predicted shadow flicker at receivers no. 109, 110, 170 and 171 (hours/year) – Worst Case Scenario

### 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 10.17.

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 two instead of 62 as shown in worst-case scenario. For further detail modelling result, please refer to Appendix K.

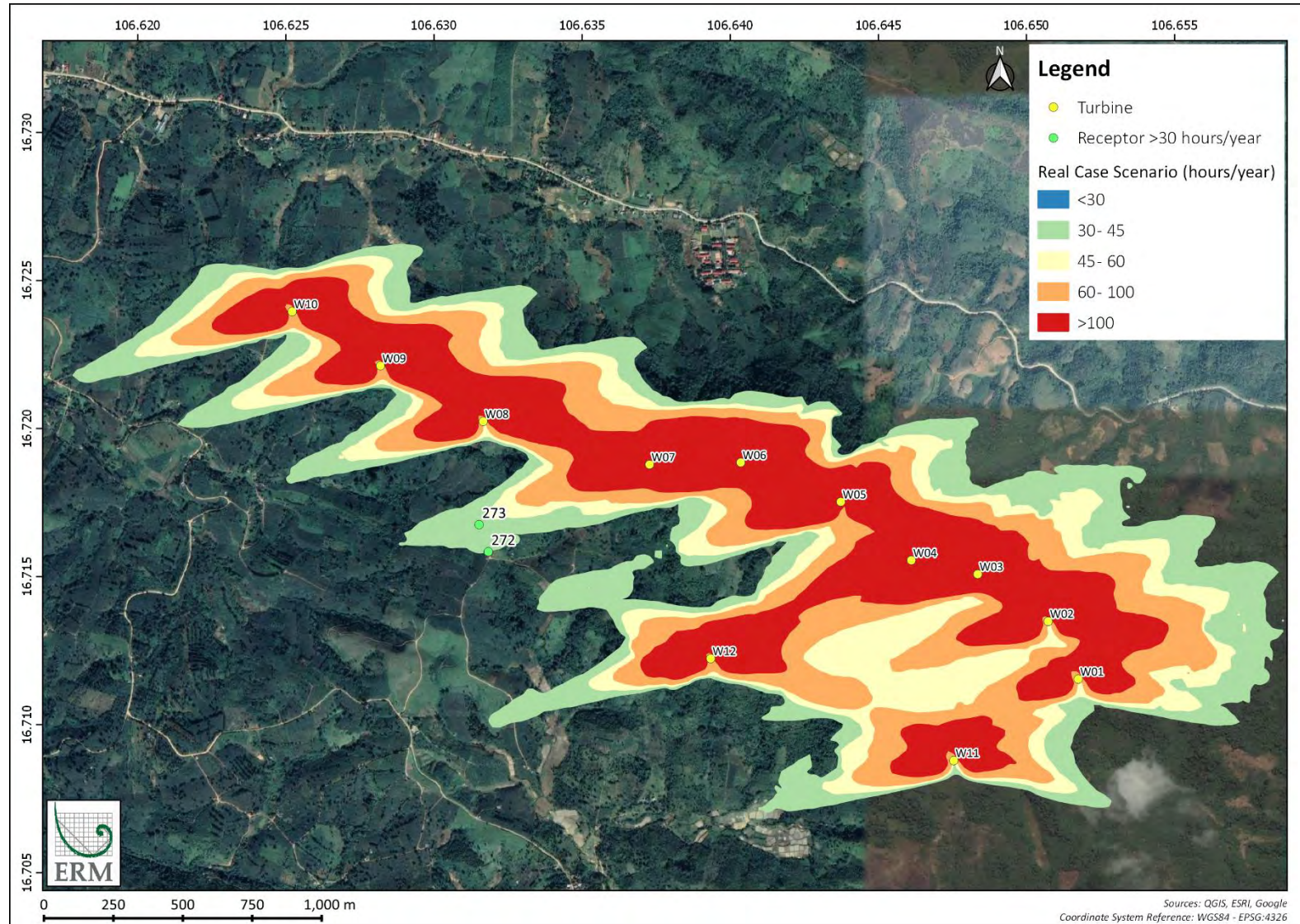


Figure 10.17 Map of Predicted shadow flicker (hours/year) – Real Case Scenario

## 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, even though the amount of receptors in real case scenario had been substantially reduced comparing to worst case scenario (2 versus 62 shadow receivers), 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. These conditions can reduce the potential to experience shadow flicker in real conditions;
- 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 1,500 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 10.18** Environmental setting at receptors no. 377 to 383, 391 to 398, 403 to 412, 421 to 423, 425 and 426



**Figure 10.19** Environmental setting at shadow receptor no. 271 to 276



**Figure 10.20** Environmental setting at shadow receptor no. 109, 110, 170 and 171

**Table 10.37 Impacts of Shadow Flickering**

Impact Nature	<b>Negative</b>		Positive	Neutral	
Impact Type	<b>Direct</b>		Indirect	Induced	
Impact Duration	Temporary	Short-term	<b>Long-term</b>		Permanent
	The impact duration is <b>Long-term</b> .				
Impact Extent	<b>Local</b>		Regional		Global
	Impacts are within the Project area.				
Impact Frequency	Throughout the operation phase of the Project. WTGs operate 24 hours/day				
Impact Magnitude	Positive	Negligible	Small	<b>Medium</b>	Large
	The impact magnitude is <b>Negligible</b> .				
Vulnerability of Receptors	Low		<b>Medium</b>		High
	The vulnerability of receptor is <b>Medium</b> .				
Impact Significance	Negligible		Minor	<b>Moderate</b>	Major
	The significance is <b>Moderate</b> .				

#### 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 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;
- 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 **Minor**.

### 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 10.8, 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 sensitivities 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.

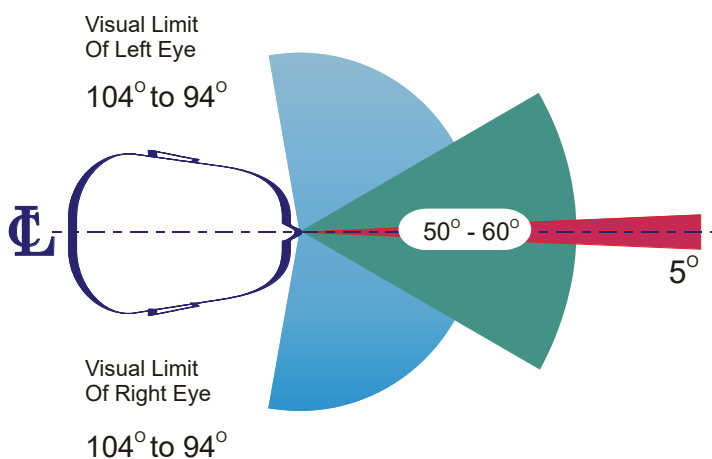
This ZTV was determined through a viewshed analysis using the software ArcMap 10.7. The viewshed analysis is based only on topography (i.e. digital elevation model), and represents the areas where the wind farm could be potentially visible. For this specific assessment SRTM (Shuttle Radar Topography 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<sup>60</sup> 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.

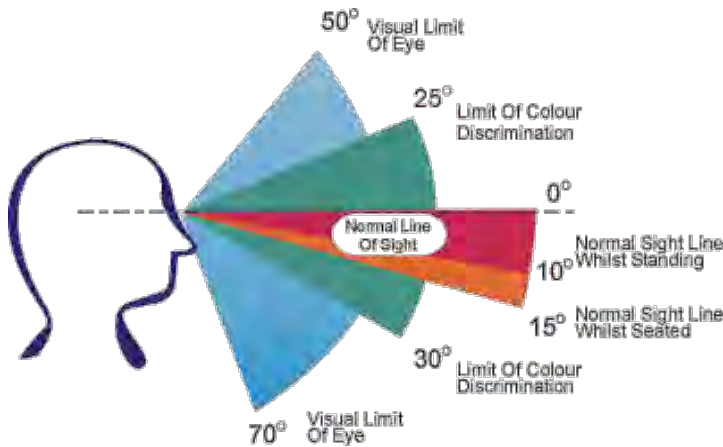


#### B. Vertical Field of View

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

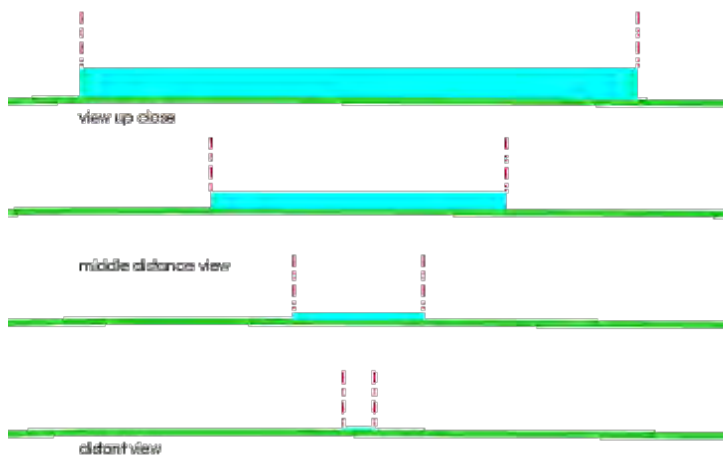
<sup>60</sup> Source: Human Dimension & Interior Space – A Source Book of Design Reference Standards, Julius Panero and Martin Zelnik, The Architectural Press Ltd. London, 1979

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.



### 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 10.38, 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 10.38 Horizontal Field of View**

Horizontal Field of View	Impact	Distance from Observer to a 138.25 m 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 10.39), shows the relationship between impact and the proportion that the development occupies within the vertical line of sight.

**Table 10.39 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 brought 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 10.21 shows the ZTV mapping from any points inside the buffer area.

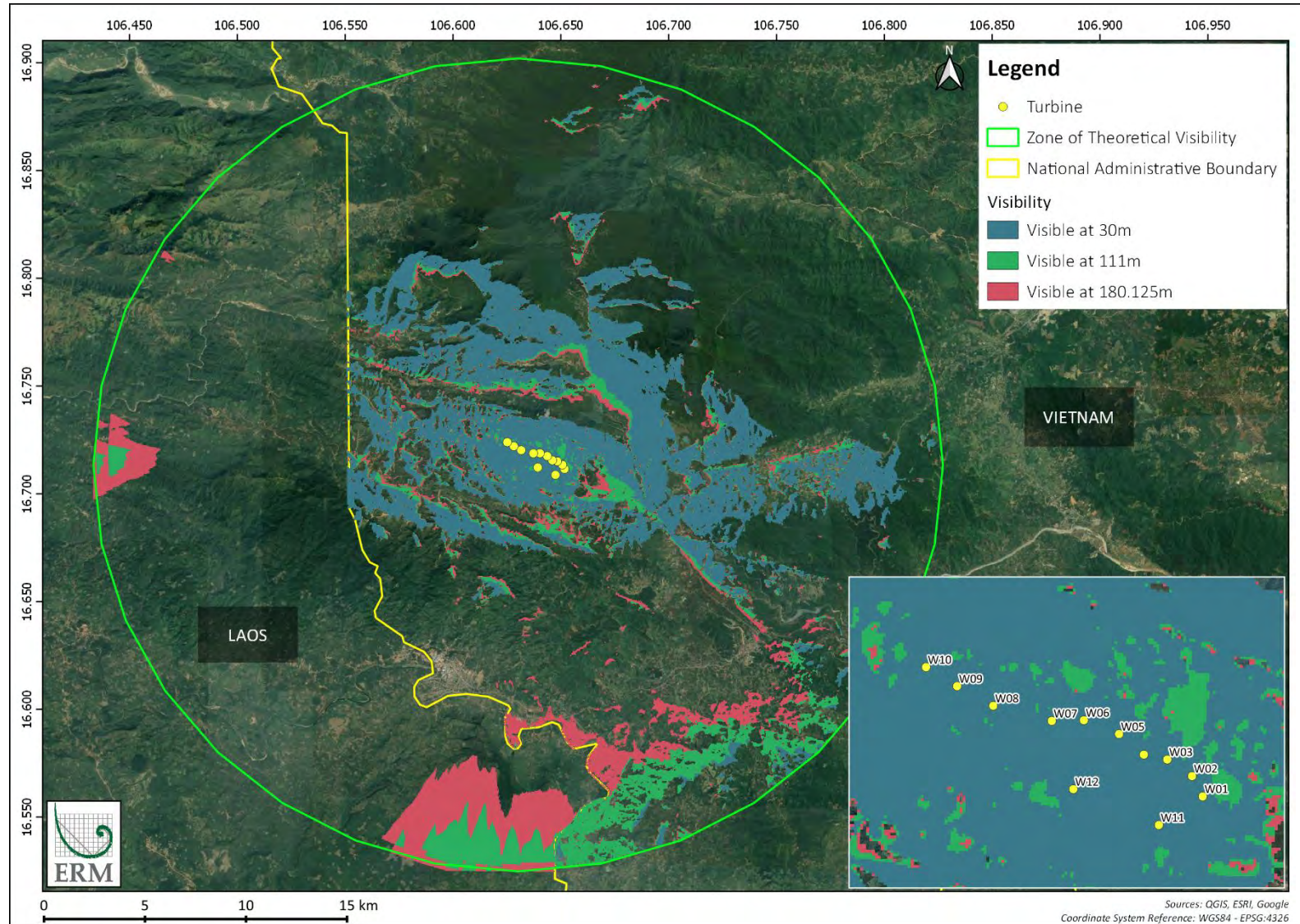


Figure 10.21 Viewshed (21 km buffer)

The results of the viewshed assessment as presented in Figure 10.21 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 Cop and Phung Lam Villages of Huong Phung Commune. Additionally, residents in Khe Sanh Town and Lao Bao Town (approximately 13 km and 11 km respectively from the Project site) can also be able to observe the Huong Phung 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 10.21 shows the locations of the VSRs selected for analysis.

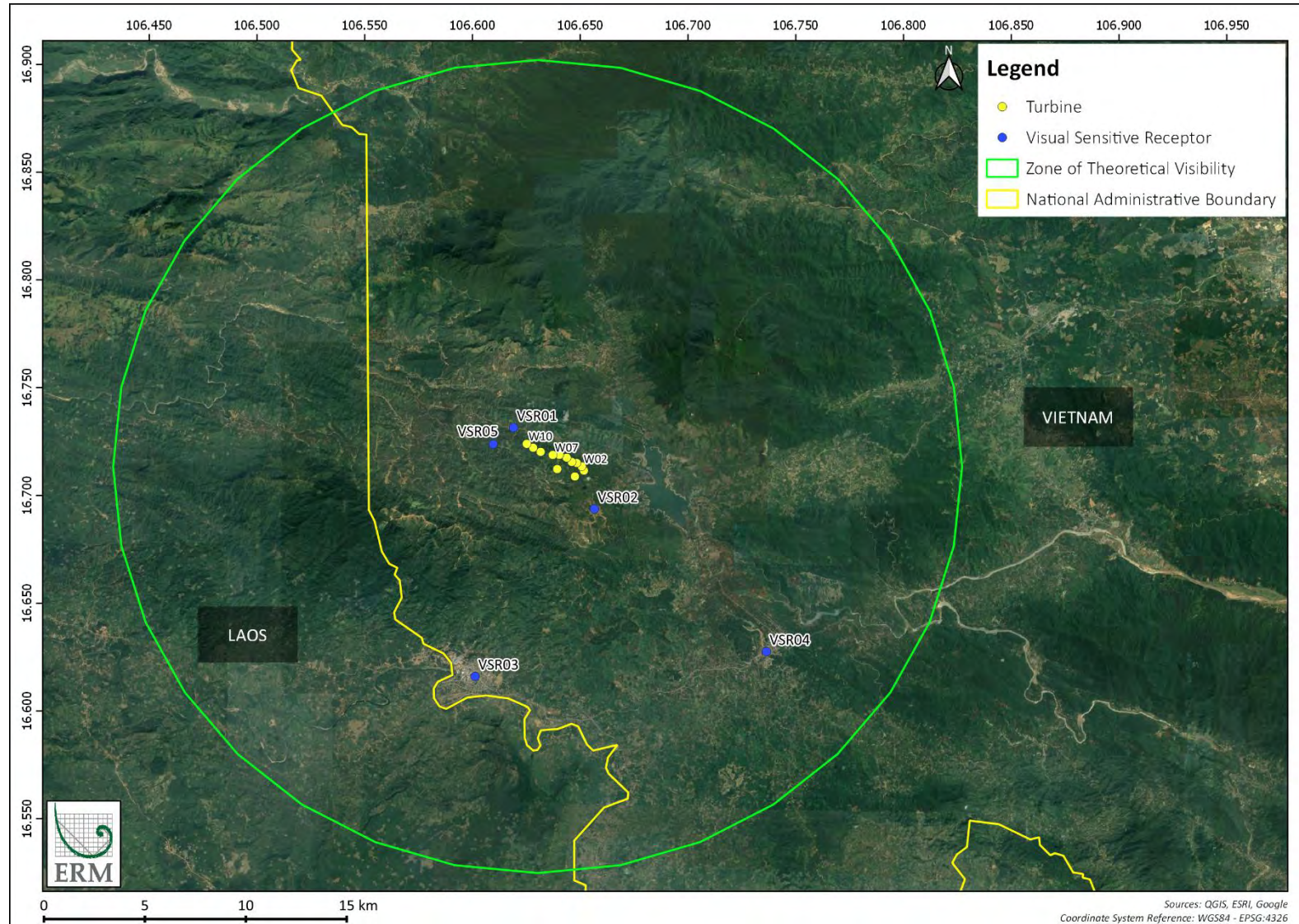


Figure 10.22 Visual Sensitive Receptors Location

## 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 10.40 indicates the relative sensitivities of a number of visual receptors.

**Table 10.40 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 10.41.

**Table 10.41 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 10.42 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

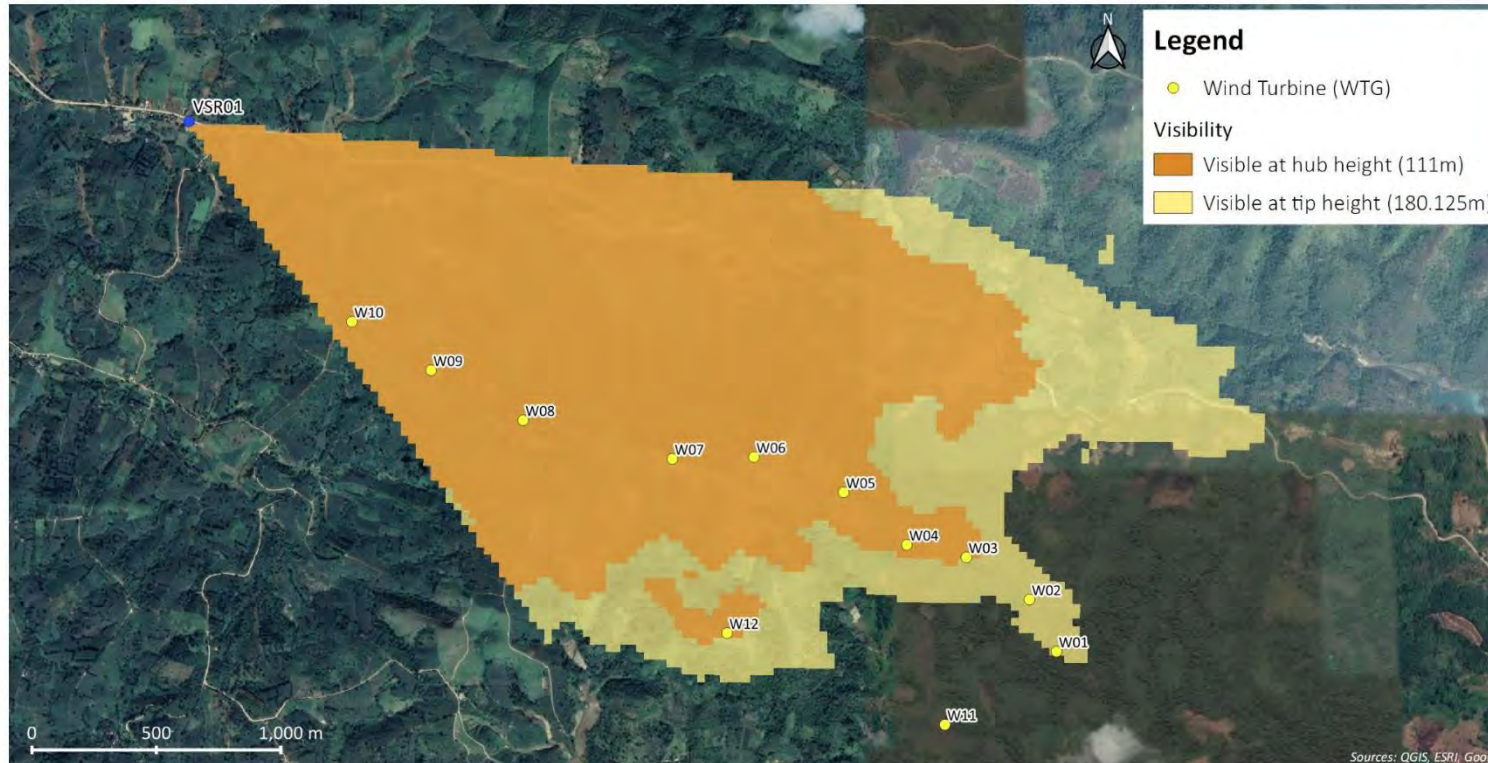
The visual impact is a product of the magnitude of change to the existing baseline conditions, the landscape context and the sensitivities of VSRs.

The viewshed analysis 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 10.22 shows the location of the VSRs which have been selected for the analysis and Table 10.43 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)
106.619076	16.731498	1.5	ESE	50	12	11	8	1,082.49	3,932.29

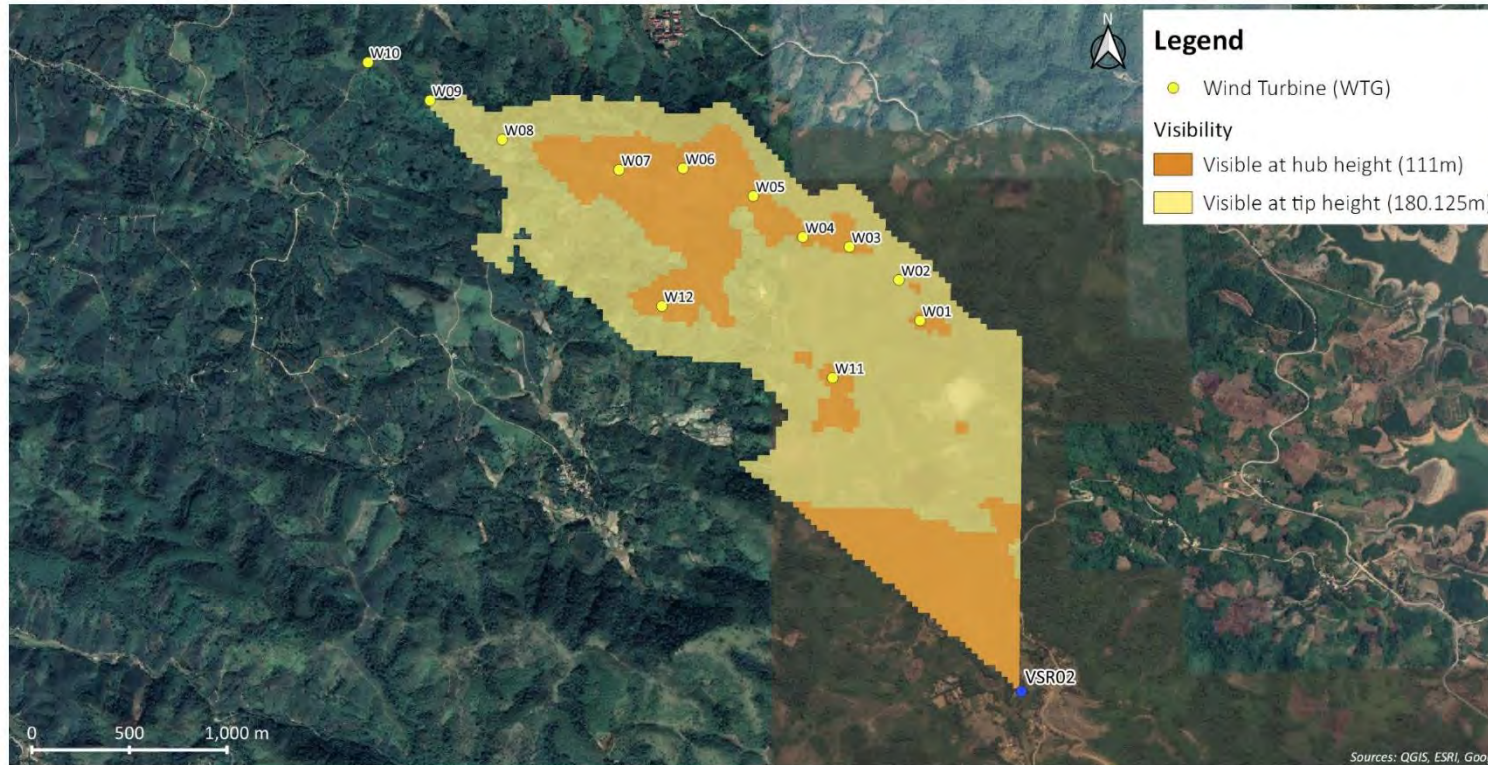
#### Visual Sensitivity

The view is taken from the residential area of Cop Village, Huong Phung Commune along the Ho Chi Minh West trail. 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

#### Magnitude of Change

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 medium

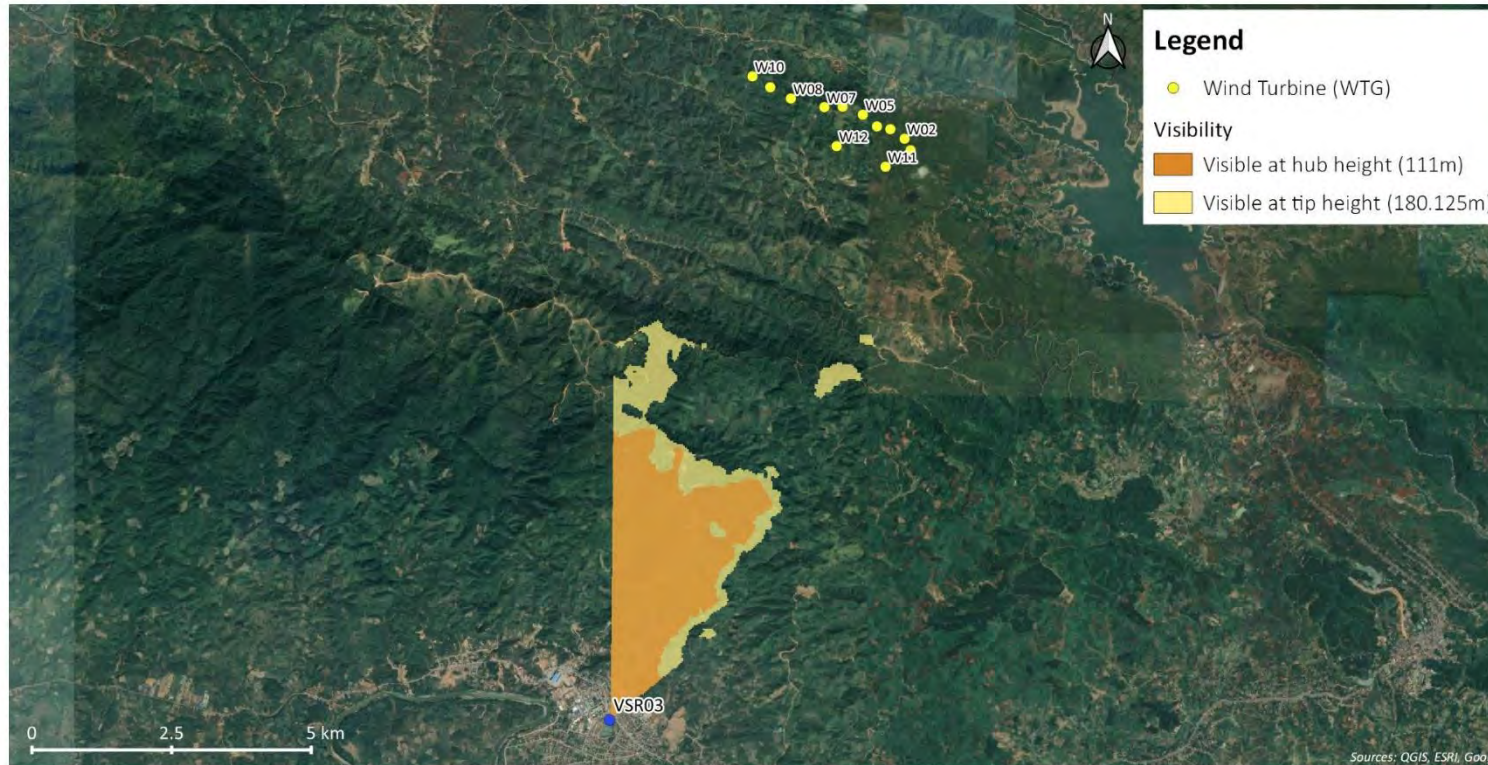
### VIEWPOINT VSR02



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)
106.656620	16.693720	1.5	NNW	50	12	11	8	1,941.32	4,729.85

Visual Sensitivity	Magnitude of Change
The view is taken from a scattered dwellings of Huong Tan 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 medium

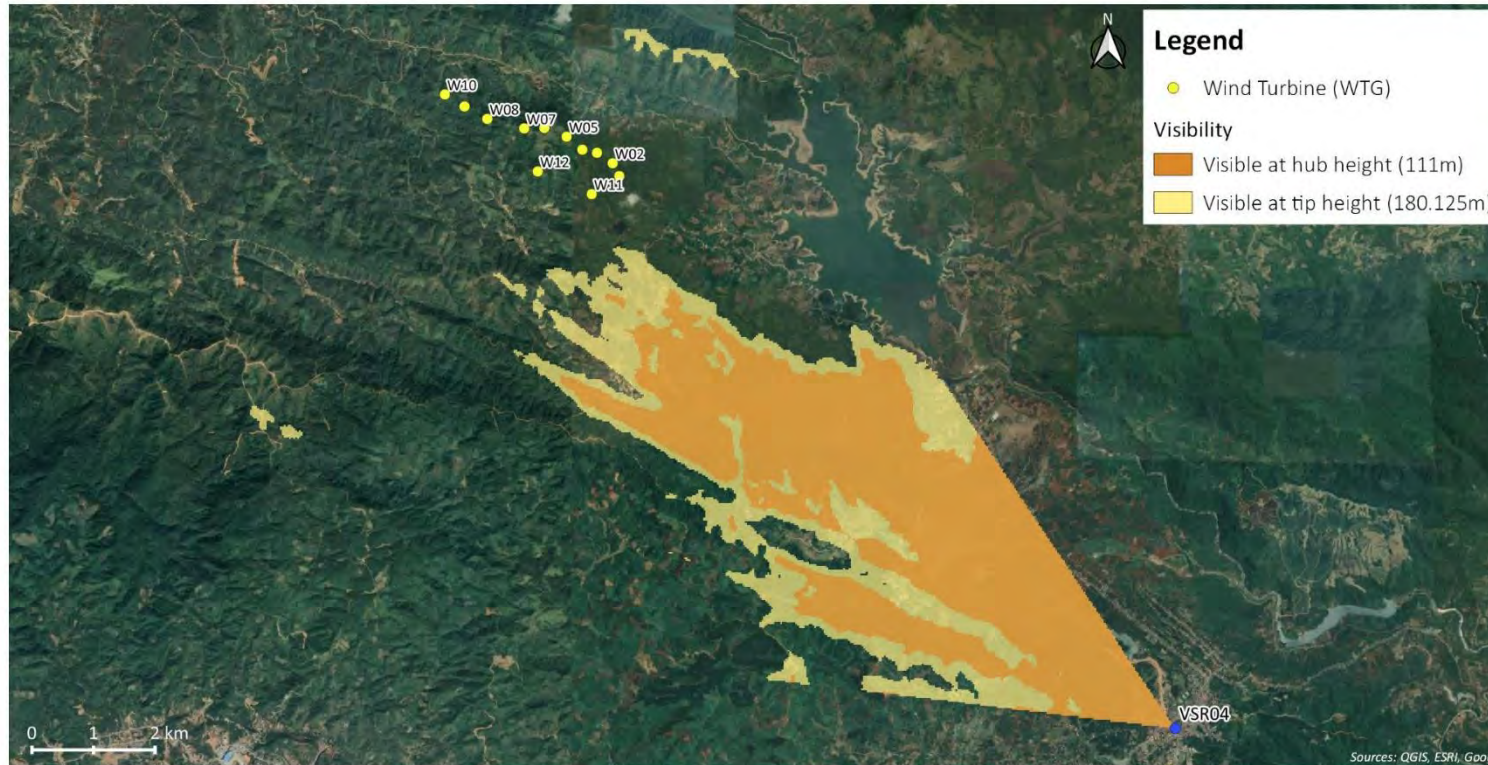
### VIEWPOINT VSR03



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)
106.601243	16.616052	1.5	NNE	50	12	0	0	11,410.94	12,226.817

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 will be visible. It is considered that the magnitude of change is negligible

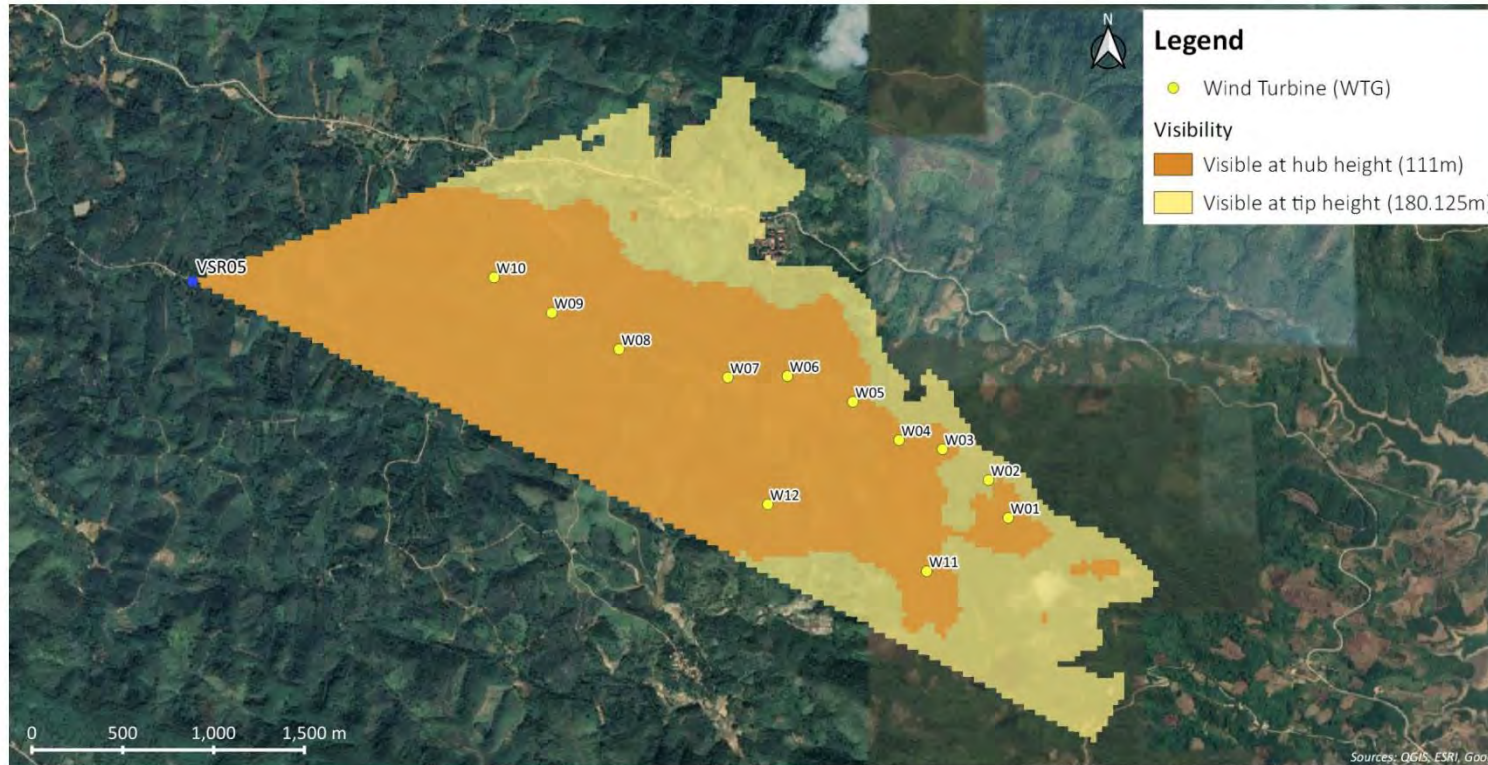
### VIEWPOINT VSR04



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)
106.736399	16.627550	1.5	NW	50	12	0	0	13,069.78	15,958.76

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 will be visible. It is considered that the magnitude of change is negligible

### 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)
106.609645	16.723739	1.5	E	50	12	11	12	1,655.36	4,688.26

Visual Sensitivity	Magnitude of Change
The present view is taken from the Phung Lam Village of Huong Phung. Due to the relatively 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 low	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 10.43 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	1.1 km	Visible	Medium	Medium	Moderate
VSR02	1.9 km	Visible	Medium	Medium	Moderate
VSR03	11.4 km	Not visible	High	Negligible	Negligible
VSR04	13.1 km	Not visible	High	Negligible	Negligible
VSR05	1.7 km	Visible	Low	Large	Moderate

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 **Minor**.

### 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 10.44 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 ( $\mu\text{T}$ ) or milli-Gauss (mG). The World Bank Group’s (WBG) Environmental, Health and Safety (EHS) Guideline<sup>61</sup> for Power Transmission and Distribution (WBG, 2007) refers to the International Commission on Non-Ionizing Radiation Protection (ICNIRP)<sup>62 63</sup> for health and safety standards relative to exposure to EMF. The World Health Organization (WHO)<sup>64</sup> 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 10.45). 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

<sup>61</sup> EHS Guidelines for Power Transmission and Distribution, April 30, 2007

<sup>62</sup> The ICNIRP Guidelines (2010) for limiting exposure to time-varying electric, magnetic and electromagnetic field (up to 300GHz) (<http://www.icnirp.de/PubEMF.htm>)

<sup>63</sup> These values represent the ICNIRP occupational exposure limits.

<sup>64</sup> 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 10.45 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 ( $\mu$ T)	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<sup>65</sup> for the calculation of electromagnetic field (EMF) around transmission and distribution overhead lines was used to calculate EMF for the 110kV 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 110kV transmission line

##### ■ Input data

As mentioned in Chapter of Project Description. 110kV transmission line is 110kV 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

<sup>65</sup> <http://electrical-engineering-portal.com/download-center/electrical-ms-excel-spreadsheets/emf-td-overhead-lines>

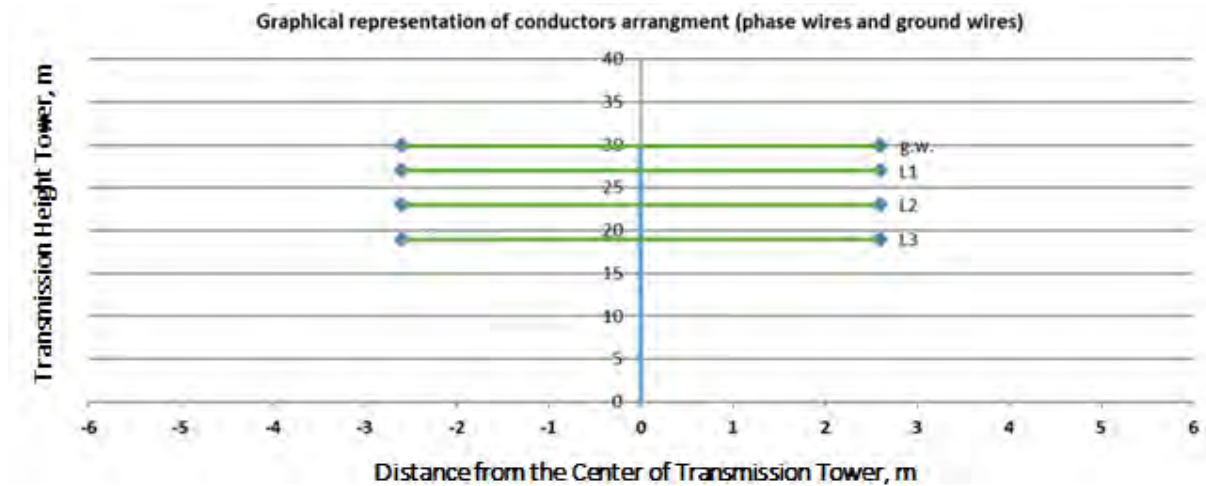
26 (34;38;42;46;50;54)	Height of Tower
A,B,C	Bearing Level

The input data used for setting up the transmission tower and circuit lines is given for Tower D122 - 30B and shown in Table 10.46 and Figure 10.23.

**Table 10.46 Transmission Line Parameters of Tower D122 - 30B**

			X [m]	Y [m]	Umax [kV]	I[A]	rA [mm]	dA [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<sub>A</sub> [mm] – wire radius; d<sub>A</sub> [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 10.23 Schematic Representation of Transmission Tower with Power Line Arrangement (for Transmission Tower D122 - 30B)**

Appendix M provides the different Tower configurations upon which this assessment is based

According to Feasibility Study, 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/NĐ-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

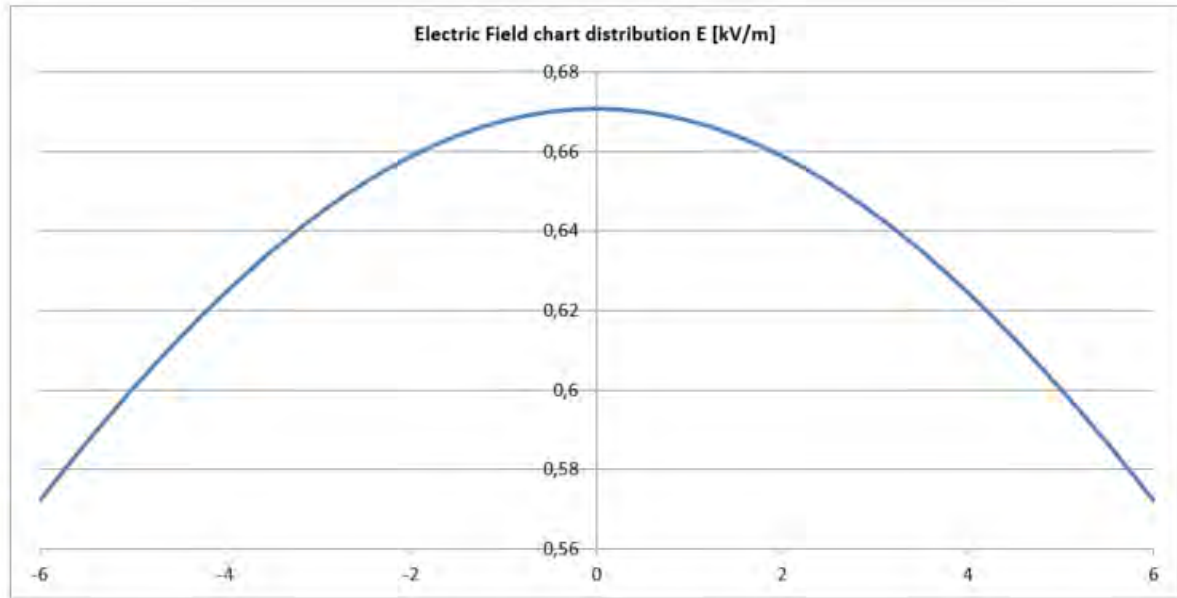
The mitigation measures identified in the EIAs include:

- 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.

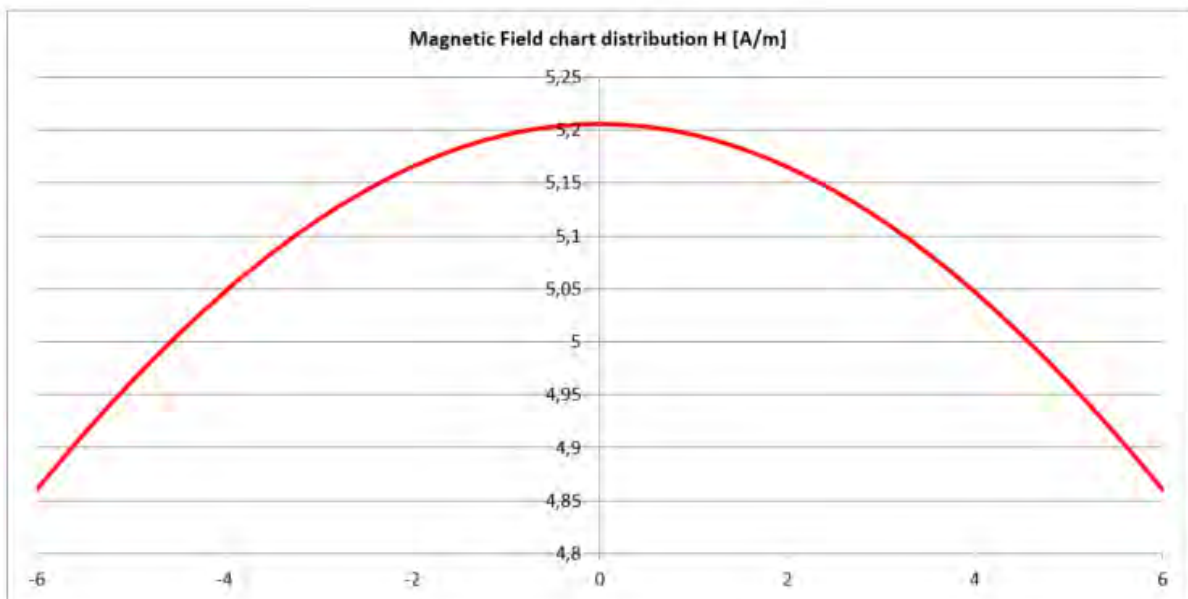
#### 10.8.4.1.3 Significance of Impacts

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 10.24 and Figure 10.25. The maximum electric and magnetic fields are 0.67 kV/m, 5.21 A/m respectively at 1 m above the ground.



**Figure 10.24** Electric Field Distribution for the Proposed Transmission Tower at 1 m above the ground



**Figure 10.25** 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 10.47. 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 ICNIRP and Decree 14/2014/NĐ-CP, dated 26<sup>th</sup> 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 10.47 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 10.48).

**Table 10.48 EMF Impact Assessment from overhead transmission line for the Operation Phase**

Impact Nature	<b>Negative</b>	Positive	Neutral
	Impact on health is considered Negative		
Impact Type	<b>Direct</b>	Indirect	Induced
	Direct impact on health of livelihoods or residences within the ROW		
Impact Duration	Temporary	Short-term	<b>Long-term</b>
	The impact duration is Long-term within the ROW.		
Impact Extent	<b>Local</b>	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	<b>Small</b>	Medium	Large
	The impact magnitude is Small.				
Receptor Sensitivity	<b>Low</b>	Medium		High	
	The vulnerability of receptor is Low as explained above.				
Impact Significance	<b>Negligible</b>	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 locally approved regulatory EIA states that the electromagnetic field should be monitored in the safety corridors of the 110kV transmission line, at the substation and at the location of turbine No.10. 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 26<sup>th</sup>, 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

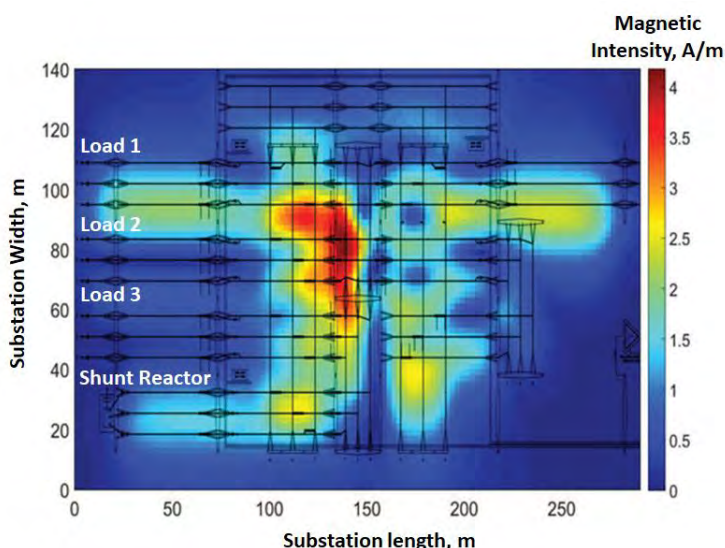
Electromagnetic fields from transformers in substation.

#### 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 400kV side connected to three loads, a shunt reactance and an autotransformer to step down the voltage to 220kV. 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 400kV side). The normal operating currents at frequency of 50Hz for each load. The magnetic field distribution was calculated at the height of 1.7m where measurements were available for comparison. The computed results for the normal operating currents are presented in Figure 10.26.



**Figure 10.26 Magnetic Field Distribution in the Substation Studied by Tamrizi et al. (2016) for a 400kV substation (280m long, 140m wide)**

Figure 10.26 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)<sup>66</sup> 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<sup>67</sup>, 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 10.49.

**Table 10.49 Impacts of EMF during Operation Phase from the Substation**

Impact Nature	<b>Negative</b>	Positive	Neutral		
	Impacts on health is considered <b>Negative</b>				
Impact Type	<b>Direct</b>	Indirect	Induced		
	Occupation health within the substation				
Impact Duration	<b>Temporary</b>	Short-term	Long-term	Permanent	
	The impact duration is <b>Temporary</b> within the substation				
Impact Extent	<b>Local</b>	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	<b>Small</b>	Medium	Large
	The impact magnitude is <b>Small</b> .				
Receptors Sensitivity	<b>Low</b>	Medium	High		
	The vulnerability of receptor is <b>Low</b> as explained above.				
Impact Significance	<b>Negligible</b>	Minor	Moderate	Major	
	The significance is <b>Negligible</b>				

#### 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:

<sup>66</sup> 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.

<sup>67</sup> 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) (20<sup>th</sup> 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.

- 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;
- 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 field 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 26<sup>th</sup>, 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.

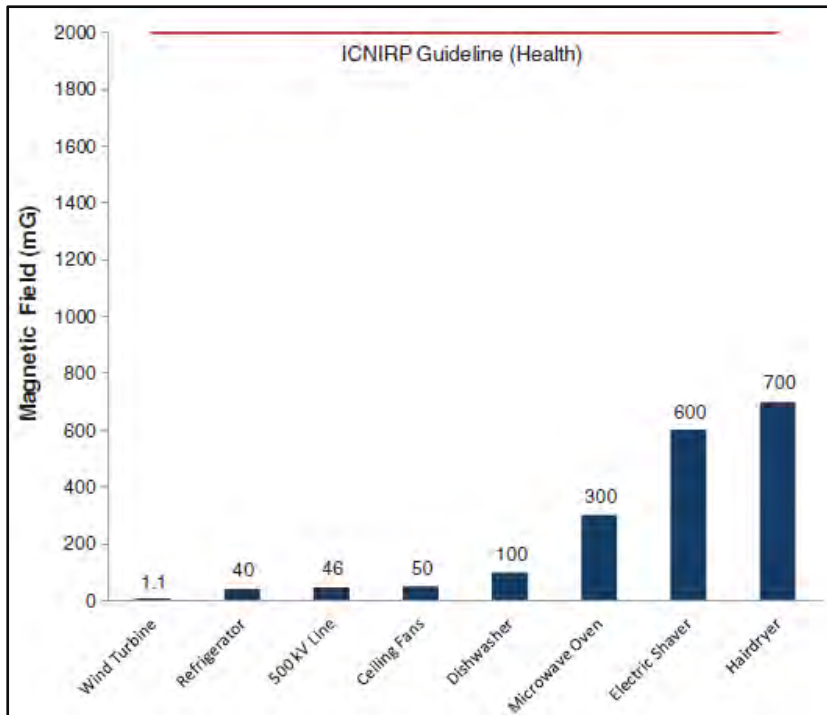
#### 10.8.4.3 EMF from wind turbine

##### 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 22kV with rated capacity of 3.8MVA, are expected to be lower than the 110kV 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)<sup>68</sup>, 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 (See Figure 10.27). 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.

<sup>68</sup> 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



Source: McCallum et al. 2011

**Figure 10.27 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.

#### 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, etc. ) and transportation of turbine and material from Hon La port and material purchasing point to the Project site;
- 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<sup>69</sup> in the year 2100 relative to preindustrial values (+2.6, +4.5, +6.0 and +8.5 W/m<sup>2</sup>, 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
- Temperature increase for Quang Tri Province is projected to vary between 0.4 and 1.2°C in the beginning of 21<sup>st</sup> Century, 1.0 and 2.0°C by middle 21<sup>st</sup> Century and 1.3 and 4.6°C by the end of 21<sup>st</sup> 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 21<sup>st</sup> Century, 7.5-26.2% by middle 21<sup>st</sup> Century and by 9.8-31.3% by the end of 21<sup>st</sup> Century (MONRE, 2016).

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<sup>69</sup> 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 December 2019)

## 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 21<sup>st</sup> century (MONRE, 2016). By the end of the 21<sup>st</sup> 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  $\geq 35^{\circ}\text{C}$ ) is predicted to increase to be 35 - 45 days per year by the middle of the 21<sup>st</sup> century and exceed 100 days per year by the end of the 21<sup>st</sup> 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 ( $\text{tCO}_2\text{e}$ )<sup>70</sup>.

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 ( $\text{CO}_2$ ), that contributing to climate change impacts.

<sup>70</sup> IFC Greenhouse Gas Reduction Accounting Guidance for Climate Related Projects. IFC Climate Business Department, May 2017

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 10.50

**Table 10.50 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 <sub>2</sub> , 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 <sub>4</sub> and N <sub>2</sub> O 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<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O 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 10.51 .

**Equation 1 Fuel Combustion**

$$E_j = \frac{Q_i \times EC_j \times EF_{ijoxec}}{1000}$$

where:

- E<sub>j</sub> = Estimated emissions of gas type j (CO<sub>2</sub>, CH<sub>4</sub> or N<sub>2</sub>O) (t CO<sub>2</sub>-e/year) from fuel type (i)
- Q<sub>i</sub> = Estimated quantity of fuel type (i) (tonnes or GJ/year)
- EC<sub>j</sub> = Energy content factor of fuel (j) (GJ/t or GJ/kL)
- EF<sub>ijoxec</sub> = Emission factor for each fuel type (j) (kg CO<sub>2</sub>-e/GJ or tonne)

**Table 10.51 Default Emissions Factors and Energy Content Factor for Diesel Combustion in Mobile Equipment and Vehicles**

Description	Value	Units
Energy content factor for diesel	43 <sup>a</sup>	MJ/kg or GJ/t
	35.9 <sup>b</sup>	GJ/kL
Diesel density <sup>c</sup>	0.840	kg/L or t/kL
Tier 1 CO <sub>2</sub> emission factor - diesel <sup>d</sup>	74.1	kg CO <sub>2</sub> -e/ GJ
Tier 1 CH <sub>4</sub> emission factor - diesel <sup>d</sup>	4.15	kg CH <sub>4</sub> / TJ

Description	Value	Units
	0.12	kg CO <sub>2</sub> -e/ GJ
Tier 1 N <sub>2</sub> O emission factor - diesel <sup>d</sup>	28.6	kg N <sub>2</sub> O/ TJ
	7.6	kg CO <sub>2</sub> -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<sub>2</sub> emission from operation of heavy equipment with the assumption below is presented in Table 10.52. 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 10.52 Estimated CO<sub>2</sub> 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 (3 months) (excluding public holidays)
1	10 pieces (2 excavators, roller, bulldozer, grader, 02 heavy trucks (12 -15T), crane, compactor, generator)	30 liters/hour <sup>71</sup>	8 hours/day	78 working days

Diesel quantity to complete the construction of 12 wind turbine: 18,720 litres

Diesel density: 0.84 kg/litre

Emission factor (CO<sub>2</sub>-e) : 81.82 kg CO<sub>2</sub>-e/ GJ

Energy content factor for diesel: 43 MJ/kg

Total estimated CO<sub>2</sub>e emission: 18,720 litres x 2.955 kg CO<sub>2</sub>e/litre = 55.3 tons CO<sub>2</sub>e

Additionally, the estimated CO<sub>2</sub> emission from transportation of material and equipment is calculated as follows:

**Table 10.53 Estimated CO<sub>2</sub> Emission from Transportation of Materials and Equipment**

Items	Number of heavy haul vehicle movement (one-way)/ day	Number of transportation days	Diesel use Rate <sup>72</sup> (litre/day)	Diesel Use Demand
Wind turbine component (turbine blade, Nacelle, Hub, Tower sections) and Transmission line component were transported by specialized trailers	2	78	68	10,608 litres

<sup>71</sup> 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

<sup>72</sup> Decision No 1134/QĐ-BXD of Ministry of Construction, dated October 8 2015 on Rate of fuel consumption of construction equipment.

Items	Number of heavy haul vehicle movement (one-way)/ day	Number of transportation days	Diesel use Rate <sup>72</sup> (litre/day)	Diesel Use Demand
Material (sand, stone, cement, steel) with a total volume of 67,733 tons <sup>73</sup> were transported by 10 tonne trucks	75	78	57	333,450 litres

Diesel quantity to complete the transportation of material and equipment: 344,058 litres

Total estimated CO<sub>2e</sub> emission: 344,058 litres x 2.955 kg CO<sub>2e</sub>/litre = 1,016 tons CO<sub>2e</sub>

The estimated CO<sub>2</sub> 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<sub>2e</sub>). 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 approximately 200,491 MWh of electric energy per year through wind power, which is considered as zero-emission during its 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 183,048 tonnes of carbon dioxide emission per year over its 20 year lifetime<sup>74</sup>.

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;
- Flooding and landslide may affect to substation and onshore components which results in loss of supply locally.

#### 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 10.54.

<sup>73</sup> Source: Local EPP

<sup>74</sup> The grid emission factor of Vietnam for 2018 is 0.913 tCO<sub>2</sub>/MWh, according to the Announcement No. 263/BDKH-TTBVOD of Department of Climate Change, Ministry of Natural Resources and Environment



**Table 10.54 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 10.55

**Table 10.55 Summary of Environmental Impact Assessment**

No	Impacts	Significance of Impacts		
		Impact Nature	Before Mitigation*	With Mitigation**
<b>Pre-Construction and Construction Phase</b>				
1	Air Quality	Negative	Negligible	Negligible
2	Water Resource Quantity	Negative	Moderate	Minor
3	Water Resource Quality	Negative	Moderate	Minor
4	Soil Compaction and Erosion	Negative	Minor	Negligible
5	Soil Contamination	Negative	Minor	Negligible
6	Noise Emissions	Negative	Minor	Negligible
7	Biodiversity			
	Loss of Habitat	Negative	Negligible	Negligible
	Disturbance and/or Displacement of Fauna	Negative	Negligible	Negligible
	Barrier Creation, Fragmentation and Edge Effects	Negative	Negligible	Negligible
	Degradation of Habitat	Negative	Negligible	Negligible
	Mortality – Vehicle Strike, Hunting and Poaching	Negative	Negligible	Negligible
8	Project Activities on Climate Change	Negative	Negligible	Negligible
<b>Commissioning and Operation Phase</b>				
9	Noise	Negative	Minor	Minor
10	Biodiversity			
	Mortality – Turbine and Transmission Line Strike	Negative	Negligible	Negligible
11	Shadow Flicker	Negative	Moderate	Minor
12	Landscape & Visual Amenity	Negative	Moderate	Minor
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 Huong Phung 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 Areas of Influence of Social Impacts**

During the socio-economic baseline engagement, Project impacts perceived by local authorities and communities are defined. Locally perceived impacts of the Project generated from consultations with local authorities, KIIs, FGDs and household survey are summarised in Table 9.54.

**Table 11.1 Locally Perceived Impacts of the Project**

Group	Project Impacts Identified through Consultation with Local Authorities and KIIs	Project Impacts Identified through FGDs and Household Interviews
Commune authorities	<ul style="list-style-type: none"> <li>■ Noise</li> <li>■ Impacts on climate in the surrounding area</li> <li>■ Impacts on agricultural production (cultivation and husbandry)</li> <li>■ Land acquisition</li> </ul>	
Huong Choa village	<ul style="list-style-type: none"> <li>■ Impacts on living environment</li> <li>■ Impacts on local livelihoods (farming and husbandry)</li> <li>■ Impacts on cultivation land</li> <li>■ Compensation for land acquisition</li> </ul>	<ul style="list-style-type: none"> <li>■ Negative impacts on livelihoods including loss of land, loss of trees, and loss of pastures for husbandry</li> <li>■ Unfair compensation in case of land acquisition</li> <li>■ Impacts on living environment (noise pollution)</li> </ul>
Phung Lam village	<ul style="list-style-type: none"> <li>■ Compensation price in case of land acquisition</li> </ul>	<ul style="list-style-type: none"> <li>■ Loss of cultivation land</li> <li>■ Impacts on trees, environment, health, and climate</li> <li>■ Unfair compensation in case of land acquisition</li> </ul>
Cop village	<ul style="list-style-type: none"> <li>■ Community safety due to an increase of social evils</li> <li>■ Overloaded traffic in the locality</li> <li>■ Polluted environment during the Project implementation process</li> </ul>	<ul style="list-style-type: none"> <li>■ Impacts on cultivation activities, crop yield and production</li> </ul>

Source: Socio-economic survey conducted by ERM, 2020

Project development activities causing the potential impacts to stakeholders who are identified as receptors of the impacts are summarised in Table 11.2. 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 Phase:**

- 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 Phase:**

- Disturbance on local community during operation; and
- Impacts on Indigenous People (both construction and operation).

**Table 11.2 Summary of Potential Impacts, Receptors and Areas of Influence**

Project Activities	Potential Impacts	Receptors	Areas of Influence
<i>Pre-Construction Phase</i>			
<ul style="list-style-type: none"> <li>■ Land acquisition</li> <li>■ Site clearance</li> </ul>	Economic displacement and loss of livelihoods: <ul style="list-style-type: none"> <li>■ Loss of land and access to land owned by local people and indigenous people</li> <li>■ Loss or relocation of assets on land</li> <li>■ Change of land use</li> <li>■ Loss of/Impact on livelihood associated with loss of land resulting in full or partial loss of income</li> </ul>	<ul style="list-style-type: none"> <li>■ Local land users who will have their production land acquired by the Projects;</li> <li>■ Local agriculture and forest farmers whose livelihoods are dependent on the land area to be acquired by the Projects;</li> </ul>	<ul style="list-style-type: none"> <li>■ Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> </ul>
<ul style="list-style-type: none"> <li>■ Land preparation (site clearance, excavation and levelling), fencing, and civil works</li> </ul>	<ul style="list-style-type: none"> <li>■ Potential disturbances to the nearby agriculture activities</li> <li>■ General disturbances from dust, noise and vibration</li> </ul>	<ul style="list-style-type: none"> <li>■ Nearby land users who have land adjacent to Project area</li> </ul>	<ul style="list-style-type: none"> <li>■ Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> </ul>
<i>Construction Phase</i>			
<ul style="list-style-type: none"> <li>■ Equipment and material transport and supply</li> <li>■ Construction of turbine foundations, transmission line pylons, internal road, auxiliary works and turbine installation</li> </ul>	General disturbances and tensions with local communities: <ul style="list-style-type: none"> <li>■ General disturbances caused by construction activities producing dust, waste and wastewater</li> <li>■ Temporary occupation of farming land during construction of transmission line and substation</li> <li>■ Tension with local community linked to issues of cultural conflict between local people and migrant workers</li> <li>■ Tensions among different stakeholder groups due to unequal distribution of benefits and impacts</li> </ul>	<ul style="list-style-type: none"> <li>■ Local farmers who have land along the transmission lines</li> <li>■ Local communities nearby Project sites</li> <li>■ Local authorities at commune/district levels</li> </ul>	<ul style="list-style-type: none"> <li>■ Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> <li>■ Surrounding communes in Huong Hoa district</li> </ul>

Project Activities	Potential Impacts	Receptors	Areas of Influence
<ul style="list-style-type: none"> <li>Wastes, emissions and discharges generation, handling and disposal</li> </ul>	<ul style="list-style-type: none"> <li>Potential burdens on local infrastructure and public services (health care, food and commodities, road, electricity supply, water supply and waste collection)</li> </ul>		
<ul style="list-style-type: none"> <li>Operation of associated facilities such as the concrete batching plant</li> <li>Construction water usage</li> <li>Workforce Presence</li> </ul>	<p>Potential benefits from local recruitment and local procurement:</p> <ul style="list-style-type: none"> <li>Increased local employment and revenue</li> <li>Income from compensation payment for households with land acquisition</li> <li>Temporary direct employment for the Project and induced employment opportunities by local suppliers</li> <li>Improved local infrastructure thanks to renovation for Project's access road</li> <li>Support to community through community development program of the Project</li> </ul>	<ul style="list-style-type: none"> <li>Local authorities at commune/district level</li> <li>Local economy, local businesses</li> <li>Affected households</li> <li>Local communities</li> <li>Local contractors/suppliers</li> </ul>	<ul style="list-style-type: none"> <li>Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> <li>Huong Hoa district</li> <li>Quang Tri province</li> </ul>
	<p>Community health, safety and security:</p> <ul style="list-style-type: none"> <li>Health impacts associated with dust, waste management, noise generated from construction activities</li> <li>Potential increase in the transmission of communicable diseases</li> <li>Increased incidence of traffic accidents from construction vehicles traffic and commuting</li> <li>Security related impacts or concerns</li> </ul>	<ul style="list-style-type: none"> <li>Local communities nearby Project sites</li> <li>Local communities residing/ commuting along the transportation routes</li> </ul>	<ul style="list-style-type: none"> <li>Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> <li>Surrounding communes in Huong Hoa district</li> </ul>
	<p>Cultural heritage of Indigenous Peoples:</p> <ul style="list-style-type: none"> <li>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</li> </ul>	<ul style="list-style-type: none"> <li>Cultural heritage values</li> </ul>	<ul style="list-style-type: none"> <li>Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> </ul>

*Commissioning and Operation Phase*

Project Activities	Potential Impacts	Receptors	Areas of Influence
<ul style="list-style-type: none"> <li>■ Workforce Presence</li> <li>■ WTG Operation</li> </ul>	<p>Economy and livelihood:</p> <ul style="list-style-type: none"> <li>■ Increased local revenue and employment;</li> <li>■ Improved local small and medium businesses and skills; improved local infrastructure (access road, school and clinics);</li> <li>■ Support to local community development plans</li> <li>■ Create landscapes that might attract tourism to the area</li> </ul>	<ul style="list-style-type: none"> <li>■ Local communities and suppliers</li> <li>■ Local authorities</li> <li>■ Vietnam Electricity Corporate (EVN)</li> </ul>	<ul style="list-style-type: none"> <li>■ Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> <li>■ Huong Hoa District</li> <li>■ Quang Tri Province</li> </ul>
<ul style="list-style-type: none"> <li>■ WTG Inspection and Maintenance</li> <li>■ Waste, emissions and discharge generation, handling and disposal</li> </ul>	<p>General disturbances to local communities:</p> <ul style="list-style-type: none"> <li>■ Impacts from operation noise of turbines and transformers</li> <li>■ Impacts from shadow flicker</li> </ul>	<ul style="list-style-type: none"> <li>■ Local communities</li> </ul>	<ul style="list-style-type: none"> <li>■ Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> </ul>

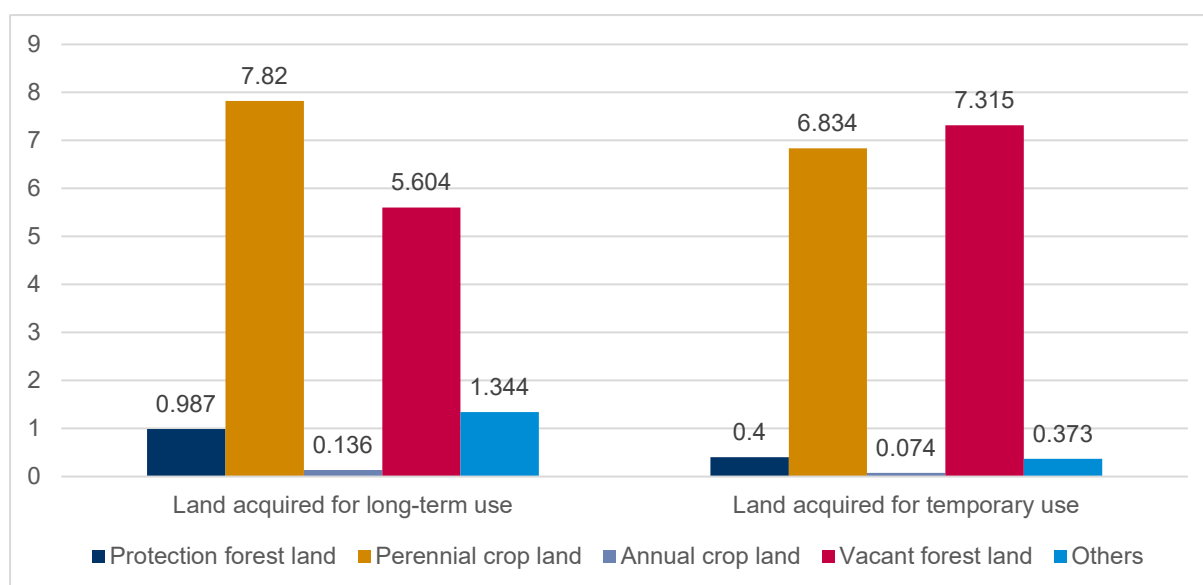
*Unplanned Events*

<ul style="list-style-type: none"> <li>■ Leakage and spill incidents</li> <li>■ Fire and explosion</li> <li>■ Vehicle accident</li> <li>■ Blade throw</li> <li>■ Transmission line snapping</li> <li>■ Natural hazards (flood and landslide)</li> </ul>	<ul style="list-style-type: none"> <li>■ Community health</li> <li>■ Community safety and security</li> <li>■ Environmental Quality</li> </ul>	<ul style="list-style-type: none"> <li>■ Local communities</li> </ul>	<ul style="list-style-type: none"> <li>■ Huong Phung, Huong Linh, Huong Tan, and Tan Hop communes</li> </ul>
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## 11.2 Impacts on Economic Displacement and Loss of Livelihoods

### 11.2.1 Potential Impacts

Land acquired for the Project is estimated to be 30.887 ha, including 15.891 ha for fixed term use (including turbine foundations and safety corridor, transmission lines, warehouse and inter-village and internal roads) and 14.995 ha for temporary use (for example, the laydown area and safety corridors of the transmission lines). A large proportion of acquired land is perennial crop land and forest land (see Figure 11.2). Moreover, more than one ha of annual crop land will be acquired.



**Figure 11.2 Land Areas Acquired for the Project**

The land acquisition and compensation for the Project started in mid-2019. Based on ERM's review of decisions on land acquisition by Huong Hoa District People's Committee for the Project (Batch 1 and 2), there are 32 households whose lands will be acquired for the Project. Thirteen out of 32 affected households by land acquisition are Van Kieu ethnic minorities. An update list of affected households sent by the Project has resulted an additional group of 51 households. All of Project affected households relate to economical displacement and no physical displacement will be occurred. It is noted that the exact number of affected households will be confirmed once the final CSR plans for the Project are completed.

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.

#### **Loss of Land and Livelihood Impacts**

The socio-economic baseline finding indicates that land-based livelihoods are dominate in the affected communes, with approximate 85% of the surveyed households engaging in cultivation. In Cop village, 95% of residents rely on land-based activities with an average income from agriculture of 850,000 VND per month. Rice The average area of agricultural land per household is 12,582 m<sup>2</sup>. Rice, coffee and cassava are common crops of the surveyed households. Rice cultivation is mainly for domestic use, while coffee and cassava are for a commercial purpose. Even when local people have a secondary

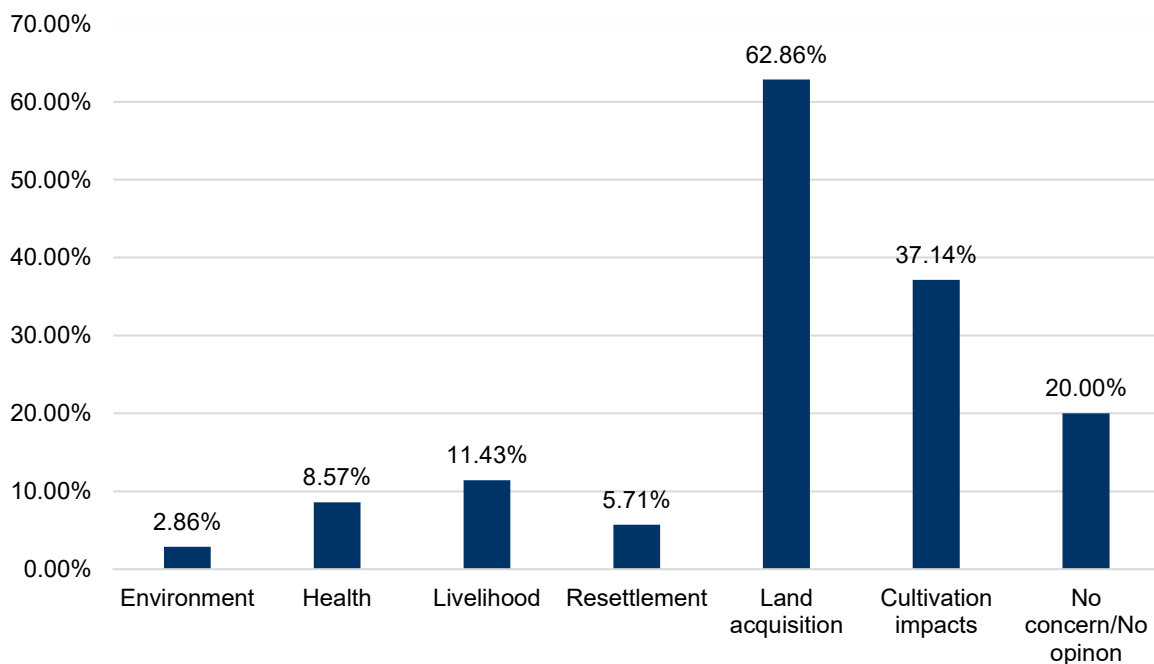


occupation, a majority of them works as hired labourers. 25% of surveyed population see their work as temporary.

It should be noted that local households who usually do not have money to buy fertilizers have to buy them with loans from local agricultural agents. These agents purchase coffee when the households harvest their beans, but selling coffee is lower than selling to other traders. Balancing income and expenditure is an evitable concern - 97% of surveyed households have to get financial support as their monthly income over the preceding three years did not cover their household expenditure.

Among the 35 surveyed households, 13 are recognised as poor households, and this is the highest category (37.1%). Eight households (22.9%) are classified as near poor, four (11.4%) as female-headed households, three (8.6%) having a family member who is physically disabled and two (5.7%) with an illiterate main bread-winner. There is one household with orphans/abandoned children and one household including an elderly person above the age of 60 living alone (2.9% for each category). There is one household with a single mother under the poor household category and raising children under the age of 16 or children aged 16-18 and attending school (2.9%).

Land acquisition is the biggest concern of the surveyed households about the Project implementation. Surveyed households shared their concerns about the Project through household interviews (see Figure 9.85). Most of the interviewed households practice agriculture or rely on land-based livelihoods so they are worried about land acquisition (62.9%) and cultivation impacts (37.1%) when the Project is implemented in the locality.



Source: Socio-economic survey conducted by ERM, 2020

**Figure 11.3 Local Concerns about the Project Impacts**

Land-based livelihood is also important as it ensures domestic food security. Many households in Huong Choa village expressed their fears about loss of cultivation land as a result of the Project implementation. Their worries may be greater than others because they have gradually established their lives in the village after resettlement as a result of the hydropower development in 2006.

I am afraid that the Project affects cultivation land and local living (HP02, male respondent, 26 years old, Van Kieu ethnic group, Huong Choa village, 11 February 2020).

Land acquisition may result in loss of cultivation land, residential land, and land-based livelihood (HP12, male respondent, 40 years old, Van Kieu ethnic group, Huong Choa village, 11 February 2020).

Our concerns include loss of cultivation land, unreasonable compensation, and negative impacts of the Project on our plants and health (HP23, male respondent, 34 years old, Kinh ethnic group, Phung Lam village, 12 February 2020).

We concern that our future generation will not have land for living and cultivating if our land is acquired for the Project implementation (HP11, male respondent, 49 years old, Van Kieu people, Huong Choa village, 11 February 2020).

Loss of cultivation land will potentially pose greater livelihood impacts on local women. Women seem to do most of the household work such as farming, water carrying, taking care of children, and cooking. In a Van Kieu family, there is a shared responsibility between men and women in income generation and household work, although men's involvement in family work is limited. In a Kinh household, men mainly do the heavy work such as fertilizing and spraying while women do pruning and cutting tree branches (FGD, agriculture and forestry group, Kinh ethnic group, Phung Lam village, 12 February 2020). Both men and women engage in income generation, but men have the voice in the family and make decisions on household affairs (KII, male respondent, Van Kieu ethnic group, Huong Choa village, 12 February 2020). It should be noted that there are four out of 35 surveyed households, or 11.4%, are female-headed.

### ***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. For most of surveyed households, land is not only a valuable asset, but also a result of their work and their hopes for a stable life for themselves and their descendants.

More importantly, there is a high proportion of households without a land use right certificate (LURC) for their agricultural land. Of the 33 surveyed households with agricultural land, only eight households have LURCs, accounting for 24%. Notably, 100% households in Huong Choa with agriculture land do not have LURCs for their land plots. Some households are concerned that they may not be eligible for land compensation as they do not have LURCs for their land.

Land acquisition and compensation price are our concern (HP06, male respondent, 41 years old, Van Kieu ethnic group, Huong Choa village, 11 February 2020).

We do hope the Project provides reasonable compensation for affected households (HP07, male respondent, 30 years old, Van Kieu ethnic group, Huong Choa village, 11 February 2020).

We are afraid that we cannot get money for our affected land as our land has not been granted with a LURC (HP09, male respondent, 30 years old, Van Kieu ethnic group, Huong Choa village, 11 February 2020).

### ***Social and 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 when 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 still imposes a reputational risk to the Project Owner. It may lead to disturbance towards Project's future activities.

### 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 4.7 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, 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 affected 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 High.

From the above discussion, the impact of economic displacement and loss of livelihood is evaluated as being Major.

**Table 11.3 Economic Displacement and Loss of Livelihood**

Impact Nature	<b>Negative</b>		Positive		Neutral	
Impact Type	<b>Direct</b>		Indirect		Induced	
Impact Duration	Temporary	Short-term	Long-term		<b>Permanent</b>	
Impact Extent	<b>Local</b>		Regional		International	
Impact Magnitude	Positive	Negligible	Small	<b>Medium</b>	Large	
Receptor Sensitivity	Low		Medium		<b>High</b>	
Impact Significance	Negligible	Minor	Moderate		<b>Major</b>	

### 11.2.4 Additional Mitigation and Management Measures

As the potential impact is identified as Moderate significance for economic displacement and livelihood, the following 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 Community 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 10 on Soil Impact Assessment, the impacts from soil erosion and soil contamination are 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, 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 11.4 Disturbance to Agriculture Production due to Construction and Operation Activities**

Impact Nature	Positive		Neutral		<b>Negative</b>	
Impact Type	Induced		<b>Indirect</b>		Direct	
Impact Duration	Temporary	<b>Short-term</b>		Long-term	Permanent	
Impact Extent	<b>Local</b>		Regional		International	
Frequency	Intermittent (rainy seasons) during the construction and operation phase					
Impact Magnitude	Positive	Negligible	<b>Small</b>		Medium	Large
Receptor Sensitivity	Low		<b>Medium</b>		High	
Impact Significance	Negligible		<b>Minor</b>		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:

- 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.

#### ***Health Issues as result of Noise, Dust and Vibration***

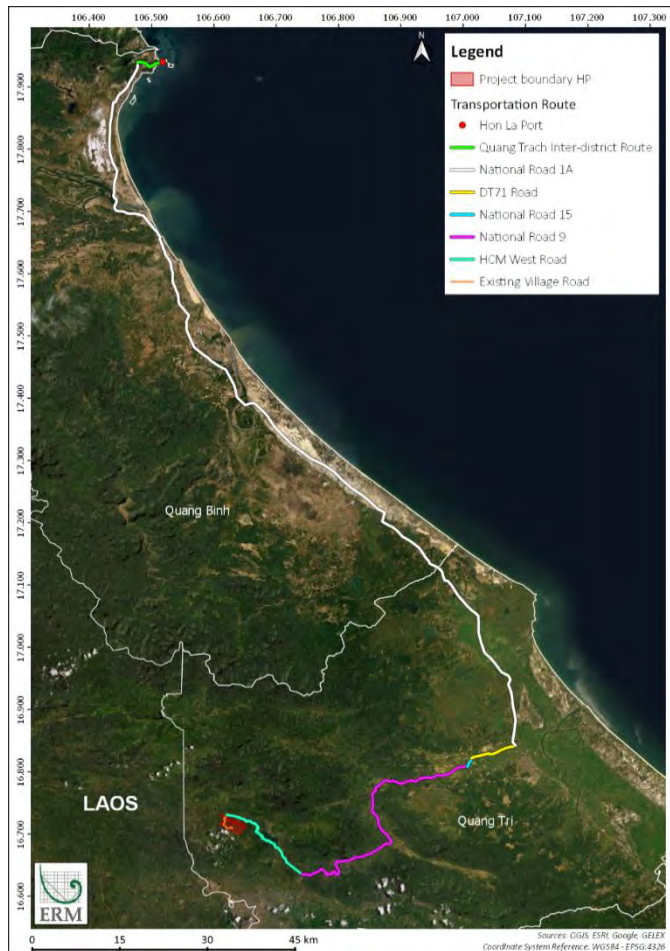
The main sources of noise and vibration in the construction phase are transportation, mobilisation of construction material and operation of heavy machineries during the construction process (main site and transmission line), include piling activities. However, these construction activities do not represent 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.

#### ***Traffic Safety Issue during the Construction Phase***

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 Cõp, 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 11.4):



**Figure 11.4 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<sup>75</sup> 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 (see Figure 11.5). The wind turbine

<sup>75</sup> It should be noted that raw materials will be prioritised to be supplied by local suppliers; therefore transportation will be likely limited, e.g. not a full distance of the National Road. It is recommended that the Project Owner and EPC Contractor prioritise local suppliers for basic construction materials (see Section 11.6.3).

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 two 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 built 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 - 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 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 11.5 Ho Chi Minh West Road (Left) and An Inter-village road in Huong Phung Commune (Right)**

### **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<sup>76</sup> 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.

<sup>76</sup> Source: <https://baovephapluat.vn/phap-luat-ban-doc/dieu-tra-theo-don-thu/xot-xa-can-hang-tram-cay-rung-bi-don-ha-tro-goc-o-quang-tri-74929.html>



## 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 11.5 Impacts on Community Health, Safety and Security during Construction Phase**

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

## 11.4.4 Additional Mitigation and Management Measures

In addition to measured proposed in the EPPs, 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 90 people in total. The number of employees during the operation phase is approximately 40 persons. The main labour source for the construction phase includes local labour supplied by domestic construction companies and Project's EPC labour resources (approximately 20 employees). 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

Due to the small number of immigrants, the impact magnitude of the influx-induced risks are small. Based on consultations with key informants in Project affected villages indicated that the villages are open towards migrants. Neighbouring projects in Huong Linh commune (about 10km from the Project site and now in operation) experiences 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, 71% of surveyed households were 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 11.6 Impacts Associated with Influx during Construction**

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	<b>Moderate</b>	Major
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### 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 Minor.

### 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 both Construction and Operation Phases

### 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 90 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 Phung 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 40 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 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;
- 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 and products and local supply, for example basic construction materials, to enhance benefiting to the local communities.
- Establish a clear grievance mechanism as mentioned in previous section.
- 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, utilise 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.

## 11.7 Disturbance on Local Community during Operation Phase

### 11.7.1 Potential Impacts

During the operation phase (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 40 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 10 – 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 negligible to minor 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 Chapter 10 – 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, as the project's surrounding is currently a mountainous area and local people are quite sensitive to noise, especially at night, the sensitivity of receptors in the area is considered Medium. Overall, the impact significance is assessed to be Minor.

**Table 11.7 Disturbance to Local 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 10 for Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment.

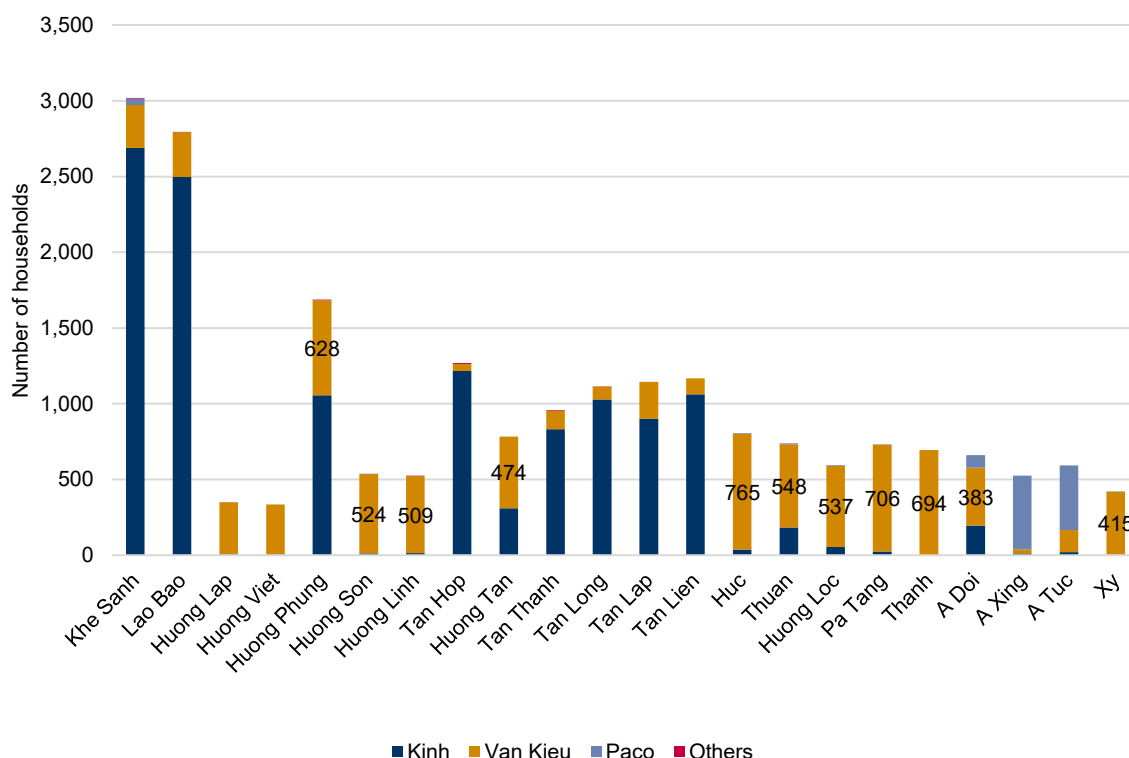
## 11.8 Impacts on Indigenous People both Construction and Operation Phases

As described in the socio-economic baseline, 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 IFC 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 11.6 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 11.6 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 (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 Sacred 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 Moderate significance.

**Table 11.8 Impacts on Indigenous People**

Impact Nature	<b>Negative</b>		Positive	Neutral	
Impact Type	<b>Direct</b>		Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	<b>Local</b>		Regional	International	
Frequency	Throughout the Project's life cycle				
Impact Magnitude	Positive	Negligible	Small	<b>Medium</b>	Large
Receptor Sensitivity	Low		Medium		<b>High</b>
Impact Significance	Negligible	Minor	<b>Moderate</b>		<b>Major</b>

### 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.
- 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.

### 11.8.5 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 11.9.

**Table 11.9 Summary of Social Impact Assessment**

Sections	Impacts	Significance of Impacts		
		Impact Nature	Before Mitigation*	With Mitigation**
<b>Pre-Construction and Construction Phases</b>				
11.2	Economic displacement and livelihood impacts	Negative	Major	Minor
11.3	Disturbance to agriculture production	Negative	Minor	Negligible
11.4	Community health, safety and security impacts during construction	Negative	Moderate	Minor
11.5	Impacts associated with construction workers	Negative	Moderate	Minor
11.6	Benefits to local communities (both construction and operation)	Positive		
<b>Commissioning and Operation Phases</b>				
11.7	Disturbance on local community during operation	Negative	Minor	Negligible
11.8	Impacts on Indigenous People (both construction and operation)	Negative	Major	Minor

**Note:** (\*) without mitigation measures/management suggested from the ESHIA.

(\*\*) with mitigation measures/management suggested from the ESHIA.

## 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/QĐ-TTĐ dated 14th January 2013 promulgating the regulation on oil spill response; and
- Related to Fire, Explosion, and Toxic Release:
  - Decree No. 113/2017/NĐ-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/NĐ-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

	<p>respond to accidental and emergency situations associated to prevent and mitigate any harm to people and/or the environment.</p> <p>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</p>
<p>PS4: Community Health, Safety, and Security</p>	<p>Emergency Preparedness and Response</p> <p>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</p>

## 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)
<b>Physical Environment</b>	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
<b>Biological Environment</b>	Impacts such as localised or short	Impacts such as localised, long term degradation of	Impacts such as localised but irreversible habitat	Impacts such as significant, widespread	Impacts such as persistent reduction in ecosystem

	Incidental (A)	Minor (B)	Moderate (C)	Major (D)	Severe (E)
	term effects on habitat or species	sensitive habitat or widespread, short-term impacts to habitat or species	loss or widespread, long-term effects on habitat or species	and persistent changes in habitat or species	function on a landscape scale or significant disruption of a sensitive species.
<b>Social Environment</b>	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 planned 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	<ul style="list-style-type: none"> <li>■ Nearby communities</li> <li>■ Habitats, flora, and fauna in the vicinity of the site</li> </ul>
Commissioning and Operation	Small scale leakage and spill incidents from activities on site	Users of groundwater
	Fire and explosion	<ul style="list-style-type: none"> <li>■ Nearby communities</li> <li>■ Forest, habitats, flora, and fauna in the vicinity of the site</li> </ul>
	Blade ejection failure	Nearby communities
	Accidental transmission line snapping and tower swaying/collapsing	Nearby communities
	Natural Unplanned Events - Flooding and Landslides	<ul style="list-style-type: none"> <li>■ Nearby communities</li> <li>■ Forest, habitats, flora, and fauna in the vicinity of the site</li> </ul>

Potential impacts from these events were 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
<b>Site Preparation / Construction</b>				
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.	<b>Communities</b> – 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)
			<b>Environment</b> – 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 As above with livestock in the road	<b>Communities</b> – 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)
			<b>Communities</b> – 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,	<b>Communities</b> – 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)
			<b>Environment:</b> – 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)
<b>Commissioning and Operation</b>				
4	Small scale spill from activities on-site	Corrosion, dropped objects or other damage to small storage vessels; failure to secure valves; failure to maintain equipment.	<b>Communities</b> –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)
			<b>Environment</b> - 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)

No.	Unplanned Event	Cause	Consequence	Risk Ranking
				Pre-mitigation
5	Fire and explosion	Leakage and spill incidents of flammable materials, malfunctioning equipment, short-circuit power, Damage of transmission lines or Lightning strike	<p><b>Communities</b> – 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.</p> <p><b>Environment:</b> – 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.</p>	2E (Major)
				2D (Moderate)
6	Blade ejection failure	Root connection; catastrophic structural buckling or separation; leading edge, trailing edge, or other bond separation; lightning 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 <sup>77</sup>	<p><b>Communities</b> – 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</p> <p><b>Environment</b> – As above with local flora and fauna.</p>	3E (Major)
				3C (Moderate)
7	Accidental transmission line snapping and tower swaying/collapsing	Wind/cyclonic/meteorological conditions, catastrophic structural separation, corrosion	<p><b>Communities</b> –. Electrocutions that involved community members, resulting in injury or fatality, livestock leading to death of livestock and loss/reduction in community member's livelihood</p>	3D (Major)

<sup>77</sup> 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
8	Natural Hazards  Flooding & Landslide	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 <sup>0</sup> ) and vegetation removing that weakens soil bearing capacity.	<b>Communities:</b> 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. <b>Environment:</b> 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 bioaccumulate. 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 below.

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	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
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on emergency response will	The Project Owner	Before site preparation

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
	provide regular information on safety drills and guidance to residents in the event of an unplanned event.		
Prevent	Ensure good inspection and maintenance procedures for large mobile construction plant to minimise small leaks and spills.	EPC Contractor	During site preparation and construction
Mitigate	Prepare Emergency Response Plan and Emergency Management Plan.	The Project Owner	Planning stage (before commissioning and operations)
Mitigate	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 remain as the same. In these cases, the mitigative measures described in the previous section would apply to minimise impacts with regards to their likelihoods.

		Risk Significance
Without Control Measures	Communities	<b>3C Moderate</b>
	Environment	<b>3B Minor</b>
With Control Measures	Communities	<b>2C Minor</b>
	Environment	<b>2B Minor</b>

#### 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. Based on estimated transportation period and equipment and materials need to be delivered to the Site, the average number of vehicles movements including heavy load vehicle and non-heavy load vehicle was predicted 76 turns per day. 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.

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Developed and implemented a Transportation Management Plan. This should include measures such as: <ul style="list-style-type: none"> <li>■ Active traffic controls (e.g. flaggers to direct traffic at the Project site entrance); and</li> <li>■ Schedule construction deliveries and employee shift changes to minimise traffic congestion and delay</li> </ul>	EPC Contractor	Site preparation and construction
Prevent	Design an H&S plan and good safety practices for the transportation (e.g. alcohol policy, good driving practice).	EPC Contractor	Construction
Prevent	Upgrade the access road to the Project site	The Project owner	Site preparation
Prevent	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
Mitigate	Prepare Emergency Response Plan and Emergency Management Plan.	The Project owner	Planning stage (before commissioning and operations)
Mitigate	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 impacts based on the drop of their likelihood.

		Risk Significance
Without Mitigation Measures	Communities	<b>4E Major</b>

		Risk Significance
With Mitigation Measures	Communities (livestock)	<b>4C Moderate</b>
	Communities	<b>3E Major</b>
	Communities (livestock)	<b>3C Moderate</b>

### 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.

Type of Event (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	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
Prevent	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
Prevent	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
Prevent	Contact relevant authority bodies and conduct the UXO clearance.	The Project owner	Site preparation
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response. Engagement on	The Project owner	Site preparation and construction



Type of Event (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
	emergency response will provide regular information on safety drills and guidance to residents in the event of an unplanned event.		
Prevent	Implement routine inspection and maintenance procedures (in line with international best practice) for large storage vessels.	EPC Contractor	Site preparation and construction
Mitigate	Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	EPC Contractor/ The Project owner	Site preparation
	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 lessen the likelihood of the events.

		Risk Significance
Without Mitigation Measures	Communities	<b>3D Major</b>
	Environment	<b>3D Major</b>
With Mitigation Measures	Communities	<b>2D Moderate</b>
	Environment	<b>2D Moderate</b>

### 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 below

Type of Event (i.e. Prevent/Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	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
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Mitigate	Prepare an Emergency Preparedness and Response Plan to cover accidental and emergency situations. This Plan will detail: <ul style="list-style-type: none"> <li>■ Planning coordination: including procedures for informing local communities about emergency response, documentation and first aid / medical treatment;</li> <li>■ Emergency equipment: including equipment in the project design and any additional emergency equipment; and</li> <li>■ Training: employees and contractors will be trained in emergency response procedures.</li> <li>■ Auditing: audit records will be maintained on how the Plan is being implemented.</li> </ul>	O&M Contractor/ The Project owner	Before commissioning and operation
Mitigate	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 at moderate level. In these cases, the mitigation measures described in the previous section would apply to minimise risks' occurrence.

		Risk Significance
Without Mitigation Measures	Communities	<b>3C Moderate</b>
	Environment	<b>3C Moderate</b>
With Mitigation Measures	Communities	<b>2C Minor</b>
	Environment	<b>2C Minor</b>

### 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 lightning 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

Type of Event (i.e. Prevent/Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Implement the recommendations of the QRA process into the planned management measures.	O&M Contractor/ The Project owner	During commissioning and operation
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Prevent	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
Prevent	Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed.	The Project owner	Prior commissioning
Mitigate	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	<b>2E Major</b>
	Environment	<b>2D Moderate</b>
With Mitigation Measures	Communities	<b>2D Moderate</b>
	Environment	<b>2C Minor</b>

## 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.

### 12.4.2.3.2 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) lightning 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<sup>78</sup>.

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.

### 12.4.2.3.3 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 12 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.

According to the theoretical setback distances of the WTGs as per IFC wind guidelines, this information is used to independently assess the setback distances of the receptors that were identified using the latest satellite imagery of the Project area.

### 12.4.2.3.4 Significance (Before Mitigation)

The significance is provided in Table 12.5.

### 12.4.2.3.5 Mitigation and Monitoring

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental blade throw are summarised in table below

Type of Event (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	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	The Project owner	Prior commissioning

<sup>78</sup> 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 (i.e. Prevent/Mitigate)	Management Control	Responsibility - Organisation	Timing
	shadow flicker limits be maintained with respect to sensitive residential receptors to provide further protection.		
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	O&M Contractor/ The Project owner	During commissioning and operation
Prevent	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
Mitigate	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

#### 12.4.2.3.6 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 the risks.

		Risk Significance
Without Mitigation Measures	Communities	<b>3E Major</b>
	Environment	<b>3C Moderate</b>
With Mitigation Measures	Communities	<b>2E Major</b>
	Environment	<b>2C Minor</b>

### 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

Type of Event (i.e. Prevent/Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	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
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	O&M Contractor/ The Project owner	During commissioning and operation
Prevent	Install warning system, signal boards, lighting prevention system, anti-climbing devices on the tower.	The Project owner	Prior commissioning
Mitigate	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 the likelihood.

		Risk Significance
Without Mitigation Measures	Communities	<b>3D Major</b>
With Mitigation Measures	Communities	<b>2D Moderate</b>

#### 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

430mm 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<sup>79</sup>

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 -520m, which are sloping from southwest to northeast.

The likelihood for the development to increase the flood risk is considered to be Likely.

In addition, the Project is located in Huong Hoa District where was recorded as the most landslide events occurred in Quang Tri Province. Communes with high level of landslides are located mainly in the north of National Road No 9, where are in the mountainous area and steep slopes such as Huong Linh, Huong Phung, Huong Son, Huong Lap, etc. Area of landslide was recorded as 60,896 m<sup>2</sup> according to survey in 2012 -2013<sup>80</sup>, which accounting for 52.2% of total of landslide area in Quang Tri Province.

### 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

Type of Event (i.e. Prevent/Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.	The Project owner	Prior commissioning
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	The Project owner	During commissioning and operation
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	O&M Contractor/ The Project owner	During commissioning and operation
Prevent	Install warning system, signal boards, flood prevention systems.	The Project owner	Prior commissioning
Prevent	Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.	The Project owner	Prior commissioning
Mitigate	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

<sup>79</sup> Source: Feasibility Study Report, 2019.

<sup>80</sup> Source: Ha Van Hanh, Truong Dinh Trong and et. “Analyzing the cause, the extent of damage due to the natural disaster in Huong Hoa District, Quang Tri Province and Proposing solutions for mitigating the damage.” – Journal of Social Sciences, Humanities and education – Vol 4. No.2 (2014)

#### 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 mitigation measures to minimise impacts and damage caused by Flood and Landslide.

		Risk Significance
Without Mitigation Measures	Communities	<b>4D Major</b>
With Mitigation Measures	Communities	<b>3D Major</b>



## 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 Phung 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:

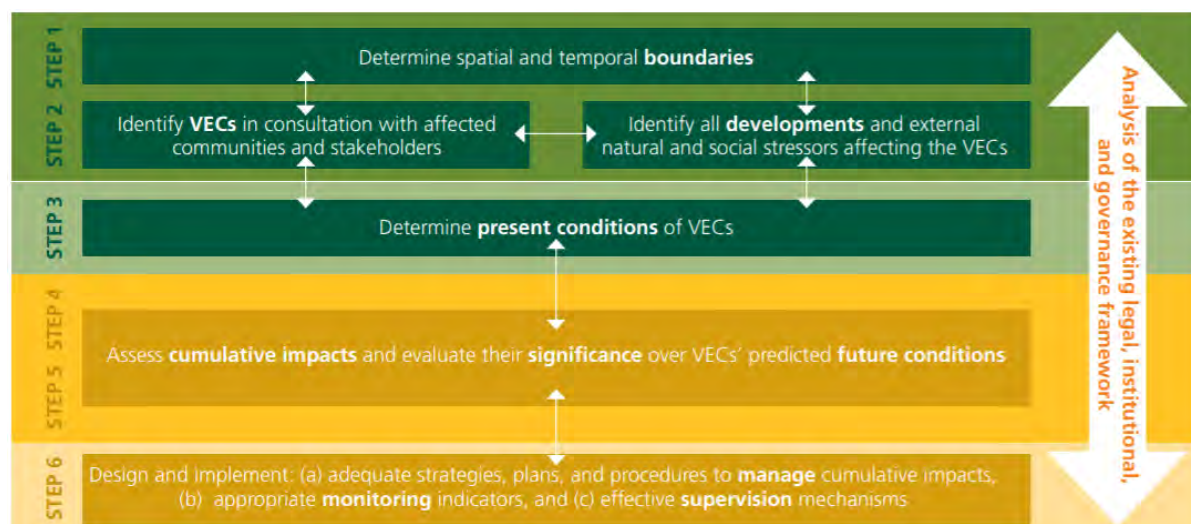
- Use the outcomes of the preceding chapters of this ESIA to determine spatial and temporal boundaries, identify VEC's and all development and external natural and social stressors affecting them;
- Recognise and identify how the Project, along with other existing and future projects may contribute to 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 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:

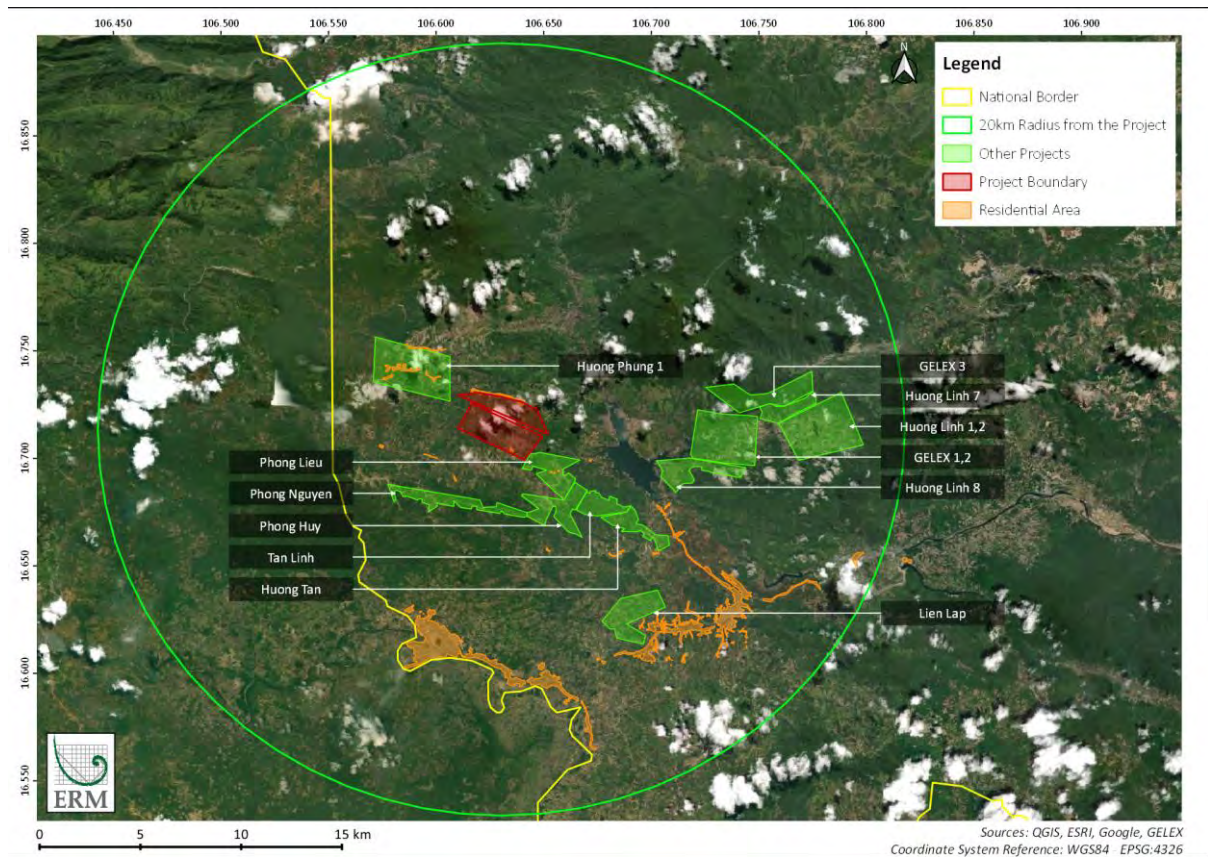
- Noise receptors in close proximity to the Project site;
- The inhabitants of Huong Phung Commune of Huong Hoa District which occur within the projects Aol; and
- Biodiversity values and particularly bird and bats which are at risk from blade strike, and to a lesser extent habitat loss.

### 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 District and Con Co District with total area of 1,036 hectares.

Figure 13.2 summarises 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 summarizes existing and proposed windfarm projects in proximity to the Project.

**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 Huong Phung Project Components		
							Turbines (km)	Sub-station (km)	T-line (km)
<b>Key developments</b>									
1	Huong Linh 1 & 2 Wind farm	Onshore wind farm in Huong Linh Commune	60 MW	8	Operation	-	11.5	13.4	5.7
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	-	10.5	12.4	6.0
4	Huong Linh 8 Wind farm	Onshore wind farm in Huong Linh Commune			Planning	-	5.6	7.6	0.4
5	Gelex 1 & 2 Wind farm	Onshore wind farm in Huong Linh Commune	60 MW	33.36	Construction	Quarter IV 2021	7.2	9.1	2.3
6	Gelex 3 Wind farm	Onshore wind farm in Huong Linh Commune	30 MW	19.05	Construction	Quarter IV 2021	8.2	9.8	5.7
7	Huong Phung Wind farm 1	Onshore wind farm in Huong Phung Commune	30 MW	-	Construction	-	2	3.1	1.3
8	Huong Hiep Wind farm 1	Onshore wind farm in Huong Hiep Commune	30 MW	-	Construction	-	-	-	-
9	Lien Lap Wind farm	Onshore wind farm in Tan Lien Commune	48 MW	-	Construction	-	9.1	10.9	3.4
10	Tan Linh Wind farm	Onshore wind farm in Huong Linh and Huong Tan Commune	46.2	30.5	Construction	Quarter IV 2021	3.6	5.4	1
11	Huong Tan Wind farm	Onshore wind farm in Huong Tan Commune	46.2	31.2	Construction	Quarter IV 2021	5.1	6.9	1

No.	Project	Location	Capacity (MW)	Land Area (ha)	Development Status at the time of CIA	Tentative schedule for operation	Distance to Huong Phung Project Components		
							Turbines (km)	Sub-station (km)	T-line (km)
12	Phong Lieu Wind farm	Onshore wind farm in Huong Phung and Huong Linh Commune	48 MW	16.51	Planning	2021	0.7	2.2	1
13	Phong Huy Wind farm	Onshore wind farm at Tan Lap and Tan Lien wind farm	50.4 MW	25.52	Construction	Quarter IV 2021	2.9	4.1	1.5
14	Phong Nguyen Wind farm	Onshore wind farm at Huong Phung and Tan Thanh Commune	50.4MW	25.62	Construction	Quarter IV 2021	3.7	4.5	3.9

### 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
<b>Noise</b>	Local communities in Huong Phung 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.
<b>Bird and bat strike and habitat loss.</b>	Species of conservation significance known to habitat the local area (Chapter 10)	A detailed assessment of biodiversity impacts is provided in Chapter 10 and identifies impacts associated with the Huong Phung 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.
<b>Visual Impacts</b>	Local communities living in Huong Hoa District.	A visual assessment is provided at Chapter 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.
<b>Shadow Flickering Impacts</b>	Local communities living in Huong Phung Commune.	Given that the Aol of shadow flickering issues is only within 10 times WTG's rotor diameter, residents who live in Cop and Phung Lam Villages of Huong Phung Commune are likely to experience shadow flickering periods during the day and throughout the year from Huong Phung windfarm. However, as an adjacent windfarm is currently under planning stage which can potentially increase the cumulative experience of shadow flickering issue on such residents.	Cumulative assessment to be conducted using the findings from the assessment for the Project as guidance on the extent and likely significance of impacts.

Impact Type	VEC's Likely to be Impacted	Existing Assessment in ESIA	RCIA Scope
<b>Waste</b>	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
<b>Socio-Economic: Community Health and Safety</b>	The VECs likely to be impacted are those people residing in Huong Hoa District.	Chapter 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.
<b>Socio-Economic: Economy and Employment</b>	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 Chapter 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.
<b>Socio-Economic: Traffic</b>	The VECs likely to be impacted are those people residing in Huong Hoa District.	Chapter 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.
<b>Socio-Economic: Infrastructure and Public Services</b>	The VECs likely to be impacted are those people residing in Huong Hoa District.	Chapter 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.



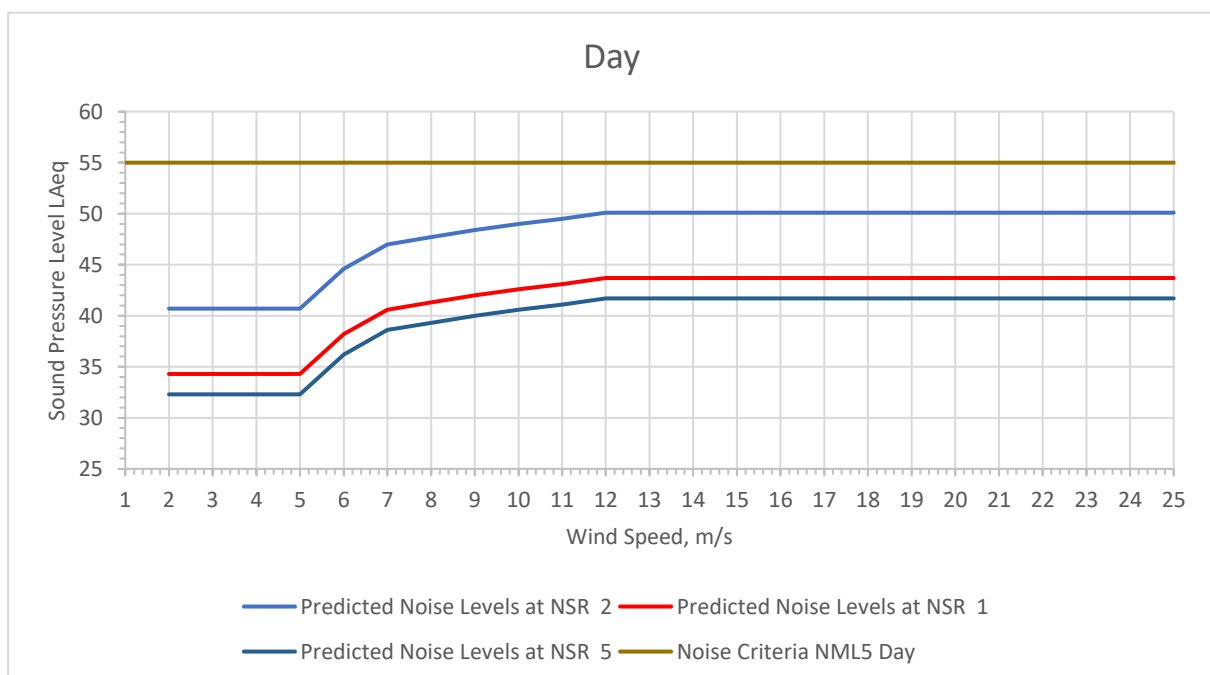
## 13.4 Cumulative Noise from Existing Wind Farms Nearby

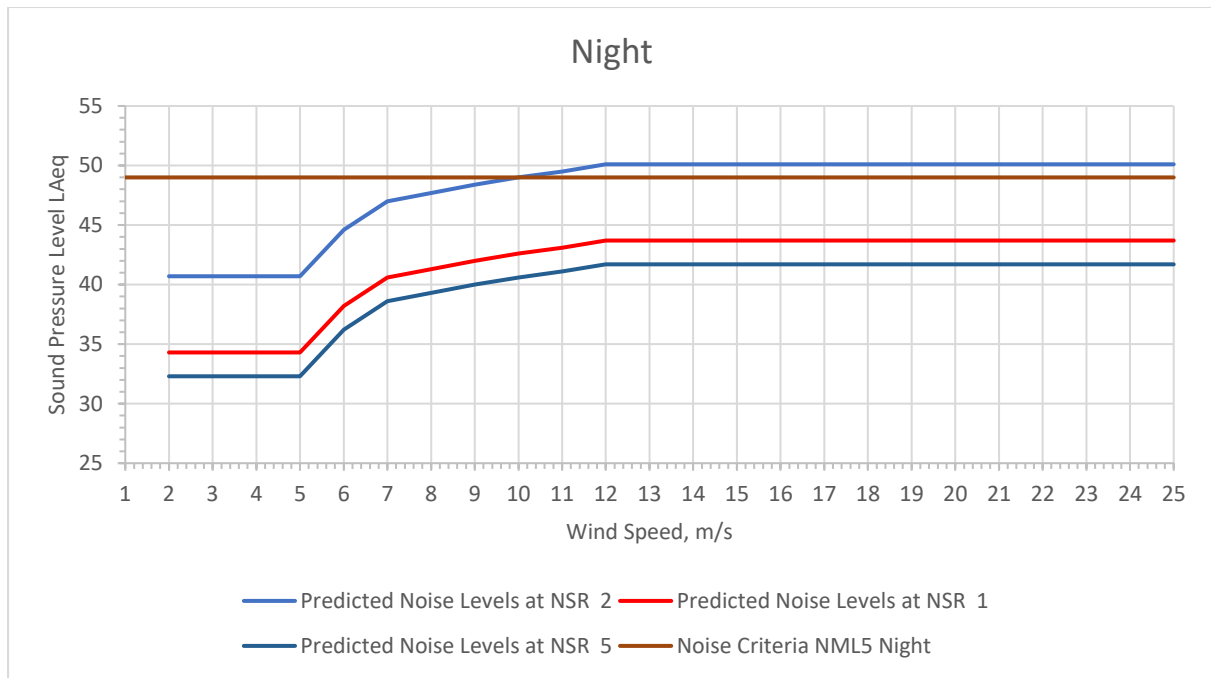
### 13.4.1 PCC1 Phong Huy

Noise has been predicted at NSRs associated with the Project but also considering noise from the PCC1 Phong Huy windfarm. Initial modelling suggests a noise level from the PCC1 Phong Huy wind farm of less than 45 dB  $L_{eq}$  at the nearest NSR. However, a noise contribution (from PCC1 Phong Huy wind farm) of up to 41 dB  $L_{eq}$  is predicted at the closest NSR to the GELEX Huong Phung wind farm, where a predicted noise level from the Project at this location is 37 dB  $L_{eq}$ . The additional noise contribution increases the predicted noise level at this location by approximately 6 dB addition, to 42 dB  $L_{eq}$  when considering both wind farms operating cumulatively. For that reason, noise from the PCC1 Phong Huy 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 CC1 Phong Huy 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 PCC1 Phong Huy wind farm at the same time because they are in-between PCC1 Phong Huy and the Project. As a result of this, it can be concluded that the PCC1 Phong Huy wind farm does not have potential to give rise to significant adverse cumulative impacts.

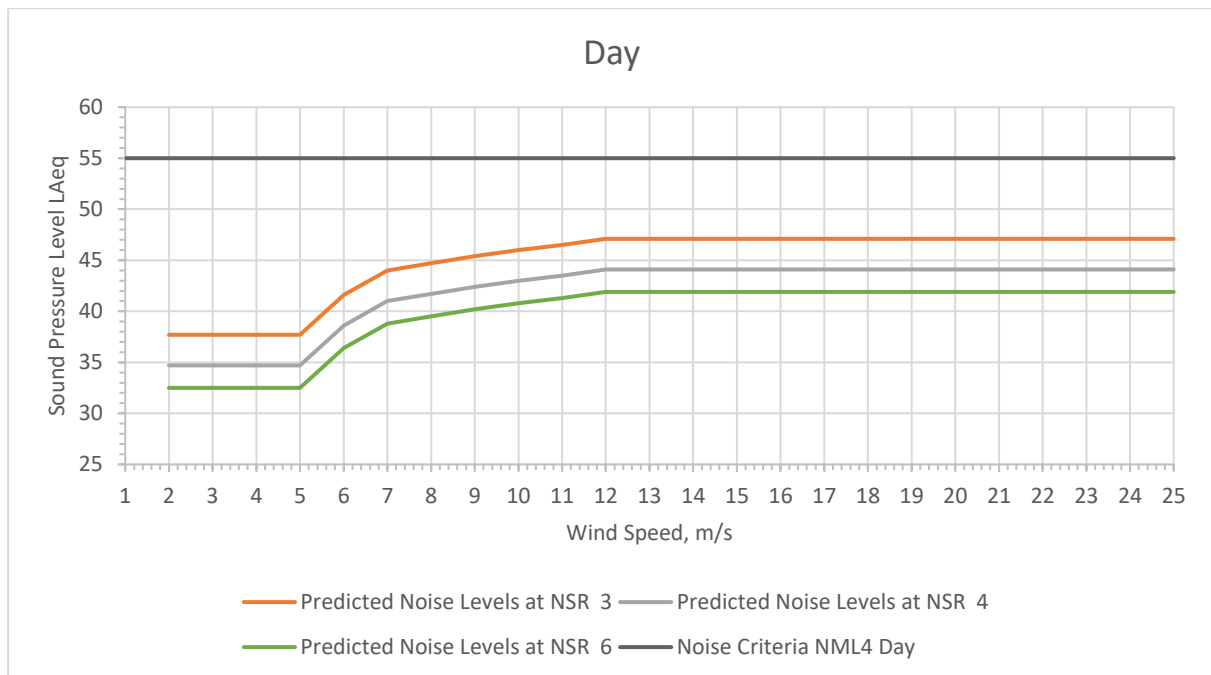
### 13.4.2 Phong Lieu

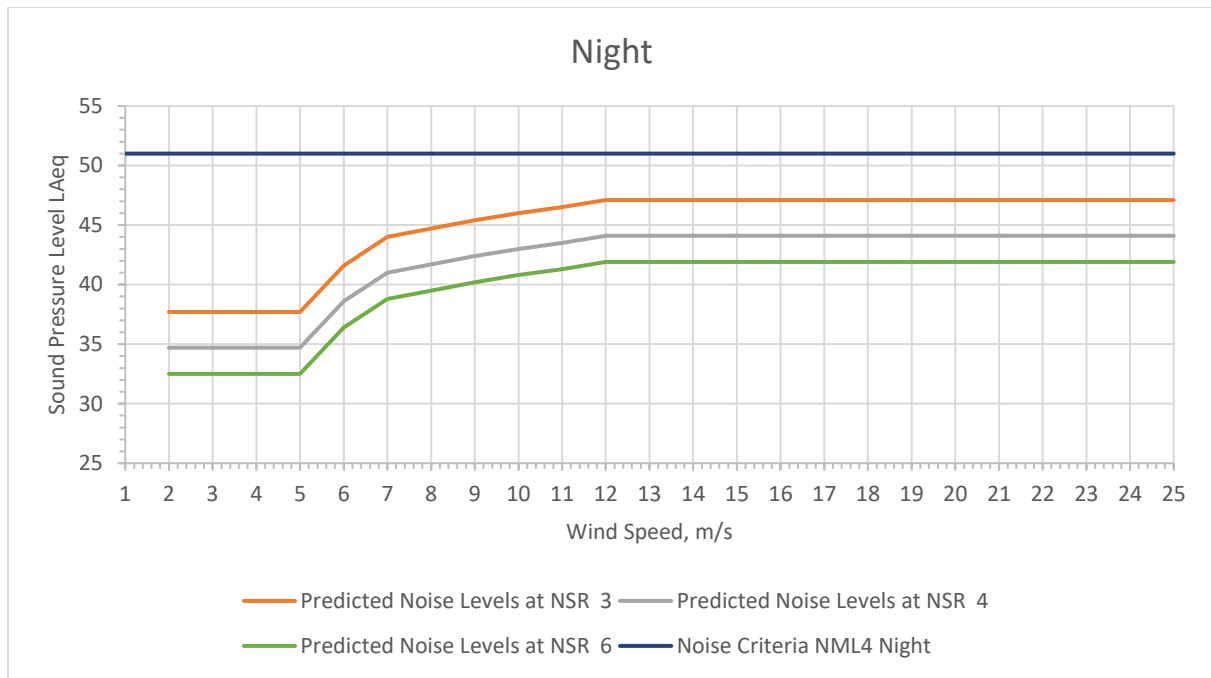
As the Phong Lieu wind farm is still in planning, and specific turbine layouts have not yet been finalised, initial modelling of the wind farm could not be undertaken. However, in most cases, the noise level will be dominated by the nearest WTG and this will be either from the Phon Lieu site or the Project 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 Phong Lieu 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 against (Hub Height) Wind Speed for NSR 1, NSR 2, and NSR 5 (which refer to Baseline Location NML 5)**





**Figure 13.4** Predicted Wind Farm Noise Levels and Noise Assessment Criteria against (Hub Height) Wind Speed for NSR 3, NSR 4, and NSR 6 (which refer to Baseline Location NML 4)

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
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	1	-	-	-	-
12	-	1	-	-	-	-
13	-	1	-	-	-	-
14	-	1	-	-	-	-
15	-	1	-	-	-	-
16	-	1	-	-	-	-
17	-	1	-	-	-	-
18	-	1	-	-	-	-
19	-	1	-	-	-	-
20	-	1	-	-	-	-
21	-	1	-	-	-	-
22	-	1	-	-	-	-
23	-	1	-	-	-	-
24	-	1	-	-	-	-
25	-	1	-	-	-	-

No noise impacts are predicted during the day.

At night, noise impacts are predicted at NSR 2 with an exceedance of 1 dB. These impacts are dependent on wind speed and there are no impacts at wind speeds at or below 6 m/s. Analysis of a year of wind speed data during the night at the wind mast (WML) 1km southeast of NSR 2 shows that wind speeds are 6m/s or lower for approximately 58% of the year, indicating there would be no noise impact for 58% of the year.

Significant adverse cumulative noise impacts have not been identified at seven of the eight cumulative wind farms assessed. As a specific turbine layout is yet to be finalised at the Phong Lieu 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 Phong Lieu project should consider the noise levels from the Project site with the objective of avoiding cumulative noise.

### 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 13.3, 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 13.3 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	Gelex 1 & 2 Wind farm	C
6	Gelex 3 Wind farm	C
7	Huong Phung Wind farm 1	C
8	Huong Hiep Wind farm 1	C
9	Lien Lap Wind farm	C
10	Tan Linh Wind farm	C
11	Huong Tan Wind farm	C
12	Phong Lieu Wind farm	P
13	Phong Huy Wind farm	C
14	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 13.4 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	Gelex 1 & 2 Wind farm	C
6	Gelex 3 Wind farm	C
7	Huong Phung Wind farm 1	C
8	Huong Hiep Wind farm 1	C
9	Lien Lap Wind farm	C
10	Tan Linh Wind farm	C
11	Huong Tan Wind farm	C
12	Phong Lieu Wind farm	P
13	Phong Huy Wind farm	C
14	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 13.5 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	Gelex 1 & 2 Wind farm	C	C
6	Gelex 3 Wind farm	C	C
7	Huong Phung Wind farm 1	C	C
8	Huong Hiep Wind farm 1	C	C
9	Lien Lap Wind farm	C	C
10	Tan Linh Wind farm	C	C
11	Huong Tan Wind farm	C	C
12	Phong Lieu Wind farm	P	P
13	Phong Huy Wind farm	C	C
14	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 13.6 Cumulative impact scoping for traffic**

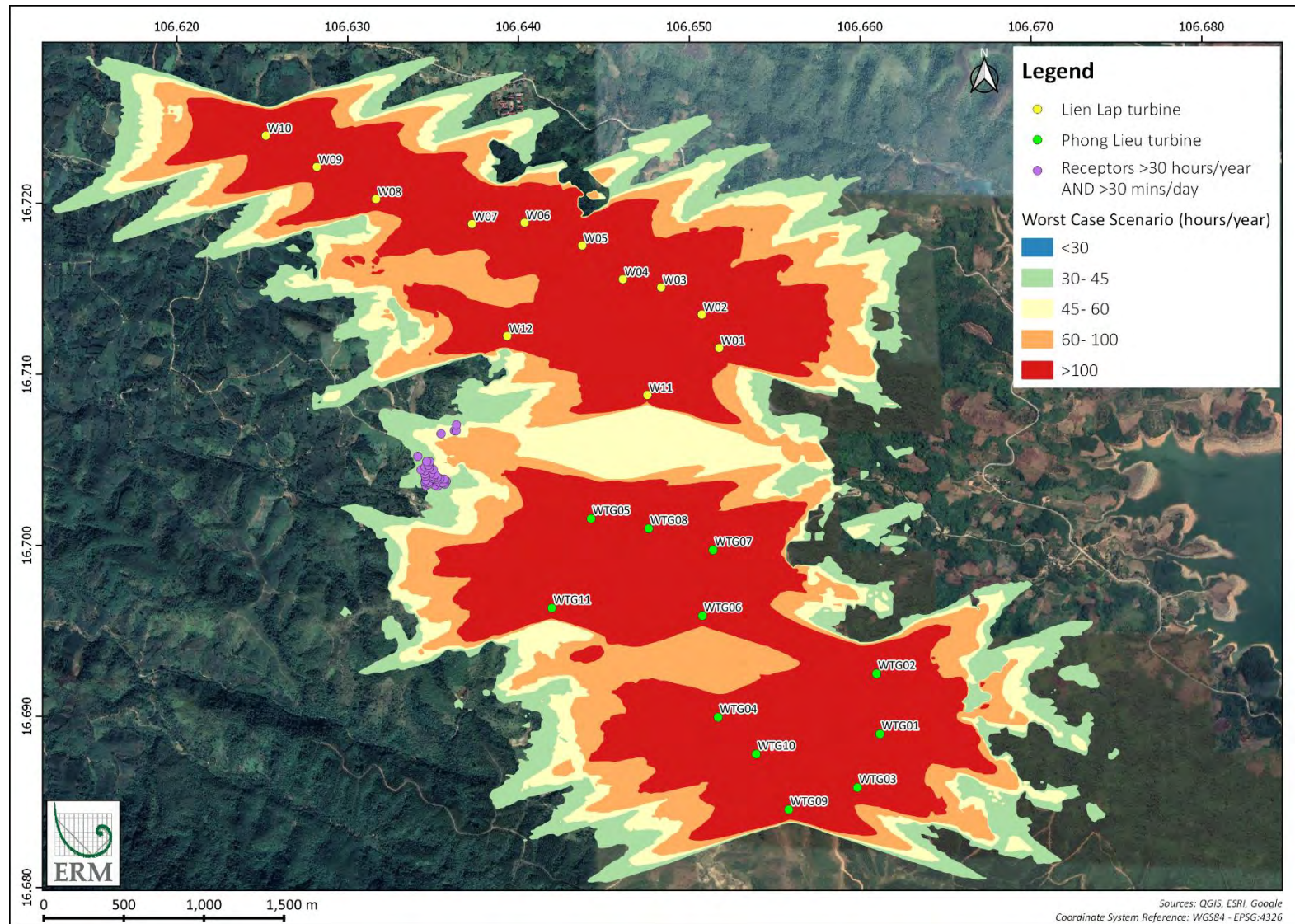
No.	Projects	Traffic
1	Huong Linh 1 & 2 Wind farm	O
2	Huong Linh 3 & 4 Wind farm	O
3	Huong Linh 7 Wind farm	P
4	Huong Linh 8 Wind farm	P
5	Gelex 1 & 2 Wind farm	C
6	Gelex 3 Wind farm	C
7	Huong Phung Wind farm 1	C
8	Huong Hiep Wind farm 1	C
9	Lien Lap Wind farm	C
10	Tan Linh Wind farm	C
11	Huong Tan Wind farm	C
12	Phong Lieu Wind farm	P
13	Phong Huy Wind farm	C
14	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

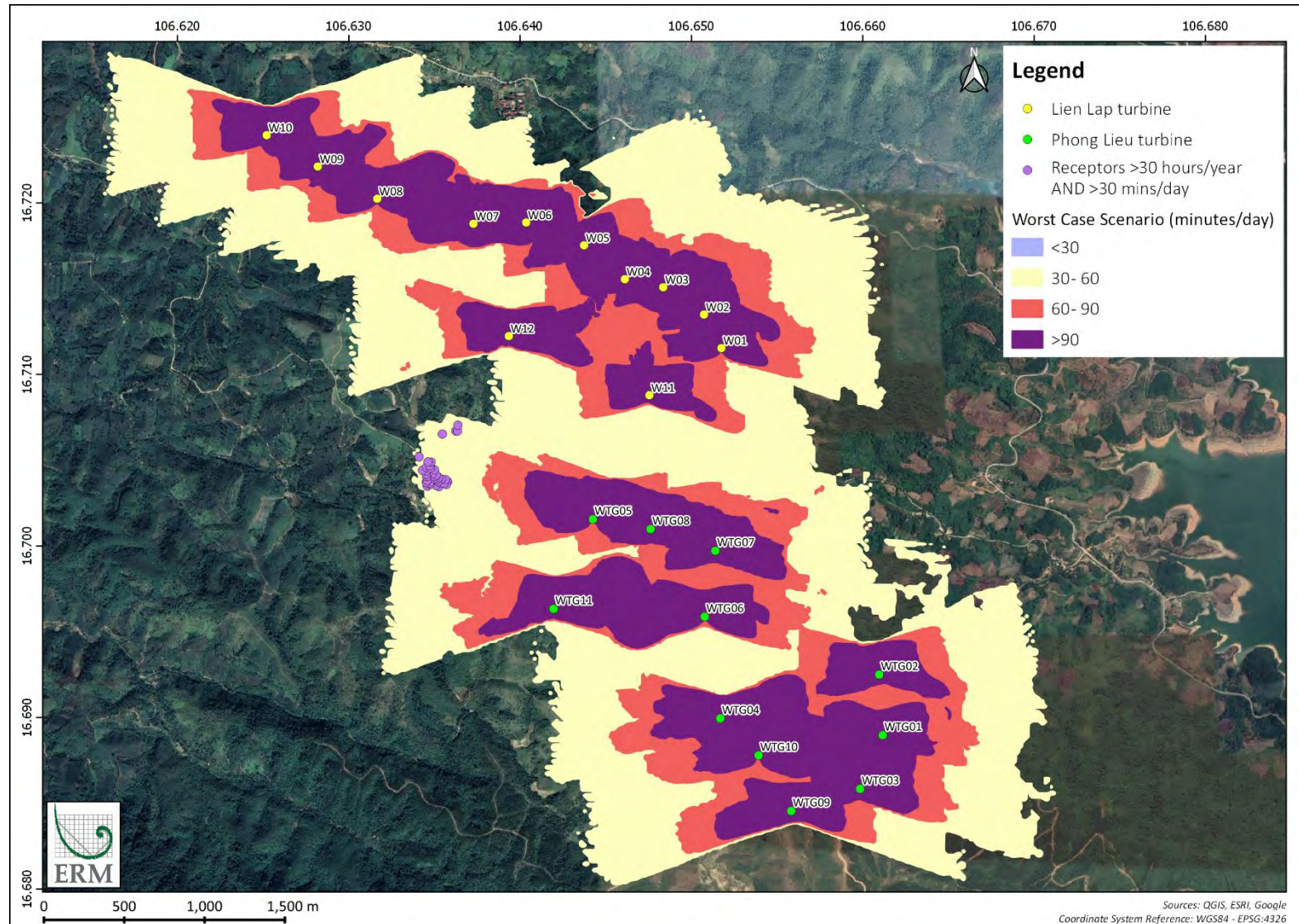
### 13.10 Cumulative Impacts on Shadow Flicker

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 moderate to minor. However, as the Area of Influence will be limited within 10 times of rotor diameter, only Phong Lieu – the adjacent windfarm to Huong Phung project can potentially create a cumulative impact to neighbouring residents of those two windfarms. According to the modelled data for worst-case scenario, there are potentially 35 receptors (Figure 13.7) who will experience the shadow flickering issues from both wind power projects and exceed the threshold of international standard. Huong Phung windfarm causes shadow issue for those receivers mainly during June, July and August especially WTG no. 11 whilst Phong Lieu will cast for mostly other months within the year. Therefore, the impact will be moderate for those 35 potential shadow receivers. Though, it should be noted that the impact can prospectively reduce further due to the positions of Phong Lieu’s wind turbines have yet been fixed as well as Phong Lieu windfarm is still under planning process.

Figure 13.5 and Figure 13.6 presented the affected receptors of shadow flickering issues by Huong Phung and Phong Lieu 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.



**Figure 13.5 Cumulative Impact on Shadow Flicker of nearby Windfarms – hours/year (Worst Case Scenario)**



**Figure 13.6 Cumulative Impact on Shadow Flicker of nearby Windfarms – minutes/day (Worst Case Scenario)**

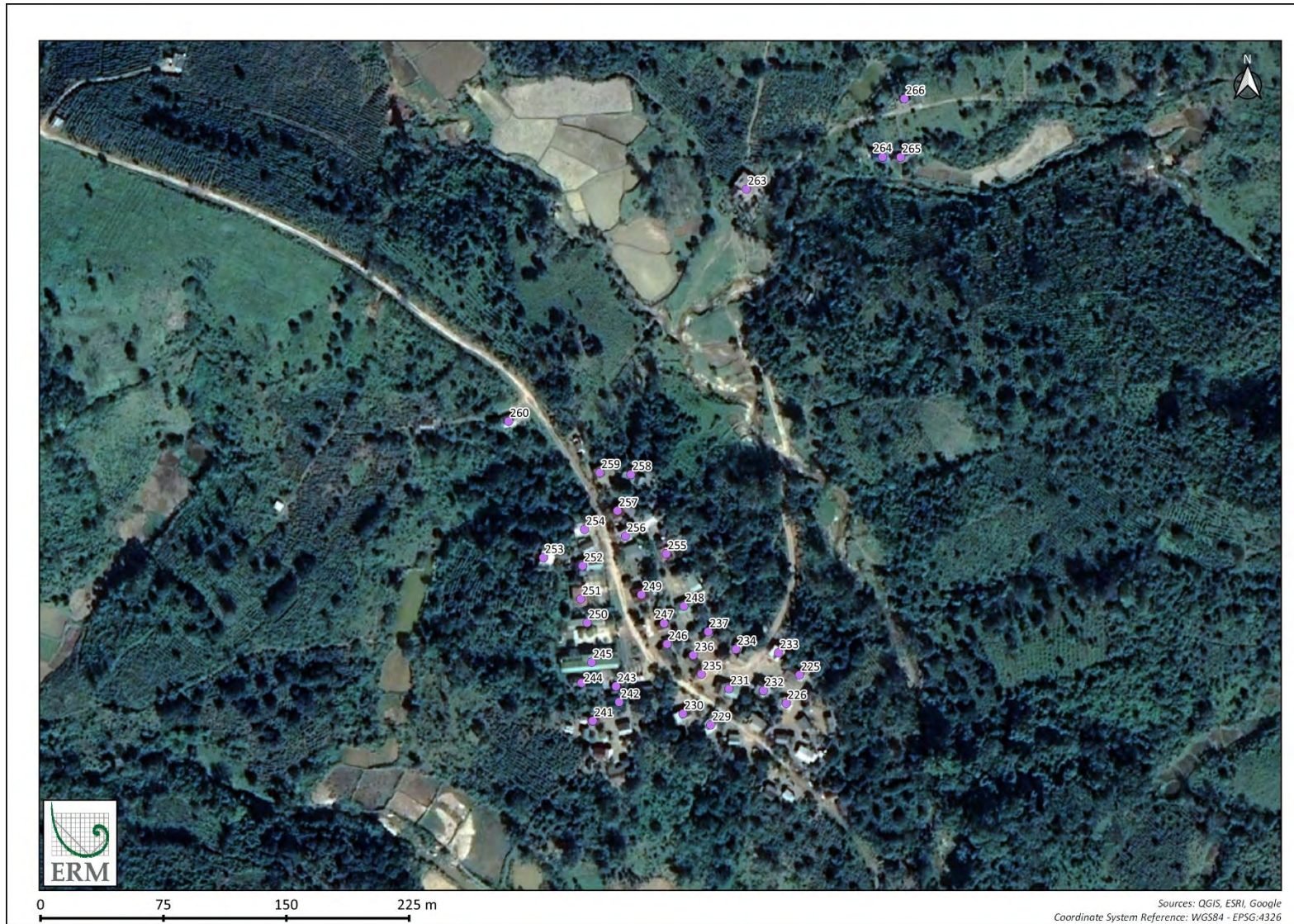


Figure 13.7 Shadow Receptors of nearby Windfarms' Cumulative Impact

### 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 EIA 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 EIA 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
- Manage 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 performing. 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 be 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 and EIA were approved. The ESMP will include mitigation measures proposed in local EPP and EIA as well. It is noted that no monitoring reporting is specified in the local EPP and EIA, 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 Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
<b>Pre-Construction and Construction Phase</b>							
<ul style="list-style-type: none"> <li>■ Land preparation and civil works such as land clearance, demolition, earthworks.</li> <li>■ Substation, transmission line, access road, laydown area construction</li> <li>■ Operation of associated facilities such as the concrete batching plant, diesel generator for power supply</li> <li>■ Transportation of equipment and materials,</li> </ul>	<ul style="list-style-type: none"> <li>■ Increased dust (e.g. PM10) from ground preparation, work sites and material / equipment transportation</li> <li>■ Exhaust emissions (e.g. SOx, CO, NOx) from movement and operation of construction vehicles, machinery and other heavy equipment such as bulldozers,</li> </ul>	EIA	The Project owner will upgrade in priority roads which will use to transport materials and machines such as the road through Cop, Huong Choa and Phung Lam villages, Huong Phung commune	<ul style="list-style-type: none"> <li>■ Project owner</li> <li>■ EPC Contractor</li> </ul>	Temperature, humidity, wind speed, dust, CO, NOx, SO <sub>2</sub> .	<ul style="list-style-type: none"> <li>■ Monitoring locations: 03 locations                             <ul style="list-style-type: none"> <li>- 01 location at the Project site (WGS84 – Latitude: 16.71608541; Longitude: 106.61410253);</li> <li>- 01 location at the gate of the construction site (WGS84 – Latitude: 16.73101226; Longitude: 106.62041442); and</li> <li>- 01 location at the turbine area (WGS84 – Latitude: 16.72024685; Longitude: 106.63167526);</li> </ul> </li> <li>■ Frequency: every six months.</li> </ul>	Monitoring Report
			Trucks will be covered with tarpaulins to avoid spillage of materials on the way of transportation				
			Do not use vehicles and machines which are too old and high potential cause pollution Water spraying should be conducted at least twice a day during the dry season at communal roads and roads to access Cop and Phung Lam villages, Huong Phung commune				
			Ensure transport vehicles are not over-capacity and restrict transportation during rush hour and night time				
			PPEs must be provided adequately for all workers.				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
workers daily movement	excavators, compactors and diesel generator.	ESIA	<p>Develop and implement a Traffic Management Plan to reduce the impacts of dust and emissions from transport vehicles;</p> <p>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</p> <p>Cover construction material trucks during the transportation</p> <p>Control the speed limit of trucks and other vehicles, so as not to exceed 10 km/h within the Project's boundaries</p> <p>Areas of construction, stockpile areas and other exposed soils should be designated, such as in order to minimise vehicle movements over these areas</p> <p>Maintain all vehicles and equipment in good working order</p> <p>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</p>	-	No additional specific monitoring is required.	No additional specific monitoring is required.	-

## 14.9.2 Water Resource Management

**Table 14.3 Water Resource Management**

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
<b>Pre-Construction and Construction Phase</b>							
<ul style="list-style-type: none"> <li>■ Land Preparation and civil works;</li> <li>■ Substation, transmission line, laydown area and operation house construction;</li> <li>■ Operation of associated facilities such as concrete batching plant;</li> <li>■ Waste and wastewater management from construction and worker's activities; and</li> <li>■ Hazardous storage and handling.</li> </ul>	<ul style="list-style-type: none"> <li>■ Reduction of downstream surface water availability;</li> <li>■ Increased turbidity due to suspended sediment washed into stream and creeks;</li> <li>■ Increase contaminants washed into the water-bodies;</li> <li>■ Waste discharged from construction activities and worker's activities; and</li> <li>■ Spillage of oil, chemicals,</li> </ul>	EIA; EPP	<p>To build septic toilets in construction phase for workers;</p> <p>To manage wastewater generating during construction phase as following measurements:</p> <ul style="list-style-type: none"> <li>■ Utilise maximum water for maintenance activities;</li> <li>■ Save water during concrete mixing process; and</li> <li>■ To minimize the leakage of grease from machines.</li> </ul> <p>Rain water:</p> <ul style="list-style-type: none"> <li>■ To build the synchronized drainage system;</li> <li>■ To check regularly to ensure no block the drainage system;</li> <li>■ To collect solid waste into trash;</li> <li>■ To build a warehouse which stores material and/or cover machine when raining;</li> <li>■ Do not put material nearby drainage system to prevent falling into the system;</li> </ul>	<ul style="list-style-type: none"> <li>■ Project owner</li> <li>■ EPC Contractor</li> </ul>	pH, DO, BOD5, TSS, COD, NO <sup>3-</sup> , PO <sup>4</sup> <sup>3-</sup> , Oil and Grease	<ul style="list-style-type: none"> <li>■ Monitoring locations: 02 locations                             <ul style="list-style-type: none"> <li>- 01 location at Pa Rong stream, Phung Lam Village, Huong Phung Commune (VN2000 – X: 1.849.419; Y: 538.831); and</li> <li>- 01 location at streams at Cop Village, Huong Phung Commune (VN2000 – X: 1.850.398; Y: 539.500)</li> </ul> </li> <li>■ Frequency: every six months.</li> </ul>	Monitoring Report

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
	hazardous chemicals from use of vehicles and construction machines during the construction phase.		<ul style="list-style-type: none"> <li>■ Only do maintain machine and vehicles at the garage; and</li> <li>■ To make a plan to ensure all main items building in dry season.</li> </ul> <p>Domestic solid waste:</p> <ul style="list-style-type: none"> <li>■ To provide two 120 L trash at worker's house to collect solid waste, and to remind workers to follow the waste disposal regulations; and</li> <li>■ To do classification for solid waste. The organic solid waste will be collected, transported and handled by Huong Hoa environmental and urban agency</li> </ul> <p>Waste generating in construction activity:</p> <ul style="list-style-type: none"> <li>■ Do the solid waste classification between domestic solid waste and solid waste generating in construction activity; and</li> <li>■ To create a place for gathering solid waste.</li> </ul> <p>PPEs must be provided adequately for all workers.</p>				
		ESIA	Collect and store solid waste, domestic waste and hazardous waste in containers during both construction and operation phases;	-	-	-	-



Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			<p>Solid waste will be collected, stored and processed by functional units in accordance to Circular No. 36/2015/TT-BTNMT;</p> <p>Domestic solid waste will be collected daily. The project investor will sign an agreement with functional units for transporting and handling respective wastes;</p> <p>Domestic wastewater will be collected and processed by the septic tanks;</p> <p>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;</p> <p>Establish internal rules and activities for environmental protection, including littering and disposal of wastes;</p> <p>Select appropriate methods and equipment to reduce disturbances to fresh water;</p> <p>Develop and establish a Soil and Erosion Management Plan;</p> <p>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);</p>				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			<p>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;</p> <p>Equipment will be regularly checked for oil leakage;</p> <p>Prohibit discharging of waste and wastewater directly into fresh water bodies; and</p> <p>Supervise implementation of proposed mitigation measures by the Contractors.</p>				

### 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
<b>Pre-Construction and Construction Phase - Soil Compaction and Erosion</b>							
<ul style="list-style-type: none"> <li>■ Groundworks and construction activities:                             <ul style="list-style-type: none"> <li>- Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon</li> <li>- Excavation for WTG foundations and electrical poles; and</li> <li>- Construction of internal road system</li> </ul> </li> <li>■ Accidental leaks/spills of fuel, oil and hazardous</li> </ul>	<ul style="list-style-type: none"> <li>■ Loss of soil stabilizing vegetation;</li> <li>■ Soil compaction and erosion</li> </ul>	EIA	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	<ul style="list-style-type: none"> <li>■ Project owner</li> <li>■ EPC Contractor</li> </ul>	-	-	-
			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				
	Site should be restored at the end of the Project life-cycle to pre-Project level						

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
materials/waste from machine during construction phase							

**Pre-Construction and Construction Phase - Soil Contamination**

<p>■ Groundworks and construction activities:</p> <ul style="list-style-type: none"> <li>- Land and vegetation clearance in areas designated for WTG foundation, transmission line pylon</li> <li>- Excavation for WTG foundations and electrical poles; and</li> <li>- Construction of internal road system</li> </ul>	Soil contamination	EIA	Do not clear all the area of the safety corridor that goes through the annual crop land of the people, do clear only enough the area which serves for construction activity	-	-	-	-
			Undertakes to occupy only the right area				
			Activities of site clearance and vegetation clearance are carried out in phases				
			Control wastes released into the environment and take appropriate measures to treat wastes that may cause harm to the environment				
			Take measures to manage and strictly control workers to avoid hunting and deforestation				
			Train and educate workers to raise awareness of environmental protection				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
Accidental leaks/spills of fuel, oil and hazardous		ESIA	Contract a competent/ licensed contractor to collect, transport and treat domestic, construction and hazardous wastes from the project site		Arsenic, Cadmium, Total Chromium, Copper, Lead and Zinc	<ul style="list-style-type: none"> <li>■ Monitoring locations: 02 locations                             <ul style="list-style-type: none"> <li>- 01 location at the Project site (WGS84 – Latitude: 16.71608541; Longitude: 106.61410253); and</li> <li>- 01 location at the turbine area (WGS84 – Latitude: 16.72024685; Longitude: 106.63167526)</li> </ul> </li> <li>■ Frequency: every six months.</li> </ul>	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. 36/2015/TT-BTNMT, QVCN 07:2009/BTNMT on Hazardous Waste as follows: <ul style="list-style-type: none"> <li>■ Hazardous waste is prohibited to be illegally disposed into the ground;</li> <li>■ All workers shall be trained on hazardous and non-hazardous waste classification and their handling methods;</li> <li>■ 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</li> <li>■ Appropriate organizations with proper license shall be contracted in order to</li> </ul>				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			<p>periodically transport and dispose hazardous waste; and</p> <ul style="list-style-type: none"> <li>■ 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 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</li> </ul> <p>In case of accidental/ unintended spillage, the contaminated soil should be immediately collected and stored as hazardous waste</p>				

## 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
<b>Pre-Construction and Construction Phase</b>							
<ul style="list-style-type: none"> <li>■ Equipment and material transport and supply</li> <li>■ Land preparation and civil works such as land clearance, demolition, earthworks</li> <li>■ Substation, transmission line and laydown area construction</li> <li>■ Operation of associated facilities such as the concrete batching plant</li> <li>■ Transportation of equipment,</li> </ul>	<p>Potential consequences to human health can vary, depending on other factors such as noise level, human health conditions and age:</p> <ul style="list-style-type: none"> <li>■ Noise exposure had associated with hearing loss (ADLWD 2019), tinnitus, hypertension, vasoconstriction and other cardiovascular adverse effects (University of California 2019);</li> </ul>	EIA	<p>The locations of turbines must meet a safe distance from the nearest residential area <math>\geq 300</math> 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</p> <p>Technology selection with low noise and non-infrasound machinery to minimize the impact on people and animals</p> <p>Develop regular maintenance schedules for all vehicles, machines and equipment to detect early problems and reduce unnecessary noise and vibration</p> <p>Regulate the speed of vehicles when operating</p> <p>Arrange reasonable working time in high noise areas to ensure long-term health for workers.</p> <p>Provide PPEs if workers work in places where high noise level</p>	<ul style="list-style-type: none"> <li>■ Project owner</li> <li>■ EPC Contractor</li> </ul>	Noise level in compliance with QCVN 26:2010/BTNMT	<ul style="list-style-type: none"> <li>■ Monitoring locations: 03 locations                             <ul style="list-style-type: none"> <li>- 01 location at Turbine No.2 (WGS84 – Latitude: 16.71015518; Longitude: 106.64943476);</li> <li>- 01 location at Turbine No.4 (WGS84 – Latitude: 16.71384229; Longitude: 106.61005653); and</li> <li>- 01 location at Turbine No.5 (WGS84 – Latitude: 16.71885718; Longitude: 106.6402719)</li> </ul> </li> <li>■ Frequency: every six months.</li> </ul>	Monitoring Report

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
workers and materials ■ Foundation construction and Installation work of the WTGs	<ul style="list-style-type: none"> <li>■ Changes in immune system and birth effects (Passchier 2000); and</li> <li>■ Chronic noise exposure can cause in sleep disturbances and increased rate of diabetes.</li> </ul>	ESIA	<p>Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient</p> <p>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</p> <p>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</p> <p>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</p> <p>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</p>	-	-	-	-



Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency and Sampling Locations	Reporting
			<p>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</p> <p>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</p> <p>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</p>				

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				
<b>Operation phase</b>							
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
<b>Operation phase</b>							
EMF from overhead 110kV transmission line	Exposure to high levels of EMF can pose a health risk for people	EIA	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	<ul style="list-style-type: none"> <li>■ Monitoring location: 02 locations:                             <ul style="list-style-type: none"> <li>- 01 location at turbine No. 2</li> <li>- 01 location at the substation area</li> </ul> </li> <li>■ Frequency: 02 time/year</li> </ul>	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				
			Organise 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	-	-
			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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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	EIA	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 of the operation on a quarterly basis.	-
Installation of a passive shielding loop can be effective in reducing the magnetic field at a particular point							
EMF from substation	Exposure to high levels of EMF can pose a	EIA	N/A	Project Owner	EMF	Electromagnetic filed should be monitored at the vicinity of the substation. The EMF monitoring	-

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	health risk for people					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	-	-
			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				
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	-	-	-

## 14.9.6 Biodiversity Management

**Table 14.7 Biodiversity Management**

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
<b>Pre-Construction and Construction Phase</b>							
<ul style="list-style-type: none"> <li>■ Land preparation and civil works such as land clearance, demolition, earthworks</li> <li>■ Substation, transmission line and laydown area construction</li> <li>■ Transportation of equipment, workers and materials</li> <li>■ Foundation construction and Installation work of the WTGs</li> </ul>	Loss of Terrestrial Habitat	EIA	Project activities are to be restricted to contractually approved area.	Project Owner/ EPC Contractor	-	<ul style="list-style-type: none"> <li>■ Regular check (weekly)</li> <li>■ Regular inspection (quarterly) to determine plant</li> </ul>	Quarterly report
			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.				
		The Project owner shall provide training to staff, workers and visitors on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can be expected if any staff or worker or other person associated with the Project violates rules and regulations.					
		ESIA	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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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.				
			Once construction is complete the temporary construction areas will be rehabilitated to pre-construction land type				
			All land rehabilitation will be undertaken using native indigenous species.				
	Disturbance and/or Displacement of Fauna	EIA	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							
Construction schedule will be managed to avoid high concentration of work load 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					



Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			<p>All machinery and hand held equipment used must comply with required air and noise emission standards</p> <p>All light sources are to be directed away from areas of natural habitat</p> <p>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</p> <p>Fencing is to be placed around major project sites during construction to restrict access to fauna</p>				
Barrier Creation, Fragmentation and Edge Effects	EIA		Land clearance must follow procedures to prevent unplanned changes to natural habitat and allow fauna to move away from area safely	Project Owner/ EPC Contractor	-	-	-
	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	EIA		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 <i>Invasive</i>		

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			Drainage system will be constructed to avoid erosion		Species Management Plan and rehabilitation works		
		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 <i>Sediment and Erosion Control Plan</i> .				
			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 <i>Invasive Species Management Plan</i> incorporated into the EMMP and include measures such as:				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			<ul style="list-style-type: none"> <li>■ The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination.</li> <li>■ 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).</li> <li>■ Invasive species control measures are to be utilised in areas of natural habitat</li> </ul>				
	Mortality – Vehicle Strike, Hunting and Poaching	ESIA	<p>Hunting and poaching 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</p> <p>All vehicles are to maintain a speed of a maximum of 20 km/h within work sites to reduce the risk of fauna strike.</p>				

**Operation phase**

Operating activities of the Project	Mortality – Turbine and Transmission Line Strike	ESIA	<p>The transmission line will include the following measures:</p> <ul style="list-style-type: none"> <li>■ 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;</li> <li>■ Removing the thin neutral or earth (shield) wire above the high voltage transmission</li> </ul>	Project Owner/ EPC Contractor	Monitoring will be required as part of the <i>Bird and Bat Management Plan</i> in the EMMP		Fatalities will be recorded along with information relating to the season, species and location of the fatalities
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Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			<p>lines where feasible, and where this is not possible, marking the line to make it more visible;</p> <ul style="list-style-type: none"> <li>■ Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk;</li> <li>■ Habitat manipulation to influence flight activity and bird behaviour, e.g. tree lines under the high voltage lines to increase visibility;</li> <li>■ 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;</li> <li>■ 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</li> </ul> <p>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</p> <p>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</p> <p>A carcass monitoring program is to be conducted on a weekly basis at the base of</p>				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measure	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			all turbines and along transmission line as part of a <i>Bird and Bat Management Plan</i> . 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 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
<b>Operation Phase</b>							
Operation of the turbines	The association between shadow flicker caused by wind turbines and the effects on human health is highly debated.	ESIA	<p>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</p> <p>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</p>	Project Owner	-	-	-

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
<b>Pre-construction, Construction and Operation Phases</b>							
<ul style="list-style-type: none"> <li>■ Construction and Installation of Wind turbine</li> <li>■ Operation of the turbines</li> </ul>	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
<b>Pre-Construction and Construction Phase</b>							
Small scale leakage and spill incidents from site-preparation/ construction activities	<p><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.</p> <p><u>Environment</u> – Based on the liquid fuel storage volumes potential for loss of containment of oil/chemicals into ground of</p>	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).	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractor</li> </ul>	-	-	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
	surrounding area, 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	<p>Developed and implemented a Transportation Management Plan. This should include measures such as:</p> <ul style="list-style-type: none"> <li>■ Active traffic controls (e.g. flaggers to direct traffic at the Project site entrance); and</li> <li>■ Schedule construction deliveries and employee shift changes to minimise traffic congestion and delay</li> <li>■ Design an H&amp;S plan and good safety practices for the transportation (e.g. alcohol policy, good driving practice).</li> <li>■ Upgrade the access road to the Project site</li> </ul> <p>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.</p>	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractor</li> </ul>	-	-	Monitoring Report

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.	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractor</li> </ul>	-	-	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.	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractor</li> </ul>	-	-	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.		<p>and community safety risk, as identified in the HAZID/ENVID process and ensure risks are reduced to as low as reasonably practicable.</p> <p>Implement the recommendations of the QRA process into the design of the plant and the planned management measures</p> <p>Contact relevant authority bodies and conduct the UXO clearance.</p> <p>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.</p> <p>Implement routine inspection and maintenance procedures (in line with international best practice) for large storage vessels.</p> <p>Develop an Emergency Response Plan and Emergency Management Plan and monitor contractors to ensure consistent implementation.</p> <p>Implement an Emergency Response Plan and Emergency Management Plan and monitor</p>				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			contractors to ensure consistent implementation				

**Commissioning and Operation phase**

Small scale spill from activities on-site	<p><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 is not contained.</p> <p><u>Environment</u> – Based on the liquid fuel storage volumes potential for loss of containment of oil/chemicals into</p>	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							

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	ground of surrounding area, including nearby surface water resources resulting in localised, potentially long-term, degradation.		Training: employees and contractors will be trained in emergency response procedures. 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	<p><u>Communities</u> – A large-scale fire could result in injuries to people in the surrounding communities, or in the worst-case fatalities.</p> <p>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</p>	EIA  ESIA	Install lightning protection systems for turbines and transformer stations. Establish fire protection team.  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.	Project Owner	-	-	Monitoring Report

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	<p>surrounding communities, or in the worst-case fatalities.</p> <p><u>Environment:</u> – 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.</p>		<p>Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed.</p> <p>Implement Emergency Preparedness and Response Plan with forest fire protection and monitor contractors to ensure consistent implementation</p> <p>Provide regularly safety and fire prevention &amp; fighting drills.</p>				
		EIA	N/A	-	-	-	-

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
Blade ejection failure	<p><u>Communities</u> – 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.</p> <p><u>Environment</u> – As above with local flora and fauna.</p>	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 sensitive residential receptors to provide further protection	Project Owner	-	-	Monitoring Report
			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				



Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			contractors to ensure consistent implementation				
Accidental transmission line snapping and tower swaying/collapsing	<u>Communities</u> –. Electrocutions that involved community members, resulting in injury or fatality, livestock leading to death of livestock and loss/reduction in community member's livelihood.	EIA	N/A	-	-	-	-
		ESIA	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.	Project Owner	-	-	Monitoring Report
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	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.				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	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.		<p>Prepare forces, facilities and equipment to coordinate and respond to overcome before and after the incident.</p> <p>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 the local authorities for flood and storm prevention and search and rescue for timely rescue</p>				
		ESIA	<p>Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.</p> <p>The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.</p> <p>Implement periodic routine inspection and maintenance procedures (in line with international best practice).</p> <p>Install warning system, signal boards, flood prevention systems.</p> <p>Develop an Emergency Response Plan and Emergency Management Plan and monitor</p>				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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
<b>Pre-construction and Construction phase</b>							
Land acquisition process	<ul style="list-style-type: none"> <li>■ Economic displacement: loss of land and access to production land, resulting in loss of access, livelihood and income to the land users;</li> <li>■ Dissatisfaction towards the compensation price; and</li> <li>■ Social/ cultural tension from the unequal compensation between the affected households, especially among the Indigenous People</li> </ul>	EPP	Other than the compensation payment in cash, there is no other compensation or supporting method to be applied to assist affected households	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ The Government</li> </ul>	-	-	-
		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.	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ The Government</li> </ul>	<ul style="list-style-type: none"> <li>■ Comply with the monitoring and evaluation framework proposed in the LAA, SEP, LRP and CDP during the implementation of these plans.</li> <li>■ Engage a third party to undertake a Livelihood Restoration Completion audit when livelihoods of displaced people are</li> </ul>	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
			<p>communities so that they must be aware of the procedure, submission channels, and responsible person from the Project owner.</p> <p>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..</p> <p>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</p>		considered being sustainably restored.		
Disturbance to Agricultural Production during Construction Phase	Impacts on the agriculture production of local people	EPP	<p>Conduct land clearance and construction in the dry season</p> <p>Cover the construction area during heavy rainfall events</p> <p>Concrete the storm water drainage system</p>	Project Owner	-	-	-

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	<ul style="list-style-type: none"> <li>■ Health Issues as result of Noise, Dust and Vibration</li> <li>■ Traffic Safety Issue during the Construction Phase</li> <li>■ Security issues</li> </ul>	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	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractors</li> </ul>	-	-	-
		ESIA	Ensure all new drivers are licensed with good experience, and should be required to undergo safety training	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractors and sub-contractors</li> <li>■ Local authorities</li> <li>■ Local communities</li> </ul>	<ul style="list-style-type: none"> <li>■ Ongoing monitoring and periodical audit are required to check if the above mitigation measures are implemented;</li> <li>■ Monitoring and audit are also required to be conducted in accordance to the schedule proposed in the management plans relating to air quality, noise</li> </ul>	-	As defined in the Social Management Plans
			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							

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			<p>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</p> <p>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</p> <p>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</p> <p>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</p>		and traffic management		



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	<ul style="list-style-type: none"> <li>■ Potential employment of child or forced labour;</li> <li>■ Accidents, injuries or other health and safety risks, which can arise from inappropriate working conditions, such as lack of safety measures, excessive working hours</li> </ul>	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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
	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	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. Frequency and schedule for the monitoring and audits are as proposed in the SEP and internal-external Grievance mechanism	-	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
			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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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				

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			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	-	-	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	■ EPC Contractors			
Communicate clear information about Project-related employment and business opportunities and prioritize local people during both construction and operation							

Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			<p>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)</p> <p>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</p> <p>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</p> <p>At the end of construction phase, the Project Owner should consider to provide</p>				



Activity/Aspect	Potential Impact	Source Document	Mitigation Measures	Responsibility	Monitoring Parameter	Monitoring Frequency	Reporting
			<p>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</p> <p>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</p> <p>Establish a clear grievance mechanism as mentioned in previous section</p>				
<b>Operation phase</b>							
Benefits to local communities	Positive impacts on employment and procurement opportunities	<ul style="list-style-type: none"> <li>■ EPP</li> <li>■ ESIA</li> </ul>	Similar to measures proposed in Construction phase	<ul style="list-style-type: none"> <li>■ Project Owner</li> <li>■ EPC Contractors</li> </ul>	-	-	-
Disturbance on Local Community	<ul style="list-style-type: none"> <li>■ Impacts from operation noise of turbines and transformers</li> </ul>	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
	<ul style="list-style-type: none"> <li>Impacts from shadow flicker</li> </ul>		<p>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</p>				
			<p>Choosing the most advanced wind turbine available, the design is compact and compact, reducing the project's visual impact.</p>				
		ESIA	<p>Project Owner should keep implementing the SEP including grievance procedure during the Project's operation.</p> <p>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.</p> <p>Project Owner should basic skill requirements for operation phase should be announced at least six months in advance so that local people can have</p>	<ul style="list-style-type: none"> <li>Project Owner</li> <li>EPC Contractors</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing monitoring and periodical audit as proposed in the ESMP to ensure the above mitigation measures are in implementation;</li> <li>Monitoring and audit are also required to be conducted in accordance to the schedule proposed in</li> </ul>	-	As defined in the Social Management Plans

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	<ul style="list-style-type: none"> <li>■ Loss of livelihood and/or income from the land-based livelihood.</li> <li>■ Social/cultural conflicts among the community.</li> <li>■ Lack of Project information may lead to misunderstanding and unnecessary concerns about the Project impacts, and in the worst case, rejection to the</li> </ul>	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		<p>Establish a grievance mechanism that is understood by and accessible for all villagers</p> <p>Review all public consultation process to ensure the continued access to natural resources independent of Project's land purchasing</p> <p>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</p> <p>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</p>				

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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**ERM Vietnam**

3rd Floor, Saigon Finance Centre  
09 Dinh Tien Hoang, Dakao Ward  
District 1, Ho Chi Minh City  
Vietnam

T: +84 28 3914 7800

F: +84 28 3914 7801

[www.erm.com](http://www.erm.com)