Monsoon Wind Power Project, Sekong and Attapeu Provinces, Lao PDR

Environmental and Social Impact Assessment (Chapter 9-11)

28 March 2023

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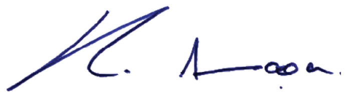

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Acronyms and Abbreviations

Name	Description
AoI	Area of Influence
ADB	Asian Development Bank
ALARP	As Low As Reasonably Practicable
ASEAN	Association of Southeast Asian Nations
BOD5	Five-day biochemical oxygen demand
CAPE	Convective available potential energy
CARE	Cooperative for Assistance and Relief Everywhere
CCRA	Climate Change Risk Assessment
CEMP	Construction and Environmental Management Plan
CESMMP	Construction Environmental and Social Management and Monitoring Plan
CF	Carbon fraction of dry matter
CIA	cumulative impact assessment
CLO	Community Liaison Officers
CO	Carbon Monoxide
COD	Commercial Operations Date
dBA	Decibels A
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DFC	Development Finance Corporation
DMC	District Disaster Management Committees
DO	Dissolved Oxygen
DONRE	Department of Natural Resources and Environment
DTM	Digital Terrain Model
EAAA	Ecologically Appropriate Area of Analyses
EDL	The state power company Electricite du Laos
EHS	Environmental, Health and Safety
EIA	Environment Impact Assessment
EIB	European Investment Bank
EMMP	Environmental Management and Monitoring Plan
EP	Equator Principles
EPC	Engineering, Procurement and Construction
EPFI	Equator Principles Financial Institutions
EPSG	European Petroleum Survey Group
ERM	ERM-Siam Company Limited
ESCAP	Economic and Social Commission for Asia and the Pacific
ESHS	Environmental, Social, Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan

Name	Description
ESMS	Environmental and Social Management System
EVN	Vietnam Electricity
FGD	Focus Group Discussions
GAD	Gender and Development
GDP	Gross Domestic Product
GHG	Greenhouse gases
GII	Gender Inequality Index
GIIP	Good International Industry Practice
GL	Germanischer Lloyd
GLAD	German-Laos Association Development
GOL	Government of Laos
GOV	Government of Vietnam
GPG	Good Practise Guide
GPM	Global Precipitation Measurement
GW	Giga-Watt
GWP	Global warming potential
H&S	Health & Safety
HAWT	Horizontal Axis Wind Turbine
HCB	Hexachlorobenzenze
HDI	Human Development Index
HH	Household
HIV	Human Immunodeficiency Virus
HSE	Health and Safety Executive
HSSE	Health, Safety, Security and Environment
IA	Impact Assessment
IAO	Institute of Acoustics
IBTrACS	Best Track Archive for Climate Stewardship
IEAD	Impact Energy Asia Development Limited
IEC	The International Electrotechnical Commission
IEE	Initial Environmental Examinations
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
ILO	International Labour Organization
IOA	Institute of Acoustics
IP	Indigenous People
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
IWGIA	International Work Group for Indigenous Affairs
JICA	Japan International Cooperation Agency
KBA	Key Biodiversity Area

Name	Description
KII	Key Informant Interviews
LAeq	Equivalent Continuous Sound Level
LAK	Laotian Kip (Official national currency of Laos)
LCA	Life-Cycle Assessment
LCU	Landscape Character Unit
LDC	Least develop country
LMIC	Middle income country
LREMDP	Livelihood Restoration and Ethnic Minority Development Plan
LUC	Land Use Consultants
LWU	Lao Women's Union
MAB	Man and Biosphere
MLA	Multilateral Agencies
MONRE	Ministry of Natural Resources and Environment
MoU	Memorandum of Understanding
MPI	Multidimensional Poverty Index
MPN	Maximum Probable Number
MW	Megawatt
MWPCL	Monsoon Wind Power Company Limited
NA	Not Available/Not Applicable
NAPA	National Adaptation Programme of Action to Climate Change
ND	Not Detected
NDC	Nationally Determined Contribution
NDMC	National Disaster Management Committee
NGO	Non-Governmental Organisations
NGPES	National Growth Poverty Eradication Strategy
NOAA	National Oceanic and Atmospheric Administration
NTP	Notice to Proceed NTP
NSEDP	National Socio-Economic Development Plan
NSSL	National Severe Storm Laboratory
NT	Near threatened
NTFP	Non-Timber Forest Product
OCSC	Office of the Civil Service Commission
OESMMP	Operation Environmental and Social Management and Monitoring Plan
OH&S	Occupational Health And Safety
ORP	Oxidation Reduction Potential
PA	Protected Area
PAP	Project Affected People
PDA	Project Development Agreement
PDR	People's Democratic Republic
PHC	Primary Health Care
PM	Particulate Matter

Name	Description
POESMMP	Project Owners Environmental and Social Management and Monitoring Plan
RP	Resettlement Plan
PRF	Provider Relief Fund
PS	Performance Standards
PSAoI	Project Social Area of Influence
QC	Quality Control
RAMSAR	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
RAP	Resettlement Action Plan
ROW	Right of Way
RPM	Revolutions Per Minute
SAR	Second Assessment Report
SEP	Stakeholder Engagement Plan
SPS	Safeguard Policy Statement
SRTM	Shuttle Radar Topography Mission
SUFORD	Scaling Up Participatory Sustainable Forest Management
SW	Surface Water
TCFD	Task Force on Climate-Related Financial Disclosures
TJ	Terajoule
TL	Transmission Line
TOR	Terms of Reference
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UCRSEA	Urban Climate Resilience in Southeast Asia
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
VAWT	Vertical Axis Wind Turbine
VP	Vantage Point
VSR	Visual Sensitive Receptors
VU	Vulnerable
WBCSD	World Business Council for Sustainable Development
WBG	World Bank Group
WHO	World Health Organisation
WRI	World Resources Institute
WSDI	Wind Speed/Direction Indicator
WTG	Wind Turbine Generator

Name	Description
WWF	World Wide Fund
ZTV	Zone of Theoretical Visibility

9 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

9.1 Introduction

This section presents an assessment of impacts for key environmental and social aspects identified in in Phase 1 of the Project. The impact assessment method is described in ***Section 6***. This section assesses the project's likely positive and negative direct and indirect impacts to physical (***Section 9.3***), biological (***Section 9.4***), social (***Section 9.5***) and unplanned events (***Section 9.7***) in the Project's area of influence. The outcomes of the assessment will inform the development of the ESMP (***Chapter 10***), which will be used to implement relevant management plans.

This section also identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, transboundary, and cumulative impacts as appropriate.

9.2 Identification of Impacts

Following the determination of Area of Influence, a Scoping Matrix (***Table 9.1***) was used as a tool to support a methodological identification of potential interactions each Project activity may have on the range of resources/receptors within the AoI. This matrix was prepared in line with the gaps identified from the Phase 1 of the Study for consideration in this Supplemental ESIA.

It consists of, on one side of the matrix, a list of Project activities during the construction and operation phases which may give rise to significant impacts. These are set against a list of environmental and social resources/receptors within the AoI with potential to interact. Entries in the matrix cells are colored to indicate following potential impacts:

	Key
	Scoped in - Potentially significant impact requiring further assessment
	Scoped out - Potential interaction unlikely to be significant
	Positive impacts - An interaction with positive impact expected
	An interaction is not reasonably expected

Table 9.1: Scoping Matrix

Environmental and Social Receptors / Project Phase and Activities	Environment											Social								
	Air Quality	Noise and Vibration	Topography	Shadow Flicker	Geology & Soil	Ground and Surface Water	Landscape and Visual	Terrestrial Fauna and Flora	Aquatic Flora and Fauna	Protected Areas / Sensitive Species	Avifauna	Economic Opportunities	Economic Displacement and	Ethnic Groups	Local Amenity	Gender	Traffic and Transport	Occupational Health and Safety	Community Health, Safety and	Cultural Heritage
Pre-Construction																				
Workforce Mobilization and Presence																				
Land Preparation (site clearance, excavation and levelling), fencing, and civil works																				
Construction																				
Equipment and material transport and supply																				
Construction of turbine foundations, transmission line pylons, internal road, auxiliary works and turbine installation																				
Wastes, emissions and discharges generation, handling and disposal																				
Construction / operation of auxiliary facilities, i.e., concrete batching plant																				
Construction water usage																				
Commissioning and Operation																				
Workforce Presence																				

Environmental and Social Receptors / Project Phase and Activities	**Environment**											**Social**								
	Air Quality	Noise and Vibration	Topography	Shadow Flicker	Geology & Soil	Ground and Surface Water	Landscape and Visual	Terrestrial Fauna and Flora	Aquatic Flora and Fauna	Protected Areas / Sensitive Species	Avifauna	Economic Opportunities	Economic Displacement and	Ethnic Groups	Local Amenity	Gender	Traffic and Transport	Occupational Health and Safety	Community Health, Safety and	Cultural Heritage
WTG Operation																				
WTG and Transmission line Inspection and Maintenance																				
Waste, emissions and discharge generation, handling and disposal																				
Unplanned Events																				
Leakage and spill incident																				
Fire and Explosion																				
Vehicle Collision																				
Blade throw																				
Transmission line snapping																				
Natural Hazards (Flood and Landslide)																				
Decommissioning and Rehabilitation																				
WTG removal																				

9.2.1 Scoped Out Impacts

The scoped out impacts and rationale are summarised in ***Table 9.2***.

Table 9.2: Scoped Out Impacts

Project Activity and Receptor	Rationale
Air emissions during operation and from routine maintenance	Impacts to ambient air quality will be from vehicle use from maintenance activities only. The Project will comply with good international industrial practise and impacts are not likely to be significance.
Waste generation and disposal during operation	Waste generation and disposal during operation will be from the small scale domestic wastes from the operational facilities and maintenance activities only.There will be some waste from maintenance works generated such as waste oil, lubricant etc. This type of waste will be collected and disposed of in compliance with applicable regulations. Waste generation will be from the consumption of employee. The solid waste generation will include food wastes, scrap papers and plastics that will be sent to the authorized agencies for further disposal. Papers, water bottles, glasses, metal and plastics will be recycled. The hazardous material will include diesel oil, paint, etc. The actual amounts of waste to be generated by the Project are currently not available. As such, a Waste Management Plan for operation will be developed required including the estimated types, volumes, and transportation and disposal/treatment.
Land Acquisition and Physical Displacement – Local Communities and Livelihoods	The Project layout will involve the acquisition of land for access roads and transmission lines. However, siting has avoided villagers' houses, therefore there will not be physical displacement impact on villagers. Despite this, it is recognised that land acquisition may cause economic displacement as some agricultural land and forests will be cleared. Economic displacement is discussed as a separate impact in ***Section 9.5.2***. On this basis, the impact of physical displacement has been scoped out and will not be assessed further.
Electro-magnetic fields	Electric and magnetic fields (EMF) are emitted by any electrical device (e.g. power lines and electrical equipment). Electric fields are shielded by conductive materials, and trees and buildings. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance, so they are of concerns for a limited distance from the source only. However, especially in dense urban areas where transmission and distribution facilities run very close to buildings, they might represent a potential health danger. Even though there is limited scientific evidence of adverse health risks, this is still a concern from local communities. The transmission line RoW is 70 m and does not pass close to local households to warrant a significant concern to health. On this basis, it has been scoped out the assessment.

9.3 Physical Environment Impact Assessment

9.3.1 Scope of Physical Environment Impact Assessment

Potential impacts of the physical environment have been further assessed, including topography, geology and soil, climate change, air quality, noise, surface water quality, landscape values and visual amenity, and impact associated with shadow flicker. Details of the impact assessment are presented in the following sections.

9.3.2 Impacts on Topography

9.3.2.1 Potential Impacts

The Project is located in Dak Cheung District of Sekong Province and Sanxay District of Attapeu Province. These two districts have similar topographic features and weather conditions. The project area is mostly composed of the slopes of the hill and high mountainous areas, the elevation is ranging from about 1,000 to 1,600 m above sea level.

The construction activities that have the potential impact are wind turbine generator (WTG) foundation, access roads, transmission line, and other components. The construction of these project components requires levelling or cutting of the topography.

Other factors that can impact topography are the slope of the soil, rock condition, and improper land use situation.

In the operation phase, project facilities will have a permanent presence.

9.3.2.2 Existing Controls

The mitigation measures identified in the local EIA (EIA, 2022) include:

- Avoid carrying out earthwork during heavy rainfall, which will lead to erosion
- After completing construction work, earth filling and compacting must be performed;
- Conduct area clearance or cutting of trees in the Project footprint / Concession Area only;
- Define the operation area clearly by designing the use of road and temporary space for the installation of the WTG in each point in order to minimize the impact to the topography of the area;
- After the construction, conduct restoration of the area and return the landscape to the original condition as much as possible; and
- Assign staff to regularly conduct inspection and audit of the construction area.

9.3.2.3 Significance of Impacts

Methodology for Assessment of Impact Significance

The sensitivity criteria and impact magnitude criteria for topography has been provided in ***Table 9.3*** and ***Table 9.4*** respectively. The subsequent subsections will utilise these criteria to assess the impact of the Project activities to topographical changes.

Table 9.3: Sensitivity Assessment Criteria for Topography

Topography and Drainage Sensitivity	Criteria
Low	Flat topography
Medium	Undulating topography
High	Hilly area

Table 9.4: Criteria for Impact Magnitude for Assessment of Impacts on Topography

Magnitude	Criteria
Negligible	An imperceptible, barely or rarely perceptible change in topographical characteristics. The change may be short term.

Magnitude	Criteria
Small	A subtle change in topography character over a wide area of a more noticeable change either over a restricted area or infrequently perceived. The change may be short term to long term and is reversible.
Medium	A noticeable change in topographic character, frequently perceived or continuous and over a wide area; or a clearly evident change over a restricted area that may be infrequently perceived. The change may be medium to long term and may not be reversible.
Large	A clearly evident, frequently perceived and continuous change in topographic characteristics affecting an extensive area. The change may be long term and would not be reversible.

Receptor Sensitivity and Impact Magnitude

Change in topography will occur on land occupied by the wind turbines and the associated facilities (e.g. substation, labour camp, site office, lay down area, crane hardstand, met masts etc.) as well as the internal access roads. Land that will temporarily be used for construction phase is anticipated to be around 60 ha for the labour camp, site office and lay down area. The temporarily used area will be reinstated after the constructional phase. The Project Development Area (excluding the transmission line) is approximately 70,828 hectares[1] , the area impact to topography will be mainly focus on the turbine base which is around 1 ha per turbine, the total area required for turbine base will be 133 ha. Area required for other facilities (Laydown area, potential batch plant, potential camp, potential crush stone production plant, potential stone resource point) is around 169 ha. Area required for access road is around 397.67 ha. Area required for pylon of 500 kV is 1.20 ha, pylon of 115 kV is 1.63 ha and pylon of 35 kV is 1.05 ha. However, the impact magnitude is considered **Medium** given the presence of access roads, substation, office based, WTGs, and ancillary facilities.

The Project area is mostly composed of hills and high mountainous areas, the elevation ranges from around 1,000 to 1,200 m above sea level. The presence of the Project during the operation phase is considered long-term. Therefore, the receptor sensitivity is considered as **Medium**.

Impact Significance

The impact significance for topography has been assessed as **Moderate**.

9.3.2.4 Additional Mitigation, Management, and Monitoring Measures

The additional mitigations measures to minimize impacts include:

- Prepare and implement a Site Restoration Management Plan.
- Provide appropriate slope protection and drainage controls.

9.3.2.5 Residual Impact Significance

The residual impact significance will remain **Moderate** after implementing above mentioned mitigation, management, and monitoring measures.

Table 9.5: Impact on Topography (Construction and Operation Phases)

Significance of Impact			
Potential Impact	Potential impacts to topography, as a result of construction and operational activities and physical presence of the Project.		
Impact Nature	**Negative**	Positive	Neutral

[1] It should be noted that the Projects' concession area will be the land required to install and construct project facilities and ROW for related transmission line, which is around 1,050 ha.

Significance of Impact					
	Potential impacts to soil would be considered to be negative				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**	
	The construction phase of the Project are expected to be completed in 30 months, which would be considered long-term; however, the physical presence of the Project during operation phase is considered long-term.				
Impact Extent	**Local**	Regional	International		
Impact Scale	Potential impacts would be limited to the Project area and hence would be considered to be local.				
Frequency	Topographic during construction and operation is considered continuous.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the impact characteristics above, the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	Based on the receptor characteristics above, the receptor sensitivity is considered as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Receptor Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.				
Residual Impact Magnitude	Positive	Negligible	Small	**Medium**	
Residual Impact Significance	Negligible	Minor	**Moderate**	Major	
	The residual negative impact will be of a 'Moderate significance during construction and operation.				

9.3.3 Impacts on Geology and Soil

9.3.3.1 Potential Impacts

During the construction phase, the potential impacts from earthworks (clearing of vegetation and grading) include loss of soil stabilizing vegetation, soil erosion, and soil compaction that would affect the physical properties of soil. The potential risk from POPs is discussed in ***Section 4.8.2*** and in the Baseline Soil Sampling Plan that is being developed and has not finalized yet. Once finalized the Baseline Soil Sampling Plan, the soil sampling will be conducted prior to commencement of the ground disturbing activities. Additionally, contaminanation to nearby surface water may arise from these acitivities, improper management of contaminant present in surface/near surface soils, which could lead to impact on contamination of surface water near by the Project site.

In addition, the construction of WTG foundation requires drilling in an octagon shape with approximately 4.2 m depth and approximately 11-18 m width at each wind turbine location. Heavy machinery may cause minor vibration and disturbance to the surrounding area. Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of topsoil. It is anticipated that the subsoil, which will be stripped and removed from the WTG foundation, transmission line route, and access road route, will be utilized for levelling/ backfilling.

The movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure. This compaction of the soil may potentially result in changed hydrological characteristics, such as reduced permeability and water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

Improper waste management practices can impact soil quality. Soil quality impacts are related with inappropriate dumping and inadequate storage/coverage during transport resulting in windblown litter. In addition, wastewater discharged, and run-off would have the potential to result in localized soil contamination within and in the vicinity of the Project area.

During the operation phase, soil compaction and erosion may occur due to heavy vehicle movement, which will be occasionally required during maintenance work.

Adequate mitigation measures will be implemented to ensure good safety practice. This includes potential organic pollutants, safety inspections, emergency plan, and fire prevention. More information can be found in ***Section 4.8*** regarding safety.

9.3.3.2 Existing Controls

The mitigation measures identified in the local EIA (EIA, 2022) include:

- In areas that are high risk (defined as land that floods at least three times annually) for erosion, where soil in the areas are primarily composed of clay loam, hard clay, and loamy sand; arrange earthwork in the dry season and avoid the rainy season, where possible, as the main cause of soil erosion along the side of water canal and non-asphalted roads during rainy season is rainfall;
- Undertake the earthwork within the Project footprint;
- The stockpiling of the construction materials must be kept at least 30 m from rivers and waterways with the intention that they do not impede or concentrate the overland flow during rainfall events or cause the creation of ponding;
- Ensure that the construction materials are stored in designated areas or in a secured place, and are not causing obstruction or located in areas of potential soil erosion;
- Construct a suitable drainage system specifically in areas of high potential soil erosion;
- Monitoring / auditing conducted to inspect erosion control measures;
- Avoid earthworks in existing forest areas as much as possible;
- Replantation to be conducted as soon as possible after completion of forest clearance or backfilling work. The success of revegetation work will depend on species selection, planting into soil rather than spoil, protection from livestock grazing, and watering as required by seasonal conditions. This will be included in the restoration plan;
- Avoid digging and removal of stockpiling of soil at the sides of the stream or canal in order to prevent sedimentation and erosion into the water sources;
- Conduct backfilling and compacting using heavy machinery to prevent the collapse of the soil as soon as possible after earthworks;
- Undertake erosion protection for WTG foundations and transmission towers that are located in a slope area.
- Undertake construction of a water drainage system at both sides of the access road to facilitate draining of water.

9.3.3.3 Significance of Impacts

Methodology for Assessment of Impact Significance

The sensitivity criteria and impact magnitude criteria for soil quality has been provided in ***Table 9.6*** and ***Table 9.7***, respectively. The subsequent subsections will utilise these criteria to assess the impact of the Project activities to soil quality.

Table 9.6: Sensitivity Assessment Criteria for Soil Quality (Compaction, Erosion, and Contamination)

Sensitivity Criteria	Contributing Criteria	
	Environment	Social
Soil quality related criteria as compaction, erosion and contamination and land use change	The extent to which the soil and its quality plays an ecosystem role in terms of supporting biodiversity. This includes its role in supporting a lifecycle stage.	The extent to which the soil and its quality provides a use (agricultural use) to the local communities and businesses or is important in terms of national resource protection objectives, targets, and legislation.

Sensitivity Criteria	Contributing Criteria	
	Environment	**Social**
Low	The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality	The soil quality has little or no role in provisioning of services as agricultural uses for the local community.
Medium	The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the study area	The soil has local importance in terms of provisioning services as agricultural services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality i.e., ready availability across the study area.
High	The soil quality supports economically important or biologically unique species or provides essential habitat for such species.	The soil is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional level for provisioning services.

Table 9.7: Criteria for Impact Magnitude for Assessment of Impact to Soil

Magnitude Criteria	Negligible	Small	Medium	Large
Soil compaction and erosion	■ Qualitative-No perceptible or readily measurable change from baseline conditions ■ Scale - Localized area as Particular activity areas ■ Time-Short duration (few days) or one time as temporary	■ Perceptible change from baseline conditions but likely to easily revert back to earlier stage with mitigation ■ Scale -Project site, activity areas and immediate vicinity not impacting any sensitive receptor ■ Short term - Only during particular activities or phase of the project lifecycle as civil works or construction phase)few months(	■ Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and/or likely take time to revert back to earlier stage with mitigation ■ Scale -Project site, activity areas and immediate vicinity impacting sensitive receptor/s ■ Long term- Spread across several phases of the project lifecycle (few years)	■ Major (e.g. order of magnitude) change in comparison to baseline conditions and/or likely difficult or may not to revert back to earlier stage with mitigation ■ Scale -Regional or international; ■ Permanent change

Magnitude Criteria	Negligible	Small	Medium	Large
Soil contamination	■ Well within standards	■ Well within standards	■ Exceeds Target Value but well within Interventional Value	■ Exceeds Interventional Value and needs intervention.

Receptor Sensitivity and Impact Magnitude

The receptor sensitivity has been assessed as **Medium** because of the importance of agriculture as a source of livelihood in the area, and a portion of land does support natural habitat.

Due to the localized area of construction within the Project area and the time taken to revert back to early conditions, the impact magnitude has been assessed to be **Medium**.

Impact Significance

The overall impact significance on soil erosion and compaction has been assessed as **Moderate.**

9.3.3.4 Additional Mitigation, Management, and Monitoring Measures

The additional mitigations measures to minimize impacts include:

- Prepare and implement and Spoil Management Plan and Soil Erosion and Sediment Control Management Plan prior to construction.
- Update the Spoil Management Plan following the results of POPs analysis in soil. If POPs are identified in soil, spoil must be treated as hazardous waste.
- A Waste Management Plan (WMP) for the Project should be developed and implemented. The WMP should include the following:
  - Good housekeeping practices for waste storage and handling referencing good international industry practice (GIIP);
  - A waste inventory developed in the planning stage, in discussion with the engineers, to establish the types of wastes (hazardous and non-hazardous) expected from the construction and to identify appropriate disposal routes;
  - Construction materials should be managed in a way to avoid over-ordering, poor storage and maintenance, mishandling as well as improper operation procedures;
  - Construction wastes should be separated into reusable items and materials to be disposed of or recycled whenever possible;
  - Waste suitable for reuse should be stored on site and reintroduced to the construction process as and when required;
  - The WMP should identify disposal routes (including transport options and disposal sites) for all wastes generated during the construction phase and operation phase. This should comply with applicable local regulations;
  - A hazardous waste management system covering waste classification (including hazardous chemical waste), separation, collection, storage, transfer and disposal should be set up and operated. The waste management system should comply with applicable regulation of the Laotian law or GIIP, depending on which has a higher standard;
  - Hazardous waste should be stored in such a way as to prevent and control accidental release to the environment (e.g. secondary containment, sealed containers);

- As the Project is responsible for its waste management to the point where it foresees that waste is appropriately disposed in a benign manner, it should see to that waste is collected and shall be disposed (whether temporary or permanent) in landfills (designed, sited, constructed, and managed in accordance with the requirements as mentioned in CA) to minimize contact with water during normal and abnormal weather events, and with environmental controls in place, including run-on/run-off controls, liners, leachate collection systems, groundwater monitoring, closure controls, daily (or other operational) cover, and fugitive dust controls;
- Recyclables such as scrap steel, metals, plastics, and paper items should be collected for recycling wherever possible;
- Disposal of construction waste in or off the construction site should be prohibited;
- Chain of custody documents should be used for construction waste and hazardous waste to monitor disposal; and
- Waste segregation should be practiced at the labour camp with an emphasis placed on reducing, reusing and recycling of waste streams as appropriate.

The Company will comply with the requirements of waste and spoil disposal in line with requirements stipulate in the **CA section 2.5 Waste Management**.

- The access route for movement of heavy machinery will be designated to avoid the soil compaction in other areas.
- Conduct monitoring of Total Suspended Solids (TSS) at nearby water sources.
- Conduct pre-construction soil sampling in accordance with the approved Soil Sampling Plan to identify the potential presence of Persistent Organic Pollutants (POPs), which may include PCBs, dibenzofurans, and dioxins. If POPs are identified in the soil, the spoil will be treated as hazardous waste and will need to be managed and disposed of according to GIIP.

9.3.3.5 Residual Impact Significance

The residual impact significance will reduce to **Minor** after implementing above mentioned mitigation, management, and monitoring measures (***Table 9.8***).

Table 9.8: Soil Impacts from Soil Erosion and Compaction (Construction and Operational Phase)

Significance of Impact				
Potential Impact	Potential impacts on soil due to soil erosion and compaction, as a result of earthworks and use of heavy machinery.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to soil would be considered to be negative.			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would be direct impacts.			
Impact Duration	Temporary	Short-term	**Long-term**	**Permanent**
	The construction phase of the Project is expected to be completed in 30 months, which would be considered long-term and permanent for operation.			
Impact Extent	**Local**	Regional	International	
	Potential impacts would be limited to the Project area and hence would be considered to be local.			
Impact Scale	Impact scale is considered localised and small.			
Frequency	Impacts to soil could occur intermittently during the construction phase.			

Significance of Impact					
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Based on the impact characteristics above, the impact magnitude is considered to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	Based on the receptor characteristics above, the receptor sensitivity is considered as medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Receptor Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.				
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium	
Residual Impact Significance	Negligible	**Minor**	Moderate	Major	
	Although the aforementioned mitigation measures are expected to help control the impact, the significance of residual impacts is expected to reduce to Minor.				

9.3.4 Impacts on Air Quality

9.3.4.1 Potential Impacts

The ambient air quality is likely to be impacted by site development works. This includes site clearance, the removal of vegetation as well as earthwork and civil construction creating free flying fugitive dust/dust nuisance into the air, which could be hazardous for human health. Project activity potentially causing air emissions during the construction phase also includes transportation of personnel and material.

The potential impact based on the Project activities (site clearance, earth work, construction) is dust soiling and increased ambient PM_{10} concentrations due to dust arising from activities on the site. Other potential impacts are from transportation of personnel and materials. There will be an increase in concentrations of airborne particles, nitrogen dioxide, sulphur dioxide due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery) and vehicles accessing the site.

During the operation phase, passenger vehicles used by staff to travel to and from the Project is to be expected, air emissions generated from these vehicles are very minor and the number of vehicles is expected to be minimal. As such, no significant air quality impacts are expected during Project operation.

9.3.4.2 Existing Controls

The mitigation measures identified in the local EIA (EIA, 2022) include:

- Conduct air quality monitoring as per recommendations in the local EIA (2022);
- Reduce the speed of vehicles: to mitigate the potential occurrence of dust from the transportation of construction materials to the project construction site, it is required to limit and control the speed of vehicles arriving to and leaving the affected villages at not exceeding 20 km/hour;
- The roads within the Project area should be paved. If the road isn't paved, it is required to regularly spray water at least two times per day, especially roads that pass through villages and access roads to the construction sites;

- In the construction area, areas located near the communities, it is required to build a 2 m height of fence around the site to reduce dust dispersion from soil digging, removing, dumping, and filling works if the construction site is within 500 m of communities;
- The construction contractor must regularly undertake maintenance of vehicles and heavy machinery of all types which are used in the construction of the project;
- Vehicles transporting construction materials must be properly covered, particularly the transportation of soil, sand, and gravel to the construction site;
- Conduct pre-construction soil sampling in accordance with the approved Soil Sampling Plan to identify the potential presence of Persistent Organic Pollutants (POPs), which may include PCBs, dibenzofurans, and dioxins. If POPs are identified in the soil, the spoil will be treated as hazardous waste and will need to be managed and disposed of according to GIIP;
- Have a wheel washing facility on exit from the site for vehicles to prevent the vehicles from carrying mud or sediment to outside construction site and communities; and
- Training should be organized and staff and workers to be prohibited from burning rubbish and wastes that will cause potential air pollution.

9.3.4.3 Significance of Impacts

Methodology for Assessment of Impact Significance

The sensitivity criteria and impact magnitude criteria for ambient air quality has been provided in ***Table 9.9*** and ***Table 9.10,*** respectively. The subsequent subsections will utilise these criteria to assess the impact of the Project activities to the ambient air quality.

Table 9.9: Sensitivity Assessment Criteria for Air Quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	Ecological Receptors
Low	Locations where human exposure is transient.	Locally designated sites; and / or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Few Receptors (settlements) within 1 km of project activity area as wind turbine, roads, batching plant etc.	Nationally designated sites.
High	Densely populated receptors (settlements) within 1 km of project activity area as wind turbine, roads, batching plants.	Internationally designated sites

Table 9.10: Criteria for Impact Magnitude for Assessment of Impact to Air Quality

Magnitude	Criteria
Negligible	Low levels of emissions/ dust generation due to Project activity Impact extent is local Temporary dust generation and emission from Projects
Small	Soil type with large grain size (e.g. sand) Impact extent is local Dust generation and emissions from Projects for short duration

Magnitude	Criteria
Medium	Moderately dusty soil type (e.g. silt) Impact extent is local to regional Dust generation and emission from Projects for long duration
Large	Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) Impact extent is local to international Significant process emissions from Project for the entire Project cycle

Receptor Sensitivity and Impact Magnitude

The receptor sensitivity has been assessed as **Medium** due to the presence of sensitive receptors (settlements) within 1 km of the site. The impact magnitude is considered to be **Medium**.

Impact Significance

The overall impact significance on air quality from land preparation and civil works, and transportation of personnel and material has been assessed as **Moderate,** respectively.

9.3.4.4 Additional Mitigation, Management, and Monitoring Measures

The additional mitigations measures to minimize impacts include:

- Prepare and Implement and Air Quality Management Plan prior to construction.
- Prioritise materials to be supplied by local suppliers (Laos suppliers);
- Water sprays should be applied at land preparation area, access roads and any other exposed surfaces which could be source of dust are to be watered;
- Construction material at the storage area will be covered to minimize dust dispersion during construction;
- No open burning of and materials including cleared vegetation. Cleared vegetation will either be composed or reused for stabilization purposes;
- Vehicles transporting materials within or outside the construction site will not to be overloaded;
- Vehicle engines need to be properly maintained to ensure minimization in vehicular emissions;
- Use of modern equipment and vehicles meeting appropriate emissions standards, and regular preventative maintenance; and
- Minimizing stockpiling by coordinating excavations, spreading, and regrading and compaction activities. Stockpile is to be covered if materials are stored over a period exceeding a week or two weeks.
- No waste is to be burnt

9.3.4.5 Residual Impact Significance

With the implementation of both the embedded control as well as the suggested additional mitigation measures, uplifted fugitive dust dispersion emission of gases from vehicles can be limited and controlled. As a result, the residual negative impact associated with decreased air quality will be of a **Minor** significance (***Table 9.11***). Impacts during operation are not considered to be significant during Scoping and have been scoped out of the assessment.

Table 9.11: Air Quality Impacts (Construction Phase)

Significance of Impact					
Impact	• Fugitive dust emission causing degradation in ambient air quality				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to air quality would be considered to be negative				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to air quality would be direct impacts through mainly uplifting of fugitive dust during land preparation and civil works.				
Impact Duration	**Temporary**	Short-term	**Long-term**	Permanent	
	The construction phase of the Project is expected to be completed in 30 months, which would be considered long-term. The impact to air quality due to land preparation and civil work is expected to be transient.				
Impact Extent	**Local**	Regional	International		
	The impact will only be localized within the Area of Influence of the Project.				
Impact Scale	Impact scale is considered localized and small.				
Frequency	Impacts to air quality could occur intermittently during the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	**Large**
	■ Based on the characteristic above, the impact is likely to be medium				
Receptor Sensitivity	Low	**Medium**	High		
	The location of the nearest sensitive receptor (i.e. village houses are less than 1 km away from the construction site).				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude will result in a Moderate impact significance.				
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium	
Residual Impact Significance	Negligible	**Minor**	Moderate	Major	
	Upon considering the mitigation measure, the residual impact is assessed to be Minor.				

9.3.5 Impacts on Noise

This section describes the methodology and findings of the noise assessment forming part of the Environmental and Social Impact Assessment (ESIA). Detailed in this report are the main aspects of the proposed Project, the construction of the project, the wind farm noise assessment criteria and the predicted noise levels at all potentially affected receptors within the potential area of influence of the wind farm.

As the methodologies for assessing noise impacts will vary between construction and operational phases, these have been separated for the purposes of this assessment.

9.3.5.1 Construction Phase

Potential Impacts

During the construction phase, a range of works and activities will be required at various locations within the area. Those with the potential to generate significant noise emissions include:

- Site preparation, construction and installation works associated with each of the proposed wind turbines.
- Site preparation and building construction works associated any permanent facilities.
- Construction and installation of the internal electrical network (between turbines) and any associated transmission lines.
- Use of specialised (e.g. concrete batching plants) or unforeseen wind farm construction equipment, or activities that are to be undertaken.

Existing Controls

- Conduct noise monitoring as per the recommendations in the local EIA report (2022).
- 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.

Significance of Impacts

Methodology for Assessment of Impact Significance

A quantitative noise modelling assessment has not been conducted for construction; however, these works and activities (or similar activities) are expected to generate noise levels that would potentially generate impacts. This is typical of many construction works associated with major developments. Elevated levels will not represent a constant or long-term emission that would be experienced by the community throughout the project’s construction schedule, or for the operational life of the wind farm. Construction noise levels would only be experienced for limited periods of time when works are occurring at select locations; they would often not be experienced for full daytime, evening or night time periods. Any impacts associated with these works would be temporary and will not represent a permanent impact on the community and the surrounding environment.

At the time of the assessment a list of equipment to be used on site and their respective sound level was not available to ERM, However, ERM has undertaken some distance based calculations assuming construction activities of sound power level of 116 dB, The closest noise sensitive receptor to the a WTG is R85 at a distance of 160 m from WTG WH1050. This sensitive receptor is a cemetery and predicted noise level is 64 dB (Using BS5228 standard for construction noise). Some noise from construction sites is inevitable, such that good construction management practices usually focus on minimising noise impacts, rather than only on achieving numeric noise levels. Good-practice construction noise management and noise mitigation techniques may be required for construction of the Project to reduce noise levels as far as practicable. These would need to be considered and then implemented, where necessary.

The sensitivity criteria and impact magnitude criteria for ambient noise has been provided in ***Table 9.12*** and ***Table 9.13***, respectively.

Table 9.12: Criteria for Impact Magnitude for Assessment of Impact to Noise Level

Magnitude	Criteria
Negligible	■ Predicted noise levels are at or less than 3 dB (A) above the relevant limits / thresholds ■ Human exposure is transient within 500 m of project site ■ No designated sites and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team) within 500 m of project site ■ Impact extent is local ■ Temporary exposure
Small	■ Predicted noise levels are 3 to less than 5 dB (A) above the relevant limits / thresholds ■ Receptors include industrial, retail, or transient receptors within 500 m of project site ■ Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team) within 500 m of project site. ■ Impact extent is local ■ Short-term exposure
Medium	■ Predicted noise levels are between 5 and 10 dB (A) above the relevant limits / thresholds ■ Receptors include residential and recreational space' within 500 m of project site ■ Nationally designated sites and/or areas of specific ecological interest within 500 m of project site ■ Impact extent is local to regional ■ Long-term exposure
Large	■ Predicted noise levels are at or more than 10 dB (A) above the relevant limits / thresholds ■ Receptors include educational/ religious/ medical facilities within 500 m of project site ■ Internationally designated sites and/or areas of specific ecological interest within 500 m of project site ■ Impact extent is local to international ■ Permanent exposure

Table 9.13: Noise Receptor Sensitivity

Category	Designation / Importance / Vulnerability
High	Existing ambient noise is already under stress and/ or public health is very sensitive to change (children, schools).
Medium	Existing noise quality conditions already shows some signs of stress and/ or supports ecological resources that could be sensitive to change in noise quality (protected species, migratory birds, protected areas).
Low	Existing noise quality condition is good and the ecological resources that it supports are not sensitive to a change in noise quality.

Receptor Sensitivity and Impact Magnitude

Given the above, the receptor sensitivity is classified as **Medium** and the construction noise will be **Medium** magnitude.

Impact Significance

The duration of the construction period is expected to be 30 months, but this time period is distributed over a massive area (the whole project area).

Assuming that activities will be hold only during daytime, for a short period of construction duration and that the shortest distance between receptors and WTGs is more than 550 m, just a **Moderate** impact is expected.

Additional Mitigation, Management, and Monitoring Measures

Based on the findings of the qualitative construction noise assessment noise mitigation will be adopted as follows:

- 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.
- Ensure the appropriate personal protective equipment (PPE) and necessary response supplies are available at the construction site, in good condition, and workers are trained in their proper use and maintenance.
- EPC contractor shall place the machine with high noise level to avoid sensitive receptor. The machine layout plan will be prepared by EPC Contractor and the noise monitoring at sensitive receptors shall be conducted as per ***Table 9.23***.
- High noise-generating construction works and activities should be limited to the daytime period (7 AM to 10 PM; as per WBG EHS definition of daytime and night-time), and work should be avoided on Sundays or public holidays if possible. In the case that Project activities necessarily have to be conducted during night-time period, the Project will consult with village heads for approval.
- Any works that are required during the night-time period (10 PM to 7 AM) should be justified and task-specific noise mitigation and management measures should be implemented to reduce noise impacts to acceptable levels. These additional measures should consider the potential for sleep disturbance impacts that could occur during the night-time period due to “peak” or “maximum” noise level events e.g. metal on metal contact, or general clangs and bangs. In the case that Project activities necessarily have to be conducted during night-time period, the Project will consult with village heads for approval
- 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.

Residual Impact Significance

Based on the findings discussed above suitable recommendations, which can be considered and potentially implemented on-site, are provided in next section of this report. Construction noise levels would be reduced to Minor (***Table 9.14***).

Table 9.14: Noise Impact Assessment (Construction)

Significance of Impact					
Impact	• Construction noise from equipment and vehicle use.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to ambient noise would be considered to be negative				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to ambient noise would be direct impacts mainly from installation and vehicle use.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase of the Project is expected to be completed in 30 months, which would be considered long-term.				
Impact Extent	**Local**	Regional	International		
	The impact will only be localized within the Area of Influence of the Project.				
Impact Scale	Impact scale is considered localized and small.				
Frequency	Impacts to ambient noise would occur intermittently during the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	**Large**
	■ Based on the characteristic above, the impact is likely to be medium				
Receptor Sensitivity	Low	**Medium**	High		
	The location of the nearest sensitive receptor (i.e. village houses are less than 1 km away from the construction site).				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude will result in a Moderate impact significance.				
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium	
Residual Impact Significance	Negligible	**Minor**	Moderate	Major	
	Upon considering the mitigation measure, the residual impact is assessed to be Minor.				

9.3.5.2 Operation Phase

Potential Impacts

Nuisance, or an unacceptable level of noise amenity, may arise from operational activities associated with new wind farm sites. This potential for noise issues to arise is associated with emissions from significant noise generating sources/assets such as wind turbine generators. The purpose of this assessment is to address these potential noise issues by predicting and assessing wind farm operational noise levels from the Project at nearby sensitive receptors.

Significance of Impacts

Methodology for Assessment of Impact Significance

The noise limits of the Monsoon Wind Farm Project have been based on the requirements of national Lao Regulations and the ADB requirements, which refer to the World Bank Group International Finance Corporation Environmental, Health, and Safety (EHS) Guidelines and other relevant documentation.

The IFC General EHS Guideline noise guidelines are also referenced in the IFC wind energy guidance, which are 55 dB LAeq, 1 hour during the day (07.00 to 22.00) and 45 dB LAeq, 1 hour at night (22.00 to 07.00). National Lao noise regulations define the noise limit of 70 dB LAeq for a period of 24 hours. A summary of the national and international noise regulations is presented in ***Table 9.15***.

The noise limit at each of the receivers around the project is defined as the existing background noise level + 3 dB, or the base limit for each receiver type. Therefore, the limit which gives the higher noise criterion of the two discussed above has been adopted in this study. However, as mentioned in ***Section 8***, the measured noise levels did not provide a clear correlation between wind speed and the background noise levels on R1 and R4. For those receptors, a conservative approach has been adopted, where only the IFC noise limits for day and night have been used.

Table 9.15: LAO National Regulation vs IFC Guidelines

	LAO National regulation	IFC Guidelines
Period	24 hours	Day/Night
Absolute Limit	70 dB(A)	55/45 dB(A)

When assessing the significance of an impact for the noise assessment, the process is slightly different to most other topics in this ESIA. The significance of an impact is derived from the impact magnitude, but takes account of other factors such as duration and the design detail of the noise sensitive property, for example if the construction will take place during a very short period of time, the significance of the potential impacts may be downgraded.

The sensitivity of the receptor is taken account of when calculating the impact magnitude as the criteria take into account the receptor's sensitivity to noise. For example, receptors sensitive to noise during the daytime only are assessed using criteria that consider the impact of noise on daytime activities, whilst those rated as sensitive during the night time are assessed using criteria that consider the impact of noise on sleep disturbance. The significance of noise effects is set out below in ***Table 9.16***.

Table 9.16: Magnitude and Significance of Noise Effects

Exceedance of criteria, dBA	Magnitude of predicted impact	Other relevant factors	Resulting Significance of effect
5 or more below the criteria	Negligible	Factors which may influence significance of effects, e.g. duration of construction activity	Insignificant
> 5 below, up to the criteria	Small		Minor
Up to 5 dB above the criteria	Medium		Moderate
> 5 above the criteria	Large		Major

The classification of significance refers to not-significant, minor, moderate and major. A conservative approach ("Up to 5 dB above the criteria") indicating that any exceedance of the criteria is to be considered a Moderate impact is used, and Impacts rated as Moderate or Major should be mitigated where practicable, feasible and reasonable with proportionately more emphasis on the Major items. Mitigation may not fully eliminate an impact, but would be expected to reduce its severity.

Noise modelling typically calculates LAeq,1hr site contributions for direct comparison to the IFC Disturbance criteria. The source sound power levels determined according to IEC 61400-11 are provided in terms of LAeq. To obtain the LA90 parameter required by IFC noise regulations, it is necessary to apply a correction to the prediction results. Based on the experience of the IOA-NWG and recent research[2] , the assumption described in ETSU-R-97 in this regard continues to remain valid. A

[2] T. Evans and J. Cooper, Comparison of compliance results obtained from the various wind farm standards used in Australia, Proceedings of ACOUSTICS 2011, 2-4 November 2011, Gold Coast, Australia (The Australian Acoustical Society).

correction of -2 dB is commonly applied. Hence to increase the background noise level by more than 3 dB, the calculated LAeq,1hr site contribution level would need to be 5 dB above the LA90 background level.

Receptor Sensitivity

In addition to the 4 locations (R1-R4) where background noise data were collected, for modelling purposes, additional 90 receptors have been taken into consideration (***Table 9.17***), which are considered potentially impacted by the noise produced from the operation of the project. The location of the additional receptors is presented in ***Figure 9.1***.

Figure 9.1: Additional Receptors

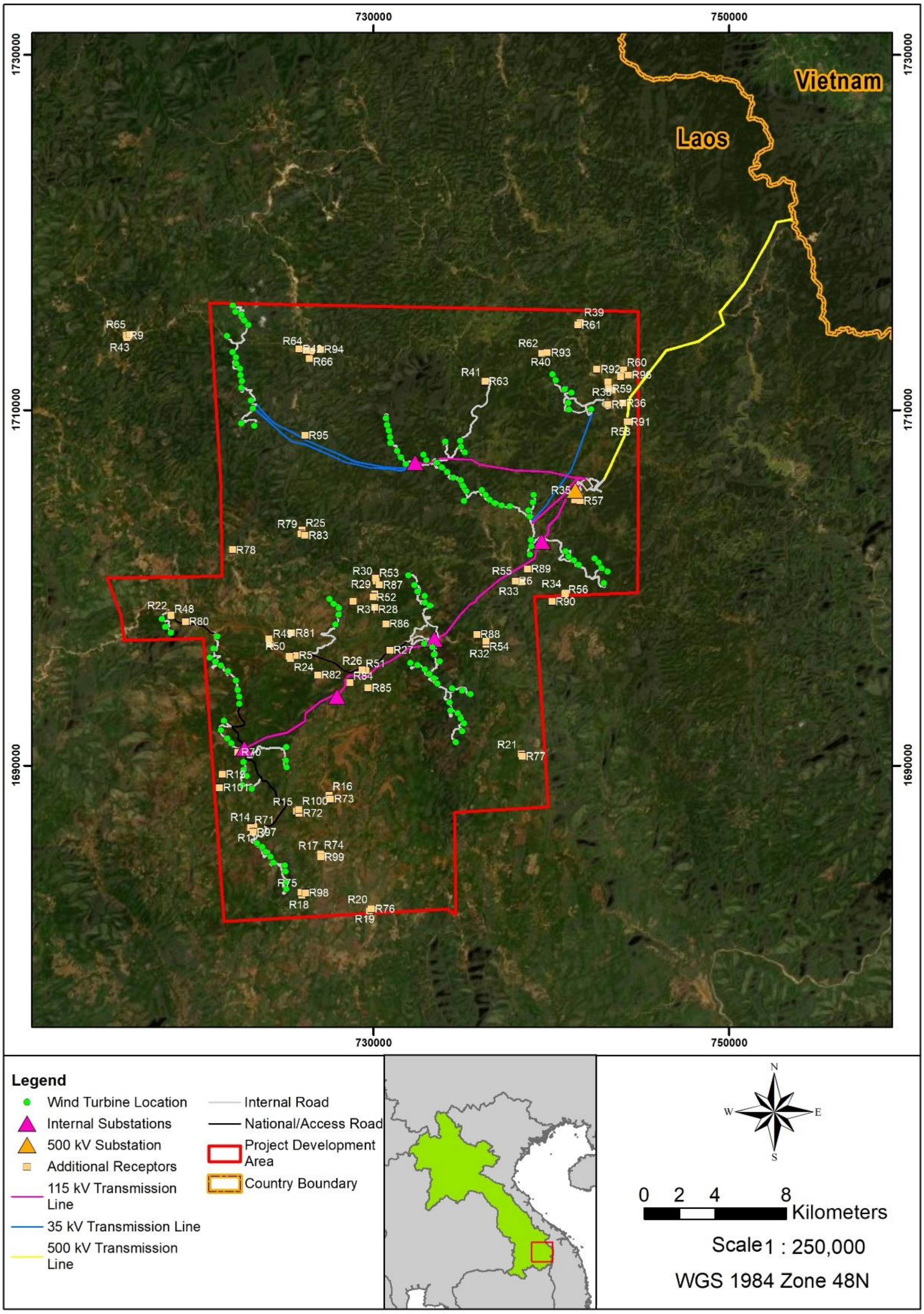

Table 9.17: Additional Receptors

Receptor	Description	UTM WGS 84 zone 48N		Distance to the nearest potential WTG	
		Easting	Northing	m	WTG
R5	Xiengluang Health Center	725582	1696196	2,848	WA094
R6	Dak Dor Health Center	737964	1700374	1,692	WA138
R7	Hospital Of Dak Chueng District	743174	1710307	972	WA154
R9	Dak Jom Health Center	716066	1714186	5,669	WA007
R10	B. Prao Health Center	726450	1713303	3,795	WA004
R11	Dak Samor Health Center	723246	1686465	865	WA142
R12	NamNgonnuea Health Center	729752	1681773	4,833	WA150
R13	Dak Nong Primary School	721478	1689492	1,216	WA1390
R14	Dak Samor Primary School	723266	1686539	934	WA142
R15	Dak Yok Primary School	725648	1687406	2,546	WA132
R16	DaK Dor Primary School	727486	1688327	2,857	WA132
R17	Dak Sied Primary School	727086	1684927	2,171	WA147
R18	Dak Xuem Primary School	725942	1682695	920	WA150
R19	NamNgonnuea High School	729964	1681880	5,013	WA150
R20	NamNgonnuea Primary School	729876	1681895	4,924	WA150
R21	Dak Padou Primary School	738291	1690621	3,565	WA093
R22	Dak Tiem Primary & Lower Secondary School	718590	1698430	559	WA102
R23	Dak Seng Primary School	724169	1696811	2,803	WA122
R24	Xiengluang Primary & High School	725312	1696012	3,174	WA094
R25	Dak Sieng A Primary School	725967	1703255	4,198	WA074
R26	Dak Terb Primary School 01	729561	1695330	2,533	WA073
R27	Dak Terb Primary School 02	730912	1696489	1,362	WA073
R28	Dak Yang Primary School 01	730056	1698865	2,018	WA096
R29	Dak Yang Primary School 02	730052	1699638	2,158	WA096
R30	Dak Yen Primary School 01	730138	1700380	1,838	WA066
R31	Dak Yen Primary School 02	728846	1699210	880	WA096
R32	Trongmueang Primary School	736311	1696824	2787	WA079
R33	Dak Dor Primary & High School	738320	1700330	1,592	WA138
R34	Dak Den Primary School	740791	1699669	1,774	WA059
R35	Dak Rant Primary School	741310	1704942	2,329	WA048
R36	Dak Bong Primary School	744012	1710378	1,805	WA154
R37	Dakchueng Primary School	743419	1711116	1,594	WA154

Receptor	Description	UTM WGS 84 zone 48N		Distance to the nearest potential WTG	
		Easting	Northing	m	WTG
R38	Dakchueng Lower Secondary School	743186	1711556	1,784	WA154
R39	Dak Pum Primary School	741628	1714935	3,319	WA015
R40	Tongxieng Primary School	739472	1713231	1,348	WA015
R41	Dak Lern Primary School	736246	1711574	3,584	WA022
R42	B. Prao & Dakkung Primary School	725795	1713437	3,142	WA004
R43	Dak Jom Primary & Lower Secondary School	716104	1714067	5,632	WA007
R44	NgonDone Primary & High School	743876	1711861	2,445	WA154
R48	Dak Tiem village	718585	1698466	568	WA102
R49	Dak Xeng village	724116	1697095	2,937	WA123
R50	Xiengluang village	725240	1696154	3,150	WA094
R51	Dak Terb village	729357	1695390	2,726	WA073
R52	Dak Yang village	729970	1699494	2,033	WA096
R53	Dak Yen village	730101	1700539	1,855	WA066
R54	Trongmueang village	736317	1696970	2,848	WA079
R55	Dak Dor village	737986	1700380	1,676	WA138
R56	Dak Den village	740747	1699625	1,832	WA059
R57	Dak Rant village	741622	1704882	2,646	WA048
R58	Dak Bong village	744383	1709315	2,266	WA154
R59	Dak Chueng village	743203	1711192	1,499	WA154
R60	Ngon Done village	744053	1712262	2,865	WA154
R61	Dak Pum village	741494	1714790	3,129	WA015
R62	Tongxieng village	739465	1713201	1,324	WA015
R63	Daklern village	736267	1711615	3,630	WA022
R64	B. Prao village	726198	1713335	3,551	WA004
R65	Dak Jom village	716267	1714262	5,468	WA007
R66	Dak Kung village	726377	1712905	3,903	WA004
R70	Dak Nong village	722344	1690728	610	WA111
R71	Dak Samor village	723078	1686508	955	WA142
R72	Dak Yok village	725807	1687306	2,681	WA132
R73	Dak Dor village	727562	1688115	3,040	WA132
R74	Dak Sied village	726995	1684992	2,101	WA147
R75	Dak Xuem village	725900	1682832	839	WA150

Receptor	Description	UTM WGS 84 zone 48N		Distance to the nearest potential WTG	
		Easting	Northing	m	WTG
R76	Nam Ngonnuea village	729866	1681908	4,911	WA150
R77	Dak Padou village	738360	1690511	3,670	WA093
R78	Xiengmai village	722057	1702122	4,947	WA153
R79	Sieng A village	725900	1703033	4,019	WA074
R80	Dak Tiem Cemetery	719405	1698097	1,033	WA104
R81	Dak Seng Cemetery	725386	1697432	2,511	WA094
R82	Xiengluang Cemetery	726850	1695092	2,999	WA094
R83	Dak Sieng A Cemetery	726124	1702946	3,853	WA074
R84	Dak Terb Cemetery 01	728659	1694665	3,353	WA094
R85	Dak Terb Cemetery 02	729680	1694344	2,765	WA073
R86	Dak Yang Cemetery	730690	1697966	2,419	WA076
R87	Dak Yen Cemetery	730314	1700144	1,725	WA066
R88	Trongmueang Cemetery	735809	1697377	2,607	WA079
R89	Dak Dor Cemetery	738663	1701034	827	WA138
R90	Dakden Cemetery	740032	1699213	2,556	WA059
R91	Dak Bong Cemetery	744263	1709336	2,145	WA154
R92	Dakchueng Cemetery	742562	1712294	1,951	WA018
R93	Tongxieng Cemetery	739767	1713228	1,247	WA015
R94	B. Prao Cemetery	726996	1713402	4,271	WA004
R95	Dakkung Cemetery	726140	1708564	2,910	WA0060
R96	NgonDone Cemetery	744319	1711973	2,837	WA154
R97	Dak Samor Cemetery	723219	1686240	655	WA142
R98	Dak Xuem Cemetery	726164	1682829	1,098	WA150
R99	Dak Sied Cemetery	727018	1684832	2,082	WA147
R100	Dak Yok Cemetery	725779	1687500	2,487	WA132
R101	Dak Nong Cemetery	721325	1688742	1,296	WA1060

Methodology

Noise Prediction Method

The noise model used in this study to predict wind farm noise levels at sensitive receptors is based on ISO 9613-2:1996[3] as implemented in the SoundPlan 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. SoundPlan 8.0 is one of the most recognised noise prediction tool, used extensively in road, railway and industry noise modelling.

The industrial model is comprehensive and allows:

- Modelling of sound power sources in third of octave;
- Modelling of noise sources as point, line or area sources;
- 2D and 3D directivity of sources;
- 3D topography;
- Noise sources ranking;
- Use of various noise model standards (ISO, Concawe, Nordic, etc.);
- Screening and meteorological effects
- Modelling of Wind Turbine.

This software applies the “ray tracing” method. Sources are simulated as surfaces, lines or points: each source propagates sound waves. The resulting acoustic field depends on the absorptions and reflections characteristics of all existent obstacles between the source and the receptor.

Every ray carries a part of the acoustic energy of the sound source. The energy decreases along the way, as a result of the absorption of surfaces, geometrical divergence and atmospheric absorption.

The absorption of sound energy by air is related to the dispersion of energy caused by the collisions of air molecules among them. Every collision scatters one small part of the energy and causes more impacts.

In the area of interest, the acoustic field will be the result of the acoustic energies sum of “n” rays that reach the receiver. The levels in the whole area are indicated by iso-phones with equivalent steps, at a conventional height of 1.5 meters a.g.l. same height has been considered for receptors.

The mathematical model uses international standards for sound attenuation in the environment. In this study *ISO 9613 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation* has been applied. This standard has many equations regulating the propagation and it allows calculating noise levels in the study area with a defined accuracy.

The aim of such methodology is to determine the equivalent continuous A- weighted sound pressure level, as described in ISO 1996/1-2-3, under meteorological conditions favourable to sound propagation from sources of known power emission.

Predicted L_{Aeq} noise levels were calculated based upon sound power levels determined in accordance with the recognised standard IEC-61400-11:2012[4] , where available, for the wind range of 3 m/s to 24 m/s.

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[3] International Organization for Standardization (1996). ISO 9613-2:1996 *Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation.* https://www.iso.org/obp/ui/#iso:std:iso:9613:-2:ed-1:v1:en

[4] International Electrotechnical Commission (2012). IEC 61400-11 Edition 3.0 2012-11. *Wind turbines – Part 11: Acoustic noise measurement techniques*

Topographic and Environmental Variables

Soundplan 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.

- A 3D topography has been interpolated from NASA's SRTM 1 Arcsec Cartography.
- A ground absorption factor of 0.6 was adopted across the entire modelled region, which represents an absorption factor for partly soft ground.
- In the scenario the whole set of known 3D buildings has been recreated.
- The scenario has been implemented also with forest to produce a linear absorption as for the ISO 9613
- Standard atmosphere variables have been implemented.

Noise Emission Sources

The Project will include the installation of 133 Envision Energy EN-171/4.5 MW WTGs with a hub height of 110 metres. The WTG specifications for the standard operation mode, have been provided by the client. ***Table 9.18*** and ***Table 9.19*** summarise the relevant turbine input data used for noise level prediction.

Table 9.18: Goldwind WTG Manufacturer Data

Make, Model, Power	EN-171/4.5 MW
Rotor Diameter (metres)	171
Hub Height (metres)	110
Cut-In Wind Speed (m/s)	3
Cut-Out Wind Speed (m/s)	25
Max. Sound Power Level (dBA)	110.1

Table 9.19: Sound Power Levels vs Wind Speed

Wind Speed at Hub Height (m/s)	Sound Power Level at Hub Height EN-171/4.5 MW (dBA)
5	100.6
6	102.6
7	105.9
8	108.7
9	109.9
10	110.1
11	110.1
12	110.1
13	110.1
14	110.1

The manufacturer did not provide sound power data for 3 to 4 m/s wind speed. The sound power level of the 5 m/s wind speed has been adopted for this missing range, for each type of WTG.

The reference spectrum in 1/3 of octave at various wind speed provided by the manufacturer is reported in ***Table 9.20***.

Table 9.20: Envision Energy WTGs Sound Power Levels

Spectral Data – dBA in 1/3 Octave Bands						
1/3 Octave band Hz	**5 m/s**	**6 m/s**	**7 m/s**	**8 m/s**	**9 m/s**	**10 m/s**
20	55	57	60	63	64	65
25	57	59	63	65	67	67
31	60	62	65	68	69	70
40	63	65	69	71	73	73
50	67	69	72	75	76	76
63	71	73	76	79	80	80
80	75	77	80	83	84	84
100	79	81	84	87	88	88
125	82	84	88	91	92	92
160	86	88	91	94	95	95
200	89	91	94	97	98	98
250	90	92	96	98	100	100
315	91	93	97	99	101	101
400	92	94	97	100	101	101
500	91	93	97	99	101	101
630	91	93	96	99	100	100
800	90	92	96	98	99	100
1000	89	91	95	97	99	99
1250	88	90	94	96	98	98
1600	87	89	92	95	96	96
2000	85	87	90	93	94	95
2500	83	85	88	91	92	93
3150	81	83	86	89	90	90
4000	77	79	83	85	87	87
5000	74	76	79	82	83	83
6300	69	71	75	77	78	79
8000	64	66	69	72	73	73
10000	58	60	63	66	67	67
Overall Lw dB(A)	**101**	**103**	**106**	**109**	**110**	**110**

Impact Assessment

Noise level have been predicted at each of the four measurements site (R1-R4) for all the wind speeds involved in the assessment. For the receptors (R5-R46), noise levels have been predicted only for the wind speed range that results the greatest sound power level (9 m/s to cut off).

Since the national noise regulations are significantly higher than the IFC standards, it is important to notice that for R1 and R4 data were not sufficient to undertake the assessment based on the background + 3dB criteria, then the absolute criteria for day and night time has been used instead. Just for R2 and R3, both the absolute criteria and the background + 3dB criteria have been considered and adopted, whatever is higher for any wind speed class.

As explained in ***Section 8.3.5*** the measured data did not provide a clear correlation between wind speed and measured noise level on R1 and R4; the absolute criteria of IFC has been considered for the assessment purpose in comparison with the predicted model noise.

Predicted Wind Farm Operational Noise Levels

The predicted noise levels vs wind speeds at receptors R1-R4 are presented in ***Table 9.21.*** Graphically this comparison is noticeable in ***Figure 9.2*** to ***Figure 9.5***.

Table 9.21: Predicted Operational Noise Levels (L_{Aeq}) vs IFC limits

Wind Speed		3	4	5	6	7	8	9	10
R1 (*)	Predicted Noise Level dB(A)	22	22	22	24	27	30	31	31
	IFC Day time limit dB(A)	55	55	55	55	55	55	55	55
	IFC Night time limit dB(A)	45	45	45	45	45	45	45	45
R2	Predicted Noise Level dB(A)	31	31	31	33	36	39	40	40
	IFC Day time limit dB(A)	55	55	55	55	55	55	55	55
	IFC Night time limit dB(A)	47	48	48	48	49	49	49	50
R3	Predicted Noise Level dB(A)	30	30	30	32	36	38	40	40
	IFC Day time limit dB(A)	55	55	55	55	55	55	55	55
	IFC Night time limit dB(A)	47	48	48	49	50	51	52	52
R4 (*)	Predicted Noise Level dB(A)	31	31	31	33	37	39	41	41
	IFC Day time limit dB(A)	55	55	55	55	55	55	55	55
	IFC Night time limit dB(A)	45	45	45	45	45	45	45	45

* Based on IFC absolute criteria considered

Figure 9.2: Predicted Noise Levels at R1 vs IFC Criteria

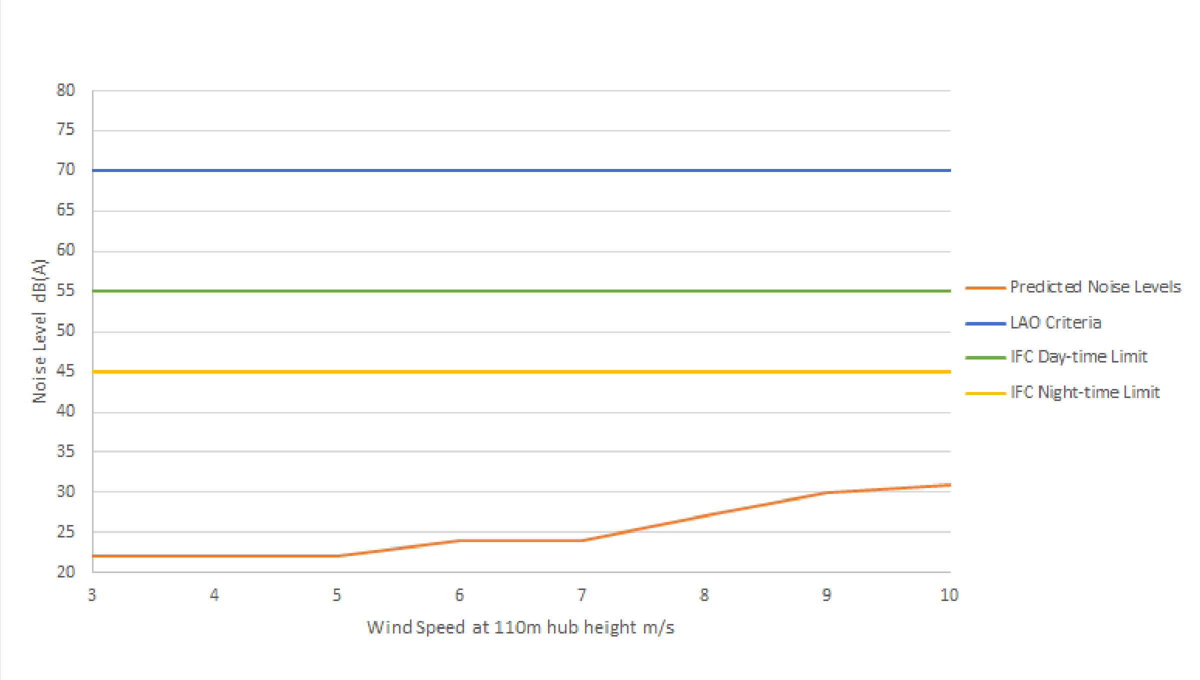


Figure 9.3: Predicted Noise Levels at R2 vs IFC Criteria

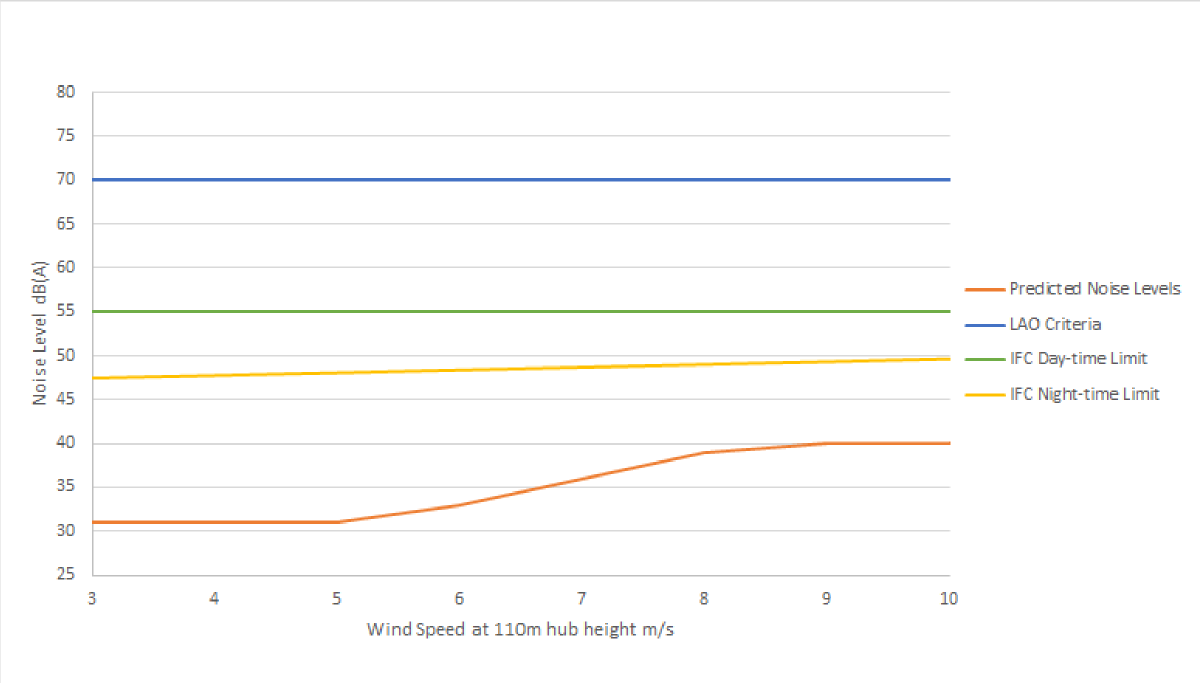


Figure 9.4: Predicted Noise Levels at R3 vs IFC Criteria

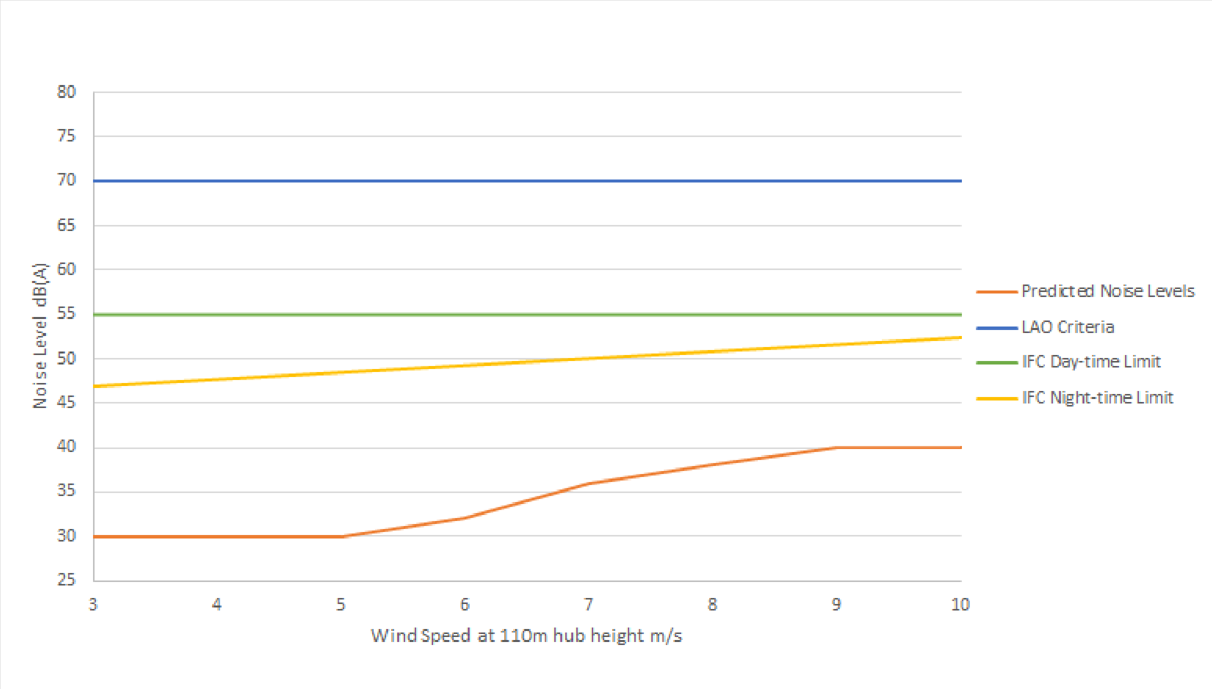
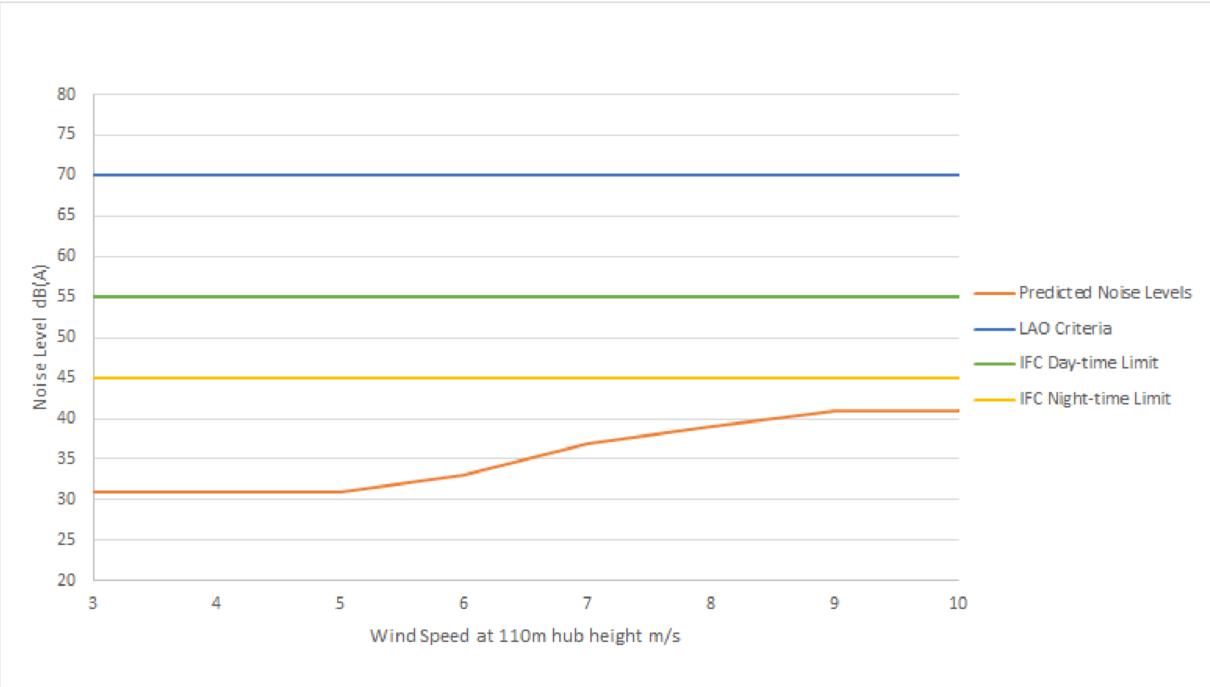


Figure 9.5: Predicted Noise Levels at R4 vs IFC Criteria



Predicted noise levels do not exceed the criteria at any of the four receptors.

Predicted noise levels for wind speeds between 9 m/s to cut off for the receptors R5 to R101 are shown in ***Table 9.22*** presenting also a comparison with the IFC criteria. Predicted noise contours are presented in ***Figure 9.6.***

Due to the original scope of work, in those additional receptors no background measurements have been conducted. It has been preferred to increase the number of receptors through a model scenario in order to cover a big amount of different residential areas that would have been impossible to cover with in-situ measurements.

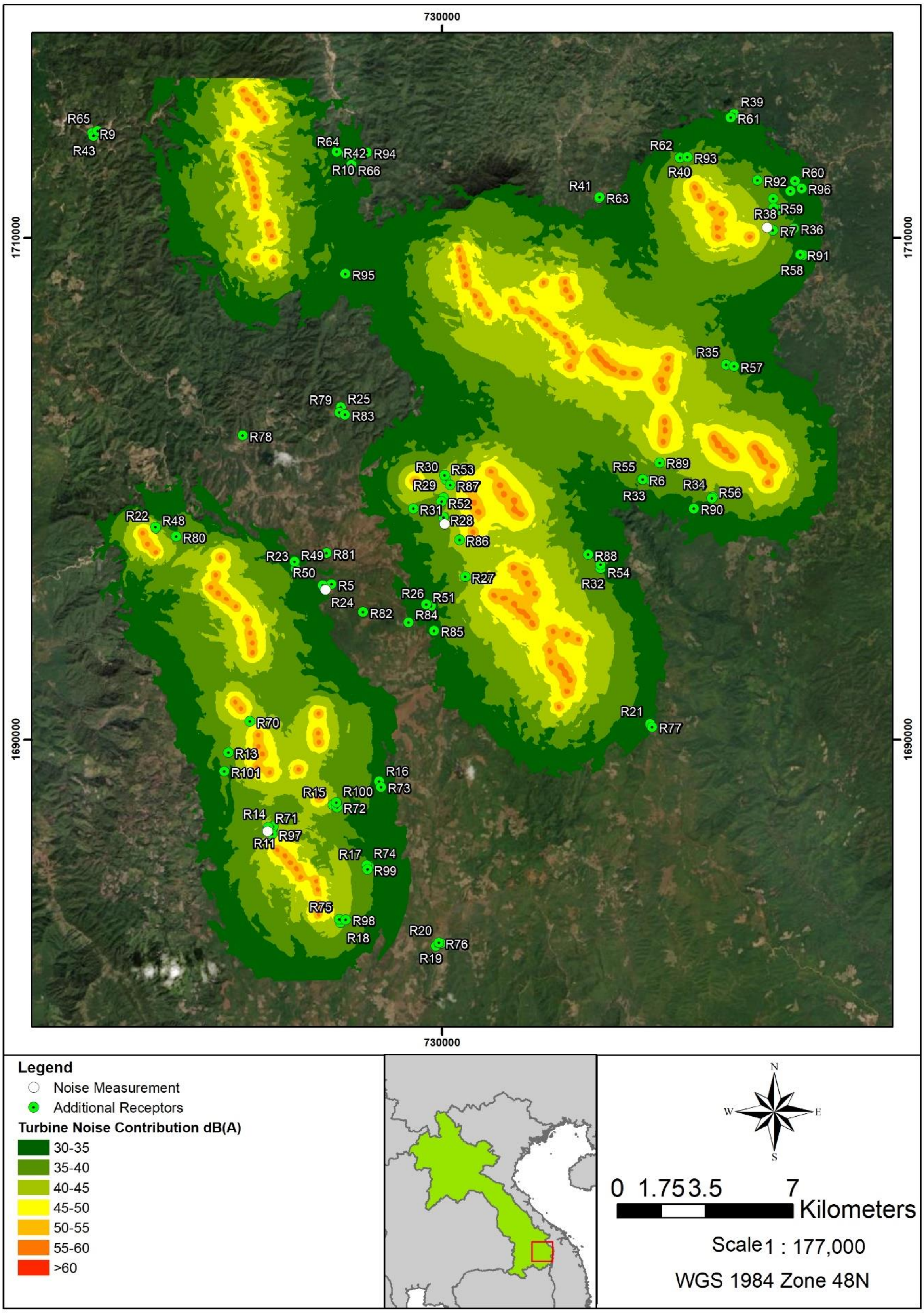
Table 9.22: Predicted Noise Levels

Receptor	Description	UTM 48N WGS84 m		IFC Limit dB(A)		Predicted noise level LeqA dB(A)
		Easting	Northing	Day-time	Night-time	
R5	Xiengluang Health Center	725582	1696196	55	45	27
R6	Dak Dor Health Center	737964	1700374	55	45	37
R7	Hospital Of Dak Chueng District	743174	1710307	55	45	39
R9	Dak Jom Health Center	716066	1714186	55	45	21
R10	B. Prao Health Center	726450	1713303	55	45	32
R11	Dak Samor Health Center	723246	1686465	55	45	39
R12	NamNgonnuea Health Center	729752	1681773	55	45	20
R13	Dak Nong Primary School	721478	1689492	55	45	40
R14	Dak Samor Primary School	723266	1686539	55	45	39
R15	Dak Yok Primary School	725648	1687406	55	45	39
R16	DaK Dor Primary School	727486	1688327	55	45	33
R17	Dak Sied Primary School	727086	1684927	55	45	37
R18	Dak Xuem Primary School	725942	1682695	55	45	42
R19	NamNgonnuea High School	729964	1681880	55	45	23
R20	NamNgonnuea Primary School	729876	1681895	55	45	17
R21	Dak Padou Primary School	738291	1690621	55	45	30
R22	Dak Tiem Primary & Lower Secondary School	718590	1698430	55	45	43
R23	Dak Seng Primary School	724169	1696811	55	45	35
R24	Xiengluang Primary & High School	725312	1696012	55	45	32
R25	Dak Sieng A Primary School	725967	1703255	55	45	22
R26	Dak Terb Primary School 01	729561	1695330	55	45	34
R27	Dak Terb Primary School 02	730912	1696489	55	45	40
R28	Dak Yang Primary School 01	730056	1698865	55	45	39
R29	Dak Yang Primary School 02	730052	1699638	55	45	39
R30	Dak Yen Primary School 01	730138	1700380	55	45	41
R31	Dak Yen Primary School 02	728846	1699210	55	45	37
R32	Trongmueang Primary School	736311	1696824	55	45	36
R33	Dak Dor Primary & High School	738320	1700330	55	45	35
R34	Dak Den Primary School	740791	1699669	55	45	36
R35	Dak Rant Primary School	741310	1704942	55	45	35
R36	Dak Bong Primary School	744012	1710378	55	45	35
R37	Dakchueng Primary School	743419	1711116	55	45	36
R38	Dakchueng Lower Secondary School	743186	1711556	55	45	37
R39	Dak Pum Primary School	741628	1714935	55	45	30
R40	Tongxieng Primary School	739472	1713231	55	45	37
R41	Dak Lern Primary School	736246	1711574	55	45	28
R42	B. Prao & Dakkung Primary School	725795	1713437	55	45	34

Receptor	Description	UTM 48N WGS84 m		IFC Limit dB(A)		Predicted noise level LeqA dB(A)
		Easting	Northing	Day-time	Night-time	
R43	Dak Jom Primary & Lower Secondary School	716104	1714067	55	45	17
R44	NgonDone Primary & High School	743876	1711861	55	45	34
R48	Dak Tiem village	718585	1698466	55	45	43
R49	Dak Xeng village	724116	1697095	55	45	35
R50	Xiengluang village	725240	1696154	55	45	30
R51	Dak Terb village	729357	1695390	55	45	34
R52	Dak Yang village	729970	1699494	55	45	40
R53	Dak Yen village	730101	1700539	55	45	41
R54	Trongmueang village	736317	1696970	55	45	37
R55	Dak Dor village	737986	1700380	55	45	36
R56	Dak Den village	740747	1699625	55	45	36
R57	Dak Rant village	741622	1704882	55	45	34
R58	Dak Bong village	744383	1709315	55	45	33
R59	Dak Chueng village	743203	1711192	55	45	36
R60	Ngon Done village	744053	1712262	55	45	32
R61	Dak Pum village	741494	1714790	55	45	29
R62	Tongxieng village	739465	1713201	55	45	37
R63	Daklern village	736267	1711615	55	45	28
R64	B. Prao village	726198	1713335	55	45	33
R65	Dak Jom village	716267	1714262	55	45	18
R66	Dak Kung village	726377	1712905	55	45	32
R70	Dak Nong village	722344	1690728	55	45	44
R71	Dak Samor village	723078	1686508	55	45	40
R72	Dak Yok village	725807	1687306	55	45	39
R73	Dak Dor village	727562	1688115	55	45	34
R74	Dak Sied village	726995	1684992	55	45	37
R75	Dak Xuem village	725900	1682832	55	45	42
R76	Nam Ngonnuea village	729866	1681908	55	45	17
R77	Dak Padou village	738360	1690511	55	45	31
R78	Xiengmai village	722057	1702122	55	45	17
R79	Sieng A village	725900	1703033	55	45	22
R80	Dak Tiem Cemetery	719405	1698097	55	45	38
R81	Dak Seng Cemetery	725386	1697432	55	45	27
R82	Xiengluang Cemetery	726850	1695092	55	45	26
R83	Dak Sieng A Cemetery	726124	1702946	55	45	21
R84	Dak Terb Cemetery 01	728659	1694665	55	45	30
R85	Dak Terb Cemetery 02	729680	1694344	55	45	34
R86	Dak Yang Cemetery	730690	1697966	55	45	43
R87	Dak Yen Cemetery	730314	1700144	55	45	43
R88	Trongmueang Cemetery	735809	1697377	55	45	36

Receptor	Description	UTM 48N WGS84 m		IFC Limit dB(A)		Predicted noise level LeqA dB(A)
		Easting	Northing	Day-time	Night-time	
R89	Dak Dor Cemetery	738663	1701034	55	45	41
R90	Dakden Cemetery	740032	1699213	55	45	33
R91	Dak Bong Cemetery	744263	1709336	55	45	33
R92	Dakchueng Cemetery	742562	1712294	55	45	38
R93	Tongxieng Cemetery	739767	1713228	55	45	37
R94	B. Prao Cemetery	726996	1713402	55	45	27
R95	Dakkung Cemetery	726140	1708564	55	45	33
R96	NgonDone Cemetery	744319	1711973	55	45	32
R97	Dak Samor Cemetery	723219	1686240	55	45	40
R98	Dak Xuem Cemetery	726164	1682829	55	45	41
R99	Dak Sied Cemetery	727018	1684832	55	45	36
R100	Dak Yok Cemetery	725779	1687500	55	45	39
R101	Dak Nong Cemetery	721325	1688742	55	45	38

Figure 9.6: Predicted Noise Contours



The predicted noise levels comply with IFC daytime and nighttime criteria at all the receptors. No exceedances are shown by the assessment. **Impact Magnitude**

Table 9.23 presents the significance of impacts based on the predicted noise levels and the sensitivity of receptors. The table presents the receptors at which the predicted levels are up to 5 dB(A) below the criteria.

Table 9.23: Significance of Impacts

Receptor	Type of receptor	Time Period	Sensitivity	Magnitude	Significance of impact
R13	Health Center	Night	Very High	Small	Minor
R18	School	Night	Medium	Small	Minor
R22	School	Night	Medium	Small	Minor
R27	School	Night	Medium	Small	Minor
R30	School	Night	Medium	Small	Minor
R48	Village	Night	High	Small	Minor
R52	Village	Night	High	Small	Minor
R53	Village	Night	High	Small	Minor
R70	Village	Night	High	Small	Minor
R71	Village	Night	High	Small	Minor
R75	Village	Night	High	Small	Minor
R86	Cemetery	Night	Low	Small	Minor
R87	Cemetery	Night	Low	Small	Minor
R89	Cemetery	Night	Low	Small	Minor
R97	Cemetery	Night	Low	Small	Minor
R98	Cemetery	Night	Low	Small	Minor

Additional Mitigation, Management, and Monitoring Measures

Predicted noise levels due to the operation of the project are likely to have just minor impacts at receptors shown in ***Table 9.23***. Therefore no additional mitigation are needed. It is however a good practice to conduct regularly noise measurements particularly during the night time, to check compliance with the noise criteria, and where exceedance are detected, additional mitigation measures should be implemented.

9.3.6 Impacts to Surface Water Quality

9.3.6.1 Potential Impacts

During the construction phase, water will be required for construction activity, such as during civil work, dust suppression, and domestic use. Potential impacts on surface water may arise from foundation work and civil construction, improper management of wastewater and accidental spills/leaks at storage area, which could lead to impact on contamination of surface water near by the Project site. It is estimated up to 1,300 workers will be working on-site during the construction phase of the Project. Wastewater is mainly generated from the toilet used by construction workers that is equivalent to about 80% of the volume of consumption water or about 800 m^3/day. Mis-management of sewage and wastewaters would have the potential to result in contamination of surface waters, which may result in localized land/ecological contamination, impacts to health, odour nuisance and attraction of vermin.

In addition, if water is required for the Project from a nearby stream, this could impact local communities' availability of water resources. It is noted in ***Section 8.5.3.7,*** the villages in Dak Cheung District and Sanxay District mostly use the gravity-fed water systems, whereas rivers and streams are still used to a lesser extent for domestic water. Water source is from multiple sources including wells (Nam Sang), river stream (Houay), and gravity-fed water systems (Nam Lin), which is sourced from streams to store in common tank for water supply to households in the villages. Rainwater is stored in tanks for drinking and domestic use during rainy season. It is noted that piped water supply system (Nam Papa) is not available in the surveyed villages (water is not pumped into homes). However, ***Section 9.6.2.2*** notes that the overall hazard ratings for availability of water is considered to be 'Low' in the Project Area meaning that water availability is not a key concern in the area.

During the operation phase, water will be required for domestic use and drinking water for operational workforce at the project site. Improper management of wastewater from the Project and accidental spills/leaks at storage area, which could lead to impacts on quality of surface water near by the Project site.

Given a groundwater or surface water will be utilized, a water use/extraction plan will be developed by EPC that will be available at later stage. So, the Project's water requirement will not result in water constraint of the local communities. In addition, all sources of water supply will be surveyed and identified particularly those close to project facilities or will be traversed by the internal road system which will be constructed. Any impact on water supply due to project activities should be compensated/replaced. All details of the survey will be updated in Water Quality Management Plan and relevant EPC Management Plan that will be updated at later stage.

Wastewater will be generated from the toilet, ablutions, kitchens, concrete batching plants and concrete truck wash down. The project requires the contractor to provide mobile toilet tanks with sufficient storage tanks for use by workers. Detail of wastewater treatment and disposal process will be provided in relevant ESMF and subsequent MP that will be developed by EPC.

9.3.6.2 Existing Controls

The mitigation measures identified in the local EIA (EIA, 2022) include:

- Conduct water quality monitoring as per the recommendations of the local EIA Report (2022);
- Control of sedimentation and water turbidity: The project must avoid undertaking construction and installation near water sources, where possible ; and proper drainage management plan diverting upstream clean runoff from disturbed areas should be implemented. Install sediment retention ponds or other measures to manage dirty runoff
- No washing vehicles of all types and construction equipment at rivers or streams in the project area;
- Toilets for workers should be provided. A proper wastewater treatment system should be installed for batching plants and camp sites and complies with the environmental engineering techniques and will be located far from the river to avoid and reduce contaminated water released into the river;
- A drainage system should be installed and collected wastewater into the wastewater treatment system; and
- EPC contractor will implement systematic sewage treatment measures as follows:
  - The implementation of package treatment system of adequate proportion to the maximum anticipated wastewater production rates;
  - conventional sewage and toilet sewage separation (Independent sewer, drainage pipe system), to minimize the need for sewage treatment;
  - EPC contractor will hire professional environmental companies or contractors (If any) to design local sewage treatment facilities to meet the local sewage discharge standards;
  - After the completion of the sewage treatment design and construction, EPC contractor will test and monitor the discharged sewage to confirm/satisfy the discharge standard;
  - Experienced environmental engineers will be assigned to manage and monitor sewage discharge to avoid the complication with the requirement of the contract.
  - Comply with the waste management requirements outlined in the ESMF and ESMP

9.3.6.3 Significance of Impacts

Methodology for Assessment of Impact Significance

The sensitivity criteria and impact magnitude criteria for surface water quality has been provided in ***Table 9.24*** and ***Table 9.25,*** respectively. The subsequent subsections will utilise these criteria to assess the impact of the Project activities to surface water quality.

Table 9.24: Sensitivity Assessment Criteria for Water Resources (Surface Water)

Sensitivity Criteria	Contributing Criteria	
	Environment	Social
Water Resources - Surface water and ground water (quality/quantity related criteria)	The extent to which the water resource plays an ecosystem or amenity role in terms of supporting biodiversity either directly or indirectly, particularly with respect to dependent ecosystems.	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic or industrial, use as waterways) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation.
Low	The water resource does not support diverse aquatic habitat or populations, or supports aquatic habitat or population that is of low quality.	The water resource has little or no role in terms of provisioning services as agricultural water source, other domestic uses as washing, bathing, industrial use and waterways for the local community. The groundwater resource is not currently abstracted and used in the vicinity of the Project, but is of sufficient quality and yield to be used for that purpose in the future (and there is a reasonable potential for future use).
Medium	The water resource supports diverse populations of flora and / or fauna but available in the surface water bodies in the region.	The surface water resources have local importance in terms of provisioning services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality. The groundwater resource is an important water supply, and is currently used, but there is capacity and / or adequate opportunity for alternative sources of comparable quality.
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species.	The surface water resources are wholly relied upon locally, with no suitable technically or economically feasible alternatives, it is important at a regional or transboundary watershed level for provisioning services. The groundwater resource is wholly relied upon locally, with no suitable technically or economically feasible alternatives. The development stage of groundwater is critical or over exploited.

Table 9.25: Criteria for Impact Magnitude for Assessment of Impact to Surface Water

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 mode 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.
Surface Water	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 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 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 resource available at the time of use (i.e. taking into account seasonal fluctuation)

Receptor Sensitivity and Impact Magnitude

The receptor sensitivity has been assessed as **Medium** as local communities are dependent on local watercourses for domestic use and agriculture. Also the water quality tested showed slightly elevated levels of coliform bacteria and COD; likely to be from human and animal feces in the Study Area entering watercourses.

Based on the impact characteristics, the impact magnitude is considered to be **Medium** during construction given that it is required for the duration of the construction period and that water use during construction will be sourced from nearby streams, and **Small** during operation (as only small scale operation and maintenance activities will occur).

The impact magnitude for water resource use is **medium** given the water availability variations in the dry season.

Impact Significance

The overall impact significance during construction phase and operation phase is assessed to be **Moderate** and **Minor,** respectively for water quality and **Moderate** for water resource use.

9.3.6.4 Additional Mitigation, Management, and Monitoring Measures

The additional mitigations measures to minimize impacts include:

- All sources of water supply will be surveyed and identified particularly those close to project facilities or will be traversed by the internal road system which will be constructed. Any impact on water supply due to project activities should be compensated/replaced. All details of the survey will be updated in Water Quality Management Plan.
- In case the Project requires water from streams, rivers, lakes and groundwater in the Project area, the Project should prepare and implement a water use plan. This plan must be communicated and agreed with the local people and with the District and Provincial Authorities. Additionally, the Project

will comply with the requirements outlined in the sub-plan in the ESMF and the EPC's Water Quality Management Plan.

- A Waste Management Plan will be prepared for the Project (as detailed in the topography impact assessment section);
- A Drainage management plan will be prepared by EPC for the Project that should be included diversion of clean runoff from “dirty” or disturbed areas, containment, treatment and reuse of wastewater from batching plants
- Construction workers will be given training about water conservation and encouraged for optimal use of water;
- Optimum use of water during sprinkling on roads for dust settlement, concrete mixing for WTG foundation, etc.;
- Regular inspection for identification of water leakages and preventing wastage of water from water tankers; and
- Recycling and reusing water to the extent possible.

9.3.6.5 Residual Impact Significance

The residual impact significance during construction phase and during operation phase is envisaged to be **Minor** and **Negligible**, upon application of mitigation, management, and monitoring measures for water quality and **Minor** residual for water resource use (***Table 9.26*** to ***Table 9.28***).

Table 9.26: Impacts to Surface Water Quality (Construction Phases)

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Potential Impact</td><td colspan="5">Potential impacts on surface water due to:
■ Run-off from foundation work and civil construction;
■ improper management of wastewater;
■ Accidental spills/leaks at storage area and improper management of hazardous materials storage and handling.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td colspan="2">Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="5">Potential impacts to surface water would be considered to be negative</td></tr>
<tr><td rowspan="2">Impact Type</td><td colspan="2">Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="5">Potential impacts would be direct impacts.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td colspan="2">Long-term</td><td>Permanent</td></tr>
<tr><td colspan="5">The construction phase of the Project is expected to be completed in 30 months, which would be considered long-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td colspan="2">Local</td><td colspan="2">Regional</td><td>International</td></tr>
<tr><td colspan="5">Potential impacts would be limited to the Project area and hence would be considered to be local.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">Impact scale is considered localized and small.</td></tr>
<tr><td>Frequency</td><td colspan="5">Impacts to surface water could occur intermittently during the construction phase.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on the impact characteristics above, the impact magnitude is considered to be medium.</td></tr>
<tr><td></td><td colspan="2">Low</td><td colspan="2">Medium</td><td>High</td></tr>
</table>

Significance of Impact				
Receptor Sensitivity	The identified nearby canals are considered as medium.			
Impact Significance	Negligible	Minor	**Moderate**	Major
	The combination of a Low Receptor Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.			
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium
Residual Magnitude Significance	Negligible	**Minor**	Moderate	Major
	As a result, the mitigation measures, residual negative impact will be of a 'Minor' significance.			

Table 9.27: Impact on Surface Water Quality (Operation Phase)

Significance of Impact					
Potential Impact	Potential impacts on surface water due to: ■ Potential impacts on water quality from general operation activities; ■ Accidental spills/leaks at storage area and improper management of hazardous materials storage and handling.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to surface water would be considered to be negative				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**		
	The operation phase of the Project is considered long-term.				
Impact Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project area and hence would be considered to be local.				
Impact Scale	Impact scale is considered localized and small.				
Frequency	Impacts to surface water could occur intermittently during the operation phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Based on the impact characteristics above, the impact magnitude is considered to be small.				
Receptor Sensitivity	Low	**Medium**	High		
	The identified nearby drainage canals are considered as medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Low Receptor Sensitivity and Small Impact Magnitude will result in an overall Minor impact.				
Residual Impact Magnitude	Positive	**Negligible**	Small	Medium	
Residual Magnitude Significance	**Negligible**	Minor	Moderate	Major	
	As a result, the mitigation measures, residual negative impact will be of a 'Negligible' significance.				

Table 9.28: Impact on Surface and Groundwater Water Resource Competition (Construction and Operation Phase)

<table>
<tr><th colspan="6">Significance of Impact</th></tr>
<tr><td>Potential Impact</td><td colspan="5">Potential impacts on surface water/groundwater resource competition due to:
■ Decreased water availability from the water resources of the area from construction and operation activities.</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td colspan="2">Positive</td><td colspan="2">Neutral</td></tr>
<tr><td colspan="5">Decreased water availability from the water resources of the area would be considered to be negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td colspan="2">Indirect</td><td colspan="2">Induced</td></tr>
<tr><td colspan="5">Potential impacts would be direct impacts.</td></tr>
<tr><td rowspan="2">Impact Duration</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td colspan="2"></td></tr>
<tr><td colspan="5">The construction and operation phase of the Project is considered long-term.</td></tr>
<tr><td rowspan="2">Impact Extent</td><td>Local</td><td colspan="2">Regional</td><td colspan="2">International</td></tr>
<tr><td colspan="5">Potential impacts would be limited to the Project area and hence would be considered to be local.</td></tr>
<tr><td>Impact Scale</td><td colspan="5">Impact scale is considered localized and small.</td></tr>
<tr><td>Frequency</td><td colspan="5">Impacts to surface water could occur intermittently during the construction and operation phase.</td></tr>
<tr><td rowspan="2">Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td>Medium</td><td>Large</td></tr>
<tr><td colspan="5">Based on water availability, the impact magnitude is considered to be medium.</td></tr>
<tr><td rowspan="2">Receptor Sensitivity</td><td>Low</td><td colspan="2">Medium</td><td colspan="2">High</td></tr>
<tr><td colspan="5">The receptor sensitivity in the area is considered as medium due to rivers/streams plays local importance role in terms of provisioning services such as domestic use and drinking water.</td></tr>
<tr><td rowspan="2">Impact Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">The combination of a Medium Receptor Sensitivity and Medium Impact Magnitude will result in an overall Moderate impact.</td></tr>
<tr><td>Residual Impact Magnitude</td><td>Positive</td><td>Negligible</td><td>Small</td><td colspan="2">Medium</td></tr>
<tr><td rowspan="2">Residual Magnitude Significance</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td colspan="2">Major</td></tr>
<tr><td colspan="5">As a result, the mitigation measures, residual negative impact will be of minor significance.</td></tr>
</table>

9.3.7 Impacts to Landscape Values and Visual Amenity

9.3.7.1 Potential Impacts

Landscape Value

Landscape sensitivity can be assessed by the ability of a particular landscape character to absorb aesthetic alterations. Landscape impacts may occur upon a Landscape Characteristic Unit (LCU) as a direct result of the presence of the Project within an area of a particular landscape character. The LCU area identified for the Project has a predominant abundance of forest and agricultural area, with several hills nearby. The presence of the WTGs (and associated aviation lighting) and transmission line is likely to cause impacts to landscape value.

Visual

Visual impacts refer mainly to the visual character changes of available views resulting from project development, such as obstruction of existing views; removal of screening elements, thereby exposing viewers to unsightly views; the introduction of new elements into the views; and intrusion of foreign elements into the viewshed of landscape features. The presence of the WTGs and transmission line is likely to cause impacts to visual.

9.3.7.2 Significance of Impacts

Landscape Value

Methodology for Assessment of Impact Significance

The landscape impact assessment describes the nature and scale of changes to individual landscape elements and characteristics, and the subsequent effect on the landscape as a resource. To determine the significance of landscape effects it is necessary to consider the sensitivity of the landscape against the magnitude of landscape effects.

Landscape resources have been assessed in terms of their sensitivity, combining judgements on their susceptibility to the specific change proposed and the value attached to the resource. Susceptibility is the degree to which a particular landscape type or area can accommodate change arising from the Project, without detrimental effects on its character, and will vary with the:

- Existing land use;
- Pattern and scale of the landscape;
- Sense of enclosure and tranquility;
- Condition of the landscape; and
- Scope of mitigation, which would be in character with the existing landscape.

The value of landscape resources will, to some degree, reflect landscape designations and the level of importance they signify. The sensitivity of a landscape is judged based on the extent to which it can accept changes of a particular type and scale without adverse effects on its character. Sensitivity varies according to the type of development proposed and the nature of the landscape, such as its individual elements, key characteristics (land use, pattern and scale of landscape, enclosure /openness), inherent quality, condition, presence of detracting elements (e.g., pylons), value and capacity to accommodate change, and any specific values, such as designations, that apply. Grades of sensitivity can be defined as low, medium and high and are defined in ***Table 9.29***.

Table 9.29: Landscape sensitivity

Visual Receptors	Sensitivity
A moderately valued landscape, perhaps a locally important landscape, or where its character, land use, pattern and scale may have the capacity to accommodate a degree of the type of change envisaged.	Low
A landscape protected by a structure plan or national policy designation and/or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged.	Medium
A landscape protected by a regional (structure plan) or national designation and/or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged.	High

Note: Although different ethnic groups have slightly different beliefs, cultures, traditions; they do not have different use or views on the landscape. Through the KIIs with village heads and FGDs with ethnic groups, concerns regards to landscape and visual change impacts on their belief, rituals, etc., were not identified.

Judgements on the magnitude of effect have also been recorded on a scale (e.g., negligible, small, medium and large). More weight is generally given to effects that are greater in scale and permanent or long term. Therefore, a temporary change confined to a small area may be considered to be of low magnitude. Where planting is proposed as mitigation, its effectiveness during the early periods of a project should be taken into account in suggesting reductions in magnitude. The typical criteria in determining the magnitude of effect on the landscape are set out in ***Table 9.30***.

Table 9.30: Landscape magnitude

Typical criteria and thresholds	Visual magnitude of effect
An imperceptible, barely, or rarely perceptible change in landscape characteristics.	Negligible
A small change in landscape characteristics over a wide area or a moderate change either over a restricted area or infrequently perceived.	Small
A moderate change in landscape characteristics, frequent or continuous, and over a wide area, or a clearly evident change either over a restricted area or infrequently perceived.	Medium
A clearly evident and frequent/continuous change in landscape characteristics affecting an extensive area.	Large

Receptor Sensitivity and Impact Magnitude

When determining the significance of landscape effects, the following should also be considered:

- The loss of mature or diverse landscape elements or features is likely to be more significant than the loss of new or uniform elements;
- Effects on character areas, which are representative, may be more important than the loss of areas in poor condition or degraded areas. The test of significance is not directly related to planning policy;
- The loss of landscape elements, features or characteristics will be given greater weight if they are identified as being of high value. Therefore, effects on nationally designated areas are likely to be more significant than effects on areas of local value; and

- The sensitivity of the landscape is dependent on both the attributes of the landscape and the characteristics of the Project. Landscapes with a high sensitivity to the type of change proposed are more likely to be seriously affected than those with a lower sensitivity.

The landscape sensitivity and scenic amenity values of the area are **medium**. The magnitude of impact of the construction activities on the landscape character is considered **medium**, for the following reasons:

- Construction yards will be highly visible in order to host more than 1,000 workers;
- Relatively small access roads will have several construction vehicles generating dust, noise and air emissions;
- The occasional vegetation will not hide any construction activities; and
- The landscape character unit identified is a virgin environment, where the human presence is sporadic and non-invasive. The ability of this landscape to adsorb the type of change envisaged by the Project is considered to be low.

Impact Significance

The impact of the Project on the landscape character is considered **moderate**, due to the following reasons:

- The high landscape sensitivity and scenic amenity value of the rural areas;
- The fragmented and limited extent of native vegetation with low-level local scenic amenity value; and
- The landscape character type identified has not been modified in a substantial way by human activities and it is considered to have poor capacity to absorb the type of change envisaged by the Project.

Visual

Methodology for Assessment of Impact Significance - Visual

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.

Visual receptors include 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 is 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 9.31*** indicates the relative sensitivities of a number of visual receptors.

Table 9.31: Sensitivity of Visual Receptors

Visual Receptors	Sensitivity
Small number of visitors with interest in their surroundings. Viewers with a passing interest, not specifically focused 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 number of residents and moderate number 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 number 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

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 based on:
- 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 for determining the magnitude of effect on visual receptors are set out in ***Table 9.32***.

Table 9.32: Magnitude of Visual Effect

Typical criteria and thresholds	Visual magnitude of effect
A change, which is barely or rarely perceptible, at a 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 at 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 within a short 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

Receptor Sensitivity and Impact Magnitude

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 visual impact is a product of the magnitude of change to the existing baseline conditions, the landscape context, and the sensitivities of Visual Sensitive Receptors (VSRs).

The viewshed analysis (***Figure 9.8*** and ***Figure 9.36***) shows that the proposed wind turbines have the potential to be visible in the nearby areas, although not continuously due to the variability of the landscape for the area surrounding the Project.

Receptor Sensitivity, Impact Magnitude and Impact Significance

Specific considerations were made for each VSR, and the results can be viewed in the graphic sheets presented below and the impact significance, receptor sensitivity, and impact magnitude is summarized in ***Table 9.33***.

Table 9.33: Summary of Visual Impact

VSR	Village	Distance to nearest wind turbine	Project visibility	Sensitivity of receptor	Magnitude of visual effect	Significance of visual effect
VSR1	Ban Namtiap	20.5 km	Visible	Medium	Negligible	Negligible
VSR2	Ban Paor	7.6 km	Not visible	Medium	Negligible	Negligible
VSR3	Ban Daska	8.2 km	Visible	Medium	Negligible	Negligible
VSR4	Ban Chaling	6.3 km	Not visible	Medium	Negligible	Negligible
VSR5	Ban Daktreb	2.5 km	Visible	Medium	Small	Minor
VSR6	Ban Dakdor	1.5 km	Visible	Medium	Small	Minor
VSR7	Dak Cheung	1.5 km	Visible	Medium	Medium	Moderate
VSR8	Ban Chalernxay	1.5 km	Visible	Medium	Small	Minor
VSR9	Ban Maithavone	5.9 km	Visible	Medium	Small	Minor
VSR11	Laos / Vietnam border	15.3 km	Visible	Low	Negligible	Negligible
VSR12	Ban Saoksavang	19.0 km	Not visible	Medium	Negligible	Negligible
VSR13	Road	0.8 km	Visible	Low	Medium	Minor
VSR15	Xekaman 3 HPP	11.9 km	Not visible	Medium	Negligible	Negligible
VSR16	Ban Chavik - Nalaiy	23.4 km	Not visible	Medium	Negligible	Negligible
VSR17	School	0.5 km	Visible	Medium	Medium - Large	Moderate - Major
VSR18	Village	1.0 km	Visible	Medium	Medium - Large	Moderate - Major
VSR19	Dakyen	30.8 km	Visible	Medium	Medium	Moderate

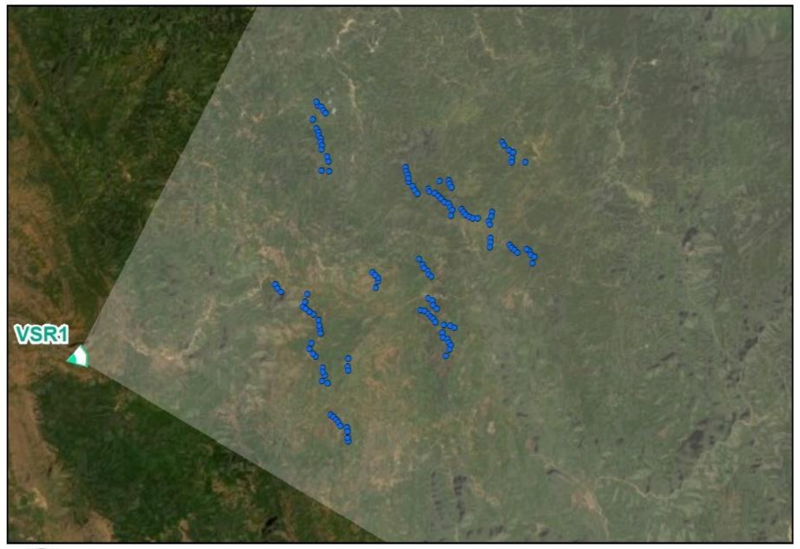
Figure 9.7 outlines how the graphic sheets below are organized, with sections matching these numbered descriptions:

1. Location and direction of VSR;
2. Distance and visibility of turbines within view;
3. Photo current state;
4. Photo simulation;
5. Wireframe view; and
6. Summary of visual impact.

Figure 9.7: Legend of Visual Graphic Sheets

Figure 9.8: Photomontage for VSR1

Coordinate system	VSR1
WGS84-UTM 48N	
X 698867 Y 1691144	**Ban Namtiap**



VSR view direction: 74°

WTG nearest 20.5 km
WTG farther 47.3 km
WTGs in the field of view (FoV) 133
WTGs visible only considering terrain surface
⇒ at tip height 4
⇒ at hub height 2

The view is taken from a road in the local community of Ban Namtiap. Being a residential area with a Small number of viewers with proprietary interest, the sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude level is therefore considered to be Negligible.

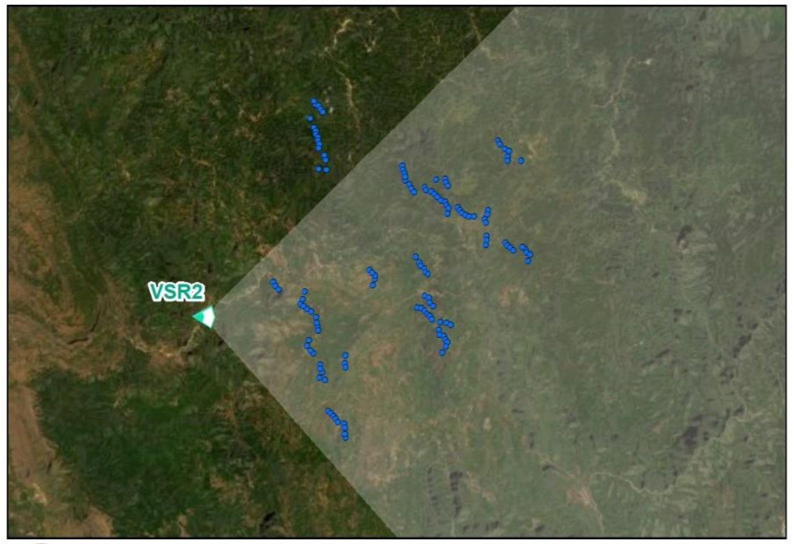
Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

Environmental and Social Impact Assessment – Landscape and Visual Component

ERM

Figure 9.9: Photomontage for VSR2

Coordinate system	VSR2
WGS84-UTM 48N	Ban Paor
X 711277 Y 1694801	



VSR view direction: 92°

WTG nearest 7.6 km

WTG farther 34.5 km

WTGs in the field of view (FoV) 116

WTGs visible only considering terrain surface

⇒ at tip height 0

⇒ at hub height 0

The view is taken from a road in the local community of Ban Paor near a school. Being a residential area with a Small number of viewers with proprietary interest, the sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude level is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

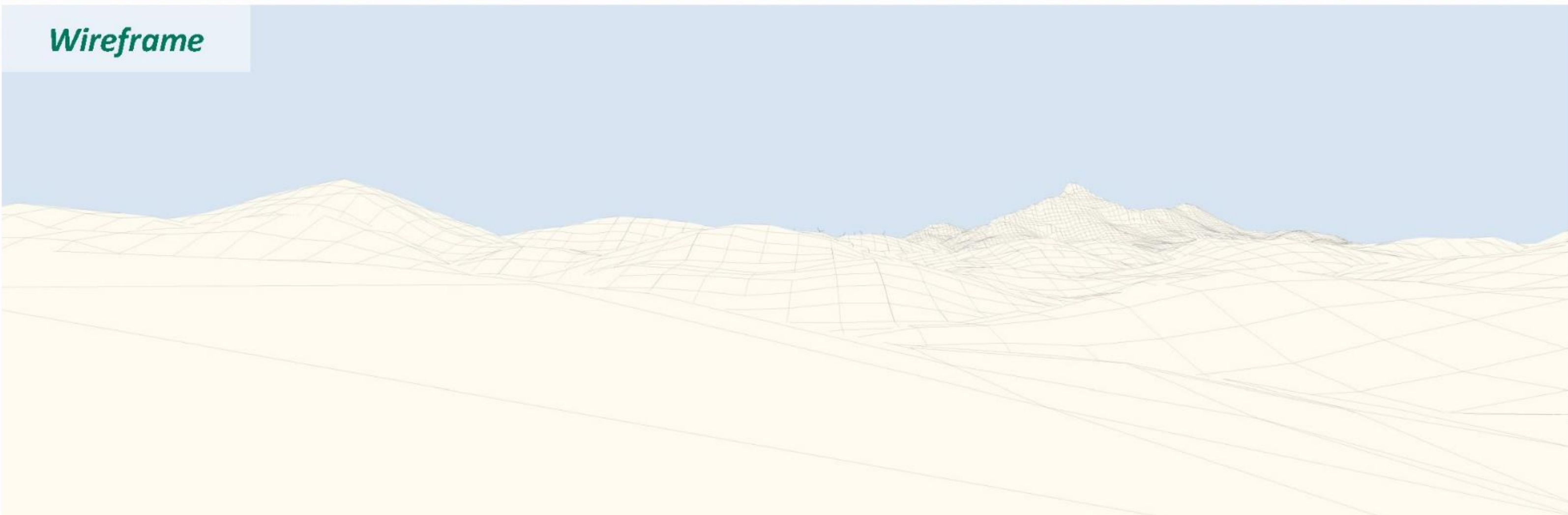
Environmental and Social Impact Assessment – Landscape and Visual Component

Figure 9.10: Photomontage for VSR3

Current

Photomontage

Wireframe



Coordinate system

WGS84-UTM 48N

X 734409 Y 1717973

VSR3

Ban Daksa

VSR view direction: 178°

WTG nearest 8.2 km

WTG farther 36.3 km

WTGs in the field of view (FoV) 116

WTGs visible only considering terrain surface

- ⇒ at tip height 7
- ⇒ at hub height 3

The view is taken in the local community of Ban Daksa, surrounded by hills and forest. The sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude level is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

Environmental and Social Impact Assessment – Landscape and Visual Component

ERM

Figure 9.11: Photomontage for VSR4 (1)

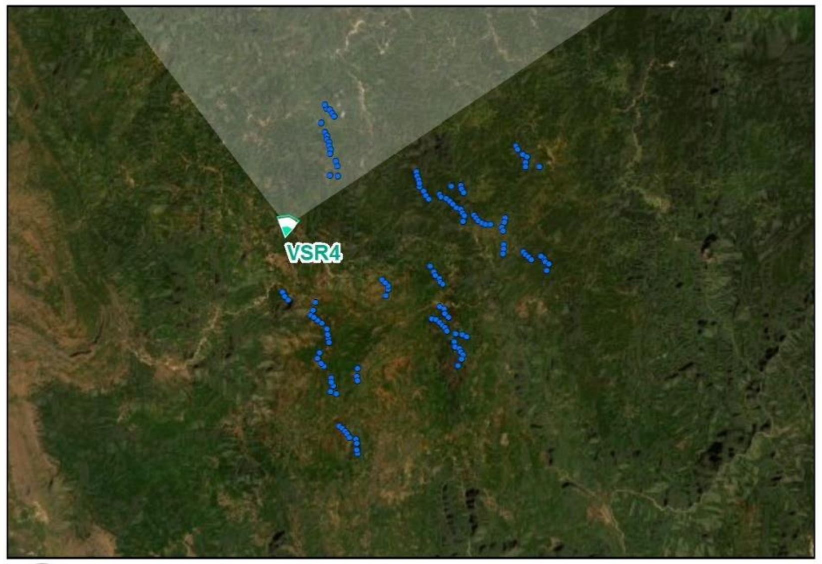
Coordinate system

WGS84-UTM 48N

X 718458 Y 1704417

VSR4 (1 of 2)

Ban Chaling



VSR view direction: 10°

WTG nearest 6.3 km
WTG farther 12.0 km
WTGs in the field of view (FoV) 17
WTGs visible only considering terrain surface
⇒ at tip height 0
⇒ at hub height 0

The view is taken in the local community of Ban Chaling, surrounded by a forest and near a river. The sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

Figure 9.12: Photomontage for VSR4 (2)

Coordinate system

WGS84-UTM 48N

X 718458 Y 1704417

VSR4 (2 of 2)

Ban Chaling

VSR view direction: 113°

WTG nearest 7.7 km

WTG farther 24.9 km

WTGs in the field of view (FoV) 89

WTGs visible only considering terrain surface

⇒ at tip height 0

⇒ at hub height 0

The view is taken in the local community of Ban Chaling, surrounded by a forest and near a river. The sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

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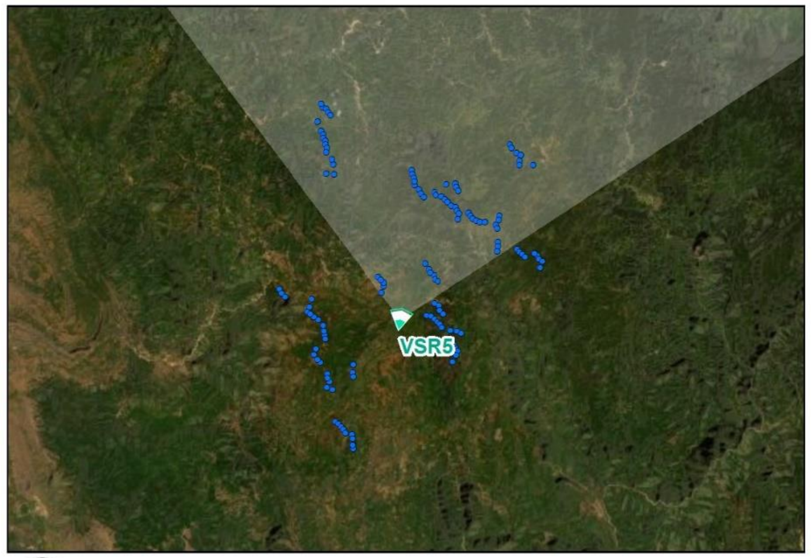
Figure 9.13: Photomontage for VSR5 (1)

Coordinate system	**VSR5** (1 of 4)
WGS84-UTM 48N	**Ban Daktreb**
X 729578 Y 1695290	



VSR view direction: 10°

WTG nearest 3.1 km
WTG farther 22.0 km
WTGs in the field of view (FoV) 70
WTGs visible only considering terrain surface
⇒ at tip height 0
⇒ at hub height 0

The view is taken in the local community of Ban Daktreb near a school. The sensitivity level is therefore considered to be Medium.

Due to the topography and vegetation, at this point wind turbines are not visible or they are only exposed from the upper portion of the rotor. The magnitude is considered Small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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ERM

Figure 9.14: Photomontage for VSR5 (2)

Coordinate system	**VSR5** (2 of 4)
WGS84-UTM 48N	
X 729578 Y 1695290	**Ban Daktreb**

VSR view direction: 100°

WTG nearest 2.5 km
WTG farther 14.7 km
WTGs in the field of view (FoV) 31
WTGs visible only considering terrain surface
⇒ at tip height 18
⇒ at hub height 13

The view is taken in the local community of Ban Daktreb near a school. The sensitivity level is therefore considered to be Medium.

Due to the topography and vegetation, at this point wind turbines are not visible or they are only exposed from the upper portion of the rotor. The magnitude is considered small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

Environmental and Social Impact Assessment – Landscape and Visual Component

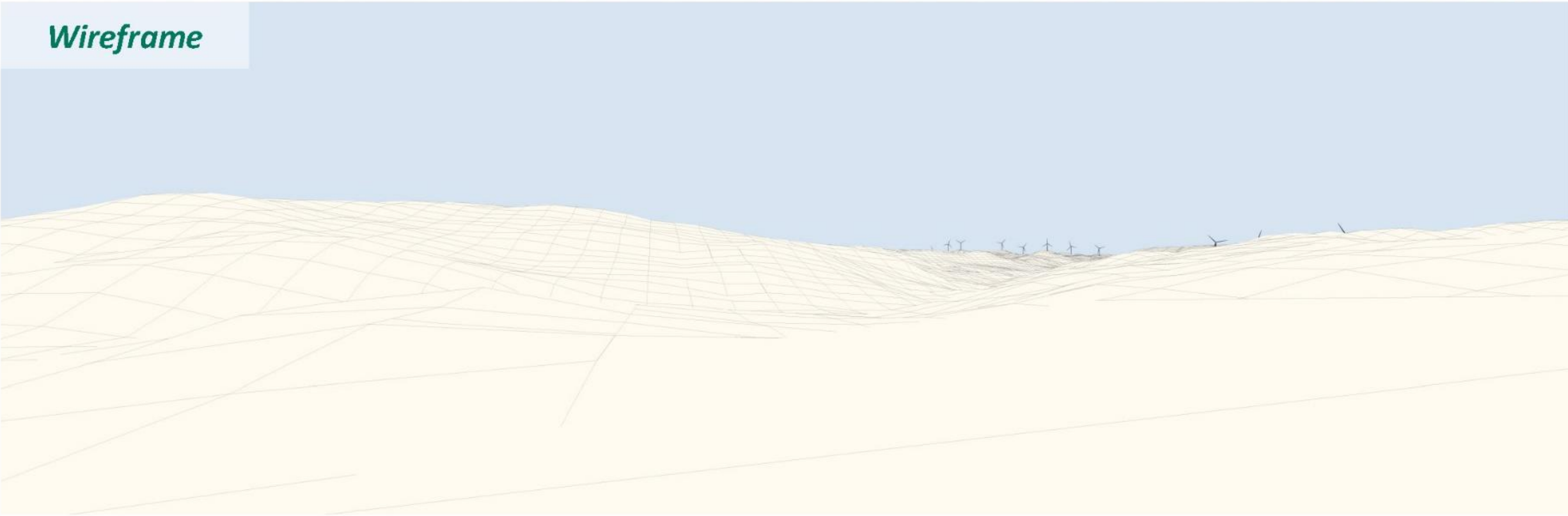
ERM

Figure 9.15: Photomontage for VSR5 (3)

Current

Photomontage

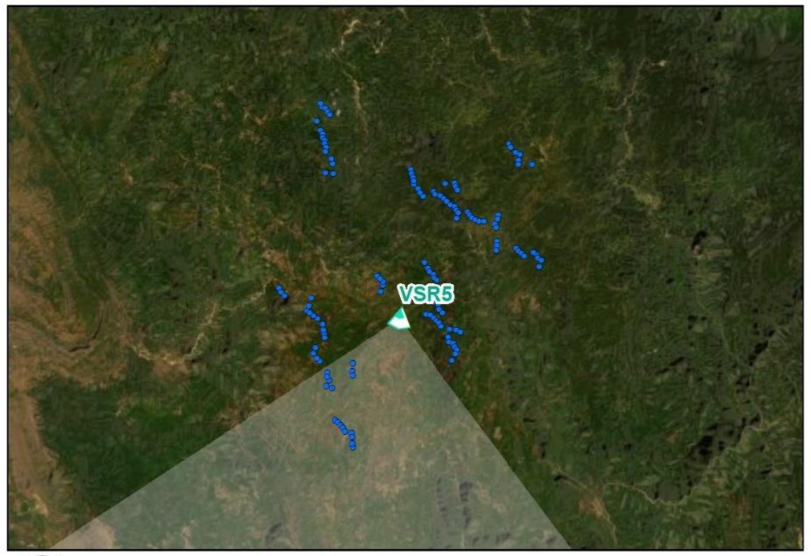
Wireframe



Coordinate system
WGS84-UTM 48N
X 729578 Y 1695290

VSR5 (3 of 4)

Ban Daktreb



VSR view direction: 190°

WTG nearest 6.2 km
WTG farther 13.1 km
WTGs in the field of view (FoV) 17
WTGs visible only considering terrain surface
⇒ at tip height 13
⇒ at hub height 8

The view is taken in the local community of Ban Daktreb near a school. The sensitivity level is therefore considered to be Medium.

Due to the topography and vegetation, at this point wind turbines are not visible or they are only exposed from the upper portion of the rotor. The magnitude is considered small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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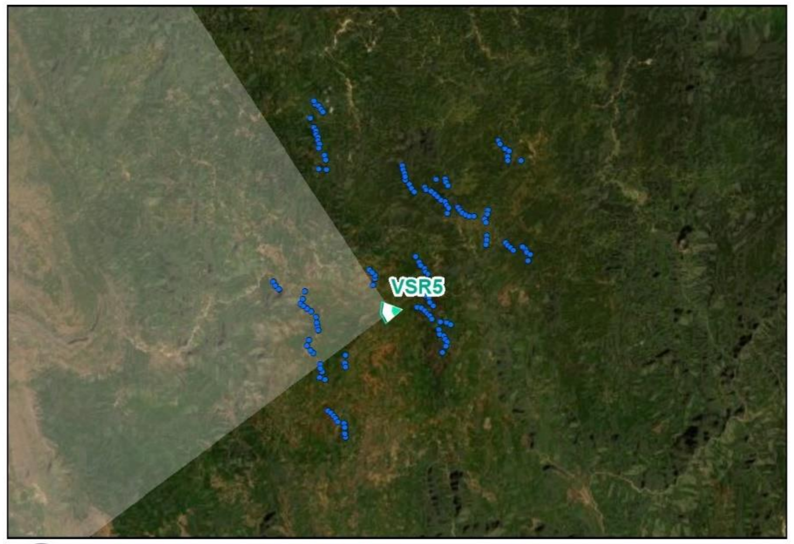
Figure 9.16: Photomontage for VSR5 (4)

Coordinate system WGS84-UTM 48N X 729578 Y 1695290	**VSR5** **(4 of 4)** **Ban Daktreb**



VSR view direction: 280°

WTG nearest 3.1 km
WTG farther 11.8 km
WTGs in the field of view (FoV) 19
WTGs visible only considering terrain surface
⇒ at tip height 1
⇒ at hub height 0

The view is taken in the local community of Ban Daktreb near a school. The sensitivity level is therefore considered to be Medium.

Due to the topography and vegetation, at this point wind turbines are not visible or they are only exposed from the upper portion of the rotor. The magnitude is considered small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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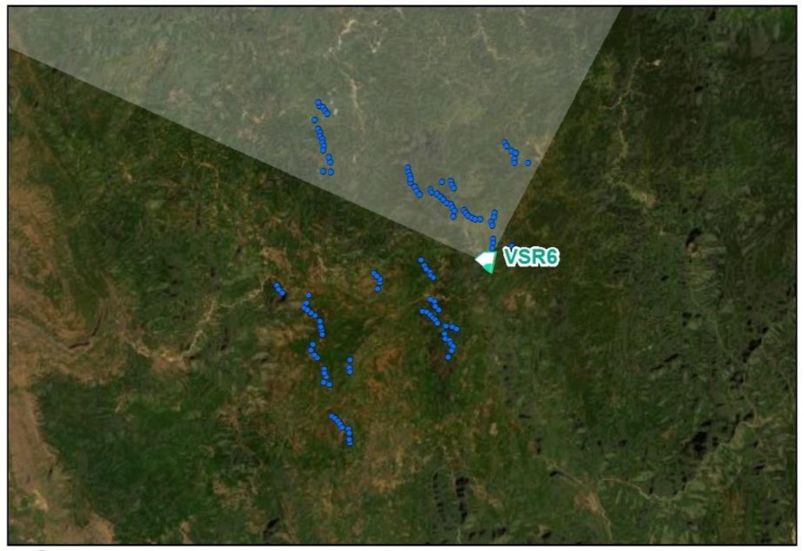
Figure 9.17: Photomontage for VSR6 (1)

Coordinate system	**VSR6** (1 of 2)
WGS84-UTM 48N	
X 738363 Y 1700377	**Ban Dakdor**



VSR view direction: 341°

WTG nearest 1.5 km
WTG farther 22.5 km
WTGs in the field of view (FoV) 59
WTGs visible only considering terrain surface
⇒ at tip height 0
⇒ at hub height 0

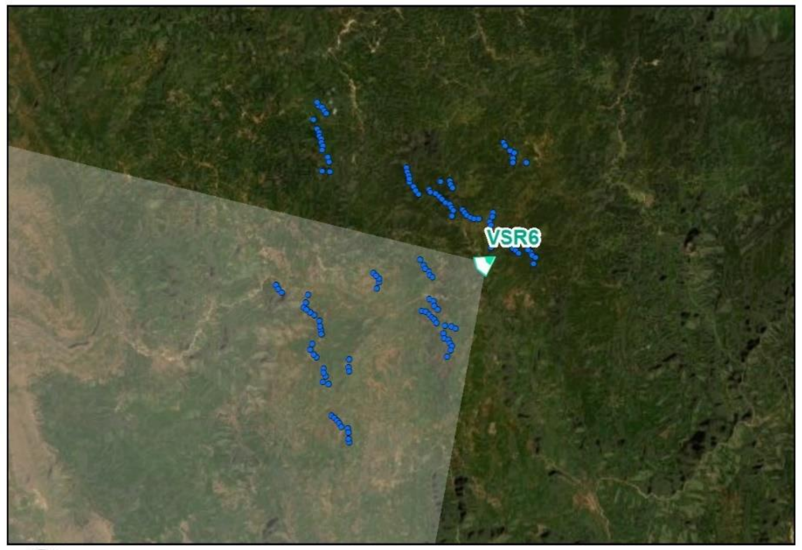
The view is taken in the local community of Ban Dakdor, surrounded by hills and a forest. The sensitivity level is therefore considered to be Medium.

Due to the topography and distance, at this point not all wind turbines are visible and they are only exposed from the upper portion of the rotor. The magnitude is considered Small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

Figure 9.18: Photomontage for VSR6 (2)

Coordinate system WGS84-UTM 48N X 738363 Y 1700377	**VSR6** (2 of 2) **Ban Dakdor**



VSR view direction: 235°

WTG nearest 5.3 km
WTG farther 21.9 km
WTGs in the field of view (FoV) 65
WTGs visible only considering terrain surface
⇒ at tip height 9
⇒ at hub height 4

The view is taken in the local community of Ban Dakdor, surrounded by hills and a forest. The sensitivity level is therefore considered to be Medium.

Due to the topography and distance, at this point not all wind turbines are visible and they are only exposed from the upper portion of the rotor. The magnitude is considered small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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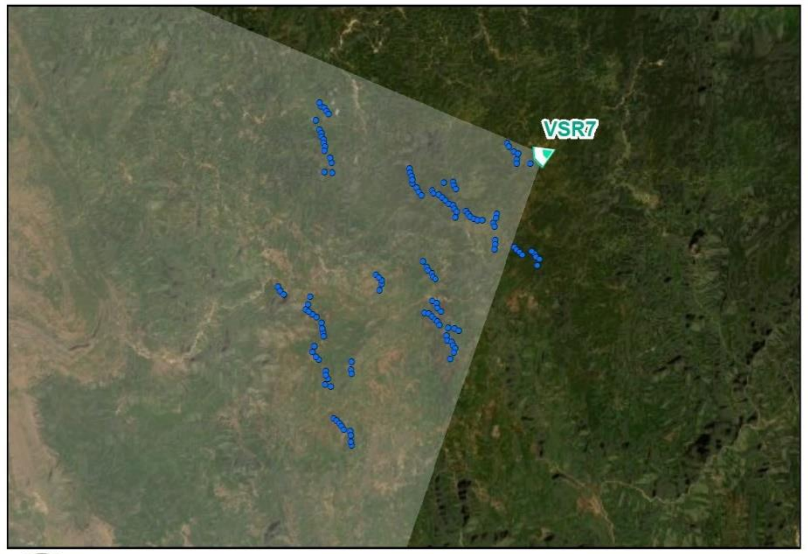
Figure 9.19: Photomontage for VSR7

Coordinate system	**VSR7**
WGS84-UTM 48N	
X 743524 Y 1710931	**Dakchueng**



VSR view direction: 246°

WTG nearest 1.5 km
WTG farther 33.5 km
WTGs in the field of view (FoV) 124
WTGs visible only considering terrain surface
⇒ at tip height 41
⇒ at hub height 29

The view is taken from the urban area of Dakchueng with stores and shops. The sensitivity level is therefore considered to be Medium.

Turbines are visible at a short distance. The magnitude is therefore considered as Medium.

Sensitivity	Magnitude	Significance
Medium	Medium	**Moderate**

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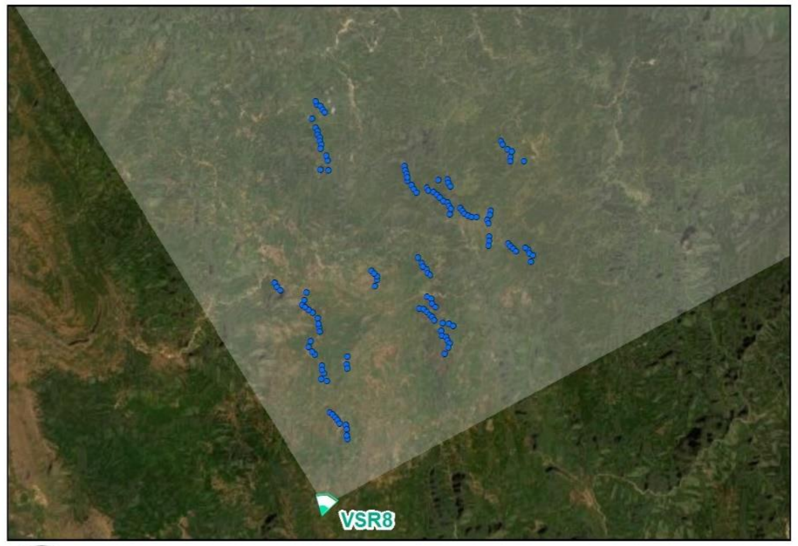
Figure 9.20: Photomontage for VSR8

Coordinate system	**VSR8**
WGS84-UTM 48N	
X 722913 Y 1676582	**Ban Chalernxay**



VSR view direction: 15°

WTG nearest 6.8 km
WTG farther 39.5 km
WTGs in the field of view (FoV) 124
WTGs visible only considering terrain surface
⇒ at tip height 41
⇒ at hub height 29

The view is taken along a road near the village of Ban Chalernxay in the Xanxay's district. The sensitivity level is therefore considered to be High.

Due to topography and distance, only the upper portion of the rotor of few turbines will be visible, forming a clearly discernible, but not dominant, element of the view. The magnitude is therefore considered as Small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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ERM

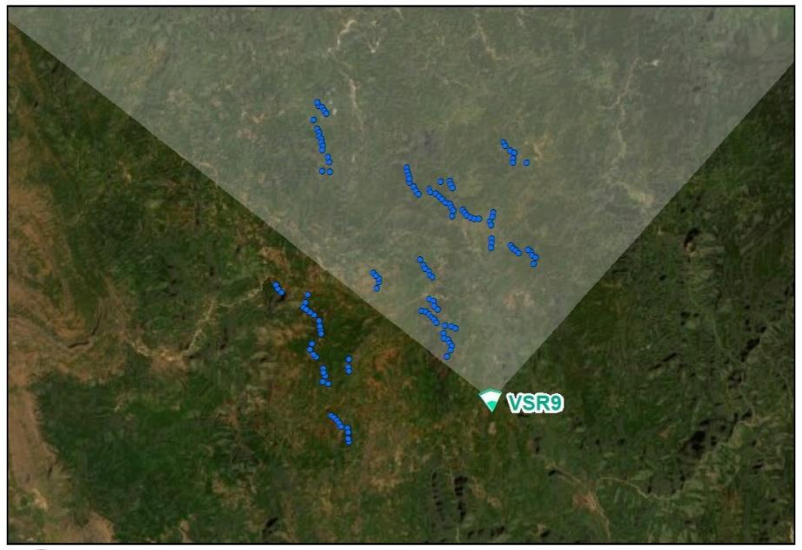
Figure 9.21: Photomontage for VSR9 (1)

Current

Photomontage

Wireframe

Coordinate system WGS84-UTM 48N X 738830 Y 1687061	**VSR9** (1 of 2) **Ban Maithavone**



VSR view direction: 355°

WTG nearest 5.9 km
WTG farther 33.4 km
WTGs in the field of view (FoV) 99
WTGs visible only considering terrain surface
⇒ at tip height 27
⇒ at hub height 11

The view is taken in the local community of Ban Maithavone near a farm. The sensitivity level is therefore considered to be Medium.

Due to topography and distance, only the upper portion of the rotor of few turbines will be visible, forming a clearly discernible, but not dominant, element of the view. The magnitude is therefore considered as Small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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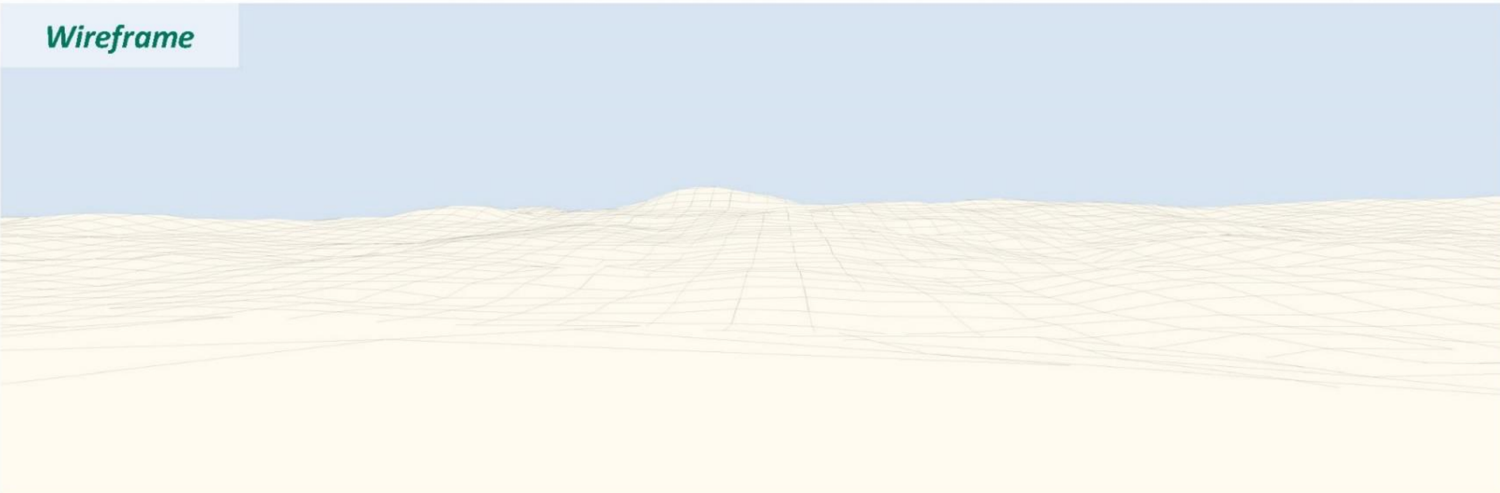
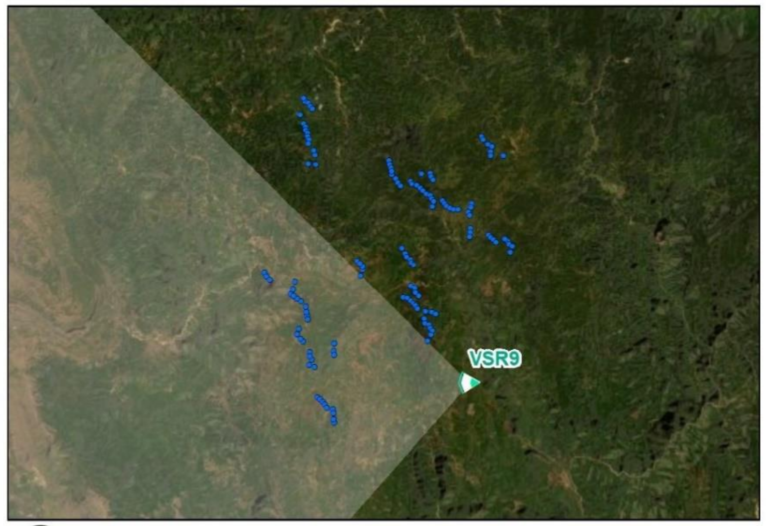
ERM

Figure 9.22: Photomontage for VSR9 (2)



Coordinate system WGS84-UTM 48N X 738830 Y 1687061	**VSR9** (2 of 2) **Ban Maithavone**



VSR view direction: 268°

WTG nearest 5.9 km
WTG farther 23.5 km
WTGs in the field of view (FoV) 35
WTGs visible only considering terrain surface
⇒ at tip height 1
⇒ at hub height 0

The view is taken from the local community of Ban Maithavone near a farm. The sensitivity level is therefore considered to be Medium.

Due to topography and distance, only the upper portion of the rotor of few turbines will be visible, forming a clearly discernible, but not dominant, element of the view. The magnitude is therefore considered as Small.

Sensitivity	Magnitude	Significance
Medium	Small	**Minor**

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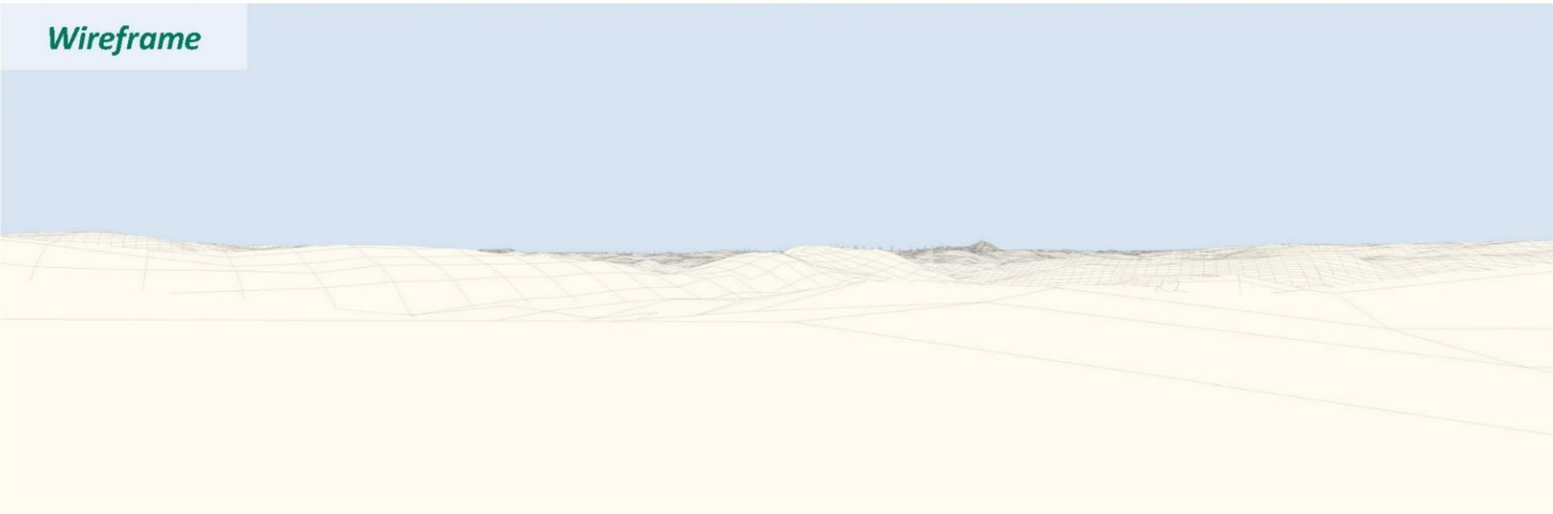
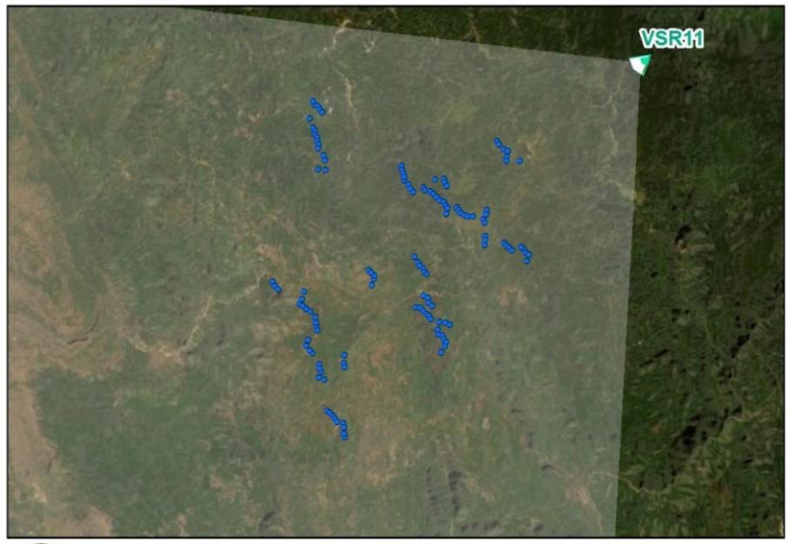
Figure 9.23: Photomontage for VSR11



Coordinate system	**VSR11**
WGS84-UTM 48N	
X 754164 Y 1719633	**Boundary Laos/Vietnam**



VSR view direction: 230°

WTG nearest 15.3 km
WTG farther 46.9 km
WTGs in the field of view (FoV) 133
WTGs visible only considering terrain surface
⇒ at tip height 79
⇒ at hub height 57

The view is taken along a road near the border between Laos and Vietnam. The sensitivity level is therefore considered to be Low.

Due to topography and distance, not all wind turbines are visible at this location and do not constitute a perceptible change in landscape character. The magnitude is therefore considered Negligible.

Sensitivity	Magnitude	Significance
Low	Negligible	**Negligible**

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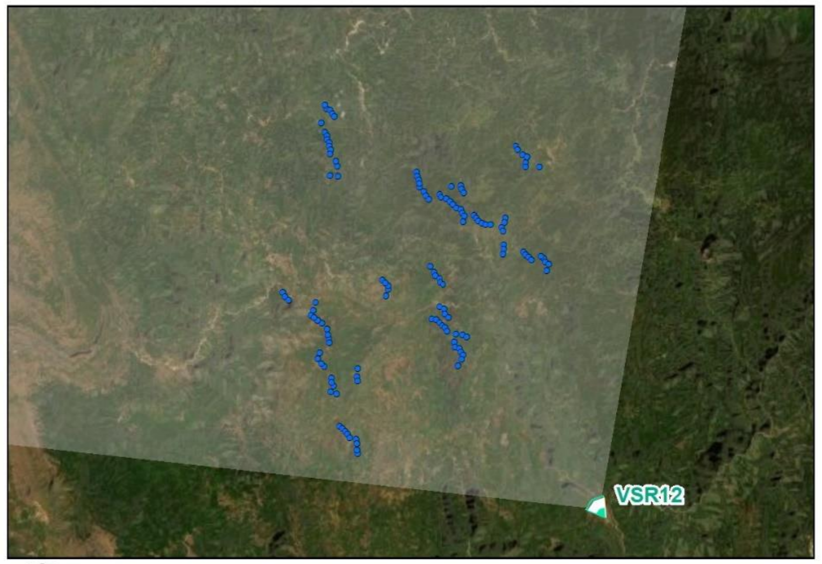
Figure 9.24: Photomontage for VSR12

Coordinate system	**VSR12**
WGS84-UTM 48N	
X 747981 Y 1677805	**Ban Saoksavang**



VSR view direction: 323°

WTG nearest 19.0 km
WTG farther 46.2 km
WTGs in the field of view (FoV) 133
WTGs visible only considering terrain surface
⇒ at tip height 0
⇒ at hub height 0

The view is taken in the settlement of Ban Souksavang along a road. The sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

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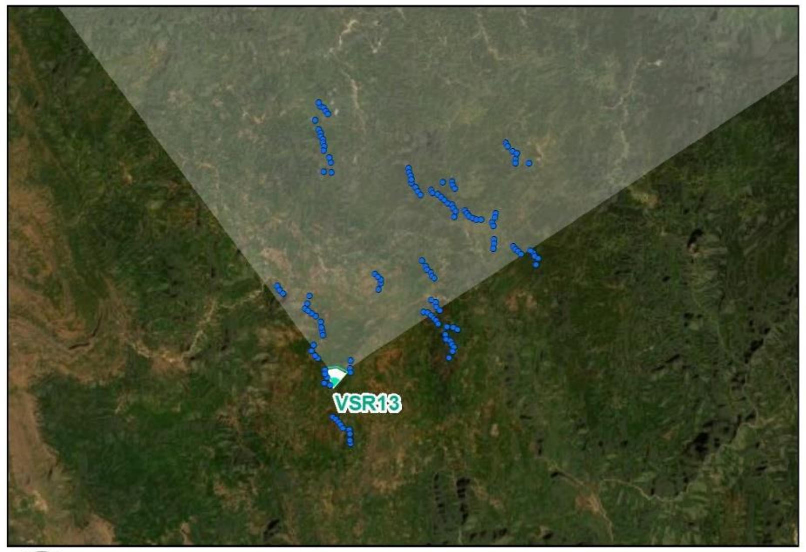
Figure 9.25: Photomontage for VSR13 (1)

Coordinate system WGS84-UTM 48N X 723589 Y 1689411	**VSR13** (1 of 3) **Along a road**



VSR view direction: 10°

WTG nearest 1.7 km
WTG farther 28.0 km
WTGs in the field of view (FoV) 95
WTGs visible only considering terrain surface
⇒ at tip height 47
⇒ at hub height 23

The view is taken along a road near a old farm. The sensitivity level is therefore considered to be Low.

Due to the topography and the distance, at this point not all wind turbines are visible. The magnitude is considered medium.

Sensitivity	Magnitude	Significance
Low	Medium	**Minor**

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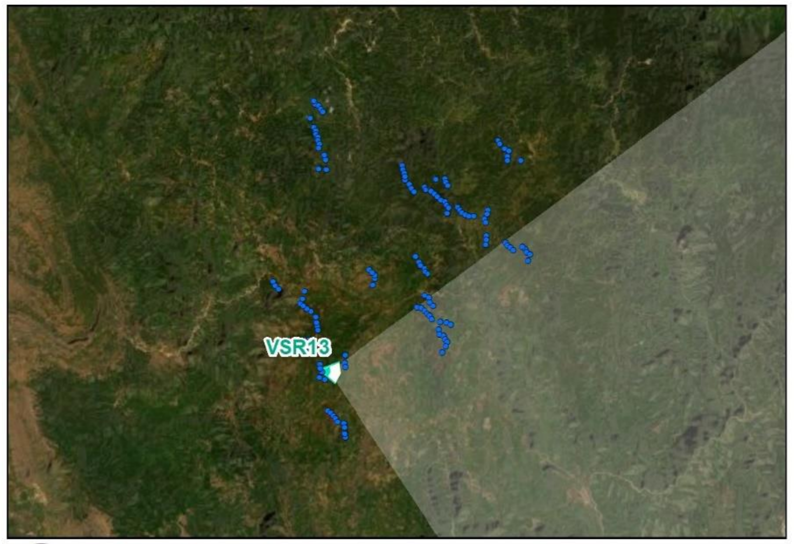
ERM

Figure 9.26: Photomontage for VSR13 (2)

Coordinate system WGS84-UTM 48N X 723589 Y 1689411	**VSR13** (2 of 3) **Along a road**



VSR view direction: 100°

WTG nearest 1.5 km
WTG farther 22.7 km
WTGs in the field of view (FoV) 30
WTGs visible only considering terrain surface
⇒ at tip height 24
⇒ at hub height 21

The view is taken along a road near a old farm. The sensitivity level is therefore considered to be Low.

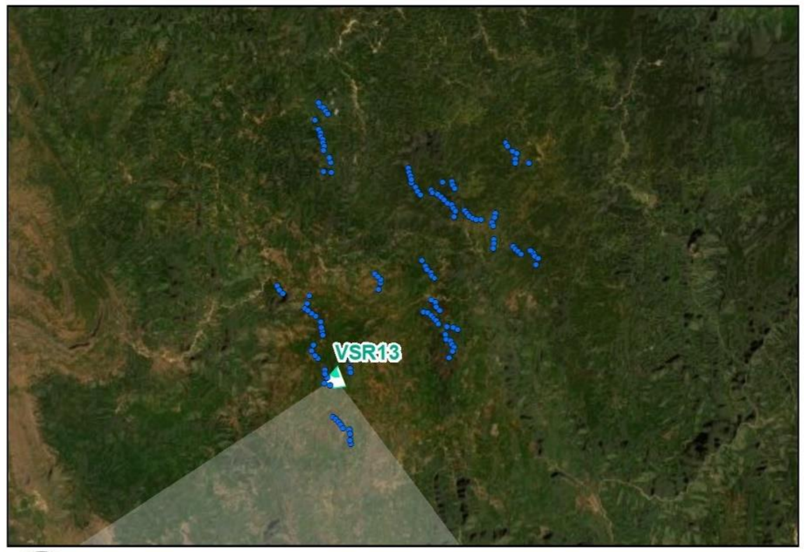
Due to the topography and the distance, at this point not all wind turbines are visible. The magnitude is considered medium.

Sensitivity	Magnitude	Significance
Low	Medium	**Minor**

Environmental and Social Impact Assessment – Landscape and Visual Component

Figure 9.27: Photomontage for VSR13 (3)

Coordinate system WGS84-UTM 48N	**VSR13** (3 of 3)
X 723589 Y 1689411	**Along a road**



VSR view direction: 190°

WTG nearest 0.8 km
WTG farther 6.5 km
WTGs in the field of view (FoV) 11
WTGs visible only considering terrain surface
⇒ at tip height 2
⇒ at hub height 0

The view is taken along a road near a old farm. The sensitivity level is therefore considered to be Low.

Due to the topography and the distance, at this point not all wind turbines are visible. The magnitude is considered medium.

Sensitivity	Magnitude	Significance
Low	Medium	**Minor**

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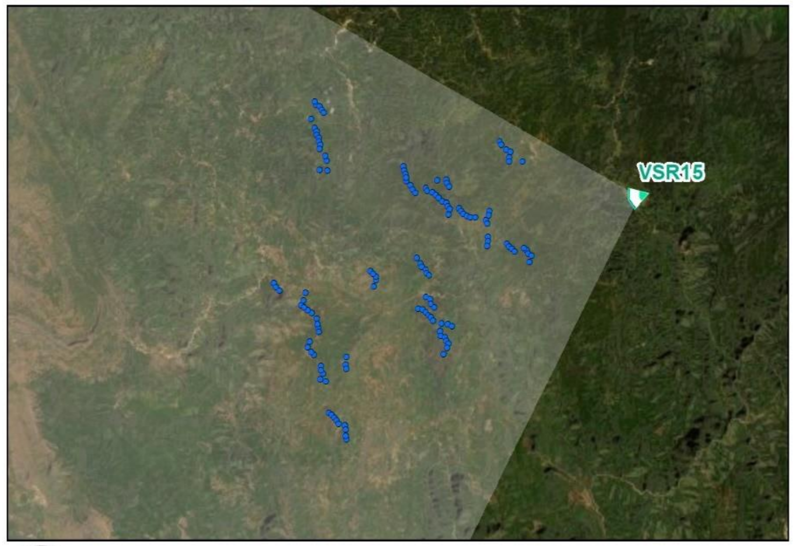
Figure 9.28: Photomontage for VSR15

Current

Photomontage

Wireframe

Coordinate system	VSR15
WGS84-UTM 48N	
X 753565 Y 1706637	Sekamarn 3 Hydropower



VSR view direction: 253"

WTG nearest 11.9 km
WTG farther 37.0 km
WTGs in the field of view (FoV) 133
WTGs visible only considering terrain surface
⇒ at tip height 0
⇒ at hub height 0

The view is taken from the reservoir of the Sekamarn 3 Hydropower Dam. The sensitivity level is therefore considered to be Low.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

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ERM

Figure 9.29: Photomontage for VSR16

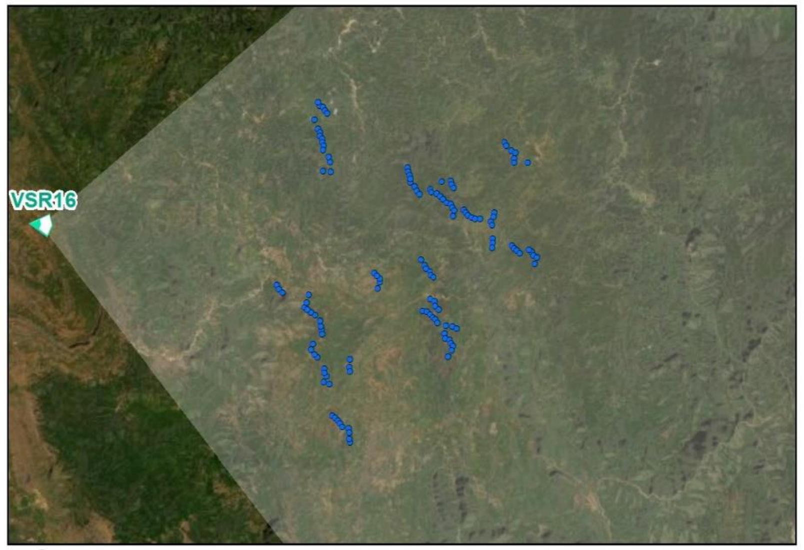
Coordinate system

WGS84-UTM 48N

X 695340 Y 1703968

VSR16

Ban Chavik - Nalaiy



VSR view direction: 96"

WTG nearest 23.4 km

WTG farther 47.9 km

WTGs in the field of view (FoV) 133

WTGs visible only considering terrain surface

⇒ at tip height 0

⇒ at hub height 0

The view is taken near a river where local people spend time after work. The sensitivity level is therefore considered to be Medium.

Turbines are unlikely to be visible from this viewpoint. Hence, a perceptible change to landscape character from the Project is unlikely to occur. The magnitude is therefore considered to be Negligible.

Sensitivity	Magnitude	Significance
Medium	Negligible	**Negligible**

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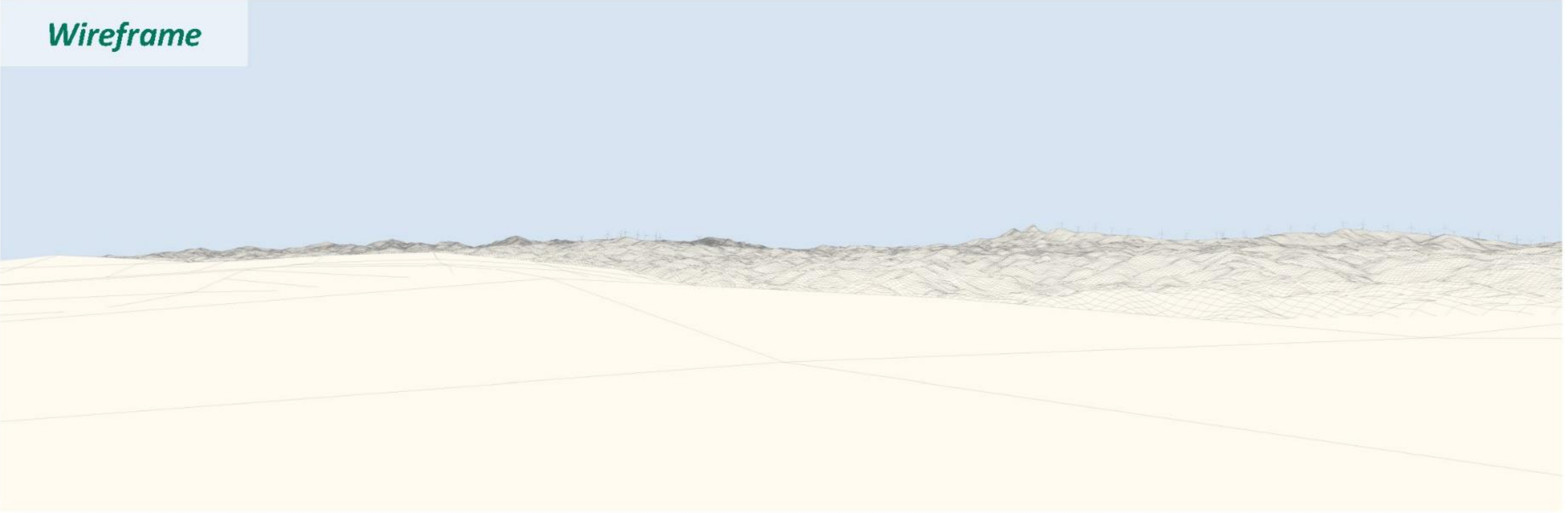
Figure 9.30: Photomontage for VSR17 (1)

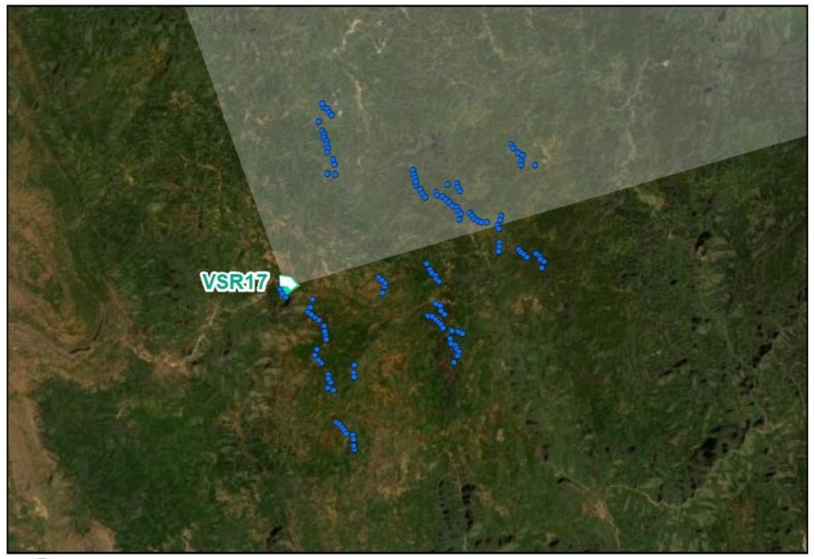
Current

Photomontage

Wireframe



Coordinate system WGS84-UTM 48N X 718596 Y 1698390	**VSR17** (1 of 3) **School**



VSR view direction: 27°

WTG nearest 11.5 km
WTG farther 26.3 km
WTGs in the field of view (FoV) 55
WTGs visible only considering terrain surface
⇒ at tip height 49
⇒ at hub height 42

The view is taken from the school in Daktiem village. The sensitivity level is therefore considered to be Medium.

The turbines are visible at a short distance affecting part of the view. The magnitude is therefore considered as Medium-Large.

Sensitivity	Magnitude	Significance
Medium	Medium-Large	**Moderate-Major**

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ERM

Figure 9.31: Photomontage for VSR17 (2)

Coordinate system WGS84-UTM 48N X 718596 Y 1698390	**VSR17** **(2 of 3)** **School**

VSR view direction: 117°

WTG nearest 2.8 km
WTG farther 24.6 km
WTGs in the field of view (FoV) 82
WTGs visible only considering terrain surface
⇒ at tip height 82
⇒ at hub height 73

The view is taken from the school in Daktiem village. The sensitivity level is therefore considered to be Medium.

The turbines are visible at a short distance affecting part of the view. The magnitude is therefore considered as Medium-Large.

Sensitivity	Magnitude	Significance
Medium	Medium-Large	**Moderate-Major**

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ERM

Figure 9.32: Photomontage for VSR17 (3)

Coordinate system WGS84-UTM 48N X 718596 Y 1698390	**VSR17** (3 of 3) **School**

VSR view direction: 228°

WTG nearest 0.5 km
WTG farther 0.9 km
WTGs in the field of view (FoV) 3
WTGs visible only considering terrain surface
⇒ at tip height 3
⇒ at hub height 3

The view is taken from the school in Daktiem village. The sensitivity level is therefore considered to be Medium.

The turbines are visible at a short distance affecting part of the view. The magnitude is therefore considered as Medium-Large.

Sensitivity	Magnitude	Significance
Medium	Medium-Large	**Moderate-Major**

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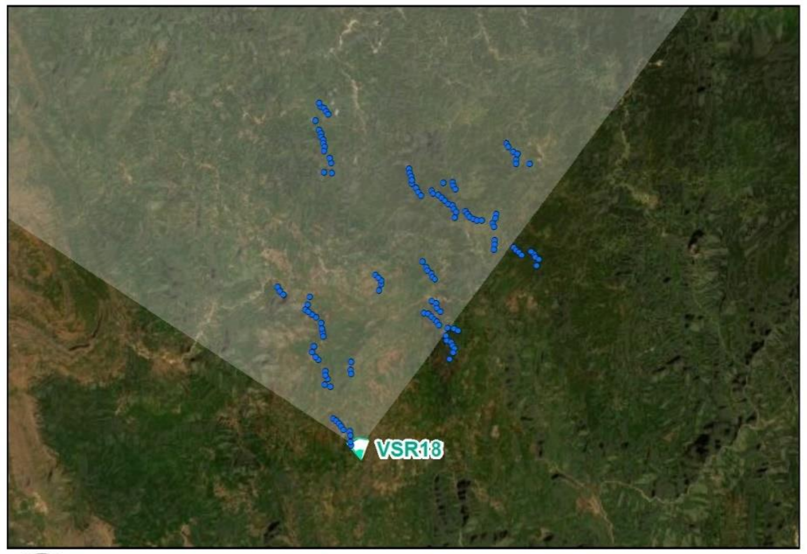
Figure 9.33: Photomontage for VSR18

Coordinate system

WGS84-UTM 48N

X 725898 Y 1682732

VSR18



VSR view direction: 350°

WTG nearest 1.0 km

WTG farther 33.5 km

WTGs in the field of view (FoV) 114

WTGs visible only considering terrain surface

⇒ at tip height 4

⇒ at hub height 3

The view is taken along a road near a village. The sensitivity level is therefore considered to be Medium.

The turbines are visible at a short distance affecting part of the view. The magnitude is therefore considered as Medium-Large.

Sensitivity	Magnitude	Significance
Medium	Medium-Large	**Moderate-Major**

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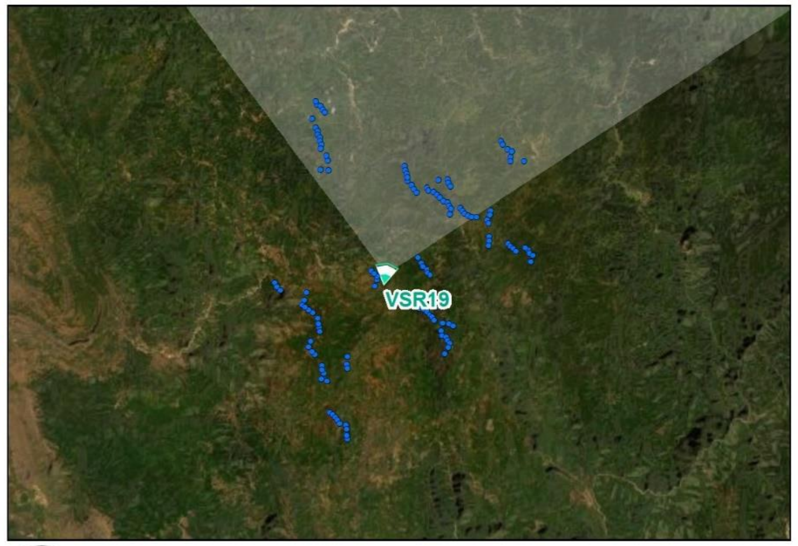
Figure 9.34: Photomontage for VSR19 (1)

Coordinate system WGS84-UTM 48N X 728863 Y 1699044	**VSR19** **(1 of 3)** **Dakyen**



VSR view direction: 10"

WTG nearest 8.4 km
WTG farther 18.2 km
WTGs in the field of view (FoV) 51
WTGs visible only considering terrain surface
⇒ at tip height 3
⇒ at hub height 0

The view is taken in the settlement of Dakyen. The sensitivity level is therefore considered to be Medium.

The closest turbine are visible clearly discernible but partially hidden by the vegetation and affecting part of the view. The magnitude is therefore considered as Medium.

Sensitivity	Magnitude	Significance
Medium	Medium	**Moderate**

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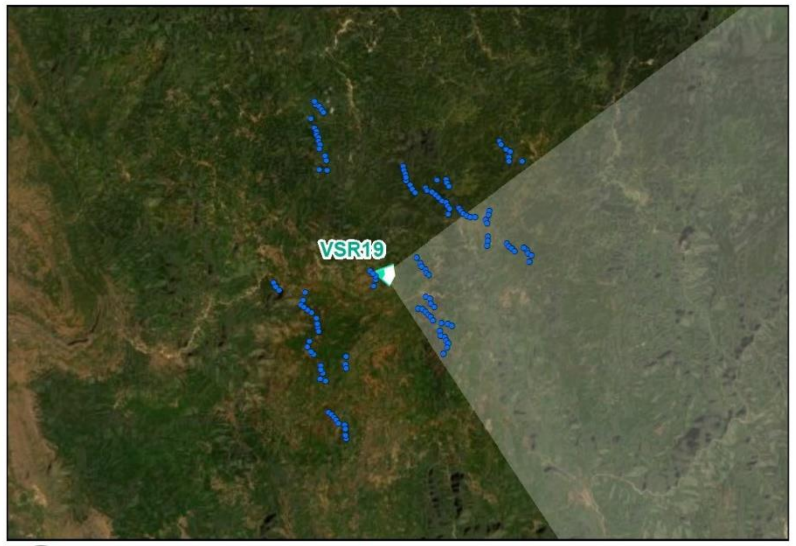
Figure 9.35: Photomontage for VSR19 (2)

Coordinate system	VSR19 (2 of 3)
WGS84-UTM 48N	
X 728863 Y 1699044	Dakyen



VSR view direction: 100"

WTG nearest 3.5 km
WTG farther 14.4 km
WTGs in the field of view (FoV) 46
WTGs visible only considering terrain surface
⇒ at tip height 15
⇒ at hub height 7

The view is taken in the settlement of Dakyen. The sensitivity level is therefore considered to be Medium.

The closest turbine are visible clearly discernible but partially hidden by the vegetation and affecting part of the view. The magnitude is therefore considered as Medium.

Sensitivity	Magnitude	Significance
Medium	Medium	**Moderate**

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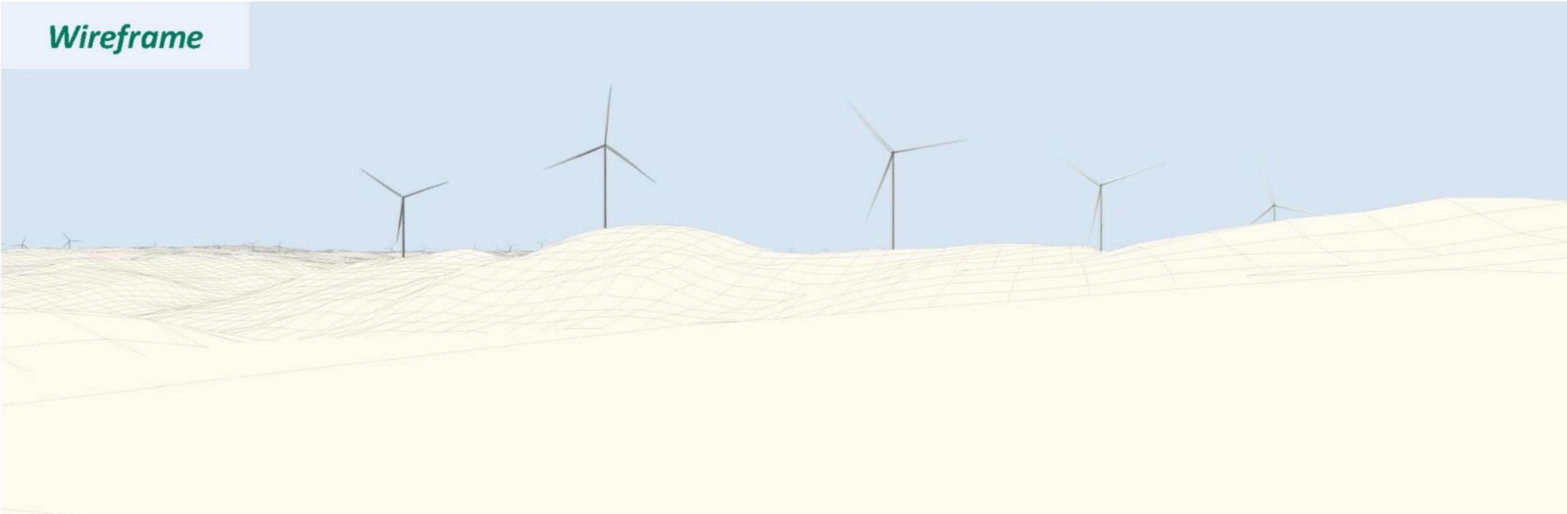
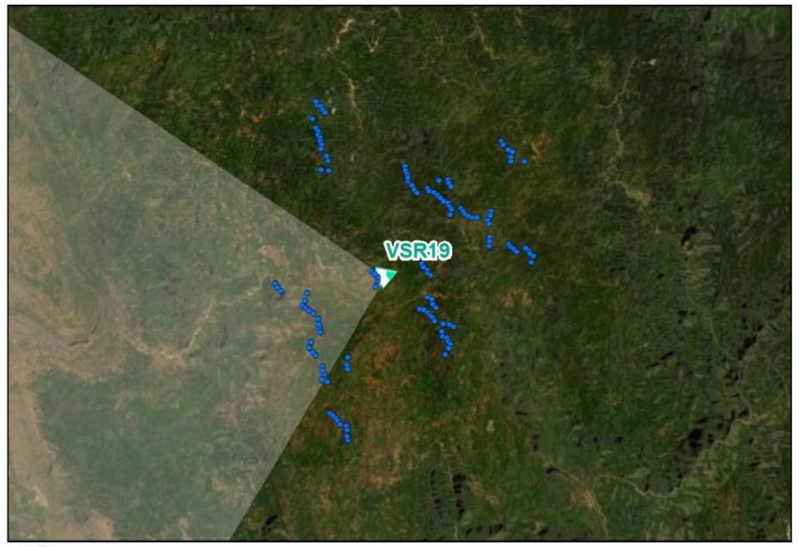
ERM

Figure 9.36: Photomontage for VSR19 (3)



Coordinate system WGS84-UTM 48N X 728863 Y 1699044	**VSR19** (3 of 3) **Dakyen**



VSR view direction: 250"

WTG nearest 0.8 km
WTG farther 11.9 km
WTGs in the field of view (FoV) 30
WTGs visible only considering terrain surface
⇒ at tip height 26
⇒ at hub height 20

The view is taken in the settlement of Dakyen. The sensitivity level is therefore considered to be Medium.

The closest turbine are visible clearly discernible but partially hidden by the vegetation and affecting part of the view. The magnitude is therefore considered as Medium.

Sensitivity	Magnitude	Significance
Medium	Medium	**Moderate**

Environmental and Social Impact Assessment – Landscape and Visual Component

ERM

9.3.7.3 Additional Mitigation, Management, and Monitoring Measures

Recommended Mitigation Measures – Landscape Value

In order to mitigate the landscape impacts, there are different actions that should be considered, especially during the construction phase, such as:

- Demarcate construction boundaries and minimize areas of surface disturbance;
- Where possible, locate laydown areas and construction camps in areas that are already disturbed or cleared of vegetation;
- For the construction site maintenance, conduct good housekeeping on site to avoid litter and minimize waste;
- Use existing tracks/roads for access, where possible; and
- Within the environmental management system, prepare a restoration management plan including replanting indigenous species, and landscaping and rehabilitating construction yards.

Recommended Mitigation Measures – Visual

The following identifies mitigation measures to be applied for visual impacts, including:

- Where possible, locate laydown areas and construction camps in areas that are already disturbed or cleared of vegetation;
- For the construction site maintenance, conduct good housekeeping on site to avoid litter and minimize waste;
- Minimize night lighting while guaranteeing the minimum safety level;
- Use of materials that will minimize light reflection should be used for all Project components;
- Bright patterns and obvious logos should be avoided on WTG;
- The replacement of wind turbines with visually different wind turbines can result in visual clutter, therefore wind turbines with the same or a visually similar model should be used for replacements; and
- Existing vegetation should be retained to the greatest extent possible. Vegetation should be retained along roads, and other Project infrastructure.

9.3.7.4 Residual Impact Significance

With the implementation of both the embedded control as well as the suggested additional mitigation measures, residual impact significance during construction and operation are expected to be **moderate** for landscape and **negligible** to **moderate** for visual, depending on the receptor (as provided in ***Table 9.34*** and ***Table 9.35*** respectively).

Table 9.34: Landscape Value Impacts (Construction and Operation Phase)

Significance of Impact			
Impact	• Landscape value impacts during construction and operation.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to landscape value would be considered to be negative		
Impact Type	**Direct**	Indirect	Induced

Significance of Impact					
	Impacts to landscape value would be direct impacts site preparation and clearance and presence of WTGs and transmission lines				
Impact Duration	**Temporary**	Short-term	**Long-term**	**Permanent**	
	The construction phase of the Project is expected to be completed in 30 months, which would be considered long-term. Operational impacts are permanent.				
Impact Extent	**Local**	Regional	International		
	The impact will only be localized within the Area of Influence of the Project.				
Impact Scale	Impact scale is considered localized and small.				
Frequency	Impacts could occur during the construction and operation phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	■ Based on the characteristic above, the impact is likely to be medium.				
Receptor Sensitivity	Low	**Medium**	High		
	The value of the landscape is considered to be Medium.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The medium sensitivity and magnitude are assessed as moderate.				
Residual Impact Magnitude	Positive	Negligible	Small	**Medium**	
Residual Magnitude Significance	Negligible	Minor	**Moderate**	Major	
	Upon considering the mitigation measure, the residual impact is assessed to be Moderate.				

Table 9.35: Visual Impacts (Construction and Operation Phase)

Significance of Impact					
Impact	• Visual impacts during construction and operation.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to visual would be considered to be negative				
Impact Type	**Direct**	Indirect	Induced		
	Impacts to visual would be direct impacts site preparation and clearance and presence of WTGs and transmission lines				
Impact Duration	**Temporary**	Short-term	**Long-term**	**Permanent**	
	The construction phase of the Project is expected to be completed in 30 months, which would be considered long-term. Operational impacts are permanent.				
Impact Extent	**Local**	Regional	International		
	The impact will only be localized within the Area of Influence of the Project.				
Impact Scale	Impact scale is considered localized and small.				
Frequency	Impacts could occur during the construction and operation phase.				
Impact Magnitude	Positive	**Negligible**	**Small**	**Medium**	**Large**
	Based on the characteristic above, the impact is likely to be negligible to Large depending on the receptor				
	Low	**Medium**	High		

Significance of Impact				
Receptor Sensitivity	The receptors are Low to medium sensitivity.			
Impact Significance	**Negligible**	**Minor**	**Moderate**	**Major**
	The moderate to major impacts are for VSR , 7, 17, 18, and 19.			
Residual Impact Magnitude	Positive	Negligible	Small	**Medium**
Residual Magnitude Significance	**Negligible**	**Minor**	**Moderate**	Major
	Upon considering the mitigation measure, the residual impact is assessed to be Moderate, at worst.			

9.3.8 Impacts Associated with Shadow Flicker

Shadow flicker is "*the flickering effect caused when rotating wind turbine blades periodically cast shadows through constrained openings such as the windows of neighboring properties*".[5] Its occurrence in a specific location can be modelled and assessed[6] taking into account the relative positions of the sun throughout the year (dependent on the latitude of the site), the wind turbine layout and orientation, and the presence of sensitive receptors (e.g., inhabitants of residential buildings).

9.3.8.1 Scope of Assessment

The likelihood and duration of the flicker effect depends upon a number of factors, including:

- Direction of the property relative to the turbine;
- Turbine height and rotor diameter;
- Time of 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 affects potential wind turbine orientation); and
- Weather conditions (presence of cloud cover, fog, and humidity reduces the occurrence of shadow flicker as the visibility itself of the turbine is reduced).

In general, shadow flicker occurs during clear sky conditions, when the sun is low on the horizon. As the angle of the sun on the horizon changes throughout the year, the locations experiencing the phenomenon changes, so specific shadow receptors can be affected in different periods.

The theoretical number of hours of shadow flicker experienced annually at a given location can be calculated using modelling packages incorporating the sun path, topographic variation over the wind farm site, and wind turbine details, such as rotor diameter and hub height.

When assessing shadow flicker impacts, the worst case and/or real case impacts are determined by:

- ***Worst Case Scenario***: the astronomical maximum possible shadow flicker duration is defined as the shadow flicker duration which occurs when the sun is always shining during daylight hours (i.e.,

[5] https://www.gov.uk/government/news/wind-turbine-shadow-flicker-study-published

[6] It should be noted that modelling methods tend to be conservative and typically result in an over-estimation of the number of hours of shadow flicker likely to be experienced at the identified receptors.

the sky is always clear), the wind turbine is always rotating and the rotor plane is always perpendicular to the line from the WTG to the sun;

- ***Real Case Scenario***: the expected shadow flicker duration is when the average sunshine hour probabilities and wind statistics of the particular region are taken into account.

The following section briefly describes the modelling package used, as well as the input criteria for assessing the shadow flicker throughout the different scenarios identified in the introduction.

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, learning and/or health care 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 at higher latitudes where the sun is lower in the sky and therefore shadows are longer, which extends the radius where potentially significant shadow flicker impact will be experienced.
- If it is not possible to locate the wind turbines where neighboring receptors experience no shadow flicker effects, it is recommended that the predicted duration of shadow flicker 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 prevention and control measures to avoid significant shadow flicker impacts include siting wind turbines appropriately to avoid shadow flicker being experienced or to meet limits placed on the duration of shadow flicker occurrence, as set out in the paragraph above, or programming turbines to shut down at times when shadow flicker limits are exceeded.

Globally, several countries have identified national guidelines to evaluate and assess the potential impacts related to shadow flickering. As the shadow flickering is affected by the angle of the sun at the horizon, it is considered to be more relevant at higher latitudes, leading northern and southern countries to publish specific technical guidelines. In the relatively few cases where the real case impact is regulated, the limit value for dwellings is 8 or 10 hours per year.

Table 9.36 outlines the most relevant guidelines currently in place worldwide and that are able to inform and influence international best practice and standards.

Table 9.36: Relevant National Standards

Country	Reference	Relevant Notes
England	■ Planning for Renewable Energy - A companion guide to PPS22 (Planning policy statement 22) – Office of the Deputy Prime Minister 2004 ■ Onshore Wind Energy Planning Conditions Guidance notes – Renewables Advisory Board and	■ Shadow flicker has been proven to occur only within a distance of 10 rotor diameters from the turbines. ■ Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening.

Country	Reference	Relevant Notes
	BERR (Business Enterprise and Regulatory Reform) 2007 ■ UK Government Department for Communities and Local Government (March 2012) ■ National Planning Policy Framework ■ UK Government Department for Communities and Local Government (July 2013) Planning practice guidance for renewable and low carbon energy	
Northern Ireland	■ Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy' – Northern Ireland Department of the Environment 2009	■ Shadow flicker only occurs inside buildings through narrow window openings. ■ The potential for shadow flicker at distances greater than 10 rotor diameters is very low. ■ It is recommended that shadow flicker at neighboring residential buildings and offices should not exceed 30 hours per year.
Ireland	■ Ireland Government Department of Environment (2013) Wind Energy Development ■ Guidelines	■ Shadow flicker only occurs inside buildings through narrow window openings. ■ The potential for shadow flicker at distances greater than 10 rotor diameters is very low. ■ It is recommended that shadow flicker at neighboring residential buildings and offices should not exceed 30 hours per year.
Germany	■ Länderausschuss für Immissionsschutz (2002) Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergieanlagen (WEA-Schattenwurf-Hinweise) (Guideline for Identification and Evaluation of the Optical Emissions of Wind Turbines)	■ Worst case scenario limited to a maximum of 30 hours per year and 30 minutes per day. ■ Real case limited to 8 hours per day (a limitation driven by sensor equipment and if worst case limit would be exceeded).
Australia	■ Environment Protection and Heritage Council (EPHC) (2010) National Wind Farm Development Guidelines	■ Worst case: 30 hours/year. ■ No daily limit. ■ Real case: 10 hours/year (only required if worst case exceeds 30 hours/year).
Canada	■ Natural Forces Wind Inc (June 2013) Gaetz Brook Wind Farm Shadow Flicker Assessment Report	■ Worst case: 30 hours/year and 30 min/day.

Country	Reference	Relevant Notes
USA	■ National Association of Regulatory Utility Commissioners (NARUC) Grants & Research Department (January 2012) Wind Energy & Wind Park Siting and Zoning Best Practices and Guidance for States	■ Worst case: 30 hours/year and 30 min/day.
Denmark	■ Danish Government – Miljøministeriet Naturstyrelsen (2015) Vejledning om planlægning for og tilladelse til opstilling af vindmøller, 19-20	■ Real case: 10 hours/year
Netherlands	■ Nederlandse overheid – Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (2017) Regeling algemene regels voor inrichtingen milieubeheer, Art. 3.12	■ Wind turbines shall be equipped with an automatic shadow flicker control system, which stalls the turbine if shadow flicker occurs at sensitive receptors and the distance between the turbine and the sensitive receptor is less than 12 times the rotor diameter and if on average the shadow flicker occurs more than 17 days per year for more than 20 minutes per day. ■ Receptors like office buildings are not mapped as sensitive receptors.

Currently, **Laos has not defined national legislation or guidelines to assess shadow flickering** and there are no international guidelines on standards to be followed for the real case scenario. Among the above mentioned national standards, there are a few differences in the exact implementation of the shadow flicker regulation. Some countries and jurisdictions only consider the worst case scenario, relatively few countries also consider the real case impact.

The table shows that not all countries have guidelines or regulations for assessing and limiting shadow flicker impacts. In countries lacking regulations for shadow flicker, the German guideline is often applied as best practice.

As per this consideration, this study considered the IFC guidelines as a reference, integrating the results with a real case scenario modeling in order to assess the effect raised by the inclusion of more local conditions. Based on the analysis of the different national standards, it is proposed to take into consideration the most conservative ones that place the annual limits at 8 or 10 hours (Germany, Australia, and Denmark).

Receptors

Some internationally adopted reference standards (A.D. Clarke 1991)[7] exclude the occurrence of flickering shadows beyond a distance of 10 times the rotor size (in this case 1,710m).

[7] Clarke A.D. 1991: A case of shadow flicker / flashing: assessment and solution. Techno Policy Group, Open University. Milton Keynes, UK

This approach has been criticized recently in 2017 by ClimateXChange (Scotland's centre of expertise connecting climate change research and policy) and LUC (landuse.co.uk), and suggested that the Scottish guidance should not include a reference to 10 times the rotor diameter.

Considering the receptor distribution and the characteristics of the local landscape, in order to apply a more conservative approach, it was assumed to consider a 2 km study area to map the receptors, beyond the more standard approach suggested by A.D. Clarke.

A total of 2,513 potential shadow flicker receptors (***Figure 9.37***) were identified in a desktop study using topographical maps, aerial photographs, and on site field visits. The project is located in a forested area (***Figure 9.38***).

There are sparsely populated settlements or small communities, where the land is mainly dedicated to agricultural activities. The largest residential area is Dak Chueng in the North East area.

Figure 9.37: Location of Receptors

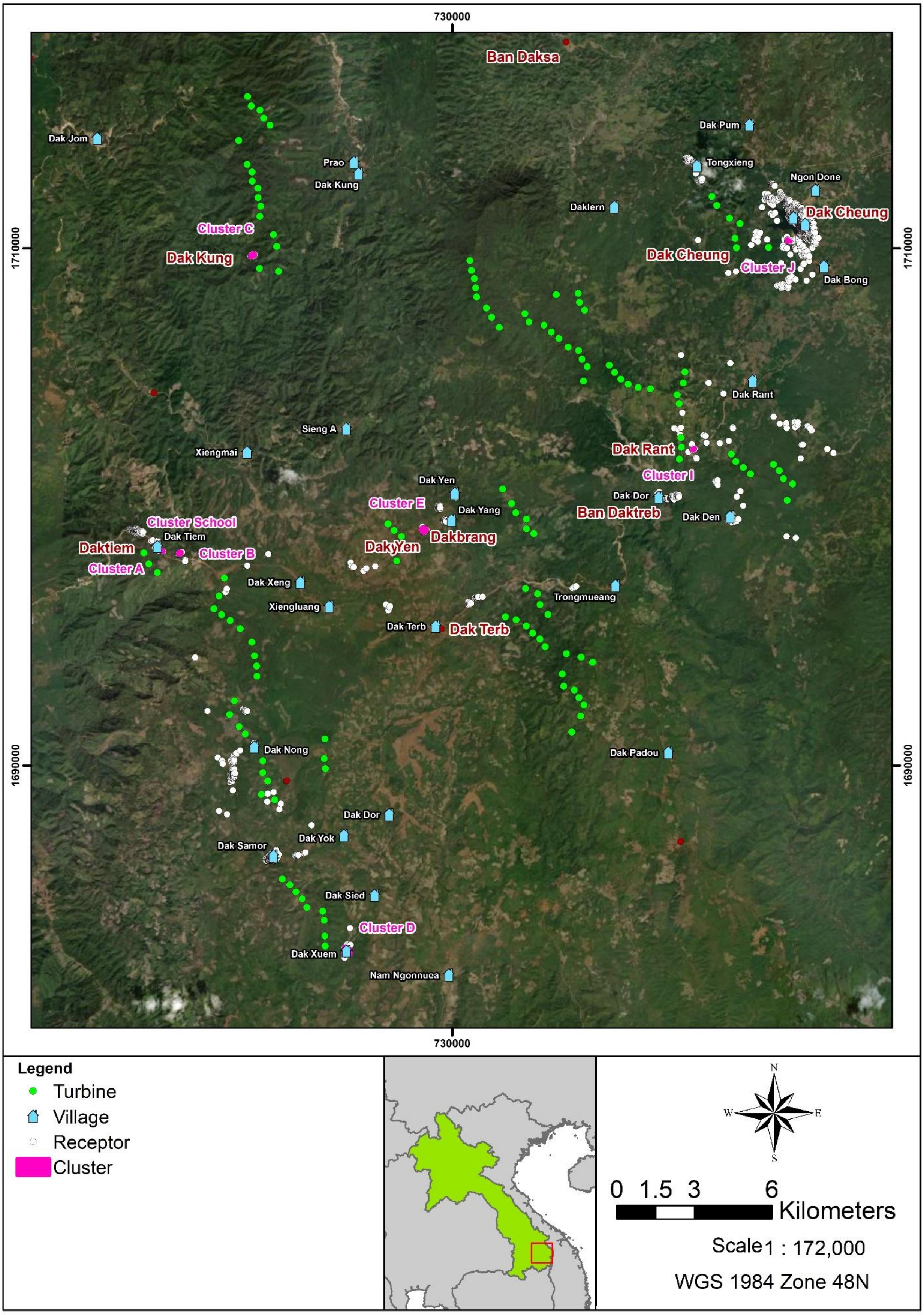


Figure 9.38: Photos of Forests Surrounding Receptors

Shadow Flicker Analysis and Results

WindPro Model: Scenarios and Input Criteria

This assessment has been undertaken using the WindPro 3.5©; a computer package widely used in the wind industry. The software package includes a Shadow Flicker Module (SHADOW) that calculates how often and the intervals in which a specific neighbor or area will be affected by one or more wind turbines.

As reported in the introduction, two main scenarios have been modelled: Worst Case Scenario and Real Case Scenario.

Within the Worst Case Scenario, the calculations are based on conditions that would provide the maximum amount of shadow flicker with no parameters characterizing the local settings and conditions, as well as project specific characteristics, such as:

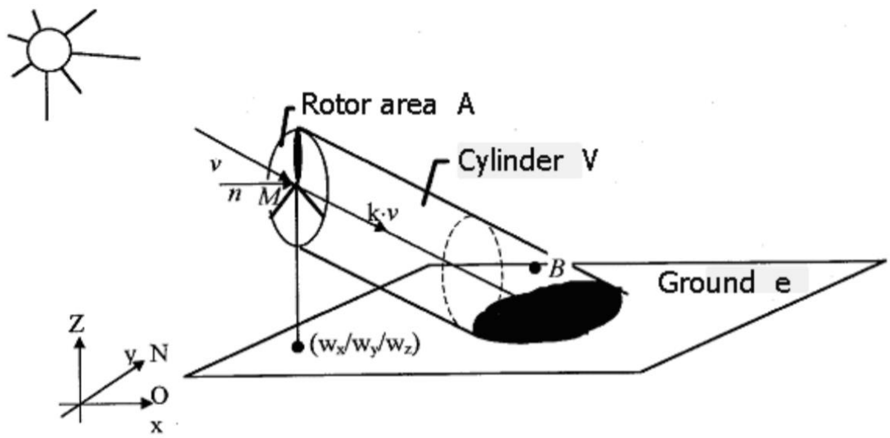
- The presence of physical barriers is not considered;
- Natural vegetation screening is not included;
- Cloud cover, and humidity is not included;
- The sun is shining all the day, from sunrise to sunset;
- Rotor is not turned off for low winds or high winds; and
- Shadow receptors are modelled using the greenhouse mode, meaning that each receptor will face all directions (360 degree visibility).

Within the Real Case Scenario, calculations are based on a more realistic situation where the sun shining probability is based on real datasets. However, it should be stated that such modelling assumptions are not taking into consideration other parameters characterizing the local settings (e.g., wind speed or monsoons) and in any case may lead to an overestimation of the shadow flickering occurrence.

All scenarios have been carried out with a temporal resolution of 1 minute, meaning 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 ***Figure 9.39***.

Figure 9.39: Shadow flickering theory



Source: WindPro user manual

All dwellings/group of dwellings on site have been modelled taking into consideration the following:

- Single story buildings, and so shadow flicker has been calculated at a height of 1 m (equivalent to the first floor windows);
- Slope of the window has been set to 90°; and
- The identified receptors are simulated as fixed points with the possibility to view 360°C, representing an unrealistic scenario, as real windows would be facing only a particular direction.

Worst Case Scenario

The following assumptions have been considered in the modelling setting for Worst Case Scenario:

- Rotors are always turning;
- Sun is always shining, all the day, from sunrise to sunset;
- Local topography has been obtained from digital terrain model (DTM)
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and sunlight;
- Receptors modelled using greenhouse mode (the receptor is not facing one particular direction, but instead is facing all directions); and
- No physical barriers are considered.

Real Case by Statistics Scenario

The following assumptions have been considered in the modelling setting for Real Case Scenario:

- Data about the average daily sunshine hours presented in below (derived statistically for the site from ERA5 cloud cover data):

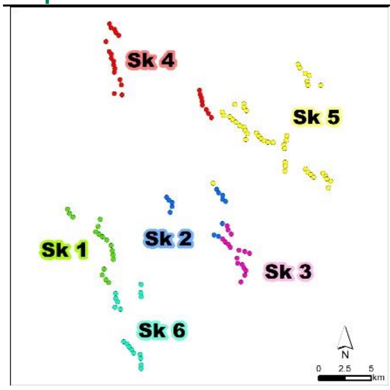
Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4,98	7,98	6,98	2,79	2,56	1,24	2,13	0,53	1,41	0,47	3,63	2,78

- Local topography has been obtained from SRTM DTM;
- Estimation of indicative annual cloud coverage, no 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 such as forests; and
- Rotors are always turning; the site was divided into six areas and the operational hours for each sector depends on the area of the site in which the turbine is located (***Table 9.37***).

Table 9.37: Operational Hours by Dector for Every Site Areas

Map



Area	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
Sk 1	147	262	3.015	686	200	281	424	957	1.937	439	221	191	8.760
Sk 2	136	314	3.584	417	135	270	742	858	781	686	508	329	8.760
Sk 3	159	164	3.182	1.175	146	201	359	495	1.157	1.043	363	314	8.758
Sk 4	223	367	2.810	686	230	286	519	914	1.363	710	416	236	8.760
Sk 5	142	2.813	688	94	81	96	432	1.408	2.111	590	184	121	8.760
Sk 6	159	1.110	2.432	258	166	416	1.314	1.190	614	437	403	260	8.759

It should be noted that for the Real Case Scenario the shadow flickering assessment performed with such assumptions is still likely an over estimation in terms of the annual number of hours of flickering experienced at a specific location due to the following reasons:

- The occurrence of cloud cover has the potential to significantly reduce the number of hours during which the observer is experiencing the flickering;
- 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 wind turbine is dependent on the degree that direct sunlight is diffused, which is strictly dependent on the amount of dispersant in between the observer and the rotor; and
- The analysis has not considered the presence of vegetation or other physical barriers around a receptor that are able to shield the view (at least partially) of the turbine.

Table 9.38 outlines the modeling settings adopted for each scenario.

Table 9.38: WindPro Shadow Module Inputs (The Key Differences Between the Scenarios are in Bold)

Inputs	Worst Case Scenario	Real Case Scenario
Rotor diameter and hub height	171m / 110m	171m / 110m
Wind turbine operation	Rotors are always turning	Rotors are always turning
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 / 1 m large / 1 m from the first floor	1 m height / 1 m large / 1 m from the first floor
Cloud cover	Not considered	ERA5 cloud cover data
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

Inputs	Worst Case Scenario	Real Case Scenario
Shining period	**The sun is always shining all day, from sunrise to sunset**	**The sun is shining as per local sunshine data provided**
Height contour	SRTM DTM	SRTM DTM
Eye height	1.5 m	1.5 m

Model Results

As presented above, two scenarios have been modelled using Shadow Flickering WindPro Module to identify the receptors potentially affected by the flickering. The project area is characterized by the presence of different dwellings/group of dwellings, mainly in the Dak Cheung Village.

The following sections outline the number of potentially affected receptors for each scenario.

1. Worst Case Scenario – Results

As reported above, the modelling package calculates the predicted shadow flickering durations at receptors. The Worst Case Scenario has considered a fully worst case scenario with unrealistic conditions leading to a potential of 488 impacted receptors (both for hours/year and minutes/day) among the 2,513 mapped receptors. For these, IFC thresholds have been exceeded for both parameters: hours/year and minutes/day.

The following maps present the distribution of areas where flickering is calculated according to the Worst Case Scenario (***Figure 9.40*** and ***Figure 9.41***). For further detailed modeling results, refer to ***Appendix V.***

Figure 9.40: Map of Predicted Shadow Flicker (hours/year) – Worst Case Scenario

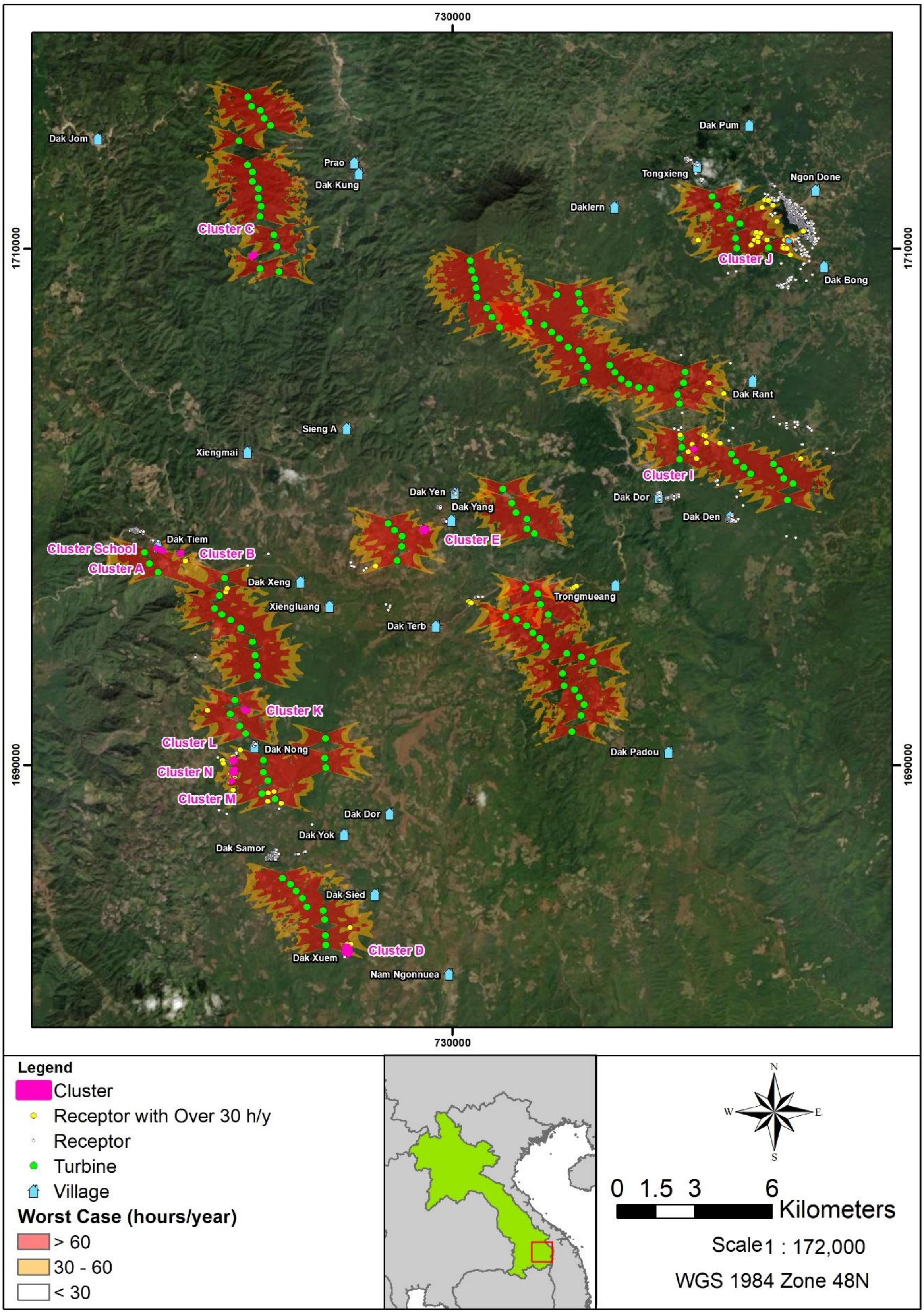
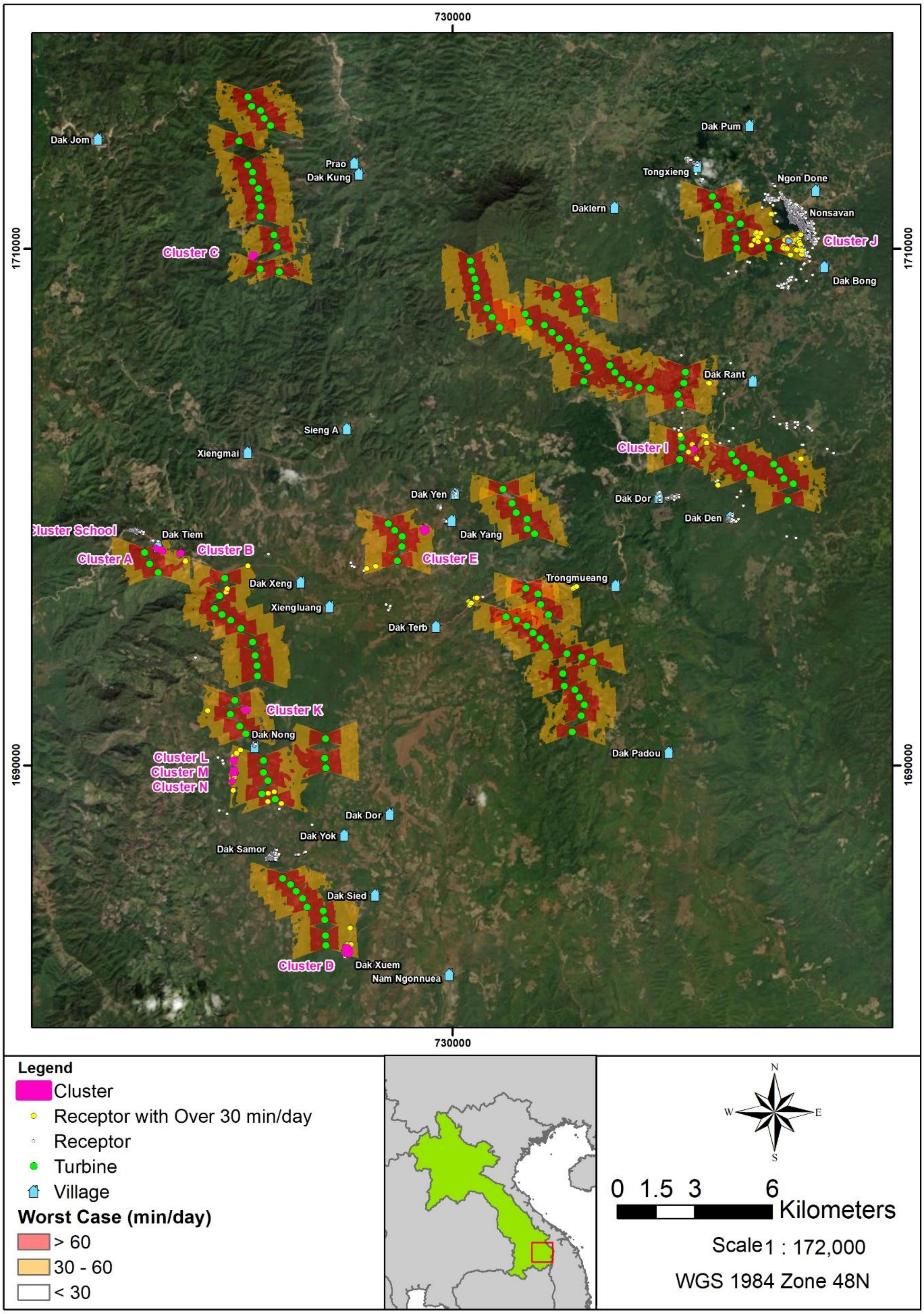


Figure 9.41: Map of Predicted Shadow Flicker (min/day) – Worst Case Scenario



2. Real Case by Statistics Results – Real Case Scenario

Following the results of the Worst Case Scenario presented in the previous section, a second scenario was calculated in order to assess the effect raised by the inclusion of more local conditions (the average daily sunshine hours and wind direction) on the 484 receptors that exceeded the threshold defined by the World Bank EHS for shadow flicker issues.

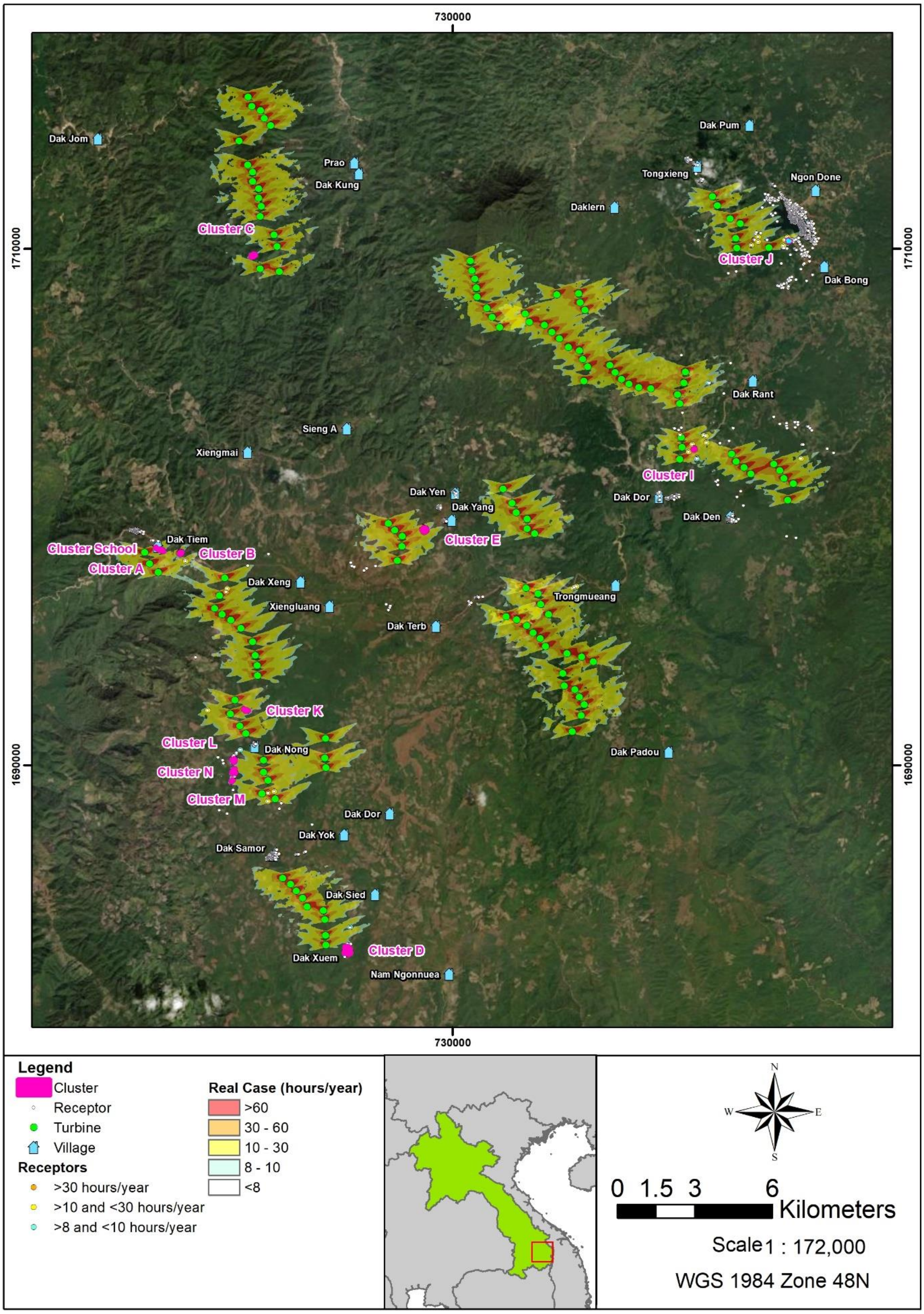
There are no international guidelines on standards to be followed internationally for the Real Case Scenario, and we decided to take into consideration the most conservative standards that place the annual limits at 8 or 10 hours.

Based on the annual limit of 8 or 10 hours the Real Case Scenario leads to a potential of 267 impacted receptors (see ***Appendix V*** for more detailed results), with:

- 72 impacted receptors experiencing between 8-10 hours/year;
- 170 impacted receptors experiencing between 10-30 hours/year; and
- 17 impacted receptors more than 30 hours/year.

The predicted shadow flicker durations at receptors are presented in ***Figure 9.42***.

Figure 9.42: Map of predicted shadow flicker (hours/year) – Real Case Scenario



9.3.8.2 Potential Impacts

The association between shadow flicker caused by wind turbines and the effect on human health is highly debated.

Some studies suggest that flicker from turbines pose 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).

9.3.8.3 Existing Controls

Automated shutdown will be in place to migtigate shadow flicker impacts above the guidelines.

9.3.8.4 Significance of Impacts

Methodology for Assessment of Impact Significance

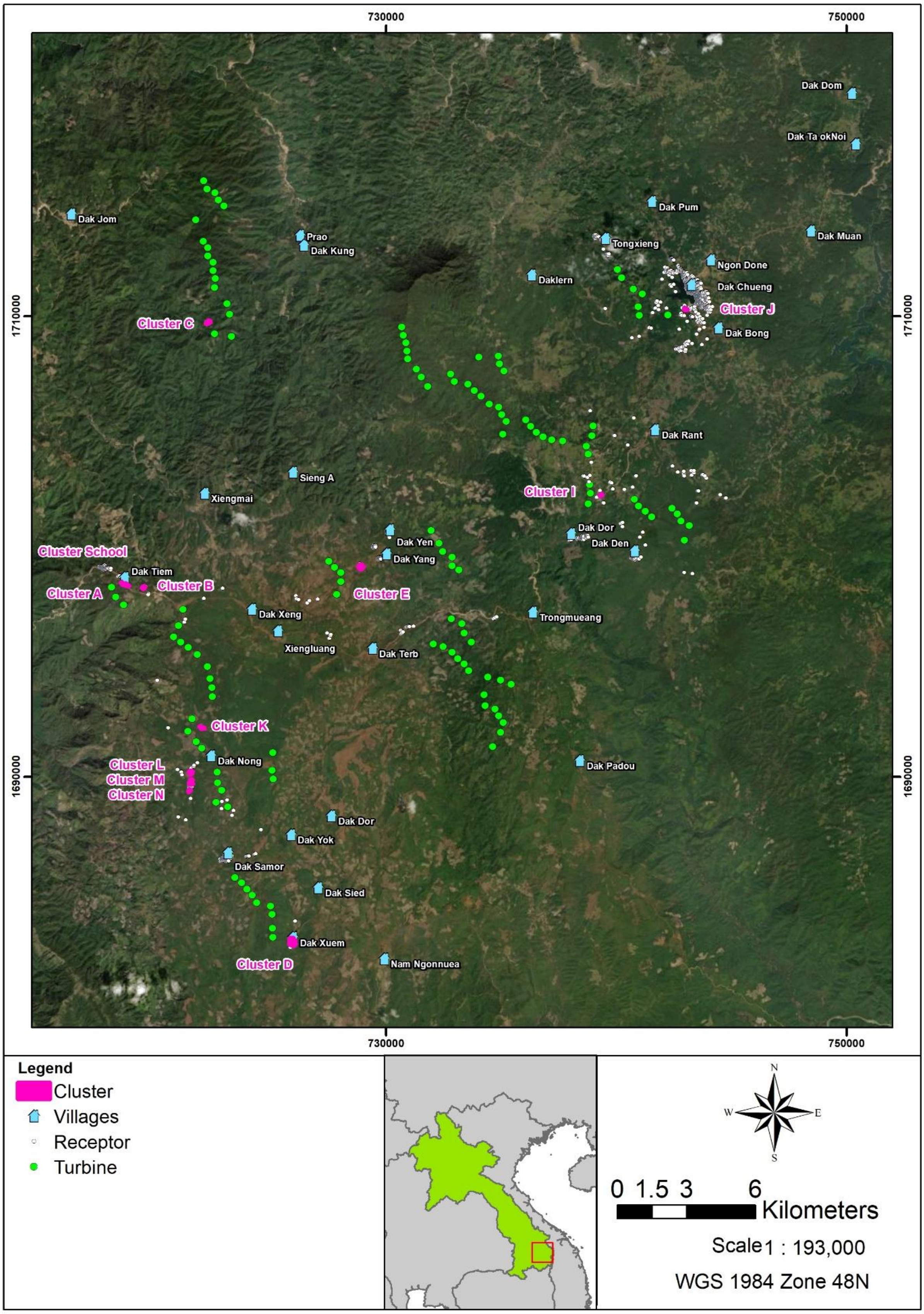
The Impact Assessment Methodology is a quantitative methodology, generated through a spreadsheet provided by a model, and backed up by professional judgement in the application of the criteria.

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, many receptors are considered to be potentially impacted by shadow flickering above international guidance levels.

Shadow flicker impacts are negative, direct and long-term during the operation phase of the Project. The impact scale is within 1,300 m of the WTGs on the receptors in the north-northwest of the WTGs. Impact magnitude varies based on the distance of receptors from the WTGs and their orientation.

Based on the modelling results, it should be noted that the shadow flickering occurrence is limited to 12 clusters of potentially affected receptors (***Figure 9.43***).

Figure 9.43: Cluster Locations



Some general considerations are provided, based on the outcomes of the field photo survey, that can prevent/reduce shadow flickering once the Project is in operation:

- A majority of receptors were observed to have no windows facing the shadow direction of the turbines.
- Most of the typical houses are equipped with awnings.
- There are existing natural barriers (i.e., forest, vegetation patches) surrounding the receptors.

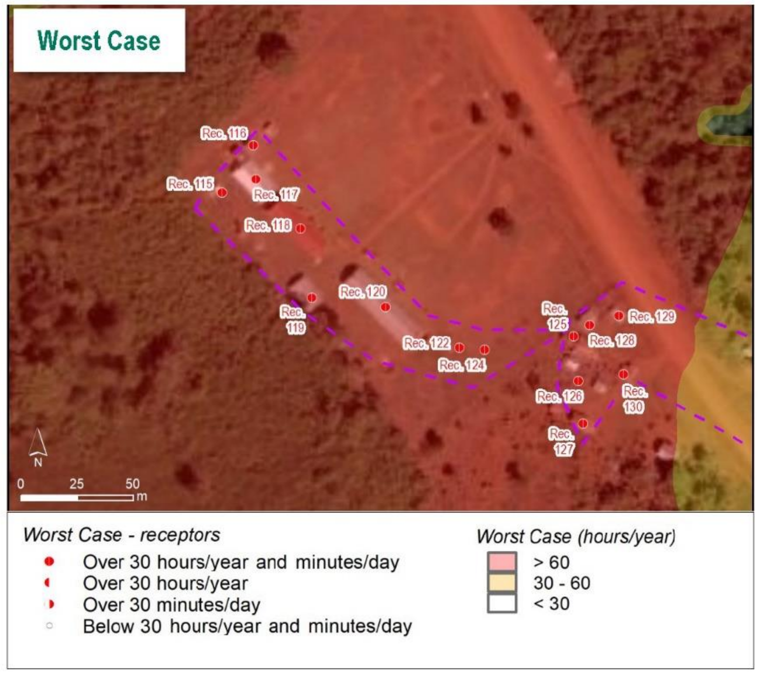
As outlined above, the real case is still affected by conservative results. Specific considerations were made within each cluster, and the results can be viewed in the graphic sheets presented below.

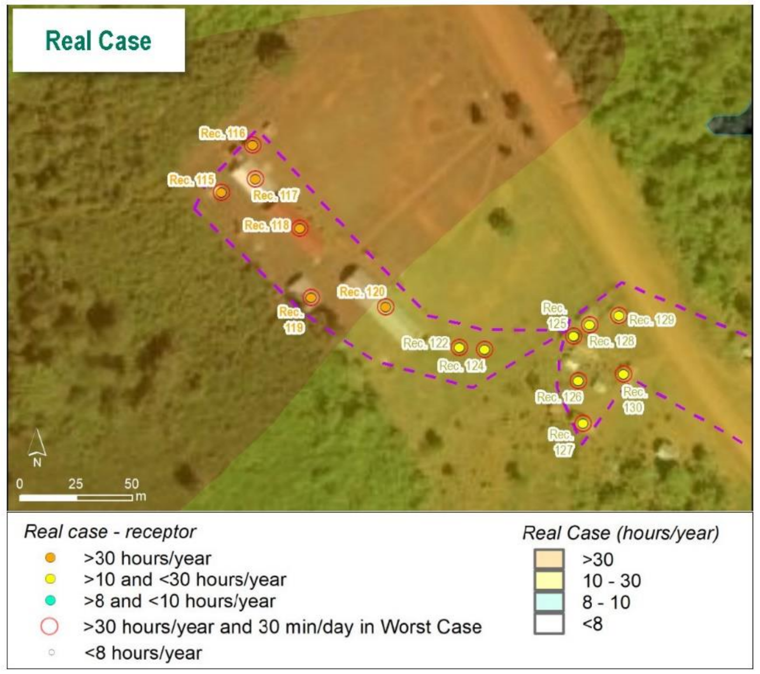
The graphic sheets are organized as presented in ***Figure 9.44***:

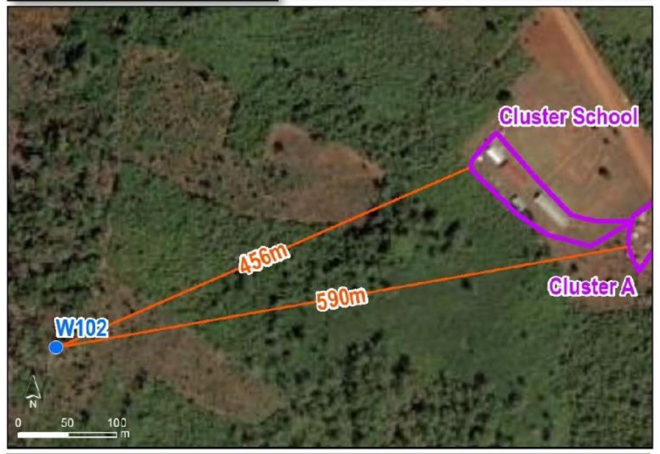
1. Cluster location;
2. Cluster name;
3. Distance and positioning of the turbine with respect to the cluster on which it impacts;
4. Turbine calendar telling when (hours, days and months) the flickering problems may occur (worst case);
5. Worst case cluster map;
6. Real case cluster map;
7. Assumptions;
8. Considerations;
9. Photos of some receptors of the cluster.

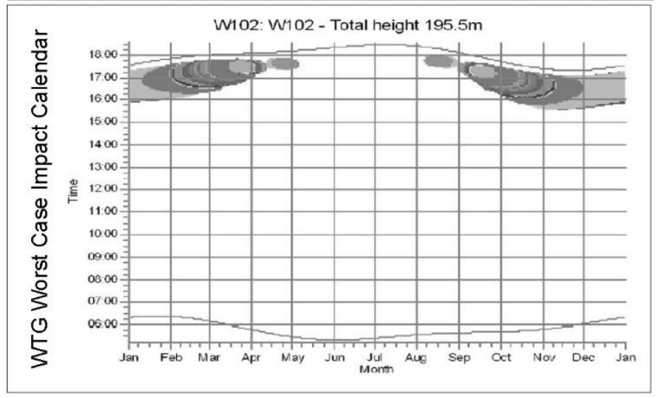
Figure 9.44: Legend of Cluster Graphic Sheets

Figure 9.45: Shadow Flicker Results – Cluster: School









<u>Assumptions:</u>

⇒ Shadow receptors are modelled using the greenhouse mode *(each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

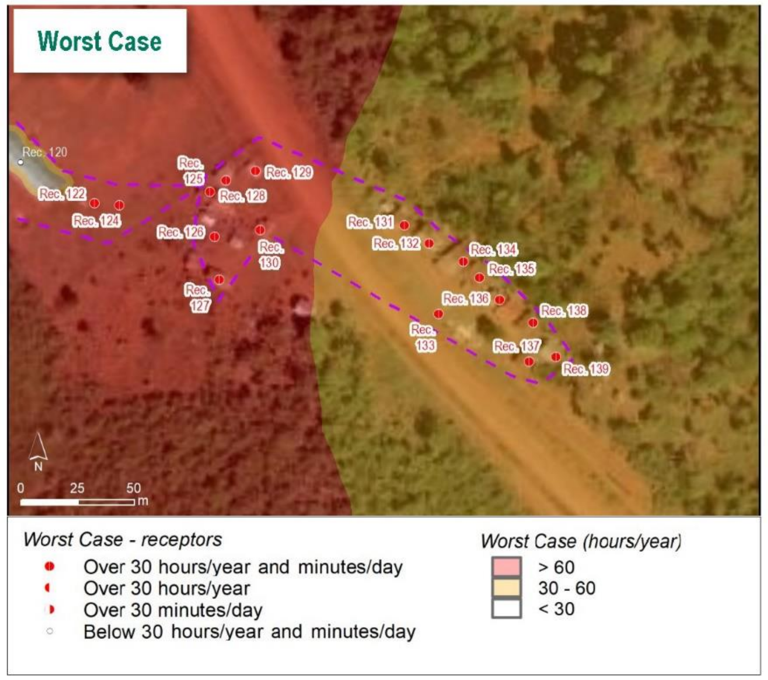
<u>Considerations:</u>

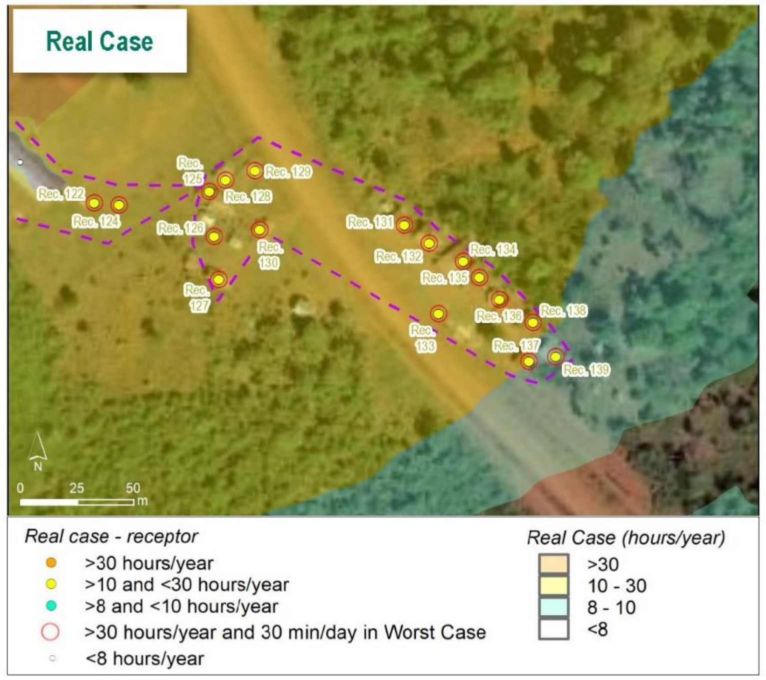
The potential impact will occur in a limited time frame from 4:00 pm to 6:00 pm from September through mid-April

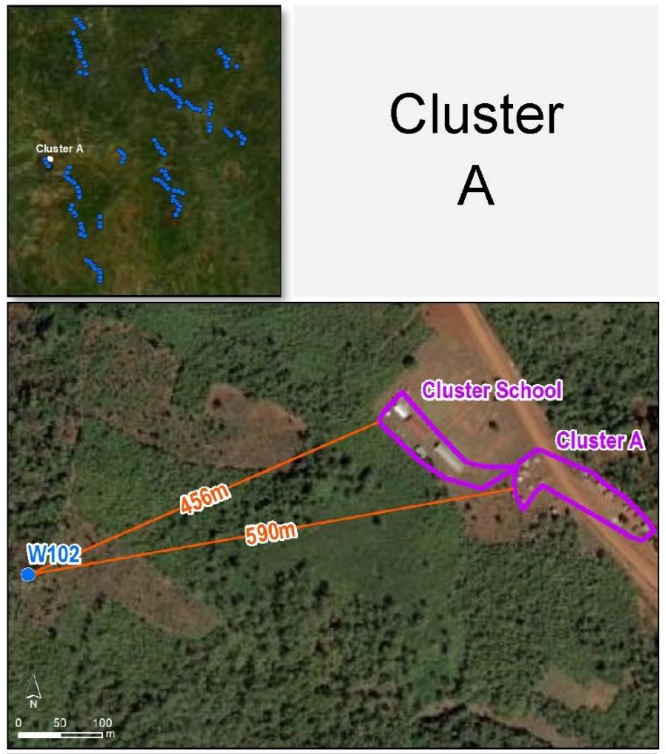
The receptors were observed to have windows facing the shadow direction of the turbines, but there were also existing natural barriers observed in the form of trees covering the receptor group area, which may reduce the impact.

Environmental and Social Impact Assessment – Shadow Flicker Component ERM

Figure 9.46: Shadow Flicker Results – Cluster: A







Assumptions:

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions*)

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

Considerations:

The potential impact will occur in a limited time frame from 4:00 pm to 6:00 pm from September through mid-April

Some of the receptors observed not to have windows facing the shadow direction of the turbines (e.g. photo 3).

Even if the houses is observed to have windows, the shadow flicker impact should not be a concern for the house is equipped with awning or a sloping roof sheltering (e.g. rec 127)

ddd

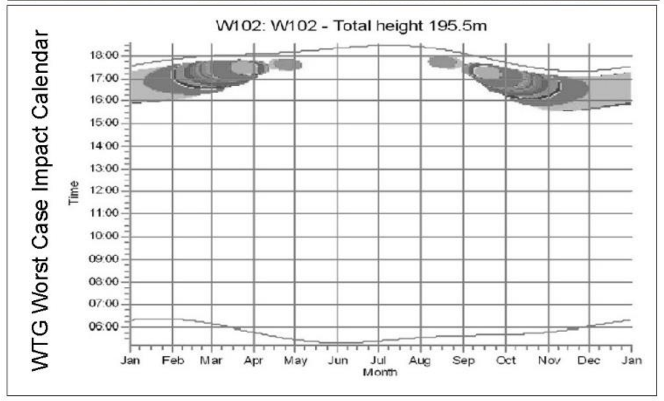


Figure 9.47: Shadow Flicker Results – Cluster: B

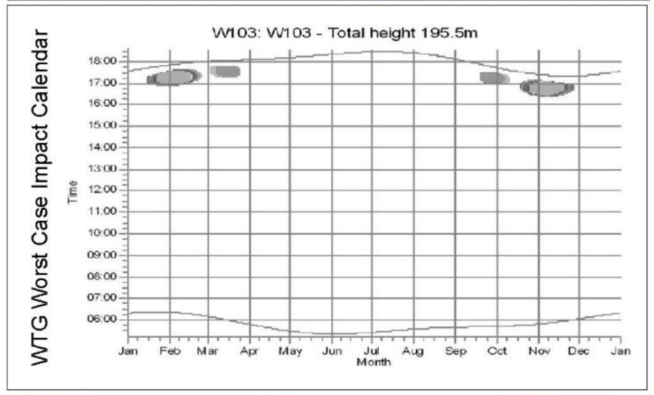
Worst Case - receptors
- Over 30 hours/year and minutes/day
- Over 30 hours/year
- Over 30 minutes/day
- Below 30 hours/year and minutes/day

Worst Case (hours/year)
- > 60
- 30 - 60
- < 30

Real case - receptor
- >30 hours/year
- >10 and <30 hours/year
- >8 and <10 hours/year
- >30 hours/year and 30 min/day in Worst Case
- <8 hours/year

Real Case (hours/year)
- >30
- 10 - 30
- 8 - 10
- <8

Cluster
B



<u>Assumptions:</u>

⇒ Shadow receptors are modelled using the greenhouse mode *(each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

<u>Considerations:</u>

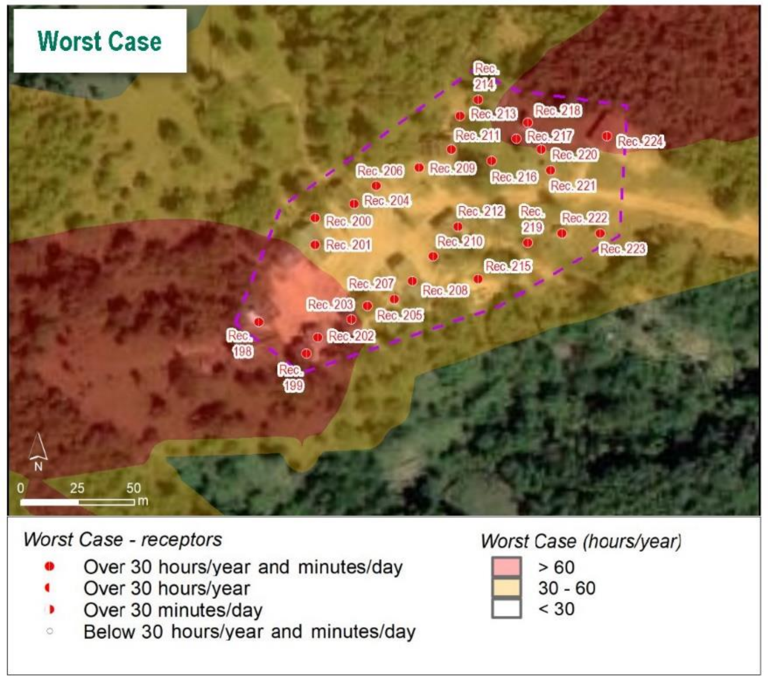
The potential impact will occur in a limited time frame from 4:30 pm to 6:30 pm in January, February, March, October and November

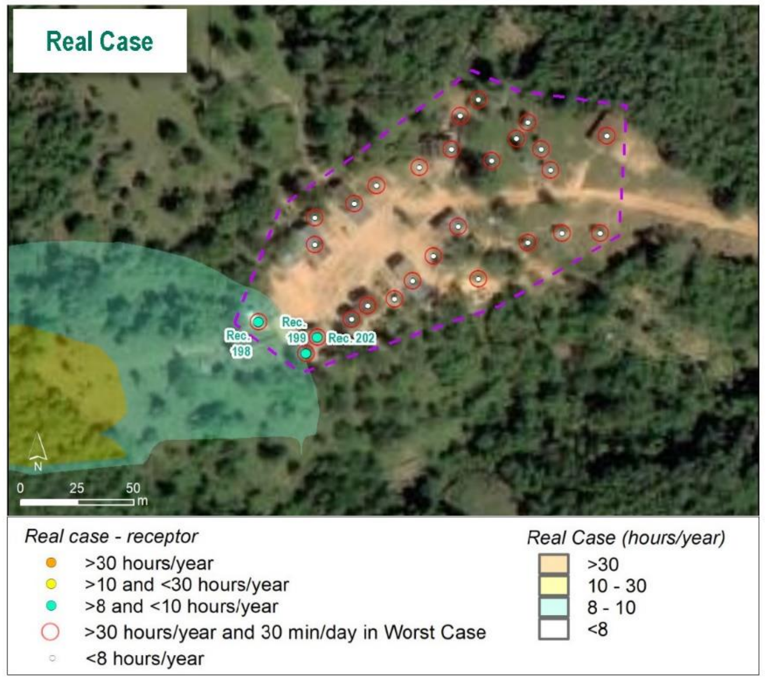
There were many natural barriers in the form of trees covering the receptors group area which is considered to be able to reduce the impact.

Even if the houses is observed to have windows, the shadow flicker impact should not be a concern for the house is equipped with awning or a sloping roof sheltering

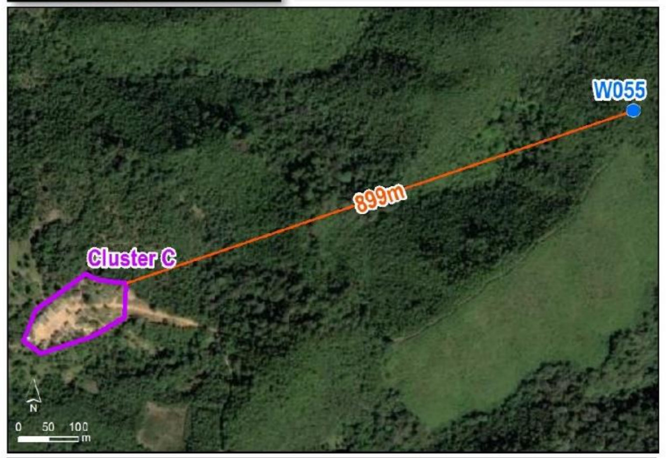
Environmental and Social Impact Assessment – Shadow Flicker Component

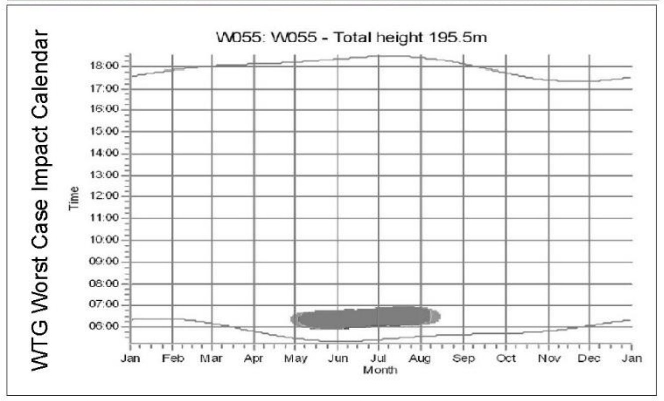
Figure 9.48: Shadow Flicker Results – Cluster: C





Cluster C





Assumptions:

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

Considerations:

The potential impact will occur in a limited time frame from 6:00 am to 7:00 am from May through mid-August

There were many natural barriers in the form of trees covering the receptors group area which is considered to be able to reduce the impact.

Even if the houses is observed to have windows, the shadow flicker impact should not be a concern for the house is equipped with awning or a sloping roof sheltering

Rec. 205

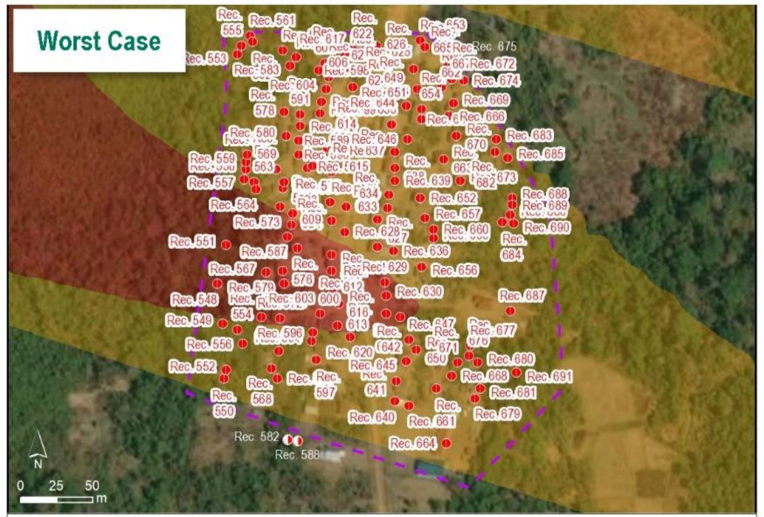
Rec. 208

View 1

View 2

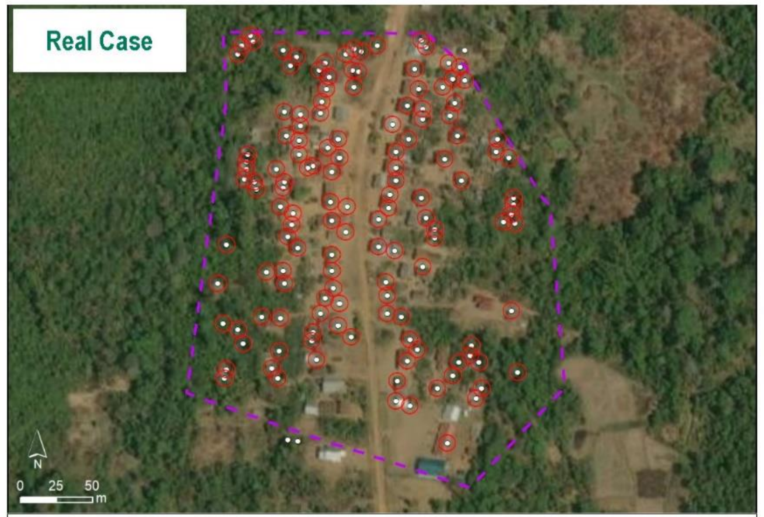
Environmental and Social Impact Assessment – Shadow Flicker Component

Figure 9.49: Shadow Flicker Results – Cluster: D



Worst Case - receptors
- Over 30 hours/year and minutes/day
- Over 30 hours/year
- Over 30 minutes/day
- Below 30 hours/year and minutes/day

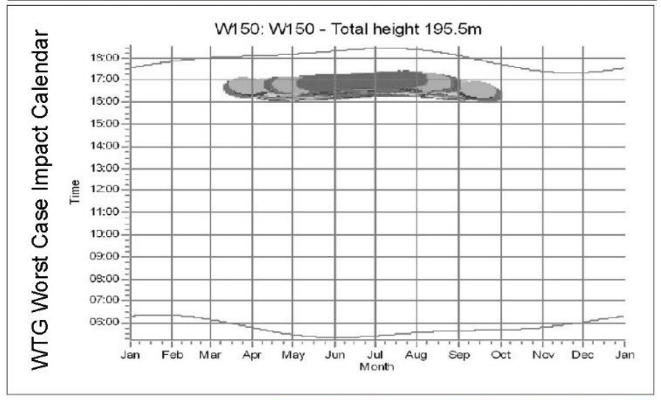
Worst Case (hours/year)
- > 60
- 30 - 60
- < 30



Real case - receptor
- >30 hours/year
- >10 and <30 hours/year
- >8 and <10 hours/year
- >30 hours/year and 30 min/day in Worst Case
- <8 hours/year

Real Case (hours/year)
- >30
- 10 - 30
- 8 - 10
- <8

Cluster
D



<u>Assumptions:</u>

⇒ Shadow receptors are modelled using the greenhouse mode *(each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

<u>Considerations:</u>

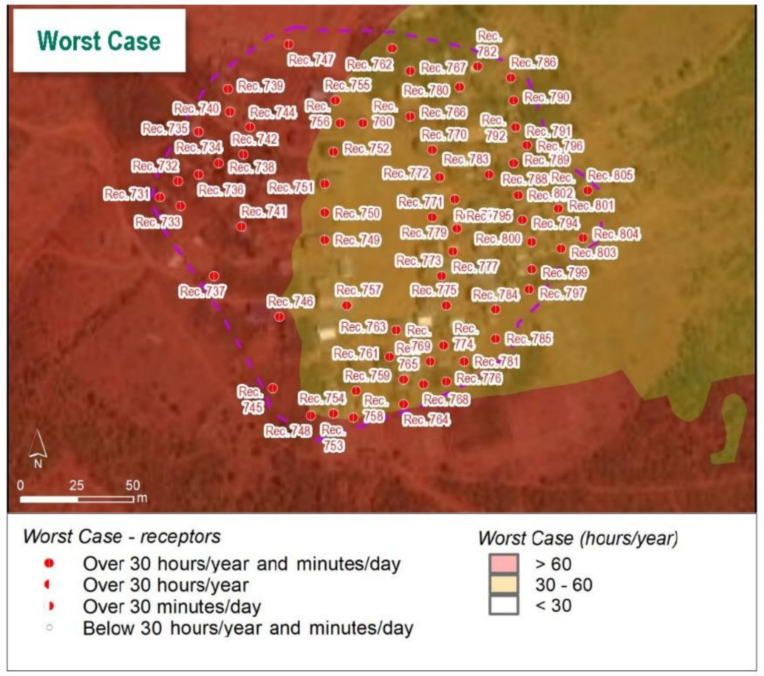
The potential impact will occur in a limited time frame from 4:00 pm to 5:30 pm from March to the end of September

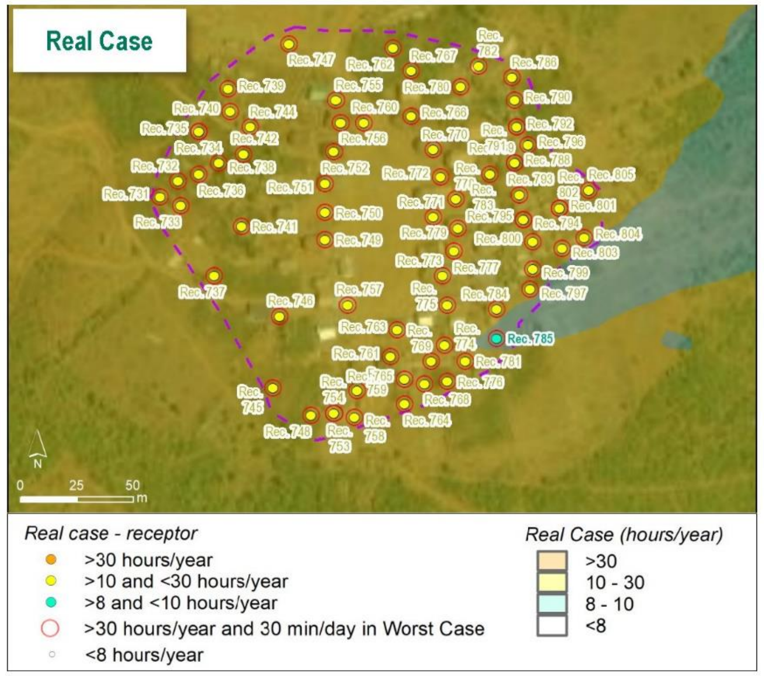
There were many natural barriers in the form of trees covering the receptors group area which is considered to be able to reduce the impact.

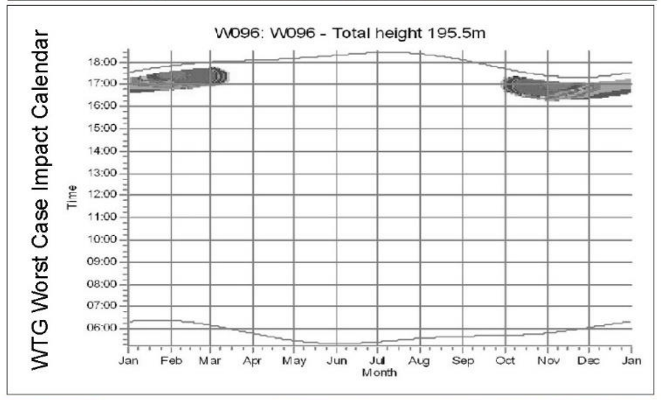
Moreover the houses are close to each other creating barriers that reduce shadows and the houses are equipped with a sloping roof sheltering

Environmental and Social Impact Assessment – Shadow Flicker Component

Figure 9.50: Shadow Flicker Results – Cluster: E







<u>Assumptions:</u>

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions*)

⇒ Natural vegetation screening or presence of physical barriers is not considered (*e.g. the nearby building*)

⇒ Rotor is not turning off for low winds or high winds (*e.g. Monsoon period*)

so the results value are very conservative and can be seen as a worst-case scenario.

<u>Considerations:</u>

The potential impact will occur in a limited time frame from 4:30 pm to 6:00 pm from October to mid-March

The shadow flicker impact should not be a concern for the house is equipped with awning or a sloping roof sheltering (e.g. Rec. 761)

Houses are close to each other, which creates barriers that reduce shadows on hidden receptors

Environmental and Social Impact Assessment – Shadow Flicker Component

Figure 9.51: Shadow Flicker Results – Cluster: I

Worst Case

Worst Case - receptors
- Over 30 hours/year and minutes/day
- Over 30 hours/year
- Over 30 minutes/day
- Below 30 hours/year and minutes/day

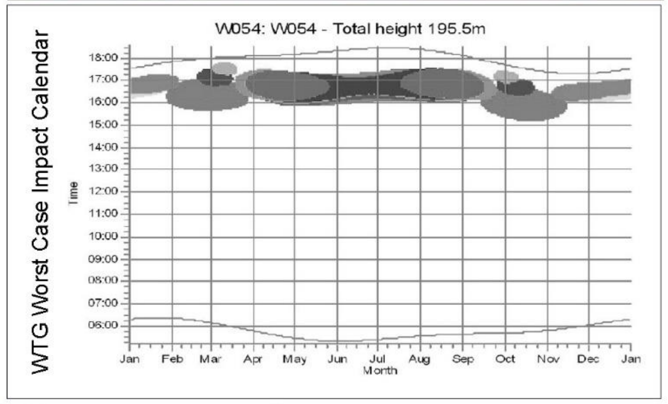
Worst Case (hours/year)
- > 60
- 30 - 60
- < 30

Real Case

Real case - receptor
- >30 hours/year
- >10 and <30 hours/year
- >8 and <10 hours/year
- >30 hours/year and 30 min/day in Worst Case
- <8 hours/year

Real Case (hours/year)
- >30
- 10 - 30
- 8 - 10
- <8

Cluster
I



Assumptions:

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

Considerations:

The potential impact will occur from 3:00 pm to 6:00 pm during all the year round

Some of the receptors observed not to have windows facing the shadow direction of the turbines
The shadow flicker impact should not be a concern for the house is equipped with awning or a sloping roof sheltering (e.g. Rec. 1267)

Houses are close to each other creating barriers that reduce shadows on hidden receptors. There were also observed existing natural barriers in the form of trees covering the receptor group area which is considered to be able to reduce the impact

Rec. 1267

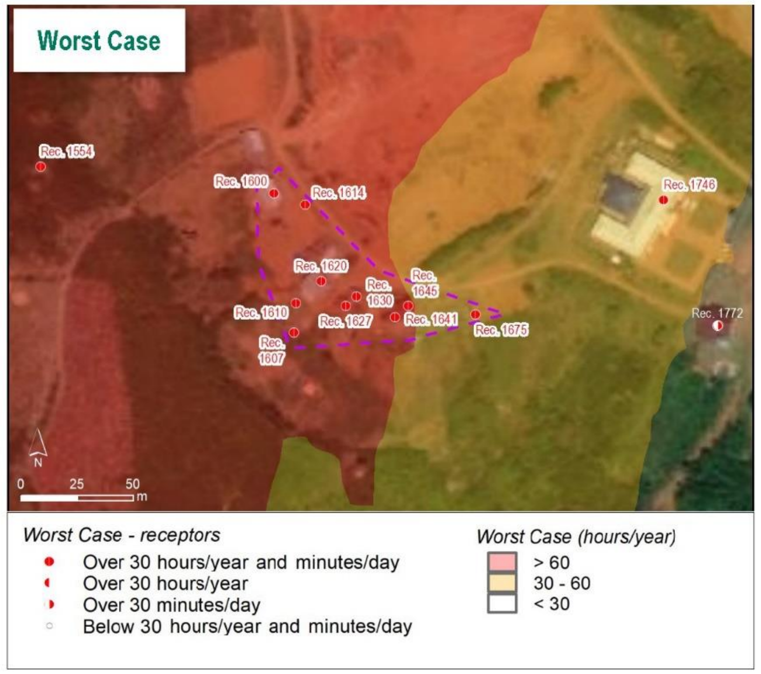
Rec. 1269

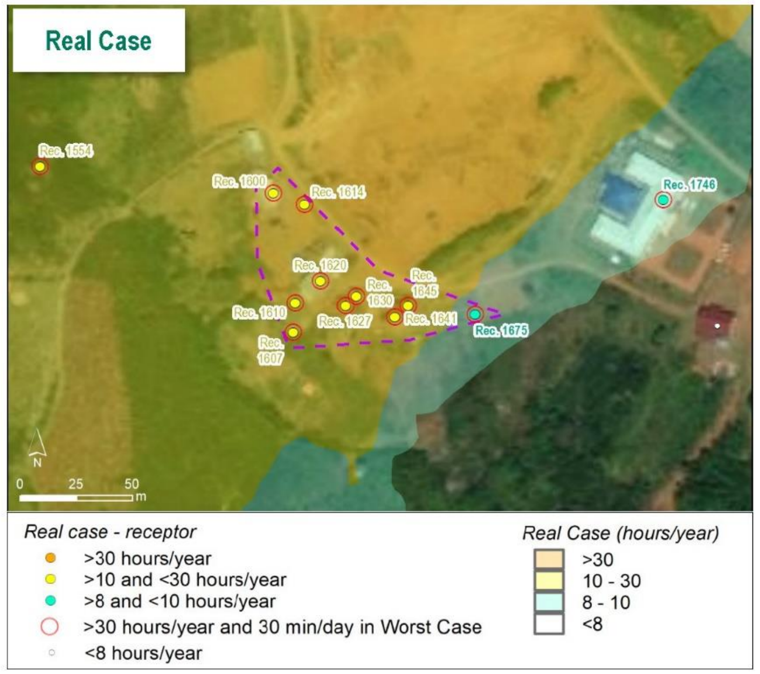
Rec. 1272

Rec. 1280

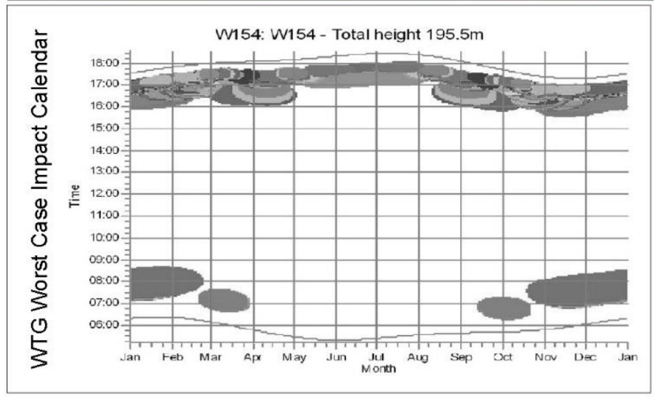
Environmental and Social Impact Assessment – Shadow Flicker Component

Figure 9.52: Shadow Flicker Results – Cluster: J





Cluster J



<u>Assumptions:</u>

⇒ Shadow receptors are modelled using the greenhouse mode *(each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

<u>Considerations:</u>

The potential impact will occur from 3:30 pm to 6:00 pm during all the year round and from 6:00 am to 9:00 am from mid-Septembre to April

Some of the receptors observed not to have windows facing the shadow direction of the turbines
The shadow flicker impact should not be a concern for the house is equipped with awning or a sloping roof sheltering (e.g. Rec. 1600)


Rec. 1600


Rec. 1645

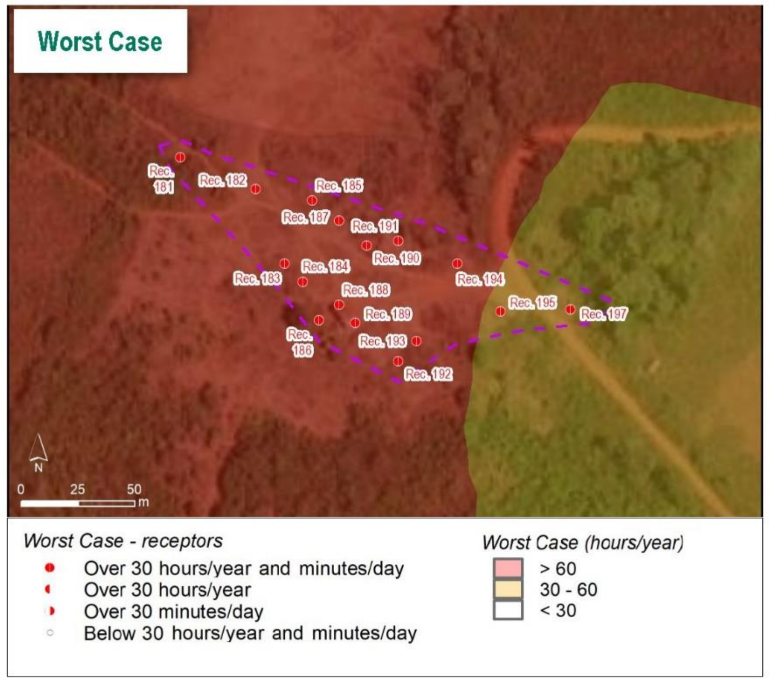

View 1

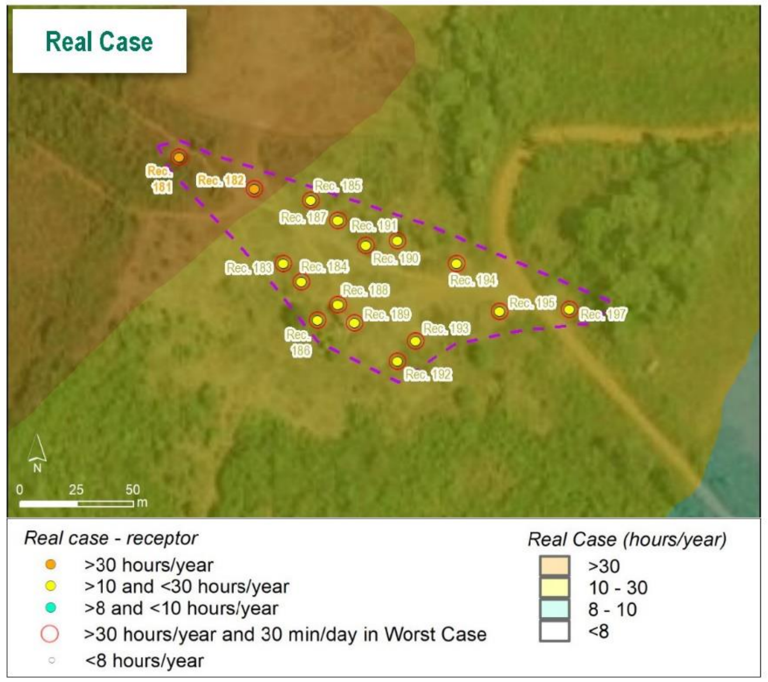

View 2

Environmental and Social Impact Assessment – Shadow Flicker Component

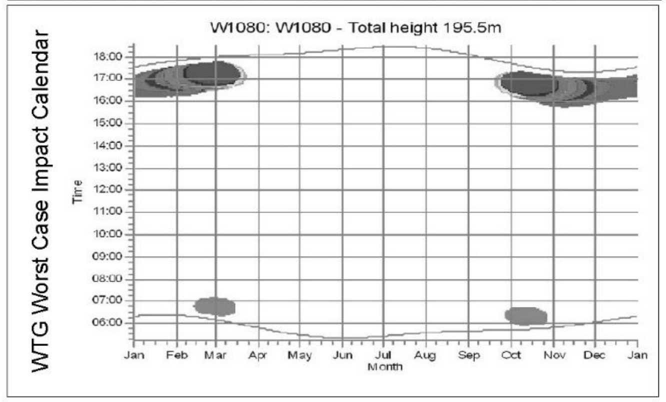
ERM

Figure 9.53: Shadow Flicker Results – Cluster: K





Cluster
K



Assumptions:

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

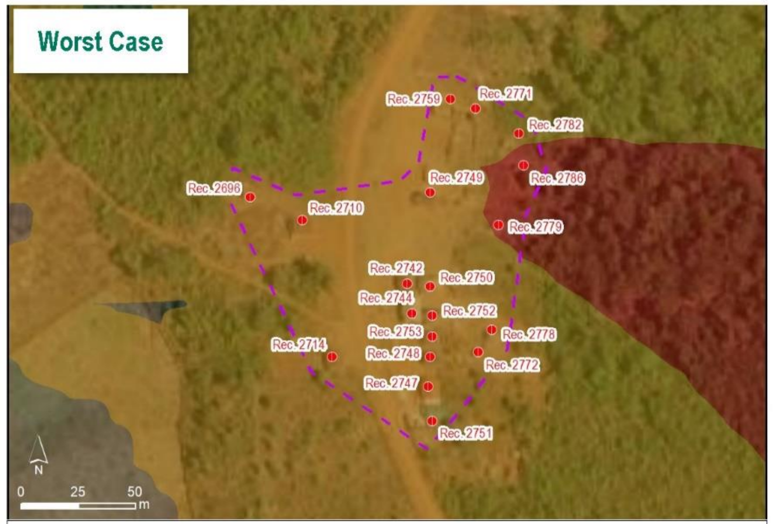
so the results value are very conservative and can be seen as a worst-case scenario.

Considerations:

The potential impact will occur from 3:30 pm to 6:00 pm from October to April and from 6:00 am to 7:00 am in February, March and October

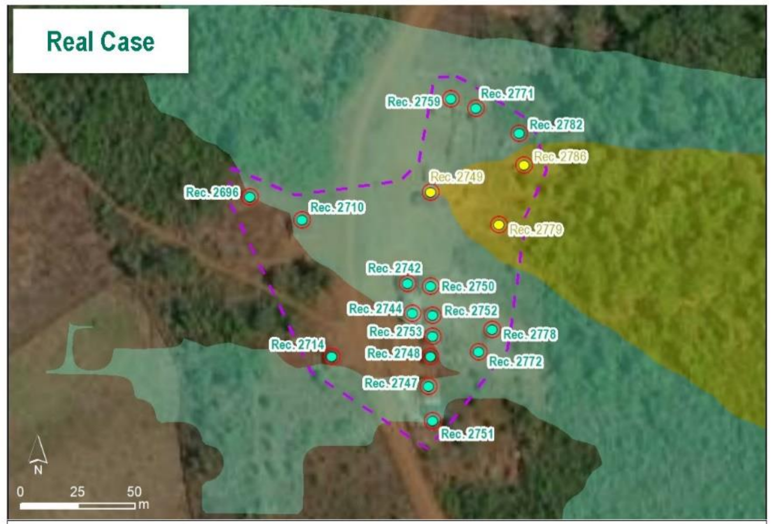
-	-	-	-
not surveyed	not surveyed	not surveyed	not surveyed

Figure 9.54: Shadow Flicker Results – Cluster: L



Worst Case - receptors
- Over 30 hours/year and minutes/day
- Over 30 hours/year
- Over 30 minutes/day
- Below 30 hours/year and minutes/day

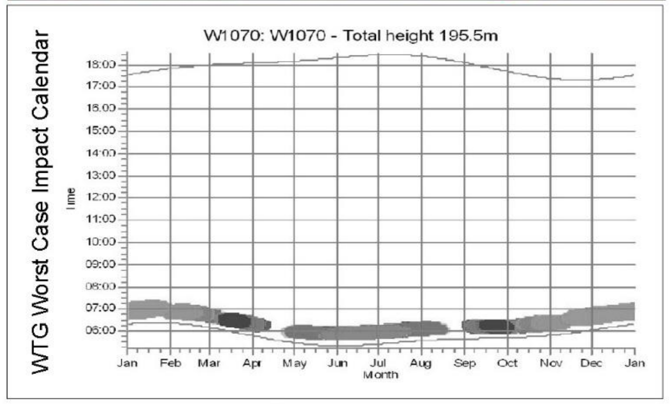
Worst Case (hours/year)
- > 60
- 30 - 60
- < 30



Real case - receptor
- >30 hours/year
- >10 and <30 hours/year
- >8 and <10 hours/year
- >30 hours/year and 30 min/day in Worst Case
- <8 hours/year

Real Case (hours/year)
- >30
- 10 - 30
- 8 - 10
- <8

Cluster
L



Assumptions:

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

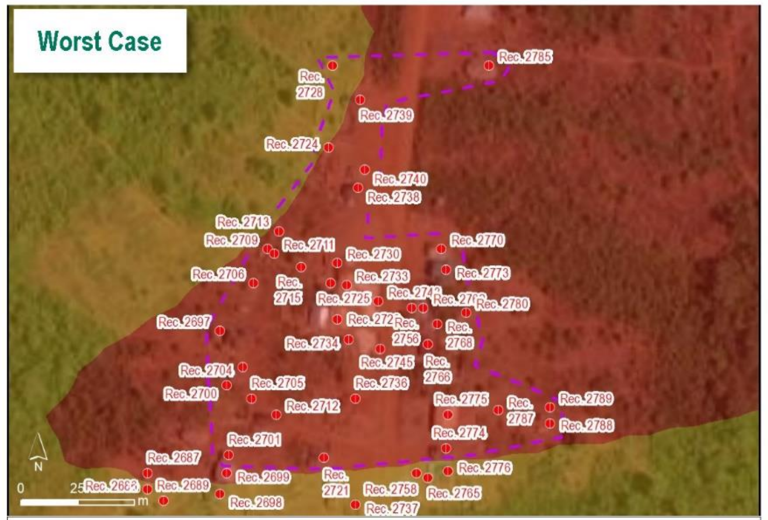
Considerations:

The potential impact will occur from 6:00 am to 7:30 am during all year round

- - - -

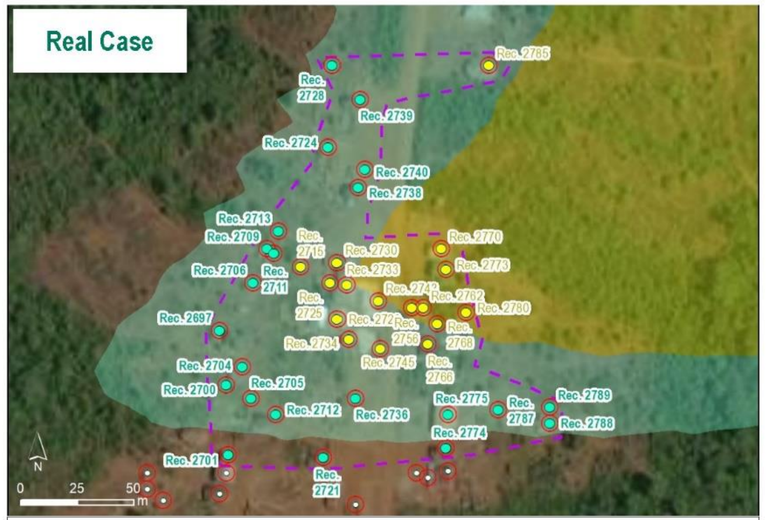
not surveyed not surveyed not surveyed not surveyed

Figure 9.55: Shadow Flicker Results – Cluster: M



Worst Case - receptors
- Over 30 hours/year and minutes/day
- Over 30 hours/year
- Over 30 minutes/day
- Below 30 hours/year and minutes/day

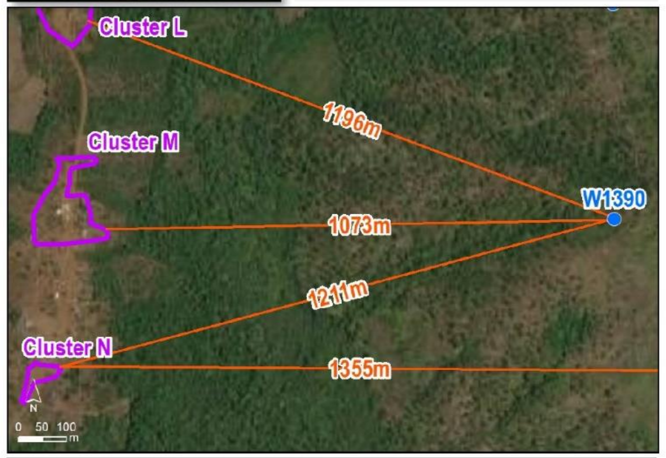
Worst Case (hours/year)
- > 60
- 30 - 60
- < 30

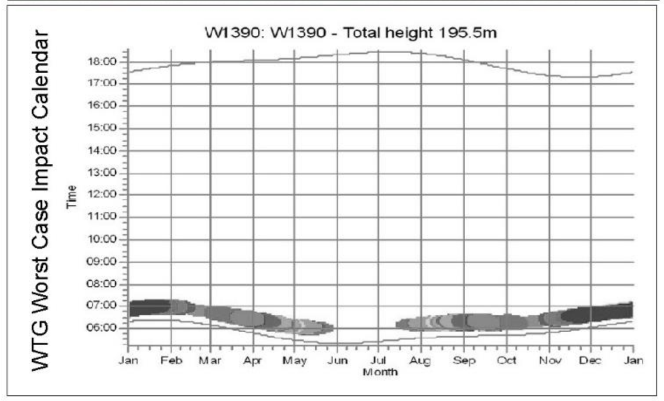


Real case - receptor
- >30 hours/year
- >10 and <30 hours/year
- >8 and <10 hours/year
- >30 hours/year and 30 min/day in Worst Case
- <8 hours/year

Real Case (hours/year)
- >30
- 10 - 30
- 8 - 10
- <8

Cluster
M





Assumptions:

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

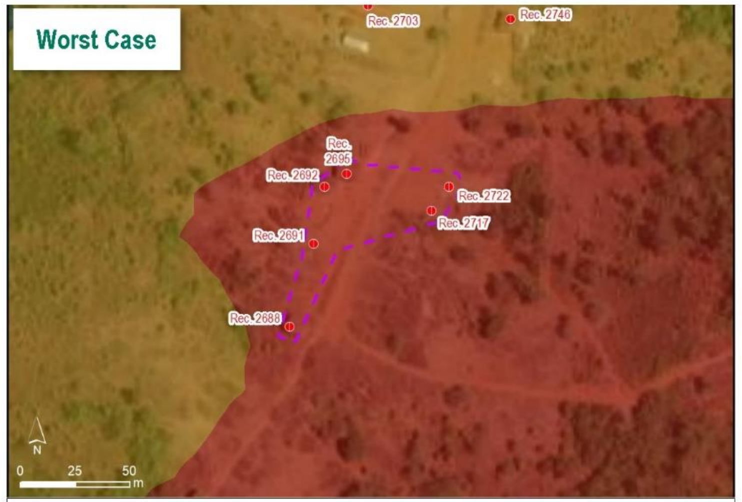
Considerations:

The potential impact will occur from 6:00 am to 7:30 am from mid-July to the end of May

- - - -

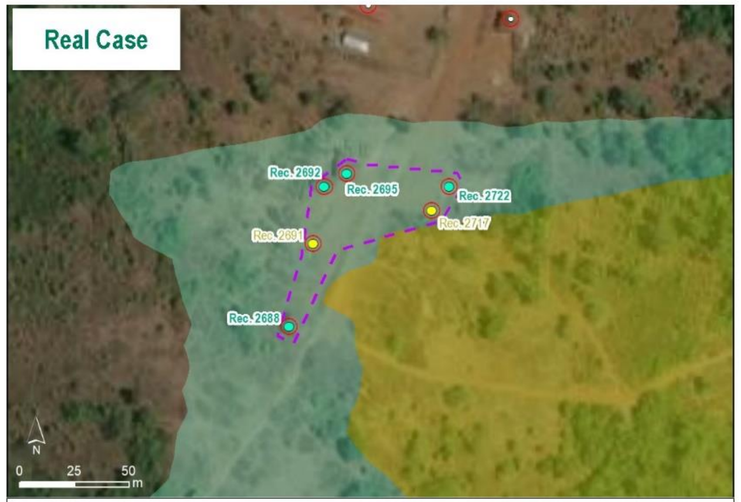
not surveyed not surveyed not surveyed not surveyed

Figure 9.56: Shadow Flicker Results – Cluster: N



Worst Case - receptors
- Over 30 hours/year and minutes/day
- Over 30 hours/year
- Over 30 minutes/day
- Below 30 hours/year and minutes/day

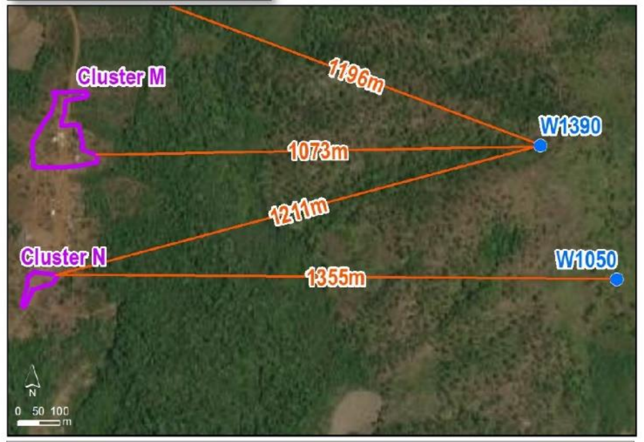
Worst Case (hours/year)
- > 60
- 30 - 60
- < 30

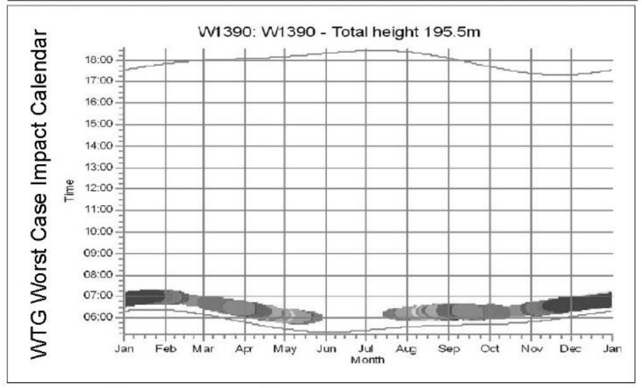


Real case - receptor
- >30 hours/year
- >10 and <30 hours/year
- >8 and <10 hours/year
- >30 hours/year and 30 min/day in Worst Case
- <8 hours/year

Real Case (hours/year)
- >30
- 10 - 30
- 8 - 10
- <8

Cluster
N





<u>Assumptions:</u>

⇒ Shadow receptors are modelled using the greenhouse mode (*each receptor will face all directions)*

⇒ Natural vegetation screening or presence of physical barriers is not considered *(e.g. the nearby building)*

⇒ Rotor is not turning off for low winds or high winds *(e.g. Monsoon period)*

so the results value are very conservative and can be seen as a worst-case scenario.

<u>Considerations:</u>

The potential impact will occur from 6:00 am to 7:30 am from mid-July to the end of May

-	-	-	-
not surveyed	not surveyed	not surveyed	not surveyed

Receptor Sensitivity and Impact Magnitude

Based on the modeling results and the photographic field survey, the sensitivity of the 12 clusters is estimated as shown in ***Table 9.39***. The overall impact significance is negligible to moderate depending on the cluster (based on real case scenario).

Table 9.39: Cluster Sensitivity and Magnitude

Cluster	Sensitivity	Magnitude	Impact Significance
School	Low - Medium	Small	Minor
A	Medium	Small - Medium	Moderate
B	Medium	Small	Minor
C	Medium	Negligible	Negligible
D	Medium	Negligible	Negligible
E	Medium	Small - Medium	Moderate
I	Medium	Small - Medium	Minor
J	Medium	Small - Medium	Moderate
K	Medium	Small - Medium	Moderate
L	Medium	Small	Minor
M	Medium	Small	Minor
N	Medium	Small	Minor

9.3.8.5 Additional Mitigation, Management, and Monitoring Measures

- All structures within the 12 clusters have to be verified on the ground and

A) Categorize based on the following: (a) abandoned and non-existent (b) sensitive non-residential (e.g., schools), (c) other non-residential; (d) residential receptors.

B) Assess each structure orientation relative to the WTGs will also be noted (e.g., windows facing the WTG direction).

C) Interview occupants on their usage pattern and also note if they understand what shadow flicker is. These data will help refine the input to the shadow detection system that will be the main mitigating measure for the project. They should also be informed on the potential impacts and mitigation measures as part of the consultation and disclosure activities.

The proposed project went through a process to design the layout including aspect related to potential shadow flickering occurrence. It is envisaged that once the executive project will be developed, a final run of the model will be performed and a detailed survey will be organized in order to identify the potential most critical receptors, taking into account local specific receptor settings (such as the mutual position of buildings that can limit the occurrence of shadow flickering, the presence of vegetation barriers, window orientation etc)The outcome of the field survey will allow a proper development of dedicated grievance mechanism and reporting system able to monitor closely through engagement with residents during the operational phase, where there are predicted impacts from shadow flickers for locations that have been finalized by the project proponent and earmarked for construction.Based on the type of grievances that will be collected, specific on-site verification of the occurrence of shadow flickering will be managed and tailored mitigation measures will be adopted as follow:

- Visual Screening (Natural) – Continuously assess identified and any potentially sensitive receptors, where shadow flicker modelling indicates the amount could exceed 30 hours per year and 30 minutes per day, to ascertain the extent of existing natural visual screening in place. If not existing, the occurrence of shadow flickering during operation could be further investigated, and if confirmed, natural screening could be implemented to minimize the effect.

- Visual Screening (Architectural/Structural) - If grievances will be received or if natural visual screening at potentially 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.
- Control - Use of turbine control strategies which shut down turbines when shadow flicker is likely to occur.To conduct a more detailed survey for the potentially impacted receptors in order to evaluate a reduction in terms of numbers and evaluate the shadow detection system mitigation measures input

9.3.8.6 Residual Impact Significance

The mitigation measures above will be implemented for identified receptors that experience shadow flicker. Residual impacts following the implementation of these mitigation measures will reduce to **Minor** (***Table 9.40***).

Table 9.40: Impact of Shadow Flicker (Operation)

Significance of Impact					
Impact	Shadow flicker impacts during construction and operation.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts from shadow flicker would be considered to be negative				
Impact Type	**Direct**	Indirect	Induced		
	Impacts would be direct				
Impact Duration	**Temporary**	Short-term	**Long-term**	**Permanent**	
	Only a certain times under right conditions				
Impact Extent	**Local**	Regional	International		
	The impact will only be localized within the Area of Influence of the Project.				
Impact Scale	Impact scale is considered localized and small.				
Frequency	Impacts could occur during the operation phase.				
Impact Magnitude	Positive	**Negligible**	**Small**	**Medium**	Large
	Based on the characteristic above, the impact is likely to be at worst case medium, depending on the receptor.				
Receptor Sensitivity	**Low**	**Medium**	High		
	The sensitivity is considered to be at worst case Medium, depending on the receptor.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	Cluster A, E, J and K are moderate (based on real case scenario).				
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium	
Residual Magnitude Significance	Negligible	**Minor**	Moderate	Major	
	Upon considering the mitigation measure, the residual impact is assessed to be Minor.				

9.4 Biological Environment Impact Assessment

9.4.1 Introduction

Renewable energy projects such wind farms play an important role in moving towards a more sustainable energy sector that can assist with combating the negative impacts of non-renewable energy on global climate (Bennun *et al.,* 2021). However, these 'clean' energy projects can also result in unintended negative impacts and consequences to the environment unless carefully planned and managed. This includes risks and potential impacts to biodiversity, which underpins the resilience and functions of ecosystems and the flow of ecosystem goods and services (Bennun *et al.,* 2021).

Biodiversity impact assessment is the process of determining the types and significance of effects a project will have on biodiversity, and the various components thereof, and is the core of the ESIA process (Hardner *et al*., 2015). Risks and impacts to biodiversity typically vary according to the project being assessed as well as the context of the receiving environment where the project is located. The biodiversity impact assessment that follows has been undertaken specifically for the Monsoon WF project located in Lao PDR.

9.4.2 Approach & Methods

The approach to the assessment of biodiversity impacts was as follows:

Step 1: Defining the AoI

The Area of Influence (AoI) for the project was defined to include the development footprint and any temporary works infrastructure, operational activities and infrastructure, any offsite facilities (borrow areas for example) as well as areas beyond the immediate area of effect that could be subjected to indirect impacts (e.g. emissions, noise, water quality issues, etc.).

Step 2: Identification of key ecological receptors and describe biodiversity values

Once the AoI had been defined, the biodiversity 'values' (*also termed biodiversity 'features' or 'attributes'*) and ecological sensitivity of the various environmental receptors were identified (i.e. relates back to key habitats and species identified in the baseline biodiversity assessment).

Step 3: Identification of impacts to biodiversity

Potential project impacts to the key ecological receptors and important biodiversity were identified, including site-specific direct, indirect and induced impacts to biodiversity. The following guidelines were also referred to in identifying and describing biodiversity impacts:

- "Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning" (Hardner et al., 2015[1]); and
- "Mitigating biodiversity impacts associated with solar and wind energy development: Guidelines for project developers" (Bennun et al., 2021[2]).

Step 4: Assessment of impact significance

Biodiversity impact significance is the product of the value or importance of the biodiversity components that will be impacted and the intensity or magnitude (degree and extent of change) of the impact on those resources, systems and/or components. Some regulators, lenders, or corporate standards will use the term "significant" to refer to a threshold of consequence and/or risk that requires management

[1] Hardner, J., R.E. Gullison, S. Anstee, M. Meyer. (2015). Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning. Prepared for the Multilateral Financing Institutions Biodiversity Working Group. Available online at: https://publications.iadb.org/publications/english/document/Good-Practices-for-Biodiversity-Inclusive-Impact-Assessment-and-Management-Planning.pdf

[2] Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., Carbone, G. (2021). Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy. Available online at: https://portals.iucn.org/library/sites/library/files/documents/2021-004-En.pdf

or may not be acceptable. The approach to impact significance assessment is based on the traditional risk assessment formula which rates the **magnitude of effect** as the realistic 'worst-case' consequence or end-point of a project activity based on the perceived **importance and/or sensitivity** of a particular environmental receptor. Separate assessment matrices for habitat and species have been used for the assessment of impact significance, and these are contained in ***Table 9.41*** and ***Table 9.42***, respectively.

Table 9.41: Matrix Used to Rate Impact Significance Criteria for Habitat

Habitat Importance / Sensitivity		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
Negligible	Habitats with negligible interest for biodiversity.	Insignificant	Insignificant	Insignificant	Insignificant
Low	Habitats with no or local designation / recognition; habitats of significance for species of Least Concern (LC) on IUCN RDL of Threatened Species; habitats which are common and widespread within the region, or with low conservation interest based on expert opinion.	Insignificant	Insignificant	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and / or congregatory species, and low value habitats used by species of medium value.	Insignificant	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and / or congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	Insignificant	Moderate	Major	Critical

Magnitude of Effect definitions for habitat receptors*:*

Negligible *- Effect is within the normal range of natural variation.*

Small *- Affects only a small area of habitat, such that there is no loss of viability / function of the habitat.*

Medium *- Affects a sufficient proportion of the habitat that the viability/function of part of the habitat or the entire habitat is reduced, but does not threaten the long-term viability of the habitat or species dependent on it.*

Large*- Affects the entire habitat or a significant proportion thereof, to the extent that the viability/function of the habitat is threatened.*

Table 9.42: Matrix Used to Rate Impact Significance Criteria for Species

Species Importance / Sensitivity		Magnitude of Effect			
		Negligible	Small	Medium	Large
Negligible	Species with no specific value or importance attached to them.	Insignificant	Insignificant	Insignificant	Insignificant
Low	Species and sub-species of LC on the IUCN RDL, or not meeting criteria for medium or high value.	Insignificant	Insignificant	Minor	Moderate
Medium	Species listed on IUCN RDL as VU, NT, or DD, species protected under national legislation, nationally restricted-range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	Insignificant	Minor	Moderate	Major
High	Species included on the IUCN RDL as CR or EN. Nationally or internationally important populations of Annex II or Annex IV species. Species with restricted ranges or global breeding range for birds of less than 50,000 km^2.) Internationally important concentrations of migratory and/or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	Insignificant	Moderate	Major	Critical

Magnitude of Effect definitions for species receptors:

Negligible - *Effect is within the normal range of variation for the population of the species.*

Small – *Effect does not cause a substantial change in the population of the species, or other species dependent on it.*

Medium – *Effect causes a substantial change in abundance and / or reduction in distribution of a population over one, or more generations, but does not*

threaten the long term viability / function of that population, or any population dependent on it.

Large - *Affects entire population, or a significant part of it causing a substantial decline in abundance and / or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).*

Step 5: Impact mitigation and management measures

Appropriate impact mitigation and management measures are recommended to reduce the magnitude (based on aspects that include the scale, probability and intensity of impact) and thereby reduce the significance of the impact consequence to an environmentally acceptable level where possible. The following best/good practice guidelines were referred to closely for informing impact management and the suite of mitigation measures recommended:

- "Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning" (Hardner et al., 2015);
- "Mitigating biodiversity impacts associated with solar and wind energy development: Guidelines for project developers" (Bennun et al., 2021); and

- "A cross-sector guide to implementing the Mitigation Hierarchy" (Ekstrom et al., 2015[1]).

Step 6: Assess residual impacts

The final step is to assess residual impacts, which are those impacts that are likely to persist after taking into account the mitigation and management measures recommended as part of the mitigation strategy for the project, and their likely implementation success.

9.4.3 Biodiversity Impact Assessment

9.4.3.1 Project AoI

The AoI (Area of Influence) of the WF project was considered for the construction and operational/maintenance phases of the project, and is documented in ***Table 9.43.***

The reader is also referred to ***Section 4.3*** of the ESIA for the full detailed description of project facilities and components as well as a map (***Figure 4.2***) indicating the location of the turbines, access roads, substations and transmission lines and a second map (***Figure 4.5***) showing the location of ancillary facilities (local crush stone location, batching plants, worker camps, laydown areas).

[1] Ekstrom, J., Bennun, L. and Mitchell, R. (2015). A cross-sector guide for implementing the Mitigation Hierarchy. The Biodiversity Consultancy Ltd with inputs from the IFC (International Finance Corporation). Cambridge, United Kingdom. Available online at: https://www.csbi.org.uk/wp-content/uploads/2017/10/CSBI-Mitigation-Hierarchy-Guide.pdf

Table 9.43: Defining the AoI for Construction and Operational/Maintenance Components of the Project

Project Component	Habitats	Plants	Terrestrial Fauna (volant)	Terrestrial Fauna (non-volant)	Aquatic Ecosystems	Notes
CONSTRUCTION PHASE						
Access roads	350 m	350 m	250 m	250 m	Small streams crossed	■ Several small streams crossed by planned roads
Substations	350 m	350 m	250 m	250 m	n/a	■ Based on dust emissions (350m) and likely disturbance distance of most sensitive species. ■ Based on literature such as Kwon et al. (2018[1]), there is a strong possibility that species could be disturbed by noise up to a radius of approximately 250m from the construction site, and outside of the 250m, noise level from construction should have been attenuated to background noise levels, with the exception of when piling occurs in which case which the disturbing zone could be larger
Wind Turbines	350 m	350 m	250 m	250 m	n/a	
Worker camps	350 m	350 m	250 m	250 m	n/a	
Laydown areas	350 m	350 m	250 m	250 m	n/a	
Concrete batching plants	350 m	350 m	250 m	250 m	n/a	
Crush stone locations	350 m	350 m	250 m	250 m	n/a	
Transmission lines	350 m	350 m	250 m	250 m	Streams / rivers crossed	■ Transmission line impacts to linear ecosystems such as streams/rivers are likely to be minimal.
OPERATIONAL / MAINTENANCE PHASE						
Wind Turbines	350 m	350 m	10 km	250 m	n/a	■ Adjacent areas, including protected areas and key biodiversity areas within a 10km range from the project development area (to account for potential risks to volant populations up to, due to the nature of wind farm projects and their potential avifauna collision risks
Access roads	350 m	350 m	250 m	250 m	Small streams crossed	■ Several small streams crossed by planned roads.
Transmission lines	350 m	350 m	10 km	250 m	Streams / rivers crossed	■ Transmission line impacts to linear ecosystems such as streams/rivers are likely to be minimal.

[1] Kwon, N., Song, K., Lee, H.-S., Kim, J. & Park, M. (2018). Construction Noise Risk Assessment Model Focusing on Construction Equipment. Journal of Construction Engineering and Management, vol. 144. Available online at: https://www.researchgate.net/publication/324259324_Construction_Noise_Risk_Assessment_Model_Focusing_on_Construction_Equipment

9.4.3.2 Key Receptors & Important Biodiversity

Key ecological receptors and important biodiversity linked with the AoI for the project include the various habitat types and species identified in the Baseline Biodiversity Assessment (see ***Chapter 7.4** of the ESIA*). Several medium to high sensitivity ecological receptors and important biodiversity linked with the project AoI were identified, and these are summarized in ***Table 9.44***. Critical habitats identified in the CHA (***Appendix T***) have also been included here, including their value from an ecosystem services perspective.

Table 9.44: Summary of Key Ecological Receptors and Important Biodiversity for the Project Area

Ecological value	Applicability to the Project
Species level aspects of biodiversity	
Protected/Threatened species of conservation importance : **flora**	1 globally endangered plant species: *Zingiber mellis* (EN), recorded within Montane Forest vegetation community
Protected/Threatened species of conservation importance: **fauna**[1]	Several globally threatened species of fauna have been confirmed in the study area, including CR, EN, VU, NT and DD species of birds, mammals and herpetofauna. **Birds:** 5 bird species (includes VU & NT) ■ Greater Hornbill, *Buceros bicornis* (VU) ■ Chestnut-eared Laughing thrush, *Ianthocincla konkakinhensis* (VU) ■ Black-crowned Barwing, *Actinodura sodangorum* (NT) ■ Mountain Hawk-eagle, *Nisaetus nipalensis* (NT) ■ Rufous-bellied Eagle, *Lophotriorchis kienerii* (NT) ■ Blossom-headed Parakeet, *Psittacula roseata* (NT), ■ Grey-headed Parakeet, *Psittacula finschii* (NT), ■ Red-breasted Parakeet, *P. alexandri* (NT), ■ Rufous-bellied Eagle, *Lophotriorchis kienerii* (NT), ■ Wreathed Hornbill, *Rhyticeros undulatus* (VU), and ■ Yellow-billed Nuthatch, *Sitta solangiae* (NT). **Mammals:** 11 mammal species (includes CR, EN & VU) ■ Bengal Slow Loris, *Nycticebus bengalensis* (EN) ■ Pygmy Slow Loris, *Nycticebus pygmaeus* (EN) ■ Northern Buff-cheeked gibbon, *Nomascus annamensis* (EN) ■ Northern Pig-tailed Macaque, *Macaca leionina* (VU) ■ Red-shanked Douc Langur, *Pygathrix nemaeus* (CR)Chinese Pangolin, *Manis pentadactyla* (CR)

[1] For the detailed rationale as to why certain species have or have not been considered in the Critical Habitat Assessment see Appendix A and B of the Critical Habitat Assessment (***Appendix T***)

Ecological value	Applicability to the Project
	■ Sunda Pangolin, *Manis javanica* (CR) ■ Owston's Civet, *Chrotogale owstoni* (EN) ■ Large-antlered Muntjac, *Muntiacus vuquangensis* (CR) ■ Annamite Striped Rabbit, *Nesolagus timminsi* (EN) ■ Silver Langur, *Trachypithecus spec.* (EN) ■ Smooth-coated Otter (Lutrogale perspicillata (VU) ■ Asiatic black bear, *Ursus thibetanus* (VU) ■ Sun bear, Ursus malayanus (VU) ■ Greater Hog Badger, *Arctonyx collaris* (VU) ■ Chinese Serow, Capricornis milneedwardsii (VU) ■ Sambar Deer, *Cervus unicolor* (VU) **Reptiles**: 4 treptile species (includes EN, VU & DD) ■ Red River Krait, *Bungarus slowinskii* (VU) ■ Impressed Tortoise, *Manouria impressa* (EN) ■ Asiatic Softshell Turtle, *Amyda cartilaginea* (VU) ■ Chinese Softshell Turtle, *Pelodiscus sinensis* (VU) **Amphibians:** 1 amphibian species recorded ■ Firth's Litter Toad, *Leptobrachella firthi* (EN) **Bats**: no threatened bat species recorded (all of LC). **Fish:** no threatened fish species recorded (all of LC)
Keystone species performing a key ecological role (e.g. key predator, primary producer)	No specific species identified that may be considered keystone species contributing to long-term forest health, etc.
Large or congregatory species populations	None identified.
Endemic species or species with **restricted ranges**	Several endemic and/or restricted-range species of birds, mammals, reptiles, amphibians and plant species recorded. **Birds:** 2 restricted-range bird species ■ Chestnut-eared Laughing thrush, *Ianthocincla konkakinhensis* (VU) ■ Black-crowned Barwing, *Actinodura sodangorum* (NT) **Reptiles:** 1 restricted-range reptile species ■ Red River Krait, Bungarus slowinskii (VU)

Ecological value	Applicability to the Project
	Amphibians: 1 known and 3 species potentially 'new to science' could possibly be restricted-range (see Previously Unknown Species below) ■ Yellow-eyed spadefoot toad, *Leptobrachium xanthops (EN)* **Fish:** 2 LC restricted-range fish species could possibly occur ■ *Schistura imitator* (LC) ■ *Schistura clatrata* (LC) **Plants**: 10 species potentially 'new to science' that could also be restricted-range (see Previously Unknown Species below). **Bats:** none.
Previously unknown species	**Amphibians**: 3 species of frog that could be potentially 'new to science' (requiring further confirmation) ■ *Quasipaa sp.* ■ *Xenophrys cf maosonensis*[1] ■ *Rhacophorus sp*. **Plants:**10 plant species that could be potentially 'new to science' (requiring further confirmation) ■ *Camellia sp.* ■ *Garcinia sp.* ■ *Lasianthus sp. 1* ■ *Lasianthus sp. 2* ■ *Machilus sp.* ■ *Melastoma sp.* ■ *Neolitsea sp.* ■ *Polyosma sp.1* ■ *Polyosma sp.2* ■ *Smilax sp.*
Ecosystem level aspects of biodiversity	
Unique ecosystems	The Project area is unlikely to comprise highly unique ecosystems.
Locally adapted communities or assemblages	The Project area is unlikely to contain unique species assemblages
The main uses and users of the area and its ecosystem goods and services: **important ecosystem**	Given the potential for the forest ecosystems to provide key ecosystem services at both a local/regional and global scale, which are also considered 'Priority ecosystem services' as per the definition provided in

[1] Herpetologist that conducted the field surveys state that *X. maosonesis* is a species complex, and the individual found will certainly be split as a new species in the near future.

Ecological value	Applicability to the Project
services (e.g. important water yield area, coastal buffer), **valued ecosystem goods** (e.g. harvestable goods important for lives and / or livelihoods), **valued cultural areas.**	IFC PS6 (as impacts to these ecosystems may result in adverse impacts to Affected Communities, in terms of undermining cultural values and conflicting with subsistence resource needs), the evergreen forest ecosystems are considered important.
Important Areas for Conservation	
Protected Areas & Key Biodiversity Areas (KBAs)	Song Thanh Nature Reserve located on the Laos-Viet Nam border to the east of the Project area and within close proximity to the transmission line, is known to be an important area of the Annamite Ranges, comprising one of the most extensive contiguous forests in Viet Nam. Dakchung Plateau is both a KBA and IBA located in the middle of the Project area. Although extensively degraded, it is thought to hold important concentrations of Black-crowned Barwing (NT), and potentially the Yellow-billed Nuthatch (NT), both species which have adapted to disturbed and secondary habitats. Phou Ahyon and Ngoc Linh are designated as KBAs, IBAs and Alliance for Zero Extinction (AZE) sites[1], located north of the project area. These areas hold some of the last remaining populations of restricted-range bird species found in the Kon Tum Plateau EBA, such as the Vietnamese Crested Argus (CR), and Yellow-billed Nuthatch (NT). Additionally, Ngoc Linh also contains populations of the Black-crowned Barwing (NT). The Phou Ahyon AZE is triggered by the amphibian *Leptobrachium xanthops* (EN). According to the AZE website[2], the Phou Ahyon AZE hosts the entire known population of *L. xanthops*. ERM investigated the planned TL route through this area and delineated clearly identifiable streams, of which one will be crossed by the transmission line (see **ESIA *Appendix T*** and the initial Biodiversity Action Plan for more information and mitigation measures). Upper Xe Kaman is a KBA and an IBA supporting relatively intact old-growth semi-evergreen forest and riverine habitats, with species of conservation importance including Masked Finfoot *Heliopais personata* (CR), hornbill species, a range of gibbon species and Siamese crocodile *Crocodylus siamensis* (CR).

***Key to table**:*

***IUCN Global Red List of threatened species status**: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; NE = Not Evaluated.*

Note that there is no national Red List of threatened species available for Lao PDR.

9.4.3.3 Identification of Biodiversity Impacts

Detailed information on the Construction Phase of the project (***Section 4.9.1*** of the ESIA) and Operational/Maintenance Phase (***Section 4.9.2***) were referred to specifically in identifying and assessing biodiversity impacts. Maintenance has been included in the operational phase, noting that onshore wind farms typically have low maintenance and servicing requirements (Bennun *et al.,* 2021). The project concession period will be 25 years with little information on the decommissioning phase

[1] AZE sites are aligned to the boundary of existing or proposed designated or protected areas the focal specie(s) inhabit, rather than the distribution of the species within it.

[2] https://zeroextinction.org/site-identification/2018-global-aze-map/

available, however decommissioning phase impacts are likely be similar to construction phase impacts and have therefore not been assessed directly. Cumulative impacts are addressed later on in the ESIA, and include cumulative impacts on biodiversity.

Biodiversity impacts identified for the Monsoon WF project and related activities and infrastructure have been conceptualized and discussed in detail in ***Table 9.45***. Impacts are defined in terms of construction and operational (including maintenance) project phases, and include direct, indirect and induced impacts. Pathways of effect are used to understand how biodiversity may be impacted (e.g. direct habitat loss, indirect habitat loss due to disturbance, increased hunting pressure due to settlement associated with the creation of new access roads and other infrastructure).

Impacts associated with the WF are considered to be both ‘area based’ and ‘linear‘ in nature, and relate to the construction and operation of several wind turbines, electrical substations, the planned electricity distribution network (transmission line) from the WF towards Vietnam, as well as temporary worker camps and equipment laydown areas:

- Biodiversity impacts appear most intimately linked with direct and indirect impacts to that natural and modified terrestrial forest ecosystems, as well as the biodiversity components that these important habitat types support, including the species of fauna & flora that characterize the study area and the ecosystem services that forest ecosystems supply at local, regional and even global scales.
- There are also likely to be localized impacts on freshwater biodiversity, associated mainly with the construction of new access roads across watercourses such as small streams. The risk of incurring potential impacts to these highly connected ecosystems needs to be acknowledged.
- There are also likely to be a range of permanent operational impacts of lower significance associated with the installation and operation of the hard infrastructure (turbines and transmission lines).
- Construction-phase impacts likely to be more temporary in nature (e.g. temporary areas, noise, vibrations and emissions) and therefore far less significant in the long-term.

Table 9.45: Biodiversity Impacts Identified and Conceptualized for the Monsoon WF Project

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
Direct Impacts: *linked with the development project footprint and key activities*				
1a Physical destruction and/or disturbance of vegetation	**Construction phase:** The physical footprint of the wind farm (including turbines, electrical substations, access roads and transmission lines) will be relatively small in scale, being localised and limited to the actual footprint of infrastructure where vegetation will be cleared and converted to artificial surfaces (i.e. wind turbine foundations, access roads, substation foundations and pylons for the transmission line) or modified from wooded (forest) vegetation and maintained as low shrub or grass cover for the transmission line corridor. The following vegetation communities will be affected: • Montane Forest and Wet Evergreen Forest subject to varying degrees of existing degradation and fragmentation, • smaller isolated (highly fragmented and degraded) forest patches, • secondary or young/seral forest patches, and • modified (artificial) shrub land/grassland. The perceived importance of the biodiversity loss associated with loss of forest vegetation is typically linked to the conservation/threat status of the vegetation type, which has not been formally determined for Lao PDR, however the ecoregion is considered 'Vulnerable'. Given the extent of loss of forest vegetation which has been sustained (according to the WWF, 2021, "*in excess of 75% of the ecoregion's natural habitat has been converted or degraded*"), the vegetation threat status may actually be higher than VU realistically, and moreover the forest communities have been identified as important for harbouring threatened plant species (e.g. *Zingiber mellis,* EN) as well as plants that may be potentially 'new to science'. Therefore, the perceived importance of the biodiversity features that stand to be impacted is considered 'High'. Whilst there will also be localised impacts to other vegetation communities, including shrub land and small grassland patches, these vegetation types have been identified as having	Habitat	High	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	been artificially created through shifting cultivation practices, and are therefore rather small and transitionary habitat types of limited biodiversity value as herbaceous communities, in comparison to the forest types in the project area. Where there is no or limited access to remote areas, new access road infrastructure across ‘greenfield’ areas will almost certainly result in the direct transformation of forest, mainly associated with some of the lesser impacted and more contiguous Montane Forest community. Where existing access roads will be upgraded only, the additional loss of vegetation is considered to be negligible and largely insignificant, especially given the level of degradation and fragmentation of the forest communities that has already occurred in these areas. In the context of there being significant areas of natural and modified forest remaining within the EAAAs, the following forest losses have been estimated: 65.02 ha of Montane Evergreen Forest (lesser impacted) 204.69 ha of Montaine Evergeen Forest (degraded) 20.30 ha of Wet Evergreen Forest *Note that detailed habitat loss calculations are contained in the Biodiversity Action Plan (BAP) and that this factors in Access Roads, Wind Turbine foundations Powerline towers/pylons, and TL right-of-way. Access roads through forest to access pylon foundation sites will be temporary according to MWPCL and therefore will not incur in permanent loss of habitat. Where existing roads will be used for access, these are not included as habitat losses.* Temporary forest habitat loss due to temporary infrastructure (e.g. laydown areas, crush stone plant, crush stone resource points, batch plant and site camp) is estimated to total an additional 61.2 hectares of degraded Montane Evergreen Forest. This habitat will be subject to rehabilitation once construction has been completed; as such rehabilitation will not in most cases restore areas to their original quality, residual habitat quality impacts will also count towards offset requirements.			

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	The WF development is unlikely to threaten the long-term viability of the forest habitat or species dependent on it, with large areas of forest to remain undisturbed. **Operational/Maintenance Phase:** The physical destruction/disturbance of vegetation is primarily a construction-phase impact initiated by construction activities, albeit that the effects will be permanent in many cases where vegetation is changed.			
1b Reduction in habitat for supporting key species of conservation importance	**Construction phase:** Changes to species habitat is linked to the direct destruction of or change to the corresponding forest vegetation communities and any additional disturbance through typical edge impacts adjacent to construction activities. The reduction in habitat is primarily a construction-phase impact initiated by construction activities and vegetation transformation, albeit that the effects will be permanent in many cases where habitat is transformed by infrastructure such as foundations and roads. Transmission line corridor habitat will be modified (forest to be modified to shrub land most likely) but not lost entirely. Given that forest-dependent species that are CR and EN (belonging to the following faunal groups: small and medium0sized mammals, birds, reptiles and amphibians) could be affected by reduced habitat availability, linked with the change in forest vegetation described above, the biodiversity importance associated with this impact is considered to be reasonably 'High'. This is especially true for critical habitat qualifying species (which include several primates, reptiles, birds and frogs) which show a preference for primary Montane Evergreen Forest, and the estimated loss of ~65 ha of lesser-impacted Montane Evergreen Forest is therefore likely to have the most significant effect on conservation important species such as these. Secondary or degraded forest habitat can also potentially support several of these species as well, but are probably less important than the more intact forest patches. Wet Evergreen Forest (associated with the Phou Ahyon KBA and AZE site) is considered important for supporting	Habitat & Species	High	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	fewer species (namely the endangered Annamite Striped Rabbit and Yellow-eyed Spadefoot toad), however habitat losses are expected to be low for this type. One can expect losses of some conservation-important species, particularly the slower moving and more sedentary species (such as tortoises and frogs) and this will be more relevant to the lesser impacted, more contiguous forest habitat in the north and east sections of the project area, however it is probably unlikely that significant populations of threatened herpetofauna could be negatively affected as the majority of these have specific habitat requirements associated with freshwater streams which will be avoided in most instances . Most species of mammals and birds are highly mobile and the more sensitive species are capable of moving away from areas as human presence increases at the construction site. Since the direct loss of habitat will be relatively small, the impact is unlikely to result in a substantial change in the populations of forest-dwelling species, with sufficient forest habitat remaining available in the area (magnitude of effect is likely to be 'small' as a result). **Operational/Maintenance Phase:** This impact is initiated during construction but can be permanent in the case of hard structures such as foundations and roads, and more long-term in the case of habitat change associated with transmission lines.			
1c Illegal hunting/poaching and collection of forest resources	**Construction phase:** Whilst increased human activity in the area could result in increased pressure on local forest resources (through illegal hunting/poaching and harvesting of forest products, for example), this will likely be highly localised and relatively short-lived. r. *This is also addressed in terms of the project Cumulative Impact Assessment ("CIA") later*. This impact may possibly occur if not mitigated but is not likely to result in a substantial change in the population of species identified, thus magnitude of effect is likely to be relatively 'small'. **Operational/Maintenance Phase:**	Species	High	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	This impact will likely be less important during operation, as construction crews would have vacated the site and only a small operations and maintenance staff complement would remain on site, and not all the time.			
1d Bird & bat collisions with wind turbines resulting in injury or mortality	**Construction phase:** This impact is not relevant to the construction phase. **Operational/Maintenance Phase:** Bird and bat species that utilise the airspace in the project area are potentially at risk of collision with wind turbine rotator blades and risk incurring serious injury or death. **Birds:** ■ Bennun *et al.* (2021) indicate that collision risk for migratory species is considered generally greater than for more sedentary species. Larger birds with lower aerial manoeuvrability (such as cranes, storks, geese/swans, eagles and vultures) would probably be most at risk of collision. While most species in the area likely to be affected by the wind farm are considered locally common resident species of Least Concern (LC), there are several birds that are globall species. ERM assessed the collision risk to birds, based on a review of the baseline bird surey data to ascertain the need for further collision risk modelling (CRM) for selected species, It was concluded that there will not be a meaningful collision risk within the lifetime of the WF based on the low level of aerial occupancy by key RDL species of birds observed in the area, including Mountain Hawk-eagle (*Nisaetus nipalensis*, NT) and Rufous-bellied Eagle (*Lophotriorchis kienerii*, NT) (*noting here that the ecologically acceptable mortality rate or threshold for near threatened species should typically be considered lower or more stringent than for species of least concern*). Aerial occupancy rates were found to be so low that there would be no value in running a formal CRM.Given the species NT status of RDL birds, the importance/sensitivity of these biodiversity features is considered 'Medium'.	Species	Medium	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	■ Most of the common resident bird species (of LC) are also unlikely to trigger a significant collision risk and all species belong to widespread and locally common and stable populations. Only local effects on common species of LC may occur, due to the statistically low likelihood of collision and widespread and common nature of these bird populations. Furthermore, extensive field observations during key migratory periods suggest that the study area does not represent a significant migratory or congregatory area. ■ Migrant species are also of LC, and based on observations (very low aerial occupancy rates) and experience in CRM the WF is unlikely to result in a statistically significant risk of collision for these species within the lifetime of the WF. The only migrant species that was more frequently encountered and which recorded activity at levels of flight that could be associated with potential collision risk was the Grey-faced buzzard (*Butastur indicus,* LC), which was subject to further Collision Risk Modelling (CRM). The CRM (contained in Appendix S) estimated the annual mortality rate of Grey-faced Buzzard for the planned wind farm project based on the CRM results and Potential Biological Removal (PBR) calculations, with the results suggesting a mortality rate of 1 bird every 3 years (0.34 birds/annum); and PBR calculations concluded that *"In the worst-case scenario of 10,000 individuals, the project is likely to cause 0.16% of the total annual global non-natural mortalities that could occur before significant negative impacts on the global population occur*". For a best case scenario, a removal rate of 0.009% of the total global non-natural mortalities is considered negligible. The project magnitude of effect on birds susceptible to collision was therefore considered to be small based on the worst-case PBR scenario for Grey-faced Buzzard. **Bats:** ■ With the exception of *Rhinolophus francisi* which has yet to be evaluated by the IUCN, all bat species identified during the baseline biodiversity assessment are considered locally			

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	common species of LC, and as such the importance/sensitivity of these biodiversity features is considered relatively 'Low'. ■ Most bat species mortalities linked to WF projects relate mainly to migratory, foliage-roosting and tree-roosting species, and especially those species adapted for foraging insects in open spaces above the ground and far from vegetation. Based primarily on foraging strategy, 10 of the bat species recorded are considered to be at high risk for collision and potential fatality, with 11 medium risk of collision species. As bats are typically long-lived and have exceptionally low reproductive rates, fatalities of significant bat numbers could affect local populations of LC species. ■ Since local bat activity can change after WF construction, pre-construction studies have consistently proven to be poor predictors of the scale and magnitude of bat fatality impacts at species and population levels (Hein *et a*l., *2013*, Lintott *et al*., 2016). Given the constraints in determining bat fatality impacts prior to operation of the WF, it will be necessary to undertake further operational monitoring to validate operational impacts and to inform appropriate mitigation options.			
1e Bird & bat collisions with transmission lines or electrocution resulting in injury or mortality	**Operational phase only:** Collisions with the earth wire of transmission lines (which is typically quite poorly visible to avifauna) may lead to injury or even fatalities in bird and bat species. TL projects can also result in electrocution when birds or bats earth live elements of the line, which is particularly relevant for larger species (with large wing spans). Electrocution risk is most relevant to the distribution lines and substations. **Birds:** ■ Electrocution risk is typically quite species-specific, and may disproportionally affect species that utilise the pylons as perches when hunting or for nesting purposes, and this is most significant for raptors and other larger perching birds with large wing spans (Bennun	Species	Medium	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	et al., 2021). There is therefore some risk posed to some of the larger perching raptor species such as Mountain Hawk-eagle (*Nisaetus nipalensis,* NT) and Rufous-bellied Eagle (*Lophotriorchis kienerii,* NT), with other raptors such as Black Eagle, Crested Serpent Eagle being locally common resident species of Least Concern (LC). For larger voltage lines, electrocution risk will be minimised as live elements will be placed at a distance from each other such that the chance of birds completing the live circuit will be negligible. However, the lower voltage distribution lines (e.g. 35 kV and 115 kV) that are more compact in design may present a risk of electrocution for perching and low-flying birds with larger wingspans. ■ Although the incidence of collisions of raptors per km of power line is typically quite low in general, collisions are also more likely where species are more abundant and in areas with higher flight activity. The results of the VP monitoring suggest that common resident raptor species of Least Concern (LC) such as Black Eagle (*Ictinaetus malaiensis*), Crested Serpent Eagle (*Spilornis cheela*), Grey-faced Buzzard (*Butastur indicus*), Oriental Honey Buzzard (*Pernis ptilorhynchus*) and Shikra (*Accipiter badius*) were the most abundant and recorded the greatest flight times. However, most species were observed at great heights (exceeding 100m and up to 3000m elevation), such that it is only the less commonly observed species such as Rufous-bellied Eagle and particularly the Great Hornbill (*Buceros bicornis*, VU) that are likely to fly at lower heights typically where risk of collision with overhead power lines could become a concern. Previous experience with collision risk modelling and assessments would conclude that based on the level of aerial occupancy at collision height for the Rufous-Bellied Eagle and Great Hornbill, that collision risk would be unlikely. However, given the propensity for Great Hornbill to utilise evergreen forest habitats, some of which will be traversed by the planned TL to Vietnam, there may be associated risks with the TL in these areas where additional mitigation will need to be considered for this species. Given the VU status for Great Hornbill, the importance/sensitivity of this biodiversity feature is considered 'Medium'.			

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	Bats: ■ There is limited evidence of risks posed by transmission lines to bats, although electrocution of large bat species, particularly fruit bats (such as 'Flying Foxes' which are unlikely to occur in the area), has been identified as an issue associated with some distribution lines (Bennun *et al.,* 2021). ■ Since the bat species recorded are largely small insectivores of LC, bat collisions with the transmission lines and possible electrocution risks are considered largely insignificant for this project.			
1f Vehicular collisions with wildlife	**Construction phase:** Construction vehicles accessing and working within the site pose a risk of colliding with species utilizing the habitats and crossing roads between habitats. Some species may also be attracted to access roads created as easy corridors to move between areas and these animals are likely to be more at risk. Slower moving and more sedentary species such as reptiles (e.g. tortoises) and amphibians are likely to be at a greater risk of being injured or killed by moving vehicles, even at low speeds, particularly as cold-blooded species such as reptiles may utilize roads for sunning themselves. Given that some of these species are CR and EN, the importance associated with these species is considered 'High'. Vehicular collisions, whilst probable, are likely to be localised, manageable and therefore also unlikely to diminish populations of the identified species (magnitude of effect considered 'small'). **Operational/Maintenance phase:** This impact will probably be even less significant during operation, when only small operations, maintenance and security teams would probably utilise the access roads, and not all the time.	Species	High	Small
1g Dust pollution caused by earthworks and vehicle/machinery operation	**Construction phase:** Construction activities and operations are known to increase levels of dust due to vehicles travelling on informal dirt roads and through the creation of bare surfaces where vegetation clearing and bulk earthworks take place. Where large quantities of dust are released, this can	Species	Low	Negligible

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	smother plant parts and reduce photosynthetic activity, however this is likely to be a highly localised impact. Faunal impacts are also likely to be insignificant. Impacts of increased dust will also be limited to particularly windy periods and when vehicles drive along dirt roads, and the magnitude of effect is therefore likely to be 'negligible'. **Operational/Maintenance phase:** This impact will probably be less significant during operation, when only small operations, maintenance and security patrol teams would probably utilise the roads, and not all the time.			
1h Water and soil pollution caused by potential accidental spills of hazardous substances	**Construction phase:** Fuels, oils and other chemical substances required by construction crews operating at the site of the WF will be liable to accidental spillage, and even improper disposal, unless carefully managed. This will be most relevant to sensitive species of amphibians and any fish present in watercourses which are naturally the most prone areas to water pollution impacts - given their inherent level of connectivity in the landscape and location at topographic low points. During rainfall events, contaminants could also be washed into adjacent terrestrial habitats and soils that have been subject to pollution could hinder natural plant growth. While the likelihood of significant spills occurring for a project of this nature can be considered low typically (magnitude of effect considered 'small'), where spills of hydrocarbon products and other hazardous substances do happen these can be particularly devastating and long-lasting and may require considerable remediation efforts. **Operational/Maintenance phase:** This impact may be relevant to maintenance activities, but these are likely to be limited, with insignificant quantities of fuel, oil, etc. stored and handled during the operational phase.	Habitat & Species	Medium	Small
1i Soil erosion and sedimentation of watercourses	**Construction phase:** Soil erosion and loss of topsoil is generally considered a significant risk given the high rainfall, steep topography and erodible nature of soils in the region (National University of Laos, 2008).	Habitat	Medium	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	Soil erosion and sedimentation is likely to be most relevant to watercourses (small mountain streams and the larger rivers in valley bottom areas) and specifically where these are crossed by new access roads. Erosion of stream beds and banks would alter the morphology of these ecosystems and potentially reduce habitat availability for aquatic and sub-aquatic species such as fish and amphibians, and certain reptiles. Bare surfaces and open excavations can also be sources of sediment in themselves and excessive sediment can blanket vegetation and habitats, leading to altered instream habitat/biotopes and possibly affecting fish spawning sites and amphibian habitats important for completing species' life stages. The magnitude of effect has been rated as 'small' given the small size of the affected watercourses (small mountain streams) and the potential ease of mitigation. **Operational/Maintenance phase:** Although operational activities are unlikely to initiate any new erosion/sediment effects in themselves, erosion/sediment related impacts initiated during the construction phase may be prolonged and extend into operations unless properly addressed during the construction phase.			
1j Disturbance and nuisance caused by increased noise, light and/or vibrations	**Construction phase:** General nuisance and disturbance as a by-product of construction activities, including that associated with increased noise / vibrations from heavy construction machinery and artificial light. There are few studies available on the distance to which fauna are typically displaced during the construction phase of wind turbine projects. The displacement of fauna during construction is considered to be mostly associated to noise (for birds and non-volant mammals) and vibrations (herpetofauna). Locally common species are likely to be less sensitive to noise/light disturbance can probably become habituated at the site. Based on literature such as Kwon *et al.* (2018), there is a strong possibility that species could be disturbed by noise up to a radius of approximately 250m from the construction site, and outside of the 250m, noise level from construction should have been attenuated to background noise levels, with the exception of when piling occurs in which case which the disturbing zone could be larger. Given that the turbines are high in number and clustered relatively close together in areas, this could in theory render relatively areas susceptible to indirect disturbance but this may be more localized.	Species	Medium	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	Operational/Maintenance phase: Artificial light impacts during operation are likely when specific facilities such as substations may need to be well-lit for safety and security purposes. This can also attract certain species of insects, which can lead to increased activity by insectivorous species such as bats and small reptiles. Noise and visual disturbance from operating wind farms may not pose as much immediate risks to non-volant fauna, so they show less avoidance behaviors and can be habituated to the disturbances quite easily (Kopucki & Mróz, 2016[1]). The magnitude of effect is likely to remain 'small' given the temporary nature of construction activities and low intensity of operational activities anticipated.			
1k Barriers or interference with species movement	**Construction phase:** Artificial barriers to species movement, such as roads, will be initiated during construction and will continue as long as infrastructure is in place during operations. **Operational/Maintenance phase:** Migratory bird species are likely to be the most affected by wind farm barrier effects, however no IBAs for migration are found within 50km of the proposed WF project and extensive field surveys did not indicate significant migratory or congregatory populations, suggesting that there is likely to be little effect on bird populations in terms of altered species movement. Whilst there is some evidence of broad front raptor migration in the area, all raptor species involved are species of LC and will probably be largely unaffected. Bats may avoid the wind turbine locations but equally they may be attracted to feed around these areas in the case of insectivores, where artificial light and disturbance may attract greater concentrations of insects to the WF. Barrier effects may also affect terrestrial species such as mammals if wind farms are fenced, particularly for larger migratory mammals (which is not so problematic for this project). It is therefore unlikely that Project will have any population level effect on species movement (magnitude of effect will be 'small').	Species	High	Small

[1] Kopucki, R. & Mróz, I. (2016). An assessment of non-volant terrestrial vertebrates response to wind farms: a study of small mammals. *Environmental monitoring and assessment*, vol. 188, no. 2, p. 122. Available online at: https://www.researchgate.net/publication/292186245_An_assessment_of_non-volant_terrestrial_vertebrates_response_to_wind_farms-a_study_of_small_mammals

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
Indirect Impacts: *associated indirectly with the main project activities and operations*				
2a Increased susceptibility of forest habitat to disturbance	**Construction phase:** Whilst disturbance is initiated during construction, this impact is principally a long-term effect that continues into the operational phase. **Operational/Maintenance phase:** Where less impacted and largely contiguous areas of older growth (primary) forest will be traversed by the transmission line and access roads, the disturbance caused will also increase susceptibility to the effect of other forms of natural disturbance, such as increased exposure to wind (especially during storms) along the newly created forest edges which would not yet have developed sufficient low ground cover to provide shelter from wind impacts. The magnitude of effect will likely remain 'small', as only localised sections of mostly fragmented and degraded forest habitats are likely to be affected.	Habitat	Medium	Small
2b Introduction of alien plant species and/or disturbance leading to invasion by alien plants and weeds	**Construction phase:** The movement of vehicles, people and equipment into and through the project area may facilitate the introduction of Invasive Alien Plants (IAPs) to the area, or contribute to the spread of existing IAP species, primarily through the transport of seed attached to machinery, soils, clothing, etc. The disturbance created by vegetation clearing and earthworks may also create suitable conditions for IAPs and weeds to become established and possibly spread into adjacent habitats. IAPs can have far reaching detrimental effects on native biota and are widely accepted as being a leading cause of biodiversity loss. Key species are likely to be related to those introduced by Laotian plantation programmes (production forestry), and include *Eucalyptus* spp., *Acacia* spp., *Elaeis guineensis* (Oil palm), *Hevea brasiliensis* (Rubber	Habitat & Species	High	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	tree) and *Jatropha* spp. (Tong, 2009[1]) although there may be other key plants. The Global Register of Introduced and Invasive Species v1.1 (Pagad, 2020[2]) has recorded 297 species of invasive alien plants for Lao PDR and can be accessed online to view species details. **Operational/Maintenance phase:** The introduction of invasive alien plants into the lesser disturbed and ecologically important forest ecosystems can have a significant and lasting negative effect on the habitat and plant communities, that can extend well past the construction phase unless controlled. However, with mitigation this will probably be localised and therefore the magnitude of effect is considered 'small'.			
2c Reduced habitat connectivity caused by fragmentation of habitat	**Construction phase:** Whilst indirectly related to the destruction of vegetation and habitat during construction phase of the project, a reduction in habitat connectivity is a long-term and possibly a permanent effect in many cases, extending past construction and into the operational phase. **Operational/Maintenance phase:** New planned access roads can potentially fragment the remaining contiguous forest habitats and contribute to further fragmentation of areas already degraded and with patchy cover. Fragmentation of habitat can result in a landscape that has a lower capacity to support wildlife, preventing regular movement of species, limiting access to critical resources or increasing the energy required to take advantage of resources (Cornwall & Davis, 2003[3]). This is likely to be the most significant for migratory species, and given that large populations of migratory	Habitat & Species	High	Small

[1] Tong, P.S. (2009). Lao People's Democratic Republic: Forestry Outlook Study. Asia-Pacific Forestry Sector Outlook Study II, Working Paper Series. No. APFSOS II/WP/2009/17. Food and Agriculture Organization (FAO) of the United Nations, Regional Office for Asia and the Pacific. Bangkok, 2009. Available online at: https://www.fao.org/3/am612e/am612e.pdf

[2] Pagad, S. (2020): Global Register of Introduced and Invasive Species- Laos. v1.1. Invasive Species Specialist Group ISSG. Dataset/Checklist. Available online at: https://cloud.gbif.org/griis/resource?r=griis-laos&v=1.1

[3] Cornwall, C. and Davis, M.K. (2003). *Fencing guidelines and specifications for conservation easements*. Sonoma Ecology Center, Santa Rosa, California. USA. July 2003.

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	species have not been highlighted for the project area (and that additional habitat fragmentation impacts are unlikely to be severe), the magnitude of effect is considered 'small'.			
2d Loss of ecosystem services	**Construction phase:** Key ecosystem services are thought to be provided by the natural (and to a lesser extent, modified) forest habitats, and relate mainly to timber and non-timber products that are important for sustaining local livelihoods of the communities in the area that are dependent on these resources. A reduction in forest extent through destruction and degradation could contribute to a diminished supply of key provisioning and regulating/supporting services, however the linear nature of the more significant forest losses is likely to be more of a forest connectivity issue and have less of an overall effect on reducing key forest-related services. Any loss of ecosystem services is likely to be minor ('small' magnitude of effect). **Operational/Maintenance phase:** Whilst there is a possibility that development can restrict access to natural areas by local communities, the opposite is likely to be the case for this project, with increased accessibility likely to result, meaning that local communities can potentially make increased usage of forest resources and products. As discussed elsewhere in this chapter (under impact 3a below), this comes with its own unique set of unintended consequences on the local biodiversity values of the project area.	Habitat	Medium	Small
Induced Impacts: *typically not directly attributable to the project and related activities*				
3a Increased hunting/harvesting pressure due to enhanced accessibility to the area	**Construction phase:** An increase in the presence of construction workers in the area could result in increased pressure on local forest resources (through illegal hunting/poaching and harvesting of forest products, for example) but, even if unmitigated, this would be localised and relatively short-lived. Of greater concern are induced impacts, specifically the potential for project clearance and roads increasing access to forests for local and non-local hunters. This impact will be limited through most of the Project area owing to extensive existing access via roads and	Species	High	Small

Impact	Description	Receptor	Perceived Importance/ Sensitivity of Habitat and/or Species	Magnitude of Effect
	forest trails, as can be seen through widespread depletion of species' populations in the area through hunting to date. In one particular area (the ridge supporting the cluster of four turbines WA025 to WA028), greater concern exists over potential induced access to more remote and higher quality forest habitat, that may potentially host more substantial populations of forest-dependent conservation-important species. Nonetheless, project access roads will directly follow/align with an existing track accessible to people and motorbikes for approximately 7 to 8 km of a total of 11 km away from the existing road. Project roads will thus, only increase access to this area from the existing people and motorbike access, so the magnitude of effect is considered likely to be 'small'. **Operational/Maintenance phase:** While direct impacts will be negligible during operation, as construction crews will have vacated the site and only a small operations and maintenance staff complement will remain on site, potential indirect impacts will remain at a similar level as during construction.			

Scoped out / Excluded impacts: Note that the following potential biodiversity-related impacts were initially identified for the project, however a decision was made to exclude them from the assessment of impact significance, with the reasons for excluding impacts provided:

Increased risk of fire – whilst fires can have negative impacts on habitats such as forests that are adapted to lack of fire, the project in itself is unlikely to pose a significant risk of fire. This risk, albeit low, can be readily mitigated through simple controls and preventative measures during construction and operation.

Trophic cascade effects – behavioral changes in species can result in cascading effects on the various trophic levels, however these are typically not well- documented or understood and any species-level effects would be purely theoretical and conceptual at this stage and cannot be determined with any high level of confidence or accuracy/ long-term species monitoring at the site will be required to study such effects of the project.

9.4.3.4 Alternatives and Existing Controls

Several project alternatives have already considered within the context of avoiding impacts to biodiversity where possible (detail in ***Section 5*** of the ESIA):

- Through a process of avoiding impacts where possible (according to the application of the mitigation hierarchy), the extent of forest destruction and disturbance has been minimized as far as possible.
- Project alternatives considered included alternative power generation, site selection, technology and locations for infrastructure development. Turbine layout has been optimized from 240 turbines to 133 turbines, reducing the project footprint quite substantially as well as the areas required for temporary works (laydown areas, installation areas, access roads and WTGs).
- Clustering of turbines as far as possible will reduce the overall area over which the footprint occurs and reduce the number and length of access roads.
- The original transmission line planned to the Ban Lak 25 substation was amended to connect to Thanh My substation in Vietnam, reducing the overall length of the line considerably, thereby reducing overall extent of natural forest clearing and avoiding impacts to two important KBAs. Efforts were focused on planning transmission lines alignments outside of Protected Areas (e.g. Dong Hua Sao PA to the west) and where possible minimizing the impact to KBAs (Key Biodiversity Areas),
- Two alternative transmission line alignments were considered, with the first option selected, resulting in more favorable conditions for construction and maintenance of turbines and facilitating shorter access routes to the towers, reducing the overall area of environmental impact due to road construction.
- Complete avoidance of Dakchung Plateau KBA could not be realized fully for technical reasons pertaining to the feasibility of the project and positioning of WTGs where maximum power generation potential can be achieved to make the project viable. However the TL length is restricted in this area and the number of WTGs is also limited in comparison to other clusters of WTGs in the project area. Furthermore, as biodiversity enhancement through an offset intervention has been recommended for portions of Dakchung Plateau KBA to restore degraded forest habitat, in an effort to achieve at least a no net loss of biodiversity for the project, and this should sufficiently compensate for impacts of the project on the KBA habitats. This is discussed in ***Section 9.4.3.7 'Residual Impacts to Biodiversity***' with further detail on the preliminary offset strategy contained in the initial **BAP: Biodiversity Action Plan**.
- The potential to avoid of locating infrastructure within the particularly sensitive, less disturbed high elevation Montane Forest habitat on the ridgeline associated with Survey Block 4 (Phou Kounking) was also considered by ERM. This is detailed in the Briefing Note to MWPCL dated 11 March 2022. Given the significant contribution the high elevation turbines within Survey Block 4 make to the viability of the Monsoon WF project, avoidance of the area described may not be entirely possible, and in this case minimization of impacts would need to be considered through micro-siting of turbines, control of access and agreement with local communities on sustainable access and use.
- The engineers from Wind Pioneers ran an analysis and concluded that the relocation of the turbines would be detrimental to the overall feasibility of the project from the perspective of the proportional energy generation contribution from these particular WTs. The WTs in question are positioned in an area with sustained high wind velocities, making these the best performing of the entire WF project and critical to the feasibility and technical/financial success of the project. The turbines on the Ridge were among the highest net output turbines for the entire windfarm with an average of 15.58 GWh/a, whereas the alternative locations had an average net output of only 10.97 GWh/a, with a net reduction of output of 30%. The reduction in net energy was valuated in the Project's financial model, suggesting that the reduction of net output of 18.49 GWh/a (62.35 – 43.86) for the four turbines alone would reduce the overall project's net output to below that stipulated in the PPA. This reduction

in generation would negatively impact both the Project's Equity Internal Rate of Return (IRR) to below the acceptable minimum established by the shareholders, making the project un-investable.

- Given the significant contribution the high elevation turbines within Survey Block 4 make to the viability of the Monsoon WF project, it has been demonstrated that avoidance of the area described will not be possible, and in this case minimization of impacts will need to be considered through micro-siting of turbines, control of access and agreement with local communities on sustainable access and use. Where infrastructure that is considered critical to the successful implementation of the project and realisation of its goals and objectives overlaps with more ecologically important and sensitive forest habitats, there will be a greater contribution to residual impacts on forest habitat and targets required to meet a net positive (or at least no net loss) biodiversity outcome. This would also need to be taken into consideration from a long-term costs perspective.
- Avoidance of the Wet Evergreen Forest habitat in the north-east will not be entirely possible, as this large contiguous belt of vegetation runs along a roughly west to east corridor, which the proposed transmission line to Vietnam will need to traverse at some point. Alignment as far as practically possible with more degraded forest habitat has however been suggested, rather than creating an entirely new corridor through the less disturbed forest. By aligning roads and power lines with existing disturbances (such as existing roads/transport corridors), the project can minimize further impacts to forest habitat and species. It is also worth noting that the existing access road will be used where possible to access the area for construction so as to reduce the amount of forest clearing.

Other relevant management measures, controls and embedded mitigation confirmed for the Project and identified in the local EIA (2022), as relevant to biodiversity impact mitigation, have also been acknowledged (with reference to sections ***4.6, 4.7, 4.8, 9.3.2.2, 9.3.3.2, 9.3.4.4, 9.3.5.1 and 9.3.6.2*** of the ESIA). These are summarized below.

Pre-construction Phase controls:

- Clearly define the construction zone(s) and access routes,
- Toilets for workers to be provided,
- Use of modern equipment and vehicles,
- Prepare and implement a water use plan if required,
- Implement an appropriate wastewater treatment system as required (wastewater will be treated initially by wastewater treatment tank before using the service of the septic service company for disposal),
- Prepare a Waste Management Plan, and
- Prior to commencement of work, all contractors would be required to provide detailed site-specific plans as relevant to the project.

Construction Phase controls:

- Limit clearance of vegetation to the development footprint only,
- No burning of cleared vegetation,
- Avoid earthworks in forest areas as much as possible,
- Avoid earthworks during heavy rainfall to reduce erosion risk,
- Backfilling, levelling and compaction of excavations and trenches to occur as soon as possible after completion of earthworks using subsoil initially stripped,
- Coordinate construction activities to minimize stockpiling requirements,
- Stockpiling of construction materials to be at least 30m from waterways,
- Construct suitable drainage systems,

- Avoid earthworks at the sides of streams to reduce erosion and sedimentation risk to watercourses,
- Undertake erosion protection for all foundations,
- Control sedimentation,
- Implement dust suppression on surfaces which could be a source of dust,
- Proper storage of construction material in designated areas (bunded areas, hardstands with roofs),
- Proper solid waste collection, temporary storage and disposal at suitable facilities offsite,
- Hazardous waste to be temporarily stored prior to transported off-site to an appropriate or licensed waste disposal contractor,
- Construction noise mitigation and management measures to be implemented,
- Conduct noise monitoring,
- Conduct water quality monitoring,
- Water for construction to be sourced from from nearby streams,
- Fencing and/or security to prevent community members from accessing the construction site,
- Vehicles to be properly maintained,
- No washing of vehicles and equipment in rivers or streams, and
- Conduct regular audits and inspections of the construction area.

Post-construction:

- Restoration to be done post-construction to return the landscape to as close to its original state as possible.

Operational/Maintenance Phase controls:

- Install, inspect and maintain fire protection equipment,
- Emergency plan to be prepared,
- Maintenance and cleaning work annually along the RoW area of the transmission line route, and
- Access controls and security during operation of the WF.

9.4.3.5 Biodiversity Impact Significance

The significance of the various impacts to biodiversity has been assessed using the approach and methods contained in Step 4 of the section on approach/methods, with the results presented in ***Table 9.46***. This has taken into account the alternatives already considered and existing controls identified (see ***section 9.4.3.4***).

Where considered relevant and necessary, additional mitigation measures aimed at avoiding, minimizing and remediating impacts (aligned with the mitigation hierarchy) have been included in the impact significance assessment contained in ***Table 9.46***. Repetition of the existing controls has been avoided[1]. Taking into account the recommended best/good practice mitigation measures, residual impacts have also been rated, with further details in ***section 9.4.3.7***.

[1] The mitigation approach for AZE Sites is presented in Table 9.46 and in depth in the initial Biodiversity Action Plan

Table 9.46: Biodiversity Impact Significance Assessment for the Monsoon WF Project

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
1a	**Physical destruction and/or disturbance of vegetation**	Plant species (EN)	High	Small	Moderate	Construction Operation	**Pre-construction:** ■ Demarcate areas to be cleared in advance with tape or fencing, to avoid inadvertent additional clearing. Monitor habitat clearance closely during construction to minimise risk of inadvertent additional clearing. ■ ECoW[2] accompanied by an ecologist to follow a pre-clearance procedure to undertake re-siting or, if not feasible, micro-siting of all cleared areas (e.g., construction camps, batching plants, turbines, substations and roads) to avoid or - if not feasible - minimize loss of Natural Habitat and of areas where Critical Habitat-qualifying species are actually or likely to be present. Where there is limited room for movement of pre-agreed infrastructure locations such as wind turbines, or roads between them, the focus will be on identification of opportunities for micro-siting (i.e., movement of infrastructure <300m). Where infrastructure is far more location-	Moderate* [*assuming no avoidance or offsetting]

[1] For several mitigation measures, a multi-disciplinary team of ecologists with expertise on both terrestrial and aquatic ecology will need to be appointed to work with the project engineers and develop the required measures

[2] An Ecological Clerk of Works (ECoW) oversees construction activities in ecologically sensitive areas to ensure that construction works follow a pre-determined methodology designed to prevent significant ecological impacts. Competent ECoWs can effectively oversee the management of the risks on construction sites associated with managing biodiversity and can help to ensure a smooth and cost-efficient construction process.

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							flexible - as is the case, for example, with powerline routes, camps, laydown areas, spoil areas, batching plants, production areas and quarries - full opportunities will be considered for micro- and larger-scale resiting of such infrastructure. Where full avoidance of Natural Habitat and of areas with Critical Habitat-qualifying species is not possible, constraints that make micro-siting impossible (e.g., topography) will be clearly documented. ■ Closely align powerlines to follow existing road/powerline corridors, in order to avoid or minimize additional loss of Natural Habitat. ■ Pylons in the AZE Phou Ahyon are to be located in sufficient distance (50 m) to the stream within the AZE[1]. ■ The TL at the stream crossing location will span the entire width of the stream channel and associated instream/riparian vegetation and potential habitat for freshwater frog species, and that pylons be positioned outside of the stream and adjacent areas ■ If it is not possible to avoid upgrading existing infrastructure to improve crossing design and	

[1] Initially, a 20m conservation buffer zone was advised by ERM, based on the available information on the species (i.e. found occurring within 15m of steep mountain streams - Stuart et al., 2012). However, given the cryptic nature of this species and with little available information on its behaviour and ecological/habitat requirements, a more conservative and precautionary buffer width of 50 m was advised by ADB and has been included in the BAP mitigation.

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							flows, a sensitive species survey focusing on amphibians must be undertaken beforehand and the findings and recommendations of such a survey taken into consideration in crossing design and construction ■ A pre-construction survey be undertaken at the stream crossing location to search for the presence of *L. xanthops* and document locations and potential habitat for this species ■ Compile an appropriate Construction Method Statement for working in natural forest habitats (for implementation where construction in/through forests is planned). ■ Adhere to applicable national environmental laws, specifically those governing the protection and management of wildlife and natural forests ("*Wildlife and Aquatic Animal Law*" and "*Forestry Law*") and ensure that any necessary permitting/licensing processes of planned activities in natural forests. ■ Compile a suitable post-construction rehabilitation plan for temporary areas used during construction. ■ Avoid locating construction camps and material/equipment laydown areas within 200 m of a Natural Habitat	
							Construction:	

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							■ Use existing access roads or upgrade existing roads wherever possible before considered new access road construction. ■ Avoid locating pylons supporting transmission lines within stream/river beds, rather place these away from the stream banks and ensure the line is suspended across the stream/river channel for the entire span of the stream/river. Take into account any dynamic environments such as large rivers which could flood or where the channel could change course through channel switching and result in damage to pylons. Place pylons above known river floodlines or flood risk areas. ■ Where known CH-qualifying species, CR/EN species and any species potentially 'new to science' occur and are at risk of being destroyed, prepare and implement a protected plant rescue and translocation plan and programme. ■ Limit the clearing of natural vegetation, particularly in forests, to the absolute minimum necessary to adequate complete the works whilst not comprising on health and safety requirements or laws. ■ Demarcate the construction zone or servitude for corridors on a map and on the ground clearly using high visibility tape for instance, to	

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							avoid impacting on sensitive areas outside of the permitted construction area. ■ Rehabilitate and revegetate temporary-use, construction site camps and lay down areas as soon as reasonably practicable after construction activities have been completed. ■ Implement relevant construction standards (e.g. Construction Code of Practice for the Sustainable Use of Soils on Construction Sites' – DEFRA, 2009[1]). **Operation:** ■ Develop and implement access management plans and controls to avoid access and unnecessary disturbance of natural habitats. Access restrictions will need to be in place from the earliest stages of construction in order that local people do not become accustomed to using new roads which will later be closed and rehabilitated.	
1b	**Reduction in habitat for supporting species of conservation importance**	Forest habitat / Plant & Animal species (CR, EN)	High	Small	Moderate	Construction Operation	**Pre-construction:** ■ See mitigation measures recommended for impact 1a above.	Moderate* [*assuming no avoidance or offsetting]

[1] DEFRAL Department of Environmental, Food and Rural Affairs. (2009). Construction Code of Practice for the Sustainable Use of Soils on Construction Sites Available online at: https://www.assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							■ Creation of suitable alternative habitats or enhancement of existing ones to support displaced species. **Construction:** ■ See mitigation measures recommended for impact 1a above. ■ Sweep through areas prior to construction to flush animals from habitats likely to be directly affected. The ECoW will need to be accompanied by relevant faunal ecologists/experts to advise on the approach and methods to flushing out wildlife sensibly without causing additional impacts. ■ Schedule habitat clearance, grading and road construction activities outside of conservation-important species' breeding periods where known. **Operation:** ■ Consider options to rehabilitate degraded areas that were previously forest, through a reforestation and tree-planting project - potentially a community reforestation project could be investigated.	

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
1c	**Illegal hunting/poaching and collection of forest resources**	Plant & Animal species (CR, EN)	High	Small	Moderate	Construction Operation	**Construction:** ■ Illegal activities such as hunting of wildlife or collecting of forest species is to be discussed with construction workers and such activities are to be prohibited. **Operation:** ■ Access controls to be implemented along access roads which enter areas of natural habitat, with a particular focus on restricting uncontrolled access to the lesser-impacted primary forest habitat.	Minor* [*assuming hunting/poaching controls implemented]
1d	**Bird & bat collisions with wind turbines resulting in injury or mortality**	Bird & Bat species (NT)	Medium	Small	Minor	Operation	**Operation:** ■ Implement an annual monitoring plan focused on investigating fatalities during period of heightened bird/bat activity (seasonally relevant). ■ Given the constraints in predicting bat fatality impacts prior to operation of the WF (see Table 8.48), it will be necessary to undertake further operational monitoring to confirm operational impacts and to inform appropriate mitigation options. ■ Prepare and implement a precautionary and adaptive management plan to be informed by long-term annual bat/bird carcass monitoring, to determine where additional mitigation may be necessary for specific turbines/clusters of turbines, such as: adjusting turbine cut-in	Negligible* [*assuming operational controls implemented where necessary, based on monitoring outcomes]

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							speeds (increased) for site-specific and seasonal bat activity peaks, feathering of turbine blades, auditory deterrents and/or painting of alternate turbine blades to increase visibility for birds. An ecologist / biodiversity specialist will need to be appointed to develop the adaptive management plan	
1e	**Bird & bat collisions with transmission lines or electrocution resulting in injury or mortality**	Bird & Bat species (VU)	Medium	Small	Minor	Operation	**Construction:** ■ Implement safe transmission and distribution lines, with anti-electrocution measures (insulation and spacing of conductors) that eliminate electrocution risk for birds. ■ Allow for a minimum spacing of 1m between power cables to safeguard known bat species from electrocution risk. ■ Installing bird flight diverters (BFDs: hanging or spiral diverters) along conductors of all project transmission lines in the vicinity of natural forest habitat and between larger forest patches where birds are likely to move locally, with spacing according to international good practice guidance (e.g. APLIC, 2012[1]). ■ Provide deterrents at key positions along the transmission lines where visibility is poor and particularly where less disturbed, larger forest	Negligible* [*assuming operational controls implemented where necessary, based on monitoring outcomes]

1 APLIC (Avian Power Line Interaction Committee), 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							habitats are encountered (e.g. line markers / flight diverters at 15m intervals where hornbill activity has been recorded associated with Wet Evergreen Forest habitat). This will also be based on an adaptive management approach and implemented on a case-by-case basis for specific sections of powerline where high fauna mortalities due to collisions are recorded in long-term annual monitoring.	
1f	**Vehicular collisions with wildlife**	Animal Species (CR, EN)	High	Small	Minor	Construction Operation	**Pre-construction:** ■ Use existing access roads or upgrade existing roads wherever possible before considered new access road construction. ■ Shepherding protocol to be prepared and implemented where road construction takes place, to check areas to be worked in prior to construction and remove or shepherd wildlife to safety in adjoining forest or habitat[1]. Workers are to be trained in the identification of common dangerous/poisonous/venomous wildlife such as snakes, spiders, etc. and measures to avoid hazards associated with these species, as part of the EPC contractors site inductions and training plan.	Negligible* [*assuming traffic controls implemented]

[1] An ecologist / biodiversity specialist will be appointed to advise on the shepherding protocol. A training programme will be developed to train workers on the protocol Wherever possible local people will be recruited to undertake the pre-clearance checks and shepherding/ removal

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							Construction & Operation: ■ Limit vehicle speed to 15km/hr on site for all contractor and subcontractor vehicles, as well as any non-Project vehicles allowed on access roads, to reduce risk of vehicular collisions with wildlife.Place appropriate limits on the number of vehicle movements to and from the wind farm (e.g. maximum of 5 vehicles allowed within a 1-hour window). ■ Restrict vehicles to the use of only authorised access roads. ■ Restrict activities to day time hours when visibility is good and to limit risk of impact to nocturnal species of fauna..	
1g	**Water and soil pollution caused by potential accidental spills of hazardous substance**	Habitat / Plant & Animal species	Medium	Small	Minor	Construction	**Construction:** ■ Employ best practice measures in handling and storing fuels, oils and chemicals liable to spillage. ■ Always use drip trays when temporarily storing or handling fuels or when servicing/repairing vehicles on site. ■ Pollution monitoring plan to be compiled and implemented, with a focus on watercourse monitoring. ■ Prepare an emergency spill response plan. Clean-up any spills immediately.	Negigible* [*assuming controls implemented to limit risk of spills]

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							■ Emergency spill kit provision and training. ■ Remediate any soils, watercourses or habitats where spills take place. ■ Inform the relevant authorities as soon as any significant or major spill event takes place. ■ Disposing of waste into the environment is prohibited. Waste products to be transported to registered waste facilities only for proper disposal. ■ Burial or burning of waste to be prohibited.	
1h	**Dust pollution caused by earthworks and vehicle/machinery operation**	Forest habitat / Plant species	Medium	Negligible	Negligible	Construction	**Construction:** ■ Avoid earthworks during particularly windy periods. ■ Employ dust suppression on bare soil surfaces exposed to wind and dirt roads used by heavy construction vehicles. ■ Cover soil stockpiles during windy periods. ■ Use a cover/tarp when transporting soil/sand.	Negligible* [*assuming controls implemented to limit risk of spills]
1i	**Soil erosion and sedimentation of watercourses**	Streams / Rivers	Medium	Small	Minor	Construction	**Pre-construction:** ■ Implement best practice stream crossing design and construction, taking into account the sizing of any pipe culverts and placement on the channel bed and not at height. This is to be informed by good practice guidelines for the	Negligible [*assuming controls implemented to limit risk of erosion and sedimentation]

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							design of river crossings, such as SEPA (2010[1]). ■ Compile an appropriate Construction Method Statement for working in watercourses (for implementation at all stream crossings). This is to be informed by good practice guidelines on construction methods, such as SEPA (2009[2]). ■ Compile a suitable post-construction rehabilitation plan for stream beds and banks modified but not entirely transformed by construction activities. **Construction:** ■ Implement relevant construction standards (e.g. 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites': publishing.service.gov.uk). ■ Cross streams at right-angles only. ■ Do not place more fill material within the stream channel than what is necessary.	

[1] SEPA: Scottish Environmental Protection Agency. (2010). Engineering in the Water Environment: Good Practice Guide: River Crossings. Second Edition. November 2010. Available online at: https://www.sepa.org.uk/media/ 151036/wat-sg-25.pdf

[2] SEPA: Scottish Environmental Protection Agency. (2009). Engineering in the Water Environment: Good Practice Guide: Temporary Construction Methods. First Edition. March 2009. Available online at: https://www.sepa.org.uk/media/150997/wat_sg_29.pdf

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							Remove any excess fill or material from the channel bed, taking care not to disturb the natural channel bed and bank profiles. ■ Only one stream crossing to be constructed at a time as the construction front progresses. ■ Avoid any unnecessary crossings of streams/rivers and stick to only the planned and agreed to crossings. ■ Any bare soil surfaces need to be revegetated as soon as practically possible to reduce erosion risk. ■ Install sufficient drainage works under all access roads, to reduce freshwater habitat fragmentation, avoid flooding land and damaging nearby waterbodies.	
1j	**Disturbance and nuisance caused by increased noise, light and/or vibrations**	Animal species	Medium	Small	Minor	Construction Operation	**Construction:** ■ Limit construction activities to day-time hours to limit impacts to nocturnal species. ■ Maintain vehicles and equipment in good working condition. ■ Use noise minimizing technology where possible. ■ Aim lights downwards and away from forest habitats. Use appropriate lighting that minimises ecological effects on wildlife and also limits attraction of insects e.g. use of long-	Negligible* [*assuming controls implemented to limit disturbance]

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							wavelength (warm white, orange, red and infra-red) light instead of short-wavelength (UV, cool white, blue and green LEDs).Use low intensity lights where possible and aim lights downwards and away from natural forest habitat. Use appropriate lighting that minimises ecological effects on wildlife and also limits attraction of insects. ■ Enforce good conduct by construction workers, including prohibition of hunting, trapping, fishing, and general harassment of wild animals. **Operation:** ■ Enforce good behavior by employees, including prohibition of hunting, trapping, fishing, and general harassment of wild animals. ■ Use low intensity lights where possible.	
1k	**Barriers to or interference with species movement**	Animal species (CR, EN)	High	Small	Moderate	Construction Operation	**Pre-construction:** ■ Consider alternative wind farm layouts to minimise barriers to species movement. The alignment of turbines parallel to and not across known bird flight paths or general flight directions should be investigated. ■ Arrange turbines in clusters to reduce overall footprint.	Minor* [*assuming controls implemented

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							■ Maintain connectivity around or across linear infrastructure (roads primarily) through use of appropriate animal crossings suitable for small mammals and slow-moving reptiles such as tortoises in particular. ■ Look at a single construction camp, sited in a least sensitive and already disturbed area and avoid developing multiple camp sites. ■ Use existing access roads or upgrade existing roads wherever possible before considered new access road construction. ■ Develop protocols for capturing or herding animals found in construction areas where these unable to exit by themselves. Species considered to be dangerous or poisonous/venomous to be handled by professionals. **Construction:** ■ Sequencing of construction activities to avoid construction activities and multiple teams at multiple sites, to reduce the impact spread and rather concentrate temporary impacts at key points and advance to new areas only once construction at the previous site has been completed. This can assist with permitting species movement and migrations in advance	

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							of the project activity moving to their habitat, preserving corridors at all times. ■ Any temporary excavations, fences or stockpiles of soil and materials must be removed from site once construction is complete. **Operation:** Avoid placing impermeable fences that could interfere with species movement.	
2a	**Increased susceptibility of forest habitat to disturbance**	Forest habitat / Plant species (EN)	Medium	Small	Minor	Operation	**Operation:** ■ Rehabilitate forest edges impacted and exposed to disturbance. *See mitigation measures recommended for impact 1a and impact 1b, above.*	Minor* [*assuming rehabilitation of disturbed areas]
2b	**Introduction of alien plant species and/or disturbance leading to invasion by alien plants and weeds**	Natural habitat / Plant species (EN)	High	Small	Moderate	Operation	**Operation:** ■ Compile a suitable Invasive Alien Plant (IAP) species control plan and programme to eradicate dense colonies of alien plants and control the spread of minor species and weeds. This plan must include wash stations to remove seeds from vehicle tyres and underbody. ■ Implement IAP species control plan and programme. ■ Monitor IAPs.	Minor* [*assuming IAP control plan implemented]
2c	**Reduced habitat connectivity caused by**	Animal species (CR, EN)	High	Small	Moderate	Construction Operation	**Construction:** ■ See mitigation measures recommended for impact 1a and 1b above.	Minor* [*assuming controls

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
	fragmentation of habitat						■ Rehabilitate degraded areas that were previously forest to re-connect patches of habitat. **Operation:** *See mitigation measures recommended for impact 1a and 1b above.*	implemented to limit disturbance]
2d	**Loss of ecosystem services**	Forest habitat	Medium	Small	Minor	Construction Operation	**Construction & Operation:** *See mitigation measures recommended for impact 1a, 1b, 2a, 2b and 2c (above).*	Negligible* [*assuming controls implemented to limit disturbance]
3a	**Increased hunting/harvesting pressure due to enhanced accessibility to the area**	Animal species (CR, EN) / Plant species (EN)	High	Small	Moderate	Construction Operation	**Construction:** ■ Most turbines are located in areas of existing disturbed landscapes and the design of the wind farm avoids more intact habitat blocks wherever possible. Eight turbines are located on the southern part of the Phou Koungking mountain and during road construction access to these sites from existing settlements and trails will be controlled through site security. ■ Construction workers will be prohibited from hunting or trading in wildlife and forest products, as part of their terms and conditions of employment and will be subject to security checks.	Moderate* [*assuming standard access controls and security are successful at reducing access, but assuming no avoidance of more remote forest areas]

No	Impact Description	Receptor	Biodiversity Importance / Sensitivity	Magnitude of Impact	Pre-mitigation Impact Significance	Project Phases	Mitigation Measures Recommended[1]	Residual Impact
							Operation: ■ Develop and implement appropriate access management plans and suitable control measures to restrict access and unnecessary disturbance of natural forest habitat. This may include the use of secure access gates with guard control on access roads to limit unauthorized vehicle and pedestrian access. MWPCL would need to work together with the appointed EPC Contractor to develop access control plans.Undertake stakeholder consultation with local villagers regarding access to traditional trails and access to non-timber forest products but prohibiting illegal hunting of protected species.	

Noteworthy findings from the impact significance assessment include:

1. There will be moderately significant, permanent impacts to the natural forest vegetation communities and habitats, with indirect impacts on forest-dependent species. These may be difficult to mitigate unless the lesser disturbed forest communities are avoided entirely, and residual impact will remain of moderate significance.
2. Linear infrastructure (roads and transmission lines) are likely to have the most notable impacts on forests, particularly for the lesser impacted sections of more contiguous northern Montane Forest and the Wet Evergreen Forest areas in the north and north-east (associated with the planned transmission line alignment towards Vietnam).
3. The most significant impacts are likely to be associated with the access roads and turbines planned in the northern sections of the project area, where the less disturbed and more contiguous older-growth forest compartments have been identified.
4. Increased hunting/harvesting pressure due to enhanced efficiency of access to the area (induced impact) could still remain as moderately significant where access to more remote forest habitats is not avoided, even where controls on access are implemented.
5. All other impacts have been considered to be of Minor to Moderate significance and can be readily mitigated, potentially reducing significance levels to low or insignificant levels.

9.4.3.6 Summary of Impact Mitigation

The protection of natural ecosystems and biodiversity generally begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces impacts. Mitigation requires proactive planning that is enabled by following the '**mitigation hierarchy'**. The application of the mitigation hierarchy is intended firstly, to avoid disturbance and/or loss of ecosystems, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts. The mitigation hierarchy has been applied as follows:

- Mitigation aimed at the avoidance of impacts has already been considered on the layout planning for the development, with a reduction in the number of turbines, efficient clustering of turbines and realignment of transmission lines and roads to avoid sensitive forest areas and KBAs undertaken where possible. This is documented in Chapter 4 of the ESIA (Alternatives).
- Existing mitigation measures and controls (from the local EIA, 2022) are designed to reduce construction and operational phase impacts and these will be supplemented with the additional mitigation measures contained in the ESIA (***Table 9.46***), in order to minimize and remediate/rehabilitate impacts as far as possible. These measures will likely be the most easily implementable and successful in terms of reducing the significance of residual impacts for the following to relatively minor and acceptable levels:
    - Illegal hunting/poaching of wildlife,
    - Collision risk for birds/bats (wind turbines) and other wildlife (vehicular collisions),
    - Water and soil pollution,
    - Dust pollution,
    - Soil erosion and sedimentation,
    - Nuisance disturbance,
    - Forest disturbance,

- Impacts to ecosystem services,
- Invasive Alien Plant impacts, and
- Reduced habitat connectivity.

Despite the avoidance of impacts through project design and realignment considerations and the recommendation of good practice controls and site-specific mitigation to reduce impact extent, potential and/or intensity, there are still residual impacts of moderate and major significance that are not easily mitigatable (see ***Section 9.4.3.7***). In this instance a biodiversity offset is recommended, and the initial recommendations are included below in ***Section 9.4.3.7***. An initial Biodiversity Action Plan (BAP) has also been compiled which contains the initial strategy outlining the offset (targets, offset receiving areas, principles, key actions, and next steps) with further actions regarding the following key biodiversity mitigation measures as well:

1. Micro-siting of key temporary works and infrastructure;
2. Construction Method statement (including work in watercourses);
3. Post-construction rehabilitation plan for temporary works and areas (including stream beds and banks); Access management plan and controls;
4. Protected plant rescue and translocation plan and programme;
5. Shepherding protocol;
6. Avifauna fatality monitoring protocol;
7. Precautionary and adaptive management plan to be informed by long-term annual bat/bird carcass monitoring, to determine where additional mitigation may be necessary for specific turbines/clusters;
8. Invasive Alien Plant control plan;
9. Ecologist / biodiversity specialist will need to be appointed to advise on where appropriate animal crossings for new access roads could be considered necessary and to provide recommendations for design of crossings'
10. Creation of suitable alternative habitats or enhancement of existing ones to support displaced species;
11. Support local villagers with the training, tools and finances needed to startup small-scale animal operations, such as chicken farms, etc. to support local livelihoods, to alleviate some of the local hunting pressures; and
12. Indicators and metrics recommended for the evaluation of mitigation measures / biodiversity protected plant rescue and translocation plan and programme management interventions.

9.4.3.7 Residual Impacts to Biodiversity

Residual impacts of minor to moderate impact significance that are likely to remain after other forms of mitigation have been considered (avoidance, minimization, and restoration). Moderate impacts include

1. Impact 1ab: Transformation or modification of areas of natural forest vegetation, providing key habitat for forest-dependent species and considered 'critical habitats' (direct and indirect impacts); and
2. Impact 3a: Loss of threatened and/or restricted-range species through increased hunting/harvesting pressure due to enhanced accessibility to the area (induced and cumulative impacts assessed).

These impacts are likely to result in a net biodiversity loss unless adequately mitigated through an appropriate biodiversity compensation strategy.

Importantly, the mitigation of impacts needs to align with the requirements of the ADB SPS (2009) regarding 'natural habitats' and 'critical habitats', both of which are represented in the project area and will be affected to varying degrees:

1. Natural Habitats

"*In areas of natural habitat, the project will not significantly convert or degrade such habitat, unless the following conditions are met:*

(i) No alternatives are available.
(ii) A comprehensive analysis demonstrates that the overall benefits from the project will substantially outweigh the project costs, including environmental costs.
(iii) Any conversion or degradation is appropriately mitigated.

Mitigation measures will be designed to achieve at least no net loss of biodiversity. They may include a combination of actions, such as post project restoration of habitats, offset of losses through the creation or effective conservation of ecologically comparable areas that are managed for biodiversity while respecting the ongoing use of such biodiversity by Indigenous Peoples or traditional communities, and compensation to direct users of biodiversity."

2. Critical Habitats

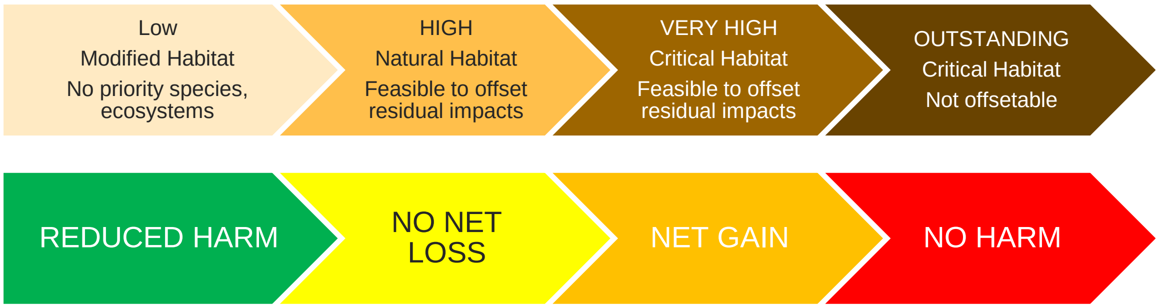
"*No project activity will be implemented in areas of critical habitat unless the following requirements are met:*

(i) There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function.
(ii) The project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species6 or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.
(iii) Any lesser impacts are mitigated in accordance with para.27."

Residual impacts of minor to moderate significance relate to the potential loss of critical habitat identified in the CHA and which is aligned strongly with the remaining untransformed but highly fragmented natural and modified Wet Evergreen Forest and Montane Evergreen Forest vegetation communities and habitats represented in the project area. Offset targets and objectives will include all significant residual impacts on Natural Habitat and on Critical Habitat-qualifying biodiversity.

Such goals may also depend on the biodiversity significance of the area. This is summarized in the graphic in ***Figure 9.57***.

Figure 9.57: Diagram Illustrating the Process of Identifying, Measuring and Mitigating Impacts to Biodiversity towards Achieving no net Loss or Net Gain Outcomes



Source: adapted from Benunn et al., 2021

Biodiversity offsets are typically required in certain situations to compensate for residual impacts to ecosystems and biodiversity, and only once all other forms of mitigation have been considered. Offsets are therefore normally only considered as the 'last resort option in the mitigation hierarchy'. The trigger for offsets is linked to the significance of residual negative impacts of development on biodiversity: where residual impacts are of high enough relative significance, offsets to compensate for biodiversity loss should be explored. Furthermore, the outcomes of the CHA (***Appendix T***) require that a Biodiversity Action Plan (BAP) be compiled to align with the ADB SPS and to include options to offset residual impacts so as to achieve at the minimum a 'no net loss' or potentially a 'net gain' outcome in terms of biodiversity.

In terms of compensating for residual impacts, it is possible that a biodiversity offset could secure the necessary conservation gains required to ensure a net gain or at a minimum at no nett loss scenario for the project. Indeed, there is much opportunity in the local area to contribute to forest habitat and species conservation in a meaningful way. It is therefore recommended that an initial BAP be compiled and used to inform the development of a detailed offset plan and programme for implementation. Some initial ideas for the BAP and biodiversity offsetting that have been identified are follows:

- KfW Bank in collaboration with the World Wildlife Fund (WWF) are currently involved in several projects in Lao PDR, supported under the International Climate Initiative (IKI) of the German Federal Ministry. Two forest corridors[29] have been identified in the Annamite Mountains region, with the objective of project work being to preserve species diversity and biodiversity through planned and focused conservation activities.
- To support its conservation objectives, WWF-Laos launched a Community-based Forest Restoration and Management for Livelihood programme[30], in partnership with Provincial Agriculture and Forestry Department (PAFO) of Sekong and Salavan province. The WWF-Laos Forest Programme aims at halting deforestation and ensuring Laos' forests are effectively protected or under improved management. The project looks not only at restoring and protecting forests and corridors, but also enhancing the income of the area's culturally diverse people who depend on forests for their livelihoods, through forest protection and sustainable use of forest resources and preserving the unique species

[29] KfW, 2022. Accessible online at: https://www.kfw.de/stories/environment/nature-conservation/laos-forest-protection/

[30] WWF, 2022. Accessible online at: https://www,wwf.org.la/projects/forest_restoration_and_management_/

diversity. One of the priority landscapes of WWF-Laos is the Central Annamites Landscape (CAL), covering southern Laos and part of Vietnam.

- There may be an opportunity for the Monsoon WF project to assist with financing or supporting these existing projects, programmes and already well-rooted conservation initiatives as a form of biodiversity offset mitigation.
- There may be key opportunities to support the existing Protected Area network, or local KBAs (Key Biodiversity Areas) which should be investigated further. Such an example could include working with the Lao PDR Ministry of Natural Resources and Environment (MoNRE) to create a protected area covering the mountain area in Survey Blocks 3 & 4, using the data collected for the Monsoon WF application to support such a designation.
- Habitat enhancement through restoring connectivity in areas suffering from high levels of fragmentation such as within the Dak Cheung KBA.
- Development of a sustainable timber and NTFP harvesting strategy.
- Implementing an Agroforestry support programme.

Initial comments received from the ADB support the general approach that offsets to compensate for biodiversity losses need to be additional, and not within existing conservation areas or overlapping existing initiatives (i.e. to avoid a 'double-dipping' scenario whereby the conservation gains from a site serve two or more purposes). Bearing this in mind then, the most logical way to offset forest habitat loss (which is the most significant direct impact of the project) is through an offset designed to restore key ecological linkages between the patchy forest cover in the vicinity of the project infrastructure, with a focus to restore larger, more contiguous areas of forest cover, which will also likely improve habitat availability and movement of fauna utilising the forests.

Initial estimates of anticipated natural forest habitat loss were undertaken to inform the impact assessment (based on anticipated WT locations, substation positions, access road widths and TL corridor widths), which were determined to be conservatively in the region of approx. 290 ha of natural forest loss for the project (see impact 1a in ***Table 9.46***). This has been split also between the loss of Montane Forest and Wet Evergreen Forest, as follows:

- Preliminary estimated loss of natural Montane Forest habitat = 270 ha
- Preliminary estimated loss of natural Wet Evergreen Forest habitat = 20 ha

Given that Lao PDR do not have a national offset policy in place at the moment to guide the development of biodiversity offsets in the country, the approach taken by ERM for the 'Nam Ngiep 1 Hydropower Project Biodiversity Offset' (ERM, 2014[31]) was used to determine preliminary offset targets for the Project. This was based on the guidelines and methodology contained in the 'Biodiversity Offset Design Handbook' (BBOP, 2012)

The following no-net-loss biodiversity offset rules have been recommended for the project (in line with ERM, 2014 and BBOP, 2012):

- Offsets should be 'like-for-like' with trading only permitted within the same land class type;

  If this is not possible offsets should address the same features and habitats within the broader landscape area;

31 ERM, 2014. Nam Ngiep 1 Hydropower Project: Biodiversity Offset Design Report. Unpublished report prepared for the Nam Ngiep 1 Power Company Ltd. July 2014. Project no.: 0200749.

- Environmental contributions for specific programs can be used to substitute for the direct management of biodiversity;
- Incremental loss and fragmentation of forest habitats is to be avoided;
- Management of offset sites can be used to improve biodiversity, however this may not replace actions that are already funded;
- Areas with existing or potential land uses that are likely to be in conflict with the objectives of biodiversity offsets will need to be avoided (mining, forestry leases;
- Offsets to be located in close proximity to the impacted area as possible, such that the gains of offset mitigation are retained in the local area impacted and not transferred to elsewhere;
- Location of offsets in the landscape that facilitate connectivity with adjacent habitats are considered preferable;
- Large offset sites that are connected to existing protected areas are also seen as preferable;
- Also, sites similarly used by comparable ethnic groups sharing similar cultural values will be of preference;
- Fairness and equity should be ensured for affected stakeholders; and
- Offsets chosen should be permanent and ongoing in perpetuity.

Initially, the biodiversity offset metric used to calculate habitat targets has been based on the Habitat Hectare Equivalents model of BBOP (2012), which considers habitat type, extent, and condition for both the impacted areas and candidate offset receiving sites with the residual habitat hectare loss calculated by multiplying loss extent by land condition value (see ***Table 9.47***):

Table 9.47: Offset Target in Habitat Hectare

Habitat Type	Estimated Permanent Habitat Loss (A)	Land Class Condition, Value (B)	Residual Impact expressed as Habitat Hectares (HH) (C = A x B)	Offset Target expressed as Habitat Hectares (HH) to meet Net Gain objective (= C+10%[32])
Montane Evergreen Forest (least impacted)	65.02 ha	High / natural, 0.8	52.01 HH	57.22 HH
Montane Evergreen Forest (degraded)	204.69 ha	Degraded, 0.2	40.94 HH	45.03 HH
Wet Evergreen Forest	20.30 ha	High / natural, 0.8	16.24 HH	17.87 HH
Subtotals	***290.01 ha***		***109.20 HH***	***120.12 HH***

[32] Note that in addition to the basic offset habitat hectares target to meet no net loss, an additional 10% habitat hectares has been included to help ensure that a Net Gain objective is met

Given that active reforestation efforts and active management will increase the biodiversity value and condition of target sites, but with limited evidence of existing conservation management actions undertaken on offsets in Lao PDR, a conservative approach to predict likely gain in terrestrial biodiversity has been used, based on the approach by ERM (2014). This suggests that gains in condition value relative to the existing value of the site prior to offset intervention, with sites with lower baseline condition likely to have a greater capacity for improvement (ERM, 2014). A conservative estimate of ~38% proportional improvement in condition over a 30-year period from low condition forest has been assumed for the project, based on ERM (2014) (see table below for offset gain calculations).

In order to achieve no net loss of biodiversity through the target of ~120 habitat hectares (see ***Table 9.47***), a minimum area of ~300 ha of low value/poor condition forest will need to be rehabilitated and managed as part of the offset. The highly fragmented landscape associated with the Dak Chung KBA has been identified as a logical starting point for planning an offset, as the site is in close proximity to the impacted forest areas, such that the gains of offset mitigation are retained in the local area impacted and not transferred to elsewhere in the country. There may be key opportunities to support the existing Protected Area network, or local KBAs (Key Biodiversity Areas) which should be investigated further. Such an example could include working with the Lao PDR Ministry of Natural Resources and Environment (MoNRE) to create a protected area covering the mountain area in Survey Blocks 3 & 4, using the data collected for the Monsoon WF application to support such a designation. Rough estimates based on the habitat mapping and classification undertaken for the biodiversity baseline assessment, suggests that for the Dak Chung KBA alone (which has a total extent of 51 km^2 or 51 000 ha) the extent of degraded/low condition forest habitat could easily exceed 50% of the area, or equating to around 25 000 ha. To secure an area of approximately 300 ha which can result in a potential no net loss and even net-gain in terrestrial biodiversity (see table below) should be relatively easy to achieve for this area alone, as this would be an estimated <1% of the Dak Chung KBA.

The target for Montane Forest habitat can therefore be quite readily achieved on dak Chung Plateau, but not for Wet Evergreen Forest. Therefore, a second site will be required to offset the comparatively far lower losses to Wet Evergreen Forest (20 ha, equating to ~18 habitat hectare equivalents), with a possible location being the existing forest disturbance caused by the formal road located to the east of the TL in the north-eastern section where this affect Wet Evergreen Forest habitat. Forest restoration along a roughly 4-5 km stretch of road through Wet Evergreen Forest can potentially net a gain of 30 ha of forest. To meet a target of 18 habitat hectare equivalents (see ***Table 9.47***) requires the rehabilitation and management of an estimated 45 ha of low condition/degraded forest of this type, which is considered easily obtainable given there is minimum 30 ha of degraded forest of this type identified at the target offset site (see ***Table 9.48***).

Table 9.48: Offset Target

Habitat Type	Offset Target in Habitat Hectares required for Net Gain [A]	Base Condition Rating for Offset Site (degraded) [B]	Target Condition Rating with Interventions [C]	Estimated Gain in Condition [D = C - B]	Target [E = A / D]
Montane Evergreen Forest	102.25	0.2	0.6	0.4	**255.63 ha**
Wet Evergreen Forest	17.87	0.2	0.6	0.4	**44.68 ha**
Sub Totals	***120.12 HH***				***300.30 ha***

As the final positions of WT's and access roads may change through micro-siting to avoid loss of natural forest, and TL corridors are also still to be finalised, the final loss calculations will need to be refined through a more detailed analysis in GIS. This will be used to inform final targets and to determine the proposed boundary of the biodiversity offset to meet targets and thus achieve at least a no net loss, possibly nett gain in biodiversity.

In addition, the following is recommended when developing the offset plan:

- Conservation outcomes are likely to be difficult to achieve without involving the local community. Community restoration / rehabilitation projects should be investigated such that the people who are most dependent on the forest resources in the area are the ones who also can benefit from the project;
- The 'Village Forest Management Planning Guideline' developed through the 'Climate Protection through Avoided Deforestation Project' (2016[33]) supports sustainable use, protection and restoration of village forests in Lao PDR, and may provide a useful reference and guidelines to support offset planning and community forest management;
- It is suggested that the relevant FSC (Forest Stewardship Council) guidelines, norms or standards that focus on natural forest management and impact mitigation be used, where appropriate, to inform the development of the BAP (most notably "FSC Principles and Criteria for Forest Stewardship" - FSC, 2015[34]); and
- Engagement of an appropriate delivery partner with a track record of supporting such biodiversity protection and rural poverty alleviation projects.

Since direct/indirect species impacts are unlikely to be significant for the project to warrant the need for offsetting, there will be no need for a specific species offset for the project. That being said, offsetting potential over-harvesting / over-hunting practises that may be induced by the project will require a different approach, focused more on averting loss of species through measures aimed at ensuring sustainable harvesting practices are followed and ensuring appropriate protection of offset sites from illegal activities.

The next step will therefore be to develop a Biodiversity Action Plan and Offset Strategy for the project, which will require initially that forest habitat losses be more accurately determined using GIS (as a proxy for biodiversity loss of habitat and species). This will first require details on road and corridor width, area of transformation associated with each wind turbine and power substation to be quantified as well as the finalisation of road and transmission line route alignments.

Final revised offset targets can then be determined based on the extent of habitat losses determined, using reasonable and appropriate (scientifically defensible) offset ratios/multipliers for the habitat type in question, which should reflect the ecosystem/habitat threat status and/or conservation/threat status of species likely to be affected. It will be important that cost estimates for implementing the biodiversity offset required to achieve no net biodiversity loss (at a minimum for the Project) be evaluated and understood by all stakeholders during offset planning process, from the perspective of initial costs and the anticipated long-term management of the offset (essentially in perpetuity or for as long the Project infrastructure remains).

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[33] Climate Protection through Avoided Deforestation Project. (2016). Village Forest Management Planning Guideline. CliPAD-TC program, a technical cooperation between GIZ, KfW and Lao Government. January 2016. Available online at: https://www.giz.de/en/downloads/Village-Forest-Management-Planning-Guideline.pdf

[34] FSC (2015). Principles and Criteria for Forest Stewardship. Reference: FSC-STD-001 V5-2 EN. Available online at: https://www.fsc.org/en/document-centre/documents/resource/392

9.5 Social Impact Assessment

The assessment of potential social impacts arising as a result of the Project are outlined in the following sections. The social impact assessment is based on the methodology provided in ***Section 6***. A Human Rights Impact Assessment (HRIA) has been undertaken in addition to the social impact assessment presented in the following sections and is provided in ***Appendix W***.

9.5.1 Scope of Social Impact Assessment

Scoping determines which impacts are likely to be significant and should become the main focus of the impact assessment. A scoping exercise was carried out early in the ESIA process, which helped to outline the potential impacts associated with the Project. The identified potential impacts formed the basis of the social baseline study and impact assessment. The scoping outcomes are summarised in ***Table 9.49***. The scoping summary does not intend to capture all potential social impacts of the Project, but key potential impacts to be examined during the social impact assessment.

The social impact assessment seeks to assess the potential social impacts from Project-related activities on sensitive receptors. The social impact assessment expands on scoping outcomes, and takes into consideration:

- The concerns and feedback received during the ESIA stakeholder engagement, baseline collection activities and information disclosure and consultation in July 2022 (refer to ***Section 6***), and
- The socio-economic characteristics of the affected villagers, particularly their vulnerability, their needs and challenges, as captured under the Social Baseline chapter (refer to ***Section 8.5***).

As part of the impact assessment process, the vulnerability of receptors has been considered as part of 'sensitivity'. It is highlighted that the precautionary principle has been applied in undertaking the assessment, including when considering vulnerability.

Table 9.49: Social Impact Scoping

Project Activities	Project Phase	Potential Social Impacts	Receptors	Location
Construction and operation of the Project	Construction Operation	Economic Opportunities ■ Local Employment and Training (refer to Community and Ethnic Group Development Plan (CEGDP) for more details) ■ Increased Access to Agricultural Land/Forest	Affected villagers	All 32 villages in the AoI
Turbine site, Access road, Internal TL 35kV, 115kV, Sub 500kV, TL500kV	Construction Operation	Economic Displacement and Impacts to Livelihoods ■ Loss of Agricultural Land ■ Loss of NTFP Collection	Affected villagers	22 villages affected by loss of agricultural land are listed in ***Table 9.53*** 25 villages affected by loss of NTFP collection are

Project Activities	Project Phase	Potential Social Impacts	Receptors	Location
				listed in *Table 9.55*
Vehicle movements from the delivery of materials and use of infrastructure and machinery, associated with construction activities	Construction	Impacts to Community Health and Safety ■ Infrastructure and Machinery ■ Vehicle Movements ■ Security ■ Potential Spread of Diseases	Affected villagers Workforce	All 32 villages in the AoI
Construction of the Project	Construction	Impacts Associated with Influx ■ Labour and Working Conditions ■ Transactional Sex ■ Community Dynamics and Gender-Based Violence ■ Public Infrastructure and Resources	Affected villagers Workforce	Location of workers camp
Operation of the Project	Operation	Impacts on Local Amenity: ■ Noise ■ Landscape and Visual Disruptions ■ Shadow Flicker	Affected villagers	All 32 villages in the AoI
Construction of the Project	Construction	Impact on Ethnic Groups ■ Erosion of Ethnic Culture	Affected villagers	All 32 villages in the AoI
Construction of the Project	Construction	Impact on Cultural Heritage (Tangible and Intangible) ■ Access/impacts to the sacred areas	Affected villagers	All 32 villages in the AoI

The following will be undertaken as part of the social impact assessment for each potential social impact:

- Description of the potential social impact, including:
  - The geographical extent of the potential social impacts;
  - Relevant Project phase (e.g. pre-construction, construction, operations); and
  - Potentially affected receptors.
- Identification of existing controls that have been developed and implemented.
- Assessment of the significance of the social impact.
- Development of additional mitigation and management measures, and associated monitoring measures.

- Assessment of residual social impact significance.
- Gender analysis and mainstreaming measures.

9.5.2 Impacts on Economic Opportunities

The development of a project typically generates economic opportunities for the local community. Potential economic opportunities for the Dak Cheung and Sanxay Districts are outlined in the following sections.

9.5.2.1 Potential Impacts

Local Employment and Training

An average of 700 workers (per day) are required during the construction phase (peak workforce requirement is 1,300 workers per day). In the construction phase, 300 positions are available for unskilled workers (90% Loas national and 10% migrant), 300 positions are available for semi-skilled workers (75% Laos national and 25% migrant), and 677 positions available for skilled workers (40% Laos national and 60% migrant).[35] While it is currently unclear as to whether the 230 semi-skilled and 70 skilled Lao national workers would be sourced from the villages within the AoI, it is highlighted that there are training opportunities available to enable some villagers work in these positions. It is anticipated that the nominated EPC Contractor will be a Chinese company and may hire Chinese workers for the Project (precise numbers of Chinese workers will be determined as part of detailed planning, following receipt of the ADB Notice to Proceed (NTP)). However, past project experience in Lao PDR suggests that there is potential that Chinese EPC Contractors may source some workers from Vietnam. Approximately 280 migrant works (560 for peak workforce period) will be engaged for construction.

A total of 80 workers will be required for the operations phase, of which 16 will be migrant workers (i.e., project manager, site and administrative manager, equipment manager, operation manager, safety manager, chef), who will immigrate to the local area.

Baseline data identifies that over 1,664 people are in the active labour force. Of the active labour force, approximately 360 people are in unpaid (working on family farms) or temporary work (e.g. on hydropower projects or coffee plantations). Some local males have trades such as blacksmithing. On this basis, it is expected that there is capacity for villagers within the AoI to be employed in unskilled work, and perhaps some semi-skilled work, for the Project.

In addition to direct employment, there may be indirect employment opportunities. For instance, the Project or workers may require short-term accommodation, or the purchase goods and services from local businesses. The increased demand may result in an associated increase in employment.

Stakeholder engagement with villagers from both the Dak Cheung and Sanxay Districts identified that they have a positive sentiment about the Project, are looking forward to anticipated benefits, most notably in the form of employment. Villagers recognise that employment opportunities associated with the construction phase are temporary, in line with the temporary nature of construction. There is also an expectation that training opportunities will be provided as part of the Project. Villagers are particularly interested in training opportunities for youths as it is the view that the youth population needs opportunities for employment.

Increased Access to Agricultural Land/Forest

Access roads will be constructed to connect the Project with the National Highway No. 16 and internal Project access roads to wind turbines, transmission lines, and other infrastructure, in the Dak Cheung and

[35] Based on the draft CA Annex W as of 21 September 2021. Note that this is subject to change following the concluding of the CA.

Sanxay Districts. While the development of these access roads will result in the acquisition of some agricultural land (assessed separately in ***Section 9.5.3***), according to the Project's Concession Agreement, all access roads developed by the Project are supposed to be made available for villagers to use. These new roads have the potential to provide access to new areas that were previously inaccessible. The new areas may provide opportunities for villagers to access to new areas for NTFP collection and establish new farms to support their land-based livelihoods. In opening up new area for NTFP collection and new farms, this will be undertaken in consultation with District Agriculture and Forestry Office (DAFO)/Provincial Agriculture and Forestry Office (PAFO) and villagers, and agreement will need to be reached with DAFO/PAFO and villagers.

These opportunities may be tempered by the presence of biodiversity in that there is a potential that the new areas will be areas of high biodiversity value, which may need to be confirmed via ecological field surveys. ***Section 9.4.3*** addressed impacts to biodiversity associated with improved accessibility gained via various access roads planned. Access roads planned could facilitate increased access to remote areas by local communities and people from outside the communities wishing to hunt wildlife for bush meat and collect forest products for subsistence and economic reasons. Increased human activity in the area could result in increased pressure on local forest resources (through illegal hunting/poaching and harvesting of forest products, for example). Without proper controls this could lead to increased pressure on both wildlife and habitat, however it is recognised that access control will be a priority as recommended in the local EIA mitigation recommendations. Nonetheless, MWPCL will work together with the government to restrict access to high biodiversity areas, as outlined mitigation measures in ***Section 9.4.3***.

Additionally, it was observed during the Information Disclosure and Consultation in July 2022 that neighbouring villages have agreements on designated NTFP collection areas for each village. Typically, NTFP collection areas are accessed on foot (as most of villagers do not own vehicles), they would note that some areas are too far. Improved access may potentially facilitate people from outside with vehicles to collect NTFPs in the area, leaving villagers whose livelihood is dependent on NTFPs collection vulnerable or more vulnerable. However, such issues can be mitigated by, for instance, locked gate for roads leading to turbine infrastructure with access given to only local villagers (as part of local employment and security arrangement).

9.5.2.2 Existing Controls

As the Project has not commenced, there are no existing benefit enhancement measures.

9.5.2.3 Significance of Impacts

Methodology for Assessment of Impact Significance

The potential economic opportunities are assessed in accordance with the criteria set out in ***Table 9.50*** and ***Table 9.51***.

Table 9.50: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional, and impact may potentially be regional in scale.

Magnitude	Definition
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

Table 9.51: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently, has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

Receptor Sensitivity and Impact Magnitude

The affected villagers are considered to have **medium** sensitivity, as they will be able to participate in decision-making through stakeholder engagement.

The impact magnitude is **positive** as economic opportunities allow affected villagers to improve their livelihoods.

Impact Significance

Based on the above, the impact significance of economic opportunities manifested through local employment, training opportunities, and potential increased access to new agricultural land and NTFP collection area has a **positive** impact significance.

9.5.2.4 Additional Mitigation, Management, and Monitoring Measures

Local Employment and Training

A Local Content and Influx Management Plan will be prepared to maximise the local employment and training opportunities afforded to the affected villagers. The Local Content and Influx Management Plan will be implemented by the nominated EPC Contractor, and will include:

- The responsibilities and management practices associated with the management of labour (covering local and migrant workers) during construction and operation of the Project.
- A hiring policy that reinforces the Project's preference to employ local workers and undertake procurement from local businesses, where possible. The policy will be a tiered system where the hiring preference will be as follows:
  - Villagers from within the AoI;
  - Villagers from the Dak Cheung District or Sanxay District;
  - Villagers from the Sekong Province or Attapeu Province and

  - Villagers from the remainder of Laos.

This will be stated in the Local Content and Influx Management Framework (includes Procurement Management Framework and Labour Management Framework).

- A training program targeting skills required for affected villagers to participate in unskilled, and potentially semi-skilled, work for the Project.
- A communications strategy to notify affected villagers of employment and procurement opportunities in advance. This will enable villagers and businesses to be prepare for the application process (e.g. contracting requirements, assistance with application, etc.). The communications strategy will be supported by the SEP.

Community and Ethnic Group Development Plan (CEGDP)

A Community Development Plan which incorporates the Ethnic Group Development Plan (due to the fact that the majority of the affected villagers are ethnic minorities) will be prepared to guide the implementation of suitable programs to support affected villagers. In the first instance, the CEGDP will investigate existing community development initiatives that may be already implemented and/or planned by the government, NGOs, and other organisations. The CEGDP will suggest collaboration with these organisations or enhance existing programs whenever feasible, which will:

- Reduce duplication of programs and resources and completing the existing programs/initiatives;
- Increase likelihood of success; and
- Promotes larger scale and longevity of the program(s).

Derived from the community risks and opportunities, existing community development programs and the Project's 'thriving community' priorities, potential programs that will be investigated in the CEGDP include:

- **Rural electrification – Off Grid Rooftop Solar Power Solutions to Communities (56 HHs):** The Proponent has delivered a number of successful renewable energy projects. Although the Project will not supply electricity to Laos, the Proponent has committed to providing a means of reliable and affordable electricity to the affected villages (Off Grid Rooftop Solar Power Solutions to Communities [56 HHs]). As part of the CEGDP, the details of implementation will be determined (e.g., provision of household solar power systems). This would further the Lao Government's Renewable Energy Development Strategy by increasing the renewable energy share. Priority will be given to the households affected by the Project's land acquisition, then poor households within the Project's affected communities, and finally the entire the affected villages if possible.   The Project will ensure that rooftop solar systems will not be sourced from supplers operatng in locations where there is hgh rsk of forced labor anc chld labor..
- **Agriculture & Animal Husbandry Support:** There are a number of existing agriculture and husbandry programs which will be investigated, such as:
  - IFAD Program supporting agriculture, providing training on weaving for women, and rearing livestock; and
  - Department of Agriculture and Forestry (2021) training on how to prepare soil for coffee plantation (part of the Greater Sub-Region Biodiversity Conservation Corridors Project).
- **Education and Sponsorship Assistance:** The current scenario suggests that there is much room for improvement in delivering quality education and support to further strengthen the education services. The majority of the structures currently in use are temporary and with very limited education supplies and materials. The Education and Sponsorship Assistance Scheme will further improve in areas of

education and refurbish or construct infrastructure and facilities that contribute to strengthening the education systems.

- **Health Support & Services:** Insufficient healthcare services, inadequate healthcare personnel and lower levels of health awareness were raised as primary community concerns in areas of health services. Various interventions will be further investigated here, such as provision of medical supplies, building and refurbishing health facilities, installation of toilets and sources of clean drinking water, conduct of health check-ups, capacity building training of health staff and awareness raising on immediate health concerns.
- **Protection, Preservation and Promotion of Cultural Heritage:** The Project entails potential impacts and risks (intrusion of workers) to tangible and intangible cultural heritage. Inward migrating workers may negatively influence existing customs and religious practices undertaken by the ethnic groups. Damage or loss of ethnic culture may occur if migrant workers and other outsiders are not respectful of or understand the various customs and religious practices, such as boundaries placed on areas that may only be accessed by women or men. There are also opportunities to promote local culture, especially indigenous crafts as part of the livelihood program.

The CEGDP will be directly supported by the SEP, to ensure the key development opportunities are driven by the community's needs and opportunities, and the community members are aware of the Project benefits and how they can participate.

Ideally, the overlapping of community development priorities and interest between the community, local government and institutions, and the Project would form the strategic community development programs for the CEGDP.

The CEGDP will include a set of criteria to be considered for the selection and prioritisation of programs. While the criteria will be refined further, they generally relate to:

- Budget and timeframe constraints;
- Practicality and potential partners to execute the program successfully;
- Potential unintended consequences from the program;
- If there is opportunity for gender mainstreaming; and
- If there will be disproportionate benefits to a certain group and the potential for the vulnerable groups to not benefit from the CEGDP initiatives.

In addition to this, the CEGDP will include, but will not be limited to:

- Context review results – internal and external;
- Results of the community needs assessment and resources analysis;
- A description of the priority elements and why these were selected as priority elements;
- An overview of stakeholder engagement activities for CEGDP prioritisation, and design and implementation of CEGDP projects;
- Identification of potential partners and partnership strategies;
- A monitoring and evaluation framework for the CEGDP;
- The budget and human resources requirements for implementation of the CEGDP; and
- An implementation plan / schedule.

Increased Access to Agricultural Land/Forest

The management of increased access within the Dak Cheung and Sanxay Districts, and restriction to high biodiversity areas, will be managed via the Construction and Environmental Management Plan (CEMP).

Mitigation measures for biodiversity impacts due to increased access are presented in ***Section 9.4.3.5*** *as follows:*

Construction:

- Most turbines are located in areas of existing disturbed landscapes and the design of the wind farm avoids more intact habitat blocks wherever possible. Eight turbines are located on the lower elevation of the Phou Koungking Mountain and during road construction access to these sites from existing settlements and trails will be controlled through site security.Construction workers will be prohibited from hunting or trading in wildlife and forest products, as part of their terms and conditions of employment and Worker Code of Conduct, and will be subject to security checks.
- Undertaken consultation with DAFO/PAFO and villagers to identify new areas for NTFP collection and farming and establish agreements with DAFO/PAFO and villagers on access and to and utilize the new areas.

Operation:

- Implement access controls including the use of gates, security cameras and security guards at sites of key infrastructure such as substations and the main access roads to turbine clusters. Access may be given to only local villagers who were already to ensure the villagers can still access to their NTFP collection or farm areas while limit activities from outsiders (as part of local employment and security arrangement).
- Undertake stakeholder consultation with local villagers regarding access to traditional trails and access to non-timber forest products but prohibiting illegal hunting of protected species.

The SEP will be paramount in informing affected villagers of areas able to be accessed, and any conditions of access. The SEP contains measures about providing information to affected villagers about the changes in access to agriculture/forest land. Aspects relating to prohibited areas not to be used for agriculture/NTFP collection as required through the biodiversity impact assessment will also be communicated to affected villagers through this mechanism.

9.5.2.5 Residual Impact Significance

The residual impact significance of the impact of economic opportunities for affected villagers remains **Positive** (***Table 9.52***).

The Project will provide various economic opportunities, particularly in the form of employment. Not only will there be direct employment, but there will be indirect employment in businesses that support the Project and its workers. Additionally, increased access to agricultural land/forest will contribute toward economic growth in the villages in the AoI, in accordance with regulatory requirements. The Project will also implement a CEGDP is to identify opportunities to improve the prospects of communities affected by the Project activities, independent of the Project presence, so the benefits will be felt long beyond the life of the Project.

Table 9.52: Economic Opportunities Impact Assessment

Significance of Impact	
Potential Impact	Economic opportunities for affected villagers

Significance of Impact					
Project Phase	Pre-Construction	**Construction**	**Operation**		
Impact Nature	Negative	**Positive**	Neutral		
	Opportunities for employment and other economic benefits from the Project.				
Impact Type	**Direct**	Indirect	Induced		
	Economic benefits will be directly provided by MWPCL to affected villagers.				
Impact Duration	Temporary	**Short-term**	**Long-term**	Permanent	
	Some economic benefits may be temporary, such as employment and training opportunities during the construction phase, while some will be long-term such as employment opportunities, increased access to agricultural land, and through the implementation of the CEGDP projects such as rural electrification, increased agricultural skills, women micro-credit scheme, and health and nutritional programs.				
Impact Extent	**Local**	Regional	International		
	The economic benefits will be limited to the villages within the AoI.				
Impact Scale	The economic benefits will be limited to the villages within the AoI.				
Frequency	The economic benefits will vary depending on the phase of the Project and will be experienced in both the construction and operation phases.				
Impact Magnitude	**Positive**	Negligible	Small	Medium	Large
	The impact of economic opportunities for affected villagers is positive.				
Receptor Sensitivity	Low	**Medium**	High		
	Affected villagers are able to participate in decision-making on the CEGDP priorities and directly receive the economic benefits provided.				
Impact Significance	Negligible	Minor	Moderate	Major	
	The impact significance is **positive**.				
Residual Impact Magnitude	**Positive**	Negligible	Small	Medium	
Residual Impact Significance	Negligible	Minor	Moderate	Major	
	The impact significance is **positive**.				

9.5.3 *Economic Displacement and Impacts to Livelihoods*

Economic displacement and impact to livelihoods are inextricably linked concepts. Economic displacement is defined by the United Nations Development Programme (UNDP) (2020b) as the restriction (partially or fully) of individuals or communities to land or resources that are important to their means of livelihood or economic wellbeing. Livelihoods comprise the capabilities, assets and activities required for a means of living (IRP & UNDP-India, n.d.). Economic displacement therefore is likely to have an impact on livelihoods.

Potential economic displacement and impacts to livelihoods associated with the Project, are described in the following sections.

9.5.3.1 Potential Impacts

The majority of Project affected households live a subsistent livelihood which relies heavily on land and other natural resources around them. The main form of land-based livelihoods are agricultural activities (e.g. farming, rearing livestock, etc.) and NTFP collection. The Project impacts on each of the land-based livelihoods are discussed separately, below.

Loss of Agricultural Land

Agricultural land will be acquired to accommodate wind turbines, access roads, 500kV trnamission line and the internal 35 and 115kV transmission line (refer to ***Figure 9.58)***. In the Sekong Province, the Project will need to acquire a total of 23.84 ha (affecting 2 households in Dak Tiem village) permanently. In addition, an area of 146.83 ha will be used temporarily during construction (affecting 168 households in 10 villages). There are 170 households in 18 villages that will have their land impacted both permanently and temporarily.

In the Attapeu Province, a total of 5.47 ha will be permanently acquired (affecting 3 households in Dak Samor village). In addition, an area of 9.70 ha (affecting 2 households in Dak Nong and Dak Yok villages) will be used temporarily during construction. Of these, 33 households in four villages will be impacted both permanently and temporarily. A summary of affected agricultural land is provided in ***Table 9.53***. The affected land was recorded as being used as primary and supplementary sources of livelihood.

The acquisition of land currently used for agricultural purposes will lead to economic displacement, since the land will be (permanently or temporarily) removed from its agricultural use, and unable to generate income for landowners and users. In this sense, the loss of agricultural land will cause economic displacement and impact on livelihoods. Whilst some households will be temporarily impacted, it is highlighted that during this period, the impact on livelihoods will experience a similar impact to those households experiencing permanent acquisition.

Figure 9.58: Agricultural Land Removal

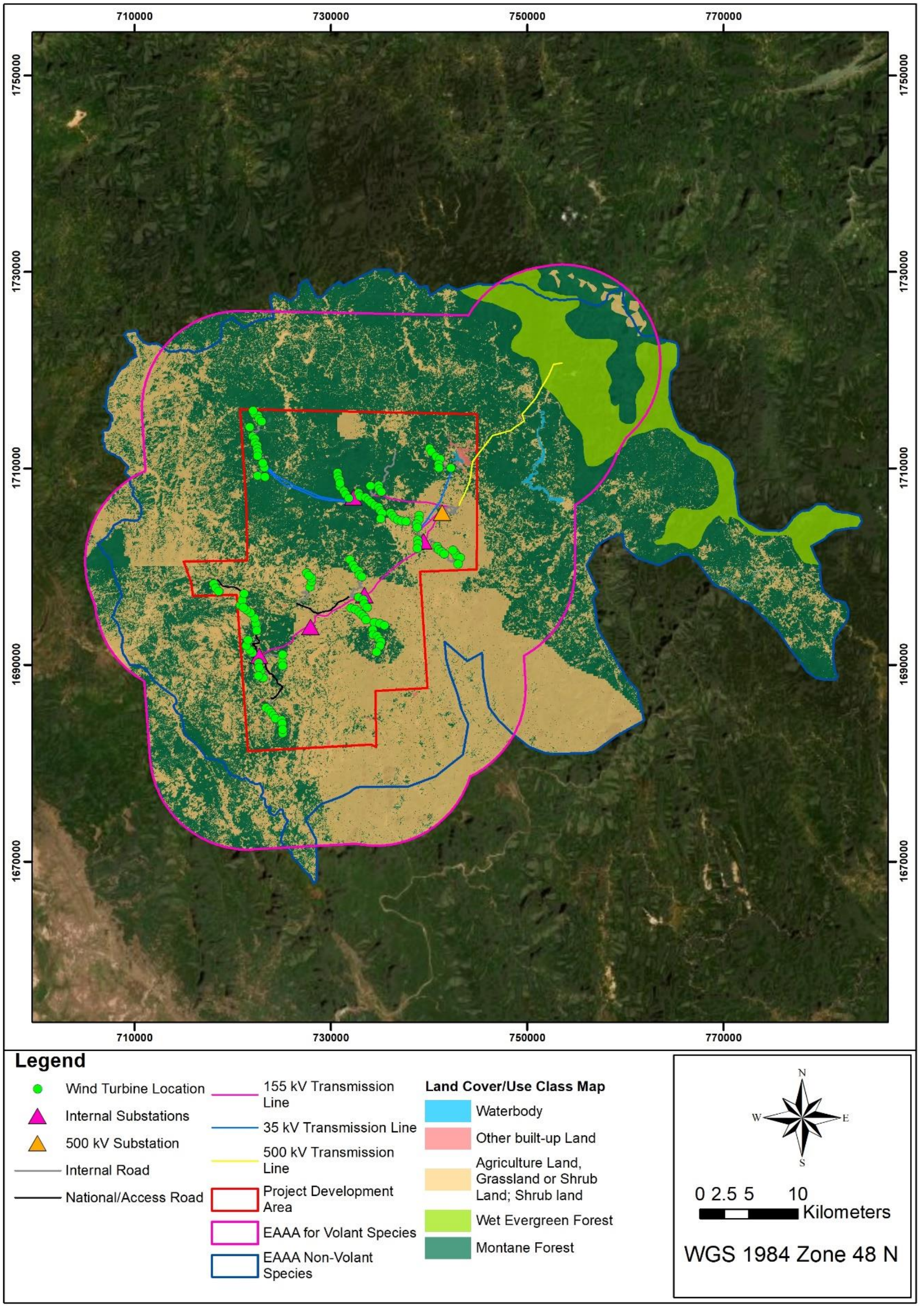


Table 9.53: Loss of Agricultural Land

No	Location	Project Activity	Loss of Agricultural Land						Livelihood Type (primary/ supplementary)
			Affected Area (ha)		Affected HHs (No.)			Total Affect HHs	
			Per.	Temp.	Per.	Per & Temp.	Temp.		
Dak Cheung District, Sekong Province									
1	Dak Tiem	Turbine site, Access Road	2.35	5.07	2	16	3	22	Both
2	Dak Xeng	Access Road	0.16	0.38	0	4	0	4	Both
3	Dak Yang	Turbine site, Access Road	1.09	1.2	0	4	0	4	Both
4	Dak Yen	Turbine site, Access Road	0.44	1.33	0	4	1	5	Both
5	Xieng Luang	Access Road, Internal TL 115kV	0.75	1.84	0	9	0	9	Both
6	Dak Terb	Internal TL 115kV, Turbine site, Access Road	0.06	6.07	0	21	16	37	Both
7	Tong Muang	Internal TL 115kV, Turbine site, Access Road	0	0.73	0	2	0	2	Both
8	Dak Dor	Internal TL 115kV	0.04	4.57	0	12	10	22	Both
9	Dak Den	Turbine site, Access Road	0.46	0.81	0	4	1	5	Both
10	Dak Rant	Turbine site, Access road, Internal TL 115kV, 35 kv ,Sub 500kV	2.65	14.94	0	26	18	43	Both
11	Dak Cheung	Access road	0.18	0.41	0	2	0	2	Both
12	Dak Lern	Access road	0.62	0.72	0	5	0	5	Both
13	Dak Kung	Turbine site, Access road, Internal TL 35 kv	1.09	1.15	0	5	0	5	Both
14	Dak Bong	Access road, Internal TL 115kV, 35kV, TL500kV	13.7	56.41	0	40	68	108	Both
15	Dak Muan	TL500kV	0.08	16.88	0	5	26	31	Both
16	Nonsavan	TL500kV	0.02	2.24	0	1	3	4	Both
17	Ngon Don	TL500kV	0.11	26.7	0	8	22	30	Both

No	Location	Project Activity	Loss of Agricultural Land						Livelihood Type (primary/ supplementary)
			Affected Area (ha)		Affected HHs (No.)			Total Affect HHs	
			Per.	Temp.	Per.	Per & Temp.	Temp.		
18	Dak Ta-ok Noi	TL500kV	0.04	5.37	0	2	0	2	Both
	Total		**23.84**	**146.83**	**2**	**170**	**168**	**340**	
Sanxay District, Attapeu Province									
1	Dak Nong	Internal TL 115kV,Turbine site, Access road	2.9181	5.3083	0	20	1	21	Both
2	Dak Samor	Turbine site, Access road	0.727	1.2842	3	6	0	9	Both
3	Dak Yok	Turbine site, Access road	1.0862	2.2363	0	3	1	4	Both
4	Dak Padou	Turbine site, Access road	0.7353	0.8714	0	4	0	4	Both
	Total		**5.47**	**9.7**	**3**	**33**	**2**	**38**	
	Grand Total		**29.31**	**156.53**	**5**	**203**	**170**	**378**	

Figure 4.5 presents locations of preliminary ancillary facilities. Based on the site visit conducted in November to December 2021 and June-July 2022, these facilities will be located on communal land, which is mostly unused land, grassland, and degraded forest. ***Table 9.56*** presents land requirements for preliminary ancillary facilities. 12.60 ha of agricultural land will be affected by land requirements of these ancillary facilities. In addition, 126.40 ha of land will be used for spoil disposal area. The spoil disposal area located approximately 2 km from Dak Seng (***Figure 4.5***), the area consists mostly degraded forest, shrub land and agriculture land.

Table 9.54: Land Requirement for Ancillary (Temporary) Facilities

No	Preliminary Ancillary Facilities	Total Area (ha)	Villages	Land		Agricultural Land		Land Use
				Area (ha)	Type	Area (ha)	Type	
1	Existing Local Crush Stone Point	0.25	Ngonedon	0	Communal	0.25	Garden land	crops
2	Potential Camp01	2.00	Dak Bong	0	Communal	2.00	Garden land	crops
3	Potential Camp02	2.00	Dak Ran	0.58	Communal	1.42	Garden land	Crops
4	Potential Batch Plant01	3.88	Dak Ran	0	Communal	3.88	Old garden land	Crops
5	Potential Crush Stone Production Plant01	2.65	Trongmueang	2.44	Communal	0.21	Garden land	Crops
6	Potential Batch Plant02	2.00	Trongmueang	1.46	Communal	0.54	Booking land	Empty land
7	Potential Camp03	2.00	Xiengluang	2	Communal	0	N/A	Forest
8	Potential Laydown Yard	50.00	Dak Tiem	50.00	Communal	0	N/A	Forest
9	Potential Crush Stone Production Plant02	4.00	Dak Tiem	0	Communal	4.00	Garden land	Crops
10	Potential Stone Resource Point02	9.00	Dak Tiem	8.70	Communal	0.30	Booking land	Empty land
11	Spoil Disposal Area	126.40	Dak Seng	-	-	-	-	-

Source: MWPCL, 2022.

In the Project area, land use arrangements for agricultural purposes are made via formal land use certificates (e.g., land title and land tax receipt), or an informal traditional booking system (refer to ***Chapter 7***). The DMS conducted in June-July 2022 suggests that, of 396 affected land parcels, 15 land parcels have land tiles (3.8%), 320 land parcels have land tax receipts (80.8%) and 61 land parcels are booking land (without land ownership documents e.g., land tax receipts) (15.04%).

The distribution of landownership between men and women varied across villages in the AoI. While most affected villagers identified that men and women have equal ownership of land, the land use certificate may state both names or the man's name only.

Through stakeholder engagement (refer to ***Chapter 6***), affected households have indicated that they are worried that they will not be reasonably compensated for the loss of agricultural land, and they have a preference for cash compensation. The affected villagers' concern is principally related to the limited availability of land suitable for rice cultivation, due to the mountainous terrain of the region. ***Section 7.2.2.2*** presents the consultations conducted by Compensation Committee on compensation unit rate where the village representatives were consulted with on unit rates as a means for market price survey. Resettlement Plan is prepared to address impacts to livelihoods due to Project land acquisition and grievance mechanism will be established to address land acquisition and compensation related grievances (refer to Chapter 7 of the RP for more details).

NTFP Collection

Social surveys undertaken confirmed that affected villagers, generally women, collect NTFP from the nearby forests (refer to ***Chapter 7***). Affected villagers are dependent on the collection of NFTP to supplement their livelihoods (e.g. Dok laiy, Ling zhi), and other household uses (e.g. firewood, wood for houses, sticks to make brooms). ***Figure 9.59*** depicts the areas where NTFP are collected.

In the Sekong Province, 101.04 ha of forest will be permanently removed, and 353.88 ha will be temporarily acquired, affecting a total of 1,752 households. In the Attapeu Province, a total of 49.75 ha of forest will be permanently removed, and 30.80 ha will be temporarily acquired, affecting 355 households (***Table 9.55***).

Although land is temporarily acquired for the Project, this may result in long-term impacts, as revegetation of the area after removal of the facilities in the area will require time. There is also potential that the clearance of forest may lead to a permanent impact, if revegetation is unsuccessful. As outlined in ***Section 9.4.3.7***, biodiversity offsets are typically required in certain situations to compensate for residual impacts to biodiversity and is the 'last resort option in the mitigation hierarchy'. The biodiversity offset rules for the project are detailed in ***Section 9.4.3.7***, to achieve no-net-loss. While the location of the biodiversity offset has not been decided, initial comments from ADB indicate support for this to occur outside of existing conservation areas / overlapping existing initiatives.

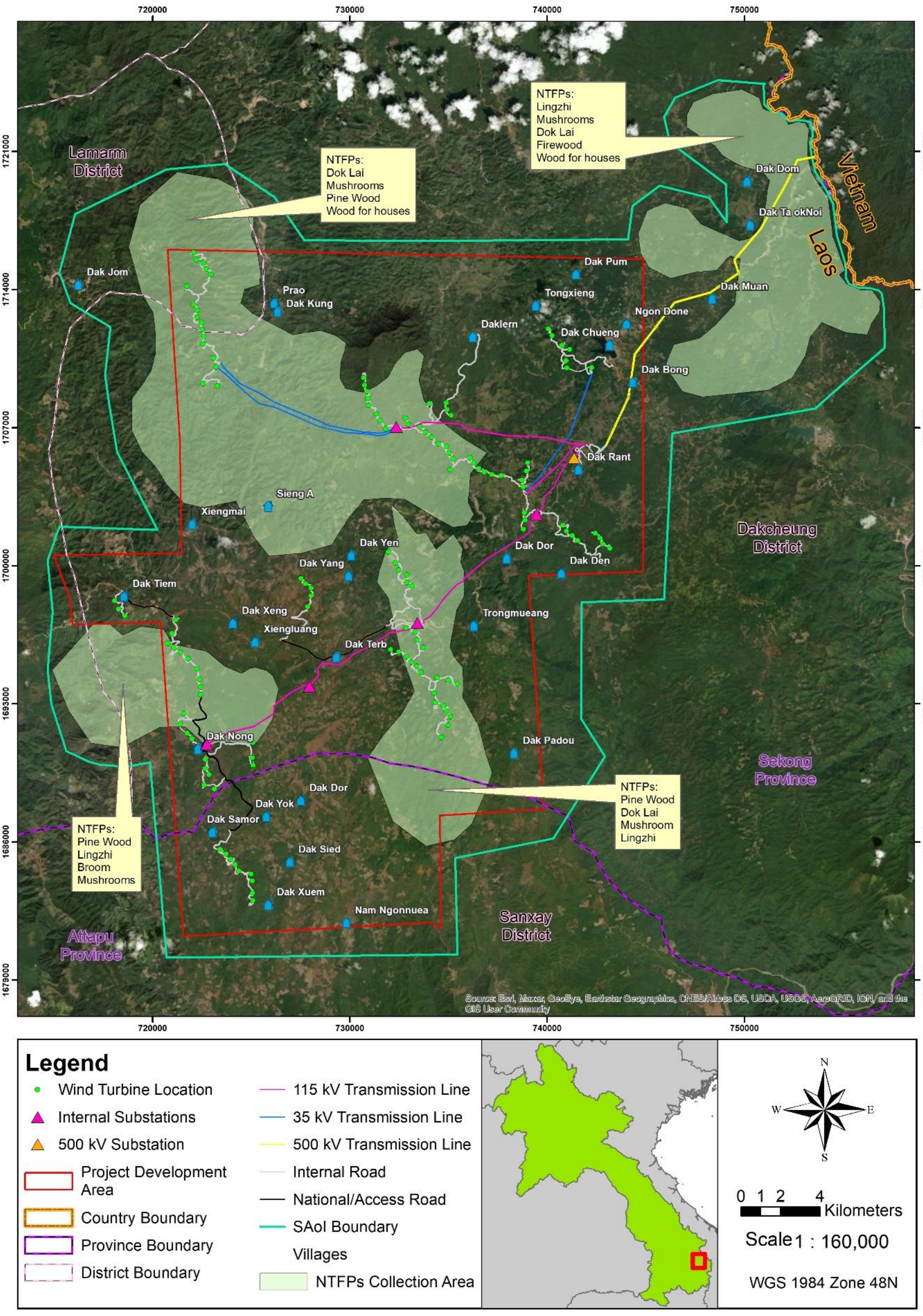
It is also noted that access to forests is still available and there will be improved access to forest resources associated with construction of access road in ***Section 9.5.2.1***. Given that small, fragmented areas of clearing will be undertaken, instead of larger areas, and new access provided by the Project, the overall impact to the supply of NTFPs will be negligibly affected.

This is further emphasized by the findings of the biodiversity assessment. ***Section 9.4.3*** also suggests that there will be limited forest clearance:

> *"In the context of there being significant areas of natural and modified forest remaining within the EAAAs, an estimated modification in the region of 100ha and transformation of roughly 50 ha of the lesser impacted forest habitat can be considered relatively 'small' in terms of the actual magnitude of effect. The WF development is unlikely to threaten the long-term viability of the forest habitat or species dependent on it, with large areas of forest to remain undisturbed."*

A summary of the impact on NTFP collection is provided in ***Table 9.55***.

Figure 9.59: NTFP Collection Areas



Source: Site visit conducted by Innogreen, November – December 2021

Table 9.55: Impact on NTFP Collection

Location	Project Activity	Produce	Affected Area (ha)		Affected HHs (No.)	Livelihood Type
			Permanent	Long term		
Dak Tiem	Access road	Mushroom, firewood, wood for houses	9.50	14.06	144	Supplementary
Xiengluang	Access road, Transmission line	Firewood, wood for houses	2.22	19.15	97	Supplementary
Dak Terb	Access road, Transmission line	Mushroom, firewood, wood for houses	7.39	23.36	149	Supplementary
Dak Yang	Access road	Mushroom, firewood, wood for houses	1.30	1.89	58	Supplementary
Dak Yen	Access road	Mushroom, firewood, wood for houses	2.60	5.92	117	Supplementary
Trongmueang	Access road, Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi	15.22	44.03	55	Supplementary
Dak Dor	Transmission line	Mushroom, firewood, wood for houses	0.01	2.34	100	Supplementary
Dak Den	Access road	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi	7.74	14.21	78	Supplementary
Dak Rant	Access road, Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi	22.01	44.69	63	Supplementary
Sieng A	Access road	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	9.16	30.59	32	Supplementary
Dak Jom	Access road	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	4	6.8	202	Supplementary
Dak Kung	Access road, Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	6.91	27.73	40	Supplementary
Daklern	Access road, Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi	4.69	36.45	38	Supplementary

Location	Project Activity	Produce	Affected Area (ha)		Affected HHs (No.)	Livelihood Type
			Permanent	Long term		
Tongxieng	Access road	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi	1.68	4	45	Supplementary
Dak Cheung	Access road, Transmission line	Mushroom, firewood, wood for houses	6.3	13.53	204	Supplementary
Dak Bong	Transmission line	Mushroom, firewood, wood for houses	0.07	11.48	54	Supplementary
Nong Don	Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	0.01	2.25	107	Supplementary
Dak Muan	Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	0.04	3.46	67	Supplementary
Dak Ta-ok Noi	Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	0.06	17.81	46	Supplementary
Dak Dom	Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	0.14	30.12	56	Supplementary
		Total Sekong	***101.04***	***353.88***	***1,752***	
Dak Nong	Transmission line	Mushroom, firewood, wood for houses, Dok laiy, Ling zhi, Brooms	6.34	11.84	72	Supplementary
Dak Samor	Access road		8.68	3.52	83	Supplementary
Dak Yok	Access road		2.35	1.27	58	Supplementary
Dak Padou	Access road		11.96	5.24	66	Supplementary
Dak Xuem	Access road		20.42	8.94	76	Supplementary
		Total Attapeu	***49.75***	***30.81***	***355***	
		Grand Total	***150.79***	***384.69***	***2,107***	

Affected villagers revealed that they were concerned about the clearing of and restricted access to the forest, as they would lose sources of food and firewood. NTFP collection remains an important source of livelihood as these products have high value and are able to be sold to buyers from nearby cities and Vietnam.

It is highlighted that the proposed permanent and temporary clearing of forest has been kept to a minimum, and comprises less than 1% of the total Project area. The number of affected households was determined based on the number of households who collect NTFP within the areas identified in ***Table 9.60***. The area of forest will be cleared will, amongst other things, allow for access roads to be laid. As stated in ***Section 9.5.2.1***, the access roads will provide greater access to other areas of the forest that the affected villagers may currently be unable to access, or have difficulty accessing. As such, while there are 2,107 households affected by the clearing of forest, the Project will not remove the ability for NTFP collection.

The biodiversity aspect of NTFP collection (ecosystem services) impacts will be covered within the biodiversity section (refer to ***Section 9.4***), as appropriate.

Existing Controls

The Project layout (including access road and transmission line routes) has been optimised to avoid physical displacement of villagers. Agricultural land and access to NTFP were also considered in the design process, and while unable to be avoided, the Project has minimised the magnitude of land acquisition and resettlement. In the current layout (Envision), the Project reduced the number of WTGs to 133 with the intention of reducing land acquisition and related impacts, particularly to agricultural and NTFP collection areas. The Project current layout results in an increased impact to agricultural land by 78.74 ha and NTFP collection area loss is reduced by 57.55 ha. The increased impact on agricultural land is attributed to the fact that villagers had already been informed of Project component locations, resulting in increased claims to land, agricultural activities on land and numbers of affected people.

Significance of Impacts

Methodology for Assessment of Impact Significance

The potential economic displacement and impacts to livelihoods are assessed in accordance with the criteria set out in ***Table 9.56*** and ***Table 9.57***.

Table 9.56: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

Table 9.57: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

Receptor Sensitivity

The affected villagers are considered to have **medium** sensitivity. This is due to their dependence on land-based livelihoods, namely agricultural practices and NTFP collection. Primarily, these land-based livelihoods are for the purpose of subsistence. Given the rural locality, it is difficult to participate in other sources of livelihood (e.g. not many wage-based or enterprise-based livelihood opportunities in or close to the villages in the AoI). This is particularly the case for vulnerable households (in particular poor households) that may already experience difficulties maintaining a secure form of livelihood. However, the Project will provide opportunities to participate in livelihood restoration mechanisms that will seek to restore the affected villagers' livelihoods to a minimum of existing levels, if not better.

Impact Magnitude

Given the number of households permanently and temporarily affected by economic displacement and impacts to livelihoods, the impact magnitude is considered to be **large**.

Impact Significance

As a result, the impact significance is designated as **major**.

9.5.3.2 Additional Mitigation, Management, and Monitoring Measures

MWPCL recognises that Project-related activities resulting in land acquisition can have adverse impacts on communities.

As such, a Resettlement Plan will be developed in response to the Project causing economic displacement and impacts to livelihoods. The Resettlement Plan will be prepared in consultation with the Government of Laos, and will define persons entitled to compensation, principles of compensation, methods of valuing affected assets, resettlement process and tools, grievance process, institutional arrangement for resettlement planning and implementation. This will include confirming specific households who are defined as vulnerable, so that appropriate steps can be taken to ensure they are able to access mitigation measures.

The following principles will guide the development of the Resettlement Plan:

- Provide a set of clear and transparent standards for compensation that will be applied consistently to all affected villagers.
- Compensation will be provided for loss of assets at full replacement cost (i.e. market value plus transaction costs (for instance registration and taxes)), and provide assistance to help affected villagers to improve, or at least restore their livelihoods.
- While reasonable efforts will be undertaken by the Project to identify land availability and options for replacement land, given the challenges in securing replacement land (refer to ***Section 9.5.3.1***), particularly for rice farms, this may be not be feasible. The Project will also help in obtaining and meeting the costs associated with securing land tenure in the name of both spouses, for those assisted to find alternative land.
- Wherever possible, in-kind compensation (e.g. land for land) will be offered to affected households (Ahs). Cash compensation will only be considered based on the preference of AHs.
- If replacement land options are not viable, other compensation measures may be investigated such as cash compensation for the value of the replacement land. It is a common practice in the region for resettlement compensation; however, experience and lessons learned across the world show that there are often consequences of providing cash compensation, and this is especially the case for ethnic groups that meet ADB SPS SR3 and IFC PS7 definition of IP and other marginalised groups due to their limited transaction experience. Accordingly, if cash compensation is offered, the Project will:

- Assess recipient's ability and financial literacy to use cash to restore their standard of living. If required, the Project should provide financial literacy classes to raise awareness on the use of compensation money.
- Provide incentives for affected households to purchase land (for instance, provide assistance in identifying suitable and secure replacement land. However, it is noted with that this will need to be discussed and agreed with local authority).
- Encourage deposition of cash compensation into a joint bank account under the name of both husband and wife. Deposition of cash compensation to either husband or wife bank account is possible if preferred and with consent from the other party.
- Seek to provide cash compensation as instalments over time, which provides the opportunity for recipients to develop improved financial management skills.

- Activities are planned and implemented with meaningful consultation, and the informed participation of those affected.
- All payments including compensation for loss of land, assets, structures, trees, etc. will be made to affected households prior to physical possession.
- Lack of formal legal rights to assets lost will not deprive affected villagers from receiving compensation and payments for non-land assets and entitlements.
- Livelihood planning should provide special assistance to women, minorities, and vulnerable groups who may be disadvantaged in securing alternative livelihoods.
- The customs and traditions, as well as the religious practices of all affected households, will be respected and protected.
- A timely, effective, and accessible Grievance Redress Mechanism will be established to manage issues and grievances related to resettlement.

9.5.3.3 Residual Impact Significance

The additional mitigation measures proposed will lower the residual impact magnitude to **medium**, however the impact significance remains as **moderate**.

Table 9.58: Economic Displacement Impact Assessment

Significance of Impact				
Potential Impact	Economic displacement and impacts to livelihoods from removal of agricultural land and forest (affecting NTFP collection).			
Project Phase	Pre-Construction	**Construction**	**Operation**	
Impact Nature	**Negative**	Positive	Neutral	
	Economic displacement and impacts to livelihoods will cause negative impact on affected villagers.			
Impact Type	**Direct**	Indirect	Induced	
	The Project will cause direct impact as removal of agricultural land and forest is required as part of the Project footprint.			
Impact Duration	**Temporary**	Short-term	Long-term	**Permanent**
	The removal of agricultural land and forest has temporary and permanent implications.			
Impact Extent	**Local**	Regional	International	
	The impact is limited to the villages in the AoI where land is required.			
Impact Scale	The impact is limited to the villages in the AoI where land is required.			

Significance of Impact					
Frequency	The impact will occur once (i.e. Permanent acquisition of agricultural land and forest will only occur once for the area required).				
Impact Magnitude	Positive	Negligible	Small	Medium	**Large**
	Due to the large number of households permanently and temporarily affected by economic displacement and impacts to livelihoods, the magnitude is large.				
Receptor Sensitivity	Low	**Medium**	High		
	The affected villagers have a medium sensitivity, due to their dependence on land-based livelihoods. However, they will be provided with opportunities to participate in resettlement planning and livelihood restoration mechanisms.				
Impact Significance	Negligible	Minor	Moderate	**Major**	
	The impact significance is moderate being mitigated by Resettlement Plan and Livelihood Restoration Program to ensure compensation is at full replacement cost, and livelihoods of those affected are restored, preferably, improved.				
Residual Impact Magnitude	Positive	Negligible	Small	**Medium**	
Residual Magnitude Significance	Negligible	Minor	**Moderate**	Major	

9.5.4 Impacts to Community Health and Safety

The Project has the potential to cause various community health and safety issues, in particular during the construction phase, as detailed in the below sections.

9.5.4.1 Potential Impacts

Infrastructure and Machinery

The presence of an active construction site, including the installation of new infrastructure and movement of large machinery, can lead to accidents and injuries if not managed appropriately. The presence of hazards around construction sites and laydown areas can create a range of safety issues, for villagers, or curious onlookers. These include:

- Villagers being struck by machinery, causing injury.
- Noise, vibration and dust resulting from general construction activities, which can cause disruptions in daily life and / or health impacts.
  - An increase in noise may interrupt sleep or cause other disruptions to community activities. Notably, disruptions associated with noise (such as sleep disruptions) have been linked to increases in depression and anxiety.
  - Increased vibration may also have an impact on buildings and other structures (e.g. causing cracks) if nearby to construction activities. Vibrations can be associated with a range of construction activities. Given the nature of the Project, in that piling and blasting will not be required, potential vibrations are not expected to be significant. For this reason, it has not been assessed in detail. Further, it is noted that vibrations were not identified during community consultation as an issue of concern.
  - Excessive dust may be generated from the movement of dirt and machinery. This dust may exacerbate the effects of respiratory diseases (e.g. asthma, upper respiratory infections).
  - Vibration from the use of machines may cause cracks of foundations and buildings.

It is noted that community health and safety impacts associated with infrastructure and machinery is limited to the construction phase, as infrastructure will be secured and construction machinery removed upon completion of construction.

Vehicle Movements

There will be a range of Project-related vehicles movements, including vehicles delivering materials and workers to and from the Project site. These movements have the potential to contribute to or be the root cause of accidents, particularly given there will be a higher number of heavy vehicles in the area. Specifically, the Project will undertake the delivery of workers and materials over an eight-month period involving a maximum total of 180 transport movements per day, as summarised in ***Table 9.59***.

Table 9.59: Project Vehicle Movements, Construction

Vehicle Type	Vehicle Movements (Times Per Day)	Purpose of Movement
Truck Bus	15	Construction materials Workers
Truck	50	Wind turbine components
Truck	15	Erection and transport work
Truck	100	Foundation poring
Total	**180**	

Source: EIA, 2022

Given its rural locality, there are low volumes of traffic currently present in the villages in the AoI. A traffic survey undertaken in September 2020 identified a total of 203 vehicle movements per day towards Dak Cheung District, of which 16 vehicles (8%) were trucks, and 179 vehicle movements towards Sekong District, of which 11 (6%) were trucks. This data is summarised in ***Table 9.60***.

Table 9.60: Traffic Survey, September 2020

Vehicle Type	Vehicles Travelling Towards Dak Cheung District (Per Day)		Vehicles Travelling Towards Sekong District (Per Day)	
	No.	%	No.	%
Two-Wheel Vehicle (Bicycle, Motorcycle, agricultural vehicle)	140	68.97	127	70.95
Car, Jeep, Pick-up	41	20.20	36	20.11
Small bus or Passenger vehicle (14 seats)	6	2.96	5	2.79
Truck (Light, Heavy of all types)	16	7.88	11	6.15
Total	**203**	**100**	**179**	**100**

Source: EIA, 2022

The total baseline truck and bus movements amounts to 38 vehicle movements per day. The Project will cause the number of truck and bus movements to triple. Villagers may not be accustomed to the hazards and risks presented by numerous heavy vehicles and machines (e.g. heavy vehicles require large stopping distances, there are blind spots / low visibility of pedestrians, etc.) and may inadvertently be involved in an incident. In addition, there will be increased noise and dust along the roads due to heavy vehicle movements, hence villages/ households located adjacent or in close proximity to roads may experience impacts. The site visit conducted in November to December 2021 suggests that the local communities are not familiar with associated health and mental health of noise, shadow flickers and pollution as there are currently no existing industries or large development in the village area.

However, impacts of noise, shadow flicker and other pollution will be covered under mitigation measures proposed in this ESIA and respective environmental management plans such as Noise and Vibration Management Plan, Waste Management Plan, Air Quality Management Plan, etc.

The potential health and safety impact associated with transport movements will be limited to the construction phase, given that there will not be deliveries of material during the operation phase, and a limited operational workforce (53 people) will need to commute to the site for maintenance or other activities.

Security

The Project will require security for the duration of the construction phase, as the Proponent has previously experienced theft of construction materials (e.g. copper wire, power supply, lighting protection, etc.). The number of security personnel required will be confirmed as part of detailed Project planning.

If conflict arises between the Project and villagers, there is potential for security personal, as has been seen in other large-scale developments, to use excessive force, which in turn can pose a risk, including a risk to human rights.

Potential Spread of Diseases

The Project will employ a range of people during construction and operation. There is potential for the workforce to introduce and/or increase the rate of spread of diseases in the Project area including COVID -19. This may occur as a result of waste management practices, or from the spread of diseases brought in by workers and their households. Flu/cold/fever and diarrhoea are common diseases occurring in the villages in the AoI.

Another factor that will influence the prevalence and rates of diseases is the creation of vector habitat during construction and potentially operation. Standing water (i.e. vector habitat) can be created in a variety of ways, such as alterations to drainage patterns during earth moving activities and establishment of trenches (which can fill with water during rainy periods). Vector habitat is of particular note in a locations such as Laos, where heavy rainfall occurs during the wet season creating large areas of standing water. This could be exacerbated by the Project, for example if trenches fill with water during the wet season. This could increase the prevalence of vector borne diseases, such as malaria, which has affected some villagers in the AoI.

Associated with the increase in transactional sex (discussed above), there is also a potential for rates of sexually transmitted infections to increase, including human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS).

FGDs and KIIs revealed that villagers were most concerned about the spread of COVID-19, and did not identify concerns with the spread of other diseases. Nonetheless, the spread of any diseases may place additional pressure on health infrastructure, discussed below.

9.5.4.2 Existing Controls

A Community Health and Safety Management Plan: Sets out the agreed controls and mitigation measures to protect the health and safety villagers in the AoI. This includes provisions for:

- Outline reuiqrements and measures to ensure community health, safety and security in compliance with IFC PS4
- Identify road safety hazard and mitigation measures for road safety for the community. Provision of traffic safety training to the communities prior to construction of any small and major roads. The training will be with the objectives of getting the communities familiar with the relevant traffic laws and aware of measures to be undertaken in case road accidents occur (to villagers and cattle).
- Fencing and/or security to prevent community members from accessing the construction site;

- Identifying and being aware of traffic hazards involving villagers;
- Requirements for construction workers to notify villager heads of key construction activities such as:
  - Deliveries of wind turbines and other large objects;
  - High volumes of truck movements;
  - Activities potentially causing noise, vibrations and/or dust; and
  - Potential presence of UXO
- An example of a program to be implemented as part of the CHSP is a community environmental and safety awareness program, which seeks to enable villagers to understand and identify construction risks, and how to stay safe. The program will include the following topics:
  - Activities that cause disruption such as air, dust, traffic and noise impacts.
  - Road safety, especially for children.
  - Workers code of conduct, worker's health and safety plan.
  - Security management.
  - Emergency preparedness and response.
  - Gender-Based violence and harassment
  - Sexually transmitted diseases such as HIV/AIDS

Potential Spread of Diseases

- It is understood that villagers in the AoI have received COVID-19 vaccinations from the Government of Lao PDR.
- All workers will be accommodated in the labour camp during construction to prevent occurrence of spreading communicable diseases to local communities
- Provide training on the most common communicable diseases to all workers to raise awareness of the likely diseases, symptoms, preventative measures, transmission routes, and treatment;
- Ensuring health check-ups of all labourers employed to screen pre-existing communicable diseases; and
- Provide access for workers to healthcare services (facilities) and medical care.

9.5.4.3 Significance of Impacts

This section assesses the significance of impact on community health and safety from construction activities. It is noted that the sensitivity and magnitude criteria for community health and safety differs from the impact assessment methodology (***Section 6***), as described below.

Methodology for Assessment of Impact Significance

Community health and safety is assessed in accordance with the criteria set out in ***Table 9.61*** and ***Table 9.62***.

Table 9.61: Sensitivity Assessment Criteria for the Impact on Community Health and Safety

Sensitivity Criteria	Contributing Criteria
Low	Communities with sufficient coping strategy who feel little or no challenge to their wellbeing as a result of project activities. They may share resources with the project occasionally and broadly understand the hazards associated with project components.
Medium	Communities with some coping strategy and some vulnerabilities, who are classed as less sensitive than the high sensitivity group. They are likely to experience temporary inconvenience as a result of changes in environmental or social determinants of health. They may share resources occasionally with the project. The communities express some concerns and anxieties of the impact of the project on their wellbeing. They have some, but far from complete, understanding of the technical hazards associated with project components.
High	Community groups who are very vulnerable because they have high sensitivity to the impacts of the project and very limited coping strategies. The technical hazards of a project component may be unfamiliar and poorly understood by a community; and this could increase sensitivity.

Table 9.62: Criteria for Impact Magnitude for Assessment of Impact on Community Health and Safety

Magnitude	Criteria
Negligible	Project does not impact on environmental, health and safety issues to the surrounding community as the project implements good international industry practices and environmental, health, safety guidelines, following national law/regulations on Environmental, Health and Safety as well as other Recognised internationally sources.
Small	Project will impact on community health, safety and security within villages in the AoI.
Medium	Project will impact on community health, safety and security at regional level.
Large	Project impacts on community health, safety and security at a national level.

Receptor Sensitivity and Impact Magnitude

Construction activities occurring in the vicinity of the villages in the AoI will expose villagers to new impacts, and has the potential to exacerbate existing risks (e.g. traffic). There is a limited ability for villagers to influence construction activities that may cause health and safety impacts, and as the Project will change the baseline environment (albeit for a limited amount of time, during the construction phase only), the villagers have a **high** sensitivity.

The impact on community health and safety from construction activities is **small**, as the impacts are limited to the villages in the AoI.

Impact Significance

As such, the impact significance is assessed to be **moderate**.

9.5.4.4 Additional Mitigation, Management, and Monitoring Measures

Other environmental management plans such as the Traffic Management Plan, Air Quality Management Plan, and Noise and Vibration Management Plan will be prepared to support the CEMP. Refer to the environmental impact assessment sessions for an outline of content will be included in these management plans.

In addition, the following will be prepared to manage potential impacts on community health and safety:

- **SEP:** The SEP will describe how Project stakeholders will be engaged throughout the Project lifecycle. The SEP will establish a systematic approach to stakeholder engagement that will help the Project build and maintain a constructive relationship with stakeholders. It will also ensure that

Project information on environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format.

- **Grievance Redress Mechanism (GRM) (within the SEP):** A grievance mechanism will be established as part of the SEP to provide villagers with an accessible and inclusive means to raise issues and grievances and allow the Project to respond to and manage such grievances. During the EIA, ESIA consultations and Project information disclosure and consultation with 32 villages in July and September 2022, they have been clearly informed of dedicated GRM for communities which is a separate from GRM for Project workers (refer to Section 5 of the SEP for more details). Additionally, they will continuously be informed of GRM in future engagements and posters pertaining grievance receiving channel will be displayed in the villages To ensure that the community grievance is received by responsible unit designated by the Project, the following measures can be put in place:
  - The management of GRM for workers and community should work in collaboration. If it was found that a villager has lodged their grievance to the wrong channel, the worker GRM should pass on the grievance to community GRM; and
  - The villagers should be made understood of follow up procedure. If the villagers lodge a grievance and do not get a response/confirmation back within specified time, they should follow up on their lodged grievance with the Project.
- **Local Content and Influx Management Plan:** In addition to the aspects outlined in ***Section 9.5.2.4***, the Local Content Plan will include:
  - A Workers Code of Conduct, which identifies behavioural standards and cultural awareness requirements for all workers to comply with.
  - A Security Code of Conduct will outline guideline for security personnel and will require security personnel to have specific training relating to:
    - The use of force, such as avoiding the use of force where possible and in accordance with national regulations where necessary).
    - How to communicate and engage with the local communities
    - GBV training
  - All security personnel will be required to undergo background check prior to employment. Security personnel will be prohibited from engaging in armed conflict, or violence towards villagers (including sexual abuse or gender-based violence).
  - The SEP will inform the communities near the Project regarding the risks and consequences of trespassing. Such engagement should start prior to the start of construction activities.
- In addition, the SEP will ensure that the communities are aware of grievance redress mechanism to lodge any grievances in relation to the conduct of security personnel. **Occupational Health and Safety Management Plan:** Sets forth the agreed controls and mitigation measures to protect the health and safety of workers. This will include:
    - Screening of migrant workers prior to entering Laos to ensure they are fit to undertake their relevant tasks/roles.
    - Safety audits which will occur during the construction and operation of the Project, to ensure safety procedures are complied with.
    - Induction and training requirements for all workers, including site-specific induction and training to highlight safety risks and mitigations, and task-specific training (e.g., complying with speed limits, etc.).
    - Measures to mitigate against the spread of communicable diseases including COVID-19 amongst workers, and from workers to other villagers.

- Measures to prevent and mitigate the spread of sexually transmitted infections, including HIV/AIDS.

9.5.4.5 Residual Impact Significance

Through the implementation of the additional mitigation measures, the residual impact significance is assessed as **negligible**.

Table 9.63: Impact Assessment for Community Health and Safety

Significance of Impact					
Potential Impact	Community health and safety.				
Project Phase	Pre-Construction	**Construction**			Operation
Impact Nature	**Negative**	Positive			Neutral
	Accidents or injury to community members.				
Impact Type	**Direct**	Indirect			Induced
	Machinery and infrastructure in a construction site are risks to community health and safety.				
Impact Duration	Temporary	**Short-term**		Long-term	Permanent
	The impact will occur in the construction phase.				
Impact Extent	**Local**	Regional			International
	The impact is limited to the villages in the AoI.				
Impact Scale	The impact is limited to the villages in the AoI.				
Frequency	The impact is not expected to occur frequently.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact is limited to the villages in the AoI.				
Receptor Sensitivity	Low	Medium			**High**
	There is limited ability for affected villagers to influence Project construction activities that may cause health and safety impacts.				
Impact Significance	Negligible	Minor		**Moderate**	Major
	The impact significance is moderate.				
Residual Receptor Sensitivity	**Low**	Medium			High
Residual Impact Magnitude	Positive	Negligible		**Small**	Medium
Residual Impact Significance	**Negligible**	**Minor**		**Moderate**	Major
	Through Project information disclosure and the community environmental and safety awareness programs, affected villagers will be able to understand and identify construction risks, and be able to stay safe.				

9.5.5 Impacts to Occupational Health and Safety

The Project will employ approximately 1,300 workers during construction (at the peak period), and up to 80 workers during operation. Occupational health and safety hazards during the construction and operation of the Project are similar to other large industrial facilities and infrastructure projects. They may include physical hazards, such as working at heights, working in confined spaces, working with rotating machinery and falling objects.

9.5.5.1 Potential Impacts

Given the nature of the Project, workers are at risk of occupational health and safety incidents. The WBG EHS Guidelines for Wind Energy (2015) highlight the following key occupational health and safety risks related to windfarm projects:

Working at Heights

Working at height occurs frequently throughout all phases of construction. The main focus when managing working at height should be the prevention of a fall. However, additional hazards that may also need to be considered at any wind energy facility and is especially relevant for maintenance purposes include falling objects and adverse weather conditions (wind speed, extreme temperatures, humidity, and precipitation/rain).

Working in Remote Locations

Given the Project is located in a remote area of Lao PDR, travelling to and from the Project site increases the risk of road accidents and injuries occurring. Based on the site visits conducted in November and December 2021, it is suggested that the conditions of the access roads to the villages and the Project site is generally poor. As such, adverse weather conditions may contribute to dangerous driving conditions.

The risks of emergency situations are amplified in remote areas due to limited/poor access to assistance. Based on the KIIs, there are no firefighting departments available at the district level and limited healthcare facilities in nearby villages. Furthermore, travelling to a hospital may take between 1 to 3 hours. This creates a risk.

Another key risk, which is common when working in a remote area, is the potential inability to communicate. Remote areas such as mountains and forests often have limited of mobile/internet signal; this may include 'blackspots' where there is no signal at all. This poses a threat to workers, who, without being able to access mobile/internal signals, may have no way of calling for help in an emergency.

Lifting Operations

During the construction phase, components are generally assembled and transported to the site where assembly will take place. This involves using large, complex equipment to repeatedly lift loads of varying dimensions and weights. The hazards associated with the use of lifting equipment in construction are:

- Hazards related to the loads, e.g. crushing due to impact of moving objects or loads falling from vehicles;
- Hazards from moving vehicles or collapsing structures, i.e. cranes falling over because of improper fixation or strong wind, unsafe loads, loads exceeding the safe weight limits;
- Falling from lifting platforms or being crushed when the platform moves;
- Hazards related to poor environmental conditions that may interfere with communication between workers (e.g. poor mobile/internet signal), or adverse weather conditions resulting in sweaty/slippery objects; and
- Contact with overhead electrical cables.
- Manual lifting tasks with high loads or repetition that may induce musculoskeletal disorders (MSDs), e.g. lower back pain. In addition to MSDs, manual lifting tasks can also lead to accidents causing acute trauma such as cuts or fractures.

9.5.5.2 Existing Controls

The following existing controls and mitigation measures will be implemented according to the WBG EHS Guidelines for Wind Energy (2015).

Working at Heights

- Eliminate or reduce the requirement to work at heights.
- If working at heights cannot be eliminated, use work equipment or other methods to prevent a fall from occurring.
- Ensure all structures are designed and built to the appropriate standards and have the appropriate working at heights systems fitted.
- Suitable exclusion zones should be established and maintained underneath any working at heights activities, where possible, to protect workers from falling objects.
- Ensure all employees working at heights are trained and competent in the use of all working at heights and rescue systems in place.
- Provide workers with a suitable work-positioning device; also ensure the connectors on positioning systems are compatible with the tower components to which they are attached.
- Ensure that hoisting equipment is properly rated and maintained and that hoist operators are properly trained.
- When working at heights, all tools and equipment should be fitted with a lanyard, where possible, and capture netting should be used if practicable.
- Signs and other obstructions should be removed from poles or structures prior to undertaking work.
- An approved tool bag should be used for raising or lowering tools or materials to workers on elevated structures.
- Avoid conducting tower installation or maintenance work during poor weather conditions and especially where there is a risk of lightning strikes.
- An Emergency Response Plan (ERP) should be in place detailing the methods to be used to rescue operatives should they become stranded or incapacitated while at heights.

Working in Remote Locations

- Suitable communication equipment available for the work crew.
- The training and competence of personnel working remotely and the readiness of all necessary safety equipment at that location.
- Supervision by competent personnel who are empowered to make decisions based on events and conditions at the work location.
- Means for managers to track the exact location of the working crew.
- Local emergency plan in place.
- Provision of suitably qualified first-aid-trained personnel in the work crew.
- Snake guard should be included as personal protective equipment (PPE) for the workers.

Lifting Operations

- Ensure all relevant information is known about the load, e.g., the size, weight, method of slinging, and attachment points.
- Ensure all lifting equipment (including load attachment points) is suitable, capable of supporting the load, in good condition, and in receipt of any statutory inspections required.
- Ensure all supervisors, equipment operators, and slingers are trained and competent in the lifting equipment and intended lifting techniques.

- Where possible, exclusion zones are to be established and maintained in order to prevent any unauthorized access to lifting areas.
- When lifting large loads, ensure weather conditions are favourable for the task.
- Safe operating parameters of heavy lifting equipment should not be exceeded at any time.
- A planning meeting between all parties involved in the lift should be carried out and should include: the details of the lift, the roles of each party involved in the lift, and the methods used to communicate instructions among the parties.

9.5.5.3 Significance of Impacts

Methodology for Assessment of Impact Significance

Occupational health and safety is assessed in accordance with the criteria set out in ***Table 9.61*** and ***Table 9.62***.

Receptor Sensitivity and Impact Magnitude

The sensitivity of the receptor is considered to be **low** as the workforce engaged for key activities related to working at height and lifting operations are expected to be trained to perform the job.

With the implementation of existing controls and mitigation measures according to the WBG EHS Guidelines for Wind Energy (2015), the impact magnitude is expected to be **small**.

Impact Significance

The significance of impacts to occupational health and safety is thus considered to be **negligible**.

9.5.5.4 Additional Mitigation, Management and Monitoring Measures

The nominated EPC Contractor will be required by the Proponent to meet regulatory requirements, as they relate to occupational health and safety. Working and living conditions are discussed under assessment section of ***Section 9.5.6***. Additionally, a number of policies and management plans will be implemented in response to the identified potential impacts to occupational health and safety, namely:

- **Occupational Health and Safety Management Plan:** Sets forth the agreed controls and mitigation measures to protect the health and safety of workers, including induction and training requirements (refer to ***Section 9.5.4.4***).
- **Emergency Preparedness and Response Plan:** Outlines the measures to respond to unplanned events or emergencies that may result in injury or death.
- **SEP:** The methodology and timing of stakeholder communication, including a community environmental and safety awareness program will be included in the SEP (refer to ***Section 9.5.4.4***), to support the aforementioned management plans. Grievance mechanism to be developed as part of the SEP for affected communities. The Project will ensure its own and EPC contractors’ grievance mechanism for workers and communicate clearly to workers of this mechanism.
- A Workers’ Camp Management Plan will also be prepared to govern the operation of the workers’ accommodation facility.
- The Local Content and Influx Management (covering Labour Management) will outline requirements and measures to ensure labour and working conditions in compliance with IFC PS2.

9.5.5.5 Residual Impact Significance

Through the implementation of the additional mitigation measures, the residual impact significance is assessed as **negligible**.

Table 9.64: Impact Assessment for Occupational Health and Safety

Significance of Impact					
Potential Impact	Occupational health and safety impacts from the construction works				
Project Phase	**Pre-Construction**	**Construction**			**Operation**
Impact Nature	**Negative**	Positive			Neutral
	Accidents or injury to workers.				
Impact Type	**Direct**	Indirect			Induced
	Machinery, infrastructure and construction activities in a construction site are risks to occupational health and safety.				
Impact Duration	Temporary	**Short-term**		**Long-term**	Permanent
	The potential impact will occur in the construction phase (short-term), and the operation phase (long-term).				
Impact Extent	**Local**	Regional			International
	The impact is limited to the workers on the Project.				
Impact Scale	The impact is limited to the workers on the Project.				
Frequency	Impacts have the potential to occur throughout the life of the Project (Pre-Construction, Construction and Operation Phases)				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is expected to be small with existing control / mitigation measures.				
Receptor Sensitivity	**Low**	Medium			High
	Sensitivity of workers is considered low with skilled workers trained for key activities related to working at height and lifting operations				
Impact Significance	**Negligible**	Minor		Moderate	Major
	The impact significance is negligible.				
Residual Receptor Sensitivity	**Low**	Medium			High
Residual Impact Magnitude	Positive	**Negligible**		Small	Medium
Residual Impact Significance	**Negligible**	Minor		Moderate	Major
	Through the Project HSE training, HSE policy, Occupational Health and Safety Management Plan and Emergency Preparedness and Response Plan, the workers will be able to identify construction risks, minimize the risks and respond to the risks and emergencies.				

9.5.6 Impacts Associated with Influx

Influx or in-migration relates to the movement of people to a Project area in anticipation of, or in response to, economic opportunities associated with a project. This includes direct employment by the project (e.g. construction worker, supplier of materials, etc.) as well as indirect employment (e.g. restaurant operators who may experience higher patronage from the construction workforce requiring them to employ more people, etc.).

The workforce requirements for the Project are stipulated in ***Chapter 3***, it is anticipated that approximately 560 directly employed workers will move to the AoI during the construction phase. This does not include the workers' families (if applicable), or any other people who may move to the local area to seek economic benefits associated with the Project.

There are a number of negative impacts of influx, such as increased risks to community health and safety, increased transboundary movements, and increased pressure on infrastructure and resources. These will be discussed in the sections, below.

9.5.6.1 Potential Impacts

Labour and Working Conditions

There are a number of fundamental principles and rights at work that apply to all workers, and these are reflected in international standards (e.g. the International Labour Organisation (ILO) Declaration on Fundamental Principles and Rights at Work and the Universal Declaration of Human Rights). Without appropriate safeguards in place, a range of potential impacts can arise, including discrimination within the workplace, mistreatment of migrant labour or other vulnerable groups, and the use of forced labour[36] (including bonded labour[37]), or child labour [38]. Additionally, workers' mistreatment may extend to:

- Poor condition of workers' accommodation (e.g. poor hygiene standards, lack of privacy, etc.); and/or
- Undue exposure to occupational health and safety risks that lead to or increase the risk of serious injury or death (e.g. lack of training/qualification, inadequate personal protective equipment (PPE), etc.).

Given that 40% of households are identified as vulnerable households, there is a potential for these villagers to be unknowingly engaged in forced labour situations in an effort to increase their income.

Migrant workers may also be vulnerable, depending on their individual socio-economic status. As with local workers, migrant workers may also be unknowingly engaged in forced labour or arrive in Laos with failed expectations of living and working conditions.

In the Lao PDR, the Government has sought to prevent mistreatment of local and migrant workers through the ratification of international conventions and the establishment of local legislation, such as the Labour Law.

Transactional Sex

The increased population due to the presence of a construction workforce, typically made up of males working away from home, may attract sex workers to the local area. Female villagers who are vulnerable may also seek to capitalise on the availability of disposable income of construction workers, and may seek out transactional sex (IFC, 2009). Notably, villagers did not raise the prevalence of sex workers as an existing issue within the villages in the AoI (refer to stakeholder engagement outcomes in ***Chapter 6***).

It is noted that the majority (approximately 60% or 780 people) of workers required during the construction phase will be locals. The small proportion of workers from outside the area (approximately 40% or 520 people) will decrease the risk of human trafficking and transactional sex occurring. In addition, workforce behaviours will be bounded by a Workers' Code of Conduct and the Project will establish advisory services for workers as well as health care provision (incorporated within typical health checks and on an as needs basis).

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[36] Forced labour is defined as "all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered himself voluntarily" (ILO, n.d.a)

[37] Bonded labour (or debt bondage) is a form of forced labour in which workers are forced to work in order to pay off their on debts or inherited debts (ILO, n.d.b)

[38] The ILO (n.d.c) defines 'child labour' as the work that is mentally, physically, socially or morally dangerous and harmful to children, and/or interferes with their schooling.

Community Dynamics and Gender-Based Violence

The in-migration of workers may change community dynamics and may be part of villagers' concerns that outsiders may deceive women and children (according to FGDs with women groups). It is anticipated that the nominated EPC Contractor will be a Chinese company and may hire Chinese workers for the Project. Given that the majority of the affected villagers are part of an ethnic group, comprising Triang, Yae and Katu peoples, it is likely that Chinese workers will have different customs and traditions to the ethnic groups that will reside in the Project area. These cultural differences have the potential to cause friction in the community, especially if local customs and traditions are not respected by foreign workers. The potential erosion of ethnic culture is assessed separately, in ***Section 9.5.8***.

Gender-based violence, that is defined as "harmful acts directed at an individual or a group of individuals based on their gender" (UN Women, 2020) has the potential to occur. Gender-based violence may take many forms, including (but not limited to) domestic violence, sexual violence, human trafficking (refer above). Despite this, it is noted that villagers did not raise gender-based violence as a concern as they have been equipped with how to identify gender-based violence and resources to contact should this occur. However, this should be viewed with a precautionary approach due to the acceptance of the society regarding traditional roles of men and women, domestic violence may be underreported or not fully understood by victims.

Public Infrastructure and Resources

The Project has the potential to impact on public infrastructure and resources, particularly relating to an increased demand on local hospital and health care facilities, as described below.

During the construction phase, there will be a temporary an increase in the local population from workers (estimated peak workforce of 1,300 people) (refer to ***Table 3.6***). The increased population has a potential to have an impact on public infrastructure, including hospitals and health care facilities.

Through KIIs and FGDs, community members voiced concerns of an increased workforce on hospital and health care facilities. Community members are concerned that the increased demands from the construction workforce may jeopardise their access and level of care available. Villagers most commonly visit healthcare centres (10 of 23 villages in the AoI have healthcare centres) or community hospitals (one in Dak Cheung District, and one in Sanxay District), however the commute to these facilities may encounter barriers to travel for instance there may be poor road conditions or villagers lack a means of transportation (refer to ***Section 8.5***). Villagers therefore consider the healthcare facilities as insufficient to address their current needs.

The increased population residing in the villages in the AoI will also place pressure on resources such as electricity, water (drinking and sanitation), and food supply. During construction and operation, the Project will source its power supply from the Lao grid (EDL) with estimated demand of 4,000 MWh/year during construction and 150 MWh/year or 400 kWh/day during operation. The water required for construction of the Project construction will be sourced from groundwater/surface water with an estimated water requirement of 1,000 m^3/day or 30,000 m^3/month. During operation, water will be sourced from from groundwater or surface water. The estimated total water consumption during operation is 20 m^3/day, which includes will be 10 m^3/day for domestic use and drinking water and 10 m3/day for the plants.

The increased demand may result in shortages, which has the potential to increase the price of resources, and in turn can make it challenging for villagers from to access resources due to the inflated prices.

As the operation phase does not involve a large workforce (i.e. 80 workers), it is not anticipated that Project operations will contribute to additional impacts on public infrastructure.

9.5.6.2 Existing Controls

Labour and Working Conditions

- A number of legislative requirements exist to protect local and migrant workers, which all employers must comply with. A Local Content and Influx Management Plan (including Labour Management Plan and Local Procurement Management Plan) will be prepared.

Community Dynamics and Gender-Based Violence

- Gender-based violence is not currently occurring within the villages in the AoI, however this may be due to the acceptance in the society regarding the traditional roles of men and women. As such, there is a potential for the gender-based violence to be underreported or misinterpreted by villagers. The government and NGOs have engaged with villagers regarding gender-based violence and gender equality to raise awareness and equip them with resources.

Public Infrastructure and Resources

- The EPC Contractor plans to have a healthcare facility at each camp which includes a nurse/doctor to treat workers directly whenever possible. This will reduce pressure on the local healthcare facilities. The healthcare workers will be recruited from outside the AoI to avoid impacting existing providers.
- A Water Use Plan will be prepared, that outlines how groundwater or surface water will be used (refer to ***Section 9.3.6***).
- Electricity generators may be brought in to supplement the supply of electricity during the construction of the Project.
- Food supply may be brought in from outside the local area, to minimise local supply of food, or can be ordered in advance so that local suppliers are able to cater for the increased demand.

9.5.6.3 Significance of Impacts

Methodology for Assessment of Impact Significance

Community health and safety is assessed in accordance with the criteria set out in ***Table 9.61*** and ***Table 9.62***.

Receptor Sensitivity and Impact Magnitude

The villagers have a **medium** sensitivity, with some ability to adapt to changes brought about by influx. This includes, education on gender-based violence, being inoculated with the COVID-19 vaccination. Further, the close-knit nature of the villagers allows them to support one another if there is pressure on infrastructure and resources.

The impact of the impact of influx is **small**, as the impacts are limited to the villages in the AoI.

Impact Significance

Based on this, the impact significance is assessed to be **minor**.

9.5.6.4 Additional Mitigation, Management, and Monitoring Measures

The nominated EPC Contractor will be required by the Proponent to meet minimum labour standards, so as to ensure workers are treated fairly. Additionally, a number of policies and management plans will be implemented in response to impacts associated with influx, namely:

- Local Content and Influx Management Plan:

- A preference for the recruitment and engagement of local workers and local businesses will be stipulated within this plan (refer to ***Section 9.5.2.4***)
- Establish a formal recruitment process with clear hiring preferences to discourage people from outside of the Project area coming to seek for employment opportunities with the Project.
- Early communication of the recruitment process and positions available to non-locals so they have time to prepare, train (if necessary) and apply.
- Set out the responsibilities and management practices associated with the management of labour during construction and operation of the Project. This will include the Workers Code of Conduct, which identifies behavioural standards and cultural awareness requirements for all workers (including security personnel) to comply with (refer to ***Section 9.5.4.4***).
- Set out the guidance and plans for camp followers
- In addition to Workers Code of Conduct, and the Project will establish advisory services on safe sex for workers as well as health care provision (incorporated within typical health checks and on an as needs basis). A Workers Code of Conduct will contain provisions that guide workforce behaviours, including behaviours linked to gender-based violence, sexual abuse, etc. following the IFC Emerging Good Practice for Private Sector Addressing Gender-Based Violence and Harassment. Workers who breach the Workers Code of Conduct will be subject to penalization. It will also outline requirements and measures to ensure labour and working conditions in compliance with IFC PS2.

- **Workers' Camp Management Plan:** The operation of the workers' accommodation facility will be governed by the Workers' Camp Management Plan in line with the IFC and EBRD Guidance Note on Workers' Accommodation: Processes and Standards, and will include aspects such as details of the services and facilities available, hygiene standards, and healthcare provision for Project workers. The audit requirements of the accommodation facilities will also be outlined. In the case that the Project or workers may require short-term accommodations, the parameters for local accommodations will be outlined in the Workforce Accommodation Plan. Guidance and plans for camp followers will be clarified in the Locan Content and Influx Management Plan
- **Community Health and Safety Management Plan (CHSMP):** Sets out the agreed controls and mitigation measures to protect the health and safety of villages in the AoI, such as the establishment of a community health baseline prior to the commencement of the Project, recruitment of local nurse/s or doctor/s to support the local health care needs. Doctors and/or nurses will be hired to be stationed for the Project. The healthcare workers will be recruited from outside the AoI to avoid impacting existing providers

  The CHSMP will outline reuiqrements and measures to ensure community health, safety and security in compliance with IFC PS4.
- **Awareness raising trainings on GBV** at the community level should be adopted by the Project. Effective social mobilization and monitoring to be adopted by the Project to mitigate child labour and any form issues of abuse at the community level during the construction of the project.
- **Occupational Health and Safety Management Plan:** Sets forth the agreed controls and mitigation measures to protect the health and safety of workers, including induction and training requirements (refer to ***Section 9.5.4.4***).
- **Emergency Preparedness and Response Plan:** Outlines the measures to respond to unplanned events or emergencies that may result in injury or death.
- **SEP:** The methodology and timing of stakeholder communication, including a community environmental and safety awareness program will be included in the SEP (refer to ***Section 9.5.4.4***), to support the aforementioned management plans. Grievance mechanism to be developed as part of the SEP for affected communities and workers (separately). The grievance mechanism will also

be available (separate for workers vs. villagers) for workers / villagers to report actual or suspected instances of GPB / exploitation.

9.5.6.5 Residual Impact Significance

Through the additional mitigation measures proposed, the residual impact magnitude is reduced to **small**, with a corresponding reduction in the residual magnitude significance to **minor** (***Table 9.65***).

Table 9.65: Worker Influx Impact Assessment

Significance of Impact					
Potential Impact	Impacts associated with construction workers.				
Project Phase	Pre-Construction	**Construction**	Operation		
Impact Nature	**Negative**	Positive	Neutral		
	The potential impacts are negative.				
Impact Type	Direct	**Indirect**	Induced		
	The impact will be indirect, as a result of an increased, migrant population.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impacts are likely to be experienced during the construction phase only, with the majority of workers in the operation phase being locally based.				
Impact Extent	**Local**	Regional	International		
	The impact is limited to the villages in the AoI.				
Impact Scale	The impact is limited to the villages in the AoI.				
Frequency	The impact is not expected to occur frequently, and is limited to the construction phase.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact is limited to the villages in the AoI.				
Receptor Sensitivity	Low	**Medium**	High		
	The villagers have a medium sensitivity, with some ability to adapt to impacts.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The impact significance is minor.				
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium	
Residual Impact Significance	Negligible	**Minor**	Moderate	Major	
	The impact significance is reduced following the implementation of additional mitigation measures.				

9.5.7 Impacts of Wind Farm Operation on Local Amenity

Amenity is the term to describe a location's pleasing attributes or character. Amenity may comprise aspects such as landscape character, air quality, and/or the amount of noise the area is exposed to. This section presents various aspects of the Project that may result in disturbance to the local amenity during its 25 year operational period.

9.5.7.1 Potential Impacts

Noise (Operation)

Although the wind turbines selected for the Project have been designed to operate as quietly as possible, low frequency noises may still be audible to affected villagers. Ambient noise monitoring was undertaken (refer to the noise baseline in ***Chapter 7***), which found that operational noise levels generally complied with the WBG criteria; exceedances during night time (22:00-7:00).

A noise impact assessment was conducted in accordance with the guidelines and standards mentioned in ***Section 9.3.5***, and found that predicted noise levels from operation of the wind farm comply with the daytime and night time noise criteria at all receptors; no exceedances are shown by the assessment. As such, minor impacts from operational noise will be experienced by receptors, with no additional noise mitigation measures proposed. However, noise monitoring is suggested in order to identify potential exceedances and allow additional mitigation measures to be implemented.

Landscape and Visual

The existing landscape and visual amenity is described as a rural, mountainous area, with villages in the AoI surrounded by forest and agricultural land (refer to the baseline landscape values and visual amenity in ***Chapter 7***). Due to the height and placement of wind turbines, visual impacts are likely to occur, as the wind turbines are likely to disrupt the rural landscape.

A landscape and visual assessment was conducted to determine the visual influence of the wind turbines on the landscape. Although the impact assessment found that there is a high likelihood of the wind turbines being visible, it is noted that the assessment was based on the topography of the landscape and did not consider potential shielding due to vegetation. This is evidenced in the photomontages provided in the visual impact assessment (refer to ***Section 9.3.7***).

Although different ethnic groups have slightly different beliefs, cultures, traditions; they did not express different use or views on the landscape. Through the KIIs with village heads and FGDs with ethnic groups, concerns regarding landscape and visual change impacts on their belief, rituals, etc., were not identified. Their main concerns were mostly related to land acquisition impacts, noise, and safety from the wind turbines.

A Restoration Management Plan will be prepared that will include replanting indigenous species, and landscaping and rehabilitation of construction yards to minimise impacts to the landscape, upon completion of construction.

Shadow Flicker

A shadow flicker assessment was undertaken to determine the potential extent of shadow flicker impacts resulting from the operation of the wind turbines. Shadow flicker may cause annoyance to villagers and livestock. The findings of the shadow flicker modelling (refer to ***Section 9.3.8***) identified potential impacts to 12 clusters of potentially affected villagers, which may experience varying levels of impact, depending on the individual. Shadow flicker impact is assessed as medium for Dak Tiem (Cluster A), Dak Yen (Cluster E), Dak Chueng (Cluster J) and Dak Nong (Cluster K) and minor for the remaining clusters.

9.5.7.2 Existing Controls

The Project layout has been optimised so as to minimise impacts to affected villagers, as well as biodiversity.

9.5.7.3 Significance of Impacts

The potential impacts of wind farm operation on local amenity are assessed in accordance with the criteria set out in ***Table 9.66*** and ***Table 9.67***.

Table 9.66: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

Table 9.67: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

Receptor Sensitivity and Impact Magnitude

The affected villagers are considered to have **high** sensitivity, as they have a limited ability to adapt to the impacts and/or influence the locations of wind turbines causing impacts to their amenity.

The impact magnitude is considered to be **small-medium**. There will be a perceptible difference from baseline conditions as a result of the combination of factors affecting amenity, for the duration of the operation of the wind farm. However, it is noted that the impact to amenity will not be felt by all villagers in the AoI; rather, a select group/area, aligning with particular aspects of amenity as discussed above, which is reflected in the varied magnitude

Impact Significance

Based on the above, the impact significance is assessed as **moderate-major**.

9.5.7.4 Additional Mitigation, Management, and Monitoring Measures

Environmental impact management plans will be prepared for the Project that will contain mitigation measures for noise, landscape and visual, and shadow flicker impacts. These include the CEMP and noise and vibration management plan. Of note, environmental impact mitigation measures that may contribute to the mitigation of impacts of wind farm operation on local amenity include:

- Regular noise monitoring will be undertaken. Where the noise criteria is exceeded, additional mitigation measures should be implemented.
- Locate laydown areas, construction camps and access roads in existing disturbed or areas cleared of vegetation.
- Prepare a restoration management plan that includes the replanting of indigenous species, and landscaping and rehabilitation of construction yards.
- Minimise night lighting to the extent possible while maintaining safety.
- Investigate means for natural, and architectural/structural screening, at locations where affected villagers may experience over 30 hours per year and 30 minutes per day of shadow flicker impact.

It is important to communicate the impacts and proposed mitigations, which will be guided by the SEP:

- **SEP:** As previously outlined, the SEP will describe how Project stakeholders will be engaged, throughout the Project lifecycle. Specifically relating to the impacts of wind farm operation on local amenity, stakeholder engagement will be undertaken to inform affected villagers of the potential noise, landscape and visual, and shadow flicker impacts and their mitigation measures. Any households directly impacted by shadow flickers will be consulted on its potential impacts and mitigation measures. The SEP will also contain a grievance redress mechanism to allow affected villagers' feedback to be communicated to the Project and resolved.

A CEGDP is also prepared so that villagers receive the maximum benefits from the Project.

9.5.7.5 Residual Impact Significance

Through the additional mitigation measures proposed, the residual impact magnitude is reduced to **negligible-small**, with a corresponding reduction in the residual magnitude significance to **negligible-moderate** (***Table 9.68***).

Table 9.68: Local Amenity Impact Assessment

Significance of Impact					
Potential Impact	Impacts of Wind Farm Operation on Local Amenity				
Project Phase	Pre-Construction	Construction	**Operation**		
Impact Nature	**Negative**	Positive	Neutral		
	The operation of the wind farm will result in negative impacts.				
Impact Type	**Direct**	Indirect	Induced		
	Direct impacts will be produced.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impacts will be experienced for the duration of the Project.				
Impact Extent	**Local**	Regional	International		
	The impacts are limited to the villages in the AoI.				
Impact Scale	The impacts are limited to the villages in the AoI.				
Frequency	The impacts will occur continuously, throughout the duration of the operation of the wind farm.				
Impact Magnitude	Positive	Negligible	**Small**	**Medium**	Large
	There is a perceptible difference from baseline conditions, affecting some villagers.				
Receptor Sensitivity	Low	Medium	**High**		
	Villagers in the AoI have a limited ability to adapt to the impacts and/or influence the locations of wind turbines causing impacts to their amenity.				
Impact Significance	Negligible	Minor	**Moderate**	**Major**	
	The impact significance is major.				
Residual Impact Magnitude	Positive	**Negligible**	**Small**	Medium	
Residual Magnitude Significance	**Negligible**	Minor	**Moderate**	Major	

9.5.8 Impact on Ethnic Groups (Erosion of Ethnic Culture)

As discussed in ***Section 8.5.3.1*** Laos is an ethnically diverse society which favours the use of the term "ethnic groups" over the use of the term "Indigenous" (IFAD, 2012). While the Government of Lao PDR officially recognises ethno-linguistic categorisation of ethnic groups, the previously used geographic categorisation continues to be used by the people throughout Laos (IFAD, 2012; Schlemmer, 2017).

As a whole, the population of the villages in the AoI is dominated by the Triang ethnic group (89%), with other ethnic groups residing in the villages being Yea (4%), Katu (4%), and other ethnic groups (2%) (mainly Ha Luk). The Triang, Yae, Katu and Ha Luk ethnic groups all belong to the Mon-Khmer linguistic group or the Lao Theung geographic group. About 1% of villagers belong to the Lao ethnic group, which is part of the Lao-Tai linguistic group or the Lao Loum geographic group. The Lao Loum geographic group contains the greatest number of tribes; approximately 70% of the Laos population identifies as being part of the Lao Loum, and it is generally considered to be "better off" than other ethnic groups (IFAD, 2013). This may be the reason why only ethnic groups that are part of the Lao Theung and Lao

Soung are considered as ‘ethnic groups’ within Laos (IFAD, 2012). On this basis, the assessment will focus on the Triang, Yae, Katu, and Ha Luk ethnic groups.

The ADB SPS SR3 (2009) and IFC PS7 (2012) provides guidance for the identification of Indigenous Peoples, which is a term used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following four characteristics to varying degrees:

(1) self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;

(2) collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;

(3) customary, cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and

(4) a distinct language, often different from the official language of the country or region.”

The guidance highlights that groups need to be “both distinct and vulnerable” to trigger application of the term Indigenous Peoples. Distinctiveness may be defined with the four characteristics, above, while vulnerability is determined by assessing economic, social, political, demographic and environmental factors.

The ethnic groups located in the villages in the Project Area of Influence (AoI) were assessed against the distinct (four characteristics listed above) and vulnerable definitions to confirm whether these ethnic groups would be considered as Indigenous Peoples for the purpose of meeting ADB SPS SR3 and IFC PS7. This assessment is provided in ***Table 9.69***.

Table 9.69: ADB and IFC Indigenous Peoples Characteristics

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
1. Distinct				
(i) Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others	Triang is classified as one of Mon-Khmer Group in Lao PDR.[39] The 2005 census identified Triang as one of the ethnic groups in Lao PDR.[40] ADB Indigenous People Plan for Education for Employment Sector Development Program (2019) recognized Triang as one of the ethnic groups.[41] Ethnic Group Development Plan (EGDP) of Ministry of Health (2011) (prepared for World Bank) recognized Triang as one of ethnic groups.[42]	Yae is classified as one of Mon-Khmer Group in Lao PDR. The 2005 census identified Yae as one of the ethnic groups in Lao PDR. ADB Indigenous People Plan for Education for Employment Sector Development Program (2019) recognized Yae as one of the ethnic groups Ethnic Group Development Plan (EGDP) of Ministry of Health (2011) (prepared for World Bank) recognized Yae as one of ethnic groups. Ethnic Group Policy Framework (EGPF)	Katu is classified as one of Mon-Khmer Group in Lao PDR. The 2005 census identified Katu as one of the ethnic groups in Lao PDR ADB Indigenous People Plan for Education for Employment Sector Development Program (2019) recognized Katu as one of the ethnic groups Ethnic Group Development Plan (EGDP) of Ministry of Health (2011) (prepared for World Bank recognized Katu as one of ethnic groups Ethnic Group Policy Framework (EGPF) (prepared for Poverty reduction Fund II	Ha Luk is classified as one of Mon-Khmer Group in Lao PDR. The 2005 census identified Ha Luk as one of the ethnic groups in Lao PDR ADB Indigenous People Plan for Education for Employment Sector Development Program (2019) recognized Ha Huk as one of the ethnic groups Ethnic Group Development Plan (EGDP) of Ministry of Health (2011) (prepared for World Bank recognized HA Huk as one of ethnic groups Ethnic Group Policy Framework (EGPF) (prepared for Poverty reduction Fund II (PRF II)) in

[39] NSC/CPI, ADB,SIDA and the World Bank, 2006.

[40] Lao Statistics Bureau (2006). Population Census Lao PDR 2005

[41] 50399-003: Education for Employment Sector Development Program (adb.org)

[42] Health Services Improvement Project Additional Financing (P124906). Retrieve from: https://projects.worldbank.org/en/projects-operations/project-detail/P124906

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
	Ethnic Group Policy Framework (EGPF) (prepared for Poverty reduction Fund II (PRF II)) in 2016 recognized Triang as one of ethnic groups.[43] Yes, as confirmed during the social baseline research through secondary and primary sources	(prepared for Poverty reduction Fund II (PRF II)) in 2016 recognized Yae as one of ethnic groups. Yes, as confirmed during the social baseline research through secondary and primary sources	(PRF II)) in 2016 recognized Katu as one of ethnic groups. Yes, as confirmed during the social baseline research through secondary and primary sources	2016 recognized Ha Hulas one of ethnic groups. Yes, as confirmed during the social baseline research through secondary and primary sources
(ii) Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories	It is common for Triang peoples to be located in the highlands (IFAD, 2012). They usually settle in geographies that are favourable for agricultural production (e.g. coffee, cassava, and rice), such as areas with hills with rivers flowing through, and flat areas along the river. Triang peoples have been found to have settled in Dak Cheung, Tha Taeng, and La Marm Districts of the Sekong Province, Sanxay and Samakkee Xai District of Attapeu Province, and Pak Xong District of Champasak Province (Department of Ethnic Affairs, 2015a). Villagers have indicated that their ancestors have been in	It is common for Yae peoples to be located in the highlands (IFAD, 2012). They usually settle in geographies that are favourable for agricultural production (e.g. coffee, cassava, and rice), such as areas with hills with rivers flowing through, and flat areas along the river. Yae peoples have been found to have settled in the Dak Cheung District of Sekong Province, and Sanxay District of Attapeu Province (Department of Ethnic Affairs, 2015c).	■ It is common for Katu peoples to be located in the highlands (IFAD, 2012) ■ They usually settle in geographies that are favourable for agricultural production (e.g. coffee, cassava, and rice), such as areas with hills with rivers flowing through, and flat areas along the river. ■ Katu peoples have been found to have settled in Kalim, Dak Cheung, and Tang Districts of Sekong Province, Lao-gnarm and Salavan Districts of	■ It is common for Ha Luk peoples to be located in the highlands (IFAD, 2012) ■ They usually settle in geographies that are favourable for agricultural production (e.g. coffee, cassava, and rice), such as areas with hills with rivers flowing through, and flat areas along the river. ■ Ha Luk peoples have been found to have settled in Lao-gnarm district of Salavan Province, Lamarm and Ta Taeng Districts of Sekong Province, Pakxong

[43] https://ewsdata.rightsindevelopment.org/files/documents/01/WB-P153401_3xQD49j.pdf

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
	this area for a long time, although the exact duration is unknown.		Salavan Province, and Pakxong and Bachiengchalernsouk Districts of Champasak Province (Department of Ethnic Affairs, 2015b).	District of Champasak Province, and ■ Sanxay and Samakkee Xai District of Attapeu Province. (Department of Ethnic Affairs, 2015d).
(iii) Customary, cultural, economic, social, or political institutions that are separate from those of the dominant society and culture	■ Yes, as confirmed during the social baseline research, such as: ■ There is a regime based on the law, similar to other areas. ■ There are festivals with slightly different traditions and beliefs. ■ There are distinct traditional costumes for males and females. ■ Lao mainstream culture and lifestyle have been absorbed due to increased contacts with people from outside communities, increased access to information through radio, television, and mobile phone and internet.	■ Yes, as confirmed during the social baseline research, such as: ■ There is a regime based on the law, similar to other areas. ■ There are festivals with slightly different traditions and beliefs. ■ There are distinct traditional costumes for males and females. ■ Lao mainstream culture and lifestyle have been absorbed due to increased contacts with people from outside communities, increased access to information through radio, television, and mobile phone and internet.	■ Yes, as confirmed during the social baseline research, such as: ■ There is a regime based on the law, similar to other areas. ■ There are festivals with slightly different traditions and beliefs. ■ There are distinct traditional costumes for males and females. ■ Lao mainstream culture and lifestyle have been absorbed due to increased contacts with people from outside communities, increased access to information through radio, television, and mobile phone and internet.	■ Yes, as confirmed during the social baseline research, such as: ■ There is a regime based on the law, similar to other areas. ■ There are festivals with slightly different traditions and beliefs. ■ There are distinct traditional costumes for males and females. ■ Lao mainstream culture and lifestyle have been absorbed due to increased contacts with people from outside communities, increased access to information through radio, television, and mobile phone and internet.

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
(iv) A distinct language, often different from the official language of the country or region	Yes, Triang peoples have a specific spoken language, similar to the Ha Luk and Yae ethnic groups, and is categorised as a Mon-Khmer language. Most Triang peoples speak the Triang language but use Lao language for writing (Department of Ethnic Affairs, 2015a).	Yes, Yae peoples have a specific spoken language, similar to Triang, Ha Luk and Katu ethnic groups, and is categorised as a Mon-Khmer language. Most Yae peoples speak the Yae language but use Lao language for writing (Department of Ethnic Affairs, 2015c).	Yes, Katu or Kaluem is spoken (Luangthongkum, 2010). Katu is categorised as a Mon-Khmer language. Most Katu peoples speak the Katu language but use the Lao language for writing (Department of Ethnic Affairs, 2015b).	Yes, Ha Luk peoples have specific spoken language, similar to Triang, Yae and Katu ethnic groups, and is categorised as a Mon-Khmer language. Most Ha Luk peoples speak the Ha Luk language but use Lao language for writing. (Department of Ethnic Affairs, 2015d).
	An assessment on language in schools in Dak Cheung District found that although Lao language is taught at all schools, many of the ethnic group members are characterized by poor Lao language skills as their ethnic languages are still largely used in day-to-day life. Children who attended lower and upper secondary could answer questions in Lao language, but their parents' needed translation to ethnic languages. [44] This language issue was confirmed during the Information Disclosure and Consultation activity in July-August 2022. Most of the villagers who participated in the activity can understand basic conversation and communicate in basic Laos; however, translation to Triang was needed for the consultation to be understood, particularly on more complicated topics discussed and for the elders and the women. It is understood that Triang is the most common language used amongst ethnic groups present in the Project AoI. Given similarity of their ethnic languages, other ethnic groups i.e., Yae, Katu and Ha Huk could also understand when translation was conducted in Triang. It is noted that during the Information Disclosure and Consultation activity, the Project ensured that a village coordinator or village head were present to facilitate translation to Triang language. The participants were also informed that they may ask questions or communicate in their ethnic languages to ensure that language barrier would not inhibit ethnic peoples from expressing their concerns, opinions, or suggestions for the Project. The Project has employed a number of Triang speakers as village coordinators to facilitate community consultation.			
2. Vulnerable In general, the most vulnerable ethnic groups have very few assets, are geographically isolated (mostly in the highlands), and face language and cultural barriers. An assessment of each ethnic group's vulnerability is below.				

[44] 50399-003: Education for Employment Sector Development Program (adb.org)

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
(i) Territorial, economic cultural, political and language barriers	■ Their location, which is geographically isolated, makes it difficult for them to access political, economic, and social opportunities. The main ethnic groups belonging to the Lao-Tai are mostly found in urban areas or low land. They often have better access to public services and opportunities for socioeconomic development (including education) offered by the government and private investment.45 . The site visit in July 2022 observed inadequate school and healthcare facilities in the villages visited. ■ Their economic status (nearly half of the surveyed population live below the national poverty line, which is much lower than the World Bank standard). The social baseline analysis found that the 40% of the population of the affected villages is vulnerable but the vulnerable population is not focussed on one particular ethnic group. According to the World Bank's annual poverty indicator (2015), there is a substantial difference in the poverty rate among the Lao-Tai groups, which stands at about 25%, while Mon-Khmer's poverty rate rises to 42%. The site visit in July 2022 found that their livelihood is highly dependent on agriculture and NTFPs collection and the people expressed that they do not have the capacity/capability to undertake alternative livelihood to diversity their livelihoods. ■ Adoption of the Lao political arrangement (i.e., village head or Naai Baan/ Pok Kong Tong Thin) and integration to the Lao government system as evidenced in participation of village head in compensation unit rate consultation by relevant governmental authorities. The village head or Naai Baan/ Pok Kong Tong Thin roles do not duplicate other informal or traditional political institutions, such as tribal leaders. . At provincial level, most of the officers are mainstream Laos, hence during the meeting on 18 July, Lao language was used. While the at district level, there are some officers who are ethnic groups (i.e. Triang, Yae, Katu) who can communicate in ethnic languages; however, these are small portion of the district officers where the majority of the officers are mainstream Laos. ■ The ethnic groups in the project, particularly elders and women, have poor Laos language skills. It is likely that the language barrier inhibits members of these ethnic groups from understanding the continuous rapid socioeconomic development that is taking place around them. They may have little exposure to and awareness of their rights and options, and therefore they may not understand government policy and the strategic development plan for their own district as a whole.[46]			
(ii) Project impacts	The Triang, Yae, Kata and Ha Luk peoples will experience the following potential impacts;			

[45] 50399-003: Education for Employment Sector Development Program (adb.org)
[46] 50399-003: Education for Employment Sector Development Program (adb.org)

<table>
<tr><th rowspan="2">Characteristics of Indigenous Peoples</th><th colspan="4">Ethnic Group</th></tr>
<tr><th>Triang (Taliang)</th><th>Yae (Yaeh / Yae')</th><th>Katu</th><th>Ha Luk</th></tr>
<tr><td></td><td colspan="4">■ Economic displacement and impacts to livelihoods from the loss of agricultural land and loss of NTFP Collection.
■ Potential risks (intrusion of workers) to Intangible Cultural Heritage with Phou Koungking. The upper elevation of the mountain was mentioned as a prohibited zone (being a sacred forest) during the FGD in July 2022. The lower elevation zone of the Koungking mountain, an area identified by villagers during the July 2022 FGD as a multi-use zone, will be impacted from land acquisition, land clearance, and construction activities of the Wind Turbine Generators (WTGs), transmission line and internal roads. Impacts may arise from noise and shadow flicker impacts from operation of WTGs.
■ Impact of construction related environment nuisance such as vibration, noise, and dust affecting cultural heritage sites close to construction sites.
■ Potential disruption to local ceremonies and activities from increased noise levels, vibration, and dust, including exclusion areas being set up to protect villagers from heavy vehicle/machinery use.
■ Potential of inward migrating workers to negatively influence existing customs and religious practices undertaken by the ethnic groups, the result of which could be an erosion or loss of ethnic culture. The loss of ethnic culture may occur if migrant workers and other outsiders are not respectful of or understand the various customs and religious practices, such as boundaries placed on areas that may only be accessed by women or men. This potential impact is concerned primarily with the construction phase, as this is when workers and other related people are likely to move to the villages in the AoI. Only a small workforce (80 people) will remain in the operation phase.</td></tr>
<tr><td>(iii) Pressure from policy on relocation of upland villages to be consolidated to the lowlands</td><td colspan="4">The GoL officially formulated the Village Relocation and Consolidation Strategy in 1989. The strategy sought to improve villagers' access to public infrastructure and services by merging villages with less than 50 households into larger villages (with a minimum of 200 people in upland areas and 500 people in lowland areas), while also relocating remote upland villages to lowland area. The key objective of upland resettlement is to bring villages closer to public infrastructure and services (e.g., roads, markets, schools, hospitals), while also transitioning their livelihoods away from upland, shifting cultivation toward lowland, paddy cultivation.[47]Based on the inquiry with Dak Cheung District Natural Resource and Environment Officer on 5 August 2022, the government does not have policy to relocate upland villages to lowland. The government only applies village consolidation policy with remote villages where there is no or limited access to the village. All 32 villages in the Project AoI have access roads which can be accessed</td></tr>
</table>

[47] : Jonas Kramp, Diana Suhardiman & Oulavanh Keovilignavong (2022). *(Un)making the upland: resettlement, rubber, and land use planning in Namai village, Laos.* The Journal of Peasant Studies, 49:1, 78-100. Retrieved from: https://www.tandfonline.com/doi/pdf/10.1080/03066150.2020.1762179?needAccess=true

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
	during both dry and rainy seasons; therefore, the government does not apply village consolidation policy to these villages and does not have any plan to relocate any villages to lowland. It can therefore be concluded that the villages are not and will not likely be threatened by upland village consolidation strategy.			
(iv) Pressure on land and resources from multiple concessions in the Project development area	**Pressure on land from Project land acquisition** Approximately 30.6 ha of agricultural land will be impacted and 160.6 ha of will be temporarily impacted. The acquisition of land currently used for agricultural purposes will lead to economic displacement, since the land will be (permanently or temporarily) removed from its agricultural use, and unable to generate income for landowners and users. In this sense, the loss of agricultural land will cause economic displacement and impact on livelihoods. Whilst some households will be temporarily impacted, it is highlighted that during this period, the impact on livelihoods will experience a similar impact to those households experiencing permanent acquisition. While the Project development area covers 70,000 ha, it is highlighted that the proposed permanent and temporary clearing of forest has been kept to a minimum and comprises less than 1% of the total Project area. The access roads will provide greater access to other areas of the forest that the affected villagers may currently be unable to access or have difficulty accessing. In opening up new area for NTFP collection, this will be undertaken in consultation with DAFO, and agreement will need to be reached with DAFO and villages. As such the Project will not remove the ability for NTFP collection Primarily, these land-based livelihoods are for the purpose of subsistence. Given the rural locality, it is difficult to participate in other sources of livelihood (e.g., not many wage-based or enterprise-based livelihood opportunities in or close to the villages in the AoI). This is particularly the case for vulnerable households (in particular poor households) that may already experience difficulties maintaining a secure form of livelihood. However, the Project will provide opportunities to participate in livelihood restoration mechanisms that will seek to restore the affected villagers' livelihoods to a minimum of existing levels, if not better. **Cumulative impact on land and NTFP resources** Other known developments (existing and planned) in and around the Project area have been identified as follows: ■ Several hydropower projects, with associated linear transmission lines, are identified in both Dak Cheung and Sanxay districts. ■ A number of road upgrade / improvement projects are identified in both Dak Cheung and Sanxay districts. ■ A potential bauxite mining project has been identified in Sanxay District, within Sekong and Attapeu provinces. A large area of the project area and surrounding areas up to the border with Vietnam may potentially be subject to surface mining. It is noted that there are currently no actual activity occurring on the ground. The GoL is now collecting data at the site to solve overlapping area with the Project development area issue. The physical footprint of the wind farm is relatively small, particularly when compared to projects such as dams for hydropower or mining, and therefore in isolation will be unlikely to significantly reduce ecosystem services. The main pathway for effects related to the wind farm would be if improved access to more intact parts of the project area leading to unstainable harvesting of forest resources. It was observed during the Information Disclosure and Consultation in July-August 2022 that neighbouring villages have			

Characteristics of Indigenous Peoples	Ethnic Group			
	Triang (Taliang)	Yae (Yaeh / Yae')	Katu	Ha Luk
	agreements on designated NTFP collection areas for each village. Typically, NTFP collection areas are accessed on foot (as most of villagers' own vehicles), they would note that some areas are too far. Improved access may potentially facilitate people from outside with vehicles to collect NTFPs in the area, leaving villagers whose livelihood is dependent on NTFPs collection vulnerable or more vulnerable. However, such issues can be mitigated by, for instance, locked gate for roads leading to turbine infrastructure with access given to only local villagers (as part of local employment and security arrangement). Future mining-related impacts on land and NTFP resources may be greater in comparison to the small scale/magnitude of impacts associated with the Project, linear road upgrades and transmission lines in the region, and may also affect the quantity and quality of water.			
(vii) Risks of becoming vulnerable or more vulnerable	■ Their livelihood is highly dependent on agriculture and NTFPs collection and villagers expressed during the Information Disclosure and Consultation activity in July-August 2022 that they do not have the capacity/capability to undertake alternative livelihood to diversity their livelihoods. If livelihood restoration programs and CEGDP implemented properly and effectively, the risk of directly affected villages (affected by Project land acquisition) becoming vulnerable or more vulnerable due to the Project will be mitigated. In addition to livelihood vulnerability, increased exposure to outside communities may increase integration to Laos mainstream society; however, this integration is already underway with the increasing penetration of information and communication technology, such as mobile telephones and mobile internet. Inward migrating workers may negatively influence existing customs and religious practices undertaken by the ethnic groups. This may contribute to an erosion or loss of ethnic culture and traditions.			

Although villagers retain their ethnic identity, such as speaking in the language of their ethnic group, it was observed that villagers of all ethnic groups are well integrated into mainstream Laos society. This was evidenced by clothing and housing styles, and it is noted that apart from some of the elderly population, most villagers can understand Lao, and are able to use written Lao. Additionally, through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) with villagers, it is understood that villagers live harmoniously. For instance, villagers celebrate ceremonies together, and no current or historical conflicts were identified. Despite the level of integration, villagers in the AoI retain their ethnic identity, which meets the ADB's definition of distinctiveness.

With respect to vulnerability, the social baseline analysis found that the 40% of the population of the affected villages is vulnerable but the vulnerable population is not focussed on one particular ethnic group. However, there are anti-discrimination laws in Laos that prohibit discrimination against ethnic groups. Villagers indicated that they do not experience discrimination based on ethnicity, and therefore are not more vulnerable within the region for this reason.

With respect to vulnerability, based on the discussed in ***Table 8.30,*** the villagers in the Project AoI are more economically disadvantaged when compared to the mainstream Tai-Lao groups— nearly half of the surveyed population live below the national poverty line, which is much lower than the World Bank standard. Their location being geographically isolated, makes it difficult for them to access public infrastructures and services, political, economic, and social opportunities. Their poor Laos language skills, particularly elders and women. It is likely that the language barrier inhibits members of these ethnic groups from understanding the continuous rapid socioeconomic development that is taking place around them. Their land and NTFP resources are under pressure posed by cumulative impacts of development projects within the Project development area—particularly mining projects which have significantly larger impacts on land and natural resources when compared to the Project and other linear developments e.g., transmission line and road improvement projects. Given that their livelihood is highly dependent on land-based livelihoods i.e. agriculture and NTFPs collection, together with the fact that the villagers expressed during the Information Disclosure and Consultation activity in July-August 2022 that they do not have the capacity/capability to undertake alternative livelihood to diversity their livelihoods—this makes them particularly susceptible to impacts on land and natural resources brought about by multiple development projects in the area. Additionally, increased exposure to outside communities and inward migrating may contribute to an erosion or loss of ethnic culture and traditions. However, there are anti-discrimination laws in Laos that prohibit discrimination against ethnic groups. Villagers indicated that they do not experience discrimination based on ethnicity, and therefore are not more vulnerable within the region for this reason.

Based on the above discussions, it is concluded that the ethnic groups in *discussion* meet ADB and IFC definition of distinct and vulnerable to a varying *degree*. Since the ethnic groups that meet ADB SR3 and IFC PS7's definition of IP may be vulnerable to losing or being exploited of their land and access to natural and cultural resources, the FPIC may be needed if any of the circumstances require FPIC is applied. FPIC is applied to project implementation, design, and expected results related to the impacts that would affect Indigenous Peoples communities. The Project was assessed against the criteria for IFC PS7 FPIC requirements.

Social Impacts Assessed Previously

Despite recognition that the Triang, Yae, Katu, and Ha Luk ethnic groups are Indigenous Peoples, it is considered that the impact assessments undertaken in ***Sections 9.5.2 – 9.5.6*** have adequately captured the specific concerns relating to Indigenous Peoples, since the overwhelming majority of the population of affected villagers comprises people from ethnic groups.

- The ethnic people are still highly dependent on natural resources such as forests and rivers. They collect food e.g. bamboo, mushrooms, and wood for cooking (firewood) and construction of houses from the forests (***Section 8.5.3.2***). The Project impact to NTFP collection area is assessed under NTFP Collection in ***Section 9.5.3***. There will be temporary and permanent loss to NTFP collection area; it is, however, noted that the loss of forest will require a biodiversity offset (discussed in

Section 9.4.3) and access to forests is still available and there will be improved access to forest resources associated with construction of access road (discussed in ***Section 9.5.2.1****)*.

- The ethnic people predominantly seek health treatment from healthcare centers, such practices of medical herbal and spiritual healing are therefore not identified as community's practice and therefore will not be impacted by loss of NTFP collection area due to the Project land requirement.
- As discussed in ***Table 9.70*** the affected ethnic communities do not have different political/social institution from the mainstream society— the communities are governed by village heads and District government. Decision making process in the villages are based on consultations of village heads, belief leaders and heads of Village Women's Union (which is a common practice across Lao PDR, not only within ethnic groups communities). The political/social institution of the communities have been influenced by the GOL policy on Koumban since 2004. The objective of the policy is to strengthen the political infrastructure to advance rural development by bringing smaller villages together in larger units, as a more efficient basis for local administration and planning.[48]
- Accordingly, no additional assessment is required for these impacts, relating to ethnic groups that meet ADB SPS SR3 and IFC PS7 definition of IP.

Erosion of Ethnic Culture

There is a potential, however, for the workers coming into the area to negatively influence existing customs and religious practices undertaken by the ethnic groups; the result of which could be an erosion or loss of ethnic culture. The loss of ethnic culture may occur if migrant workers and other outsiders are not respectful of or understand the various customs and religious practices, such as boundaries placed on areas that may only be accessed by women or men. A common mitigation against the loss of ethnic culture, is promoting cultural awareness amongst workers as part of the induction process, encouraging workers to participate in cultural practices, and providing workers who are villagers from the AoI with time off for religious or cultural festivities.

This potential impact is concerned primarily with the construction phase, as this is when workers and other related people are likely to move to the villages in the AoI (refer to impacts associated with influx in ***Section 9.5.5***). Only a small workforce (80 people) will remain in the operation phase.

ADB Requirements for Consent through Broad Community Support

Broad Community Support (BCS) is covered under ADB SPS Safeguard Requirement 3.4, and is triggered when the following three criteria are met:

(i) If there is commercial development of the cultural resources and knowledge of Indigenous Peoples.

(ii) Physical displacement from traditional or customary lands; and

(iii) Commercial development of natural resources within customary lands under use that would impact the livelihoods of the cultural, ceremonial, or spiritual uses that define the identity and community of Indigenous Peoples. (p. 18, Safeguards Policy Statement [SPS]).

The Project does not involve the commercial development of the cultural resources and knowledge of Indigenous Peoples, and nor does it require any physical displacement. The third criteria concerning the commercial development of natural resources includes three further sub-criteria: commercial development of natural resources within customary lands under use that would affect the livelihoods or the cultural, ceremonial, or spiritual uses that define the identity and community of IP. Although the

[48] Koumban is a cluster of villages which has been a priority for Lao administration since 2004 as an institutional link between District and village levels—it is '*A formal administrative grouping of villages within a District defined for a purpose of extending government policies and development programs'.* (MAF and NLMA, 2010). The main objective is to strengthen the political infrastructure to advance rural development by bringing smaller villages together in larger units, as a more efficient basis for local administration and planning. Retrieved from: http://lad.nafri.org.la/fulltext/1786-0.pdf

Project activities meet the first two sub-criteria, the third is not met as revealed during community consultation conducted in Ban Prao including villagers from Dak Kung (19 July 2022) and in Dak Lern (20 July 2022). The villagers explicitly expressed that the Project activities would not affect their identity and community as they defined these (and as is required under SR3). Based upon this it can be concluded that BCS is not triggered for this Project.

For policy application, BCS of affected IP communities refers to a collective expression by the affected IP communities, through individuals or recognized representatives, of BCS for such project activities. BCS may exist even if some individuals or groups object to them. For project activities requiring BCS, evidence of the support including documentation of processes and outcomes will be required.[49]

The Project was assessed by the Lenders' Environmental and Social Advisor (LESA)[50], against the criteria for ADB BCS requirements in ***Table 9.70***. The assessment determined that BCS is not applicable to the Project.

Table 9.70: BCS Applicability

ADB BCS Criteria	Observations/Findings	Applicability
ADB SPS SR3 Criteria: Commercial development of the cultural resources and knowledge of IP.	There are no Project activities that entail commercial development of cultural resources and knowledge of ethnic groups in the Project area	Not Applicable
ADB SPS SR3 Criteria: Physical displacement from IP traditional or customary lands	There is no physical displacement as a result of Project's land acquisition. The Project will only result in economic displacement whereby the Project has proposed mitigation measures in as outlined in the Resettlement Plan (RP) and this CEGDP	Not Applicable
ADB SPS SR3 Criteria (iii) Commercial development of natural resources within customary lands under use that would affect the livelihoods or the cultural, ceremonial, or spiritual uses that define the identity and community of IP	***Impacts to NTFP Collection in Forests.*** The Project acquisition/use will impact customary land use of IPs for livelihood support e.g., non-timber forest products and upland rotational cultivation. However, the Project ESIA ***Section 9.5.2*** and ***Section 9.5.3*** demonstrated that small, fragmented areas of clearing be undertaken, instead of larger areas, and new access to NTFP collection and agricultural areas provided by the Project, the overall impact to the supply of NTFPs will be negligibly affected. Consultation and	The Project will not have impact on cultural, ceremonial, or spiritual uses by avoiding cemeteries in its activities through design modification and locational changes. The Project activities in Phou Koungking will be in lower elevation area which is a multiple-use zone and will not breach any belief associated with the mountain. Nonetheless, the Project has undertaken to respect and apply any ceremonies considered necessary by local communities. The Project will have impact on the

49 ADB (2013) A Planning and Implementation Good Practice Sourcebook. Retrieved from: https://www.adb.org/sites/default/files/institutional-document/33748/files/ip-good-practices-sourcebook-draft.pdf
50 The role of Artelia, as Lenders' E&S advisor (LESA), is to review the activities and justification put forward by the Project and provide an opinion. Hence, verifications and reviews conducted by the LESA as part of its assignment are objective opinions and it is up to the Project to consider if these views are to be integrated in their arguments. However, similarly for all type of references, the LESA does not bear responsibility in case of issues arising from the use of its arguments by the Sponsors/ERM

ADB BCS Criteria	Observations/Findings	Applicability
	agreement with provincial government to identify and provide access to forest areas for NTFP collection. Additionally, livelihood restoration measures will be outlined in the RP and in this CEGDP. **Impacts to Agricultural Lands.** Project acquisition/use will impact customary land use by IPs for upland rotational cultivation. The impacts to agricultural lands used for rotational cultivation will be significant because they are not recognized by Lao laws as owners of the land. The Land Law (2019) only recognizes customary land use right under certain conditions and not ownership (Article 3 and 130). Land cultivated by ethnic groups and left fallow for more than 3 years without paying land tax are not compensated.[51] The Project has prepared RP and livelihood restoration programs to minimize livelihood impacts due to loss of agricultural land. **Impacts to customary lands with spiritual, ceremonial, or cultural uses and to critical cultural heritage.** The Project has optimized the Project layout to avoid all Project impacts on cemeteries. Based on consultation with Dak Kung, Dak Lern and Prao village representatives in July 2022, Phou Koungking Mountain is not regarded as a “sacred” place considered holy and deserving respect or worship. It appears that due to the steepness and inaccessibility of the terrain it is regarded as a place of some hazard and the stories surrounding it that could be construed as having intangible heritage value are more related to recognition of these hazards than animist spiritual beliefs.	livelihood on the households affected by land acquisition. But the degree of impact will not affect the identity or community of the ethnic groups in the area as assessed by members of these groups themselves. The effect on the ethnic group’s defined identity and community resulting from livelihood impact is a crucial requirement for the third criterion to be triggered for BCS. The participants in the community meeting in B. Prao, Dak Kung and Sieng A on 19 July 2022 as well as those in the FGD in Dak Lern on 20 July 2022 made the assessment that Project activities will not have that effect. This means that even if the affected lands are considered customary land albeit outside the national law, the impact on it will not trigger the BCS requirement because the identity and community of the ethnic groups will remain unaffected. Thus, none of the three SR3 criteria will trigger the BCS requirement for the Project.

[51] Under Article 144 of the Land Law (2009) holder of land use rights will lose such rights if land use fee has not been paid for three consecutive years

ADB BCS Criteria	Observations/Findings	Applicability
	Eight (8) WTGs will be developed in the lower elevation of Phou Koungking. Consultation with Dak Lern and Proa clarified that the Project activities in the lower elevation of Phou Koungking Mountain are not "Kalam" or prohibited. (In Lao language Kalam means prohibited, taboo or wrong according to the local customs.) However, prior to entering the forest and commencing construction activities, the Project must consult with Dak Lern and Prao villages and comply with villages' "Heet-Kong" or rituals. For Project construction activities, the project is required to provide budget for the village to perform a specific ritual. The ritual involves animal sacrifice with a pig, a jar of rice whisky and a copper bracelet. In addition, the Project will limit land clearance to minimize impact to the forest area. Protocols and measures to be implemented by the EPC and O&M Contractor who will be entering Phou Koungking Mountain will be discussed with affected villages and their agreements will be obtained.	

For customary land, the ADB Indigenous Peoples Safeguards Planning, and Implementation Sourcebook (2013) refers to it as patterns of long-standing **community land** and resource use in accordance with indigenous peoples' customary laws, values, customs, and traditions, rather than formal legal title to land and resources issued by the state (Paragraph 275). The 2019 Lao Land Law has six land categories and **community or communal land** is not one of these (Article 21).[52] But it grants land use rights to organizations and collectives of Lao citizen and recognizes customary land use right under certain conditions (Article 3 and 130).[53] In the Project area, there are affected areas not covered by any individual land use right certificate (LUC) or tax payment certificate which are used by the community for timber and non-timber product collection. These areas are most likely categorized by the Land Law as forest land and designated in the Forestry Law as production forest (Article 17). Production forest is allocated for supply of timber and non-timber products.

[52] The categories are as follows: (i) agricultural land; (ii) forest land; (iii) water area land; (iv) industrial land; (v) communication land; (vi) cultural land; (v) land for national defence and security; and (vi) construction land.

[53] The conditions are the following: (i) clearance, development, protection, and regular use more than 20 years before 2019; (ii) certification of village administration of continuous use; (iii) certification of adjacent landowners of continuous use; and (iv) free from past and present disputes.

The government under the Forestry Law may further designate the production forest as part of the village forest area which means that it is under village management (Article 3).[54] But the designation is to the village as a government administrative unit and not to an ethnic group. The Land Law also prescribes the use of state land for collective purposes by granting State Land Use Rights to the villagers in one or more villages to collectively use the lands in accordance with the local land allocation plans and the laws (Article 81). But this provision also clearly indicates that the right remains in the State and as such, the villagers have no right to transfer, sell, exchange, lease the land use rights, nor grant concession, use the rights as shares or as collateral.

Pertaining to Project impact (specific impacts per village during construction and operations phase are presented in ***Table 9.71)***, the Project will not have impact on cultural, ceremonial, or spiritual uses by avoiding cemeteries in its activities through design modification and locational changes. The Project activities in Phou Koungking will be in lower elevation area which is a multiple-use zone and will not breach any belief associated with the mountain. Nonetheless, the Project has undertaken to respect and apply any ceremonies considered necessary by local communities. The Project will have impact on the livelihood on the households affected by land acquisition[55]. But the degree of impact will not affect the identity or community of the ethnic groups in the area as assessed by members of these groups themselves[56]. The effect on the ethnic group's defined identity and community resulting from livelihood impact is a crucial requirement for the third criterion to be triggered for BCS. The participants in the community meeting in B. Prao, Dak Kung and Sieng A on 19 July 2022 as well as those in the FGD in Dak Lern on 20 July 2022 made the assessment that Project activities will not have that effect. This means that even if the affected lands are considered customary land albeit outside the national law, the impact on it will not trigger the BCS requirement because the identity and community of the ethnic groups will remain unaffected. Thus, none of the three SR3 criteria will trigger the BSC requirement for the project.

Table 9.71: Project Activities and Potential Impacts to the Affected Ethnic Groups Livelihoods, Cultural, Ceremonial, or Spiritual Uses of the Customary Lands in the Project Area and Requirements for BCS

Project Activities and Potential impacts	Village/s	Ethnic Groups Affected	Duration and/or Extent of Impacts	Significance of impacts (post-mitigation measures)	BCS Required? Yes/No
Construction Phase					
Land acquisition and impacts to livelihoods of ethnic groups	18 villages in Dak Cheung District and 4 villages in Sanxay District	Triang, Yae, Katu and Lao	Temporary loss of land (during construction period) and permanent loss of land	Moderate	No

[54] The village forest area can include all forest categories designated according to forest land use and allocation plans at the village level, including Village Use, Conservation and Protection Forests (Forestry Law Article 3).

[55] The affected privately-used land will be either be replaced with land of similar features or compensated at replacement value per the Resettlement Plan (RP).

[56] To assess whether the project will affect their ethnic identity and community, the meeting participants from the villages of B. Prao, Dak Kung and Sieng A were asked if the project activities will have an impact on specific indicators of these two terms. The indicators of ethnic identity were their belief, practices, the way they look at themselves as ethnic group and the way others will look at them. The indicators of community were the way they relate with each other and to outsiders, their sense of cohesion as a group and the unity of the community members. On these indicators, the answer was that the Project will not have an impact on these. The same indicators were used in Dak Lern in an FGD and the same answer was given.

Project Activities and Potential impacts	Village/s	Ethnic Groups Affected	Duration and/or Extent of Impacts	Significance of impacts (post-mitigation measures)	BCS Required? Yes/No
Impacts of the WTG, T/L, and internal roads construction to intangible cultural heritage in Phou Koungking Mountain	Prao, Dak Lern, and Dak Kung	Triang and Katu	During construction period	Minor	No
Impacts on Dak Bong Cemetery during the construction of overhead transmission line	Dak Bong	Triang, Yae, Katu and Lao	During construction period	Minor	No
Impacts of labor influx during construction phase to intangible cultural heritage of ethnic groups	All 32 villages	Triang, Yae, Katu and Lao	During construction period	Minor	No
Impact related environment nuisance such as vibration, noise, and dust affecting ethnic minority ceremonies/ rituals/activities and cultural heritage sites close to construction sites	All villages, except, Dak Jom, Nam Ngonneua, and Dak Padou	Triang, Yae, Katu and Lao	During construction period	Minor	No
Operations Phase					
Impacts of the access roads to the Phou Koungking Mountain during Operations Phase	Prao, Dak Lern, and Dak Kung	Triang and Katu	Permanent impact	Minor	No
Noise and Shadow flicker impacts on cultural heritage	N/A	N/A	N/A	Minor	No
Shadow flicker impacts	Dak Tiem, Dak Yen, Dak Chueng and Dak Nong	Triang	Permanent impact	Minor	No

IFC PS7 Requirements for Free, Prior and Informed Consent

The applicability of IFC PS7 Requirements for Free, Prior and Informed Consent was also assessed by the LESA. Per GN7.27, the process of FPIC is triggered if the project activities and outcome are associated with any of the following potentially adverse impacts:

(i) impacts on lands and natural resources subject to traditional ownership or under customary use;
(ii) relocation of Indigenous Peoples from lands and natural resources subject to traditional ownership or under customary use;
(iii) significant impacts on critical cultural heritage that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, including natural areas with cultural and/or spiritual value such as sacred groves, sacred bodies of water and waterways, sacred trees, and sacred rocks; and
(iv) use of cultural heritage, including knowledge, innovations, or practices of Indigenous Peoples for commercial purposes.

The Project will definitely not generate the last three adverse impacts because it will not entail relocation, will avoid impacts on cultural resources and will not use cultural heritage for commercial purposes.

It is the first impact that needs further analysis if it applies to the Project. The impact must be on land subject to traditional ownership or under customary use to trigger FPIC. While Indigenous Peoples may not possess legal title to these lands as defined by national law, their use of these lands, including seasonal or cyclical use, for their livelihoods, or cultural, ceremonial, and spiritual purposes that **define their identity and community,** can often be substantiated, and documented (PS7 Paragraph 13).

The NTFP area is state land but is used by ethnic groups in the Project site for livelihood. The ethnic community rely on NTFP collection for their food resources and income; however, NTFP collection was not identified as their primary livelihood (RP Section 5.3.1). The level of reliance on NTFP collection widely varies across the 25 villages where it is practiced (July-September 2022 consultation). The information gathered from two community consultations meetings and FGD during the site visit (18-21 July 2022) established that the Project will not affect areas used for cultural, ceremonial, and spiritual purposes. While the project has livelihood impact in NTFP area, it is not assessed to affect their defined ethnic identity and community as specified in PS Paragraph 13 to trigger FPIC.[57] The ethnic group members who attended the two meetings and one FGD during the site visit made this assessment themselves.

On land and natural resources under customary use, it is interpreted that the use refers to long-established consistent pattern of use incorporating beliefs and customs which have been transmitted through generations. Swidden cultivation and NTFP collection are considered as the Triang's customary use of natural resources who were semi-nomadic until recently.[58] Swidden cultivation is also the traditional livelihood paired with hunting among the Katu.[59] This seems to be also the case among the Yae and Ha Luk based on their current livelihood system (RP V2 Table 4.3). Swidden cultivation traditionally considered the main economic activity of Triang, Katu, Yae and Ha Luk, has undergone so much change that it can no longer be considered customarily practiced. The same can be said for NTFP collection which is traditionally for subsistence but is currently largely driven by the market.

The Project affected land and natural resources have to be under customary use or traditional ownership to trigger the FPIC. But for land traditionally owned outside the national laws, it must affect the ethnic group's defined identity and community to trigger the FPIC. Due to the absence of customary use and effect on the ethnic group's defined identity and community for land traditionally owned outside the national law, the Project impact would not trigger the FPIC. Thus, due to the absence of any physical displacement or impact on any cultural resources and heritage and land under customary use or effect on defined identity and community of ethnic groups, it is clear that FPIC is not applicable to the Project.

ERM also assessed that FPIC is not applicable to the Project for the reason in line with LESA's assessment discussed above.

Support of Indigenous Peoples for the Project

The Project consulted the local authorities and affected people through meetings, FGD and Key Informant Interview (KII). Four meetings were held as part of EIA preparation (2014-2020) and 8 FGD and 5 KII were done during the ESIA preparation (November-December 2021). In addition, 8 meetings were organized to disclose the ESIA (July-August 2022) (See RP V2 Table 7.3 and 7.6). The

[57] To assess whether the project will affect their ethnic identity and community, the meeting participants from the villages of B. Prao, Dak Kung and Sieng A were asked if the project activities will have an impact on specific indicators of these two terms. The indicators of ethnic identity were their belief, practices, the way they look at themselves as ethnic group and the way others will look at them. The indicators of community were the way they relate with each other and to outsiders, their sense of cohesion as a group and the unity of the community members. On these indicators, the answer was that the project will not have an impact on these. The same indicators were used in Dak Lern in an FGD and the same answer was given.

[58] Dang Nghiem Van and others. 2010. Ethnic Minorities in Vietnam. Hanoi: The Gioi Publishers. Page 82.

[59] Yap, J. 2018. The Katu in Southern Laos. The Laotian Times. 11 April.

government Compensation Committee also held another 4 meetings (February-May 2022) on unit rates (RPV2 Section 7.6.3).

From a review of the results of these engagements, it is noted that support for the Project was expressed and no opposition to the Project was articulated (RP V2 Table 7.6). Concerns over impacts (e.g., siltation of water supplies, influx of workers and disturbance of cemeteries) were expressed but they also assisted the Project to come up with measures to mitigate these impacts. Community also suggested for the Project to improve their conditions (e.g., provision of scholarships, improvement of public infrastructure and support for farm productivity) which indicates that the affected communities see the Project as a partner in local development.

The absence of any objection to the Project and the willingness of the local communities to engage with it were witnessed during the two consultations attended by affected people from 5 villages and two FGD held in Dak Lern during the Consultant's site visit (18-21 July 2022).[60] Those meetings were noted to have met the requirements for meaningful consultation.[61] IFC GN7.14 requires the Project to engage with the affected communities within the project's area of influence through a process of information disclosure and Informed Consultation and Participation (ICP). The ICP process is an antecedent from where FPIC process is built if it was applicable to the Project (GN 25).

Although it is assessed that FPIC is not applicable to this Project, the LESA noted that together with the communities and the government, the Project exhibited the six characteristics of Good Faith Negotiation (GFN). These characteristics are as follows: (i) willingness to engage in a process and availability to meet at reasonable times and frequency; (ii) provision of information necessary for informed negotiation; (iii) exploration of key issues of importance; (iv) use of mutually acceptable procedures for negotiation; (v) willingness to change initial position and modify offers where possible; and (vi) provision of sufficient time for decision making.[62]

The LESA's assessment is based on the community meetings observed, documentation of consultations contained in RP V2 (Section 7.6) and plan for future stakeholder engagement (RP V2 Section 7.5 and 7.7 and CEGDP Section 6.4). The adequacy of the GFN is measured by the extent it moves the dialogue into agreement.[63] The compromise agreement made between the government and the affected people on the unit rates and the Project's incorporation of their concerns in the safeguard documents indicate that the three parties are capable of GFN. This capability is taken as an assurance that the Project and the government will, consider the community in their decision affecting community interest, provide prior disclosure of all relevant information and negotiate with them to come up with a common agreement on the decision without deceit, intimidation, and coercion. However, the performance of the three parties on these aspects must be regularly monitored to ensure their continuous application.

Specific mitigation measures to address impacts on livelihoods, cultural heritage and other community health and safety impacts risks presented in ***Section 7.2.2.3*** were discussed and agree with communities. For instance,

- The Project agreed to comply with villages' Heet-Kong prior to any activities in the Phou Koungking

[60] The villages were B. Prau, Dak Kung, A Sieng, Dak Rant and Dak Dor.

[61] Artelia. 2022. IEAD Monsoon Wind Power Project Environmental and Social Due Diligence-Back-to-Office Report on 2 August. HCMC. Page 28 and Table 6 Item 1. Meaningful consultation according to the SPS (Paragraph 32), is a process that: (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv)is gender inclusive and responsive, tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

[62] FPIC as process requires Good Faith Negotiation (GFN) between the client and affected communities (GN25).

[63] International Labor Organization. 2013. Understanding the Indigenous and Tribal People Concention 1989 (No. 169). Handbook for ILO Tripartite Constituents. Geneva. Page 16.

- The Project agreed with Dak Rant village to provide Worker Code of Conduct for their review
- The Project agreed to inform the villages of number and timing of transportation vehicles and activities
- The Project agreed to support the villages with education and healthcare facilities, employment and vocational training, agricultural improvement, and livestock, etc.Existing Controls

The Project places a strong emphasis on respecting the cultures and customs of the villagers and has been participating in various rituals as part of granting access and permission to undertake technical studies to support the ESIA. This will be formalised as part of a management plan to apply to all workers.

9.5.8.1 Significance of Impacts

The significance of impact assessments undertaken in ***Sections 9.5.2–9.5.6*** remain unchanged. This section assesses the significance of the loss of ethnic culture.

Methodology for Assessment of Impact Significance

The potential economic displacement and impacts to livelihoods are assessed in accordance with the criteria set out in ***Table 9.72*** and ***Table 9.73***.

Table 9.72: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional, and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

Table 9.73: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

Receptor Sensitivity and Impact Magnitude

The affected villagers have a **high** sensitivity, as they are unable to influence the influx of workers and other people to the area.

The magnitude is **small**, due to the migrant workforce comprising 560 people (approximately 3% of the population of the villages in the AoI).

Impact Significance

The impact significance is therefore assessed to be **moderate**.

9.5.8.2 Additional Mitigation, Management, and Monitoring Measures

In addition to the management plans specified in previous impact assessment sections, The CEGDP will be prepared and incorporate aspects of a traditional Ethnic Group Development Plan, due to the overlap of the two management plans, given that the majority of the affected villagers belong to an ethnic group / are considered to be Indigenous Peoples. A SEP will also be prepared to support the CEGDP. These plans seek to:

- Promote ethnic cultures through Project activities in collaboration with the Project affected communities;
- Implement development programs to improve the livelihoods of ethnic groups (refer to ***Section 8.5.6.1***) including providing ethnic women with economic development opportunities;
- Implement measures to remove obstacles for ethnic minorities to participate in Project activities and decision-making, including impact mitigation and benefits; and
- Provide a grievance redress mechanism and appeal process for the Project-affected persons that is culturally appropriate.

The Local Content and Influx Management Plan will include the Workers Code of Conduct that will include cultural awareness requirements for all workers (refer to ***Section 9.5.4.4***).

9.5.8.3 Residual Impact Significance

Through the implementation of the additional mitigation measures, the magnitude is reduced to **negligible** as the migrant workforce will have cultural awareness training, and result in a **negligible** residual magnitude significance (***Table 9.74***).

Table 9.74: Ethnic Groups Impact Assessment

Significance of Impact					
Potential Impact	Impact on Ethnic Groups (Erosion of Ethnic Culture)				
Project Phase	Pre-Construction	**Construction**	Operation		
Impact Nature	**Negative**	Positive	Neutral		
	Erosion of ethnic culture is a negative impact.				
Impact Type	Direct	**Indirect**	Induced		
	Indirect impact will be produced from the migrant workforce.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impacts are limited to the construction phase.				
Impact Extent	**Local**	Regional	International		
	The impacts are limited to the villages in the AoI.				
Impact Scale	The impacts are limited to the villages in the AoI.				
Frequency	The impacts will occur infrequently.				
Impact Magnitude	**Positive**	Negligible	**Small**	Medium	Large
	The magnitude is small, as the migrant workforce comprises 560 people.				
Receptor Sensitivity	Low	Medium	**High**		
	The affected villagers have a high sensitivity as they are unable to influence the influx of workers.				

Significance of Impact				
Impact Significance	Negligible	Minor	**Moderate**	Major
	The impact significance is moderate.			
Residual Impact Magnitude	**Positive**	**Negligible**	Small	Medium
Residual Magnitude Significance	**Negligible**	Minor	Moderate	Major

9.5.9 Impact on Cultural Heritage (Tangible and Intangible)

Cultural heritage resources are defined using a combination of the ADB definition of tangible cultural heritage, IFC PS8 and the definition of cultural heritage in Lao PDR's Law on National Heritage (No. 11/NA, 2021) below:

- The Law on National Heritage (No. 11/NA, 2021) defines national heritage as "cultural, historical and natural heritage existing in the form of tangible objects, intangible items, movable or immovable and living or non-living organism that are of outstanding value and reflecting the history of Lao nation and Lao people."[64]
- The ADB SPS defines physical cultural resources as "Movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground or under water. Their cultural interest may be at the local, provincial, national, or international level."[65]
- IFC PS8 defines cultural heritage as (i) tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; (ii) unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes, and waterfalls; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.

This section discusses the potential impact of the Project on cemeteries and sacred areas which may trigger the Indigenous Peoples Safeguards consent requirement (2009) in relation to potential impacts on "*cultural resources that Indigenous Peoples own, use, occupy, or claim as an ancestral domain or asset*" and FPIC in relation to "*significant impacts on critical cultural heritage that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, including natural areas with cultural and/or spiritual value such as sacred groves, sacred bodies of water and waterways, sacred trees, and sacred rock*".

9.5.9.1 Potential Impacts

Impacts to Cemeteries

The Project has taken into consideration impacts to cultural heritage resources for Project layout optimization. Cemeteries (*paa saa*), which are mostly forested areas, are observed in all surveyed villages. Based on the consultation with Dak Lern village representative (village deputy and belief leader) on 20 August 2022, cemeteries are regarded as highly sacred place as they expressed the area as being highly respected and certain activities prohibited. The village coordinator of Dak Tiem village

[64] Law on National Heritage No. 11/NA (2021)

[65] ADB (2009). Safeguard Policy Statement, page 39-40. Retrieved from: https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf

added to this that he considers the cemetery as a highly sacred place as his parents who passed away are resting there. Activities to disturb resting of their ancestors such as chopping of wood or loud noise are prohibited—he feared if his parent are awoken from their resting by disturbing activities, the parent spirits will be angry at him for not protecting them and let them rest in peace after death. For this reason, people are prohibited from entering cemeteries for any kind of activities such as hunting or collecting timber and NTFPs. If cemeteries are impacted, it is required to undertake rites involving a sacrifice of a puppy (i.e. a young dog) and use its blood to spread across affected cemetery area.

The final Project layout has been optimized and refined to avoid impacts to all cemeteries—the Project has re-routed the transmission line and access road alignments to avoid cutting through almost all the cemeteries. It is noted that an overhead transmission line will pass over Dak Bong Cemetery (***Figure 9.60).*** The transmission line is approximately 70 m above the ground, therefore there will be no modifications (i.e., vegetation clearance and earthwork) made to the cemetery area. However, under the Regulation on Safety for High Voltage Transmission Line and Substation, EDL/ 2013, trees taller than 3 m are prohibited within the ROW area. Therefore, there is a need for the Project or relevant authority to maintain the height of trees under 3 m. The Project consulted with Dak Bong village on 21 July 2022, the village representatives indicated that cutting of trees within ROW in cemetery area is allowed; however, the Project is required to provide budget for the village to prepare and perform specific rituals to seek permission from spirits for such activities.

Impacts to Phou Koungking

Figure 8.39 presents location of Phou Koungking in relation to Dak Lern, Dak Kung and Proa villages. Eight WTGs, transmission line and internal roads (approximately 12.6 ha of land requirement) are proposed in the lower elevation which is designated as multi-use zone of the Phou Koungking Mountain, and therefore will not affect the higher elevation of Phou Koungking. Project activities within the lower elevation of the Phou Koungking Mountain are not prohibited and will not incur any impact on intangible cultural heritage if the Project consults with the villages and complies with villages' Heet-Kong. Refer to ***Section 8.5.3.1*** for details discussion of beliefs around Phou Kounging and findings from consultations with Dak Lern, Dak Kung and Prao villages in July 2022.

Phou Koungking is classified as a legally protected forest at a provincial level but not nationally protected, managed by the Provincial Agricultural & Forestry Office (PAFO). It is noted that this forest is also designated as a protected forest to protect area's watersheds. Any potential ecological impact of the Project is assessed in ***Section 9.4.3*** of the ESIA and the mitigation measures are proposed in the Biodiversity Action Plan (BAP). Interview with DAFO also corroborate that there is a sacred forest in Phou Koungking. The Project will strictly comply with the regulations and requirements from relevant authorities and the BAP and limit land clearance within this mountain as this area is also listed as a protected forest under the National guideline.[66]

Impacts on Ceremonial Grounds

There are ceremonial grounds located within villages for performing rites or ceremonies such as poles for securing animals or sacred houses (salakuan) which serve as a place for performing animal sacrifice. There are no ceremonial grounds or sacred places being affected by Project land acquisition.

Impacts on Critical Cultural Heritage

IFC PS8 para. 8 defines critical cultural heritage as (i) the internationally recognized heritage of communities who use, or have used within living memory the cultural heritage for long-standing cultural purposes; and (ii) legally protected cultural heritage areas, including those proposed by host governments for such designation.

[66] Law on Forestry (2019) No. 08/NA

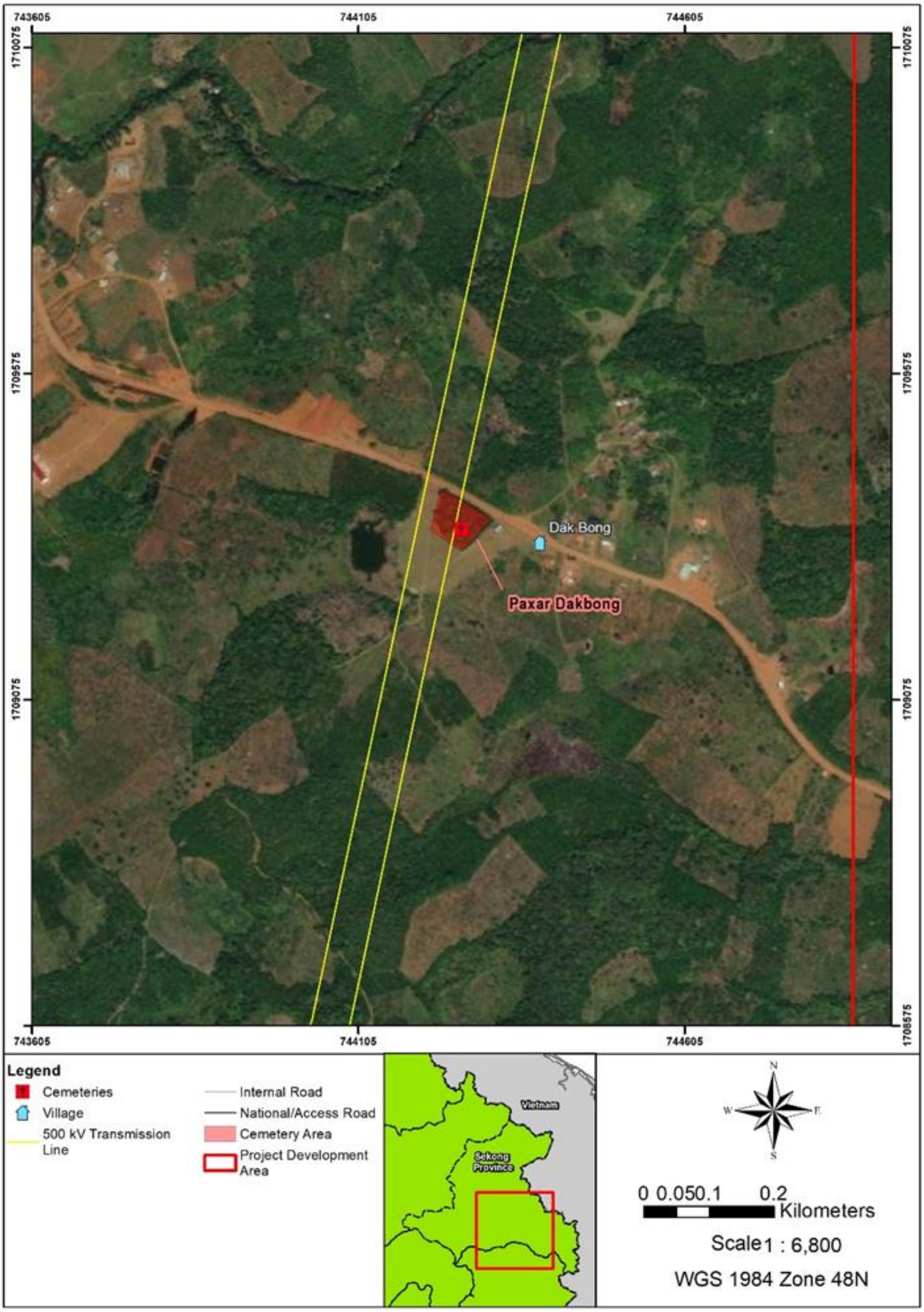
Based on the discussions of tangible and intangible cultural heritage in ***Section 8.5.3.1*** there is no critical cultural heritage identified in the Project development area or in Project vicinity and therefore the Project will not impact critical cultural heritage

Table 9.75 presents the potential impacts from project acitivites during construction and operation on cultural heritage resources.

Table 9.75: Potential Impacts from Project Activities on Cultural Heritage Resources

Phase	Potential Impacts from Project Activities
Construction	■ Potential encroachment of workers into Dak Bong Cemetery which is considered sacred ground during the construction of the overhead transmission line. ■ Impacts arising from environment nuisance such as vibration, noise, and dust affecting ethnic minority ceremonies/rituals/activities and cultural heritage sites close to construction sites. ■ Potential of impact of outside workers brought in by the project and its contractors as well as the potential entry of camp followers will negatively influence existing customs and religious practices undertaken by the ethnic groups, the result of which could be an erosion or loss of ethnic cultural elements. The loss of ethnic cultural elements may occur if migrant workers and other outsiders are not respectful of or do not understand the various customs and religious practices, such as boundaries placed on areas that may only be accessed by women or men. ■ This potential impact is primarily a concern associated with the construction phase when workers and other outsiders will likely to move to the villages in the AoI. Only a small workforce (80 people) will remain in the operation phase. ■ Construction of Project components will involve excavation and ground disturbance at several wind turbine locations. Potential impacts to cultural resources that are not yet known may occur during the construction phase of the Project during clearing or excavation work. In addition to these direct physical impacts described above, the Project has the potential to cause indirect impact to cultural heritage resources. Indirect impacts result from Project activities that do not physically damage a resource, but rather, impact stakeholders' ability to use or access to cultural heritage resources, thereby negatively affecting its cultural value. For instance, restriction on public access to existing tangible cultural heritage sites or areas used for intangible cultural heritage activities, such as forests.
Operation	■ Potential impacts of shadow flicker on cultural heritage sites located in close proximity to the wind turbine towers. ■ Changes to the natural landscape resulting from presence and operation of WTGs.

Figure 9.60: Dak Bong Cemetery



9.5.9.2 Existing Controls

The Project places a strong emphasis on respecting the cultures and customs of the villagers, and has been participating in various rituals as part of granting access and permission to undertake technical studies to support the ESIA. This will be formalised as part of a management plan to apply to all workers. The Project has also sought to minimise any impact to cultural heritage through the optimisation of the Project layout.

9.5.9.3 Significance of Impact

Methodology for the Assessment of Impact Significance

Impact on cultural heritage is assessed in accordance with the magnitude criteria in ***Table 9.76*** and sensitivity criteria in ***Table 9.76***.

Table 9.76: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

Table 9.77: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

Receptors Sensitivity and Impact Magnitude

Receptors have a **medium** sensitivity, as the Project has been proactive in seeking feedback from villagers on the location of wind turbines so as to avoid cultural heritage. However, some wind turbines are located within the Phou Koungking and TL installation activities in Dak Bong cemetery.

The magnitude of the impact is **medium**, regarding potential impact to Phou Koungking and Dak Bong cemetery, given that the impact will occur for the duration of the construction of wind turbines and installation of TL and operation of the wind farm.

9.5.9.4 Additional Mitigation, Management, and Monitoring Measures

A Cultural Heritage Management Plan will be prepared to guide the workers on the protection of cultural heritage sites, structures and values that may be impacted by the Project. In the first instance, the Cultural Heritage Management will require:

- Pre-construction survey. This will build on existing field data, to identify the presence of tangible and intangible cultural heritage resources
- Project design to avoid and minimize impacts to cultural heritage resources. Workers camps, spoil disposal sites, laydown areas and other ancillary facilities will be located away from any cultural heritage sites.
- Further consultation with the villagers who reside close to Phou Koungking to ensure the communities have a good understanding of Project activities and potential impacts on the Phou Koungking;
- Consultation with village leaders, and elders on ceremonies and rituals to be undertaken to seek permission to enter the forest for construction and ongoing maintenance purposes. ***Section 8.5.3.1*** discusses consultations with village heads and belief leaders regarding requirements to access Dak Bong cemetery and Phou Koungking mountain.
- Seek permission from the village leaders, elders and the broader community to enter and utilise the sacred areas that overlap with the Project footprint. Document the consent process and the consent itself.
- The Project will perform required rituals or provide budget for the villages to perform rituals prior to accessing Phou Koungking and Dak Bong cemetery
- The Project will plan Project activities to avoid activities that involve the use of large equipment and machinery which may cause noise and dust disturbance to the nearby villages during their ceremonies and festivals. The annual cycle of the ceremony and festival is presented in ***Table 7.30***.
- Sacred sites, burial grounds in the forest, cemeteries, sacred trees and will be marked and labelled prohibited for entry (no-go zones) by workers
- Establish a Chance Finds Procedure that will guide workers in the event that potential cultural heritage is encountered.

The cultural heritage protocol will be supported by various plans such as the SEP which provides stakeholder engagement strategies and activities throughout the Project lifecycle. The SEP outlines requirements for the Project to inform villagers regarding Project activities. The CEMP will also outline requirements for the EPC Contractors to notify the community relations team prior to entering the sacred forest to ensure appropriate notification and rituals are taken place prior to start of work.

To ensure workers are aware of the cultural heritage sensitivities and the various protocols in place, a cultural heritage training and awareness program will be provided for Project workers. Additionally, the Workers Code of Conduct will contain a statement requiring workers to respect cultural heritage and adhere to all protocols and management plans.

9.5.9.5 Residual Impact Significance

Through further consultation and confirmation of the rituals/ceremonies required, the impact magnitude will be reduced to **small**. This will in turn result in the residual magnitude significance of **minor** (***Table 9.78***).

Table 9.78: Cultural Heritage Impact Assessment

Significance of Impact						
Potential Impact	Impact on Cultural Heritage (Tangible and Intangible)					
Project Phase	Pre-Construction		**Construction**		**Operation**	
Impact Nature	**Negative**		Positive		Neutral	
	The impact is negative.					
Impact Type	**Direct**		Indirect		Induced	
	The Project will directly impact on intangible cultural heritage.					
Impact Duration	Temporary	Short-term		**Long-term**	Permanent	
	The impact will remain throughout the operations phase.					
Impact Extent	**Local**		Regional		International	
	The impact is limited to the villages in the AoI.					
Impact Scale	The impact is limited to the villages in the AoI.					
Frequency	The impact will be sustained over the operations phase.					
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large	
	The magnitude will is considered to be **medium**, being limited to the sacred forest.					
Receptor Sensitivity	Low		**Medium**		High	
	The receptors have a medium sensitivity.					
Impact Significance	Negligible	Minor	**Moderate**	Major		
	The impact significance is moderate.					
Residual Impact Magnitude	Positive	Negligible	**Small**	Medium		
Residual Magnitude Significance	Negligible	**Minor**	Moderate	Major		

9.5.10 Vulnerable Households/Groups

9.5.11 Summary of Gender Impacts and Mainstreaming Measures

The gender disaggregated socio-economic profile is presented in ***Chapter 7***. From this, it can be seen that women are well represented across the affected villages. For instance, in both the Dak Cheung and Sanxay Districts, women have taken on leadership positions including village heads and village board members. FGDs and site visit observations have also confirmed that gender-based violence is not a prevalent issue, and villagers have been equipped with knowledge to identify and manage such situations (refer to ***Section 9.5.6.1***).

Despite this, there are a number of aspects of improvement, namely:

- **Education:** The rate of education for males outpaces that of females, for instance, 59% of females have no formal educational attainment, 40% of females have attained university level educational qualifications. There is a near equal split of females and males who have obtained basic schooling, secondary schooling and vocational training. It was reported that the lack of economic resources and work were the main reasons for females discontinuing study.
- **Livelihood:** Female-headed households, and in particular where households are predominantly or wholly comprised of females, are more likely to experience food deficiency due to lower agricultural productivity (associated with smaller agricultural land and lack of male labour). While agricultural

activities are allocated equally between females and males, women generally have the additional responsibility of household chores (e.g. cooking, cleaning, etc.) and childcare.

- **Healthcare:** Through FGDs with women's groups, insufficient healthcare was identified. Specifically, there are insufficient stocks of medicines, and lack of healthcare personnel.

Through the social impact assessment above (***Sections 9.5.2-9.5.7***) there is a potential for the following impacts to disproportionately impact women. These potential impacts and their respective mitigation measures are summarised in ***Table 9.79***.

In tems of gender additionaluty, the Project is classified as Category II: Effective Gender Mainstreaming (EGM). A Gender Action Plan was prepared. Key features of the gender action plan are as follows: (i) job targets for women during operations; (ii) procurement from at least one woman-owned enterprise; (iii) technical internships for women; (iv) anti-sexual harassment policy; and (v) gender inclusion policy that supports the hiring, retention, and promotion of female staff.

Table 9.79: Summary of Gender Impacts and Mitigation Measures

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
Economic Opportunities (***Section 9.5.3***) ■ Local Employment and Training ■ Increased Access to Agricultural Land/Forest	■ The Project will seek to provide equal opportunities to access employment and training opportunities. ■ The Project will support women's economic development to capitalise on the potential new agricultural areas and/or forest.	**Impact Magnitude:** Positive **Gender Sensitivity:** Medium **Impact Significance:** Positive **Residual Impact Magnitude:** Positive **Residual Gender Sensitivity:** Medium **Residual Impact Significance:** Positive *The residual impact significance rating is the same for all stakeholders.*	**Local Content and Influx Management Plan:** ■ Ensure the hiring process is fair and equitable for women. ■ Ensure women and men are able to participate in training programs targeting skills required to participate in the Project workforce. **CEGDP:** ■ Investigate potential programs, such has IFAD Programme supporting women in agriculture, providing training on weaving for

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
			women, and rearing livestock
Economic Displacement and Impacts to Livelihoods (***Section 9.5.3***) ■ Loss of Agricultural Land ■ Loss of NTFP Collection	■ The loss of agricultural land (permanent or temporary) may further decrease the size of land for female-headed households (which typically have smaller landholdings). ■ As the collection of NTFPs is typically undertaken by women, the loss of forest would also impact upon the amount of NTFP available for women. ■ This may further impact upon livelihood security of women. ■ The impacts of economic displacement can disproportionately affect women, as their unique role in the household means they	**Impact Magnitude:** Large **Gender Sensitivity:** High **Impact Significance:** Major **Residual Impact Magnitude:** Medium **Residual Gender Sensitivity:** Medium ■ Residual Impact Significance: Moderate ■ The residual impact significance rating is the same for all stakeholders.	• **Resettlement Plan:** ■ It is critical to mainstream gender considerations into all components of resettlement planning, including engagement processes. Gender-specific consultation during the preparation of the Resettlement Plan will be undertaken, to integrate the unique needs and perspectives of women. ■ The following additional considerations

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
	may have more difficulties coping with the familial disruption that resettlement can cause than their male counterparts. This is particularly the case if resettlement-related engagement efforts do not effectively enable women's meaningful participation throughout the resettlement process.		will be made for gender equity and social inclusion: ○ Women, and Project affected families, especially from vulnerable households will be encouraged to get involved in all resettlement activities and their effective involvement will also be ensured in all local level resettlement committees. ○ Provision of asset titles, security of tenure, establishment of bank accounts and any cash and in-kind compensation will consider the head of

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
			the household along with the spouse. ○ Additional incentives to encourage joint-account for cash compensation or replacement land in the name of women. ○ Provision of trainings focused on women as a part of livelihood restoration programs. ○ Households categorised as vulnerable for Resettlement Plan will be given priority to access livelihood restoration programs and local employment or procurement

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
			schemes put in place by the Project. ○ The Project will assist with issuance of land titles and encourage land titles and/or compensation bank book in joint spouses names. Title or bank book in husband or wife name is possible if preferred and with consent from the other party
Impacts to Community Health and Safety from Construction Activities (***Section 9.5.4)*** ■ Infrastructure and Machinery ■ Vehicle Movements	■ Construction activities will not necessarily result in gender-specific impacts, however it is prudent that women are equally made aware of potential construction risks. ■ Gender Based Violence and Sexual	**Impact Magnitude:** Small **Gender Sensitivity:** High **Impact Significance:** Moderate **Residual Impact Magnitude:** Small **Residual Gender Sensitivity:** Low **Residual Impact Significance:** Negligible *The residual impact significance rating is the same for all stakeholders.*	**SEP:** ■ Gender-specific consultation should be undertaken to determine the best method to deliver the community environmental and safety awareness to

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact		Gender-Specific Mitigation Measures
■ Security	Exploitation and Child Abuse and Exploitation			women. For instance, consultation with village women in order to determine the appropriate time/period to undertake group discussions or visits.
Impacts to Occupational Health and Safety (***Section 9.5.5***) ■ Working at Heights ■ Working in Remote Locations Lifting Operations	■ Workers' activities will not necessarily result in impacts to the community/gender-specific impacts. Any potential impacts are discussed in the Impacts to Community Health and Safety section, below.	*The residual impact significance rating is the same for all stakeholders.*	N/A	
Impacts Associated with Influx (***Section 9.5.5***) ■ Labour and Working Conditions	■ It is likely that the construction workforce will be predominantly comprised of male workers. Some of	**Impact Magnitude:** Small **Gender Sensitivity:** High **Impact Significance:** Moderate **Residual Impact Magnitude:** Small **Residual Gender Sensitivity:** Medium **Residual Impact Significance:** Minor		**Local Content and Influx Management Plan** ■ Establish and enforce a WCC, which will have strict guidelines

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
■ Transactional Sex ■ Community Dynamics and Gender-Based Violence ■ Potential Spread of Diseases ■ Public Infrastructure and Resources	these workers will be migrant workers. ■ The occurrence of transactional sex may increase, which may in turn lead to the spread of diseases, such as sexually transmitted diseases. As noted earlier, there is an existing lack of healthcare provisions and workers. ■ Migrant workers may have different customs and traditions to the villagers belonging to the various ethnic groups. This may result in a change in community dynamics and/or gender-based violence against women. ■ Gender Based Violence and Sexual Exploitation and Child Abuse and Exploitation	*The residual impact significance rating is the same for all stakeholders.*	for worker interactions with local women, and fellow female workers. ■ Provide skills training to women to maximise the potential for local hiring. **Community Health and Safety Management Plan** ■ Conduct an awareness campaign on HIV/AIDS and sexually transmitted diseases (STDs) focusing on targeted groups such as transport workers and adolescents. ■ Conduct an awareness campaign on nutrition and

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
			promotion of a healthy life-style (in conjunction with the reproductive health and nutrition program within the CEGDP). ■ Conduct a waste-management and sanitation awareness campaign for preventing vector-borne diseases. ■ Supplement awareness campaigns on gender-based violence to ensure women are aware of how and where to report and provide support to facilitate the process.

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
Impacts of Wind Farm Operation on Local Amenity (***Section 9.5.7***) ■ Noise ■ Landscape and Visual ■ Shadow Flicker	No gender-specific impacts.	*The residual impact significance rating is the same for all stakeholders.*	N/A
Impact on Ethnic Groups (***Section 9.5.8***) ■ Erosion of Ethnic Culture	■ There is the potential for migrant workers to negatively influence customs and religious practices that may have gender-specific boundaries/rules. ■ For instance, women and outsiders are strictly forbidden from entering the Salakuan (sacred house).	**Impact Magnitude:** Small **Gender Sensitivity:** High **Impact Significance:** Moderate **Residual Impact Magnitude:** Negligible **Residual Gender Sensitivity:** High **Residual Impact Significance:** Negligible ***The residual impact significance rating is the same for all stakeholders.***	**CEGDP** ■ Ethnic culture will be promoted so that workers are aware of potential gender-specific cultural considerations. ■ Provide support for documentation and preservation of traditional knowledge on herbs and its benefits/usage, skills, and indigenous crafts passed through

Potential Social Impacts	Gender-Specific Impacts	Significance of Impact	Gender-Specific Mitigation Measures
			women (e.g., hand knitting mats, bamboo baskets, and woven woollen carpets). ■ Set up a women's cooperative to promote indigenous crafts, which will involve the investigation of where indigenous crafts can be sold and market for these crafts. This will support potential efforts to increase revenue.
Impact on Cultural Heritage (Tangible and Intangible) ***Section 9.5.9***)	No gender-specific impacts.	*The residual impact significance rating is the same for all stakeholders.*	N/A

9.6 Climate Change Risk and Impact Assessment

9.6.1 Impacts on Climate Change

The Project will generate electricity with installed capacity of approximately 600 MW and electricity generation capacity of 1,707 GWh/year from wind energy. This will contribute to a significant increase in electricity generated from renewable energy in Lao PDR, which could lead to a decrease in importation of fossil fuels that would have been needed in the absence of the Project. Subsequently, this Project is expected to reduce the anthropogenic emission of greenhouse gases (GHGs), particularly carbon dioxide (CO_2) which is one of the major causes of man-induced global warming.

The scope of this study covers a quantitative assessment of the GHG emissions from the Project using available information and assumptions, and a comparison of emissions from the Project to Lao energy sector's GHG emission portfolio.

9.6.1.1 Potential Impacts

Based on the ESIA dated 2020, GHG emissions during **pre-construction phase** is related to clearing of forest and agricultural land for the construction of the Project. Vegetation contains large amounts of carbon. When it is cleared, it releases much of that carbon in the form of heat trapping gases, primarily carbon dioxide (CO_2), which warms the atmosphere.[67]

The main sources of GHGs **during the construction phase** are:

- construction machinery and equipment in various activities such as clearance and levelling of the construction area,
- running transport vehicles to and from the Project area,
- construction of tower bases, and
- construction of access road etc.

Based on information provided by MWPCL, electricity will be purchased from the gird for the Site office, workers' camps, batching and crushing plants, etc. during construction phase. There is no plan for self-consumption of electricity from the Wind farm during construction.

During **operation phase**, the electricity production of the wind farm will not emit GHGs as it is a form of renewable energy and there is no involvement of fuel combustion in energy production process. Therefore, any self-consumption of produced electricity will not produce emissions and is not included in project scope for GHG emissions. Furthermore, the Project will reduce dependency on electricity from combustion of fossil fuel such as coal and natural gas, therefore the Project will help reduce the emission of GHGs, which is discussed in ***Section 9.3.4.3***. However, based on information provided by MWPCL, fuel will be needed to operate on site generators and for operating vehicles. Electricity will be purchased from the Lao grid for operation and maintenance (O&M) of accommodation and warehouse. There is a plan for self-consumption of the electricity generated from the wind power during the operation phase, and diesel generators are to be used for backup when electricity generated from the wind farm is not available.

[67] Land Clearing & Climate Change: Risks & Opportunities in the Sunshine State. Retrieved from: https://www.climatecouncil.org.au/uploads/c1e786d5d0fe4c4bc1b91fc200cbaec8.pdf

Table 9.80: Project Scope and Activity by Emission Source during Construction and Operation

Phase	Source Class	Scope 1 and Scope 2 Emission
Pre-Construction	Land use conversion	Land clearance and preparation which result in conversion of forest to developed land
Construction	Stationary combustion	Generators (diesel)
	Mobile combustion	50-80 machines and equipment for land preparation and construction activities such as cranes, backhoe, bulldozers, etc. 20-50 vehicles
	Electricity	Purchased electricity from Lao grid
Operation	Stationary combustion	Generators (diesel)
	Mobile combustion	12 cars
	Electricity	Self-consumption and purchased electricity from Lao grid
	Plant operation and maintenance	Plant operation and maintenance activites

Source: ESIA dated September 2020 and MWPCL.

Note: Mobile sources is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from one place to another. It includes vehicles used on roads for transportation of passengers or freight as well as off-road vehicles, engines, and equipment used for construction, transportation, agriculture, and other purposes. By definition, other combustion sources are considered to be stationary (Stationary Combustion Guidance, WRI/WBCSD (2005))[68].

9.6.1.2 Existing Controls

Embedded/in-built controls for Project's impacts on climate change during construction included in the ESIA are:

- During construction phase, avoid burning in area clearance activities that may lead to occurrence of fire which may, in turn, lead to burning of forests;
- Land preparation and construction work to avoid cutting of trees or removal of plant species outside of the concession area;

[68] Calculation Tool for Direct Emission from Stationary Combustion (2015). Retrieved from: https://ghgprotocol.org/sites/default/files/Stationary_Combustion_Guidance_final_1.pdf

- Develop and maintain vegetation clearances with respect to prevailing standards and regulations
- Ensure the maintenance of construction machinery and equipment to keep them in good conditions to ensure efficiency, as lower efficiency machineries generally emit higher CO_2.[69]
- Avoid emissions of CO_2 in excessive of specified standards; and
- Issue the rues to prevent staff and workers from burning waste within construction area.
- Existing controls for Project's impacts on climate change during operation included in the ESIA are:
- Replant trees in the areas where land clearance and levelling works are undertaken;
- Participate in the protection of forests and green areas in Dak Cheung District and Sanxay District. These forests and green areas in the two districts will help maintain the overall climate condition and meteorology in the Project area and in the localities; and
- Replantation in areas around the wind turbine towers, office building, and sub-station of the Project to allow the Project area.

9.6.1.3 Significance of Impacts

Impacts during Pre-construction Phase

The total release of GHG emissions (Scope 1)[70] during the pre-construction phase is estimated to be **56,980 tonnes CO_2 equivalent** (***Table 9.84)**, accounting for 80.49 % of total GHG emission from the Project throughout the Project life (28 years).

Vegetation clearing in this area can result in a change of carbon (C) stocks from the removal of living biomass.

GHG emission of vegetation clearing is estimated based on net changes in C stocks over time. The use of C stock changes to estimate CO_2 emissions and removals, is based on the fact that changes in ecosystem C stocks are predominately (but not exclusively) through CO_2 exchange between the land surface and the atmosphere. Thus, increases in total C stocks over time are equated with a net removal of CO_2 from the atmosphere and decreases in total C stocks are equated with net emission of CO_2.[71] The estimation of GHG emission due to vegetation clearing is therefore assumed for Project period (28 years) – as after vegetation have been cleared, the C stocks which serve as CO_2 sequestration will be lost (equated to CO_2 emission) throughout the Project period.

Changes in vegetation types and cover due to land-use system and land-use management activities have the potential to modify the soil-to-atmosphere GHG exchange (Raich and Tufekcioglu 2000). It is noted that that the ground will, without intervention, continue to emit CO_2 as the soil quality declines. About 30–35% of the soil C stored in the top 7 cm layer of soil was lost in the first 30 years once forests were converted

[69] STAPPA/ALAPCO. (1999). Reducing Greenhouse Gases and Air Pollution: A Menu of Harmonized Options. Retrieved from: https://www.oecd.org/environment/cc/2055676.pdf

[70] The GHG Protocol classifies removal of native vegetation – emissions resulting from removal or suppression of native vegetation for other uses (land-use change) as Scope 1 Emission. Retrieved from: https://wribrasil.org.br/sites/default/files/ghg_protocolo-florestas-technicalnote.pdf

[71] IPCC Guidelines on Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003). Retrieved from: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_0_1_Ch1_Introduction.pdf p. 1.6

into agricultural fields.[72] [73] The land use category is assumed to be forest land and crop land in line with IPCC categories (IPCC, 2003[74]). GHG emissions from land clearance are assessed using the Equation below and the parameters summarized in ***Table 9.81***.

The estimation of total GHG emission due to vegetation clearing is presented in ***Table 9.82***.

Equation: Change in Biomass Carbon Stocks on Land Converted to another Land category

$$\textbf{Annual Change in Carbon Stocks} = A_{conversion} \times (B_{after} - B_{before}) \times CF$$

Where:

Annual change in Carbon Stocks = Annual change in carbon stocks in living biomass in land converted to 'other land'[75] (ton C/year)

$A_{conversion}$ = Area of land converted to 'other land' from some initial land use (ha/year)

B_{after} = Amount of living biomass immediately after conversion to 'other land' (tonnes d.m./ha)

B_{before} = Amount of living biomass immediately before conversion to 'other land' (tonnes d.m./ha)

CF = Carbon fraction of dry matter (default = 0.5) (tonnes C/tonnes d.m.)

To convert tons of carbon to tons of carbon dioxide equivalence, multiply by the atomic weight difference between C and CO_2 (44/12).[76]

Table 9.81: Amount of Living Biomass Before and After Conversion

Description	Amount of Living Biomass (tonnes d.m./ha)
	Forest land
Before	25[a]
After	0[b]

a – carbon stocks in biomass for forest land for tropical and sub-tropical forests, montane dry region from Table 3A.1.3 from Chapter 3.3 of Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003)

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72 DeGryze, S.; Six, J.; Paustian, K.; Morris, S.J.; Paul, E.A.; Merckx, R. Soil organic carbon pool changes following land-use conversions. Glob. Change Biol. 2004, 10, 1120–1132.

73 Ozlu et.al. (2022). Carbon Footprint Management by Agricultural Practices

74 IPCC Guidelines on Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003). Retrieved from: https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

75 This category includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories (forest land, crop land, grassland, wetlands, and settlements).

76 IPCC Good Practice Guidance for LULUCF (2003). Retrieved from: https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_2_Forest_Land.pdf p. 3.51
GHG Protocol for calculation tool for forestry in Brazil. Retrieved from: https://wribrasil.org.br/sites/default/files/ghg_protocolo-florestas-technicalnote.pdf
EPA Greenhouse Gases Equivalencies Calculator - Calculations and References. Retrieved from: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
Module C-CS: Calculations for Estimating Carbon Stocks. Retrieved from: https://winrock.org/wp-content/uploads/2018/08/Winrock-Guidance-on-calculating-carbon-stocks.pdf

b – default assumption of 0 was assumed when converted to other land as per Section 3.7.2.1.1.1 form Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003)

Source: IPCC 2003 Good Practice Guidance for Land use, Land-use Changes and Forestry

Table 9.82: GHG Emission from Land Clearing in the Pre-construction Phase

Phase	Description	Calculation
Pre-construction[77]	Annual carbon stock change due to land clearing (ton C/year)	= $A_{conversion}$ x (B_{after} - B_{before}) x CF = 44.4 x (0-25) x 0.5 = -555 ton C/year
	Annual CO_2 emission due to loss of carbon stock (CO_2eq/year)	= Annual change in carbon x conversion = 555 x (44/12) **= 2,035 CO_2eq/year**
	Total change in carbon stock over the Project life (28 years) (ton C)	= Annual change in carbon stock x 28 years = 555 x 28 = 15,540 ton C
	Total CO_2 emission due to loss of carbon stock over the Project life (28 years) (tona CO_2eq)	= Total change in carbon stock x conversion = 15,540 x (44/12) = **56,980 ton CO_2eq**

Box 9.1 belows demonstrate the carbon stock (in biomass/aboveground) throughout the Project life. It is noted that carbon in soil is not taken into this calculation.

[77] The calculation of GHG emission during pre-construction does not include emissions from equipment used to clear vetgetation

Box 9.1: Carbon Stock Throughout the Project Life

<u>Carbon Stock Before the Project:</u>

Montane Forest: Approximately 42.8% of the Project Development Area (30,218.3 ha) is comprised of this habitat type.

Annual Carbon Stocks = $A_{conversion}$ x B (amount of living biomass) x CF

= 30,218.3 x 25[a] x 0.5)

= 377,728.75 ton C/year

Agricultural-Shrub Land-Grassland Mosaic: Approximately 56.3% of the Project Development Area (39,760.9 ha) is comprised of this habitat type.

Annual Carbon Stocks = $A_{conversion}$ x B (amount of living biomass) x CF

= 39,760.9 x 3.8[b] x 0.5

= 75,545.71 ton C/year

Total Carbon Stock of the Project Area = 453,274.5 ton C/year

Therefore, the carbon stock over the Project life is estimated at 453,274.5 ton C/year x 28 years = **12,691,685 ton C**

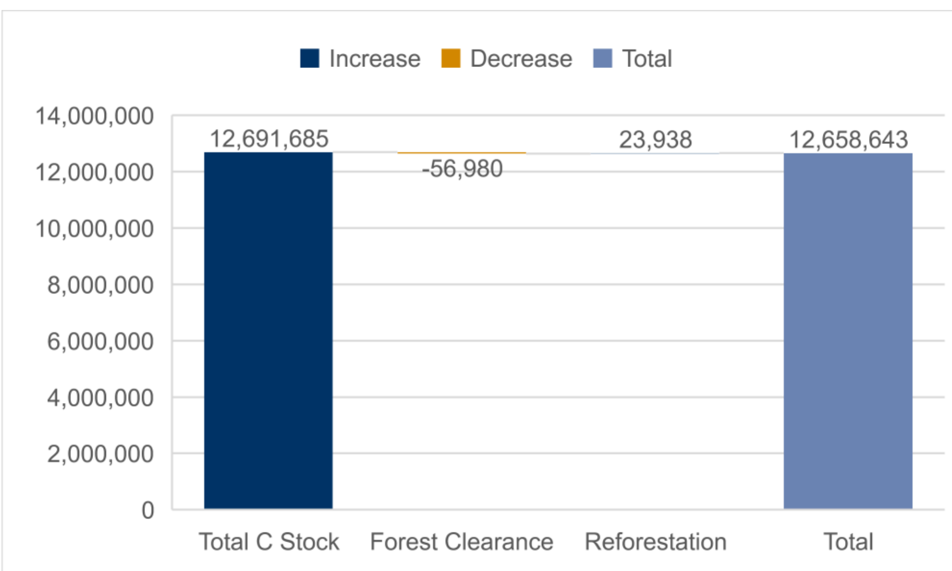
<u>Forest Clearance (pre-construction)</u>

Table 9.82 presents GHG emissions from land clearing during the pre-construction phase. Total CO_2 emission due to loss of carbon stock over the Project life (28 years) is estimated at **56,980 ton CO_2eq**.

<u>Reforestation (Biodiversity Offset) (Operation):</u>

Section 9.6.1.4 presents a calculation of carbon stock of biodiversity offset program. The mitigation measures will result in an increase of **23,937.5 ton C** over the offset period (25 years).

The figure below presents the balance of carbon stock (biomass) throughout the Project life. Given significant availability of carbon stock before the Project, it is considered that the Project will have insignificant impact to carbon stock throughout the Project life.



a – carbon stocks in biomass for forest land for tropical and sub-tropical forests, montane dry region from Table 3A.1.3 from Chapter 3.3 of Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003)

b - Tropical Dry, Aboveground net primary production (ANPP) (tonnes d.m. ha-1 yr-1). Table 3.4.2 Default estimates for standing biomass grassland (as dry matter) and aboveground net primary production, classified by climate zone

Impacts during Construction Phase

The total release of GHG emissions during construction is estimated to be **2,391.55 tonnes of CO_2 equivalent per year** or **7,174.65 CO_2 equivalent throughout** (11.35% of total emission over the Project life of 28 years) construction period (3 years) as shown in ***Table 9.84***. The majority of emissions during construction phase are from the use of mobile transportation/ equipment/ machineries, followed by stationary combustion.

Table 9.83: Emissions Breakdown by Scope and Activity during Construction

Emission Scopes	Emission/year (tCO_2eq/year)	Total Emission during construction (3 years) (tCO2eq)
Scope 1: Direct Emission		
Stationary Combustion	65.57	196.72
Mobile Combustion (equipment/machineries/vehicles)	87.98	263.93
Total Direct Emission	153.55	460.65
Scope 2: Electricity indirect GHG emissions		
Purchased electricity from the national grid	2,238	6,714
Total Emission (Scope 1 + Scope 2)	**2,391.55**	**7,174.65**

Impacts during Operation Phase

During operation phase, there would be no GHG emission from the electricity production from the wind farm. The majority of GHG emission derived from Mobile Combustion (equipment /machineries /vehicles), followed by purchased electricity and stationary combustion, respectively. The total operational lifetime of the Project by MWPCL is expected to be 25 years. The total release of GHG emissions during operation is estimated to be **236.34 tonnes of CO_2 equivalent per year** or **6,131.84 CO_2 equivalent throughout** the operation period of 25 years (8.37% of total GHG emission throughout the Project life of 28 years) as shown in ***Table 9.85.***

Table 9.84: Emissions Breakdown by Scope and Activity during Operation

Emission Scopes	Emission/year ($tCO_2eq/year$)	Total Emission during Operation (25 years) (tCO2eq)
Scope 1: Direct Emission		
Stationary Combustion	18.00	450.00
Mobile Combustion (equipment/machineries/vehicles)	132.35	3,308.75
Total Direct Emission	150.35	3,758.75
Scope 2: Electricity indirect GHG emissions		
Purchased electricity from the national grid	83.93	2,098.25
Total Emission (Scope 1 + Scope 2)	234.28	5,857.00
Plant Operation and Maintenance		
Total emission from plant operation and maintenance	1.54	38.5
Total Emission	**236.34**	**5,895.5**

Total Emission throughout the Project Life

Table 9.85 and ***Figure 9.61*** presents an overall GHG emission breakdown by phase. The assessment of GHG emission indicates that the majority of GHG emission derives from pre-construction phase (79.61%), followed by construction (11.23%), and operation (9.16%).

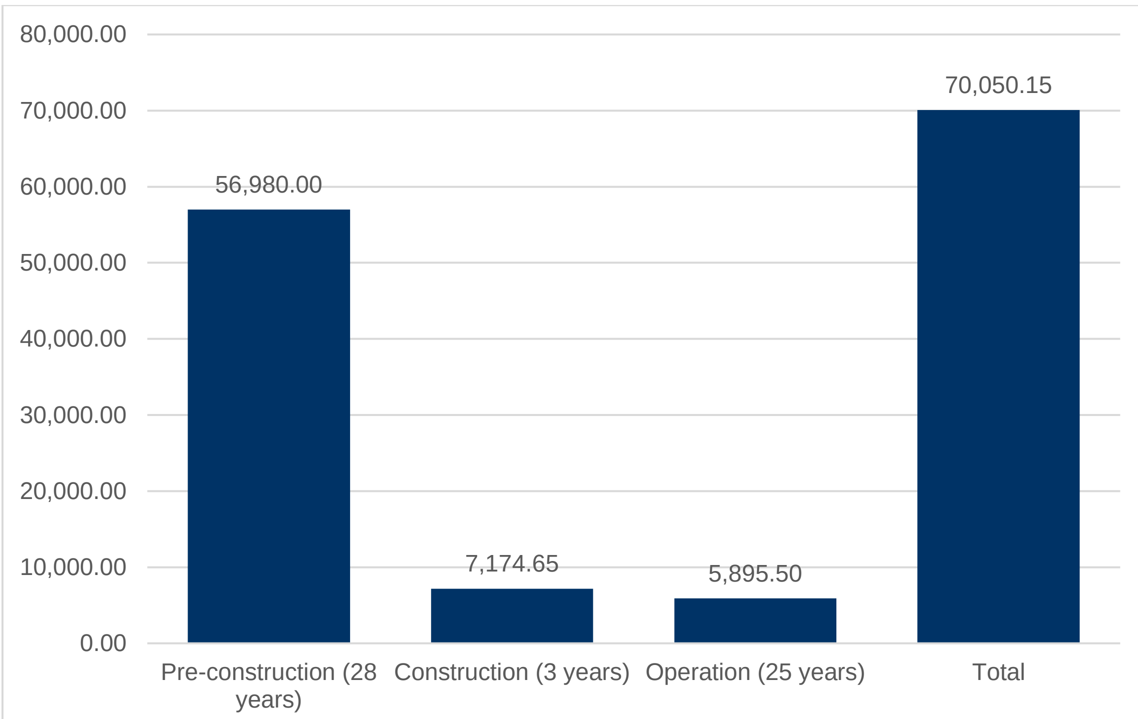
Table 9.85: GHG Emission Breakdown by Phase

Phase	Scope 1 Emission (tCO_2eq)	Scope 2 Emission (tCO_2eq)	Total Emission	% of total Emission
Pre-construction (28 years)	56,980.00	NA	56,980.00	81.34%
Construction (3 years)	460.65	6,714.00	7,174.65	10.24%
Operation (25 years)	3,758.75	2,098.25	5,895.5[78]	8.42%

[78] Include the emission from operation and maintenance activities

Phase	Scope 1 Emission (tCO_2eq)	Scope 2 Emission (tCO_2eq)	Total Emission	% of total Emission
Project Life (28 years)	**61,199.40**	**8,812.25**	**70,050.15**	**NA**
Annual Average (over 28 years)	**2,185.69**	**314.72**	**2,501.79**	**NA**

Figure 9.61: GHG Emission Breakdown by Phase



Methodology for Assessment of Impact Significance

Greenhouse emission falls under the following three scopes:

- **Scope 1 – Direct GHG emissions**: Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emission from combustion in owned or controlled generators or vehicles, etc. Direct CO_2 emissions from combustion of biomass shall not be included in Scope 1 but reported separately.
- **Scope 2 – Electricity indirect GHG emissions**: Scope 2 accounts for GHG emissions from the generation of purchased electricity produced by a third party and consumed by the company (or Project, as in this study). Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated. In this study, only emissions from the grid are considered, therefore all Scope 2 emissions are location-based. A location-based method reflects the average emissions intensity of grids on which energy consumption occurs (using mostly grid-average emission factor

data).[79] This is relevant to the site as all of the electricity purchased by the site will be from the national grid, and none of the electricity purchased will be directly from the supplier, which if relevant would be counted as market-based.

- **Scope 3 – Other indirect emissions**: Scope 3 is an optional reporting category that allows for treatment of all other indirect emissions that are related to the business operations of the site but where emissions occur from outside the boundary of the site, namely emissions from suppliers and customers. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Scope 3 emissions include some of purchased fuels, and use of sold products and services. However, according to Equator Principles, only Scope 1 and Scope 2 emissions are required to be quantified and reported publically (on annual basis); therefore, this assessment does not cover quantification of Scope 3 emission.

Scope 1 and Scope 2 have been considered for this Project, which were quantified according to the following standards:

- GHG Protocol Corporate Accounting and Reporting Standards[80]
- GHG Protocol Scope 2 Guidance[81]
- 2003 IPCC Guidelines on Good Practice Guidance for Land Use, Land-Use Change and Forestry[82]
- 2006 IPCC Guidelines for National GHG Inventories[83]
- 2010 Ministry of Natural Resources and Environment (MONRE), Lao PDR on calculation for the emission factor for electricity generation in Lao PDR[84]
- 2020 Lao's PDR's First Biennial Update Report[85]
- 2021 Lao PDR's Revised Nationally Determined Contribution (NDC)[86]

GHGs and Their Global Warming Potentials

The global warming potential (GWP) is used to evaluate the potency of non-CO_2 GHG compared to CO_2 as a baseline. For example, methane (CH4) is 25 times more potent than CO_2 in its global warming effect, meaning that 1 kg of CH4 emitted is equivalent to 25 kg of CO_2 emitted. The 100 years' time horizon is used in line with GHG inventory best practices.

Although Lao PDR's First Biennial Update Report dated 24 July 2020 applied the GWP of the 1996 IPCC Second Assessment Report (SAR); however, this assessment uses the GWP sourced from the 2007 IPCC

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[79] GHG Protocol Scope 2 Guidance. Retrieved from: https://ghgprotocol.org/sites/default/files/Scope2_ExecSum_Final.pdf

[80] GHG Protocol Corporate Accounting and Reporting Standards. Retrieved from: https://ghgprotocol.org/standards/scope-3-standard

[81] GHG Protocol Scope 2 Guidance. Retrieved from: https://ghgprotocol.org/scope_2_guidance

[82] IPCC Guidelines on Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003). Retrieved from: https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

[83] IPCC Guidelines for National GHG Inventories (2006). Retrieved from: https://www.ipcc-nggip.iges.or.jp/public/2006gl/

[84] Calculation for the emission factor for electricity generation in Lao PDR (2010). Retrieved from: http://monre.myqnapcloud.com/2017/dndmcc/images/stories/pdf/calculation%20for%20the%20emission%20factor.pdf

[85] 2020 Lao's PDR's First Biennial Update Report. Retrieved from: https://unfccc.int/sites/default/files/resource/867493251_Lao%20Peoples%20Republic-BUR1-1-Draft%20Biennial%20Update%20Report-BUR_Lao%20PDR_24July2020.pdf

[86] 2021 Lao PDR's Revised Nationally Determined Contribution (NDC). Retrieved from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Lao%20People's%20Democratic%20Republic%20First/NDC%202020%20of%20Lao%20PDR%20(English),%2009%20April%202021%20(1).pdf

Fourth Assessment Report (AR4) as the values are more updated and more commonly adapted. Detail of GWP factors used in this assessment are shown in ***Table 9.86***.

Table 9.86: Global Warming Potentials

Industrial Designation or Common Name	Chemical Formula	Global Warming Potential for 100 years' Time Horizon from IPCC Fourth Assessment Report
Carbon Dioxide	CO_2	1
Methane	CH_4	25
Nitrous Oxide	N_2O	298

Source: 2007 IPCC Fourth Assessment Report Working Group I. Retrieved from: https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Emission Factors

An emission factor represents an average emission rate for a given source, and is generally expressed as mass or volume of emission per source type or measure of activity related to the source.

The 2006 IPCC emission factors for stationary and mobile combustion were used for the purpose of GHG emission calculation of this report. Although the 2021 Lao PDR's NDC applied the 1996 IPCC guidelines, this report used the 2006 IPCC guideline as it provides a more updated data and is more widely adopted. ***Table 9.88*** provides emission factors for stationary and mobile combustion related to the Project activities and used for the purposes of this report.

Table 9.87: Emission Factors for Stationary and Mobile Combustion

Fuel	tCO_2/Litre	tCH_4/Litre	tN_2O/Litre
Emission factors for stationary combustion			
Diesel	2.7×10^{-3}	$1.09 \times 10^{+7}$	2.19×10^{-8}
Diesel B5	2.56×10^{-3}	1.04×10^{-7}	2.08×10^{-8}
Emission factors for mobile combustion			
Gasoline	2.11×10^{-3}	1.11×10^{-7}	1.11×10^{-7}
Diesel	2.70×10^{-3}	1.42×10^{-7}	1.42×10^{-7}

Source: IPCC 2006 (converted from kg/TJ)

Table 9.88 presents emission factors considered for the calculation of emission from national grid. During construction, the Project will source electricity used for construction activities from Lao PDR's national grid (Scope 2 emission), therefore the 2021 Lao PDR's NDC applied the emission factor of **0.5595 tCO_2/MWh**

for Lao PDR national electricity grid is used for calculation of GHG emission from purchased electricity for Project activities during construction.[87]

During operation, the Project will not emit GHG from the operation of the Project, avoided emission will therefore be calculated for the operation period of the Project. The Guidelines for Estimating Greenhouse Gas Emission of Asian Development Bank Projects—Additional Guidance for Clean Energy Project (2017)[88] refers to International Financial Institution (IFI) Approach to GHG Accounting for Renewable Energy Projects where "*the baseline emissions are calculated based on the energy production of project multiplied by the Combined Margin (CM) emission factor in tCO2e/MWh".* [89] This approach is also in line with the World Resources Institutes (WRI)'s Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects which outline that *"baseline emissions are estimated using a combined margin emission rate..."*

Table 9.88 presents the CM emission factors for Vietnam grid for calculation of GHG emission reduction—the CM emission factor of the Harmonized IFI Default Gird Factors 2021 is 0.493 tCO_2/MWh, while the average CM emission factor of the Institute for Global Environmental Strategies (IGES) 2021 is 0.602 tCO2e/MWh for Clean Development Mechanism (CDM) projects. The IFI CM emission factor (**0.493 tCO_2/MWh**) is used for the calculation of avoided emission of the Project as it is in line with ADB's guideline and the most updated emission factors available. It is however noted that alternative emission factor for GHG emission avoidance is available such as the emission factor provided by IGES.

Table 9.88: Emission Factors for Electricity

Emission Factor	tCO_2/MWh	Source
Lao PDR national grid emission factor	0.5595	2021 Lao PDR's NDC[90] 2010 MONRE, Lao[91]
Lao PDR CM emission factor (for GHG reduction calculation)	0.876 (intermittent energy)	Harmonized IFI Default Gird Factors 2021[92] [93]
	0.574 (average combined margin for CDM projects)	Institute for Global Environmental Strategies (IGES) 2021
Vietnam national grid	0.8041 (grid emission)	2020 Department of Climate Change, Vietnam MONRE[94]

[87] Calculation for the emission factor for electricity generation in Lao PDR (2010). Retrieved from: http://monre.mygnapcloud.com/2017/dndmcc/images/stories/pdf/calculation%20for%20the%20emission%20factor.pdf

[88] Guidelines for Estimating Greenhouse Gas Emissions of Asian Development Bank Projects: Additional Guidance for Energy Projects (adb.org)

[89] Combined Margin (CM) is derived at by combining the Operating Margin (OM) and Build Margin (BM) the weighting of 75% OM: 25% BM for variable generation (e.g. most wind and solar PV).

[90] 2021 Lao PDR's Revised Nationally Determined Contribution (NDC). Retrieved from: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Lao%20People's%20Democratic%20Republic%20First/NDC%202020%20of%20Lao%20PDR%20(English),%2009%20April%202021%20(1).pdf

[91] Calculation for the emission factor for electricity generation in Lao PDR (2010). Retrieved from: http://monre.mygnapcloud.com/2017/dndmcc/images/stories/pdf/calculation%20for%20the%20emission%20factor.pdf

[92] https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies

[93] https://unfccc.int/sites/default/files/resource/Harmonized_IFI_Default_Grid_Factors_2021_v3.2_0.xlsx)

[94] http://dcc.gov.vn/van-ban-phap-luat/1082/He-so-phat-thai-luoi-dien-Viet-Nam-2020.html

Emission Factor	tCO_2/MWh	Source
Vietnam CM emission factor (for Emission reduction calculation)	0.493 (intermittent energy)	Harmonized IFI Default Gird Factors 2021[95] [96]
	0.602 (average combined margin for CDM projects)	Institute for Global Environmental Strategies (IGES) 2021

GHG Emission Calculation Methods

Scope 1 GHG Emission

Scope 1 method of IPCC was selected since information regarding site specific or country specific emission factors are not available. This approach is used to estimate the GHG emission in general by analyzing the emission based on fuel consumption.

Applying Scope 1 emission estimation requires the following for each source category and fuel:

- Data on the amount of fuel combusted in the source category
- Emission factors

In general, GHG emissions based on fuel used is the product of fuel consumption and emission factors of the fuel source as demonstrated in Equation below:

$$\textbf{GHG Emission}_{\textbf{GHG, fuel}} = \textbf{Fuel Consumption}_{\textbf{fuel}} \times \textbf{Emission factor}_{\textbf{GHG, fuel}}$$

Where:

- $Emission_{GHG,fuel}$ = emission of a given GHG by type of fuel (tCO_2eq)
- $Fuel\ Consumption_{fuel}$ = amount of fuel combusted (litre)
- $Emission\ Factor_{GHG,\ fuel}$ = emission factors of a given GHG by type of fuel (tCO_2eq/litre) (amount (tCO_2eq) of a given GHG emitted per one unit of fuel combusted (tCO_2eq/litre))

Source: 2006 IPCC guideline for National GHG inventories; Volume 2: Energy Chapter 2

Scope 2 GHG Emission

A similar estimation method applies for Scope 2 - indirect GHG emission from purchased electricity. Data required for Scope 2 emission estimation are:

- Data on the amount of electricity consumption
- Source of electricity and emission factor of the source

Emissions assessment based on the type of electricity source (hence emission factors) and the amount of electricity consumption is illustrated in the equation below:

95 https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies
96 https://unfccc.int/sites/default/files/resource/Harmonized_IFI_Default_Grid_Factors_2021_v3.2_0.xlsx)

$$\textbf{Emission}_{\textbf{GHG, electricity source}} = \textbf{Electricity Consumption}_{\textbf{electricity source}} \times \textbf{Emission factor}_{\textbf{GHG, electricity source}}$$

Where:

- $Emission_{GHG,\ electricity\ source}$ = emission of a given GHG (tCO_2eq)
- Electricity Consumption $_{electricity\ source}$ = emission factors of a given GHG by type of electricity source (tCO_2eq/MWh) (amount of GHG emitted per one unit of electricity consumed)
- Emission Factor = amount of GHG emitted per one unit of electricity consumed (tCO_2eq/MWh)

Total GHG Emission

The estimate the total GHG emissions (Scope 1 and Scope 2) is the sum of Scope 1 and Scope 2 emission as equation outlined below:

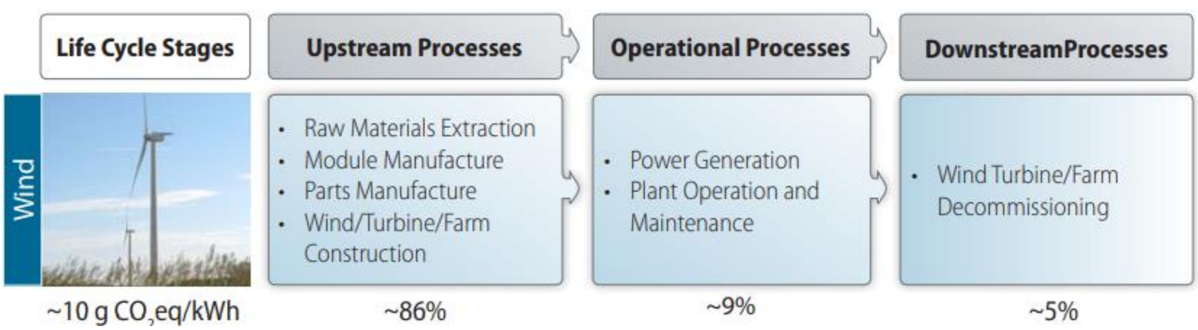
Total Emission = Scope 1 Emission (tCO_{2eq}) + Scope 2 emission (tCO_{2eq})

GHG Emission from Plant Operation and Maintenance

The National Renewable Energy Laboratory (NREL) estimates a total lifecycle emissions of 9% for operational processes including power generation, and plant operation and maintenance (***Figure 9.62)***. The emission factor is estimated at 10 gCO_{2eq}/kWh.[97]

Annual Operation and Maintenance Emissions (tCO_{2eq}) = Total annual production (kWh) x 9% x Emission factor (10gCO_{2eq}/kWh) x 1/1,000,000 (tonnes/g)

Figure 9.62: Life Cycle Analysis (LCA) of Wind Technology



Source: NREL, 2013

[97] NREL (2013). Wind LCA Harmonization

Avoided GHG emission

According to the GHG Protocol[98], avoided emissions are "*emission reductions that occur outside of a product's life cycle or value chain, but as a result of the use of that product. Other terms used to describe avoided emissions include climate positive, net-positive accounting, and scope 4*."

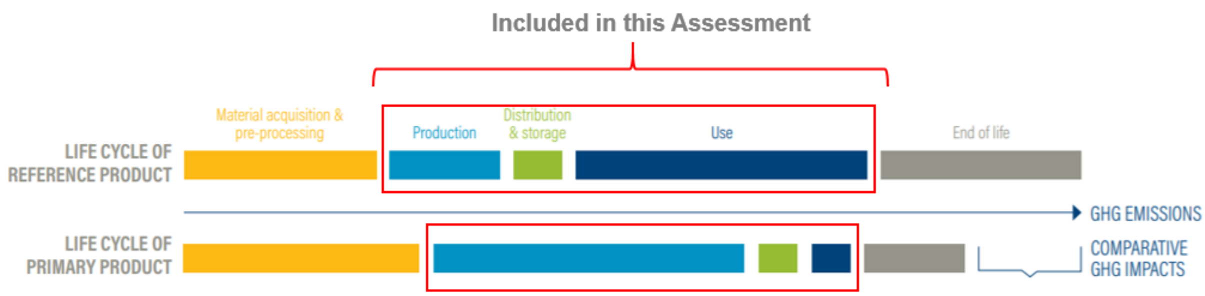
According to this statement, then avoided emissions must be considered separately from Scope 1, 2 and 3 (for example, some propose to call it Scope 4), therefore no entity or company can claim reduction of their Scope 1, 2 or 3 emissions using avoided emissions (e.g. if Scope 1, 2 and 3 emissions are 100 tonnes CO_{2eq} and avoided emissions are 100 tonnes CO_2e, then the company may not take the avoided emissions to produce a total emissions of 0 tonnes, the Scope 1, 2 and 3 remains at 100 tonnes CO_{2eq}).

Based on the World Resources Institute (WRI)[99], attributional approaches generate inventories of absolute emissions and removals that are attributed to a given entity, such as a product, company, city, or nation.

Comparative impacts are estimated as the difference between the total, attributional, life-cycle GHG inventories of a company's product (the "assessed" product) and an alternative (or "reference") product that provides an equivalent function.

Life-Cycle Emissions of Reference Product – Life-Cycle Emissions of Assessed Product

Figure 9.63: Calculating Comparative GHG Impacts Using the Attributional Life-Cycle Assessment (LCA) Approach



Source: WRI, 2019.

In this assessment, comparative GHG impact only captures comparison of GHG emissions from pre-construction, construction and operational phases of the Project, excluding of material acquisition & pre-processing, and decommissioning. The timeframe for assessment is 28 years as per the Project's lifetime.

GHG emission from the operation of national grid is *Reference Product*[100], while GHG emission from the Project pre-construction, construction, and operation is *Assessed Product.*

98 https://ghgprotocol.org/blog/do-we-need-standard-calculate-%E2%80%9Cavoided-emissions%E2%80%9D
99 WRI (2019). Estimating and Reporting the Comparative Emissions Impacts of Products
100 Based on an assumption that the majority of GHG emission from national grid is from operational phase

Therefore, avoided GHG emissions from the Project for this assessment are estimated as:

Avoided GHG emission = Life-Cycle GHG emissions from national grid – Life-Cycle GHG emissions from the wind farm

Assumption and Limitation

It is noted that GHG data in this report cannot yet be used for official GHG inventory reporting101 until the site is operational and actual operation data would be used for a more precise GHG inventory calculation.

The GHG calculation methodology for the Project's GHG emissions has been formulated using suitable calculation methodologies sourced from the 2006 Intergovernmental Panel on Climate Change (IPCC)102. These methodologies can be replicated for the GHG inventory when the Project becomes operational. In this chapter, some assumptions made include the following:

- Equator Principles (July 2020)[103] Principle 2: Environmental and Social Assessment stated:

  "GHG emissions should be calculated in line with the GHG Protocol[104] to allow for aggregation and comparability across Projects, organisations and jurisdictions. Clients may use national reporting methodologies if they are consistent with the GHG Protocol. The client will quantify Scope 1 and Scope 2 Emissions."

  Therefore, quantification of GHG emissions for the Project considers Scope 1 (direct emissions from the facilities owned or controlled within physical Project boundary) and Scope 2 (indirect emissions associated with the off-site production of energy used by the Project), and excludes other indirect Scope 3 emissions (for definitions of scopes, please refer to the section below and GHG Protocol[105]).
- This assessment focuses on CO_2, CH_4 and N_2O emissions because these are the most prevalent GHGs emitted from power production industry.
- The assessment covers pre-construction, construction (3 years), and operational (25 years) phases, totaling to an assessment period of 28 years.
- GHG emission during and post decommissioning has not been taken into account in this assessment, as the Project is a build-operate-transfer model and therefore will continue to be operated by the Government of Lao PDR or other entities.
- GHG emission due to vegetation clearing of the Project is assumed for the Project period of 28 years;
- It is assumed, given the nature of this renewable energy Project, that the combined Scope 1 and Scope 2 emissions of the Project are not exceeding 100,000 tonnes of CO_2 equivalent annually. Therefore, required by the Equator Principles (July 2020) an alternatives analysis evaluating lower GHG intensive alternatives and consideration of relevant Climate Transition Risks (as defined by the Task Force on

[101] Official GHG inventory reporting includes Sustainability Reporting, CEGDP, DJSI or other nationally relevant greenhouse reporting schemes.
[102] IPCC Guidelines for National GHG Inventories (2006). Retrieved from: https://www.ipcc-nggip.iges.or.jp/public/2006gl/
[103] Equator Principles (July 2020). Retrieved from: https://equator-principles.com/wp-content/uploads/2021/02/The-Equator-Principles-July-2020.pdf
[104] The GHG Protocol is based on a comprehensive globally standardised framework to measure and manage greenhouse gas (GHG) emissions from operations. Available from ghgprotocol.org.
[105] GHG Protocol available at: ghgprotocol.org.

Climate-Related Financial Disclosures (TCFD))[106] would be not be needed as the Project does not exceed this GHG emissions threshold.

9.6.1.4 Additional Mitigation, Management, and Monitoring Measures

The following mitigation measures will be put in place for the Project during **pre-construction** to reduce GHG emissions:

- The planned area for vegetation clearance plan linked to the construction works need to be clearly determined and demarcated by landmark to avoid accidental clearance. Site clearance plan should be prepared to identify areas that will be retained with natural vegetation within the Site's boundaries.
- Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged or associated with the Project, with sanctions, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation
- The Project should consider carbon offsetting for lost vegetation to the Project forest clearing such as re-forestation in other areas.
- The Project will plant grass in WTGs areas and other suitable available area as grass have potential to maintain and increase soil carbon levels.[107]

The following measures will be put in place for the Project **during construction** to reduce GHG emissions;

- Use high fuel efficient machineries and engines, and develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency.
- Develop vehicle maintenance plan and transport planning for construction to avoid unnecessary trips.
- Ensure that construction work is done within designated construction areas and avoid trees removal outside of construction area.
- Develop rules to prevent burning of waste within the construction area by Project workers.

The following mitigation measures will be put in place for the Project **during operation**:

- It is proposed to undertake an annual GHG inventory to monitor the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC).
- Replant trees in area where clearance and levelling work were undertaken during pre-construction and construction.

Where feasible, arrange emissions offsets, including flexible mechanisms under the United Nations Framework Convention on Climate Change (UNFCCC) and the voluntary carbon market, including reforestation, and afforestation. The Project may participate in forest protection of Dak Cheung and Sanxay districts in collaboration with relevant governmental agencies and local communities.

Qutantification of Mitigation Measures

Mitigation 1: Biodiversity Offset

Based on the Biodiversity Action Plan (BAP), Offset Target expressed as Habitat Hectares (HH) to meet Net Gain objective is 76.6 Habitat Hectare (HH). Therefore, the biodiversity offset will contribute to CO_2 sequestration as follows:

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106 https://www.fsb-tcfd.org/

107 Khatab Abdalla et al. (2022). Grassland rehabilitation significantly increases soil carbon stocks by reducing net soil CO2 emissions

Annual Change in Carbon Stocks = $A_{conversion}$ x (B_{after} - B_{before}) x CF

Table 9.89: Amount of Living Biomass Before and After Conversion

Description	Amount of Living Biomass (tonnes d.m./ha)
	Forest land
Before	0[a]
After	25[b]

a – default assumption of 0 was assumed when converted to other land as per Section 3.7.2.1.1.1 form Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003)

b – carbon stocks in biomass for forest land for tropical and sub-tropical forests, montane dry region from Table 3A.1.3 from Chapter 3.3 of Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003)

Annual Change in Carbon Stocks (ton C/year) = 76.6 x (25-0) x 0.5
= 957.5 ton C/year

Assuming for 25 years:

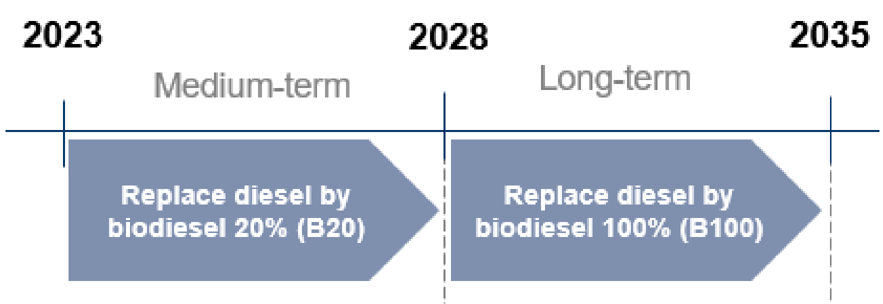
Total Change in Carbon Stocks (ton C) = 957.5 ton C/year x 25
= **23,937.5 ton C***

**This calculation assumes that the carbon sequestration is effective since the commencement of the offset and that land is converted from from non-forested land to forest land.*

Therefore, through reforestation initiatives, the Project will increase the carbon stock in the by **23,937.5 ton C** over 25 years of the reforestation program.[108]

Mitigation 2: Replace petroleum diesel by biodiesel (optional)

The Project may consider replacing petroleum diesel with biodiesel to reduce the emissions from fuel combustion (both stationary and mobile).



- **Medium-term: use of biodiesel 20 (B20) instead of diesel by 2028**

[108] When carbon stock in biomass increases, it decreases carbon emissions in the atmosphere by transforming CO2 into solid biomass materials

Whilst petroleum diesel emits 74,353.8 $kgCO_2/TJ$, B20 emits 47,363.36 $kgCO_2/TJ$ or 63.7% of diesel's emission. This means that B20 reduces the emission from the use of diesel by 26.7%.

- **Long-term target: use of Biodisel 100% (B100) instead of diesel by 2035**[109]

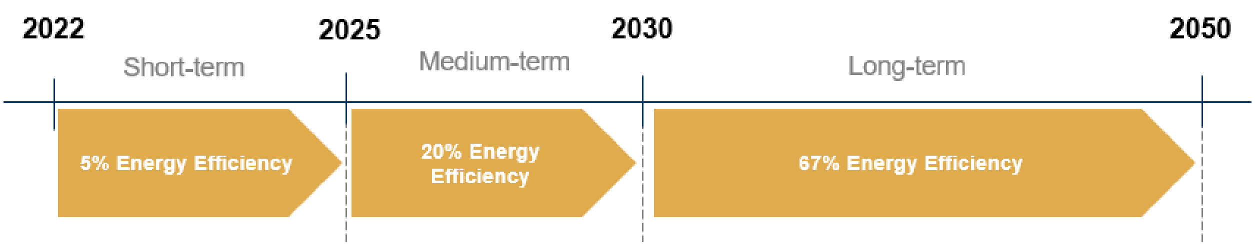
Whilst petroleum diesel emits 74,353.8 $kgCO_2/TJ$, biodiesel 100% only emits 253.8 $kgCO_2/TJ$.[110]Therefore, the use of biodiesel 100% will save almost 100% of the emission of diesel combustion (both stationary and mobile).

Therefore, if the Project adopt this mitigation measures, by phasing out petroleum diesel and replace by biodiesel 20% by 2028 and biodiesel 100% by 2035, the Project will save a total emission of approximately **2,685.6 tCO_2eq** over the Project life.

Mitigation Target	Period	Annual Emission from diesel combustion ($tCO_2eq/year$) (operational phase)	Emission Reduction (tCO_2eq)
Medium-term Replace diesel by biodiesel (B2) by 2028	2028 -2035 (7 years)	150.35	= Annual emission x years x emission reduction% = 150.35 x 7 x 26.7% = 280.0
Long-term Replace diesel by biodiesel 100% (B100) by 2032	2035 – 2051 (16 years)	150.35	= 150.35 x 16 x100% = 2,405.6

Mitigation 3: Energy Efficiency (EE) (optional)

The study estimates that energy efficiency and reduction of energy usage will reduce by 5% by 2025, 20% by 2030 and 67% by 2050. Compared to 2021 level.[111] In case the Project adopts energy efficiency measures, the Project will reduce emission by **413 tCO_2eq** throughout the Project life.



[109] Assumption based on available technologyin the future

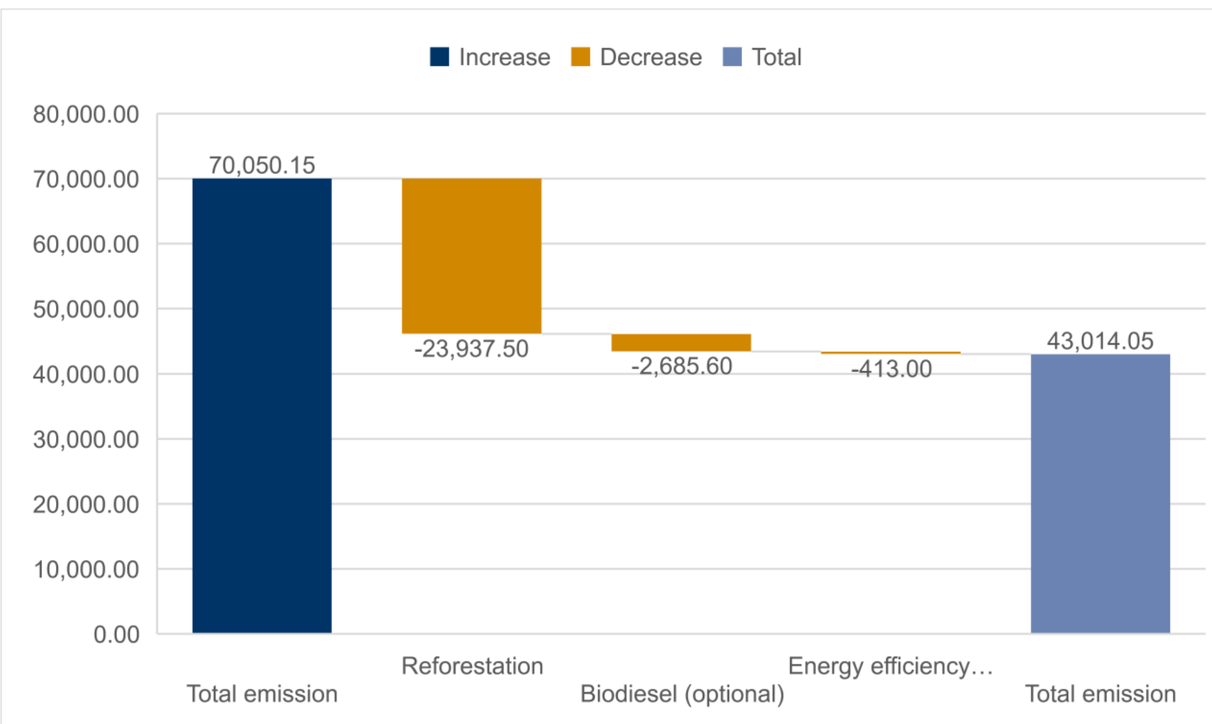
[110] Emission Factors From IPCC 2006 V.2 Ch.2 Table 2.2

[111] Based on a study of Modeling energy efficiency and cost-benefit analysis achieving Net-Zero building design, between 3-6 floors Source: Modeling Energy Efficiency Performance and Cost-Benefit Analysis Achieving Net-Zero Energy Building Design: Case Studies of Three Representative Offices in Thailand (mdpi.com)

Mitigation Target	Phase	Annual Emission from purchased electricity (tCO_2eq/year) (operational phase)	Emission Reduction (tCO_2eq)
Short-term Increase EE to 5% by 2025	2025 – 2030 (5 years)	83.93	= Annuam emission x years x emission reduction% = 83.93 x 5 x 5% = 21
Medium-term Increase EE to 20% by 2030	2030 – 2050 (20 years)	83.93	= 83.93 x 20 x 20% = 335.7
Long-term Increase EE to 67% by 2050	2050 -2051 (end of Project life)	83.93	= 83.93 x 1 x 67% = 56.2
Total Emission Reduction (tCO_2eq)			413

Figure 9.64 presents emission reduction by mitigation measures. Biodiversity offset measures contributes to the largest emission reduction (23,937.50 tCO_2eq) over the Project life. Follow by replacing petroleum diesel by biodiesel (2,685.6 tCO_2eq) and energy efficiency for buildings (413 tCO_2eq). It is note that use biodiesel and energy efficiency are optional for the Project's consideration. Overall, the Project can potentially save the reduction by 36,908.90 tCO_2eq or equivalent to 57.7% of the total emission over the Project life.

Figure 9.64: Emission Reduction by Mitigation Measures



9.6.1.5 Residual Impact Significance

After total amount of GHG emissions of the Project life-cycle are estimated, the significance of potential impacts to GHG during pre-construction, construction and operation are assessed in the following sections.

During pre-construction, construction and operation, the Project will emit 2,035.00 tCO_2eq/year, 2,391.55 tCO_2eq/year and 235.82 tCO_2eq/year, respectively, which are considered insignificant compared to the country's GHG emission of 24,099,000 tCO_2eq in 2014 (approximately 0.008%, 0.01% and 0.001%, respectively). The impacts of Project's GHG emissions on climate change have been assessed as negligible for all Project phases (pre-construction, construction and operation). With additional mitigation measures adopt by the Project, the Project's impact on climate change will be further reduced. The Project will reduce GHG emission through reforestation by 957.5 tCO_2eq/year, use of biodiesel instead of petroleum diesel will reduce 107.42 tCO_2eq/year (optional) and use of energy efficiency technology for buildings will reduce 16.52 tCO_2eq/year (optional).

Additionally, the Project will have positive impact on climate change by contributing to avoided GHG emission of 630,740.73 tCO_2eq annually, which would be 16.91% compared to the Energy sector's contribution to GHG emissions, and 2.62% compared to the net annual country emissions. Impacts Assessment for Pre-construction Phase

The impact of the Project's impact on climate change during pre-construction phase could be assessed in accordance to the amount of impact during the pre-construction period, as provided in ***Table 9.90***.

Table 9.90: Impact Assessment for Project's Impact on Climate Change during Pre-construction

Significance of Impacts				
Impacts	Potential impacts on climatic condition due to GHG emissions.			
Impact Nature	**Negative**	Positive	Neutral	
	Potential impacts to climate would be considered to be adverse (negative).			
Impact Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts through the release of emissions from fuel combustion (stationary and mobile combustion).			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	Many of the major GHGs can remain in the atmosphere for tens to hundreds of years after being released.			
Impact Extent	Local	Regional	**International**	
	GHGs are a global emission and may affect the global climate.			
Impact Scale	The emissions from the Project are calculated to be 2,035 tCO_2eq per year during pre-construction, compared to Lao PDR's GHG release of 24,099,000 tCO_2eq in			

Significance of Impacts					
	2014, the total GHG releases from the Project are insignificant (approximately 0.008%).				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Minor emissions of GHG will be emitted as a result of the Project construction, and considered insignificant emissions according applicable international standards. Magnitude is considered **Negligible**.				
Sensitive Receptor	Low	**Medium**	High		
	The direct receptor to GHG is the global atmosphere. The greenhouse effect is enhanced by GHG emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor sensitivity is rated as **Low**.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low resource sensitivity and **Negligible** impact magnitude will result in an overall Negligible potential impact.				

Impacts Assessment for Construction Phase

The impact of the Project's impact on climate change during construction phase could be assessed in accordance to the amount of impact during the construction period, as provided in ***Table 9.91***.

Table 9.91: Impact Assessment for Project's Impact on Climate Change during Construction

Significance of Impacts			
Impacts	Potential impacts on climatic condition due to GHG emissions.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to climate would be considered to be adverse (negative).		
Impact Type	**Direct**	Indirect	Induced
	Potential impacts would likely be direct impacts through the release of emissions from fuel combustion (stationary and mobile combustion).		
Impact Duration	Temporary	Short-term	**Long-term**
	Many of the major GHGs can remain in the atmosphere for tens to hundreds of years after being released.		

Significance of Impacts				
Impact Extent	Local			
	GHGs are a global emission and may affect the global climate.			
Impact Scale	The emissions from the Project are calculated to be 2,391.55 tCO_2eq per year during construction, compared to Lao PDR's GHG release of 24,099,000 tCO_2eq in 2014, the total GHG releases from the Project are insignificant (approximately 0.01%).			
Impact Magnitude	Positive	**Negligible**	Small	
	Minor emissions of GHG will be emitted as a result of the Project construction, and considered insignificant emissions according to applicable international standards. Magnitude is considered **Negligible**.			
Sensitive Receptor	**Low**	Medium	High	
	The direct receptor to GHG is the global atmosphere. The greenhouse effect is enhanced by GHG emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor sensitivity is rated as **Low**.			
Impact Significance	**Negligible**	Minor	Moderate	Major
	The combination of a Low resource sensitivity and Negligible impact magnitude will result in an overall **Negligible** potential impact.			

Impacts Assessment for Operation Phase

The impact of the Project's impact on climate change during operation phase could be assessed in accordance with the amount of impact during the operation period, as provided in ***Table 9.92***.

Table 9.92: Impact Assessment for Project's Impact on Climate Change during Operation

Significance of Impacts			
Impacts	Potential impacts on climatic condition due to GHG emissions.		
Impact Nature	**Negative**	Positive	Neutral
	Potential impacts to climate would be considered to be adverse (negative).		
Impact Type	**Direct**	Indirect	Induced
	Potential impacts would likely be direct impacts through the release of emissions from fuel combustion (stationary and mobile combustion).		

Significance of Impacts

Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major GHGs can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	GHGs are a global emission and may affect the global climate.				
Impact Scale	The emissions from the Project are calculated to be 235.82 tCO_2eq per year during operation, compared to Lao PDR's GHG release of 24,099,000 tCO_2eq in 2014, the total GHG releases from the Project are insignificant (approximately 0.001%).				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Minor emissions of GHG will be emitted as a result of the Project construction, and considered insignificant emissions according to applicable international standards. Magnitude is considered **Negligible**.				
Sensitive Receptor	**Low**	Medium	High		
	The direct receptor to GHG is the global atmosphere. The greenhouse effect is enhanced by GHG emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the Project, and not likely to significantly change atmospheric GHG concentrations. Receptor sensitivity is rated as **Low**.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low resource sensitivity and Negligible impact magnitude will result in an overall **Negligible** potential impact.				

Assessment of Avoided Emission

Based on the Guidelines for Estimating Greenhouse Gas Emission of Asian Development Bank Projects—Additional Guidance for Clean Energy Project (2017)[112] , the IFI CM emission factor of 0.493 tCO2e/MWh is used for the calculation of GHG Emissions in baseline scenario. This approach results in a total avoided GHG emission of the Project throughout its life-cycle is **20,974,868.35** tCO_2eq as shown in ***Table 9.93***. This is a significant amount of avoided GHG emissions signifying the benefit of low carbon electricity production through wind farms, however as mentioned above, the avoided emissions are used only to compare emissions between typical grid electricity production and the electricity production from the Project, and do not signify any actual GHG emission reduction

[112] Guidelines for Estimating Greenhouse Gas Emissions of Asian Development Bank Projects: Additional Guidance for Energy Projects (adb.org)

It is noted that alternative emission factors are available for the calculation. The IGES (2021) provides an average CM of 0.602 tCO2e/MWh for Vietnam grid. Bases on this IGES' emission factor, the Project would avoid GHG emission of 25,690,350 tCO_2eq/year. However, ERM recognize that the IFI approach is in line with ADB's guideline and provides the most updated and standardized emission factor. Therefore, it is deemed the most appropriate for the calculation of GHG emission avoidance.

Table 9.93: Estimation of Avoided GHG Emission

Scenario	Source of Emission	Years	CO_2 eq emission (tCO2e)	Rationale
GHG Emissions in baseline scenario in the absence of the Project	Electricity generation from the national grid	25	21,038,775.00	Without the wind farm, the grid will need to generate 1,707 GWh/year or 1,707,000 MWh/year. Emission factor for the Viet Nam grid is 0.493 (tCO_2/MWh) (IFI combined margin, 2020). Therefore, total emission of 1,707,000 (MWh) x 0.493 (tCO_2/MWh) x 25 (years) would have been emitted by the electricity generation by the grid.[113]
GHG Emission in the Project scenario	Pre-construction	NA	50,875.00	***Section 9.6.1***
	Construction	3	7,174.65	***Section 9.6.1***
	Operation	25	5,857.00	***Section 9.6.1***
	Electricity generation	25	0	Wind farm is renewable energy, thus electricity production process does not emit GHGs
Avoided Emission		28	**20,974,868.35** (749,102.44 tCO_2eq/year)	(GHG emission from national grid) – (GHG emission from the Project (wind farm)) over an assessment period of 28 years (pre-construction, construction and operation phases of the Project)

113 Based on assumption that the majority of emission is from operation phase

Result Comparison to GHG Emissions in Lao PDR

According to the draft of the First Biennial Update Report (2020)[114], the GHG inventories showed that the net national emissions was 24,099.98 GgCO_2eq (24,099,000 tCO_2eq) in the inventory year, 2014. Agriculture, Forestry and Other Land Use (AFOLU), especially forest remaining forest, cropland remaining cropland and lands converted to forest had a capacity to remove equivalent to about 13,000 GgCO_2eq/year (13,000,000 tCO_2eq/year). AFOLU sector had net emissions of 18,793.41 GgCO_2eq/year (18,793,410 tCO_2eq/year), which was the largest source of emissions, accounting for about 78% of the total country's GHG emissions. Second largest source of emissions was the Energy Sector, which emitted 3,729.42 GgCO_2eq/year (3,729,420 tCO_2eq/year) (15% of the country's emissions). Other IPCC sectors, industrial processes and product use (IPPU) and Waste accounted for 5% and 2% of the national emissions, respectively.

The evidence presented in this chapter indicated that the **annual GHG emission of 2,501.79 tCO_2eq** from the Project are expected to account for approximately 0.010% of the total GHG emission produced by Lao PDR annually, and approximately 0.067% of the GHG emissions produced by the Energy Sector annually. Therefore, the Project's contribution to national and Energy Sector emission is considered **negligible**.

Moreover, the Project's contribution to **avoided GHG emission of 749,102.44 tCO_2eq annually** would be 20.09% compared to the Energy sector's contribution to GHG emissions, and 3.11% compared to the net annual country emissions. Therefore, it can be concluded that **the Project will contribute to the country's GHG emission mitigation efforts.**

9.6.2 Risks from Climate Change

The objective of a climate change physical risk assessment is to understand the physical threats in terms of climate driven natural hazards likely to affect the said project.

Accordingly, this assessment was performed with an aim of qualitative evaluation of the natural hazards likely to affect the said projects under present (baseline) and future scenarios (climate change scenarios) of projected greenhouse gas emissions.

This assessment was conducted in accordance with the requirements of The Equator Principles. The Equator Principles Financial Institutions (EPFIs) support the objective of the 2015 Paris Agreement and recognize that EPFI's have a role to play in improving the availability of climate related information, such as the Recommendations of the Task Force on Climate Related Financial Disclosures (TCFD[115]) when assessing potential transition and physical risks of the projects financed under the Equator Principles. Equator Principles states that the Climate Change Risk Assessment should be aligned with Climate Physical Risk and Climate Transition Risk categories of the TCFD (Equator Principles 2020).

EP-4 is a risk management process that facilitates the process of determining, assessing and managing environmental and social risks risk in financing major projects. It provides a minimum standard for due diligence to support responsible risk decision making. The key features of EP-4 which relate to physical risk assessment are summarised below-

- The framework recognizes the importance of biodiversity, human rights, and climate change. As per EP-4, negative impacts on project that affects ecosystem, communities, and the climate should be avoided

[114] Ministry of Natural Resources and Environment (MONRE), Global environment Facility (GEF) and United Nations Environment Programme (UNEP). 2020. Draft of First Biennial Update Report. Retrieved from: https://unfccc.int/sites/default/files/resource/867493251_Lao%20Peoples%20Republic-BUR1-1-Draft%20Biennial%20Update%20Report-BUR_Lao%20PDR_24July2020.pdf

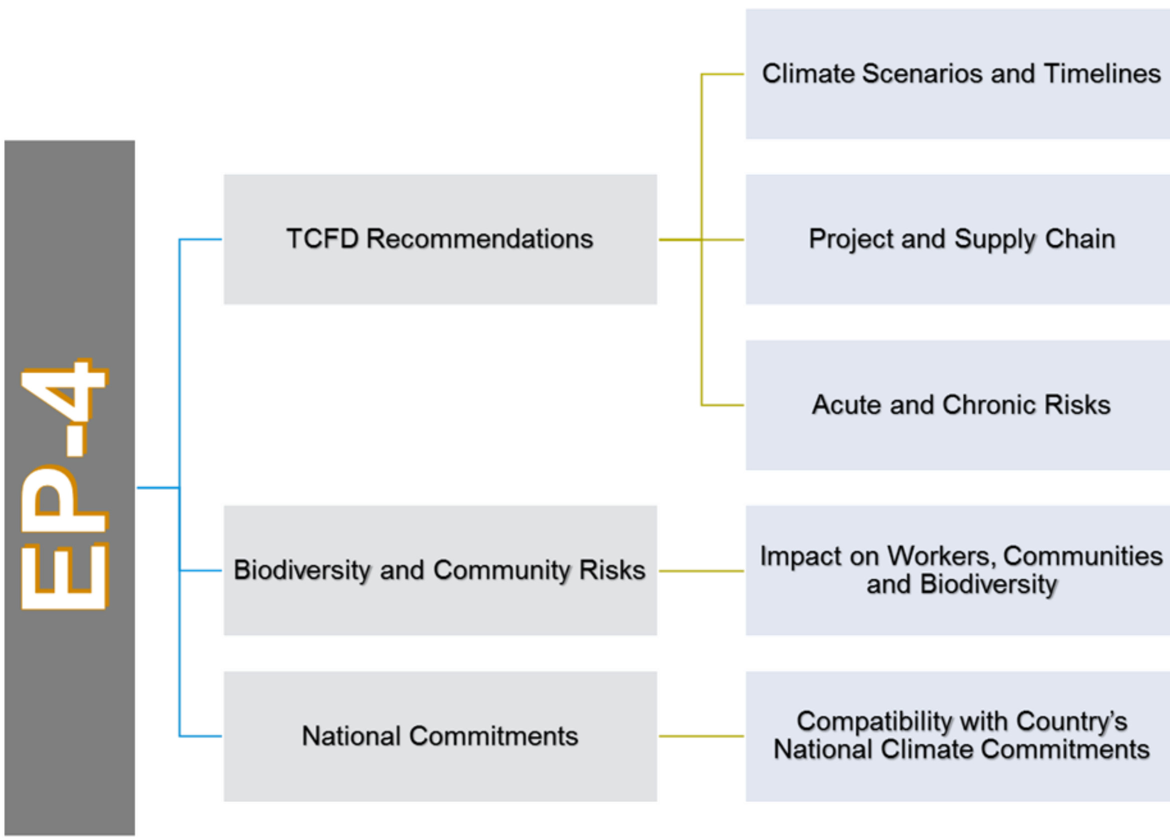
[115] TCFD, 2017. Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures. Available at: https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-TCFD-Annex-062817.pdf

where possible. If these impacts are unavoidable, then the process considers how these can be minimized, mitigated and/or offset.

- In reference to climate change, the EP-4 recommends the developer to include assessment of potential climate change risks as part of ESIA or other assessment. The depth and nature of the climate change risk assessment is reported to depend on the type of Project as well as the nature of risks, including their materiality and severity. Further, climate risk assessment is required to be aligned with climate change physical risk and climate transition risk categories of the TCFD. Additionally, the climate risk assessment is required to consider the Project's compatibility with the host country's national climate commitments, as appropriate.
- TCFD recommends assessment of financially material climate related physical risks including acute and chronic risks over different relevant time horizons and scenarios including 2°C or lower scenario. The assessment may include impacts on products and services, supply chain and/or value chain, adaptation and mitigation activities, investment in research and development, and operations.

Figure 9.65 provides an overview of EP-4 in relation to the physical risk assessment.

Figure 9.65: Key Components of EP-4 Related to Physical Risk Assessment



This assessment was conducted with the following objectives.

- Evaluate and identify the potential hazards to the Project arising from current and future climate variables for the site and the supply chain network;
- To understand the likely implications of theses hazards on proposed project, communities and ecology in the surrounding area;

- To assess any implication of the project which may exacerbate climate change impacts on climate change of communities and ecology; and
- To evaluate how the present project considerations can accommodate potential impacts of climate change in terms of physical risks.

9.6.2.1 Area for Assessment

The Area of Assessment for the Climate Change Risk Assessment (hereinafter referred to as 'CCRA') was selected based on the TCFD's recognition that physical risk can have a wide range of financial implications: supply chain disruption, impacts on availability of raw material and other natural resources, etc.

Accordingly, the study area was selected to include the major project components from all Assets as presented in ***Table 9.94***, while all Key Assets were included in one single Study area.

Table 9.94: Key Project Assets

Study Area	Assets	Major Components
Wind Turbines concession area, transmission line route, and access roads	EN-171/4.5-MW	1. Wind Turbine (WTG) 2. Inverter 3. Transmission Lines and Towers 4. Storage Room 5. Site Office 6. Access Road

9.6.2.2 Potential Risks

Overview of Climate Change Physical Risks in Laos DPR

Natural Hazards Profile

Lao is vulnerable to a wide range of natural disasters. Floods, including flash floods, severe storms, monsoons, and landslides are prevalent in the country. Additionally, Lao is susceptible to droughts, earthquakes, and epidemics with varying degrees of impact and severity in different regions.

The frequency of the extreme weather events in Lao PDR increased from about once every two years before 1992 to every year or even twice a year after 1992. Approximately three-fourths of the disasters in Lao PDR have been climate related. During 1966 to 2009, flooding was the most frequently occurring climate change hazard, followed by storms and drought.

Most storms are followed by severe flooding, threatening livelihoods almost every year, and with more frequent and intensified flooding in recent years. Flash floods in the northern mountainous areas are common (such as in the Project Area). Flooding has an adverse impact on housing, health and education, industrial activities, and infrastructure.

Lao PDR is also experiencing increasingly frequent episodes of drought, with shortages or delays in rainfall contributing to water stress. Severe droughts occurred in 1996, 1998 and 2003. It is estimated that 6 out of 17 provinces are already at high risk of droughts.

Climate Change Projections

As reported in Lao PDR's Country climate profile[116], climate change projections indicate a fairly quick and drastic change in the spatial distribution of bioclimatic conditions across the northern and mountainous regions of the country (in which the Project is located). A significant warming and modification of rainfall patterns is predicted for 2030, with further intensification in these trends by 2060.

Temperatures are projected to increase across the country as well as in the Lower Mekong Basin and across seasons. By 2060, the average annual temperature basin-wide increase could be as low as 0.1˚C or as high as 4.0˚C depending on the global emissions trajectory and pattern of changes that follow.

Rainfall could increase or decrease with significant variation in the magnitude of change and the location of impacts. Average change in rainfall by 2060 under the dry and high emission scenario is projected to be 1.7%, under the wet, and high emission scenario up to +6.0% in the most part of the country.

Climate Change Risks in Lao PDR

Eckstein (2021)[117] ranked Lao PDR 45th based on overall climate risk. Lao PDR's rank based on fatalities per 100000 inhabitants was evaluated to be 28, rank based on losses in million USD was evaluated to be 86, and rank based on losses in GDP as percentage was evaluated to be 66. The ranking was developed based on evaluation of data from 180 countries. This indicates that Lao PDR falls within top 30% of the countries in the world with highest exposure to climate related physical risks.

Climate Change Risks to Wind Farms

Climate change is causing more frequent and more severe extreme weather events, increasing the likelihood of critical coping thresholds being exceeded. Wind Energy projects may suffer infrastructure damage, project delays and constraints on water supplies, lost production/ generation, power supply transmission disruption, and variability in energy generation. Threats to health and safety of employees, business reputation, violation of regulatory standards, social license to operate and financial disruptions may become more prevalent. ***Table 9.95*** presents the potential impacts of different climatic parameters on a typical wind energy project.

Table 9.95: Potential Impacts on Wind Energy Sector

Wind Power	
Wind speed	• Changes in wind speed can reduce generation (turbines cannot operate in very high or very low winds) • Within operational wind speeds, output is greatly affected by wind speed. • Changes in wind patterns and duration affect output (e.g., ability to forecast output)
Air temperature	• Changes in extreme cold periods can affect output (e.g., through turbine blade icing)
Storm surges	• Damage to offshore wind farms
Extreme events	• Damage to infrastructure • Difficult access to offshore locations (e.g., for maintenance)

Source: ADB (2013), Guidelines for Climate Proofing Investment in the energy Sector

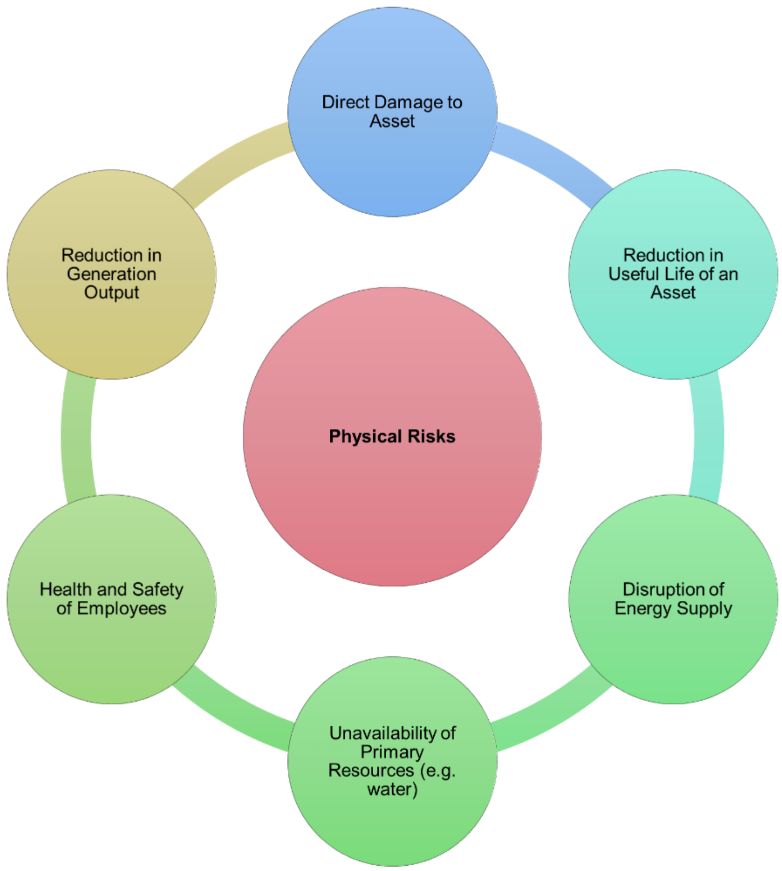
Figure 9.66 presents the general risks on wind energy projects as a result of climate change.

116 https://climateknowledgeportal.worldbank.org/sites/default/files/2021-06/15505-Lao%20PDR%20Country%20Profile-WEB.pdf

117 David Eckstein, Vera Kunzel, and Laura Schafer, Global Climate Risk Index. 2021. https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf

Anticipated impacts of these changes in climate were reported to be flooding, damage to building construction, disruption of energy transmission, increased insurance premiums, higher operating costs, early retirement of assets, decreased production capacity, and high variability in availability of water.

Figure 9.66: General Risks from Climate Change to Wind Farms



ADB's Guidance on Climate Proofing Investment in Energy Sector

Energy production and distribution can be highly vulnerable to impacts of climate change through various phases of the project including designing, construction, and operations. Insufficient attention to these impacts may result in increased long-term costs of energy sector investments and reduce the benefits that these investments could deliver.

Therefore, ADB published a guidance document on Climate Proofing of Investment in Energy Sector in May 2013, with an aim to assist its developing member countries (DMC) to enhance the climate resilience of vulnerable sectors including energy sector118.

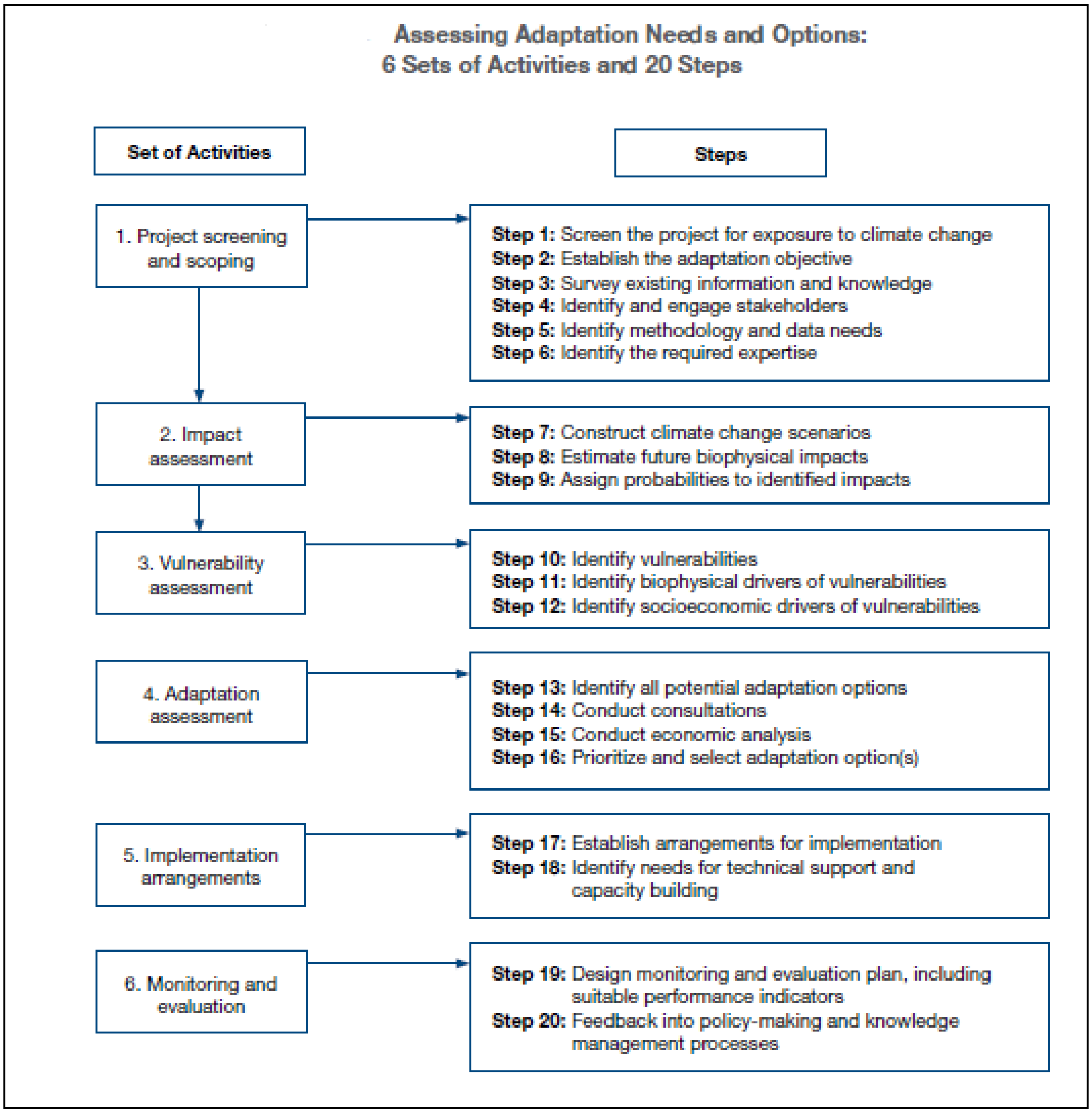
A climate change assessment is deemed to be best integrated into the activities of the project at concept stage. The methodological approach for Climate risk screening and scoping presented in this Guidelines

[118] https://www.adb.org/sites/default/files/institutional-document/33896/files/guidelines-climate-proofing-investment-energy-sector.pdf

for building adaptation into energy investment projects is divided into six different sets of activities as presented in ***Figure 9.67***. The process begins with scoping the project and defining the assessment and its objectives. The core activities related to project design fall under impact assessment, vulnerability assessment, and adaptation assessment. Finally, the process ends with defining implementation arrangements and monitoring frameworks.[119]

However, the scope of present assessment is limited to screening level assessment of natural hazard and climate change physical risks as presented in. The screening level assessment is followed by identification of high level implications of the climate related physical risk on the project.

Figure 9.67: Climate Change Risk Assessment Methodology

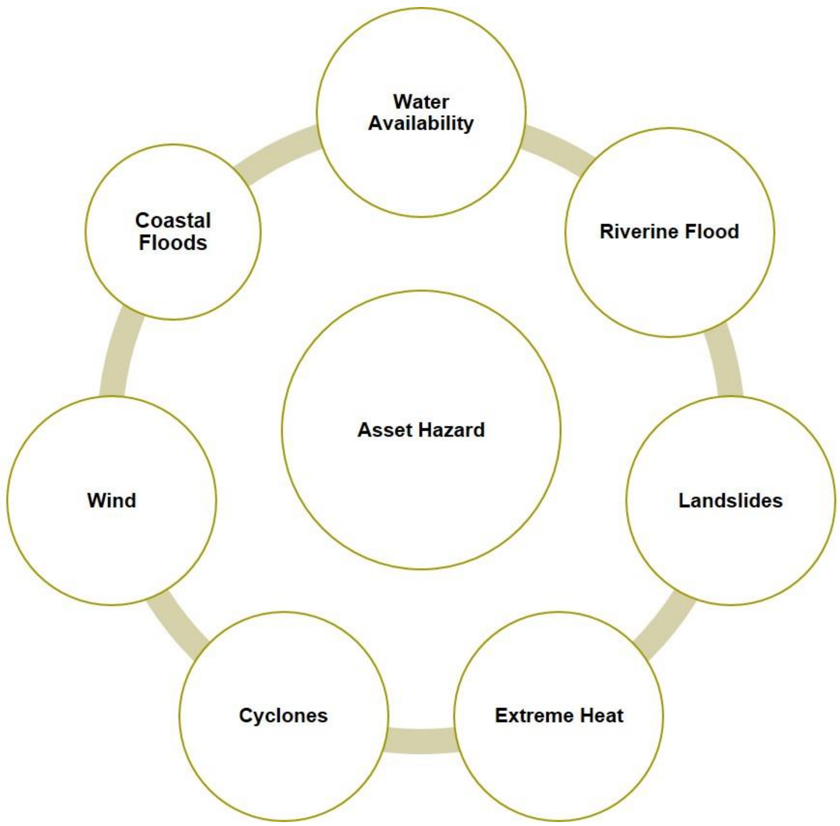


119 https://www.adb.org/sites/default/files/institutional-document/33896/files/guidelines-climate-proofing-investment-energy-sector.pdf

Approach

The assessment in general starts with the collection of geospatial information for the Study Area to be assessed. Present study aims at evaluation of natural hazards which are likely to be experienced along various roads under the purview of Project Astro (***Figure 9.68***).

Figure 9.68: Hazards Evaluated in this Assessment



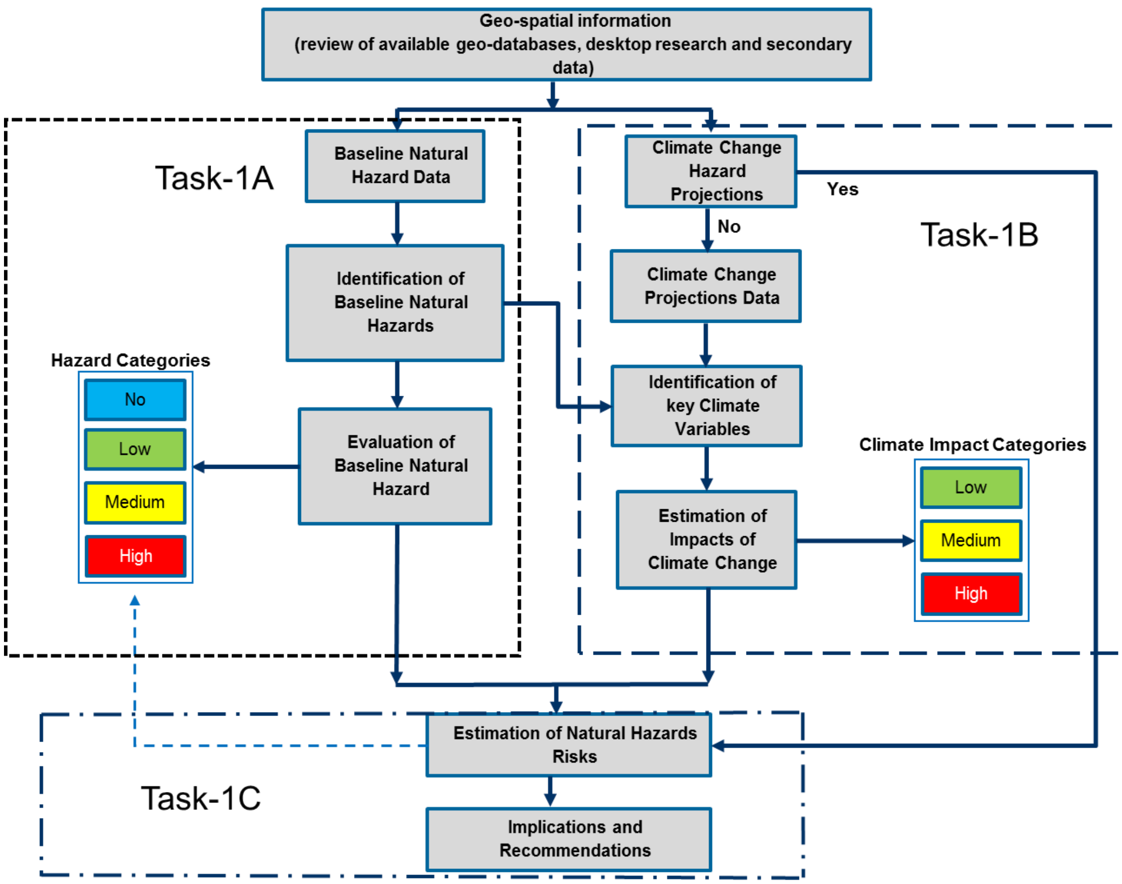
Based on the geospatial information, baseline natural hazards and the climate change projection data was collected and collated. It should be noted that the present assessment utilizes data sources which are readily available as open source. A brief description of the various steps performed in this study is provided below.

- Task – 1A: The first step focuses on evaluation of historical data on natural hazards in the area of interest to evaluate the existence and magnitude of identified natural hazards. This assessment was performed qualitatively based on the availability of historical data. The potential impact of each natural hazard was evaluated on a scale of three levels categorized as **Low, Medium, and High.** The hazard categorization was based on the potential impact on built and natural environment considering intensity/ magnitude, and/or frequency of the hazard in the region.
- Task – 2A: The second step constitutes evaluation of climate change projections to assess the extent of changes in climatic variables such as precipitation, and temperature. This provided information on any significant changes in temperature and precipitation in the upstream of the Site which may have impact on the Site operations in future.

- Task – 3A: The third step involves the evaluation of baseline risk from each natural hazard; the outputs from climate change projections are overlaid qualitatively on the baseline conditions for each hazards to categorize the climate change risk using only the hazard intensity.

Figure 9.69 provides the framework for the current assessment for the extraction of historical and projected data, evaluation of baseline natural hazards and superimposition of climate change projections. The final output is in terms of a semi-quantitative hazard matrix which presents cumulative hazard levels for each study area under baseline and climate change scenario. Based on this outcome, ERM evaluated the high-level implications and the corresponding recommendations for the project components.

Figure 9.69: General Framework for a Natural Hazard and Climate Change Impact Assessment



It should be noted that the present assessment does not aim at a detailed evaluation of asset specific climate related hazards or adequacy of existing design consideration and management plans to adapt the climate change impacts. However, it provides a high level understanding of various natural hazards which are likely to be experienced under baseline and climate change scenario in the areas/ regions in which the Project is located.

Natural Hazard and Climate Change Assessment

This section documents the baseline for natural hazards based on historical data from global, regional, and national databases followed by qualitative evaluation of impacts of climate change on natural hazards.

It should be noted that this is a very high-level review of publicly available information and no detailed site-specific analysis or modelling has been undertaken. Hence, further investigation may be required to quantify the risks in more detail for consideration of adaptation measures.

The likely changes in natural hazards presented here are based on the possible relation between the natural hazards and climatic parameters.

Water Availability

Availability of water is critical to any type of development as water is required throughout the various phases of the project i.e. construction and operational phases. Water availability in itself is not a hazard. However, unavailability of water may impact the project operations as well as health of people working at the project and nearby communities.

Water availability may be impacted by drought i.e. reduced water supply due to below normal rainfall and high evapotranspiration rates, high competition among for common water resource among multiple stakeholders including industry, agriculture and domestic, and seasonal variability.

Baseline Water Availability

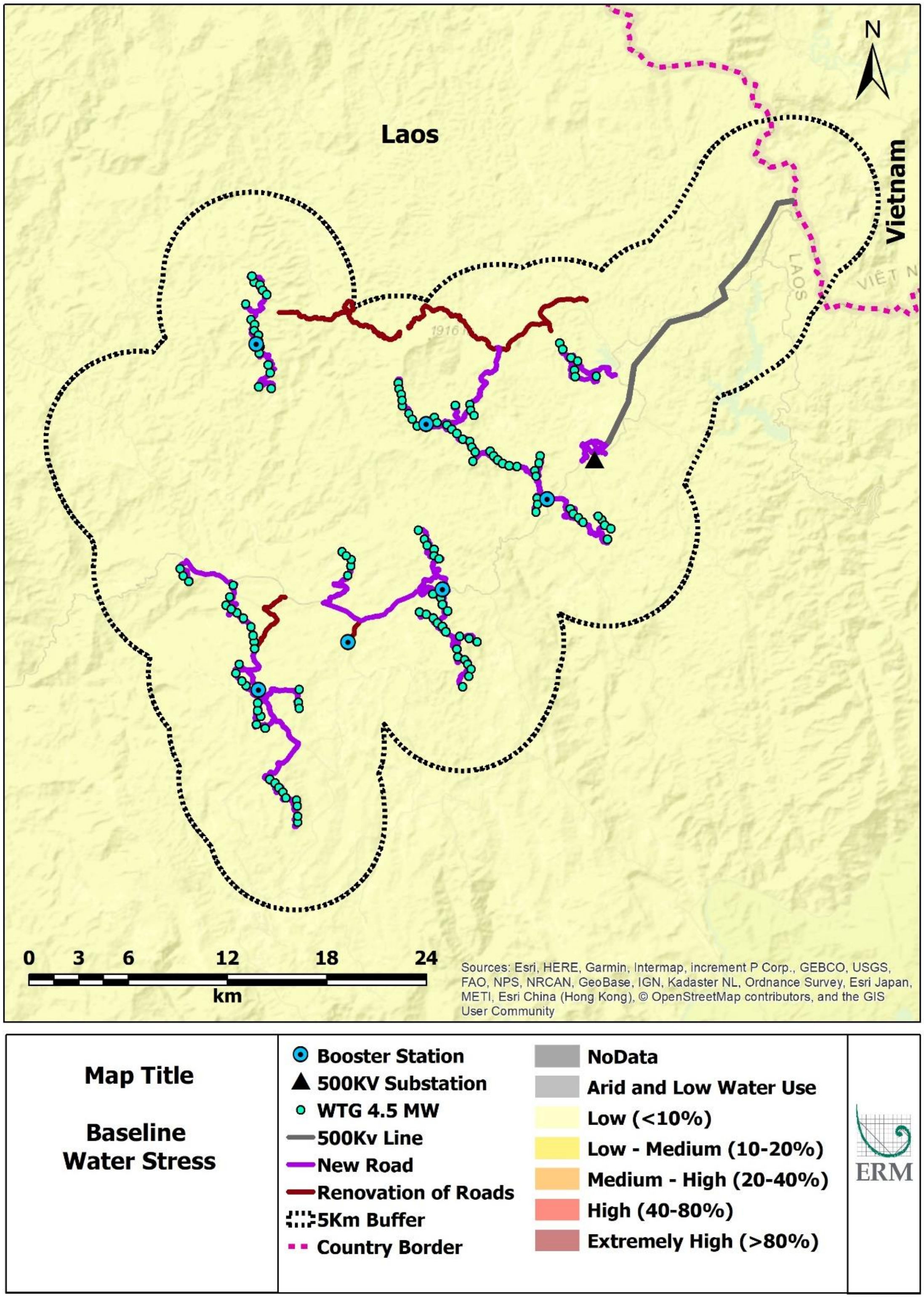
The baseline water stress map as presented in ***Figure 9.70*** indicates 'Low' water stress within the study area. Low baseline water stress may be considered to indicate higher availability of water resources or low competition for common water resource.

Water stress is a good indicator to indicate the competition for available water resource and overall availability of water. However, water availability may vary from season especially for countries dependent on seasonal rainfall. Seasonal variability results in higher availability of water during rainy (wet) season and lower availability of water (drought like conditions) during lean period. This may result in acute water scarcity during the lean periods. Therefore, in addition to the water stress parameter, seasonal variability was also assessed as part of present assessment.

The seasonal variability map presented in ***Figure 9.71*** indicates 'Medium-High' seasonal variability in the study area. Accordingly, the hazard towards availability of water due to seasonal variability is considered to be '***High'*** on a conservative basis.

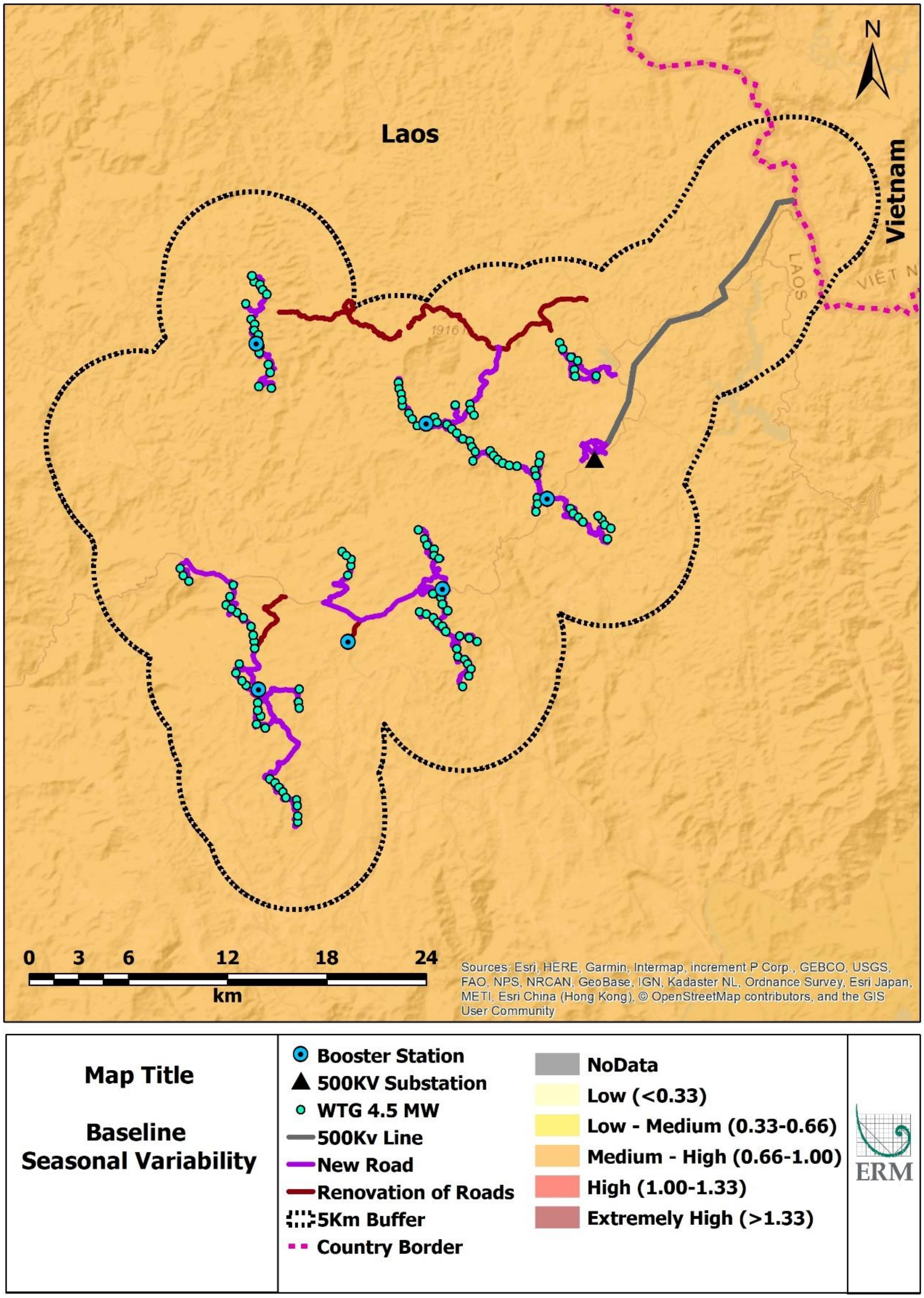
The above evaluation indicated that the area is exposed to 'Low' water stress which is likely to be due to low water usage within study area. A review of satellite imagery (Google Earth) indicated that the area under consideration is mostly covered by forest with sparse rural development and agriculture in neighbouring areas. Hence, no intensive water usage is expected in this region. Therefore, considering the Low water usage in the study area, seasonal variability is not likely to have significant impact on overall availability of water. In addition, the wind project is likely to require relatively large quantities of water only during construction phase, and not during its operations. Therefore, overall hazard towards availability of water is considered to be '**Low**' under baseline conditions.

Figure 9.70: Baseline Water Stress



Source: WRI-Aqueduct Water Risk Atlas

Figure 9.71: Baseline Seasonal Variability



Source: WRI-Aqueduct Water Risk Atlas

- Climate Change

Climate change projections for average annual rainfall indicated increasing trend under all climate change scenarios except under RCP 8.5 in 2030. Rainfall under RCP 8.5 in 2030 timeframe indicated a slight decrease (-0.06%). However, projections for evaporation indicated a slightly higher increase as compared to annual rainfall under all climate change scenario. Higher, evaporative losses are likely to be due to increase in average and maximum temperature, and longer warm spells[120]. As a result, net annual rainfall i.e. difference between annual rainfall and evaporation indicated deceasing trend as presented in ***Table 9.96.*** It is noted that the climate change projections for annual rainfall and evaporation are percentage change from the baseline.

Table 9.96: Climate Change Projections for Annual Rainfall and Evaporation

Parameter	RCP 4.5		RCP 8.5	
	2030 (%)	**2050 (%)**	**2030 (%)**	**2050 (%)**
Annual Rainfall	1.6	2.7	-0.06	2.9
Annual Evaporation	1.9	3.2	1.6	3.5
Net Annual Rainfall	-7.0	-9.1	-37.8	-8.7

Climate change projections for water supply under RCP 4.5 and RCP 8.5 scenario during 2030 and 2040` timeframes as presented in ***Figure 9.72*** to ***Figure 9.75*** indicate no significant change. Whereas, as presented in ***Figure 9.76*** to ***Figure 9.79***.Climate change projections for water demand under all climate change scenarios indicate likely increase by 1.2 x from the baseline. Increased water demand with no significant increase in water supply (renewable water) is likely to result in increased water stress in future.

However, climate change projections for water stress under RCP 4.5 and RCP 8.5 scenarios during 2030 and 2040 timeframes indicate water stress to remain 'Low' as presented in ***Figure 9.80*** to ***Figure 9.83***. Therefore, the hazard due to water stress is evaluated to be 'Low'. The Low water stress under the increased water usage scenario may be attributed to initial Low water usage against the available water under baseline conditions.

However, considering the increase in evaporative losses, increase in agriculture, domestic, and industrial water demand may lead to water stress in future. A more high-resolution modeling approach must be considered to assess the actual water availability in the region.

Seasonal variability on the other hand is projected to increase from 'High' to 'Extreme-High' as presented in ***Figure 9.84*** to ***Figure 9.87*** under RCP 4.5 and RCP 8.5 scenarios through 2040. Accordingly, hazard due to seasonal variability is considered to be '***High'***.

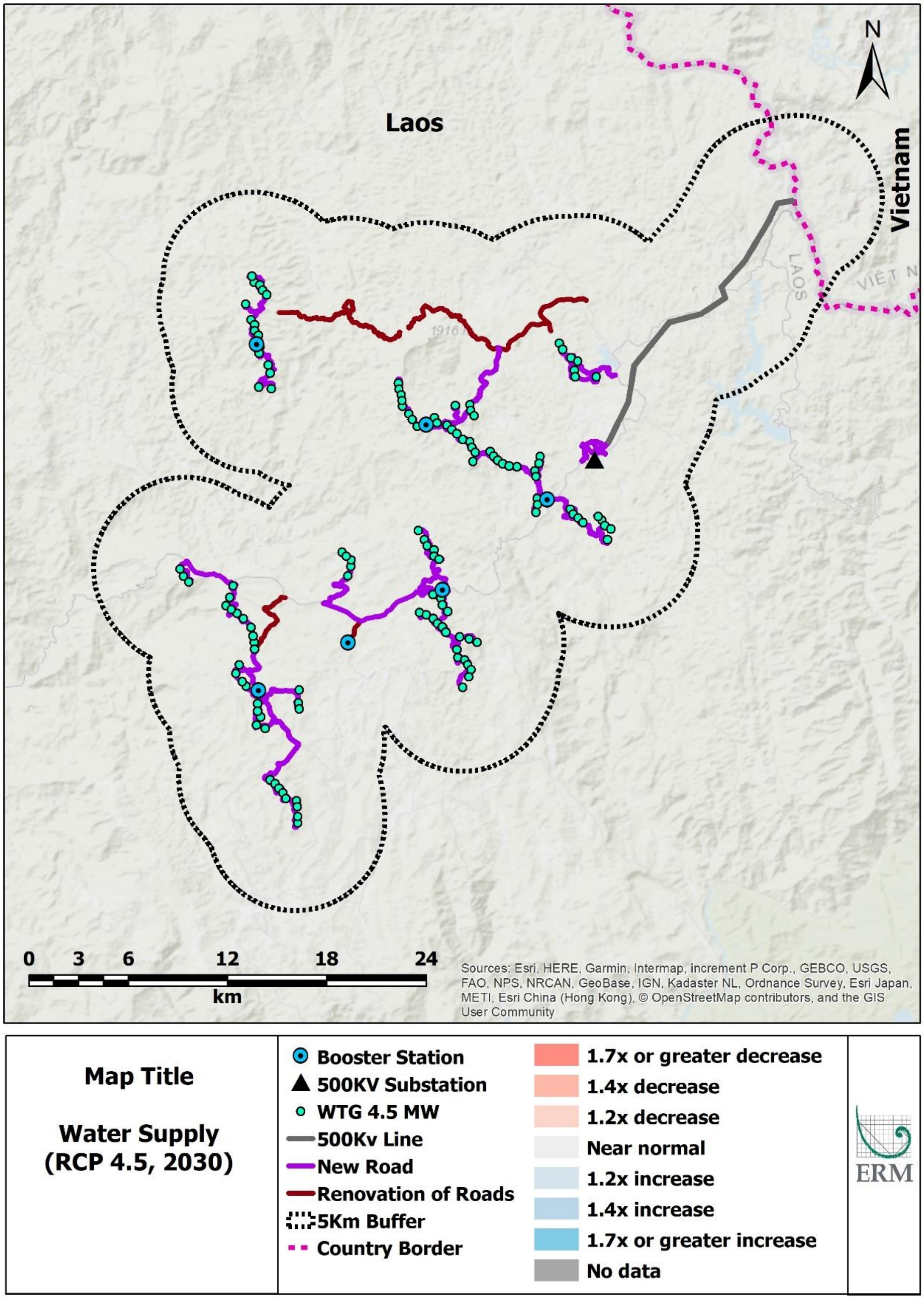
However, as discussed earlier as indicated by the land use pattern in the region, and Low water usage as indicated by Low water stress, seasonal variability is not likely to have significant impact on availability of water in general. In addition, the water requirement of the project during operational phases is likely to be significantly lower than during the construction phase. Hence, the hazard due to availability of water is considered to remain 'Low' under all climate change scenarios (***Table 9.97***).

[120] A warm Spell is a period characterised by several days of very warm temperatures compared to local or regional averages. In a warm spell, the average temperatures are not as high as heatwave and relate to unseasonably warm weather. Depending on when they occur warm spells can have an impact on human health, infrastructure, energy demand, and natural ecosystems (https://climate.copernicus.eu/esotc/2020/heatwaves-and-warm-spells-during-2020#:~:text=In%20a%20warm%20spell%2C%20the,energy%20demand%20and%20natural%20ecosystems). For example warm spells during the winter will trigger the grass plant to de-acclimate and become more susceptible to winter injuries.

Table 9.97: Summary for Hazard Due to Water Availability under Baseline and Climate Change Scenarios

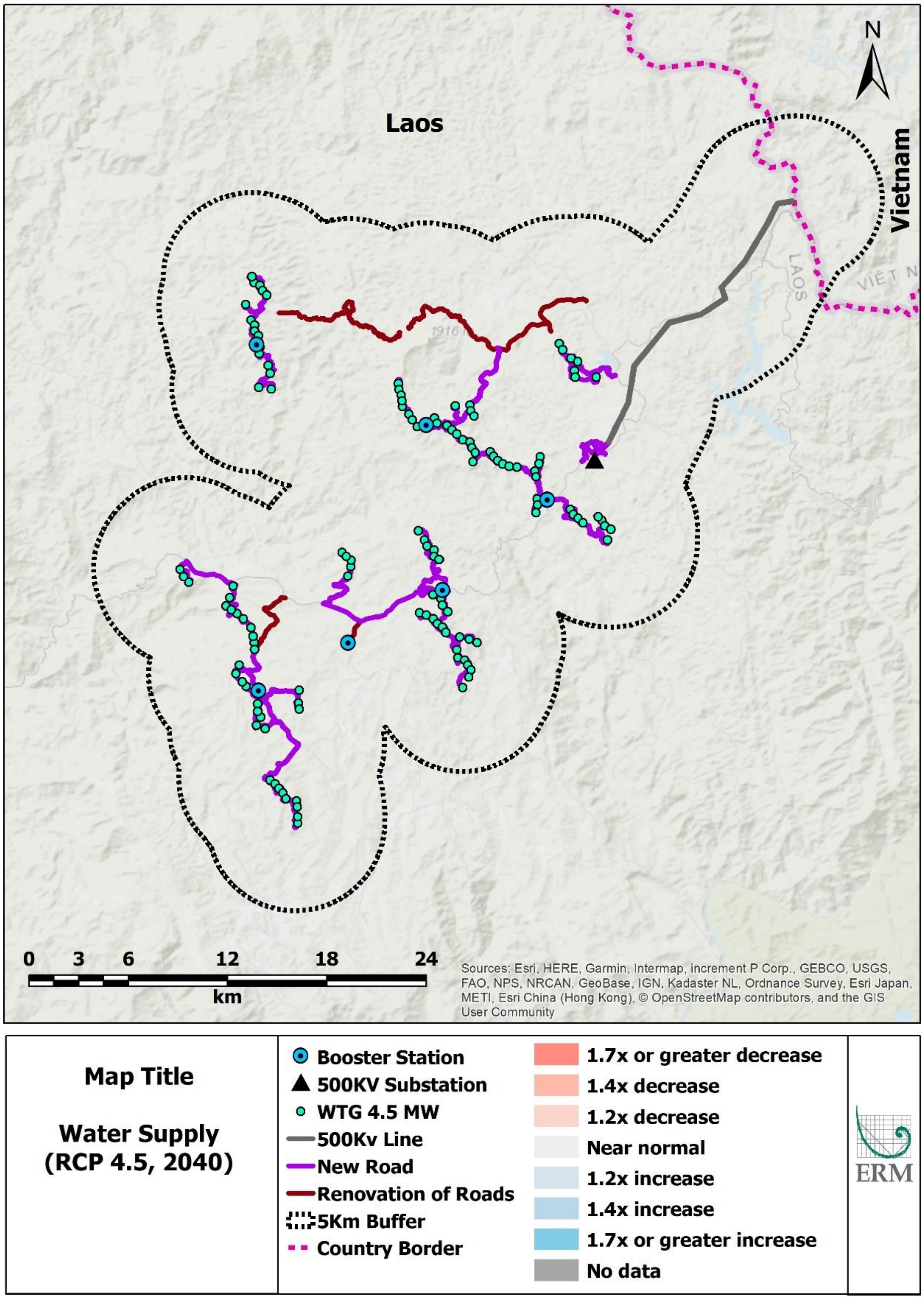
Baseline	RCP 4.5		RCP 8.5	
	2030	2050	2030	2050
Low	Low	Low	Low	Low

Figure 9.72: Water Supply RCP 4.5/2030



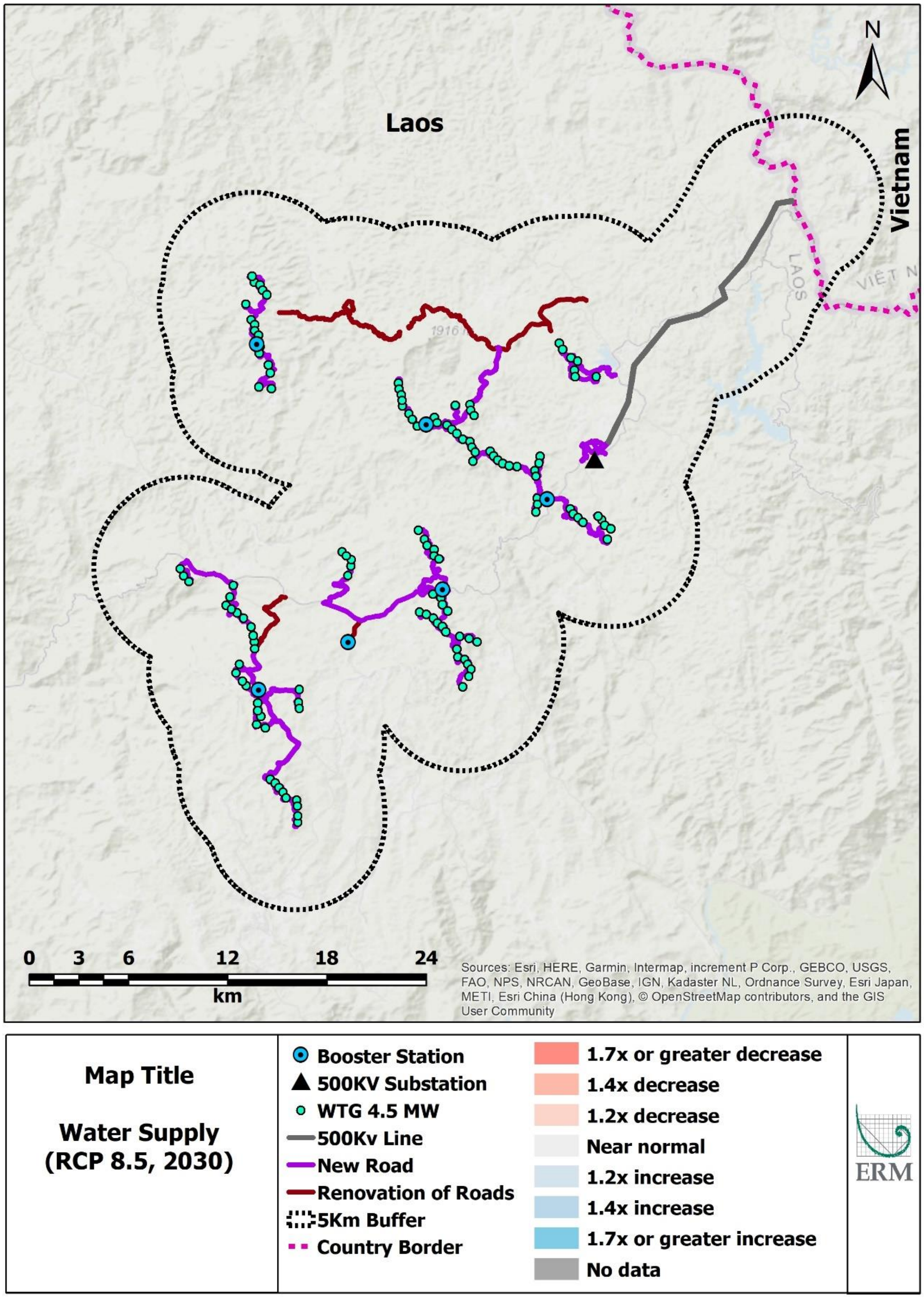
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.73: Water Supply RCP 4.5/2040



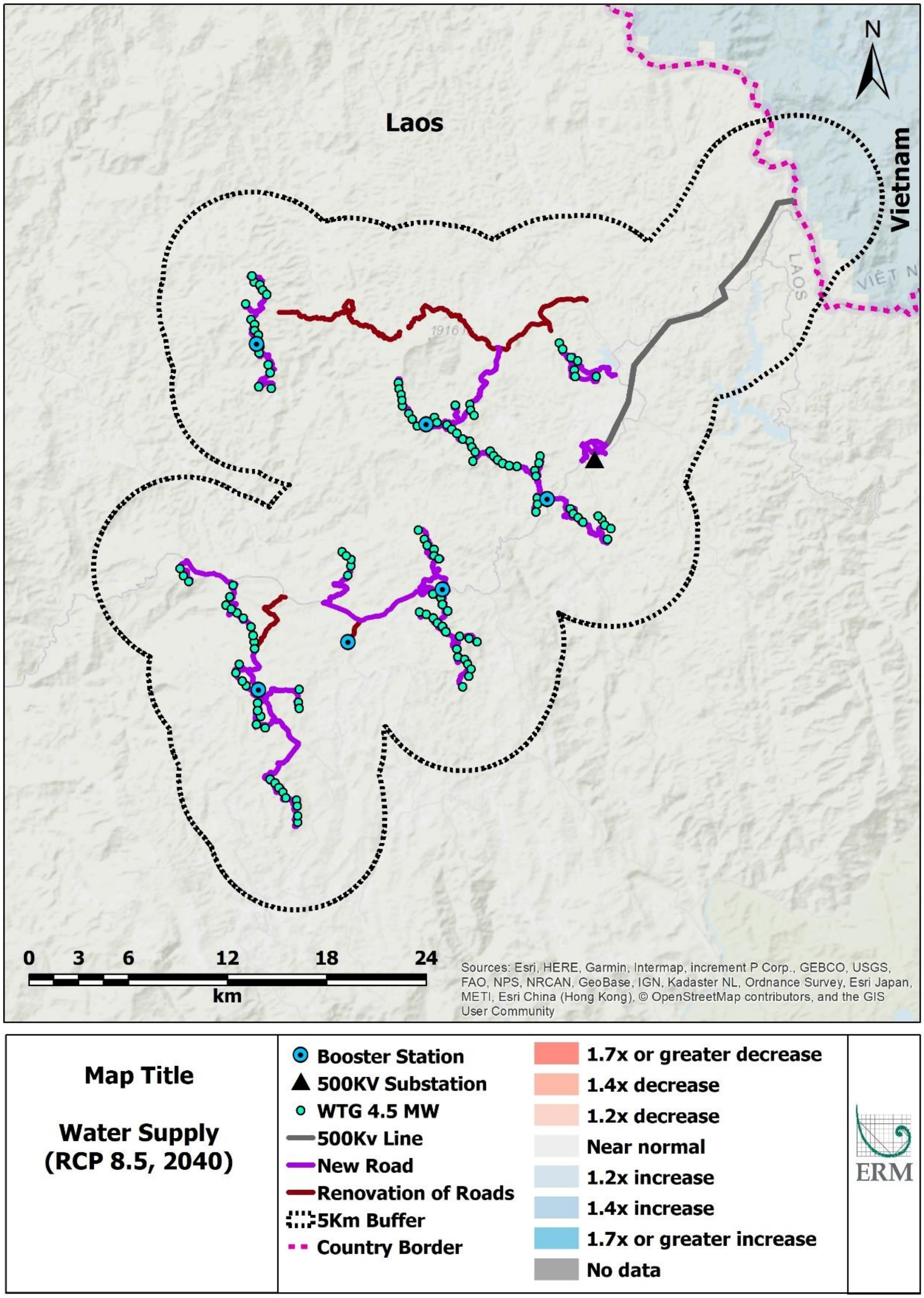
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.74: Water Supply RCP 8.5/2030



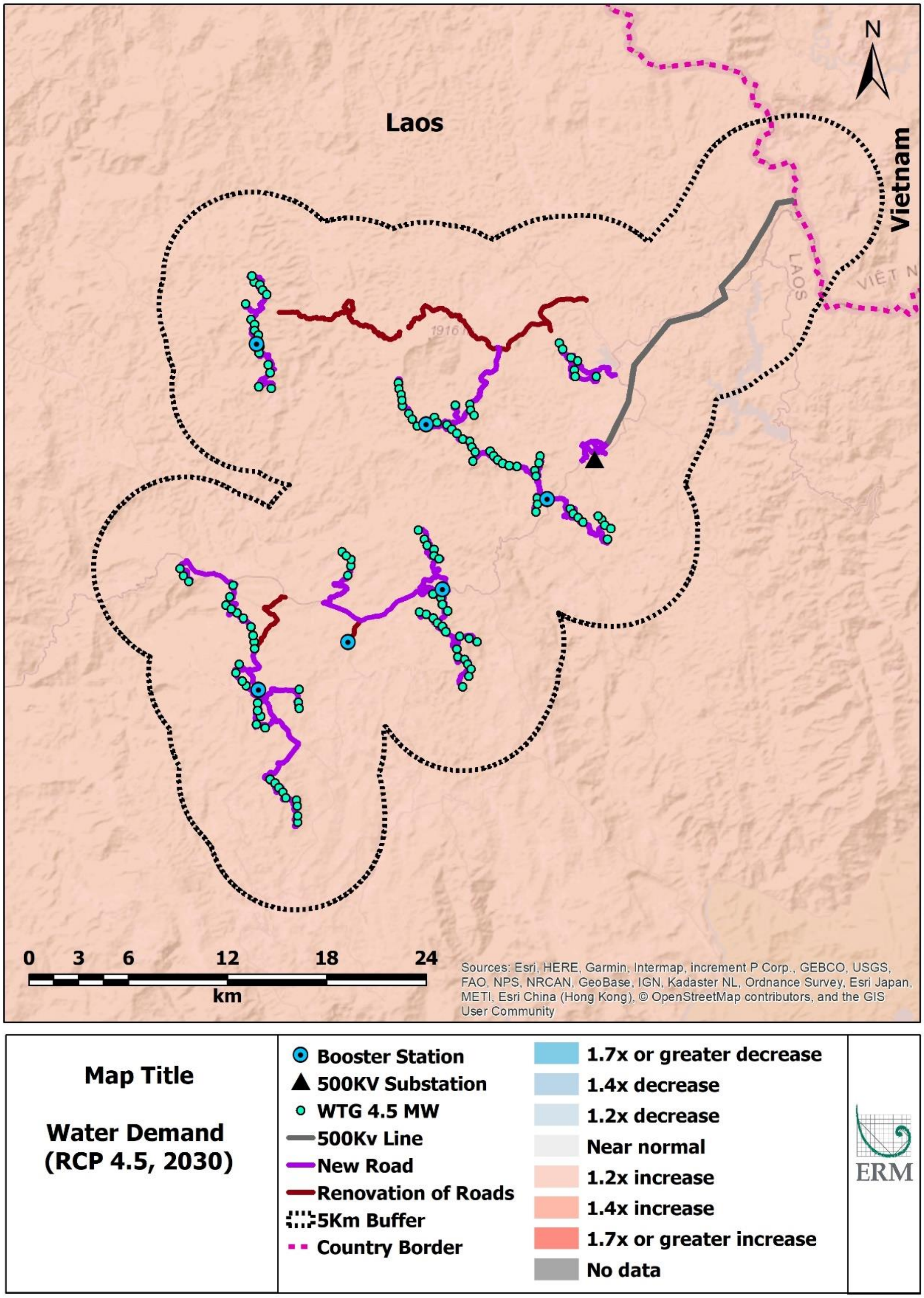
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.75: Water Supply RCP 8.5/2040



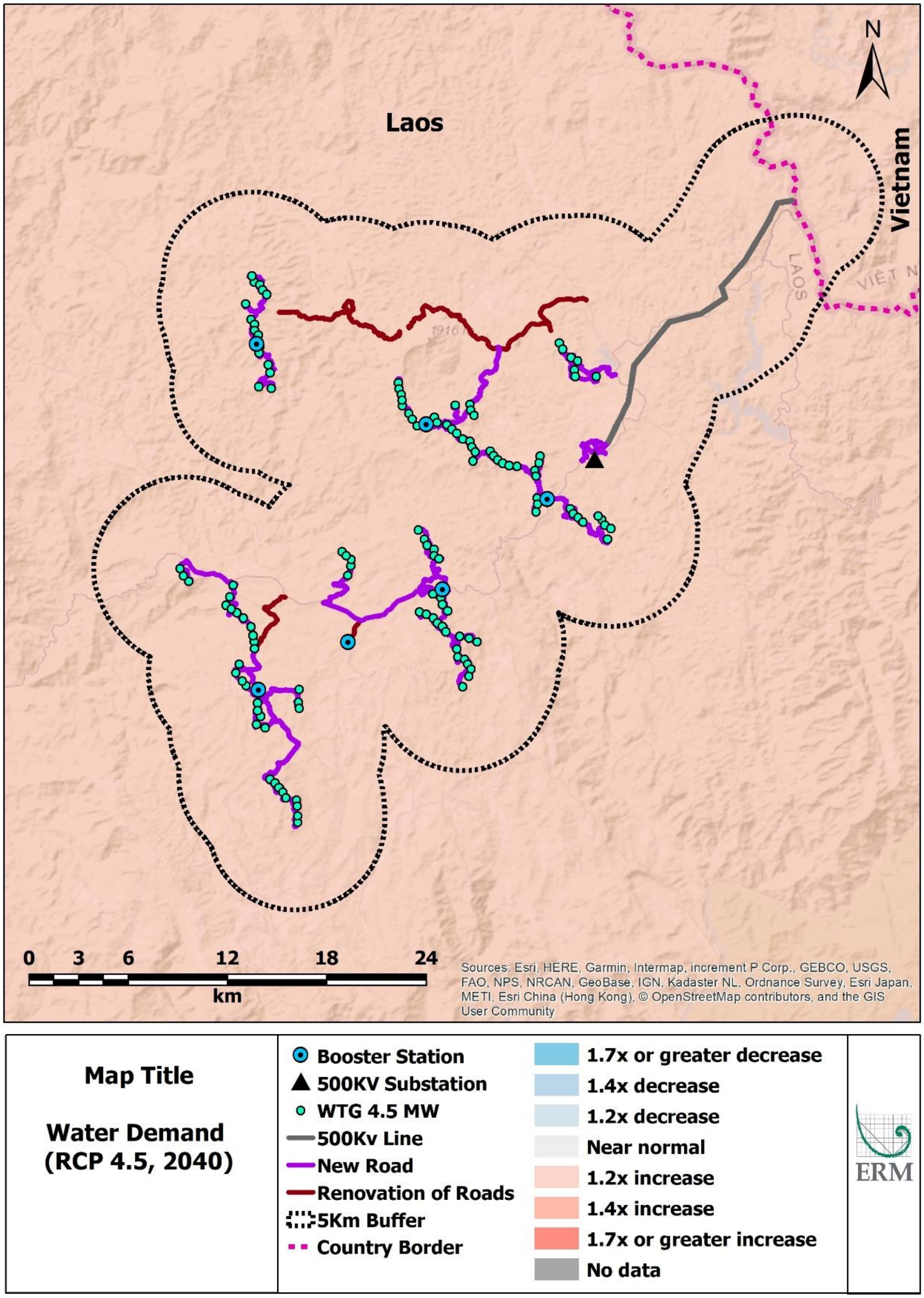
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.76: Water Demand RCP 4.5/2030



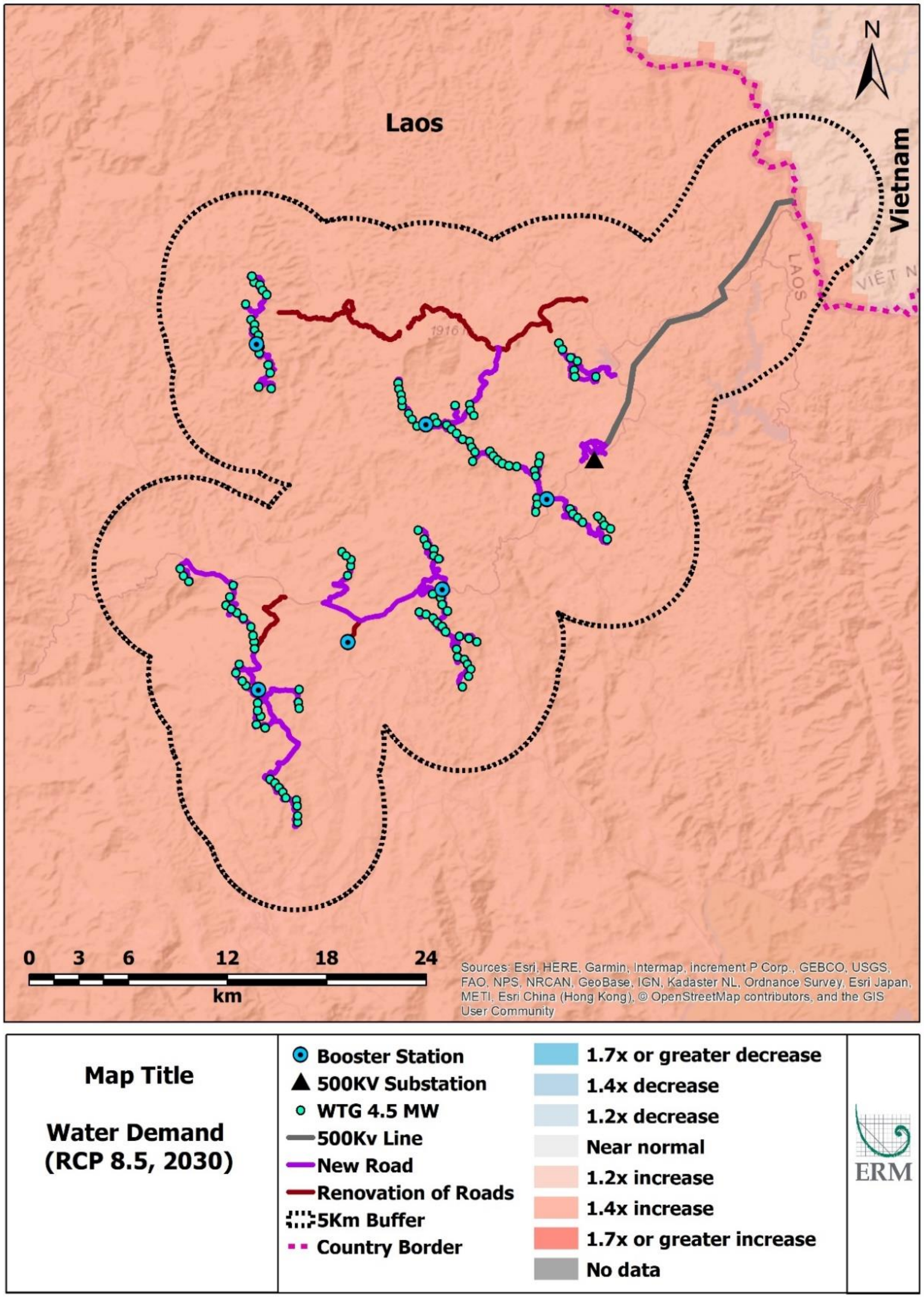
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.77: Water Demand RCP 4.5/2040



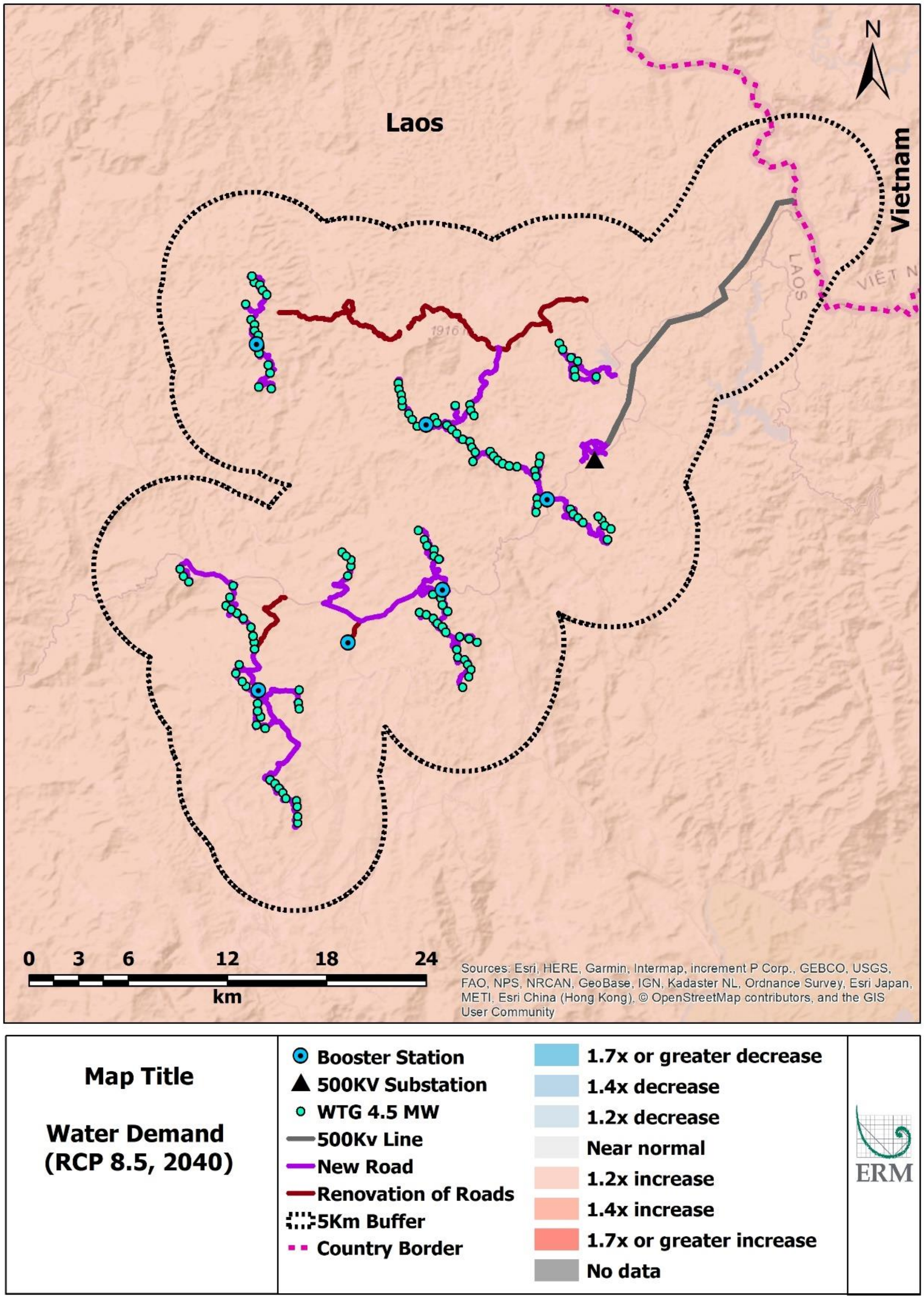
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.78: Water Demand RCP 8.5/2030



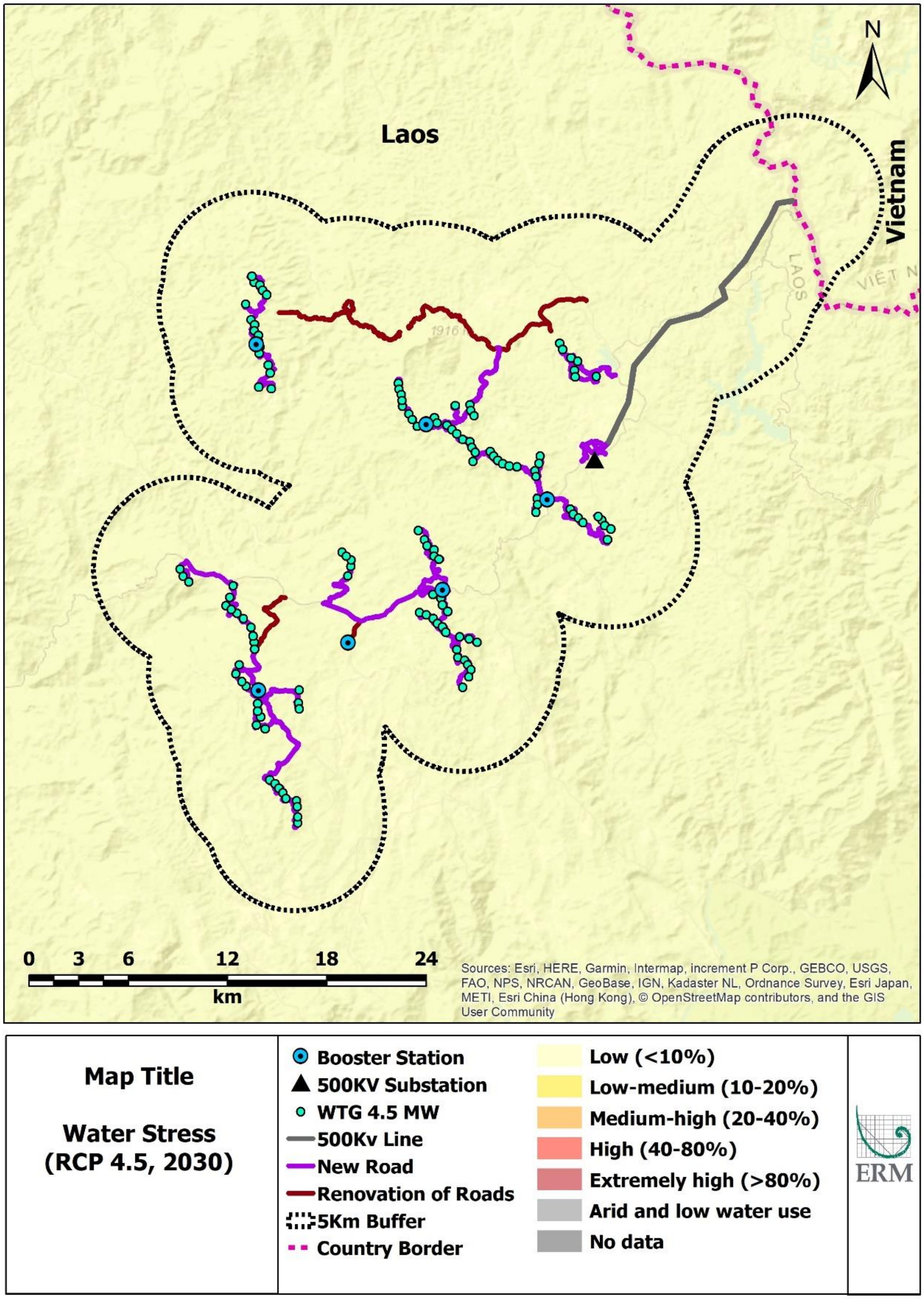
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.79: Water Demand RCP 8.5/2040



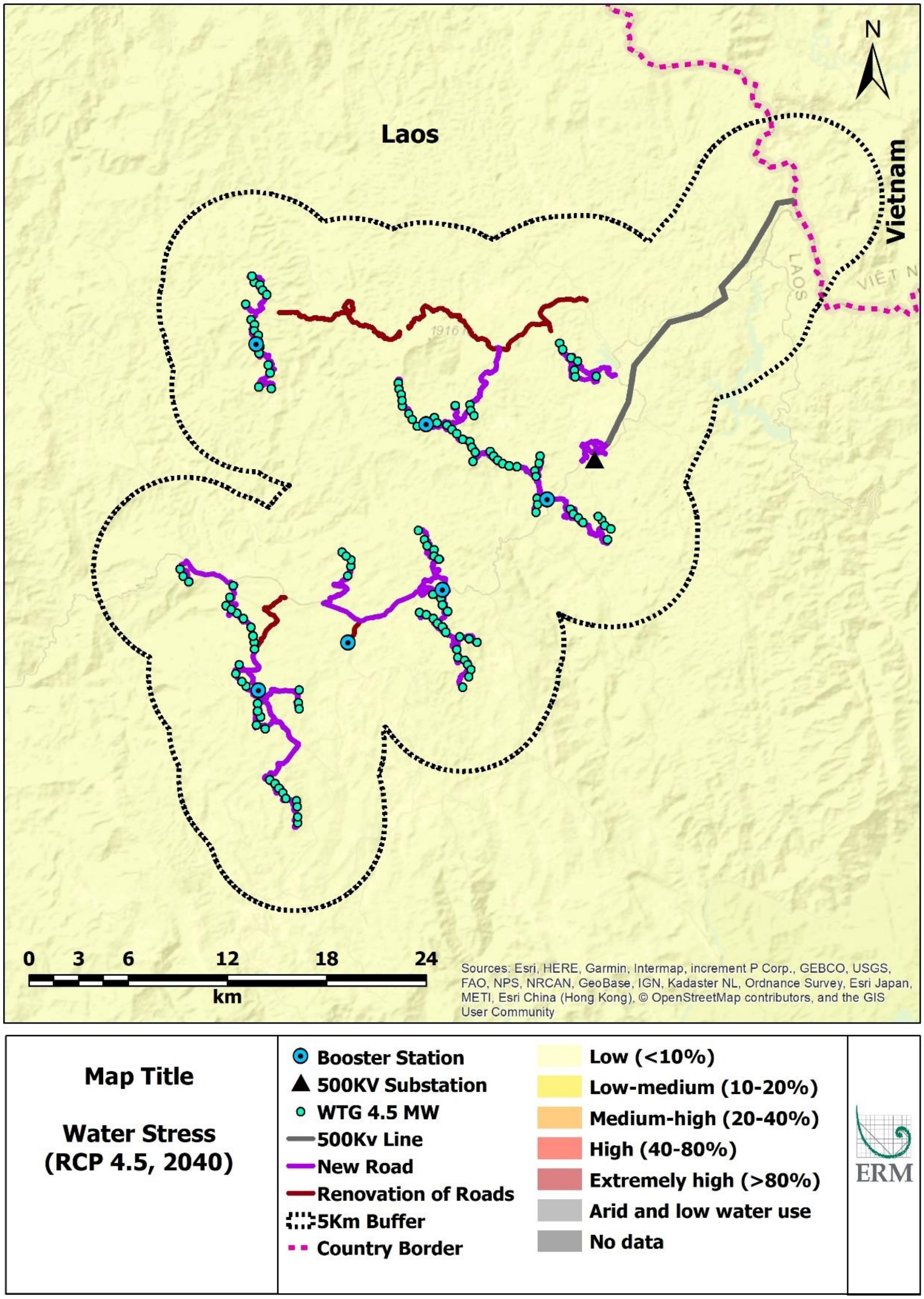
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.80: Water Stress RCP 4.5/2030



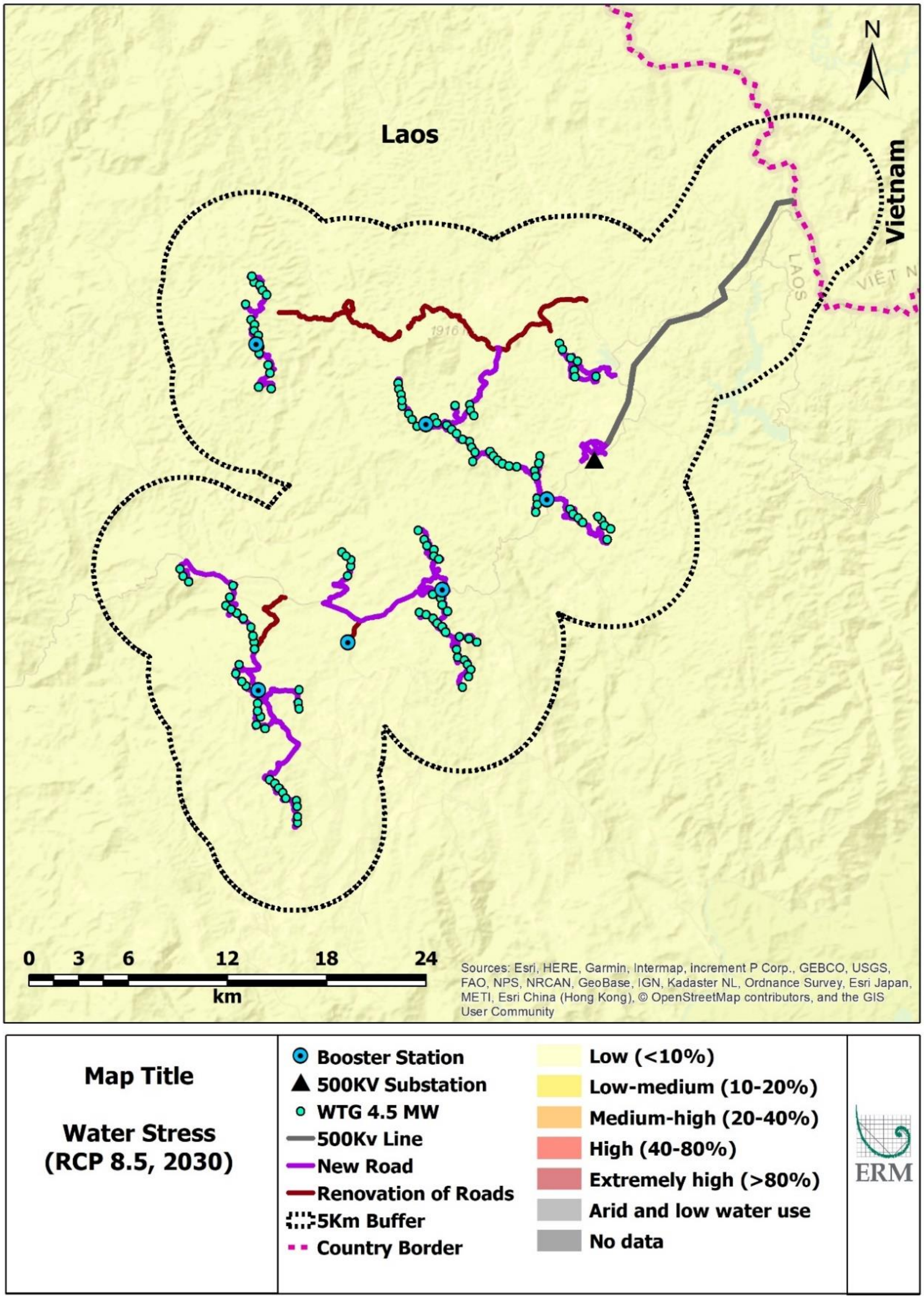
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.81: Water Stress RCP 4.5/2040



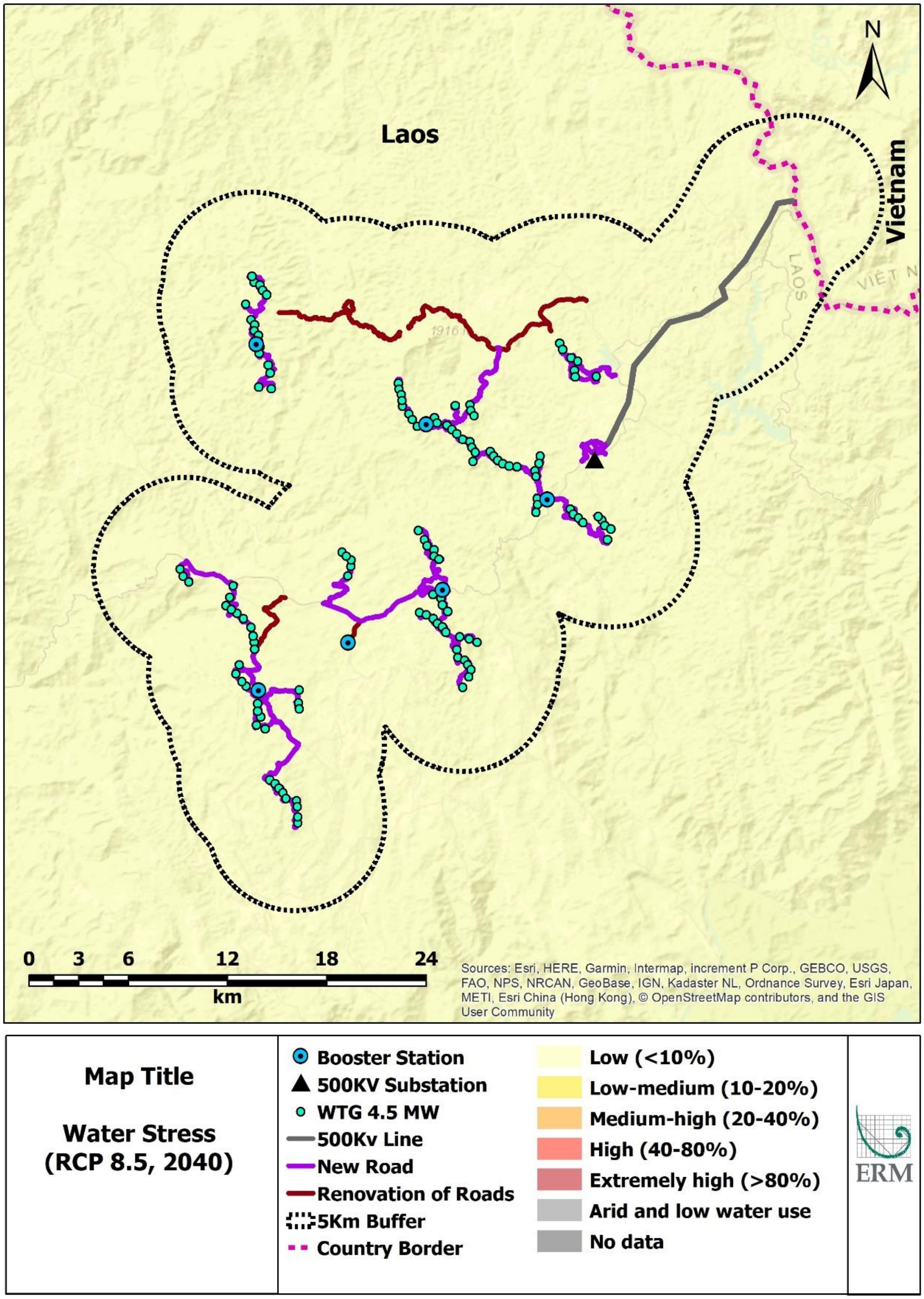
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.82: Water Stress RCP 8.5/2030



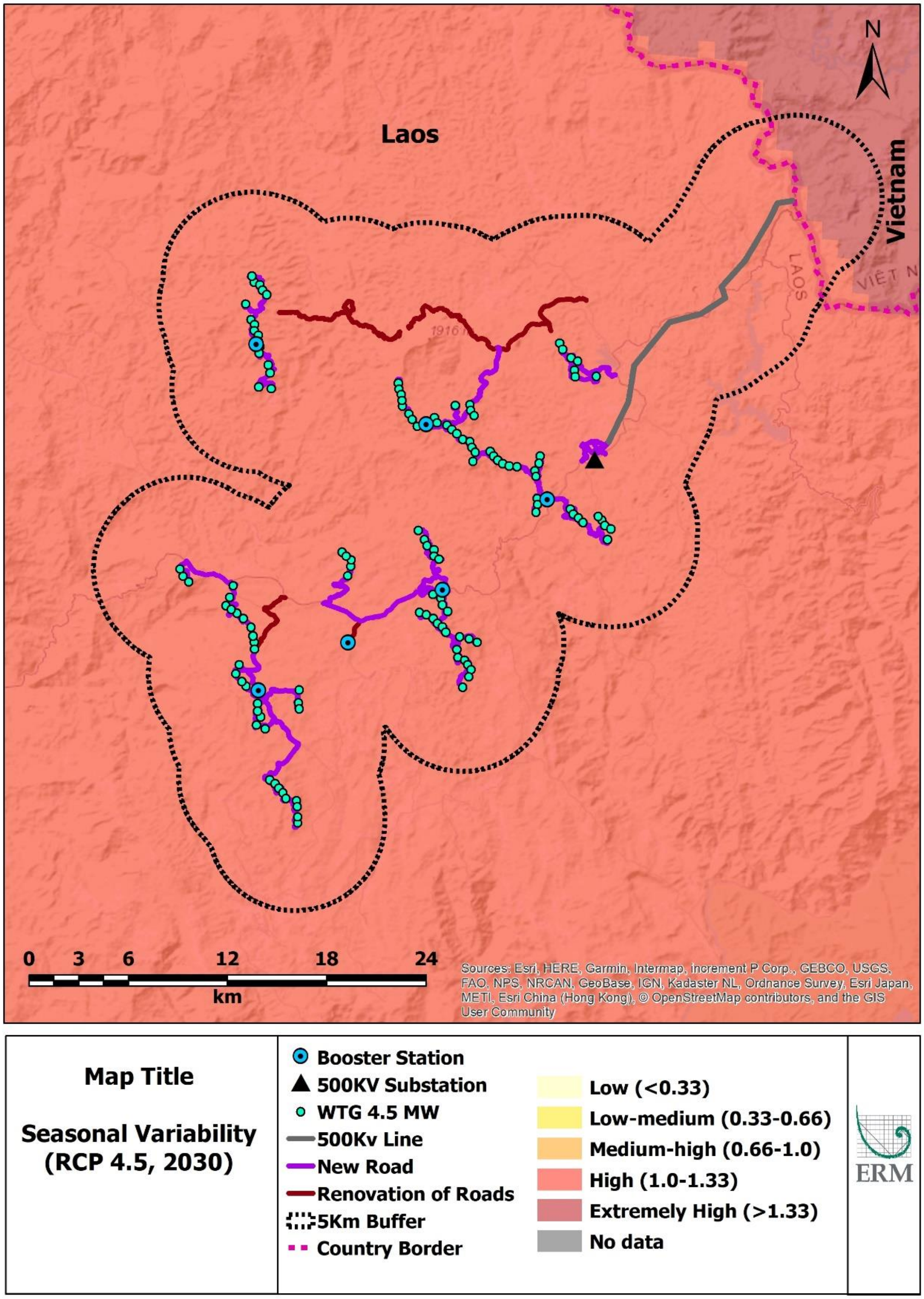
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.83: Water Stress RCP 8.5/2040



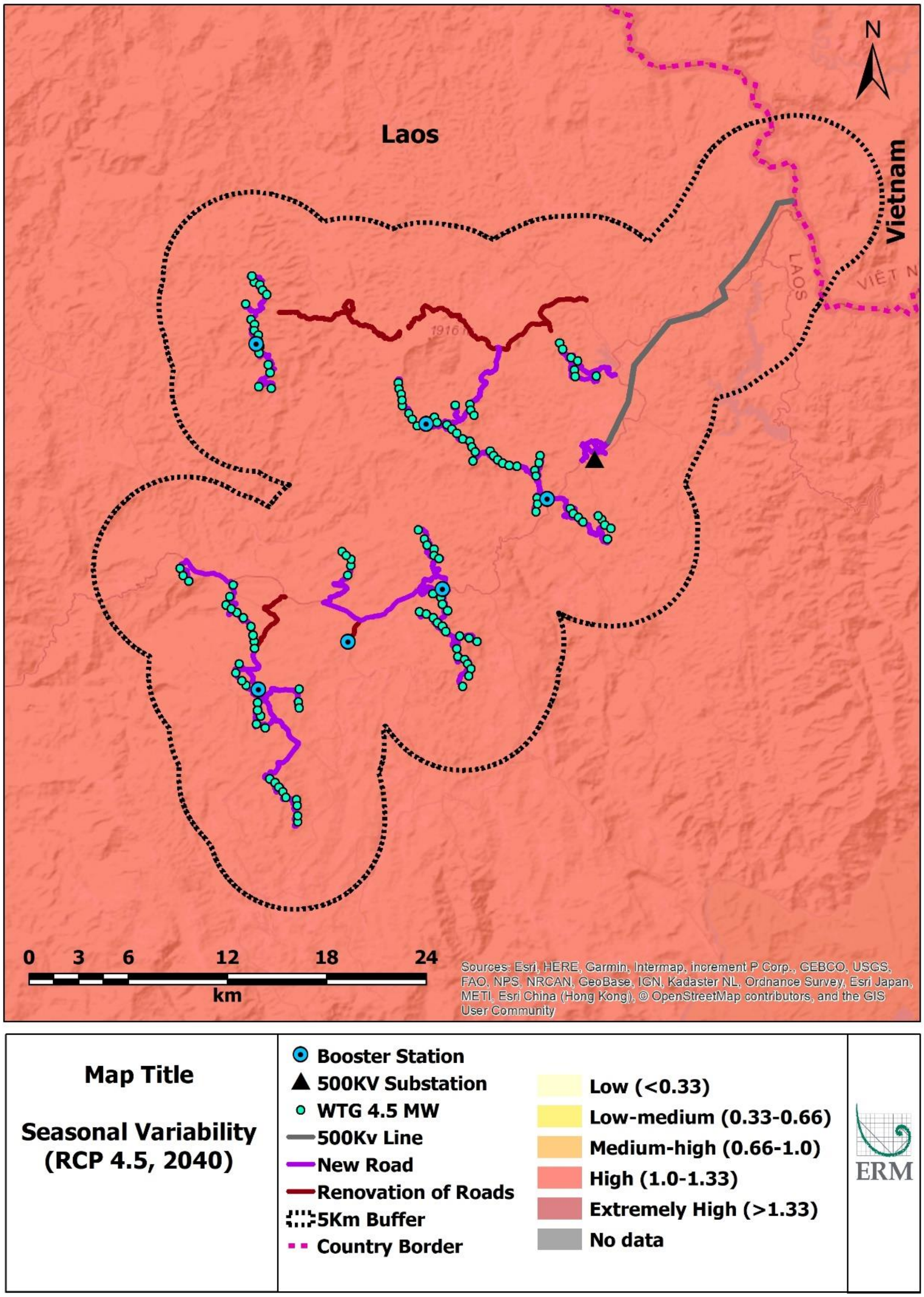
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.84: Seasonal Variability RCP 4.5/2030



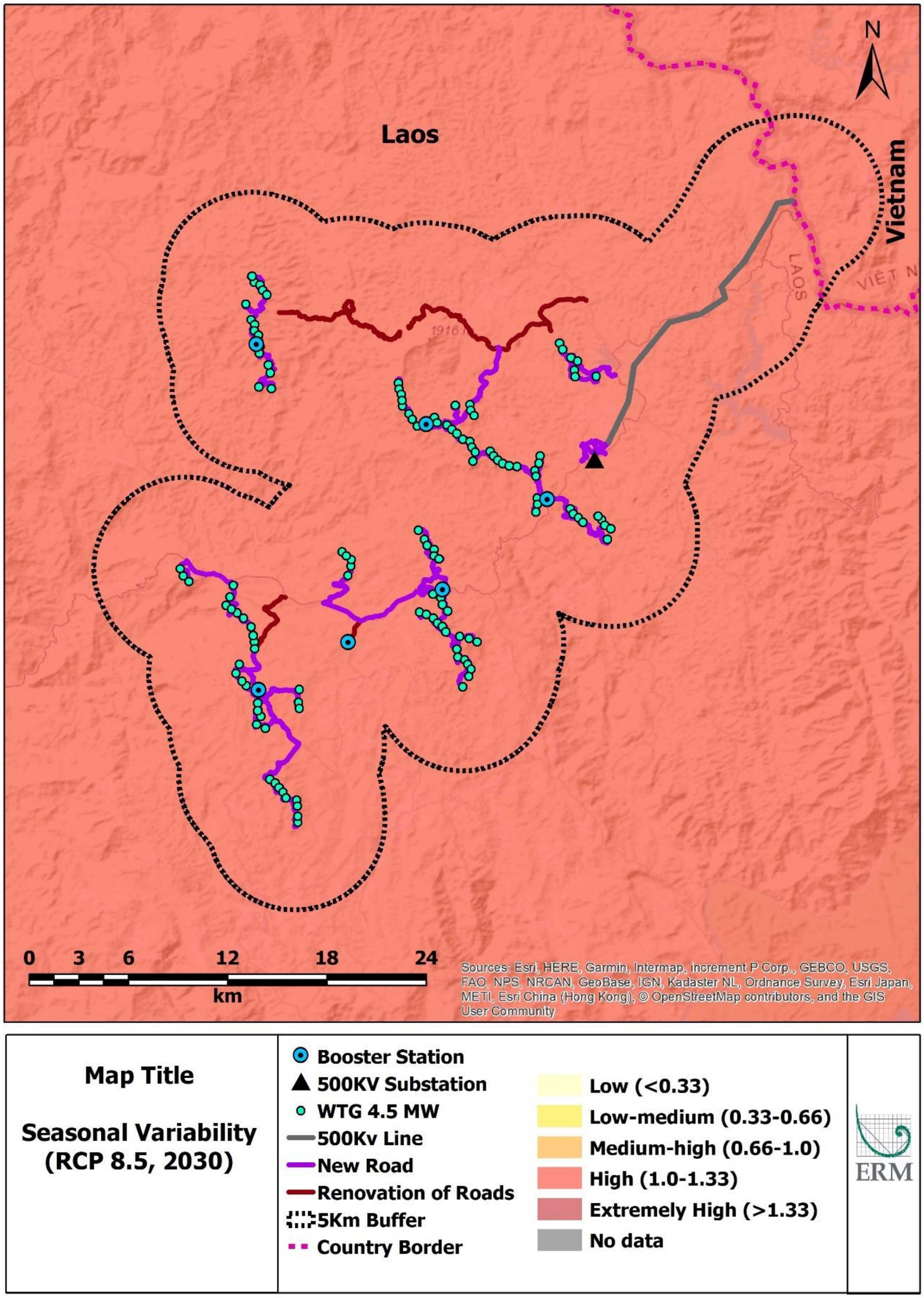
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.85: Seasonal Variability RCP 4.5/2040



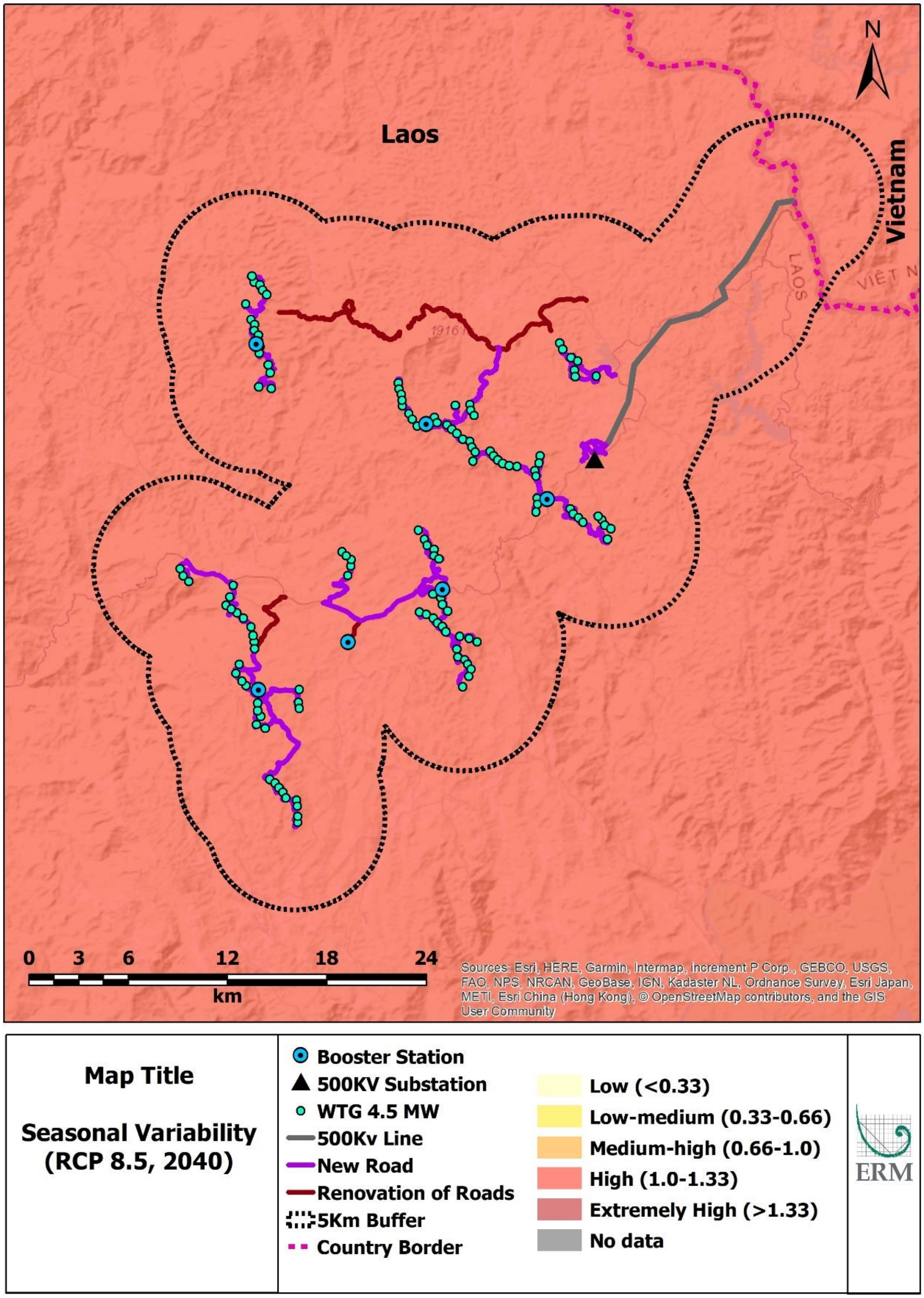
Source: WRI-Aqueduct Water Risk Atlas

Figure 9.86: Seasonal Variability RCP 8.5/2030



Source: WRI-Aqueduct Water Risk Atlas

Figure 9.87: Seasonal Variability RCP 8.5/2040



Source: WRI-Aqueduct Water Risk Atlas

Riverine Floods

Floods are defined as logging of excess water resulting in submergence of dry lands. Floods can be categorized as inland and coastal in nature. Inland flooding may be caused due to heavy rainfall, resulting in high run-off leading to water accumulation in low lying areas, or overtopping of water bodies such as rivers, streams, lakes, ponds and tanks.

Floods are likely to result in wide spread local as well as regional level destruction. This can be caused due to submergence, washing away and damage to infrastructure, buildings, structures, sewerage systems, damage to power transmission and power generation, loss of agricultural land and crops, contamination of fresh water sources, propagation of water borne diseases and loss of life.

- Baseline

Sekong and Attapeu province are reported to be among the most flood vulnerable provinces in Lao PDR[121]. However, a review of flood hazard data based on likelihood of damaging and life threatening floods (floods with depth of inundation >0.5 m) (***Figure 9.88***) indicated the flood hazard to be Very Low in Sanxay District in Attapue, and Dak Cheung District in Sekong province where the project is located.

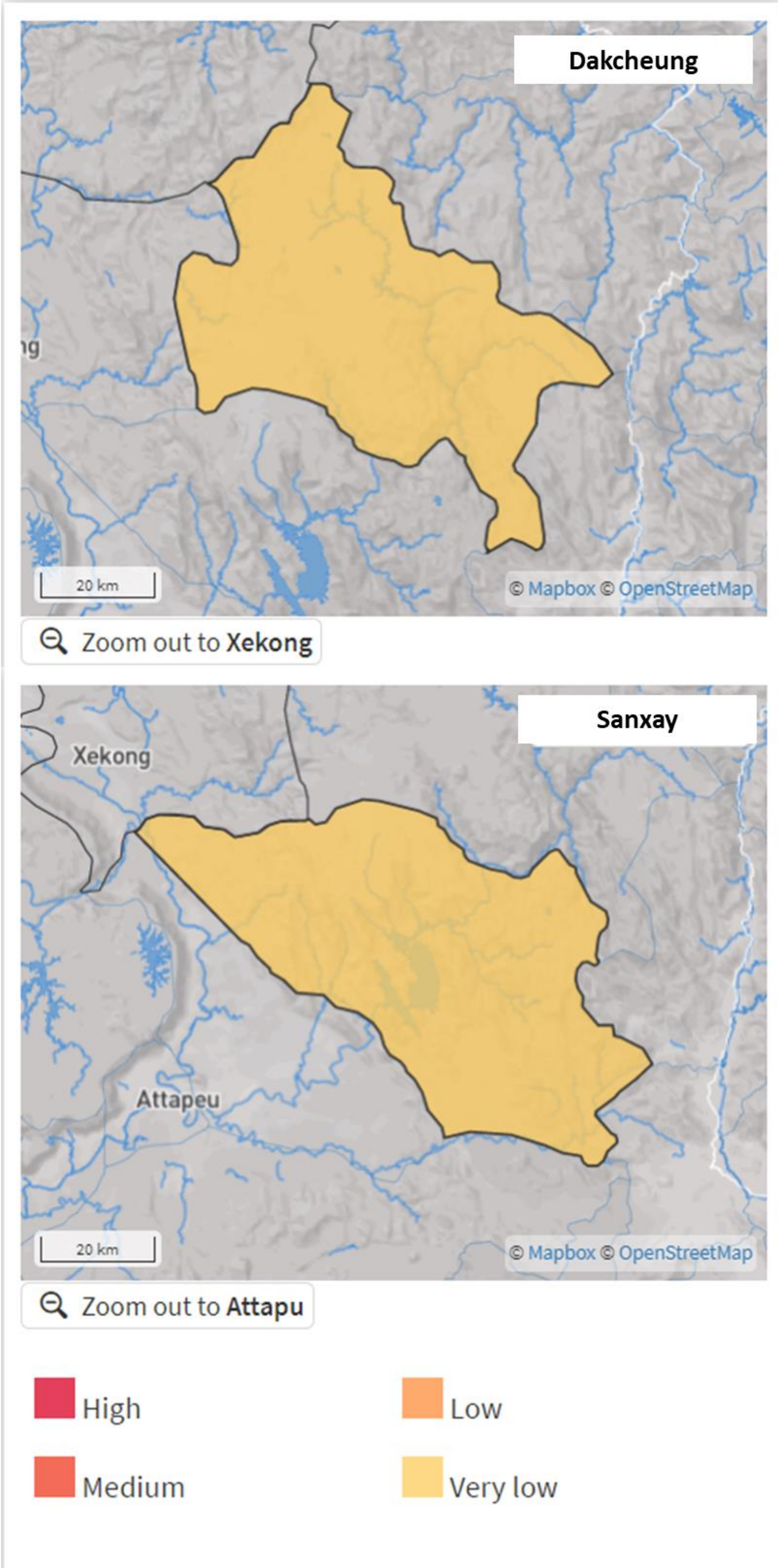
Furthermore, a review of flood hazard map(s) representing the depth of inundation under a flood with 100 year return period (***Figure 9.89***) indicated no inundation in project area.

A review of satellite imagery in and around the study area does not show any rivers flowing through the study area, except Nam Pagnou River, in eastern parts of the project area. The 500 kv transmission line is proposed to cross over the Nam Pagnou River. No other major assets are observed to be located in areas near to the Nam Pagnou River. The wind turbines are also observed to be located on the ridges. Hence, river floods are not likely to impact project assets.

Accordingly, considering the site setting (locations of assets), absence of major rivers, and no reported inundation within study area, riverine floods are not likely to have impact on the project. Hence, no hazard due to riverine flood is considered.

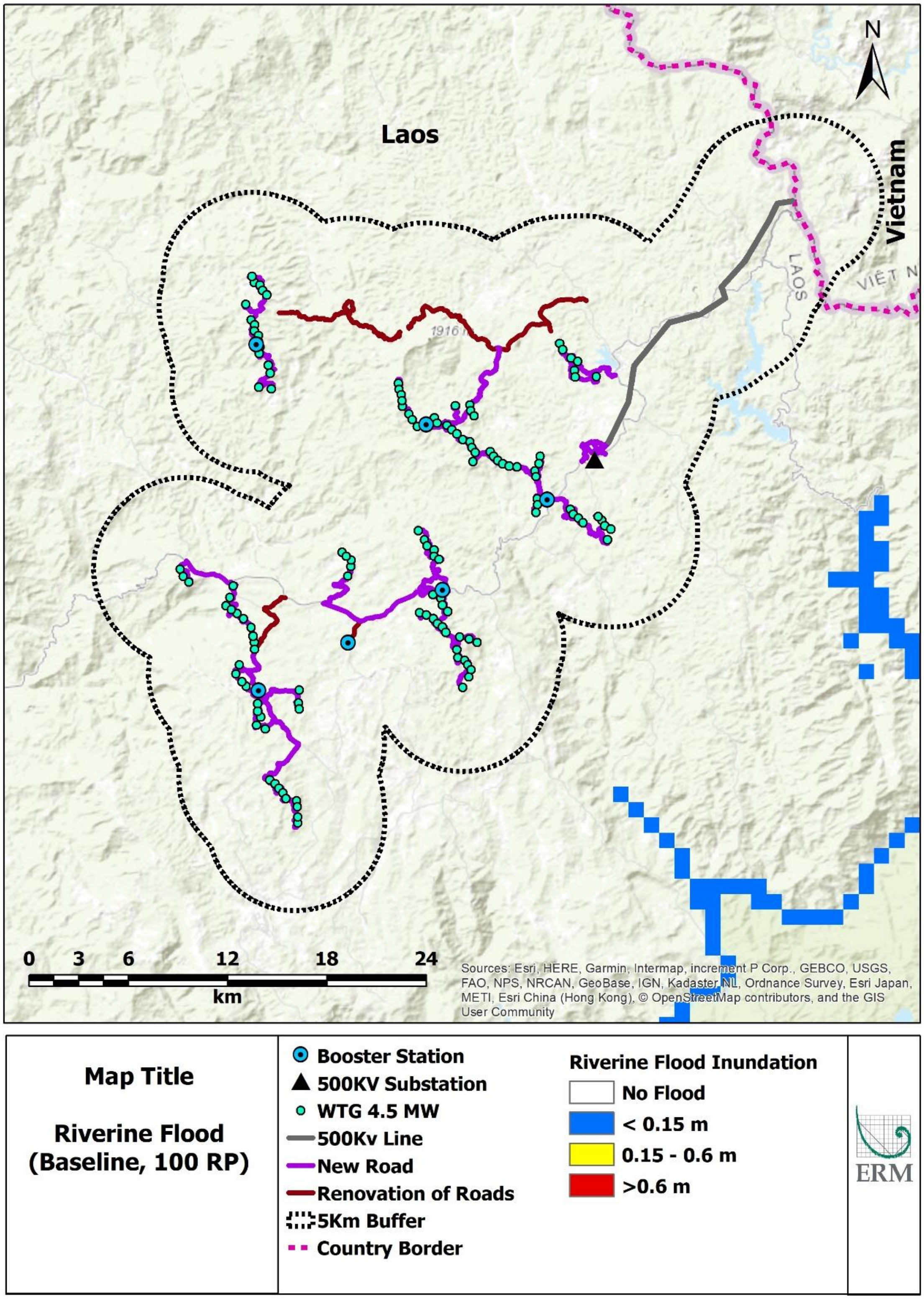
121 https://www.adpc.net/igo/category/ID416/doc/2013-ptk8Nb-ADPC-Publication_LNAReportWEB_(2).pdf

Figure 9.88: Baseline Riverine Flood Hazard



Source: Think Hazard

Figure 9.89: Baseline Riverine Flood Hazard



Source: WRI-Aqueduct Flood Tool

- Climate Change

Climate change projections for extreme precipitation (rainfall) indices of 1 day maximum rainfall, 5 day maximum rainfall, and number of days with heavy rainfall (>10mm) indicated increasing trend under all climate change scenarios, except RCP 4.5 in 2030. Extreme precipitation under RCP 4.5 indicated slight decrease in 2030. The increase in extreme precipitation is observed to be intensified with time and radiative forcing (RCP). Accordingly, highest increase in extreme precipitation is projected to be in 2050 under RCP 8.5 scenario.

Similarly, precipitation during cyclones originating in north-east Pacific Ocean is projected to increase by up to 19.4% by 2050 under RCP 8.5 scenario. Therefore, any change in topography during development of project and increased intensity of precipitation may lead to localised surface flooding, mountain floods, or flash floods in future.

Table 9.98: Climate Change Projections for Extreme Precipitation

Parameter	Absolute Values					Percentage Change (%)			
	Baseline	RCP 4.5		RCP 8.5		RCP 4.5		RCP 8..5	
		2030	2050	2030	2050	2030	2050	2030	2050
1-Day (mm)	67.1	-0.9	3.7	0.5	6.0	-1.5	5.6	0.8	9.1
5-Day (mm)	169.8	-6.9	6.9	1.7	11.9	-4.1	4.06	1.0	7.1
>10 mm (Days)	35	-0.3	1.21	0.6	2.1	-0.9	3.4	1.6	5.8
Cyclonic Precipitation* (mm)	N.D.	N.D.	N.D.	N.D.	N.D.	10.1	14.8	11.1	19.4

(: Changes in cyclonic precipitation are based on the studies conducted by Kunston et. Al.(2020)[122] providing projections for basin wise occurrences in cyclones and associated variables such as wind speed, frequency, and precipitation. For the purpose of this assessment a linear relationship is assumed between global average temperature rise and occurrences of cyclone. Accordingly, the projections for cyclones were adjusted from projections for 2°C scenario.).*

As discussed earlier, considering the absence of major rivers in the study area, and Site setting, riverine floods are not likely to impact the project components. Moreover, review of flood hazard maps (inundation under 100 year return period flood) for climate change scenarios indicated no flooding within the study area. Hence, no hazard due to riverine floods is considered.

Table 9.99: Summary of Riverine Flood Hazard under Baseline and Climate Change Scenario

Baseline	RCP 4.5		RCP 8.5	
	2030	2050	2030	2050
No Hazard	No Hazard	No Hazard	No Hazard	No Hazard

122 https://journals.ametsoc.org/view/journals/bams/101/3/bams-d-18-0194.1.xml

Landslides

As per United States Geological Survey (USGS), a landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Several factors are responsible for occurrence of landslides. Some of these are poor mechanical stability, heavy rainfall events, geological formation, earthquake, vibration (mechanical) and slope, and could be influenced largely by human activities at a local level. Some of the human activities which are likely to cause or aggravate landslides are deforestation, cultivation, construction, vibration from heavy machinery and traffic, blasting and mining activities, and large and unstable earthwork/ excavation.

It should be noted that the global data bases in general do not capture landslide events due to human activities, and these datasets are limited to the landslides occurred due to two major reasons: earthquakes and precipitation. However, earthquakes are not affected by climate change only landslides due to precipitation were evaluated under the present assessment.

For the purpose of present assessment, the landslide hazard was evaluated based on the data for rainfall triggered landslide hazard from World Bank Data Catalog and landslide hazard susceptibility data from NASA.

- Dalia Kirschbaum and Thomas Stanley have developed new map of global landslide susceptibility. The map is part of a broader effort to establish a hazards monitoring system that combines satellite observations of rainfall from the Global Precipitation Measurement (GPM) mission with an assessment of the underlying susceptibility of terrain. Steep slopes are the most important factor that make a landscape susceptible to landslides. Other key factors include deforestation, the presence of roads, the strength of bedrock and soils, and the location of faults. While other scientists have previously developed global and continental landslide susceptibility maps, Kirschbaum and Stanley used improved versions of certain datasets. They used a more robust version of elevation data collected by the Shuttle Radar Topography[123]. The new global landslide susceptibility map is intended for use in disaster planning situational awareness, and for incorporation into global decision support systems[124].

The World Bank Data Catalog provides data landslides hazard due to precipitation. The data is in the form of raster images with land slide hazard classified in four classes: Very low, Low, Medium, and High.

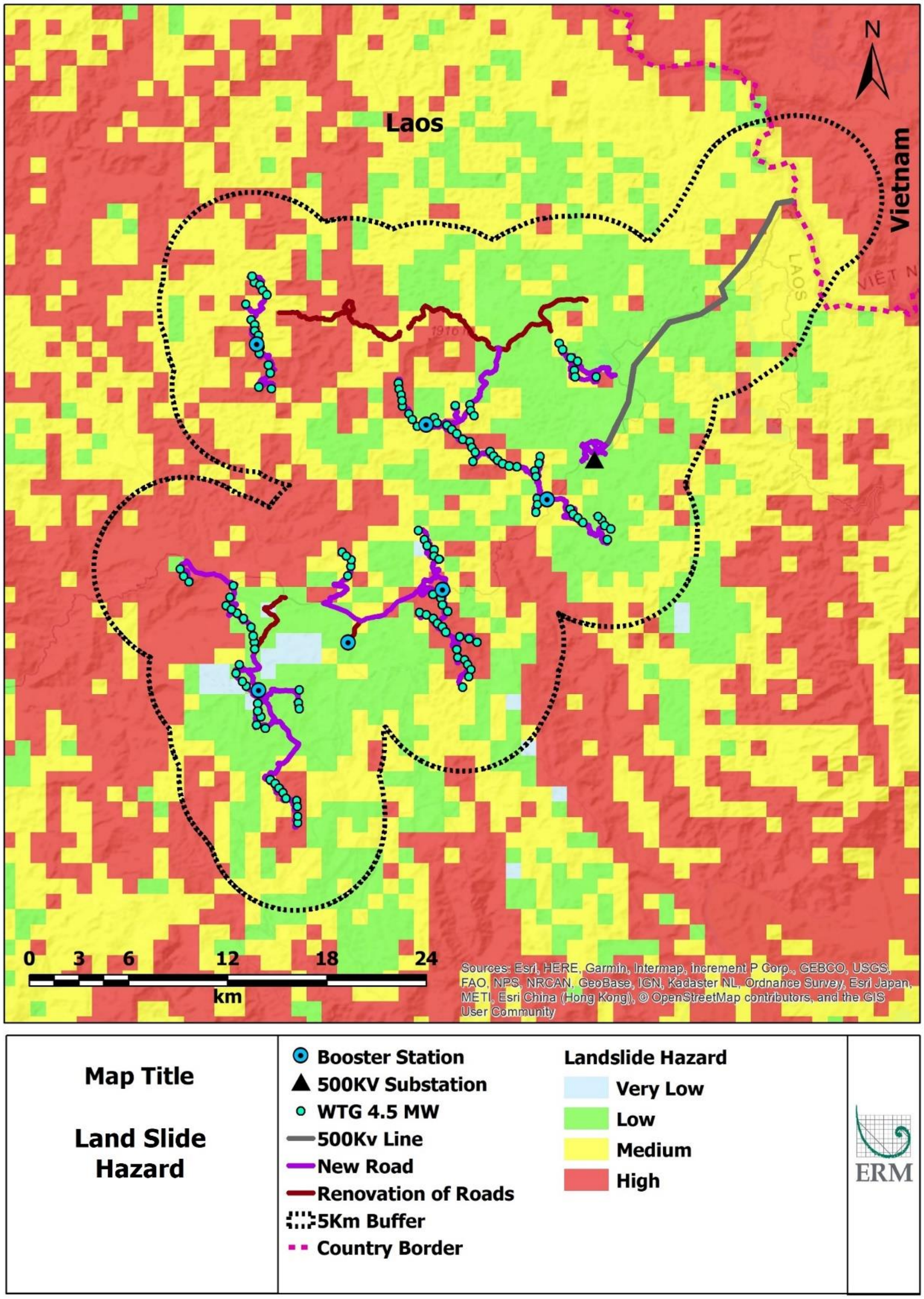
- Baseline

Landslide susceptibility within study area is reported to vary between Medium to Very High as presented in ***Figure 9.90***. This indicates that the project area is susceptible to landslides owing to factors such as land cover, soil type, and slope. Moreover, the landslide hazard map as presented in ***Figure 9.91 i***ndicate the hazard due to landslides triggered by precipitation to vary between Low-High within Study area. Accordingly, overall hazard due to landslides triggered by precipitation is considered to be '**High**'.

[123] https://earthobservatory.nasa.gov/images/89937/a-global-view-of-landslide-susceptibility

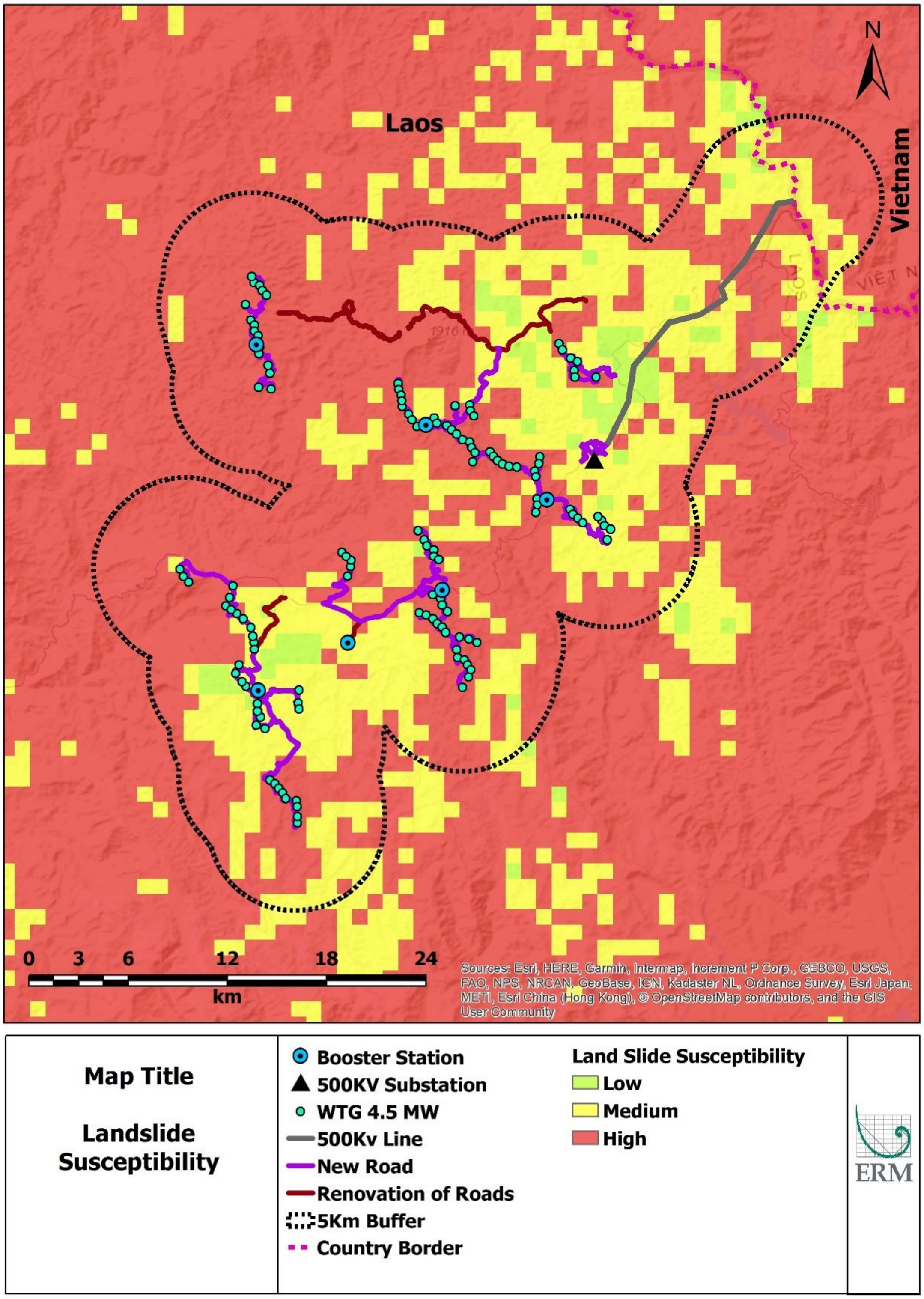
[124] https://link.springer.com/article/10.1007/s11069-017-2757-y

Figure 9.90: Baseline Landslide Hazard



Source: Word Bank Data Catalog

Figure 9.91: Landslide Susceptibility



Source: NASA

- Climate Change

As landslides due to rainfall are triggered during extreme precipitation, changes in landslide hazard were evaluated qualitatively based on the projected changes in one day maximum precipitation. Future hazard due to landslides was estimated only for those locations where baseline hazard due to landslides was reported. For other locations, no hazard due to landslides due to precipitation was considered.

Climate change projections for extreme precipitation (rainfall) indices of 1 day maximum rainfall, 5 day maximum rainfall, and number of day with heavy rainfall (>10mm) indicated increasing trend under all climate change scenarios, except RCP 4.5 in 2030. Extreme precipitation under RCP 4.5 indicated slight decrease in 2030. The increase in extreme precipitation is observed to get intensified with time and radiative forcing (RCP). Accordingly, highest increase in extreme precipitation is projected to be in 2050 under RCP 8.5 scenario.

Similarly, precipitation during cyclones originating in north-east Pacific Ocean is projected to increase by up to 19.4% by 2050 under RCP 8.5 scenario. Therefore, any change in topography during development of project and increased intensity of precipitation may lead to localised surface flooding in future.

Table 9.100: Climate Change Projections for Extreme Precipitation

Parameter	Absolute Values					Percentage Change (%)			
	Baseline	RCP 4.5		RCP 8.5		RCP 4.5		RCP 8..5	
		2030	2050	2030	2050	2030	2050	2030	2050
1-Day (mm)	67.1	-0.9	3.7	0.5	6.0	-1.5	5.6	0.8	9.1
5-Day (mm)	169.8	-6.9	6.9	1.7	11.9	-4.1	4.06	1.0	7.1
>10 mm (Days)	35	-0.3	1.21	0.6	2.1	-0.9	3.4	1.6	5.8
Cyclonic Precipitation* (mm)	N.D.	N.D.	N.D.	N.D.	N.D.	10.1	14.8	11.1	19.4

(*: Changes in cyclonic precipitation are based on the studies conducted by Kunston et. al.(2020)[125] providing projections for basin wise occurrences in cyclones and associated variables such as wind speed, frequency, and precipitation. For the purpose of this assessment a linear relationship is assumed between global average temperature rise and occurrences of cyclone. Accordingly, the projections for cyclones were adjusted from projections for 2°C scenario.).

Such increase in extreme precipitation may exacerbate the landslide hazard in future under climate change scenario. Moreover, changes in topography during the project development may locally exacerbate the landslide susceptibility. Hence, the hazard due to landslides triggered by precipitation is considered to remain '**High**' under all climate change scenarios.

Table 9.101: Summary for Landslide Hazard under Baseline and Climate Change Scenario

Baseline	RCP 4.5		RCP 8.5	
	2030	2050	2030	2050
High	High	High	High	High

125 https://journals.ametsoc.org/view/journals/bams/101/3/bams-d-18-0194.1.xml

Extreme Heat

Extreme temperature or extreme heat conditions usually happen gradually and not recognised easily as that of other extreme events such as cyclones, and floods. However, these can pose a significant threat to health and safety, increase energy demand for cooling, and destroy crops.

Typically, heat wave conditions can be characterised by temperatures exceeding 35°C. Moreover, with higher humidity extreme heat like conditions can occur at lower temperatures[126].

For the purpose of this assessment, extreme heat hazard under baseline conditions was evaluated based on the two parameters as given below.

- Occurrences of events with daily maximum temperature greater than 35°C.
- Extreme heat hazard category as evaluated by Think Hazard based on the wet bulb globe temperature.

The Wet Bulb Globe Temperature (WBGT) is a measure of the heat stress in direct sunlight, which takes into account: temperature, humidity, wind speed, sun angle and cloud cover (solar radiation). It differs from the heat index, which takes into consideration temperature and humidity and is calculated for shady areas. The WBGT has an obvious relevance for human health, but it is relevant in all kinds of projects and sectors as heat stress affects personnel and stakeholders, and therefore the design of buildings and infrastructure. In general, the WBGT is a relevant enough proxy to quantify the strain on physical infrastructure (energy, water, transport), such as increased demands for water and electricity, which may also affect decisions related to infrastructure[127,128.] Extreme heat was evaluated based on baseline and projected temperature.

- Baseline

Evaluation daily temperature data from NASA Power Viewer, indicated the daily maximum temperature to vary between 13.4-39°C with average maximum temperature of 28.2°C. Average annual temperature is reported to be 22.8°C under the baseline scenario. Moreover, on average the daily maximum temperature is reported to exceed 35°C, 18 times per year.

The extreme heat hazard as evaluated by Think Hazard indicated a Medium hazard in Sanxay District in Attapeu, and Dak Cheung District in Sekong province (***Figure 9.92***) where the Project is located.

Accordingly, the extreme heat hazard under baseline conditions is evaluated to be '**Medium**'.

The heat hazard was also evaluated to assess the impact of extreme heat conditions on wind turbines. The wind turbines are reported to be designed for operational temperature range of -20 to 45°C and -30 to 40°C.

Considering an environmental lapse rate of ~6.5°C/1000 m, the temperature at the turbine (160 m above ground level or abgl) is expected to be ~1.03°C lower than the near surface temperature discussed above. Accordingly, the maximum temperature at the level of turbine likely to vary between 12.4-38°C, with average maximum temperature of 27.2°C under baseline conditions. Whereas, minimum temperature is estimated to vary between 4.2-24.6°C, with average minimum temperature of 9.6°C.

Accordingly, based on the available information the reported baseline maximum and minimum temperature are reported to be within designed operational temperature ranges of the turbine.

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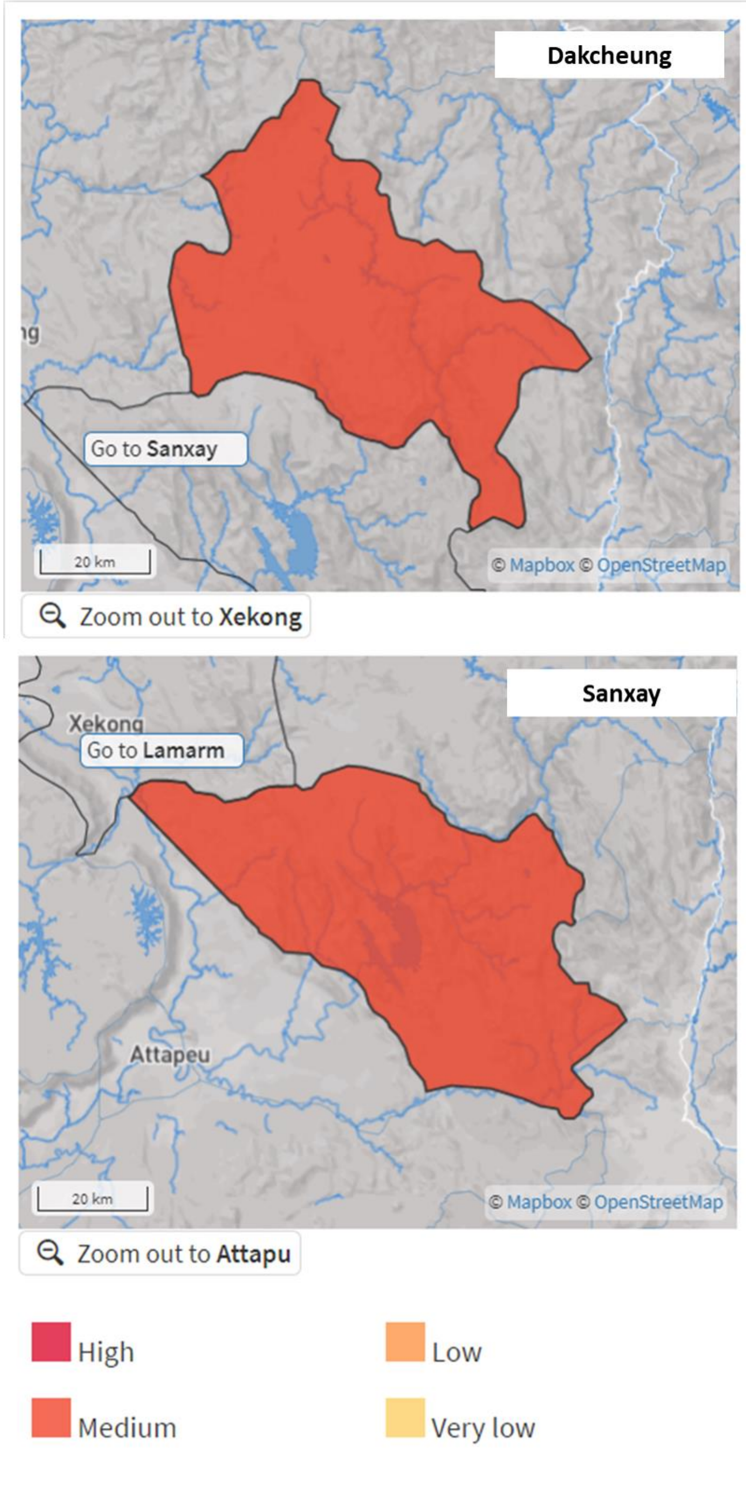
[126] https://thinkhazard.org/en/report/5770-bangladesh-chittagong-chittagong/EH

[127] https://www.weather.gov/tsa/wbgt#:~:text=The%20WetBulb%20Globe%20Temperature%20(WBGT,is%20calculated%20for%20shady%20areas.

[128] https://thinkhazard.org/static/documents/thinkhazard-methodology-report_v2_0.pdf

Figure 9.92: Baseline Extreme Heat Hazard



Source: Think Hazard

- Climate Change

Climate change projections for temperature related parameters of average, average maximum, and warm spell duration indicated an increasing trend under all climate change scenarios as presented in ***Table 9.102.***

Table 9.102: Climate Change Projections for Temperature Parameters

Parameter	Baseline	Change from Baseline			
		RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
Average Temperature (°C)	23.9	0.9	1.5	1.0	1.9
Average Maximum Temperature (°C)	27.6	0.9	1.5	1.1	1.9
WSDI (Warm spell duration index) (days)	12	32	62	35	73

Furthermore, the climate change projections for maximum daily temperature indicated an increase trend as presented in ***Table 9.103***.

Table 9.103: Climate Change Projections for Maximum Temperature

RCP 4.5		RCP 8.5	
2030	2050	2030	2050
0.9°C	1.5°C	1°C	1.9°C

Source: World Bank Climate Change Knowledge Portal

Considering the projected increase in average, average maximum temperature, maximum temperature, and WSDI, the heat hazard is likely to increase in the future under all climate change scenarios. Accordingly, the extreme heat hazard under all climate change scenario is considered to be '**High**'.

Table 9.104: Summary of Extreme Heat Hazard under Baseline and Climate Change Scenarios

Baseline	RCP 4.5		RCP 8.5	
	2030	2050	2030	2050
Medium	High	High	High	High

Similar to the baseline scenario, the heat hazard was also evaluated to assess the impact of extreme heat conditions on wind turbine. Considering the projected change in maximum temperature, the maximum temperature at the level of turbine is likely to vary between 13.3-38.9°C, with average maximum temperature of 28.1°C under baseline conditions. This indicates that the maximum temperature is likely to remain within the design operational temperature range of the turbine. However, due to increase in temperature the overall operation may be impacted.

Cyclone and Wind

As per American Meteorological Society, a cyclone is a large scale air mass that rotates around a strong centre of low atmospheric pressure. Tropical cyclones are formed over oceans due to conducive an coinciding conditions such as warm sea surface temperatures, atmospheric instability, high humidity in the lower and middle levels of troposphere, Coriolis force to develop low pressure centre, and low vertical wind shear. Cyclones bring high wind speeds and heavy downpour with them, which are likely to cause disruption to infrastructure, structures, flooding, and other damage to build and natural environment.

For the purpose of this assessment, cyclone hazard was evaluated based the historical cyclone tracks data from International Best Track Archive for Climate Stewardship (IBTrACS) from NOAA. This database provides the cyclone tracks data since 1980 to present.

- Baseline

Cyclone hazard was evaluated based on the highest storm category recorded within 100 km distance of Site Area as presented in ***Figure 9.93. Table 9.105***presents the number of storms reported under each category.

Table 9.105: Historical Cyclones Recorded within 100km Distance of the Site Location (1981-Present)

Category of Cyclone	Sustained Wind Speed (km/h)	Count
Tropical Storm	<119	
Category 1	119-153	16
Category 2	154-177	5
Category 3	178-208	1
Category 4	209-251	0
Category 5	>251	0
Total		**22**

Accordingly, considering all but one of the historical occurrences of cyclones is below category 3, the hazard rating due to cyclones is considered to be Medium***'***.

Maximum wind speed recorded at nearest location (Attapeu) located ~50 km west of the Site location indicated the variation of maximum wind speed to be between 1.0 - 23 m/s with an average of 2.4 m/s under baseline. Accordingly, the based on maximum wind speed likely to be experienced in the region, the wind hazard is considered to be '**High**'.

Further, the wind hazard was also evaluated to assess the impact of wind speed on the wind turbine. The wind turbines are reported to be designed for operational wind speed range of 2.5-26 m/s. for GW-165-4.0 MW type of turbine, and 2.5-24 m/s for GW-155-4.5 MW type of turbine.

The wind speed at the level of wind turbine is estimated based on the relationship presented in equation below

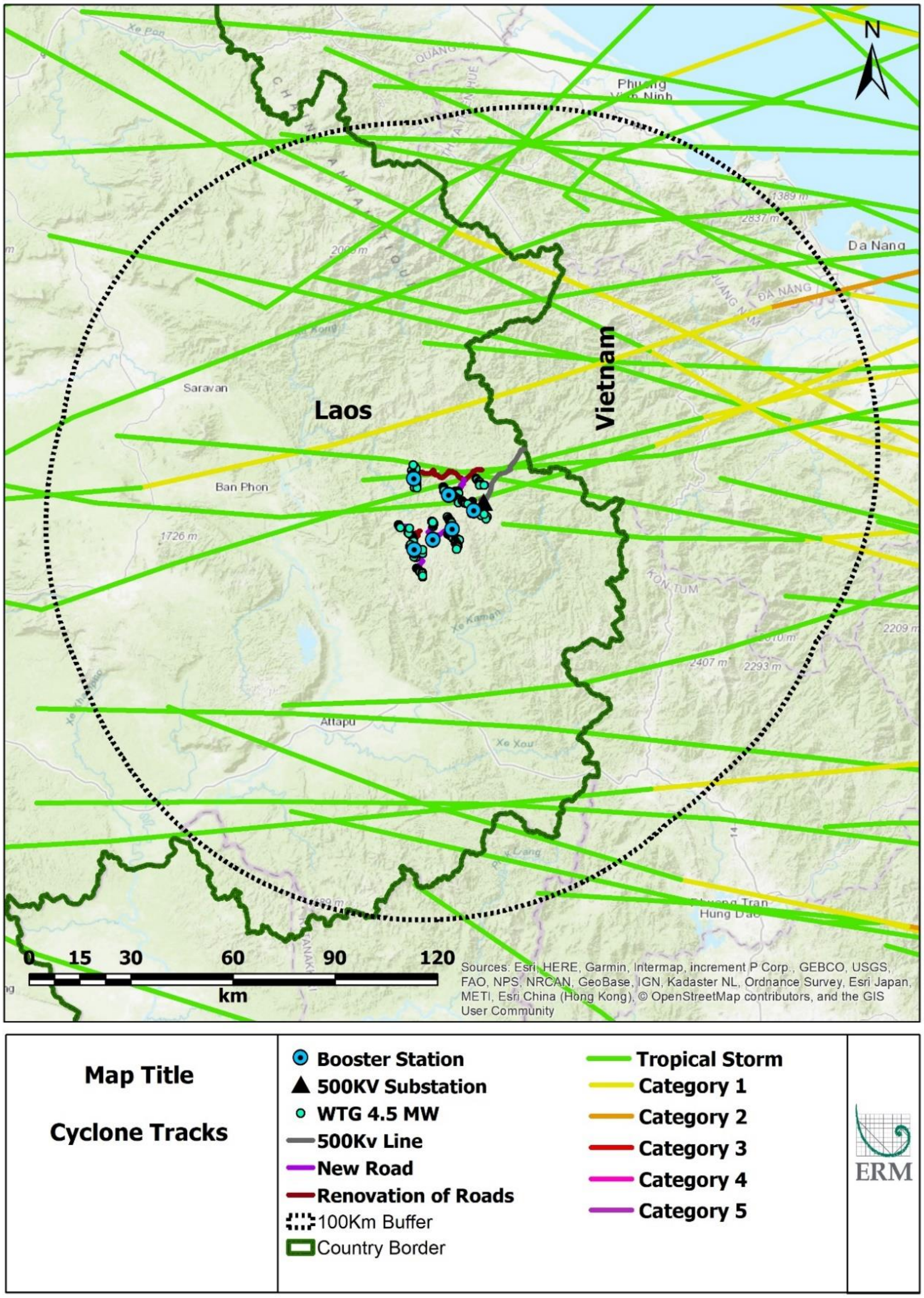
$$\frac{v}{v_o} = \left(\frac{H}{H_0}\right)^{\propto}$$

Where,

$\propto$: coefficient of friction (0.4) for Villages, hamlets and small towns, farming land with many or tall sheltering hedgerows, forest areas and very rough and uneven terrain Landscape

Accordingly, the maximum wind speed at the level of turbine (160 m-abgl) is estimated to be between 3.03-69.7 m/s. This indicates that the power generation may be interrupted during high wind conditions under the baseline scenario.

Figure 9.93: Historical Cyclone Tracks



Source: NOAA-IBTrACS

- Climate Change

Tropical cyclones or Typhoons occur in most of the tropical oceans and present significant threat to coastal communities and infrastructure. Every year, about 90 cyclones or Typhoons are reported to occur globally. Further, this number is reported to remained pretty constant since the period of geo stationary satellites (1970s). However, changes in inter-annual and multi-decadal frequency within individual ocean basin are reported to be substantial.

A literature review indicated that the detection of trends in cyclone or Typhoon occurrences (frequency and intensity) is a challenge due to: i) Changes in observation technology, ii) variations in protocol for identification of cyclones or Typhoons in different ocean basins, and iii) limited availability of homogeneous data (30-40 years).

Global reanalysis of tropical cyclone or Typhoons intensity using homogenous satellite data indicated increasing trend in intensity of cyclones, with a suggestive link between cyclone or Typhoons intensity and climate change. However, these observations based on 30 years period, are reported to be insufficient to conclusively provide the evidence for a long-term trend.

Climate change studies suggested likely increase in peak wind intensity and near storm precipitation in future tropical cyclones, and decrease in overall frequency of cyclones. Spatial resolution of some of the earlier models used in AR4 is generally reported to be too coarse to simulate tropical cyclones. The recent advances in downscaling techniques are reported to indicate some level of success in simulating/ reproducing observed tropical cyclone characteristics. However, it should be noted that there exists limitations and high uncertainty in simulation of tropical storms.

IPCC's special report on 1.5°C scenario[129] noted similar remarks stating that the limited period of 30-40 years of observations is not enough to conclusively distinguish anthropogenic induced changes with decadal changes in overall cyclone frequencies. Further studies conducted for detection of Category 4 and 5 cyclones over recent decades indicated increasing trend. However, these changes in frequency are reported to vary from one ocean basin to another. Studies conducted with higher degree of warming indicated a decreasing trend in total number of tropical cyclones while increase in Category 4-5 cyclones.

The recent study by Knuston et. al. (2020)[130] indicated the following likely changes for occurrences of tropical cyclone over North-West Pacific:

- Overall frequency of tropical cyclone by -30 to 20% with median change of -10%,
- Changes in frequency of category 4-5 cyclone between -30 to 40% with median change of -5%.
- Intensity of cyclone indicated change between 2.5 to 10% with median of 5% increase under 2°C scenario by end of the century

Considering the projected in maximum sustained wind speeds the hazard due to cyclone under all climate change scenarios is considered to remain '***High'***.

Climate change projections for maximum wind speed (non-cyclonic) indicated increase in RCP 4.5 climate change scenarios for 2030 and 2050. Also, it is observed the percent change in sustained wind speed and wind will be increase for all climate change scenarios for Ground level.

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[129] https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap3_FINAL-1.pdf

[130] Tomas Knuston, Suzana J, Camargo, Jhonny C. L. Chan, Kerry Emanuel, Chang-Hoi Ho, James Kossin, Mrutyunjay Mohapatra, Masaki Satoh, Masato Sugi, Kevin Walsh, and Ligiang Wu (2020. Tropical Cyclones and Climate Change Assessment: Part II: Projected Responses to Anthropogenic Warming. J. Bulletin of American Meteorological Society. 101 (3). 303-322. https://journals.ametsoc.org/view/journals/bams/101/3/bams-d-18-0194.1.xml

Table 9.106: Projected Changes in Maximum Wind Speeds under Climate Change Scenarios at Ground Level

Parameter	Absolute Values					Percentage Change (%)			
	Baseline	RCP 4.5		RCP 8.5		RCP 4.5		RCP 8..5	
		2030	2050	2030	2050	2030	2050	2030	2050
Average Maximum Wind Speed (m/s)	7.3	7.2	7.1	7.4	7.5	-1.9	-3.0	1.6	2.2
Maximum sustained wind at 2^0 Change of Temperature (source: *Knuston et al. (2020)*)	ND	ND	ND	ND	ND	3.0	4.4	3.3	5.8

Accordingly, considering the projected increase in cyclonic (sustained) wind speeds the overall hazard due to wind speeds is considered to remain '**High**'.

Table 9.107: Summary for Cyclone and Wind Hazard under Baseline and Climate Change Scenario

Baseline	RCP 4.5		RCP 8.5	
	2030	2050	2030	2050
High	High	High	High	High

Wild Fire

Wildfires are uncontrolled fires in areas of combustible vegetation. Of the various types of wildfires, forest fires are the most detrimental. The natural causes of wildfires are ascertained to be dry (and hot) climate, lightning, and volcanoes. The most common human causes of wildfire are listed as arson or sabotage, discarded cigarettes, power-line arcs, and sparks from equipment. The key parameters determining the occurrence and spread of wildfires are availability of flammable materials, fuel density, moisture content, ambient temperature, and weather conditions (wind speed).

The impacts of wildfires on the built and natural environment can be significant. In addition, controlling a wild forest fire can be extremely difficult task due to scale, intensity, and accessibility issues. Key impacts of wildfires include economic, environmental and ecological, infrastructural, heritage, and human health.

Wildfire risk was assessed based on the wildfire density data from the UNEP- Global Risk Data Platform, which was available at a resolution of ~2 km. ***Figure 9.94*** presents the average number of fires recorded in the Project area over a period of 1997-2010.

Regional level historical wildfire events are presented in ***Table 9.108***.

Table 9.108: Regional Level Historical Wildfire Events

Province	No of Events	Affected	Deaths	Houses Destroyed	Houses Damaged	Losses in Kip
01 Vientiane Mun.	126	347,549	12	145	13,203	2,303,468,583,001
02 Phongsaly	44	55,846	1	30	108	542,809,351,700
03 Luangnamtha	40	60,725	0	1,369	13	17,394,266,400
04 Oudomxay	89	82,007	2	119	656	86,227,761,020
05Bokeo	44	42,651	0	11	106	40,382,531,930
06 Luang Prabang	95	23,327	11	38	112	11,625,514,400
07 Huaphanh	57	350,944	6	28	4,581	4,549,943,990
08 Xayabury	120	35,656	33	1,776	1,286	140,864,951,548
09 Xiengkhuang	45	3,538	6	94	1	7,990,152,000
10 Vientiane	50	75,948	4	92	4,256	2,622,337,860
11 Borikhamxay	76	332,410	5	10,688	796	51,132,082,097
12 Khammuane	126	1,089,765	5	0	1,906	56,241,239,624
13 Savannakhet	67	366,842	4	39	24,165	3,624,720,000
14 Saravane	47	190,917	2	176	78	1,148,560,844
15 Sekong	26	27,224	18	766	4,049	637,776,280,981
16 Champasack	120	338,351	4	16	385	202,024,213,560
17 Attapeu	33	73,146	0	69	222	1,233,024,000
Total	1,205	3,496,846	115	15,456	55,923	4,111,115,514,955

- Baseline

One of the factors impacting the occurrences of wildfires is the availability of fuel. In simple words anything that can burn such as trees, grass, and shrubs can be considered as fuel. As these combustible material accumulate, the probability of occurrence of wildfire also increase. In the right conditions this fuel allows fire to burn hotter and spread on larger area, making it difficult to manage, resulting in catastrophic damages[131].

Lao PDR in general is reported to have ~56.2% of the area under the forest cover, followed by grass and shrub land covering ~23.9% and cropland 18.5%. Regional land cover distribution for Kindia, Mamou, Faranah, and Kankan is presented in ***Table 9.109***.

131 https://www.doi.gov/wildlandfire/fuels

Table 9.109: Regional Land Cover Distribution in Lao

Region	Forest	Cropland	Grass/ Shrub-land
Attapeu	73.9%	17.5%	8.1%
Sekong	80.1%	9.6%	10.%

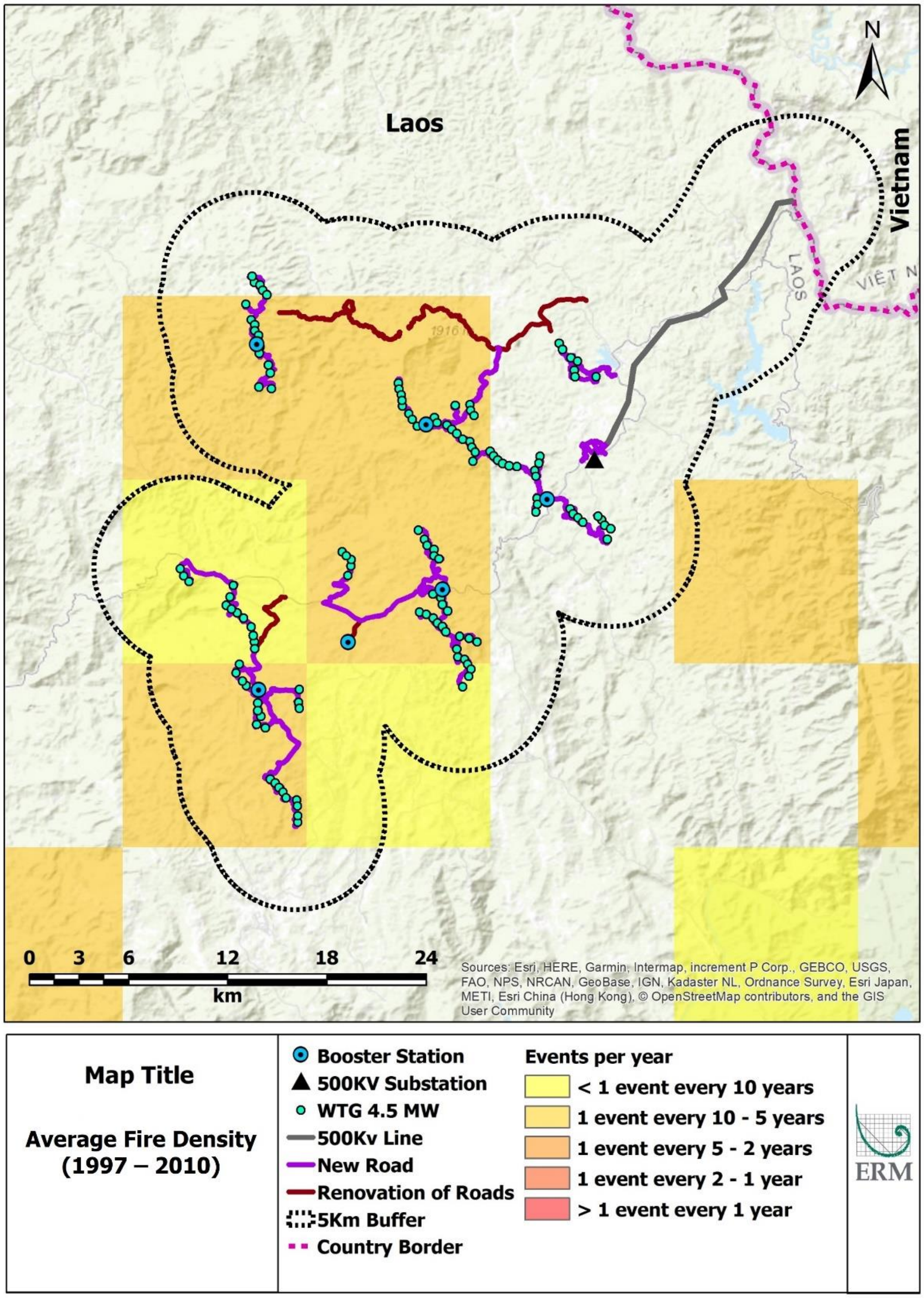
This indicates that, provided the availability of right weather conditions, the project location may be vulnerable to forest fires (wildfires).

The baseline wildfire hazard was evaluated based on frequency of occurrence, as presented in ***Figure 9.94***. Baseline wildfire hazard was reported to vary ‘Low’ to ‘Medium’ at the Project site.

Considering, the fact that a forest fire can be triggered due to multiple reasons including natural (e.g. lightning strikes) or anthropogenic (accidental or intentional burning). Frequency of fire incidences only, may not be a good indicator for climate related physical risk assessment.

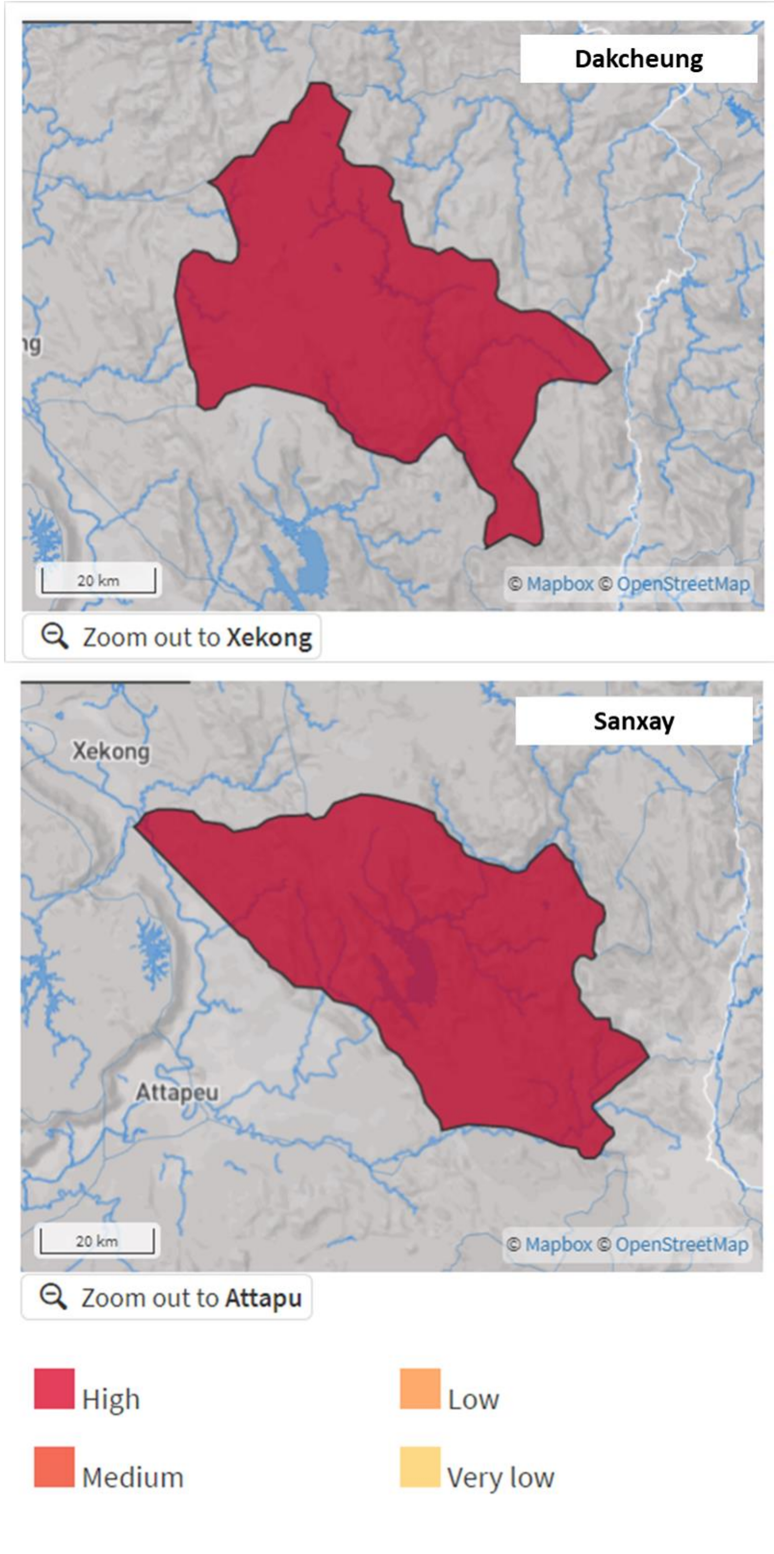
Therefore, for the purpose of this assessment, the wildfire hazard is evaluated based on the frequency of occurrence of weather which can support the significant wildfire as reported by ThinkHazard (***Figure 9.95***). Accordingly, based on prevailing weather supporting the occurrences of wildfire, the wildfire hazard is consider to be ‘**High**’.

Figure 9.94: Wild Fire Frequency



Source: UNEP- GRID

Figure 9.95: Baseline Wild Fire Hazard



Source: Think Hazard

- Climate Change

The climate change projections indicate increased maximum temperature and longer warm spells as presented in ***Table 9.110***. Therefore, the wildfire hazard is considered to remain '**High**' under all climate change scenarios

Table 9.110: Climate Change Projections for Temperature Parameters

Parameter	Baseline	Change from Baseline			
		RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
Average Temperature (°C)	3.9	0.9	1.5	1.0	1.9
Average Maximum Temperature (°C)	27.6	0.9	1.5	1.1	1.9
WSDI (days)	12	32	62	35	73

Table 9.111: Summary of Wildfire Hazard under Baseline and Climate Change Scenario

Baseline	RCP 4.5		RCP 8.5	
	2030	2050	2030	2050
High	High	High	High	High

Lightning and Thunderstorms

Thunderstorms are usually created by heating of the ground surface resulting in upward atmospheric motion that transport moisture along with air. Thunderstorms may lead to high wind conditions with gust speed exceeding 25 m/s, lightning strikes, extreme rainfall and flash floods, and hail showers[132].

As per National Severe Storm Laboratory (NSSL), lightning is a giant spark of electricity in the atmosphere between clouds, the air, or the ground. The process triggers instant release of energy of the order of 1 Gigajoule. Lightning can be caused in three (3) mechanisms; viz within the same thunder cloud, between two (2) thunderclouds or between a thundercloud and ground.

Lighting can cause damage to natural and built environment. Objects struck by lightning experience heat and magnetic forces of great magnitude. It can affect trees, by vaporizing the sap resulting in bursting of bark, damage to tall buildings and structures and several injuries or loss of life.

For the purpose of present assessment, thunderstorms and lightning were evaluated based on the lightning flash data from NASA.

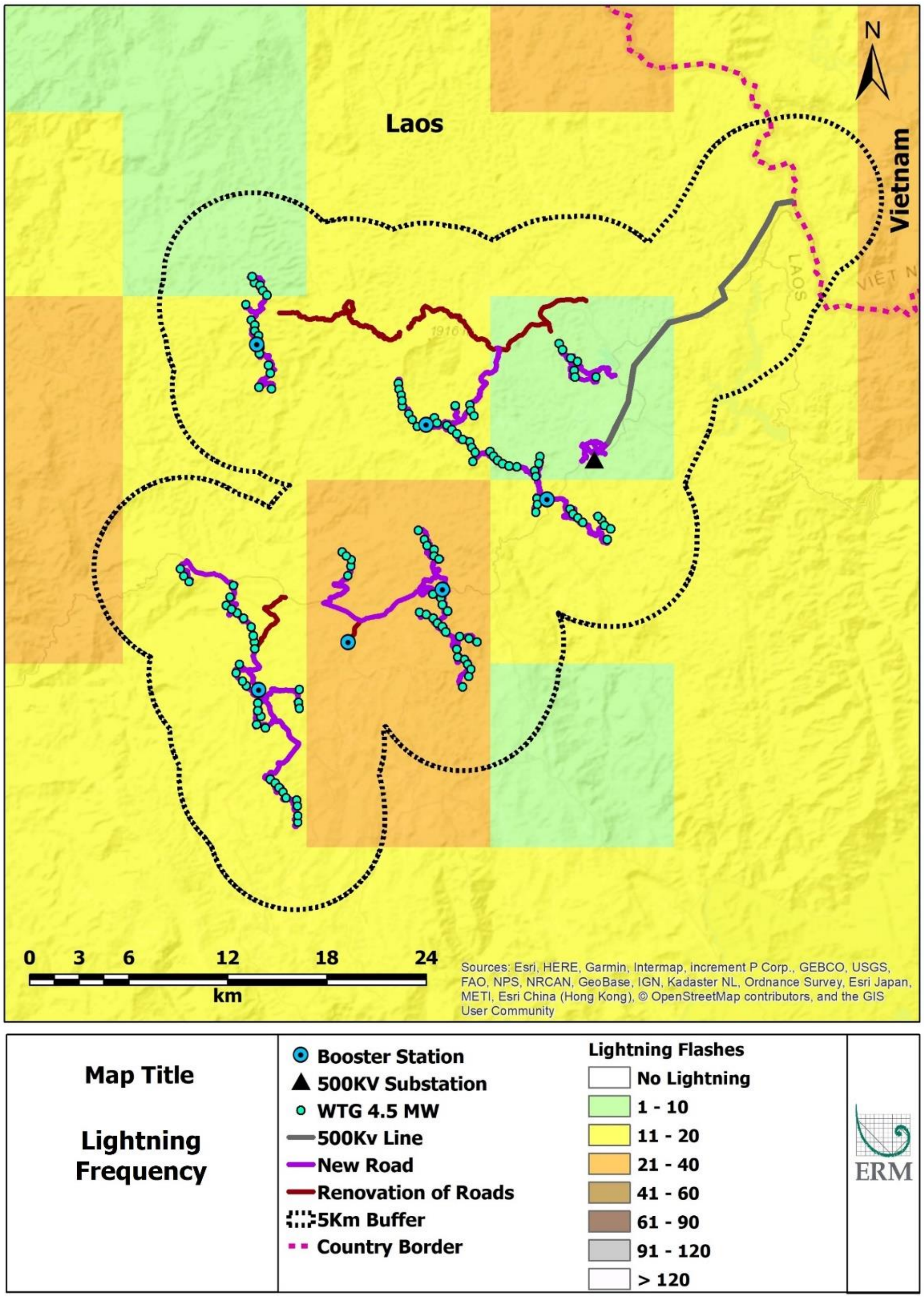
- Baseline

A lightning map based on NASA lightning flash data as presented in ***Figure 9.96*** indicates average lightning frequency to vary between less than 10 to up to 60 flashes/km^2/year in the Study Area.

[132] https://www.nssl.noaa.gov/education/svrwx101/thunderstorms/

In the absence of standards to categorize the thunderstorm/ lightning hazard, hazard categorization has not been conducted. However, these hazards are evaluated to present the historical events and provide an understanding on different types of hazards likely to be experienced at the study areas.

Figure 9.96: Lightning Frequency



Sorce: NASA-GHRC

- Climate Change

There are no direct projections available for lightning. However, as lightning usually occurs during thunderstorms, any changes in occurrences of thunderstorm are considered as measure for changes in lightning in future.

A literature review indicates that predicting changes in thunderstorm is difficult task, and hence generally changes in frequency of large scale environmental conditions conducive to thunderstorms are used as an indirect measure. One such factor is convective available potential energy (CAPE), which is a measure of maximum kinetic energy obtainable by an air parcel lifted adiabatically from near surface. CAPE is also reported to be important large scale indicator for the potential lightning.

The literature review also indicates tropical and subtropical CAPE extremes increasing sharply with warming across ensembles of global climate models participating in Coupled Model Intercomparison Project 5 (CMIP5). Projections for CAPE available from literature indicated an increase of 250-500J/kg in CAPE by end of century under RCP 8.5 scenario. Such increase in CAPE in future is likely to increase the frequency of days with conditions conducive to the formation of thunder storms by ~25 days/ year.

Hence, increase in thunderstorm and lightning activity can be expected in future under climate change scenarios. In addition, the development of windfarms may further exacerbate the lightning strikes in the area.

9.6.2.3 Existing Controls

Water Availability

- Whenever the project is required to pump water from the stream in the Project area for construction, a water use plan will be required and notified to the local people. This should be coordinated with the State agency of the district and provincial levels.
- Provide clean water for use for consumption to construction workers.

Riverine Floods

- When a rainstorm warning is received, consider suspending operations and transfer personnel to safe location.
- Review meteorological information regularly, and take precautions against possible floods, landslides, mudslides, and other disasters.
- Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms.

Landslides

- Review meteorological information regularly, and take precautions against possible floods, landslides, mudslides, and other disasters.
- Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms.
- Avoid undertaking earthwork during heavy rainfall that can cause erosion; perform backfilling and compacting work after completing the construction; replantation in suitable areas where possible.
- Extreme Heat
- Ensure designed operation temperature range ~30-40°C

Cyclone and Wind Speed

- Ensure designed operational wind turbines at wind speed ranges between ~24 to 26 m/s.
- Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms.
- Design to consider wind turbine's impeller lock process for wind speeds.

Wild Fire

- Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms.

Lightning and Thunderstorms

- Ensure lightning protection grounding of the wind turbine. A metal air termination system is installed at the blade tip. A copper conductor is used to reliability connect the air termination system to the lightening lead on hub.
- Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms.
- Ensure design according to IEC-61400-24 to achieve Grade I lightning protection to wind turbine the cross-sectional area of blade lighting protection copper conductor should not be less than $50mm^2$.

9.6.2.4 Significance of Risks

Water Availability

- There is no significant risk due to reduced or non-availability of water is expected. However, it may impact the water requirement of domestic usage including drinking and sanitation by the employees and workers at the Site.
- Water availability may impact the water required by the nearby communities for their domestic and agricultural purposes.

Riverine Floods

- No significant risk due to riverine floods is expected.

Landslides

- Landslides may damage physical infrastructure including wind turbines, transmission towers, and substations. This may also result in disruption of operations at the Site.
- Landslides can also pose a significant threat to health and safety of the employees and workers working at the Site.
- Disruption of access routes to and from the Site.

Extreme Heat

- Extreme temperature may result in reduced wind power generation,
- Wind power generation is reported to decline with increase in temperature. Therefore, occurrences of extreme temperature may result in reduced power generation efficiency of the turbines.
- Extreme temperature may also result in damage to electronic components.
- Higher temperatures can also reduce the efficiency of the power transmission

- Extreme temperature may also impact the H&S of the employees due to risk of heat stress. Higher temperature will also result in increased demand for water.

Cyclone and Wind

- Damage to physical assets including wind turbines, transmission towers, and transmission lines due to high wind speeds.
- Suspension of power generation if the wind speeds exceed maximum (cut-off) wind speeds resulting in loss of power generation.
- Threat to the safety of employees, workers working in the open, or at heights (construction or maintenance of wind turbines and transmission lines).

Wild Fire

- Wild fire can result in damage to the physical assets
- It can also pose a significant risk to safety of employees and workers due to fire as well as smoke.

Lightning

- Damage to electrical components due to lightning strike
- Grid failure due to lightning strike
- Damage to electrical components due to lightning strike
- Cost for replacement of assets
- People working in the open during thunder storm may be considered as most vulnerable
- Lightning strikes on human being may result in death or serious injuries

9.6.2.5 Additional Mitigation, Management, and Monitoring Measures

Water Availability

- The water availability related issues should be monitored and tracked closely.
- Implement water saving technologies for domestic water usage within project.

Riverine Floods

- Site to implement identified control/ response measure.
- Monitor flood situation at the Site. If any significant floods events affecting the physical infrastructure, operations, and health and safety are observed in future, detailed studies may be considered for flood mitigation measures.

Landslides

- Undertake detailed geotechnical studies to identify areas prone to landslides
- Based on the geotechnical studies identify and implement appropriate design considerations and control measures
- Regular geotechnical field inspection to check for any signs of risks of landslides
- Prepare emergency response plan for landslide events

Extreme Heat

- Worker's resting areas, on-site offices, worker's quarters should be constructed with heat resisting material to keep the indoor temperature lower.
- A heat stress management plan should be prepared as part of standard operations and safety procedures.
- Train workers to identify the symptoms of heat stress and first aid.
- Make appropriate considerations while designing the cooling systems (if required).

Cyclone and Wind

- Include cyclone and wind as one of the hazard in emergency management plan

Wild Fire

- Include wildfire as one of the hazard in emergency management plan
- Develop and maintain fire lines around the important assets
- Issue the rules to prevent staff and workers from burning waste and other burning activities within the Project area which may lead to wild fire.

Lightning

- Include lightning as one of the hazard in emergency management plan

9.6.2.6 Residual Impact Significance

Table 9.112 presents the summary of hazards under various climate change scenarios and implications of the hazard on various project components.

Table 9.112: Hazard Receptor Matrix

Hazard	Hazard Category (Acute or Chronic)	Hazard Level				Summary of Applicable Planned/ Existing Control Measures							Recommendations
		RCP 4.5		RCP 8.5									
		2030	2050	2030	2050		Wind Turbine (WTG)	Transmission line and Towers	Sub stations	Other Buildings	Employees	Communities	
Water Availability	Chronic	Low	Low	Low	Low	■ Prepare water use plan and inform the local people and coordinate with the State agency of district and provincial levels for inspecting whether the water pumping point is appropriate or not[133]. ■ Provide clean water for use for consumption to construction workers[133].	■ No Implications	■ No Implications	■ No Implications	■ No Implications	■ Reduced availability for domestic usage including sanitation and drinking	■ Reduced availability for domestic and agricultural use	■ The water availability related issues should be monitored and tracked closely ■ Implement water saving technologies for domestic water usage within project.
Riverine Floods	Acute	None	None	None	None	■ Consider cutting off outdoor power supply and suspending operations. Ensure personnel transferred to the safe place[133] ■ Review regularly meteorological information, and take precautions against possible floods, landslides, mudslides, and other disasters[134]. ■	■ No Implications	■ No Implications	■ No Implications	■ No Implications	■ No Implications	■ No Implications	■ Implement identified control measures
Landslides	Acute	High	High	High	High	• Keep an eye on meteorological	■ Physical damage to	■ Physical damage to	■ Physical damage to	■ Physical damage to	■ Health and Safety	■ Physical damage to	■ Implement identified

[133] Environmental Consultancy Company (2020). 600 MW Monsoon Wind Farm Project Dakcheung District, Sekong Province and Sanxay District, Attapeu Province Environmental and social Impact assessment Report.
[134] Goldwind International for rainstorm and flood emergency disposal plan

Hazard	Hazard Category (Acute or Chronic)	Hazard Level				Summary of Applicable Planned/ Existing Control Measures							Recommendations
		RCP 4.5		RCP 8.5									
		2030	2050	2030	2050		Wind Turbine (WTG)	Transmission line and Towers	Sub stations	Other Buildings	Employees	Communities	
						information, and take precautions against possible floods, landslides, mudslides and other disasters[133]. • Avoid undertaking earthwork during heavy rainfall that will easily cause erosion; perform backfilling and compacting work after completing the construction; plant the grass on suitable places or leave the places for the plants to grow and become green[133];	assets/ foundations	assets/ foundations ■ Disruption of supply chains	assets/ foundations	assets/ foundations	■ Disruption of access routes	infrastructure and buildings ■ Health and safety	control measure ■ Prepare emergency response plan for landslide events
Extreme Heat	Acute	High	High	High	High	■ Designed operation temperature range ~30-40°C[135]	■ Reduced Efficiency ■ Damage to electronic monitoring/ controlling component ■ Loss of production ■ Costs for replacement of damaged assets	■ Reduced transmission efficiency	■ Overheating of components resulting in damage or reduced efficiency	• Increase in cooling demand	■ Reduced comfort levels ■ Threat of heat stress/ heat stroke • Increased water demand	■ Reduced comfort levels ■ Threat of heat stress/ heat stroke • Increased water demand	• Worker's resting areas, on-site offices, worker's quarters should be constructed with heat resisting material to keep the indoor temperature lower. • A heat stress management plan should be prepared as part of standard operations and safety procedures.

[135] Information of the proposed WTG, Technical Document, 600MW Monsoon On-Shore Wind Farm Project.

Hazard	Hazard Category (Acute or Chronic)	Hazard Level				Summary of Applicable Planned/ Existing Control Measures							Recommendations
		RCP 4.5		RCP 8.5									
		2030	2050	2030	2050		Wind Turbine (WTG)	Transmission line and Towers	Sub stations	Other Buildings	Employees	Communities	
													• Train workers to identify the symptoms of heat stress and first aid. • Make appropriate considerations while designing the cooling systems (if required).
Cyclone and Wind Speed	Acute	High	High	High	High	• Operate wind turbines at wind speed ranges between ~24 to 26 m/s[135]. • Projects in combination with the practical situation of the site of the project and the project office, cyclone early warning information, based on the local meteorological department to detailed ferreting cyclone hazards, to identify the hazards and take appropriate measures, plan, supervision and control[136]. • Check the wind turbine's impeller lock situation on site[136]. • During the cyclone, people stay in permanent residence	■ Damage due to high wind speed ■ Suspension of power generation if the upper limit for wind speed exceeds ■ Lost production • Cost for replacement of assets	■ Damage, uprooting of transmission towers ■ Short-circuiting in transmission lines • Cost for replacement of assets	■ Structural damage due to heavy rainfall • Cost for replacement of assets	■ Damage/ collapse of non-permanent structures • Cost for replacement of assets	■ High wind speed can lead to threat towards safety of workers working at heights for installation or maintenance of wind turbines, transmission line during high wind conditions. The threat can be in the form of fall or injury to the eyes from the debris (sand/ dust) carried by the winds.	• Health and Safety	■ Implement identified control measure • Include cyclone and wind as one of the hazard in emergency management plan

136 Goldwind International typhoon emergency plan

Hazard	Hazard Category (Acute or Chronic)	Hazard Level				Summary of Applicable Planned/ Existing Control Measures							Recommendations
		RCP 4.5		RCP 8.5									
		2030	2050	2030	2050		Wind Turbine (WTG)	Transmission line and Towers	Sub stations	Other Buildings	Employees	Communities	
						and are prohibited from staying in temporary rooms[136] • Before the cyclone comes, should pay attention to the safety of the electric field. Important equipment such as computer and air conditioning must be off[133]							
Wildfire	Acute	High	High	High	High	• No Existing Plans Available	■ Physical damage to assets	■ Physical damage to assets	■ Physical damage to assets	■ Physical damage to assets	■ Health and Safety ■ Disruption of access routes	Physical damage to infrastructure and buildings Health and safety	■ Include wildfire as one of the hazard in emergency management plan ■ Develop and maintain fire lines around the important assets ■ Develop and maintain vegetation clearances with respect to prevailing standards and regulations
Lightning	Acute					• Check the lightning protection grounding of the wind turbine[137]. • A metal air termination system is installed at blade tip. A copper conductor is used to reliability	■ Damage to electrical components due to lightning strike ■ Lost production	■ Grid failure ■ Cost for replacement of assets	■ Damage to electrical components due to lightning strike ■ Cost for replacement of assets	■ Damage to electrical components due to lightning strike ■ Cost for replacement of damaged good	■ People working in the open during thunder storm may be considered as most vulnerable ■ Lightning strikes on human being may result in	■ People working in the open during thunder storm may be considered as most vulnerable ■ Lightning strikes on human being may result in	■ Implement identified control measures ■ Include lightning as one of the hazard in emergency

[137] WTG Specifications, 600MW On-Shore Wind Farm Project, Tendering Document

Hazard	Hazard Category (Acute or Chronic)	Hazard Level				Summary of Applicable Planned/ Existing Control Measures							Recommendations
		RCP 4.5		RCP 8.5									
		2030	2050	2030	2050		Wind Turbine (WTG)	Transmission line and Towers	Sub stations	Other Buildings	Employees	Communities	
						connect the air termination system to the lightening lead on hub. • According to IEC-61400-24 to achieve Grade I lighting protection to wind turbine the cross-sectional area of blade lighting protection copper conductor should not be less than 50mm^2 ■ If any worker wants to go out, do not carry umbrellas. At the same time, the lightning protection measures.	■ Cost for replacement of assets				death or serious injuries	death or serious injuries	management plan

EP-4 requires to identify potential impacts of project development on exacerbation of climate related risks as presented in ***Table 9.113***.

Table 9.113: Impact of Project on Exacerbation of Climate Related Physical Risks

Hazard	Hazard Category (Acute or Chronic)	Implications
Landslides	Acute and Chronic	■ Change in land use pattern and excavations may further exacerbate the landslide hazard
Lightning	Acute	■ The wind turbine tower may exacerbate the lightning strikes
Wildfire	Acute	■ Any short-circuiting between over-head power lines during high wind conditions (particularly during dry periods) may trigger wildfire.

9.7 Unplanned Events

This chapter presents the probable impacts of unplanned events associated with construction and operation 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 due to fire and explosion 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.

9.7.1 Scope of Impact Assessment of Unplanned Events

This assessment addresses the following unplanned events:

- Blade throw;
- Fire and explosion including Unexploded ordnance (UXO);
- Spillage of fuel, oil, and hazardous materials;
- Traffic accidents;
- Natural unplanned events such as landslides and floods; and
- Transmission line snapping, and transmission tower/pylon collapse;

9.7.2 Impact Assessment Methodology

To evaluate potential impacts from unplanned events, a risk-based approach is used to define:

- the most likely unplanned events leading to environmental, social and/or community health impacts; and
- 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.

9.7.2.1 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 in ***Table 9.115.***

Table 9.114: Indicative Levels of Consequence for Potential Impacts from Unplanned Events

	Incidental (A)	Minor (B)	Moderate (C)	Major (D)	Severe (E)
Physical Environment	Impacts such as localised or short term effects or environmental media, meeting all environmental standards	Impacts such as widespread, short-term impacts to environmental media, meeting all environmental standards	Impacts such as widespread, long-term effects on environmental media, meeting all environmental standards	Impacts such as significant, widespread and persistent changes in environmental media OR Exceedance of environmental standards	Exceedance of environmental standards and fine/ prosecution
Biological Environment	Impacts such as localised or short term effects on habitat or species	Impacts such as localised, long term degradation of sensitive habitat or widespread,	Impacts such as localised but irreversible habitat loss or widespread, long-	Impacts such as significant, widespread and persistent	Impacts such as persistent reduction in ecosystem function on a

	Incidental (A)	Minor (B)	Moderate (C)	Major (D)	Severe (E)
		short-term impacts to habitat or species	term effects on habitat or species	changes in habitat or species	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 lost-work injuries.	Adverse long-term, multiple impacts at a community level, but restoration possible. OR One or more lost-work 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.

9.7.2.2 Assessing 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.

9.7.2.3 Assessing 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 9.115***.

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 9.115: Risk Matrix for Potential Unplanned Events

		Likelihood of Occurrence				
		Incidental (1)	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Severe (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

9.7.3 Assessment of Potential Impacts

Based on the Project activities, the potential unplanned events that were considered to have the highest potential environmental and social risks during all phases of the Project were shown in ***Table 9.116.*** Noted that for the commissioning and operational phases, only indicative project activities were listed. A more comprehensive evaluation of potential impacts would be conducted once sufficient detailed design information is available.

Table 9.116: Unplanned Events Leading to Potential Impacts

Project Phase	Activity	Potential Receptors Affected
Site Preparation and Construction	Small scale leakage and spill incidents from site-preparation / construction activities	Users of surface water and groundwater in nearby communities
	Traffic collisions	Users of the public roadways utilised by the Project.
	Fire and explosion	Nearby communities
	Presence of Explosion of Unexploded Ordnances (UXOs)	Nearby communities
	Natural Hazards - Flooding and Landslides	Nearby communities Forest, habitats, flora, and fauna in the vicinity of the site.
Commissioning and Operation	Small scale leakage and spill incidents from activities on site	Users of groundwater in nearby communities
	Traffic collisions	Users of the public roadways utilised by the Project
	Fire and explosion	Nearby communities Forest, habitats, flora, and fauna in the vicinity of the site.
	Presence of Explosion of Unexploded Ordnances (UXOs)	Nearby communities
	Blade ejection failure	Nearby communities
	Transmission line snapping, and transmission tower/pylon collapse	Nearby communities
	Natural Hazards - Flooding and Landslides	Nearby communities Forest, habitats, flora, and fauna in the vicinity of the site.

Potential impacts from these events are described in detail in the following sections. These potential impacts had been classified using the risk-based impact assessment methodology for unplanned events ***Section 9.7.2***. 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 hazards, contributing causes, and consequences for the Project workforce, nearby communities and/or surrounding environment were summarised in ***Table 9.117***.

In order to reduce Project risk from the key potential unplanned events, the standard mitigation hierarchy should be applied. For the purposes of this assessment mitigation measures were discussed in the following sections where the pre-mitigation significance of the unplanned event is greater than Minor.

Unlike impacts from planned activities, mitigation of unplanned events should consider both pre-event preventative actions (that reduce the likelihood of the cause of the potential impact) and post-event mitigation that reduces the magnitude of the consequence.

Table 9.117: Potential Impacts from Unplanned Events and Pre-mitigation Risk Ranking

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
Site Preparation / Construction				
1.	Small scale leakage and spill incidents from site preparation/ Construction activities	Corrosion, dropped objects, or other damages to storage oil tanks/mobile gas stations; failure to secure valves; failure to maintain large mobile construction plant.	Workers and Communities – No available onsite fuel storage so likelihood of spillage of oil, lubricant to ground water and soil contamination is Low. The effects on surrounding communities utilizing groundwater resources is Low.	3B (Minor)
			Environment – No available onsite fuel storage so likelihood of spillage of oil, lubricant to ground water and soil contamination is Low.	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	Workers and Communities – Traffic accidents that involved community members, resulting in injury or fatality. Accidents might require use of local medical emergency services in the Project area and could temporarily decrease access to these services for local residents.	4E (Major)
		As above with livestock in the road	Workers and Communities – Traffic accident with livestock leading to death of livestock and loss/reduction in community member's livelihood.	4C (Moderate)
3.	Fire and explosion	Leakage and spill incidents of flammable materials, malfunctioning equipment and failure to operate large mobile construction vehicle Presence of UXO could lead to injuries and fatalities	Workers and Communities – Based on the liquid fuel storage volumes the potential exists for exposure to ignited due to malfunctioned equipment and resulting in potentially severe injuries to employees and spread to nearby communities' members.	3D (Major)
			Environment: – Based on the liquid fuel storage volumes potential for ignition of leakage or spill of oil/chemicals due to human errors and malfunctioned short-circuit equipment, accidents might lead to uncontrollable wildfire, loss of crops and habitat, causing injury and life-threatening of local community.	3D (Major)

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
4.	Presence of Explosion of Unexploded Ordnances (UXOs)	Risk of Explosion of Unexploded Ordnances (UXOs) could lead to injuries and fatalities	Workers and Communities – Based on risk of explosion of Unexploded Ordnances (UXOs) due to left behind from the war resulting in potentially severe injuries to employees and spread to nearby communities' members.	3D (Major)
			Environment: – Based on risk of explosion of Unexploded Ordnances (UXOs) due to left behind from the war might lead to uncontrollable explosion, loss of crops and habitat, causing injury and life-threatening of local community.	3D (Major)
4	Natural Hazards Flooding & Landslide	Heavy rainfall that exceeds the capacity of the natural drainage system may cause flash flood event. Clearing vegetation for site preparation increases the rate of run-off and flood risks to downstream area. Landslide occurs in combination of many causes such as intense rainstorm, steep slopes (over 20$_0$) and vegetation removing that weakens soil bearing capacity.	Workers and Communities: Flood and Landslide can result in loss of human life, damage to property, destruction of crops, and loss of livestock that affects to livelihood. Flood and landslide may affects to substation and power components that lead to loss of electricity supply locally. Environment: A large-scale flood and landslide could result in damage/death of local flora and fauna.	4D (Major)

Commissioning and Operation

5.	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.	Workers and Communities – There would be use of oil, fuel across the site during commissioning and operation phase of the Project for operation & maintenance (O&M) services. As a result, there was a risk that small volumes of oil and fuel could be spilled on-site.	3C (Moderate)
			Environment - There would be use of oil, fuel across the site during commissioning and operation phase of the Project for operation & maintenance (O&M) services. As a result, there was a risk that small volumes of oil and fuel could be spilled on-site that leads to soil contamination and water quality degradation.	3C (Moderate)
6.	Fire and explosion	Leakage and spill incidents of flammable materials, malfunctioning equipment, short-circuit power, Damage of transmission lines or Lightning strike.	Workers and Communities – A large-scale fire could result in injuries to people in the surrounding communities, or in the worst-case fatalities. Explosions of	2E (Major)

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
			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.	
			Environment: – A large-scale fire could result in damage/death of local flora and fauna. Accidents might lead to uncontrollable wildfire, loss of crops and habitat given the environment settings at the Project area.	3C (Moderate)
	Presence of Explosion of Unexploded Ordnances (UXOs)	Risk of Explosion of Unexploded Ordnances (UXOs) could lead to injuries and fatalities	Workers and Communities – Based on risk of explosion of Unexploded Ordnances (UXOs) due to left behind from the war resulting in potentially severe injuries to employees and spread to nearby communities' members.	2E (Major)
			Environment: – Based on risk of explosion of Unexploded Ordnances (UXOs) due to left behind from the war might lead to uncontrollable explosion, loss of crops and habitat, causing injury and life-threatening of local community.	3C (Moderate)

No.	Unplanned Event	Cause	Consequence	Risk Ranking Pre-mitigation
7.	Blade ejection failure	Root connection; catastrophic structural buckling or separation; leading edge, trailing edge, or other bond separation; lightening damage; erosion; failure at outboard aerodynamic device; reduction in stiffness of blades (up to 10%); superficial structural or delamination/laminate wrinkling that eventually become permanent damage; and over speeding due to failure of SCADA to rectify the failure or high wind/cyclonic/meteorological conditions[138]	Workers and Communities – Blade ejection failure could result in rapid spread of fire and projectile spread of debris given the heights of wind turbines. This could result in injuries to surrounding communities, or in the worst-case fatalities. Given the residential area living far from Project boundary and out of the setback-distance of blade throw risks, the likelihood and severity of surrounding communities is Moderate. DMS will be conducted in May to confirm that there are no structures within the 300m setback area (safety buffer zone). The nearest sensitive receptor Dak Tiem Primary & Lower Secondary School located approximately 560 m from turbine (WA102) and Dak Tiem Village located approximately 570 m from turbine (WA102)	3C (Moderate)
			Environment – As above with local flora and fauna.	3C (Moderate)
8.	Accidental transmission line snapping and tower swaying/collapsing	Wind/cyclonic/meteorological conditions, catastrophic structural separation, corrosion	Workers and Communities –. Electrocutions that involved community members, resulting in injury or fatality, livestock leading to death of livestock and loss/reduction in community member's livelihood	3D (Major)
9.	Natural Hazards Flooding & Landslide	Heavy rainfall that exceeds the capacity of the natural drainage system may cause flash flood event. Clearing vegetation for site preparation increases the rate of run-off and flood risks to downstream area. Landslide occurs in combination of many causes such as intense rainstorm, steep slopes (over 20_0) and vegetation removing that weakens soil bearing capacity.	Workers and Communities: Flood and Landslide can result in loss of human life, damage to property, destruction of crops, and loss of livestock that affects to livelihood. Flood and landslide may affects to substation and power components that lead to loss of electricity supply locally. Environment: A large-scale flood and landslide could result in damage/death of local flora and fauna.	4D (Major)

[138] 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

9.7.3.1 During Site Preparation and Construction

Leakage and Spill Incidents

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.

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental onshore spills are summarised in ***Table 9.118***.

Table 9.118: Preventative and Mitigation Measures of Leakage and Spills Incidents

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 provide regular information on safety drills and guidance to residents in the event of an unplanned event	MWPCL	Before site preparation
Prevent	Ensure good inspection and maintenance procedures for large mobile construction plant to minimize small leaks and spills.	EPC Contractor	During site preparation and construction

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Mitigate	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; and ■ Training: employees and contractors will be trained in emergency response procedures. ■ Auditing: audit records will be maintained on how the Plan is being implemented.	MWPCL	Planning stage (construction and operations)
Mitigate	Implement Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation.	EPC Contractor/MWPCL	During construction, commissioning and operations

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 severe. In these cases, the mitigation measured described in the previous section would apply to minimize impacts.

		Impact Significance
Without Mitigation Measures	Workers and Communities	3B Minor
	Environment	3B Minor
With Mitigation Measures	Workers and Communities	2B Minor
	Environment	2B Minor

Monitoring and Auditing

- Monthly monitoring the implementation of all proposed mitigation measures specified in Emergency Preparedness and Response Plan should be conducted properly;
- Daily inspection of any secondary containment of oil/chemical on site and ensure good maintenance procedures to minimize small leaks and spills.

Traffic Accidents

Background

Receptors for increased road safety risks during Project site preparation and construction included drivers, passengers, and non-motorized travelers on public roads. Although existing road users were likely to be accustomed to existing safety risks associated with poor road conditions, these receptors were unlikely to have experience driving or sharing the road with heavy trucks, of the type likely to be used during Project site preparation and especially construction.

Site preparation would require a number of vehicle trips to deliver construction equipment and supplies, as well as daily trips of employee. Additionally, the Project Site is located in mountainous area, the traffic conditions is quite unfavorable.

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.

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

Active mitigation measures that would be used to further mitigate potential road safety risks were provided in ***Table 9.119***. These measures included development of a Transportation Management Plan that would address scheduling of road activity, monitoring conditions of public roads, and active traffic controls at the Project site entrance.

Table 9.119: Preventative and Mitigation Measures of Traffic Accident

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Developed and implemented a Traffic Management Plan. This should include measures such as: ■ Active traffic controls (e.g. flaggers to direct traffic at the Project site entrance); and ■ Schedule construction deliveries and employee shift changes to minimize traffic congestion and delay	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	MWPCL	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.	MWPCL	Before site preparation
Mitigate	Develop an Emergency Preparedness and Response Plan.	MWPCL	Prior to site preparation

Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	MWPCL	Construction

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 minimize impacts.

		Impact Significance
Without Mitigation Measures	Workers and Communities	4E Major
	Communities (livestock)	4C Moderate
With Mitigation Measures	Workers and Communities	3E Major
	Communities (livestock)	2B Minor

Monitoring and Auditing

- Monthly monitoring the implementation of all proposed mitigation measures specified in the Traffic Management Plan (TMP) should be conducted;
- Regular road condition monitoring along the transportation route to understand road quality during construction phase

Fire and Explosion

Background

Onsite fuel requirement during construction phase will be diesel. Fuels will be provided for daily requirements and transported to the site by fuel specialized trucks. The onsite delivery of fuel or lubricant will be at designated location that will have an impervious base. So, risk of fire and explosion at the site will be reduced.

In addition to the failure of malfunctioning and/or outdated machinery and equipment could be also led to the risk of fires and explosions.

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).

Table 9.120: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

Table 9.121: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

The potential economic displacement and impacts to livelihoods are assessed in accordance with the criteria set out in ***Table 9.121*** and ***Table 9.120***

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental fire and explosion are summarized in ***Table 9.122***.

Table 9.122: Preventative and Mitigation Measures of Fire and Explosion

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Implement on-site prevention measures such as (i) Equip the site with proper equipment (such as fire extinguishers, proper communication equipment) and regularly inspect and maintain them; (ii) Prepare the Fire prevention and Fighting Plan that ensure compliance and Fighting; (iii) Conduct firefighting training to the emergency support team, contractors and workers on site and camping areas	EPC Contractor/	Site preparation And construction
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.	MWPCL	Site preparation and construction
Mitigate	Develop an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation. The Emergency response plan should include:	EPC Contractor/MWPCL	Site preparation

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
	■ Immediately pull the nearest fire alarm if a fire occurs, report the event to shift supervisor or foreman immediately for emergency response; ■ When the emergency alarm sounds, all employees shall stop all activities and move to emergency assembly places immediately; ■ Limit the fire areas by utilizing the appropriate firefighting equipment, if the fire is small and controllable; and ■ Follow the procedure included in the Emergency Response and Evacuation Plan to take actions		
Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	EPC Contractor/MWPCL	During construction & Operation

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 post-event measures described in the previous section would apply to minimize impacts.

		Impact Significance
Without Mitigation Measures	Workers and Communities	3D Major
	Environment	3D Major
With Mitigation Measures	Workers and Communities	2C Minor
	Environment	2C Minor

Monitoring and Auditing

A monthly audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.

Unexploded Ordnances (UXOs)

Background

Risks of presence of Unexploded Ordnances (UXOs) should be considered. UXO Clearance will be conducted after notice to proceed, it will be part of pre-site clearing activities. The UXO clearance is being undertaken by Sub-contractor namely “Silavan” (Lao company) and the UXO clearance certificate is approved by Ministry of Labour and Social Welfares and stamped by National Regulatory Authority.

A map[139] of UXO presence in Laos is provided in ***Figure 9.97*** . The Project is located in Sekong and Attapeu province in the south of Laos which are shown are high risk areas for potential presence of UXO due to bombing campaigns between 1965 and 1975.

Based on the KII with local authorities and FGDs with villagers, in general, there are concerns about UXO; however, living with UXO has become a part of their lives that they are no longer alarmed about it. For example, villagers would farm in new and un-surveyed piece of land without notifying relevant authority to conduct UXO survey and clearance. They only notify the authority when UXO are encountered. Additionally, it was informed that the last incident of injury due to explosion of UXO was a long time ago (precise year could not be obtained).

Table 9.123: Social Impact Sensitivity Criteria

Sensitivity	Definition
Low	Villagers have low vulnerability/sensitivity; consequently has a high ability to adapt to changes brought by the project
Medium	Some, but few areas of vulnerability/sensitivity; retaining an ability to at least adapt in part to change brought by the project
High	Profound or multiple levels of vulnerability/vulnerability/sensitivity that undermine the ability to adapt to changes brought by the project

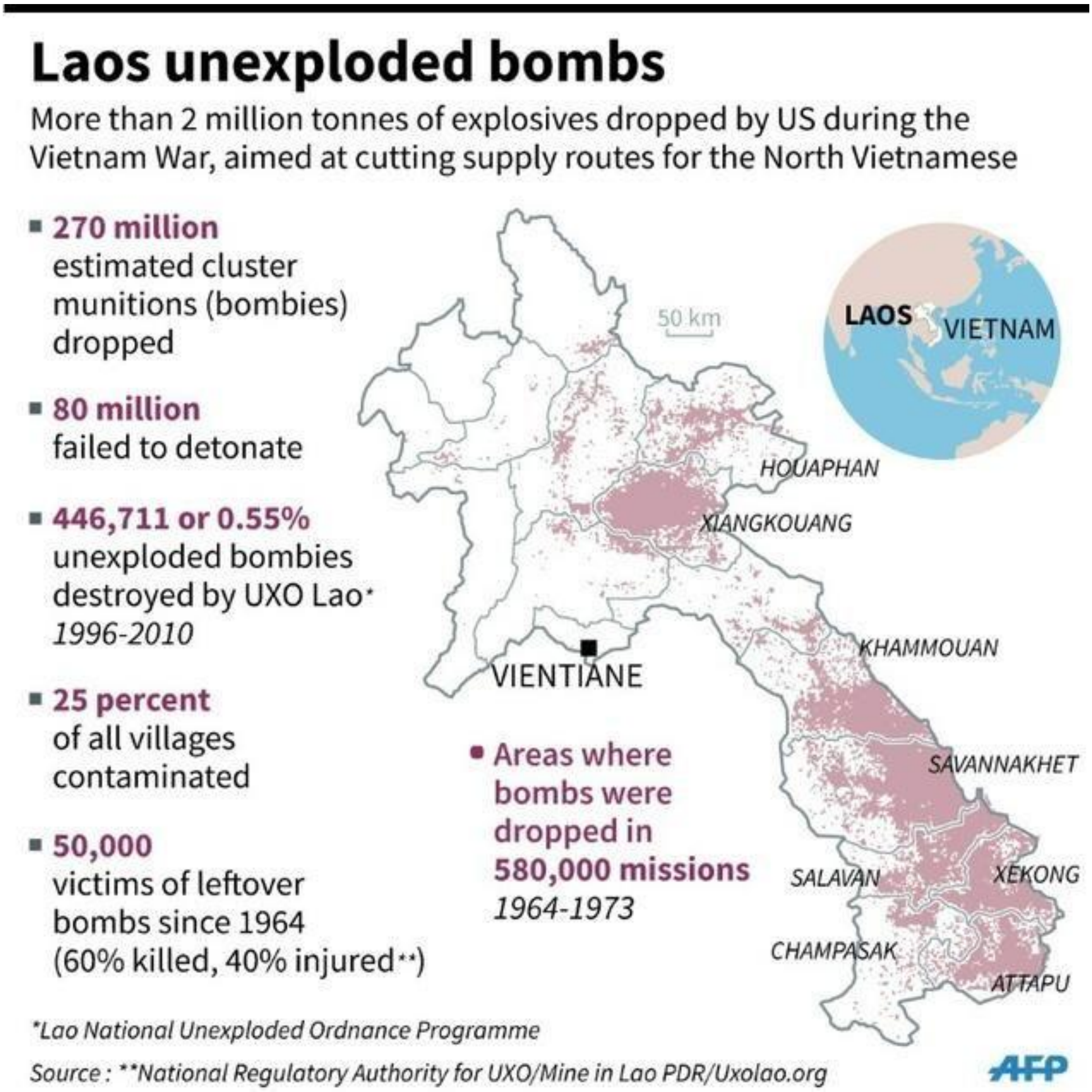
Table 9.124: Social Impact Magnitude Criteria

Magnitude	Definition
Large	Change dominates over baseline conditions. Affects the majority of the area or population in the AoI and/or persists over many years. The impact may be experienced over a regional or national area.
Medium	Early evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Negligible	Change remains within the range commonly experienced within the household or community
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that there will be a positive impact, without characterising the exact degree of positive change likely to occur.

The potential economic displacement and impacts to livelihoods are assessed in accordance with the criteria set out in ***Table 9.124*** and ***Table 9.123***.

[139] https://www.uxolao.org

Figure 9.97: Info Map of Potential UXO Presence in Laos



Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental fire and explosion are summarized in ***Table 9.125***.

Table 9.125: Preventative and Mitigation Measures of Fire and Explosion

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Contact relevant authority bodies and conduct the UXO clearance including development of a chance find procedure and a specific emergency response procedure for UXO. UXO clearance procedure will be followed as detail in UXOMF that will be further developed by EPC into UXO Management Plan.	MWPCL	Site preparation
Prevent	Implement on-site prevention measures such as (i) Equip the site with proper equipment (such as fire extinguishers, proper communication equipment) and regularly inspect and maintain them; (ii) Prepare the Fire prevention and Fighting Plan that ensure compliance and Fighting; (iii) Conduct firefighting training to the emergency support team, contractors and workers on site and camping areas	EPC Contractor/MWPCL	Site preparation And construction
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.	MWPCL	Site preparation and construction
Mitigate	Develop an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation. The Emergency response plan should include: ■ Immediately pull the nearest fire alarm if a fire occurs, report the event to shift supervisor or foreman immediately for emergency response; ■ When the emergency alarm sounds, all employees shall stop all activities and move to	EPC Contractor/MWPCL	Site preparation

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
	emergency assembly places immediately; ■ Limit the fire areas by utilizing the appropriate firefighting equipment, if the fire is small and controllable; and ■ Follow the procedure included in the Emergency Response and Evacuation Plan to take actions		
Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	EPC Contractor/MWPCL	During construction & Operation

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 post-event measures described in the previous section would apply to minimize impacts.

		Impact Significance
Without Mitigation Measures	Workers and Communities	3D Major
	Environment	3D Major
With Mitigation Measures	Workers and Communities	2C Minor
	Environment	2C Minor

Monitoring and Auditing

A monthly audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.

Natural Hazards (Flood and Landslide)

Background

Landslide susceptibility within the study area is reported to vary between Medium to Very High. This indicates that the project area is susceptible to landslides owing to factors such as land cover, soil type, and slope. In addition, it indicates the hazard due to landslides triggered by precipitation to vary between Low-High within Study area. Accordingly, overall hazard due to landslides triggered by precipitation is considered to be 'High'.

Sekong and Attapeu province are reported to be among the most (flood) vulnerable provinces in LaoPDR[140]. However, review of flood hazard data based on likelihood of damaging and life threatening floods (floods with depth of inundation >0.5 m) indicated the flood hazard to be Very Low in Sanxay district in Attapeu, and Dak Cheung district in Sekong province where the project is located. Further, review of flood hazard map(s) representing the depth of inundation under a flood with 100 year return period indicated no inundation in project area.

140 https://www.adpc.net/igo/category/ID416/doc/2013-ptk8Nb-ADPC-Publication_LNAReportWEB_(2).pdf

Accordingly, considering the site setting (locations of assets), absence of major rivers, and no reported inundation within study area, riverine floods are not likely to have impact on the project. Hence no hazard due to riverine flood is considered.

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental flood events are summarized in ***Table 9.126***.

Table 9.126: Preventative and Mitigation Measures of Natural Hazards

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.	MWPCL	Prior to Construction
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During site preparation and construction
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice)	O&M Contractor/MWPCL	During site preparation and construction
Prevent	Install warning system, signal boards, flood prevention systems.	MWPCL	Prior to Construction
Mitigate	Develop an Emergency Preparedness and Response Plan.	MWPCL	Prior to Construction
Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	EPC Contractor/ MWPCL	During Site preparation and construction

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 minimize impacts and damage caused by Flood and Landslide.

		Impact Significance
Without Mitigation Measures	Communities	4D Major
With Mitigation Measures	Communities	3C Moderate

Monitoring and Auditing

No specific monitoring program is required.

9.7.3.2 During Commissioning and Operation

Leakage and Spill Incidents

Background

There would be use of oil, fuel including hydrocarbons, across the site during commissioning and operation phase of the Project for operation & maintenance (O&M) services. As a result, there was a risk that small volumes of oil and fuel could be spilled on-site. The risk of these spills reaching the environment would be minimal in paved areas.

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental onshore spills are summarised in ***Table 9.127***.

Table 9.127: Preventative and Mitigation Measures of Leakage and Spills Incidents

Type of Control (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).	EPC Contractor/MWPCL	Prior to commissioning
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During commissioning and operation
Mitigate	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; and ■ Training: employees and contractors will be trained in emergency response procedures. ■ Auditing: audit records will be maintained on how the Plan is being implemented.	EPC Contractor/MWPCL	Before commissioning and operation
Mitigate	Implement Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation.	MWPCL	During commissioning and operation

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 as severe. In these cases, the post event measures described in the previous section would apply to minimize impacts.

		Impact Significance
Without Mitigation Measures	Workers and Communities	3C Moderate
	Environment	3C Moderate
With Mitigation Measures	Workers and Communities	2C Minor
	Environment	2B Minor

Monitoring and Auditing

- Monthly monitoring the implementation of all proposed mitigation measures specified in Emergency Preparedness and Response Plan should be conducted properly;
- Daily inspection of any secondary containment of oil/chemical on site and ensure good maintenance procedures to minimize small leaks and spills.

Fire and Explosion

Background

Damage of the wind turbine generators (WTGs) and their auxiliary components, transmission line due to lighting strikes, electrical arcs or flashovers and malfunctioned equipment which resulting fires and even explosions as WTGs materials were informatively construed as flammable materials.

Large scale fires, or worst-case explosions, could potentially release smoke and fumes in the broader area generating health issues associated with inhalation of toxic substances and uncontrollable wildfire that would contribute to a loss of crops and habitats and impacts on the economics of the area (e.g. community and workers jobs and incomes).

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental fire and explosion are summarized in ***Table 9.128***.

Table 9.128: Preventative and Mitigation Measures of Fire and Explosion

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During commissioning and operation
Prevent	Implement routine inspection and maintenance procedures (in line with international best practice) for any hazardous substances' storage vessels and WTGs.	EPC Contractor/MWPCL	During commissioning and operation
Prevent	Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed	MWPCL	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.	MWPCL	During commissioning and operation

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, 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 minimize the severity on communities and surrounding environment.

		Impact Significance
Without Mitigation Measures	Workers and Communities	2E Major
	Environment	2D Moderate
With Mitigation Measures	Workers and Communities	2D Moderate
	Environment	2C Minor

Monitoring and Auditing

A monthly audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.

Unexploded Ordnances (UXOs)

Background

Risks of presence of Unexploded Ordnances (UXOs) should be considered. UXO Clearance will be conducted after notice to proceed, it will be part of pre-site clearing activities. The UXO clearance is being undertaken by Sub-contractor namely “Silavan” (Lao company) and the UXO clearance certificate is approved by Ministry of Labour and Social Welfares and stamped by National Regulatory Authority.

UXO clearance will be completed prior to any site activity as stated in UXO management framework. UXO Management Plan is in folder below for reference.

A map[141] of UXO presence in Laos is provided in . The Project is located in Sekong and Attapeu province in the south of Laos which are shown are high risk areas for potential presence of UXO due to bombing campaigns between 1965 and 1975.

During the site visit in November to December 2021, the field team observed that there was ongoing UXO clearance in the region. UXO clearance are rolled out in areas where there are planned developments and land use such as area near towns to accommodate town expansion and expansion of agricultural land.

Based on the KII with local authorities and FGDs with villagers, in general, there are concerns about UXO; however, living with UXO has become a part of their lives that they are no longer alarmed about it. For example, villagers would farm in new and un-surveyed piece of land without notifying relevant authority to conduct UXO survey and clearance. They only notify the authority when UXO are encountered. Additionally, it was informed that the last incident of injury due to explosion of UXO was a long time ago (precise year could not be obtained).

141 https://www.uxolao.org

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental fire and explosion are summarized in ***Table 9.128***.

Table 9.129: Preventative and Mitigation Measures of Fire and Explosion

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During commissioning and operation
Prevent	Implement routine inspection and maintenance procedures (in line with international best practice) for any hazardous substances' storage vessels and WTGs.	EPC Contractor/MWPCL	During commissioning and operation
Prevent	Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed	MWPCL	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.	MWPCL	During commissioning and operation

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, 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 minimize the severity on communities and surrounding environment.

		Impact Significance
Without Mitigation Measures	Workers and Communities	2E Major
	Environment	2D Moderate
With Mitigation Measures	Workers and Communities	2D Moderate
	Environment	2C Minor

Monitoring and Auditing

A monthly audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.

Blade Ejection Failure

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 minimize the risk of damage or injury from components failure.

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental blade throw are summarized in ***Table 9.130***.

Table 9.130: Preventative and Mitigation Measures of Blade Ejection Failure

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Establish safety zone at least 300 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.	MWPCL	Prior commissioning
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During commissioning and operation
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice).	EPC Contractor/MWPCL	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.	MWPCL	Prior commissioning
Mitigate	Develop an Emergency Preparedness and Response Plan.	EPC Contractor/MWPCL	Prior commissioning
Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	MWPCL	During commissioning and operation

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, 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 minimize the severity on communities and surrounding environment.

		Impact Significance
Without Mitigation Measures	Workers and Communities	3C Moderate
	Environment	3C Moderate
With Mitigation Measures	Workers and Communities	2B Minor
	Environment	2B Minor

Monitoring and Auditing

A quarterly audit program shall be established to check the implementation of regular technical inspection of the WTGs and blades' safety. Any identify gaps or areas of opportunity will be followed up after the inspection until resolved. The auditing records will be kept onsite for future review and supervision.

Transmission Line Snapping and Transmission Pylon Collapse

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.

Significance (Before Mitigation)

The significance is provided in ***Table 9.117***.

Mitigation Measures

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental transmission line snapping and transmission pylon collapse are summarized in ***Table 9.131.***

Table 9.131: Preventative and Mitigation Measures of Transmission Line Snapping and Transmission Pylon Collapse

Type of Control (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	MWPCL	Prior commissioning
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During commissioning and operation
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice)	O&M Contractor/MWPCL	During commissioning and operation

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Install warning system, signal boards, lighting prevention system, anti-climbing devices on the tower.	MWPCL	Prior commissioning
Mitigate	Develop an Emergency Preparedness and Response Plan.	EPC Contractor/MWPCL	Prior commissioning
Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	EPC Contractor	During commissioning and operation

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 post-event measures described in the previous section would apply to minimize impacts.

		Impact Significance
Without Mitigation Measures	Communities	3D Major
With Mitigation Measures	Communities	2D Moderate

Monitoring and Auditing

A quarterly audit program shall be established to check the implementation of regular technical inspection of the transmission lines and transmission pylons' safety.

Natural Hazards (Flood and Landslide)

Background

Landslide susceptibility within study area is reported to vary between Medium to Very High. This indicates that the project areas is susceptible to landslides owing to factors such as land cover, soil type, and slope. Moreover, it indicates the hazard due to landslides triggered by precipitation to vary between Low-High within Study area. Accordingly, overall hazard due to landslides triggered by precipitation is considered to be 'High'.

Sekong and Attapeu province are reported to be among the most (flood) vulnerable provinces in Lao PDR[142]. However, review of flood hazard data based on likelihood of damaging and life threatening floods (floods with depth of inundation >0.5 m) indicated the flood hazard to be Very Low in Sanxay district in Attapeu, and Dak Cheung district in Sekong province where the project is located. Further, review of flood hazard map(s) representing the depth of inundation under a flood with 100 year return period indicated no inundation in project area.

Accordingly, considering the site setting (locations of assets), absence of major rivers, and no reported inundation within study area, riverine floods are not likely to have impact on the project. Hence no hazard due to riverine flood is considered.

Significance (Before Mitigation)

All preventative and mitigation measures proposed to reduce the likelihood and severity of accidental flood events are summarized in ***Table 9.132***.

142 https://www.adpc.net/igo/category/ID416/doc/2013-ptk8Nb-ADPC-Publication_LNAReportWEB_(2).pdf

Table 9.132: Preventative and Mitigation Measures of Natural Hazards

Type of Control (i.e. Prevent/ Mitigate)	Management Control	Responsibility - Organisation	Timing
Prevent	Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.	MWPCL	Prior commissioning
Prevent	The Project will implement the SEP and a robust stakeholder engagement programme on emergency response.	MWPCL	During commissioning and operation
Prevent	Implement periodic routine inspection and maintenance procedures (in line with international best practice)	O&M Contractor/MWPCL	During commissioning and operation
Prevent	Install warning system, signal boards, flood prevention systems.	MWPCL	Prior commissioning
Mitigate	Develop an Emergency Preparedness and Response Plan.	MWPCL	Prior commissioning
Mitigate	Implement an Emergency Preparedness and Response Plan and monitor contractors to ensure consistent implementation	EPC Contractor/ MWPCL	During commissioning and operation

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 minimize impacts and damage caused by Flood and Landslide.

		Impact Significance
Without Mitigation Measures	Communities	4D Major
With Mitigation Measures	Communities	3C Moderate

Monitoring and Auditing

No specific monitoring program is required.

9.8 Cumulative and Transboundary Impact Assessment

9.8.1 Approach

The approach to the CIA was as follows:

- Identify the spatial and temporal boundaries of the CTIA (considering the combination of potential effects of multiple impacts on biodiversity from existing, proposed and anticipated projects);
- Identify 'Valued Social and Environmental Components' ("VECs") in consultation with affected communities and key stakeholders;
- Identify developments and external natural and social stressors that may affect the VECs;
- Assess the combined impact of the development of the Project, and determine its effects on VECs in both Lao PDR and Vietnam; and
- Identify appropriate measures to management cumulative impacts.

The CIA has been broadly aligned (as and where relevant) with the specific IFC guidance on the topic of bird/bat collision risk for wind farm projects, as outlined in the "*Tafila Region Wind Power Project*

CEA" (Cumulative Effects Assessment) (IFC, 2017[143]), being the first of its kind in the Eastern Europe, Middle East and North Africa region.

9.8.1.1 Boundaries of the CIA

Temporal boundaries of the CIA included the following:

- Past activities associated with historic cultivation practices by local communities, based on historical imagery in Google Earth™ and literature dating back to the 2000's (approximately 20 years);
- The state of the environment and land uses based on the current status quo; and
- Activities associated with other projects that may take place in the near future (within the next 0-5 years. based on potential institutional planning and authorization timeframes).

Note that the temporary boundary of the CIA could be considered potentially up to 25 years (i.e. the project operational life span, as estimated), which aligns with the timeframe considered initial in the IFC Tafila project, which was defined as "…*the time during which the proposed mitigation, monitoring, and management measures will be implemented*" (IFC, 2017). However, even IFC (2017) acknowledge that this is likely to be unrealistic as the actual impacts on the VECs are not known, and instead temporal boundaries should be determined on the basis of monitoring.

Spatial boundaries of the CIA were defined as follows:

- The Monsoon WF Project development area and AoI defined for the biodiversity impact assessment (including wind farm, access roads and transmission line route to the border with Vietnam);
- The EAAAs for volant and non-volant species identified for the baseline biodiversity assessment and CHA to account for ecologically important/sensitive ecosystems, habitats and species that may be affected by the WF project;
- The corridor of contiguous Wet Evergreen Forest to the north-east of the WF to the border with Viet Nam;
- Protected Areas, Important Bird Areas and Key Biodiversity Areas within a 20km radius of the Monsoon WF project area;
- Several villages (23 villages in Dak Cheung district of Sekong province, and 8 villages in Sanxay district of Attapeu province) likely to be affected by impacts to local livelihoods; and
- The administrative boundaries of Dak Cheung and Sanxay districts, as representative of all areas that could be indirectly affected by changes in ecosystem goods and services.

9.8.1.2 Identification of VECs related to Biodiversity

VECs or Valued Social and Environmental Components were identified through the ESIA process based on the outcomes of the baseline biodiversity and social assessment findings, stakeholder and expert consultations and the Critical Habitat Assessment (CHA, ***Appendix T***). Priority VECs identified for the spatial and temporary boundaries of the CIA were selected on the basis of risk, rather than predicted impact (aligning with the IFC 2017 approach), and are summarized in ***Table 9.133*** below.

Table 9.133: VECs Selected for the CIA from a Biodiversity Impacts Perspective

VECs Identified	Rationale	Relevance to CIA?
1 Conservation important bird & bat species	Avifauna are typically at particular risk of increased mortalities caused by wind farms	Yes – several RDL species of birds identified, only LC

[143] IFC (International Finance Corporation). 2017. Tafila Region Wind Power Projects: Cumulative Effects Assessment. Available online at: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/tafila+region+wind+power+projects+-+cumulative+effects+assessment

VECs Identified	Rationale	Relevance to CIA?
(globally/nationally threatened and restricted-range species)	(turbines and power lines), with threatened species considered to be of noteworthy conservation importance.	bats. Several other transmission lines associated with other hydropower projects are planned in the AoI.
2 Large migratory or congregatory populations of bird/bat species	*Migratory species and large species congregations can be at risk of particularly high collision incidences with wind farms and species barrier effects can be particularly significant.*	*No - no large migratory or congregatory populations known for the local area.*
3 Large, contiguous forest compartments	Known to provide key habitat value for endangered species and function as important species movement corridors.	Yes – contiguous and largely natural forest compartments exist.
4 Remaining natural and modified forest (including disturbed/fragmented habitat)	Important for IUCN RDL faunal species and plants.	Yes – contiguous and largely natural forest compartments exist.
5 River valleys	*Represent important aquatic ecosystems and key wildlife corridors.*	*No – onshore wind farms typically pose negligible risks to aquatic ecosystems, in this case the project transmission line interactions with river ecosystems will be limited.*
6 Critical habitats	Critical habitats identified in the CHA are of high biodiversity value both in terms of the vegetation type and habitat supporting species of conservation importance, and impacts to these areas will be ecologically significant.	Yes - ‘critical habitat’ associated with the EAAAs as identified in the CHA.
7 Network of Protected Areas, Important Bird Area and Key Biodiversity Areas	These are key areas for supporting and conserving biodiversity where impacts can be particularly significant to biodiversity conservation goals.	Yes – several PAs and KBAs are located in the AoI.
8 Natural resources used by local communities	Local rural communities in the area are known to be strongly dependent on the natural resources provided by forest ecosystems in particular, including NTFPs and wildlife	Yes – community engagements identified local communities’ strong reliance on forest products to sustain rural livelihoods. From a social perspective, this was the most important VEC identified for local communities.
9 Other socio-cultural aspects	Additional socio-cultural aspects that were initially identified included: sense of place, tourism & recreation, current land use (farming for example), cultural/traditional lifestyles, visual amenity, air quality/climate, and employment opportunities.	*No - given that the WF will have a limited impact on these aspects and that local communities did not highlight these as being particularly important,*

9.8.1.3 Project Risks and Impacts to Biodiversity

In order to contextualize and inform the CIA, a summary of the key findings of the biodiversity impact assessment undertaken for the ESIA for Monsoon WF (ERM, 2022) has been included below:

1. Collision risk for bats and birds is considered to be ‘low’ to ‘insignificant’ based on the baseline surveys and collision modelling undertaken;
2. There are no known populations of key migratory or congregatory bird/bat species identified for the Project area that could be significantly impacted;
3. General nuisance disturbances and impacts to fauna from dust, noise, vibrations, etc. are expected to be of limited significance and can be readily mitigated;

4. Impacts to aquatic biodiversity will be minimal and easy to mitigate through appropriate road crossing design and construction across small streams;
5. Interactions of the transmission lines with streams/rivers will be negligible;
6. There will be moderately significant, permanent impacts to the natural forest vegetation communities and habitats, with possible indirect impacts on forest-dependent species;
7. Linear infrastructure (roads and transmission lines) are likely to have the most notable impacts on forests, particularly the lesser-impacted and more contiguous sections of Montane Forest to the north and the Wet Evergreen Forest habitat in the north-east (associated with the planned transmission line alignment towards Vietnam); and
8. Increased efficiency of access to more remote forest areas has been highlighted as a key induced and possible unintended consequence of the WF project, and this may result in increased pressure on forest resources (particularly hunting of endangered wildlife).

Residual impacts to forest habitat (and potentially RDL species) associated with access road and transmission line infrastructure are considered to be moderately significant and will be difficult to mitigate without avoiding impacts altogether. Despite attempts made to avoid impacts to forest habitat through project design and realignment considerations, and the recommendation of good practice controls and site-specific mitigation, the following residual impacts of particular significance are likely to be associated with the WF project:

1. Transformation and/or modification of areas of natural (lesser impacted, contiguous) forest vegetation, providing key habitat for RDL forest-dependent species and also classified as 'critical habitats' (direct and indirect impacts); and

2. Loss of threatened and/or restricted-range species through increased hunting/harvesting pressure due to increased efficiency of access to more remote areas in the project area (induced impact).

These residual impacts are likely to result in a net biodiversity loss unless adequately mitigated through an appropriate biodiversity compensation strategy. It has been recommended that a biodiversity offset be pursued to ensure that residual biodiversity impacts are compensated.

For a full description and detailed analysis of the biodiversity risks and impacts related to the Monsoon WF project, the reader is referred specifically to ***Section 9*** of the ESIA.

9.8.1.4 Other Biodiversity Stressors and Threats Identified in the AoI

Other known developments (existing and planned) in and around the Project area have been identified.

Wind farm projects:

Based on the stakeholder engagement undertaken, no other existing wind farms have been identified in Dak Cheung and Sanxay districts. A rapid scan of the AoI in GIS using Google Earth™ satellite imagery, combined with a brief literature review, confirmed that there are no other existing wind farm projects in the AoI, and this was also highlighted in the baseline biodiversity assessments completed for the study area.

Impact Energy Asia Limited (IEA) has signed a Memorandum of Understanding (MoU) with the Government of Lao PDR (GoL) in relation to the development and implementation of a new 1,000 MW wind farm planned in Dak Cheung, Xekong Province ('Xekong Wind Farm' project). The new Xekong WF would be adjacent to the Monsoon Project, and IES (Impact Electrons Siam Limited) has announced that exclusive rights have been obtained from the Government of Lao PDR to conduct a feasibility study and preliminary EIA.

The WF Project Area is likely to be considerably larger in size to Monsoon WF, with a larger number of WTGs required to generated the power required. The estimated project area includes 2 properties, 494 km^2 and 324 km^2 in extent, respectively. Based on the capacity of 1000 MW, the WF will have a combined total of 238 WTGs, with two main clusters of 83 WTGs and 150 WTGs located within the western and eastern properties, respectively. The site will be accessed via Lao Highway 16B, which is generally paved up to the western-most property.

The planned Xekong WF will be located a short distance north of Monsoon WF (see map in Figure below).

Hydropower projects:

Several hydropower projects, with associated linear transmission lines, are identified in both Dak Cheung and Sanxay districts. A map showing the existing hydropower project transmission line closest to the WF project is indicated on the map in ***Figure 9.99***.

Figure 9.98: The Boundaries of the Planned 'Xekong WF'

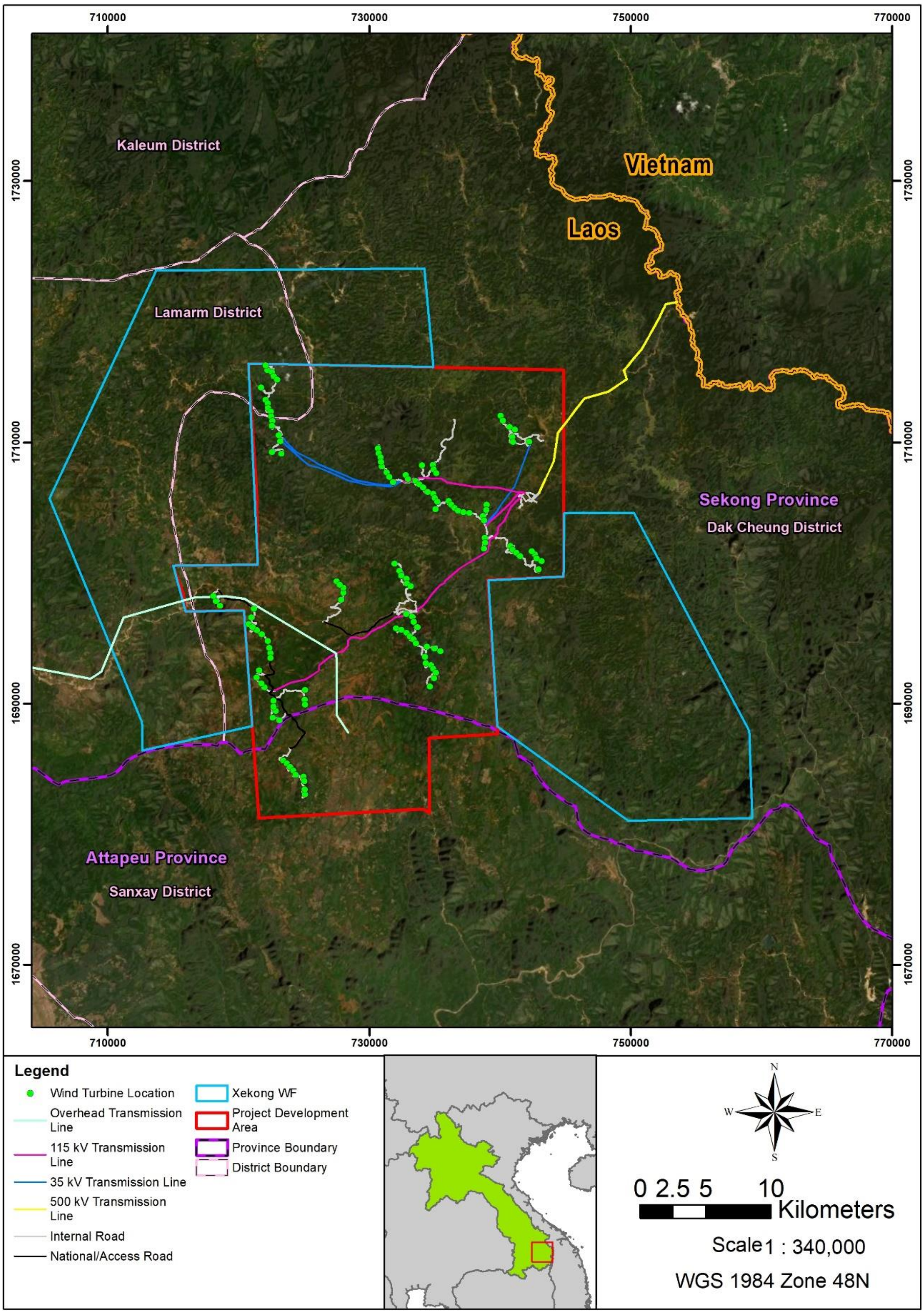
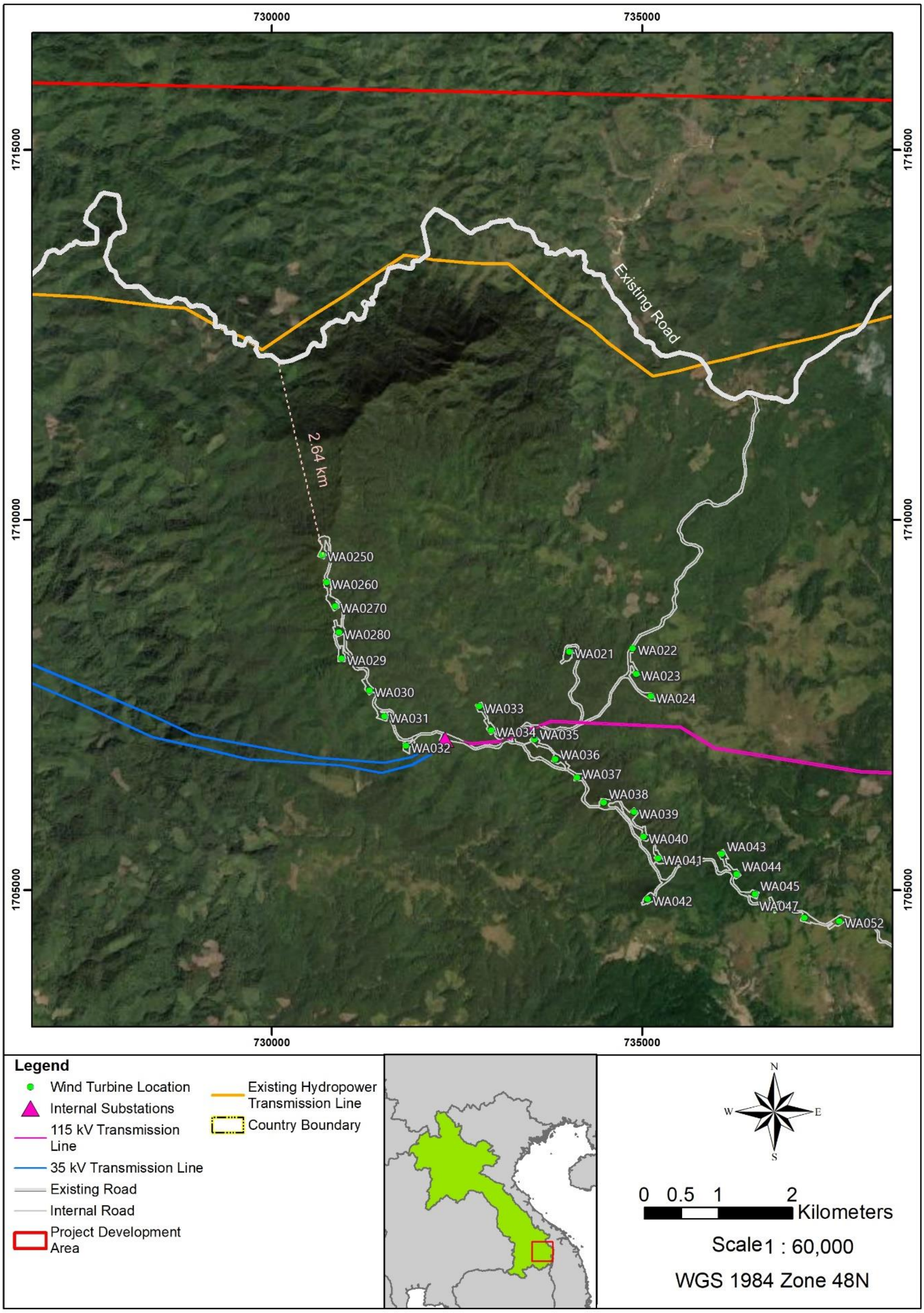


Figure 9.99: The existing Hydropower Transmission Line and Main Access Road in relation to Monsoon WF



Agriculture:

Agricultural projects include livestock husbandry, a coffee plantation project and fruit tree plantation in Dak Cheung District, with no formal agricultural projects identified in Sanxay District.

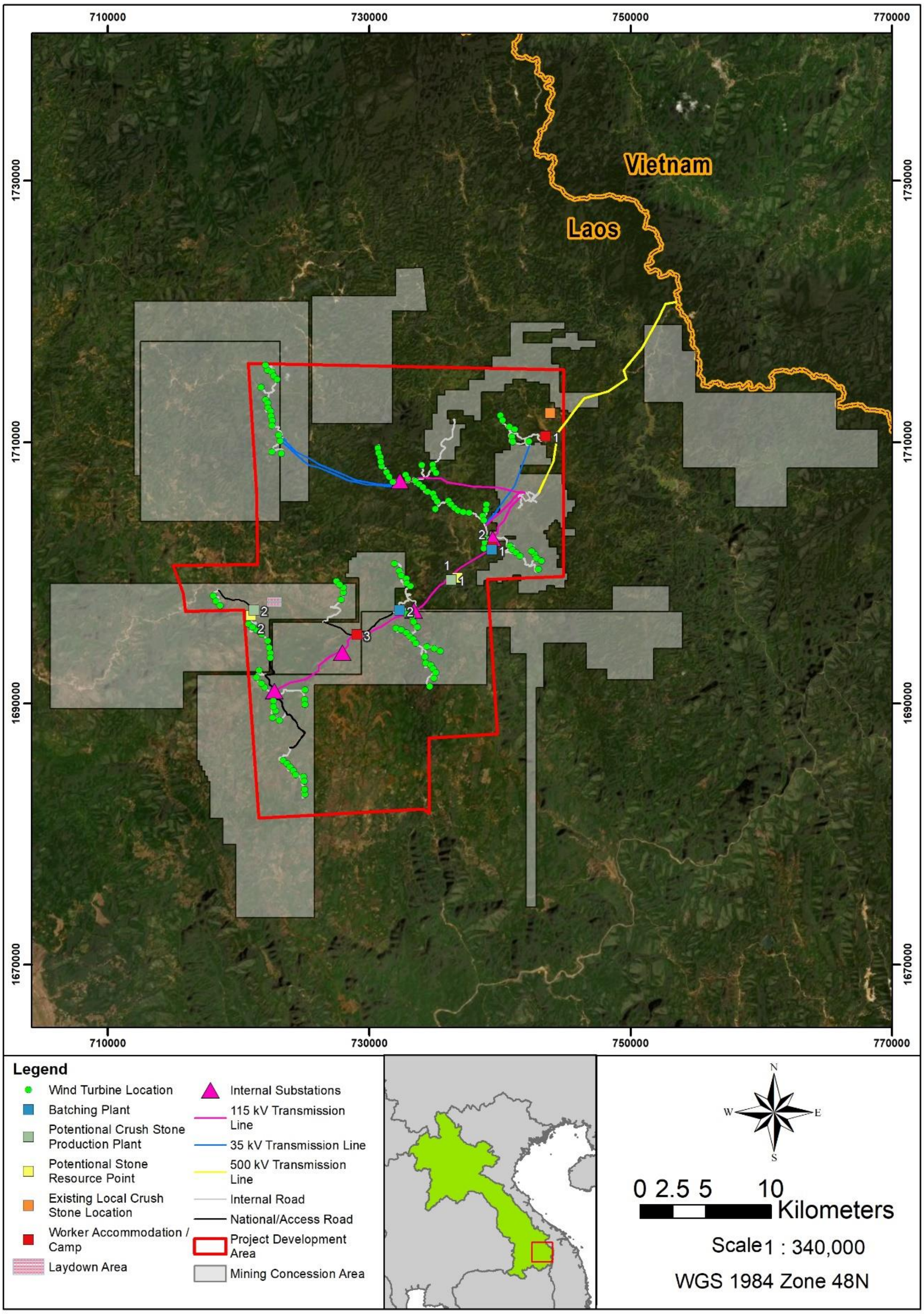
Road upgrades:

A number of road upgrade / improvement projects are identified in both Dak Cheung and Sanxay districts.

Mining projects:

A potential bauxite mining project has been identified in Sanxay District, within Sekong and Attapeu provinces. A map showing the mining area where mining rights has been granted is shown indicated on the map in Figure 9.100, suggesting that a large area of the project area and surrounding areas up to the border with Vietnam may potentially be subject to surface mining.

Figure 9.100: Areas where Bauxite Mining is Planned in Sekong and Attapeu Province, in Relation to Monsoon WF



9.8.1.5 Other land uses and biodiversity threats

Other potential land uses and threats to biodiversity (past, present and future) have also been identified through a rapid scan of the projects AoI in GIS using Google Earth™ satellite imagery, supplemented by a desktop literature review of the current and past state of biodiversity threats in Laos (with future predictions where possible). This indicated that the key threats to biodiversity (not including those associated with the Monsoon WF project) are associated with human interactions with forest habitat and resource use, which in rural areas (where the project is located) revolve around "multi-livelihood" strategies that involve a mixture of subsistence and income-earning activities that combine hunting and gathering with agriculture, horticulture, livestock farming and forestry (National University of Laos, 2008). The most significant threats to biodiversity are likely to include:

- Over-extraction or unsustainable harvesting of wood and NTPs (Non-timber Forest Products) from natural forests;
- Forest habitat loss, degradation and fragmentation mainly through cultivation activities;
- Soil erosion and soil loss; and
- Over-hunting and illegal wildlife trade.

9.8.2 Cumulative Impact Assessment

Based on the key impacts of the Monsoon WF on local biodiversity (in terms of the ESIA), together with available information on other projects, past/present/future threats and impacting land uses in the AoI defined, the focus of the cumulative assessment for biodiversity impacts was on the following impacts viewed in aggregation:

- Avifauna collision risk;
- Forest loss and degradation;
- Habitat fragmentation and reduced connectivity;
- Regional loss of RDL species of plants and animals;
- Reduction in ecosystem goods and services used by local communities (social aspect);
- Impact on biodiversity offset receiving area (Dak Chung Plateau).; and
- Contribution to clean energy sector and move away from non-renewables (positive impact)

9.8.2.1 Cumulative Impact 1: Avifauna collisions

Description

No other existing wind farms have been identified in Dak Cheung and Sanxay districts, which could contribute cumulatively to population level impacts to avifauna (birds & bats) at a regional level[144]. Indeed, no other wind farms have been identified in Lao. There are wind farms in Vietnam, but none

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[144] **SPECIAL NOTE**: In terms of bird/bat collision risk, the specific IFC guidance on this topic, as outlined in the Tafila Region Wind Power Project CEA (Cumulative Effects Assessment) (IFC, 2017) is based on an approach to cumulative assessment that considers the ecological risk posed to priority bird and bat VECs, identifies fatality thresholds for each species and then proceeds to identify key mitigation and monitoring requirements. However, the project for the Tafila Region is in the context of multiple wind farm sites having potential cumulative impacts on avifauna in the region, which is different to the case for Monsoon WF in southern Lao PDR, which will be the first for the region. The approach to identifying key ecological risks for avifauna species to determine fatality thresholds therefore has little relevance to the Monsoon project from a cumulative impacts perspective, especially given that the collision modelling for the project suggests that bird/bat collision risk will be low to insignificant overall, with minimal possible effect on populations and with no migratory species at risk. Also, fatality threshold targets for priority bird/bat species will be challenging to determine, given that lack of available or suitably accurate information on regional size and status of most populations. Similarly, limited quantitative data on vegetation and habitat status and extents limits the ability to easily set targets or thresholds for forest habitat in the region. Despite these clear limitations, available data on forest losses at the national and regional level have been reviewed as far as possible and used to better frame and contextualize possible cumulative forest habitat impacts.

are within 50km of the project.. The planned Xekong WF is of relevance as this project will be located a short distance north of the Monsoon WF. The Xekong WF Project Area will have an estiamted maximum power output capacity of 1000 MW and is likely to be considerably larger in size to Monsoon WF, with a larger number of WTGs required to generate the power required.

Given that the Xekong WF project is still in the feasibility and planning stages, with no detailed environmental impact assessment yet released for review, the lack of detail on this potential future project hinders the degree to which cumulative impacts can be assessed. Nevertheless, one can assume that based on the project's proximity to the Monsoon WF and similar habitats that will be impacted, that the same or highly similar environmental receptors will likely be affected and impacts are likely to be similar but perhaps of a higher magnitude due to the greater extent of the project and larger number of WTGs. Several hydropower projects have also been identified with associated electrical transmission lines for these projects (with the closest one being to the immediate west of the Monsoon WF site) and these projects may result in piece-meal impacts which could also interfere more broadly with avifauna. Whilst the cumulative impacts of onshore wind power on avifauna (birds and bats) have received limited consideration (Bennun et al., 2021), at a species population level migratory species of birds that typically forage over large range may experience significant cumulative mortalities. This could be relevant to some of the larger raptor species known to exist in the region and which move over distances, and which may present a risk of turbine and power line collisions leading to possible injury/fatality. However, based on the results of bird/bat collision risk modelling for the Monsoon WF project, there were no significant collision risks to key bird and bat species identified, particularly at the population level. Unfortunately, little to no population data exist for most bat species globally, which hinders understanding of the impacts of wind energy projects on long-term population viability (Bennun et al., 2021), however the Monsoon WF project ESIA determined risks to bats to be negligible, particularly given that only species of LC could be at risk and collision risk was determined to be of low significance.

Impact rating

Since large populations of migratory or congregatory birds/bats have not been reported for the area, there is unlikely to be a significant cumulative risk to migratory species or large congregations of birds/bats. At the species level, there could be minor risk of injury/fatality for some of the larger raptor species, however cumulatively the impact can still be regarded as relatively **minor**.

Mitigation of cumulative impact 1:

Given the low avifauna collision risk modelled for Monsoon WF and the probable similar additional risk posed cumulatively by other projects in the region, the project-level mitigation recommended for the Monsoon WF (ERM, 2022) is considered adequate also from a cumulative impacts perspective. This includes the following

- Long-term monitoring of bird and bat activity, including carcass monitoring, to further the understanding of collision risks for avifauna.
- Sharing of monitoring data between different projects can help in developing regional inventories, identifying trends and developing thresholds and targets for protecting species of conservation importance. Without this long-term data and trends analysis, conservation actions (even collaborative efforts) will be difficult to implement since these typically cannot be actioned easily over very broad areas.
- Where monitoring indicates impacts are greater than predicted and have potential to have population level effects, an adaptive management approach will be undertaken whereby specific mitigation options would then be implemented for turbines and power lines aimed at deterring birds/bats and reducing collision risk.

Furthermore, the following additional mitigation is recommended:

- In time, fatality thresholds could be developed to better inform the adaptive management approach but would require long-term monitoring data to establish any statistically significant trends.

It would be advisable that other wind farms and linear electrification projects (planned and future) take a similar approach and any future WF projects planned for the region should approach mitigation based on the lessons learned from the Monsoon WF project and possibly may need to apply the methodology applied for the Tafila Region Wind Power Project CEA (Cumulative Effects Assessment) (IFC, 2017) and take cognizance of the findings of this assessment.Given that other wind farms and electrification projects are planned in the region (some of which are in close proximity to the Monsoon WF site), a strategic assessment and combined CIA should ideally be done for the region that takes into account the combined impact of multiple planned wind farms and suggesting adaptive management/mitigation and monitoring strategies that encourage the sharing of data as far as possible. Alternatively or in addition, information on cumulative effects should also be fed back to the IFC's cumulative assessment project for the Sekong River Basin region in Lao PDR, that considers the management and assessment of cumulative impacts of renewable energy development in the Sekong River Basin, Lao PDR (IFC, 2019: '*Final Inception and Scoping Report of the Cumulative Impact Assessment and Management of Renewable Energy Development in the Sekong River Basin, Lao PDR*').

9.8.2.2 Cumulative Impact 2: Regional loss of important forest habitat

Description

A patchy mosaic of fragmented evergreen forest communities interspersed with cultivation and transitional shrub land and grassland (transitioning to young/seral forest) characterizes much of the AoI, still with some relatively large, contiguous forest compartments being retained in the more remote areas that have not been affected as much by local farming, timber harvesting and other human activities. The impact of further cumulative forest habitat loss and fragmentation due to Monsoon WF and other developments in the region, should therefore be evaluated in light of the existing level of loss/transformation that has occurred. Putting into context the existing loss of forest that has taken place regionally, there may be as little as 25% or less natural forest remaining based on the literature reviewed [145], with forest ecosystems being under significant threat. Any further large-scale transformation of natural forest habitat, especially within the less impacted and more contiguous forest compartments, should be considered significant (also in light of the fact that the rate of regeneration of forests is typically a slow process requiring decades). Forest habitat is also considered 'critical habitat' for supporting RDL plant and animal species in the region, and further losses to this type due to the cumulative impacts of development and subsistence harvesting and farming, could eventually reach significant and unsustainable levels.

Whilst the WF project when viewed in isolation may not exacerbate forest loss significantly other linear projects such as new transmission lines associated with hydropower projects and road upgrades planned, are also unlikely to contribute to habitat loss at the regional level. Other more intensive development activities such as mining[146] and agriculture (existing or planned in the two districts), will likely have larger impact to forests in comparison to Monsoon WF (and probably the adjacent Xekong

[145] The WWF (World Wildlife Fund, 2021) has estimated the transformation of natural forest habitat in the ecoregion having already reached levels as high as 75%, which implies that only 25% of reference forest habitat could remain at the regional level. The National University of Laos (2008) also describe the evergreen forests of the Annamite Mountain region as being "weakly represented". Tong (2009) presents some fairly detailed statistics on forest loss at a national level for Lao PDR, with earlier studies from 2002 revealing an average loss of 91, 200 ha per annum of forest over a 20-year period, reducing the overall national forest area to roughly 41%. Forest quality has also deteriorated appreciably, with dense forest cover declining from 29% to 8% between 1992 and 2005. This is not to mention the rise in forest fragmentation, with large forest compartments declining from 88% to 54% over the same period. This trend in forest loss and degradation is unlikely to have slowed down, and the situation by 2022 is likely to have deteriorated further, possibly quite substantially. Comparatively though, the loss of forest in Lao PDR is still appreciable less than that which has occurred in nearby countries such as Thailand, Vietnam and China, where substantially greater losses have been reported.

[146] Surface mining in particular is known to be associated with significant biodiversity risks and impacts, being comparatively both extensive and intensive operations that are inherently destructive to both terrestrial and aquatic ecosystems, with significant long-term and even permanent impacts known also for surface and ground water quality and quantity.

WF when considered in collaboration), although currently these avoid some of the better-quality habitat areas.

Impact rating

In comparison to the direct impacts of the Monsoon WF (which are comparatively small), the mining of bauxite in the project area is likely to result in a larger impact to forest ecosystems and habitats. It would be reasonable to assume that, where the mining company seeks international finance, it will need to meet obligations under no net loss or net gain. Where this does not happen then a cumulative effect on biodiversity is possible, depending on the location and impacts associated with the mine. This is however outside of the direct control of the Monsoon WF project.

Mitigation of cumulative impact 2

The project-level mitigation recommended for the Monsoon WF (ERM, 2022) is considered adequate from a cumulative impacts perspective. This includes the following

- Offsetting the anticipated forest habitat losses at Monsoon WF would function to compensate for the project specific impacts that would otherwise contribute to regional forest habitat loss. It has been recommended that the offset approach consider aligning with existing projects in the region, either through co-funding opportunities or ensuring that offset interventions complement existing forest conservation projects where possible.
- It is also acknowledged that there are already several projects co-funded by WWF and other international agencies (KfW for example) within the region that are aimed at improving sustainable forest utilization, forest protection and restoration of degraded forest habitats.

It is further recommended that:

- Other planned development projects in the region (including the adjacent Xekong WF and planned mining) should adopt a similar approach where significant residual impacts remain, if cumulative forest losses at the regional level are to be appropriately addressed. This will require a concerted effort from the Government of Lao PDR from an environmental compliance monitoring and enforcement perspective.
- Encouraging the sharing of long-term vegetation, habitat and species monitoring data (from baseline surveys through to operational monitoring) can be useful in furthering the understanding of regional trends in forest habitat degradation and the relative impact on forest-dependent species. Without this long-term data and trends analysis, conservation actions (even collaborative efforts) will be difficult to implement since these typically cannot be actioned easily over very broad areas
- Ultimately, development and land utilization projects need to ensure that they align with the goals and objectives of many of Government of Lao PDR’s sustainable development strategy and policies, including:
  - The Forest Strategy 2020, with a rather ambitious target to recover a forest cover of 70% by 2020 (recently being revised to be achieved by 2025 in the forthcoming Forest Strategy 2030); and
  - The National Biodiversity Strategy and Action Plan for Lao PDR (NBSAP[147]), and its 2016-2025 Action Plan, with a goal is to “*enhance the role of biodiversity as a national heritage and as a substantial contributor to poverty alleviation, as well as sustainable and resilient economic growth*”.

[147] Ministry of Natural Resources and the Environment. (2016). National Biodiversity Strategy and Action Plan (NBASAP) for Lao PDR 2016-2025. Vientiane Lao PDR. Available online at: https://www.cbd.int/doc/world/la/la-nbsap-v2-en.pdf

9.8.2.3 Cumulative Impact 3: Forest habitat fragmentation and reduced connectivity

Description

Multiple activities and stressors can create a combination of barriers to wildlife movement. Whilst the Monsoon WF project itself is unlikely to result in significant reductions in habitat connectivity that could affect local wildlife, what is important from a cumulative impacts perspective is the collective reduction in forest habitat, increased patchiness of natural forest cover, and the reduction in contiguous forest communities that function as important wildlife corridors[148]. When considered in the context of the existing levels of habitat loss and fragmentation of forests, the WF project will have some fragmenting effects on habitat, particularly in the more remote habitats to the north and north-east, however species will still be able to move across these areas to access the remaining large forest compartments. There are also no identified large new 'greenfield' road development project in the AoI, with some road improvement projects planned which are unlikely to result in any new significant risks to species movement and habitat fragmentation. Transmission lines will also have a very minor effect.

Impact rating

Overall, the cumulative risk of linear electrification and road upgrade/developments in the AoI can be considered **low/minor**. Mining development in the AoI is likely to affect habitat and has the potential to possibly disrupt wildlife movement unless carefully planned and managed.

Mitigation of cumulative impact

- Combating cumulative forest fragmentation follows a similar approach as for Cumulative Impact 2 (forest habitat loss), addressed above.
- Avoid severing key wildlife movement corridors through the construction of impermeable barriers such as fences, walls, and other hard infrastructure.
- Support local and regional endeavors to restore landscape connectivity where possible, through innovative approaches to reforestation and wildlife corridor creation, for example.

9.8.2.4 Cumulative Impact 4: Regional loss of RDL species

Description

Cumulative impacts to the availability of forest habitat and increased habitat fragmentation (discussed above) could indirectly affect populations of species of conservation importance that are forest-dependent in the region. Local communities in the area have also been identified as being strongly reliant on the forest ecosystems in the region[149] and the illegal wildlife trade has also grown in the region, placing pressure on endangered species at risk of local extinctions and depleting wildlife densities (COMBO, 2022[150]), with the species targeted for commercial trade and most at risk being mostly soft-shelled turtles, monitors, snakes, pangolins, macaques, bears, otters, civets, mousedeer,

[148] Since the important faunal species identified for the area are predominantly forest-dependent, forest habitat fragmentation (as a result of the cumulative effect of existing land degradation and transformation by farming and the additional bisecting of forests by the new access roads and transmission line corridors) will result in reduced connectivity and may inhibit the movement of key species between habitats.

[149] Locals extract wood for construction, tool making and fuel and Non-Timber Forest Products ("NTFPs") such as plants for traditional medicine and food and wildlife for use as a source of protein. Since few rural households typically do not have surplus rice, vegetables or livestock to sell, much of the annual trade income for villagers is derived from the sale of natural resources found in the forest and sold at local markets. Wildlife hunting is a key activity for subsistence, recreation and to sell at markets (fueled by a considerable demand for animal products from neighboring countries) and overhunting of wildlife is considered a key threat (National University of Laos, 2008; COMBO, 2022).

[150] COMBO: The Conservation, Mitigation and Biodiversity Offsets Programe, (2020). Available online at: https://www.comboprogram.org/Where-we-work/Lao-PDR

muntjaks and all flying squirrels (National University of Laos, 2008). The majority of these have been recorded in the project area, are known from existing records or are predicted to occur. Many of the species under greatest hunting pressure, according to National University of Laos (2008) are also considered ecological "keystone" species, with important contributions to long-term forest health. There is therefore reason to believe that significant pressure already exists, posed by the illegal wildlife trade in the region.

Impact rating

Local villagers interviewed during the ESIA commented that they have noticed a decline in wildlife in the area of the Monsoon WF over the years. Over the project development area this is a pre-existing effect, the impacts of which are linked to ease of access and proximity to settlements. Most of the wind farm area is already subject to significant levels of biodiversity loss. Improved access to more remote areas will inadvertently make such habitats more susceptible to hunting and harvesting pressures, and this would apply to other development projects collectively in the region as well. Trans-border impacts associated with illegal wildlife trade, particularly for threatened species hunted in Lao PDR and transported for sale in Vietnam, also need to be considered. This impact, cumulatively speaking, could be potentially of relatively **moderate to high significance**.

Mitigation of cumulative impact 4

- Mitigation is proposed to manage existing access to more remote areas, whilst supporting local communities continued access to important trails connecting with Dak Cheung, and sustainable and legal use of forests;
- Ultimately, this requires a sensitive approach given that communities are strongly dependent on forest resources. Monsoon WF would need to work closely with communities in mitigating impacts, ensuring a transparent process is followed that is also inclusive. This is quite clearly articulated in the ESIA, particularly the sections on residual biodiversity impacts and recommendations around offset strategy.
- Other developments in the regions that could increase access to more remote forest habitats should adopt a similar approach.
- Addressing the illegal trade in threatened species requires a concerted effort from the Government of Lao PDR, in collaboration with the authorities in Vietnam, which realistically is outside of the scope of what this assessment and project can achieve.

9.8.2.5 Cumulative Impact 5: Reduction in ecosystem goods and services used by local communities

Description

Cumulative transformation of forest habitat will likely also lead to a reduction in the ecosystem services, such as the provision of timber and non-timber forest products. The physical footprint of the wind farm is relatively small, particularly when compared to projects such as mining, and therefore in isolation will be unlikely to significantly reduce ecosystem services. The main pathway for effects related to the wind farm would be if improved access to more intact parts of the project area lead to unstainable harvesting of forest resources. Future mining-related biodiversity impacts may be greater in comparison to the small scale/magnitude of impacts associated with the Monsoon WF and other wind farms, linear road upgrades and transmission lines in the region, and may also affect the quantity and quality of water.

Impact rating

Stakeholder engagement conducted for the CIA highlighted that local communities consider the natural resources associated with forests and wildlife to still be abundant in the region, despite obvious historical impacts, however the local people have witnessed a decreasing trend in the availability of key resources due to encroachment into forests, deforestation and cultivation activities and increased wildlife poaching (from both inside and outside of the local communities). The potential risk cumulatively should be considered at least **moderately significant** for the region and protecting and ensuring the sustainable use of the harvestable resources provided by forest ecosystems in supporting local livelihoods is considered regionally important.

Mitigation of cumulative impact 5

- Mitigating the cumulative loss of ecosystem services, provided particularly by the forest ecosystems to be impacted by Monsoon WF and bearing in mind the existing impacts to these ecosystems, requires a transparent and inclusive approach that considers the needs of the local communities in the area (as already discussed under Cumulative Impact 4).
- It is recommended that future development projects work together with communities to better understand their needs and reliance on key ecosystems goods and services, to identify key areas to protect and where conservation or even offset efforts should focus to maximize the delivery and support of ecosystems providing these services and to better understand trends in declining services and their causal factors.
- Alignment with existing community-driven projects that encourage conservation and sustainable use of forests will be key for the Monsoon WF project and other development projects in the region.

9.8.2.6 Cumulative Impact 6: Impact on biodiversity offset receiving area

Description

The potential Viet Phoung bauxite mine planned in the study area poses the risk of impacting on the proposed biodiversity offset receiving area for the Monsoon WF Project, which is located within the project area associated with the Dak Cheung Plateau KBA. Mining within the offset area or in adjacent areas would be counter-productive to the objectives and activities of the biodiversity offset, potentially threatening to oppose or undermine such objectives. Key to this would be the potential for further cumulative natural habitat loss, reduced connectivity between forest areas (particularly where offset activities would be looking to improve habitat condition, structure and connectivity) and noise/vibration/dust disturbance from mining that could affect faunal species use of the offset site.

Based on ERM’s understanding at this point, the planned Viet Phuong Bauxite mine is outside of the Dak Cheung plateau KBA and target offset site, such that direct impacts on the offset site are unlikely. Still, proximal indirect effects due to mining being within the vicinity of the offset site may occur in future, as discussed above.

Other mining projects in the area are only at MOU stages and after the CA effective date (target November), MWPCL has indicated that no other projects can be built within the Monsoon WF Project boundary, which includes the Dak Cheung plateau KBA and target offset site.

Impact rating

Overall, the cumulative risk of mining activities indirect impacts on habitat connectivity and disturbance of sensitive species, in future within the vicinity of the proposed biodiversity offset site, can be considered **moderate**. Whilst direct impacts are very unlikely and the offset site would ensure that mining does not take place in the final offset boundary, mining development in the region is likely to indirectly habitat connectivity in the broader area and has the potential to possibly disrupt wildlife movement unless carefully planned and managed.

Mitigation of cumulative impact 6

- Consultations with other parties looking to develop mining projects in the project area and near the offset site will be needed and the outcomes of these interactions may affect the precise boundary of the offset area, which has not yet been concretised and would reflect in revisions to the BAP as well as the final Offset Plan for implementation, at which stage the precise boundary of the offset will be finalised and agreed to by all parties.

- It is recommended that future development projects work together with communities to better understand their needs and reliance on ecosystems, to identify key areas to protect and where conservation or even offset efforts should focus.
- Other planned development projects in the region (including planned mining) should be encouraged to adopt a similar or even complementary approach to Monsoon WF where significant residual impacts remain, if cumulative forest losses at the regional level are to be appropriately addressed.
- Ultimately, development and land utilization projects need to ensure that they align with the goals and objectives of many of Government of Lao PDR's sustainable development strategy and policies, including:
  - The Forest Strategy 2020, with a rather ambitious target to recover a forest cover of 70% by 2020 (recently being revised to be achieved by 2025 in the forthcoming Forest Strategy 2030); and
  - The National Biodiversity Strategy and Action Plan for Lao PDR (NBSAP), and its 2016-2025 Action Plan, with a goal is to *"enhance the role of biodiversity as a national heritage and as a substantial contributor to poverty alleviation, as well as sustainable and resilient economic growth"*.

9.8.2.7 Cumulative Impact 7: Contribution to clean energy sector and move away from non-renewables (positive impact)

Description

Whilst the focus of much of the assessment has been on the identification and assessment of 'negative' impacts on biodiversity associated with the project and cumulative effects of other activities, wind energy projects such as this do typically have positive effects as well. One such effect is the potential to create more sustainable, renewable and clean energy and shift away from traditional approaches to energy production involving fossil fuels that are unsustainable, non-renewable and polluting. Cumulatively speaking, together with the numerous hydropower projects operating or planned in the region, renewable energy projects can be seen as having a positive biodiversity impact through their role in moving towards a low carbon economy, and reducing the effects global climate change may have on the region[151].

Impact rating

Replacing traditional approaches in the energy sector with less impactful solutions such as wind energy is documented to have a net positive impact on both global climate and biodiversity. The potential averted biodiversity loss that could be anticipated to occur in the project area or further afield from typical fossil-fuel extraction, processing and power-generation projects could be significant. However, this would typically need to be evaluated at national and global scales (possibly regional), which is beyond the scope of what this assessment can achieve. Such benefits are also inherently difficult to predict and quantify.

Mitigation of cumulative impact 7

None required.

[151] WWF, 2018. Wildlife in a Warming World: The effects of climate change on biodiversity in WWF's Priority Places. Available online at: https://www.wwf.org.uk/sites/default/files/2018-03/WWF_Wildlife_in_a_Warming_World.pdf

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

10.1 Introduction and Objectives

Through a systematic assessment, the ESIA has identified a number of significant environmental and social impacts, which 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 eliminate or reduce the adverse environmental and social impacts to acceptable levels and as low as reasonably practicable. These mitigation measures and the actions needed for implementation of these measures are presented in this Environmental and Social Management Plan (ESMP).

The key objectives of this Environmental and Management Plan (ESMP) are to:

- Demonstrate commitment to compliance with applicable laws, regulations and executed Project agreements through documented plans and procedures;
- Collate the various mitigation and management measures developed throughout the ESIA into a single point;
- Define monitoring requirements to determine the efficacy of all mitigation and management measures;
- Provide clear roles and responsibilities of all stakeholders as to what impacts have been identified, how they will be mitigated and managed, and through what means;
- 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;
- Ensure meaningful consultation and timely disclosure of information to affected people and during monitoring of project implementation; and
- Establish and maintain GRM processes suitable for affected people as well as for project workers.
- This section provides information and instruction on how environmental and social commitments of the Project will be managed from pre-construction through to the Construction and Operation phases. The ESMP is a living document, which:
- Incorporates the environment and social mitigation measures identified as a result of the ESIA process into a comprehensive framework to facilitate and ensure appropriate management throughout the Project cycle;
- Provides a framework for incorporating commitments into the Project plans and procedures for activities that have risks, as identified in the impact assessment;
- Presents responsibilities for meeting ESMP requirements including the provision of training;
- Provides a framework for the implementation of specific management plans by the EPC; and
- Defines the monitoring/verification and reporting program (including corrective actions).

10.2 Purpose of the ESMP

The purpose of this ESMP is to specify the standards and controls required to manage and monitor environmental and social impacts during construction and operation phase. To achieve this, the ESMP identifies potential adverse impacts from the planned activities and outlines mitigation measures required to reduce the likely negative effects on the physical, natural and social environment. When there are gaps between the local regulatory requirements and ADB's SPS, the Client will identify stakeholder engagement activities to enhance the formal regulatory process, and where appropriate, commit to supplemental actions. This emphasizes the importance of managing social and environmental performance throughout the lifecycle of the Project.

The ESMP consists of three primary components:

- The Construction Environmental and Social Management and Monitoring Plan (CESMMP), primarily for the construction contractors;
- The Operation Environmental and Social Management and Monitoring Plan (OESMMP), primarily for the facility operators; and
- The Project Owners Environmental and Social Management and Monitoring Plan for those plans and mitigation measures that are not covered by the CESMMP and OESMMP, such as the Initial Biodiversity Action Plan, Resettlement Plan.

10.3 ESMP Implementation

This section addresses the implementation of the ESMP, including responsibilities, staffing, and management of change.

10.3.1 Implementation Responsibilities

MWPCL as the Project Proponent is responsible for the overall Project monitoring, ensuring compliance with environmental policy and obligations in the ESMP. MWPCL has overall responsibility for ESMP implementation. MWPCL may assign some of these responsibilities to the Contractors, Operator, and the Project Engineer, but MWPCL retains ultimate responsibility for the effective implementation of the ESMP.

The overview organisation chart during construction phase and operation phase is shown in ***Figure 10.1*** and ***Figure 10.2***.

Figure 10.1: The Organisation Chart during Construction Phase

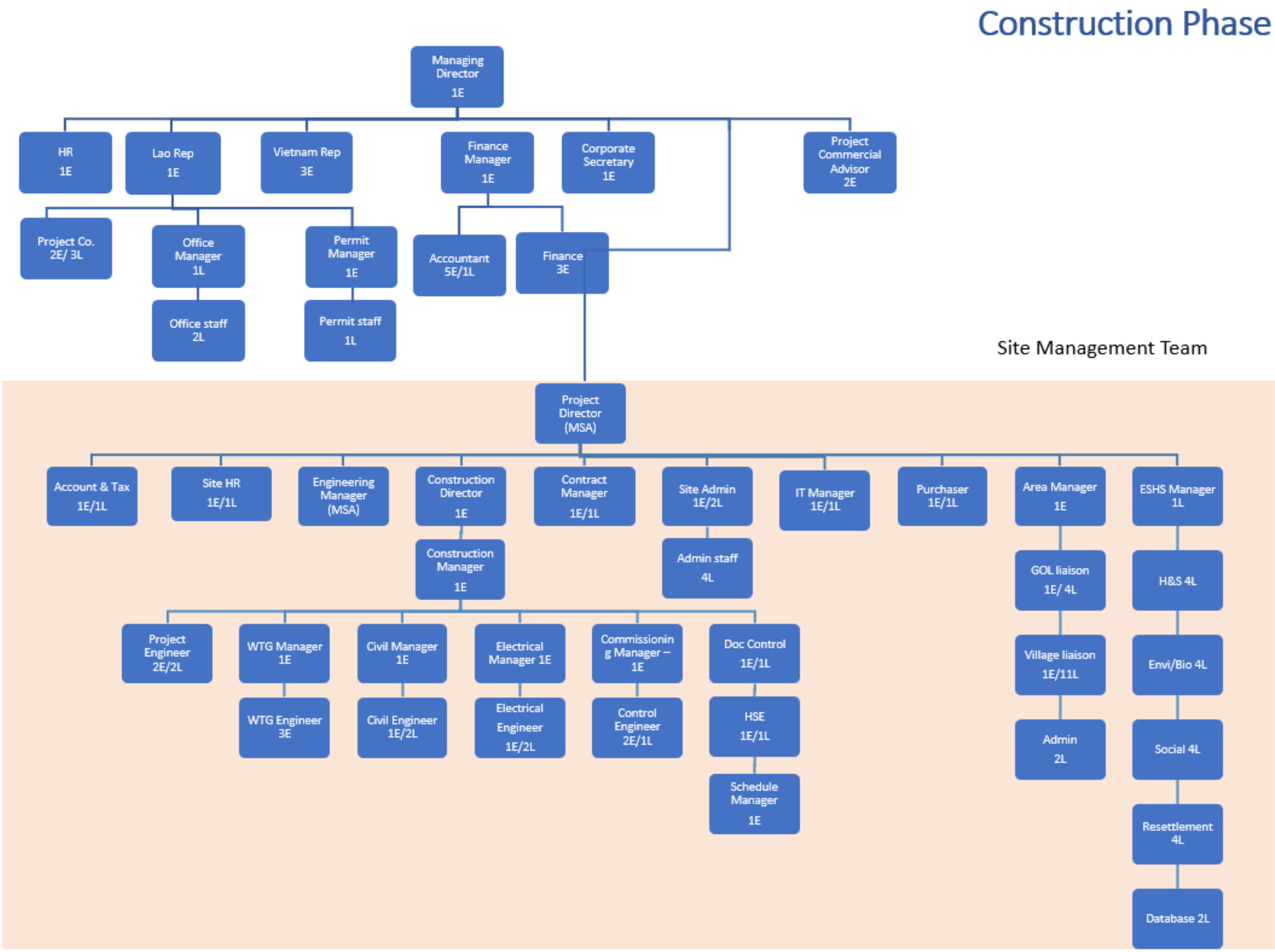
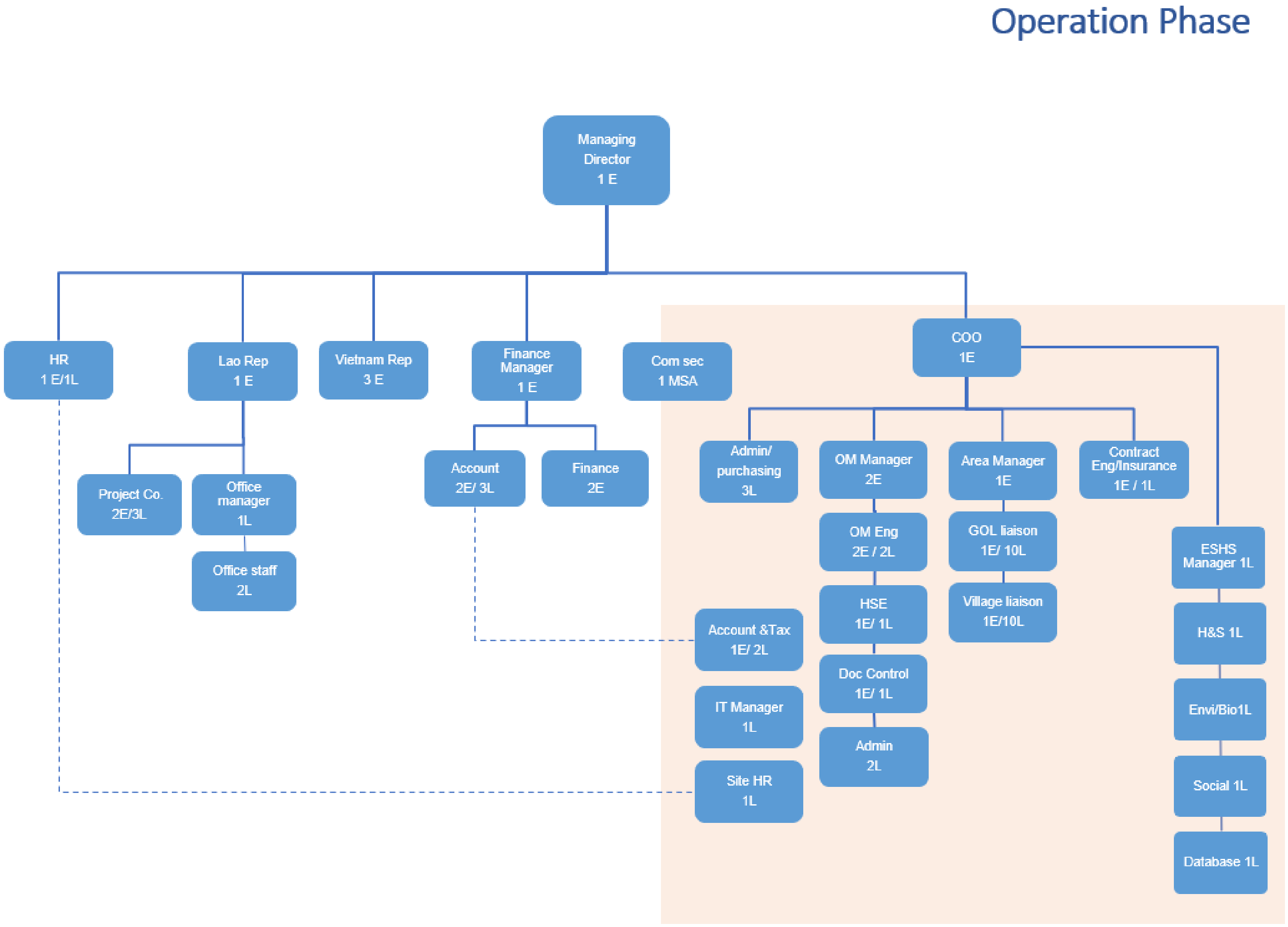


Figure 10.2: The Organisation Chart during Operation Phase



10.4 Structure of the ESMP

The structure of this ESMP includes:

- ESMP Implementation – including responsibilities, ESMP Staffing, and Management of Change;
- Training – including program and capacity;
- ESMP Audit, Reporting, and Corrective Action and Monitoring; and
- Outline of the ESMP including the construction and operational phase mitigation and management measures.

10.4.1 ESMP Staffing

As indicated above, MWPCL, the Project Engineer, the Construction Contractors, and Facility Operator will all have dedicated Environmental, Social, Health and Safety (ESHS) teams to support the implementation, monitoring, and/or oversight of mitigation measures.

10.4.1.1 MWPCL

The Role and Responsibility on Key roles and responsibilities for implementation, the actual management plan that needs to be developed following the guidance provided in this framework are outlined in ***Table 10.1***. MWPCL's ESHS Section will be supported by the Staff presented in the Organizational Organogram in ***Figure 10.1*** and ***Figure 10.2*** for the construction and operation phase. The ESHS Manager reports to Chief Operating Officer during the operation phase.
The MWPCL staff will include a series of environmental and social specialists that can be grouped into four teams:

- **The Core Management Team** consists of the ESHS manager and two Senior Managers (Senior Resettlement & Stakeholder and Senior Environment Monitoring Managers). These positions are full-time and based in Vientiane, with travel to the site at least 40%. The key tasks of the core team are (i) Provide guidance and supervise the site-based team in the implementation and monitoring of E&S activities, (ii) Provide coordination and engagement with stakeholders at all levels, including government counterparts, lenders, technical advisors, affected communities, contractors and the owner, (iii) responsible for reporting as required in the ESMF.
- **Site Based Team** consists of senior and officer positions as presented in green in the organization chart (***Figure 10.3***). These teams are full-time positions and site based. They will be implementing day-to-day activities under the supervision of the core management team.
- **The Support Team** consists of the Administrative/Finance Manager, based in Vientiane office (Orange in ***Figure 10.3***). There will be one site administrative officer to support the Site Based Team.
- **Resource Person/Specialist** (Biodiversity Specialist, GIS, Construction coordinator, and Information Management,) will be engaged part-time and presented in grey colour in ***Figure 10.3***. These positions will travel to the site from time to time as required by ESHS managers. Other conslutants/specialists such as ethnic minority specialist, communtty based forect management specialist may be engaged intermittently as needed during the course of project implementation.

As prescribed by the Annex C of the Concession Agreement, MWPCL will be responsible to establish an Environmental and Social Management Office (ESMO) within 45 days from the Effective Date. The ESMO consists of the Environmental Social Health and Safety (ESHS) Manager and the ESHS team presented in ***Figure 10.3.***

In addition, an EPC contractor will be involved during the construction phase of the project. A tentative organizational chart is presented in ***Figure 10.4***. Roles within the EPC contractor organizational chart but relevant to the management frameworks are included in the below ***Table 10.1***.

Figure 10.3: Proposed Environmental and Social Implementation Organization Chart

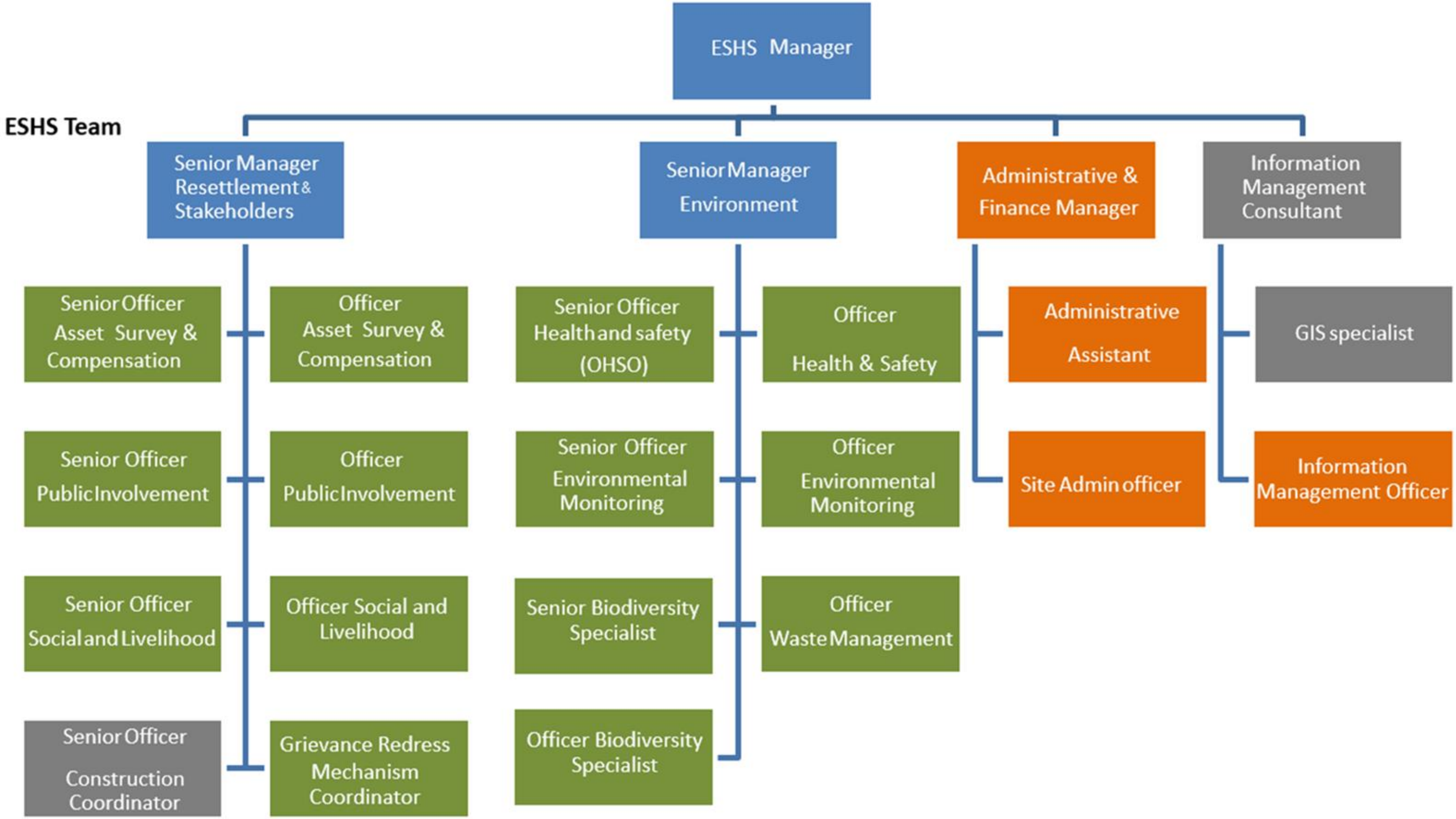


Figure 10.4 Tentative EPC Contractor Organizational Chart

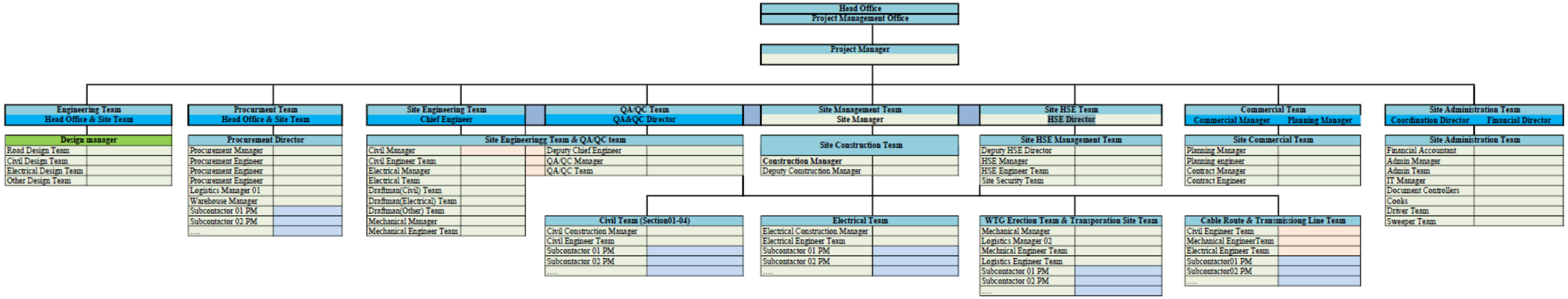


Table 10.1: Roles and Responsibilities

Role	Responsibilities
Project Director	■ Has overall accountability for ensuring the implementation of plan and Project compliance with the commitments set out within it. ■ Provide sign-off and regular revision sign-off. ■ Allocate financial and human resources and decision-making support required for plan implementation. ■ Lead annual reviews and revisions/updates of management plan.
ESHS Management Team	
ESHS Manager	■ Provide leadership, planning, and supervise the E&S team to implement the social and environmental activities according to the E&S obligation of the project. ■ Ensure the E&S activities are carried out effectively according to the CA and the ESMP and other relevant E&S documents, in line with lenders' requirements. ■ Consolidate and prepare E&S reports as required by the lenders ■ Provide coordination support to the ESHS managers in engagement with stakeholders to ensure that the E&S program activities run as agreed plan and budget. ■ Oversee the Project Grievance Redress Unit (PGRU) ■ Review and approval of the EPC contractors Management plan and ensure it meets project obligations and GIIP. ■ Report on progress in implementing management plan. ■ Oversee implementation of the ESMF and subplans ■ Manage overall environmental performance. ■ Management of ESHS Team and consultants ■ Report on progress to project Owner and Lenders. ■ Coordinate with the EPC and Owner's Engineer ■ Support Project compliance with the Project Standards and other environmental and health & safety-related requirements set out in this Plan. ■ Prepare SoP's for incident reporting and monitor strict compliance for implementation. ■ Design and implement an appropriate Training and Competency Building Program for staff and contractors, as well as visitors. ■ Ensures that appropriate training is provided to all MWPCL personnel and ensures that the MWPCL subcontractors are also providing the same level of training to their personnel (including Managers, Supervisors and Employees) so that these people have necessary skills and knowledge to implement and comply with requirements during construction and operation ■ Establish an EHSS systems, including appropriate organizational structure and responsibilities, to ensure their operations comply with MWPCL's policies and procedures, Senior Lenders' requirements, including requirements for community development aspects as set out in this framework and the workers code of conduct. ■ Ensure that EPC develops a QHSE Incident Reporting Database that tracks the number, type, location, severity etc of all incidents and maintains a record of the status of corrective action plan resulting from root cause analysis and critical analysis of any trends that may inform the need of refresher or improved training.
Senior Manager of Stakeholder, Resettlement, Social Development and Livelihood	■ Review and update all related social documents and work with stakeholders and area managers of the project to confirm the data/information before the civil construction.

Role	Responsibilities
	■ Responsible for overall planning and implementation of stakeholder engagement, Resettlement and land acquisition, social development (health, education, IP, vulnerable households), and Livelihood programs of the project. ■ Provide leadership and supervise resettlement, stakeholder engagement, livelihood restoration, and social development of senior officers and officers based at the site in implementing RP. ■ Responsible for coordinating public involvement, compensation for AHs, GRM resolution, and corrective action in complying with lenders' safeguard policy and requirements. ■ Responsible for social unit work activities, reporting to ESHS Manager.
Senior Manager of Environment	■ Review all related E&S documents and monitoring plans, including the ESIA, ESMP, ESMF, ESAP, and specific subplans and ESMMP-CP submitted by the EPC and their sub-contractors. ■ Ensure that the project's environmental performance is in compliance with MWPCL's and Senior Lenders' requirements. ■ Support the team leader in preparing E&S monitoring reports for the project.
Stakeholders, Resettlement, Social Development, and Livelihood Team	
Senior Officer Asset Survey & Compensation Officer Asset Survey & Compensation (2 people)	■ Conduct a detailed measurement survey (DMS) of affected assets and confirm the area of permanent and temporary loss of land and assets; ■ Conduct an asset registration survey/DMS, including a Social Economic Survey of Affected Households (SESAH), to confirm all impacted assets, impacted households, vulnerable households, and the number of severely affected households due to the loss of productive agricultural land and residential structures; ■ Provide maps with geo-references (e.g., MapInfo, GIS, AutoCAD) of the affected villages and all affected land (government and private own land) using unique household identifiers to link HH documents and surveys to land; ■ Provide photos of each affected household with their household ID ■ Prepare compensation agreement forms according to the impact assets ■ All documents (DMS, SESAH, compensation forms, grievances, etc.) should include household IDs on the papers and e-files in coordination with the information management team.
Senior Officer Public Involvement Officer Public Involvement (2 people)	■ Responsible for the overall implementation of SEP and GRM ■ Conduct meaningful consultations with the affected people and stakeholders. ■ Assist the stakeholder engagement manager in disseminating the cut-off date. ■ Ensure effective communication with the affected people and stakeholders. ■ Conduct public information dissemination and consultations with affected households and representatives of the ethnic groups. ■ Conduct regular field visits and, whenever necessary during construction, oversee the Resettlement Plan and Community and Ethnic Groups Development Plan implementation. ■ Track and organize records on the dissemination of information and public participation: (a) the number of public consultation meetings, (b) the number of affected households (AH) that

Role	Responsibilities
	participated, and (c) comments, suggestions, and concerns of the affected households and how these were addressed. ■ Ensure that appropriate Project information on environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format ■ Ensure a smooth transition period between the payment of compensation and assistance to the AHs before the start of civil works. ■ Ensure participation of women, ethnic AHs, and vulnerable AHs in meetings. ■ Provide a means for effective, culturally appropriate, and inclusive engagement and GRM for PAPs and other interested parties throughout the Project life cycle on issues that could potentially affect them ■ Agree on a worker's code of conduct with the affected communities ■ Reviewing, monitoring and reporting of the SEP and Grievance Mechanism ■ Investigating and responding to complex grievances and ensure grievances are solved in timely manner
GRM Coordinator	■ Records the concerns of women, ethnic affected households, and vulnerable households need in connection with their resettlement and resolution of their grievances. ■ Refer any potential community and worker related grievances to and ensure grievances are addressed by local committees effectively, appropriately and on due time. ■ Provide a means for effective, culturally appropriate, and inclusive engagement and GRM for PAPs and other interested parties throughout the Project life cycle on issues that could potentially affect them ■ Provide PAPs with accessible, culturally appropriate, and inclusive means to raise issues and grievances ■ Assign grievance and assign priority and responsibility ■ Conduct regular field visits and, whenever necessary during construction, oversee the Resettlement Plan and Community and Ethnic Groups Development Plan implementation ■ Investigating and responding to grievances and ensure grievances are solved in timely manner
Village Liaison (also referred to as Community Liaison Officers (CLOs))	■ CLOs act as the point of contact for community members and are responsible for the day-to-day stakeholder engagement activities. This position is preferably held by local villager who is aware of the community and local context. ■ Coordinate and ensure synergy between project and communities ■ Translate and communicate Project information in an ethnic language
Senior Officer Livelihood and Social Development Officer Livelihood and Social Development (2 people)	■ Assist the "Senior Manager Resettlement & Stakeholders" in developing a detailed Livelihood Restoration Plan (LRP) by considering a range of diverse livelihood options within the scope of livelihood components set out in the approved plan to restore AHs to the pre-project level. ■ Leading the consultation with AHs who has an agriculture land impact and other livelihood activities impacts (NTPF collection) and ensuring all categories of PAPs, including ethnic minority group, poor and vulnerable AHs. Women-headed AHs participate in livelihood consultation activities. ■ Conduct the implementation and monitoring of the LRP and enhance/improve livelihood through the designed and agreed Plans

Role	Responsibilities
	■ Assist "Senior Manager Resettlement & Stakeholders" in monitoring and assessing the LRP performance and target livelihood outputs. ■ Support social team/specialist in conducting social-economic survey and benchmark of livelihood restoration. ■ Provide livelihood activities monthly progress report to senior management.
Senior Officer Construction Coordinator (1 Part-time Consultant)	■ Coordinate and Work closely with the project management team and ESHS Manager and ESHS Team to ensure the E&S requirements, timeline and Procedure are integrated into the construction schedule. ■ Follow up with the contractor and project engineering team on any update of site-specific engineering design to update the impact and conduct E&S clearance and reporting. ■ Coordinate and Work closely with the project management team on the detailed construction schedule, site-specific engineering design, and layout to support E&S impact clearance and reporting
Environmental and H&S Monitoring Team	
Senior Officer Health and Safety *(Also referred to as Occupational Health and Safety Officer (OHSO) by Concession Agreement)*	■ Responsible for ensuring the safety and health of employees, workers, and communities during the construction of the Project. ■ Assess working conditions in various project components, identify safety and health-related issues and risk, and propose and implement solutions to mitigate those risks. ■ Supervise health and safety training and procedures of construction jobs, control of the working environment, emergency planning and management, and accident reporting procedures in the project. ■ Preparing and compiling the Quarterly Health and Safety reports. ■ Any additional responsibilities as prescribed by the Concession Agreement Annex C Paragraph 17 Occupational Health and Safety.
Officers Health and Safety *(The number of officers will depend on the number of workers, active construction sites and may vary over the course of the Project construction)*	■ Responsible for monitoring and assessing unsafe situations and developing measures to assure personnel safety. The Safety Officers ensure the Site Safety and Health Plan is prepared and implemented and ensures there are safety messages in each Incident Action Plan ■ Assesses health and safety risks arising from our work activities and develops and implements adequate controls. ■ Provides information, instruction, training, and supervision that is reasonably necessary to ensure that each worker is safe from injury and risks to health ■ Ensure all employees are competent to do their tasks and provides adequate training ■ Ensure facilities, equipment, and materials are properly maintained, handled, and utilized ■ Manage Safety Awareness across the project ■ Effectively implement safety policies and procedures ■ Manage Safety Documentation ■ Manage/ support work schedules to ensure the health and safety of the workforce is maintained.Monitors contractors/subcontractors' general H&S performance and takes necessary actions to strengthen their H&S management approach
Senior Officer Environmental Monitoring	■ Review the process of the Environmental and Social Management Plans

Role	Responsibilities
	■ Ensure the team conducts all the monitoring and reporting activities as set out in the Management Plans and successively reported. ■ Identify, monitor, and assess overall risks encountered during the project activities. ■ Prepare a report (weekly, monthly, quarterly, field monitoring) on the safeguard risks with appropriate actions to be taken for all sub-projects and ensure that timely measures are taken. ■ Manage Subcontractors conducting E&S works ■ Ensure potential hazards or risks identified are accurately reported and provide instruction for corrective actions to be undertaken. ■ Review of monthly reporting on Environmental and Social contents in the Monthly Progress Report, as per the EPC Contract. ■ Review the reports prepared by subcontractors/consultants before submittal to the Employer and its representatives.
Officer Environmental Monitoring Officer Waste Management (2 People)	■ Undertake field inspections and environmental and social monitoring as stated in the ESMPs, reporting any issues to the ESHS Manager. ■ Conduct all the monitoring and reporting activities in the Management Plans and successively report. ■ Prepare reports (weekly, monthly, field monitoring) on environmental issues. ■ Support the construction activities by adequately providing specific instructions/suggestions to workers. ■ Support the training and awareness programs delivered per schedule. ■ Report any non-compliances to the ESHS Manager
Senior Biodiversity Specialist	■ Monitor the collection of biodiversity data and ensure that data collection is accurate and reliable and data quality standards are met. ■ Record and categories species found in the project area based on their status per the IUCN system. ■ Overseeing the implementation of monitoring work in the project. ■ Support the construction activities by adequately providing specific instructions to workers on biodiversity protection. ■ Prepare and compile the biodiversity monitoring reports.
Biodiversity Officer	■ Support the activities of the Senior Biodiversity Specialist. ■ Prepare and compile the biodiversity monitoring reports. ■ Support training activities as necessary.
ESHS Advisors – Nation Advisor/Specialist	
Information Management Consultant	■ The Information Systems advisor will lead in developing an internal E&S documentation record and monitoring system. ■ Develop an information management system that includes a database of AHs data, linked forms, and documents for each AH-ID, including any grievance raised and resolution evidence. ■ Ensure information in the system is up to date and continue to support staff and management team on extracting information for reporting when required, such as the status of commitments obligations implementation status, and progress of E&S activities, etc. ■ Train and assist EHSD staff in understanding the process and action to be taken to provide inputs into the information management system.

Role	Responsibilities
	■ Provide guidance and supervise document control officer to register and implement registration of the events, correspondents with stakeholders, risk registration, and GRM record and resolution. ■ Supervise the recording, registering, and distribution of correspondence and documents issued during the development period of the Project ■ Train and help information management officers to perform their duties as necessary
GIS Specialist	■ Provide GIS survey, and Remote Sensing technology supports for E&S activities such as detail measurement survey (DMS), land-using planning, environmental monitoring, biology, and forest cover activities. ■ Support the E&S team in developing maps of land use planning and biodiversity. ■ Advise on GIS data record and analysis supporting the E&S work as ESHS managers require.
Ethnic Minority Specialist (intermittent)	■ Review and provide advice on CEGDP and SEP implementation particularly in preparing community development programs and monitoring and stakeholder engagement activities involving ethnic minorities
NTFP and community-based forest management program specialist (intermittent)	■ Review and provide advice on CEGDP implementation particularly on identification of suitable replacement NTFP collection areas and provide advisory support on livelihood programs and community-based forest management program
Biodiversity Expert (part-time International) *(Hired part time if/when required)*	■ Review and provide advice on the management of biodiversity risks and impacts on site during construction and initial operations, and on the design of the biodiversity offsets. ■ Provide training and build the capacity of the full-time team.
Construction Director	■ Review integration of E&S provisions in the final project design ■ Support review of the EHS commitment implementation during pre-construction and construction; ■ Conduct joint EHS inspections
MWPCL Finance Manager	■ Support engagement with local suppliers, including communication of Project tender process and contracting requirements. ■ Participate in capacity-building initiatives for local suppliers. ■ Coordinate with large Project contractors; communicate and enforce expectations around local employment and contracting. ■ Monitor compliance with this Framework through contractors and report on progress per monitoring Key Performance Indicators (KPIs).
All MWPCL Employees	■ Minimise the impact of their activities wherever practical and reasonable. ■ Comply with MWPCL company policies and procedures and with the requirements of this plan. ■ Report actual and potential project impacts to relevant supervisor. ■ Refer any potential grievances to the MWPCL GRM Coordinator.
All MWPCL Contractors and subcontractors	■ Ensure their operations comply with MWPCL's policies and procedures, including requirements for managing all aspects as set out in the Plan ■ Report actual and potential project impacts to relevant supervisor. ■ Report any known grievances to the GRM Coordinator.

Role	Responsibilities
EPC Contractor	
Logistics Manager	■ Is responsible for the Traffic Management Plan ■ Provides information of transport movement to Senior Officer Health and Safety and Senior Officer Public Involvement in a timely manner to minimize impacts to the community. ■ Minimise the impact of their activities on local communities in the Social AoI/social context wherever practical and reasonable.
Camp Manager/Site Security Team	■ Ensures day-to-day operation of the camp is aligned with relevant managements plans.
EPC Site HR Manager and Team	■ Is responsible for the Local Content and Influx Management Plan (including Labour Management Plan and Local Procurement Management Plan) ■ Ensure EPC and subcontractor compliance with Lao labor laws and internationally recognized core labor standards ■ Together with Site HSE Manager and team, monitor subcontractors' compliance with Workers Code of Conduct ■ Track, resolve worker grievances and maintain workers grievance logbook

10.4.1.2 Constructor Contractor

Each Construction Contractor will have an ESHS Team to prepare and implement the CESMMP. Each Contractor's ESHS Team will need to include a manager, who reports to their respective Construction Site Manager.

The contractor's ESHS Team will also have a senior environmental specialist, senior social/stakeholder specialist, and a senior OH&S specialist, as well as at least one staff level qualified and experienced specialists for each discipline (i.e., one environmental, one OH&S, and one social/stakeholder specialists), one each at each of the major work fronts.

The transmission line contractor's ESHS Team will have one environmental specialist, one social/stakeholder specialist, and one OH&S specialist.

Each contractor's ESHS manager will prepare monthly reports for MWPCL on the status of mitigation measure implementation, any ESHS-related incidents (e.g., spills, grievances, injuries), and the Project's overall ESHS performance.

10.4.1.3 Project Engineer

The Project Engineer,. The ESHS Team will be led by a manager (advanced degree in applicable subject and 10 years of experience who reports directly to the Project Engineer. The ESHS Team will have an environmental specialist, a social/stakeholder engagement specialist, a full-time Sediment and Erosion Control/Slope Stability Inspector, and an OH&S specialist all with appropriate education (BA/BS in applicable subject) and construction oversight experience (minimum 5 years of experience). The ESHS Team shall prepare monthly reports for MWPCL on the Project's ESHS performance.

10.4.1.4 Facility Operator

The Facility Operator will have an ESHS staff to implement the OESMMP and to monitor the Project's environmental and social performance. The ESHS staff shall include at least a qualified and experienced ESHS manager, supported by an environmental specialist, a biodiversity specialist, an H&S specialist, and two stakeholder/community relations specialists. The ESHS manager shall prepare monthly reports for MWPCL on the Project's ESHS performance.

10.4.2 Management of Change

The need may arise to modify the ESMP as work methods change or are amended or new work methods are added. This is part of and consistent with Adaptive Management approach. The ESMP shall not be weakened, all changes shall maintain or strengthen the level of environmental and social protection. The process below establishes Management of Change requirements for any and all changes to the ESMP.

The Owner may propose changes to the ESMP when it is reasonably likely that the current ESMP is not sufficient to prevent:

- Serious health and safety incidents
- Environmental and social impacts greater than those disclosed in the ESIA;
- New impacts not disclosed in the ESIA;
- Violation of Laos law;
- Non-conformance with Lenders requirements

The ADB can also propose changes to the ESMP if it is clear from the Owners reports or the ADB inspections that the risks identified above may occur. In the event of non-conformance with Lender policies and requirements, the Lender's may withhold disbursements.

The Owner will notify the ADB of any proposed changes to the ESMP and obtain their approval before implementing any changes. The Owner will respond to any changes proposed by the ADB and obtain their approval. The Owner will maintain a current copy of the ESMP. The Owner will ensure that each ESHS manager/officer has ready access to the current version of the ESMP through a document control system that prevents inappropriate reference to the wrong version of the plan.

10.5 Training Program and Capacity Building

10.5.1 Construction Phase

Prior to commencement of major civil works at site, a suitably qualified in-house/ external expert will be appointed by the EPC contractor to develop and deliver a training program on implementation of the ESMP, monitoring and reporting will be conducted in line with the applicable reference framework for the Project. The training will include the following topics:

- Environment, Health and Safety Policy of the EPC contractor;
- Environment and fundamentals of environmental pollution in relation to the Project;
- EHS management plans prepared by the EPC Contractor;
- Do's and Don'ts for the construction workers;
- Safety procedures and guidelines;
- Internal reporting and response system;
- Hazardous chemicals and waste handling;

UXO Awareness and Chance Find Procedure;In addition, specific training will be provided to the team involved in environmental and social monitoring and reporting, which will include:

- Applicable environmental and social guidelines and standards;
- Sampling site selection guidelines in line with environmental monitoring plan;
- Sample collection, storage, transportation and analysis procedures;
- Solid and hazardous waste management;
- Quality assurance and quality control;

- Environmental monitoring report preparation

The training will help in capacity building and implementation of the ESMP during the construction phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project. The timeframe for reporting and verification during the construction phase will be agreed between MWPCL, ADB, and the EPC.

10.5.2 Operation Phase

Prior to the commencement of Project operation, a suitably qualified in-house/ external environmental expert will be engaged to develop and deliver a training program on operation phase environmental and social monitoring and reporting. The topics will be mostly same as that during the construction phase. However, it will also include following modules, which are specific to the operation phase:

- Hazardous chemicals and waste management;
- Occupational health and safety programs, including Emergency Response Plan for both employee and nearby communities;

The training will help in capacity building and implementation of the ESMP during the operation phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental and social performance of the Project. The timeframe for reporting and verification during the construction phase will be agreed between MWPCL and ADB.

10.6 ESMP Audit, Reporting, and Corrective Actions

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 EHS requirements and environment and social commitments. The inspections and audits will be done by the project identified EHS staff in coordination with O&M contractors and other external agencies identified. The entire process of monitoring and audits should being documented.

MWPCL 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 checklist, incident record register, environmental and social performance reports (weekly, monthly, and quarterly, half-yearly, or yearly etc.). According to ADB’s Safeguard Policy requirements, the reporting for Environment and Social Performance should be conducted and submitted to ADB on semi-annual basis.

10.7 Outline of the ESMP

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 ESIA was approved. The ESMP will include mitigation measures proposed in local ESIA as well as responsibilities to supervise and implement the ESMP, which is presented in ***Table 10.2*** and ***Table 10.3***, for construction and operational phases respectively.

Standalone management plans will be required for the Project. These will include :

- Community Health and Safety Management Plan
- Occupational Health and Safety Management Plan
- Traffic Management Plan
- Worker's Camp Management Plan
- Construction Material Sourcing Plan
- Air Quality Management Plan

- Water Quality Management Plan
- Hazardous Materials Management Plan
- Waste Management Plan
- Noise and Vibration Management Plan
- Spoil Management Plan
- Soil Erosion and Sediment Control Management Plan
- Site Restoration Management Plan
- Local Content and Influx Management Plan (including Labour Management Plan and Local Procurement Management Plan)
- Cultural Heritage Management Plan
- Emergency Preparedness and Response Plan
- Stakeholder Engagement Plan and Grievance Redress Mechanism
- Resettlement Plan
- Community and Ethnic Group Development Plan
- Initial Biodiversity Action Plan
- Unexploded Ordinance Survey and Clearance Plan

Table 10.2: Outline of Project Construction Environmental and Social Management and Monitoring Plan (CESMMP)

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
9.3.2	**Topography**							
	Potential impacts to topography, as a result of construction activities and physical presence of the Project	■ Avoid carrying out earthwork during heavy rainfall, which will lead to erosion	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ After completing construction work, earth filling and compacting must be performed	N.A	EPC Contractor	Site Audit	After Construction	Audit Reports	Included in EPC costs.
		■ Prepare and implement a Site Restoration Management Plan.	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	Site Restoration Management Plan.	Included in EPC costs.
		■ Conduct area clearance or cutting of trees in the Project footprint / Concession Area only	N.A	EPC Contractor	Site Audit	During Pre-Construction	Audit Reports	Included in EPC costs.
		■ Define the operation area clearly by designing the use of road and temporary space for the installation of the WTG in each point in order to minimize the impact to the topography of the area	N.A	EPC Contractor, HSE Team	Site Audit	During Pre-Construction	Audit Reports	Included in EPC costs.
		■ After the construction, conduct restoration of the area and return the landscape to the original condition as much as possible	N.A	EPC Contractor, HSE Team	Site Audit	After Construction	Audit Reports	Included in EPC costs.
		■ Assign staff to regularly conduct inspection and audit of the construction area	N.A	EPC Contractor, HSE Team	Site Audit	During Pre-Construction and Construction	Audit Reports	Included in EPC costs.
		■ Provide appropriate slope protection and drainage controls	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
9.3.3	**Geology and Soil**							
	Potential impacts on soil due to soil erosion and compaction, due to earthworks and use of heavy machinery.	■ Prepare and implement and Spoil Management Plan and Soil Erosion and Sediment Control Management Plan prior to construction. ■ Update the Spoil Management Plan following the results of POPs analysis in soil. If POPs are identified in soil, spoil must be treated as hazardous waste.	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	Spoil Management Plan and Soil Erosion and Sediment Control Management Plan	Included in EPC costs.
		■ In areas that are high risk for erosion, where high risk is defined as land that floods at least three times annually; arrange earthwork in the dry season and avoid the rainy season, where possible, as the main cause of soil erosion along the side of	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		water canal and non-asphalted roads during rainy season is rainfall						
		■ Undertake the earthwork within the Project footprint	N.A	EPC Contractor	Site Audit	During Pre-Construction and Construction	Audit Reports	Included in EPC costs.
		■ The stockpiling of the construction materials must be kept at least 30 m from rivers and waterways with the intention that they do not impede or concentrate the overland flow during rainfall events or cause the creation of ponding	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Ensure that the construction materials are stored in designated areas or in a secured place, and are not causing obstruction or located in areas of potential soil erosion	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Construct a suitable drainage system specifically in areas of high potential soil erosion	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Monitoring / auditing conducted to inspect erosion control measures	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Avoid earthworks in existing forest areas as much as possible	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Replantation to be conducted as soon as possible after completion of forest clearance or backfilling work. The success of revegetation work will depend on species selection, planting into soil rather than spoil, protection from livestock grazing, and watering as required by seasonal conditions. This will be included in the restoration plan	N.A	EPC Contractor	Site Audit	After Construction	Audit Reports	Included in EPC costs.
		■ Avoid digging and removal of stockpiling of soil at the sides of the stream or canal in order to prevent sedimentation and erosion into the water sources	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Conduct backfilling and compacting using heavy machinery to prevent the collapse of the soil as soon as possible after earthworks	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Undertake erosion protection for WTG foundations and transmission towers that are located in a slope area	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Undertake construction of a water drainage system at both sides of the access road to facilitate draining of water	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ A Waste Management Plan (WMP) for the Project should be developed and implemented. The WMP should include the following: - Good housekeeping practices for waste storage and handling referencing good international industry practice (GIIP); - A waste inventory developed in the planning stage, in discussion with the engineers, to establish the types of wastes (hazardous and non-hazardous) expected from the construction and to identify appropriate disposal routes; - Construction materials should be managed in a way to avoid over-ordering, poor storage and maintenance, mishandling as well as improper operation procedures; - Construction wastes should be separated into reusable items and materials to be disposed of or recycled whenever possible; - Waste suitable for reuse should be stored on site and reintroduced to the construction process as and when required; - The WMP should identify disposal routes (including transport options and disposal sites) for all wastes generated during the construction phase and operation phase. This should comply with applicable local regulations; - A hazardous waste management system covering waste classification (including hazardous chemical waste), separation, collection, storage, transfer and disposal should be set up and operated. The waste management system should comply with applicable regulation of the Laotian law or GIIP, depending on which has a higher standard; - Hazardous waste should be stored in such a way as to prevent and control accidental release to the environment (e.g. secondary containment, sealed containers); - As the Project is responsible for its waste management to the point where it foresees that waste is appropriately disposed in a benign manner, it should see to that waste is collected and shall be disposed (whether temporary or permanent) in landfills (designed, sited, constructed, and managed in accordance with the requirements as mentioned in CA) to minimize contact with water during normal and abnormal weather events, and with environmental controls in place, including run-on/run-off controls, liners, leachate collection systems, groundwater monitoring, closure	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	Waste Management Plan (WMP)	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		controls, daily (or other operational) cover, and fugitive dust controls; - Recyclables such as scrap steel, metals, plastics, and paper items should be collected for recycling wherever possible; - Disposal of construction waste in or off the construction site should be prohibited; - Chain of custody documents should be used for construction waste and hazardous waste to monitor disposal; and - Waste segregation should be practiced at the labour camp with an emphasis placed on reducing, reusing and recycling of waste streams as appropriate.						
		■ The access route for movement of heavy machinery will be designated to avoid the soil compaction in other areas.	N.A	EPC Contractor, HSE Team	Site Audit	Prior to Construction	Audit Reports	Included in EPC costs.
		■ Conduct monitoring of Total Suspended Solids (TSS) at nearby water sources.	Total Suspended Solids (TSS) at nearby water sources.	EPC Contractor, HSE Team	Site Audit	Prior to Construction	Audit Reports	Included in EPC costs.
		■ Conduct pre-construction soil sampling in accordance with the approved Soil Sampling Plan to identify the potential presence of Persistent Organic Pollutants (POPs), which may include PCBs, dibenzofurans, and dioxins. If POPs are identified in the soil, the spoil will be treated as hazardous waste and will need to be managed and disposed of according to GIIP.	Polychlorinated Biphenyls (PCBs), Pesticides – Organochlorine Group 1, PCDDs and PCDFs (Dioxins and Furans), and Herbicides at location identified in the soil sampling plan	EPC Contractor, HSE Team	Site Audit	Prior to Construction	Audit Reports	Included in EPC costs.
9.3.4	**Air Quality**							
	Fugitive dust emission causing degradation in ambient air quality from land preparation and civil work. Potential impacts on air quality due to improper transportation of personnel and material by land.	■ Reduce the speed of vehicles: to mitigate the potential occurrence of dust from the transportation of construction materials to the project construction site, it is required to limit and control the speed of vehicles arriving to and leaving the affected villages area at not exceeding 20 km/hour	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ The roads within the project area should be paved. If the road isn't paved, it is required to regularly spray water at least two times per day, especially roads that pass through villages and access roads to the construction sites	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ In the construction area, areas located near the communities, it is required to build a 2 m height of fence around the site to reduce dust dispersion from soil digging, removing, dumping, and filling works if the construction site is within 500 m of communities	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ The construction contractor must regularly undertake maintenance of vehicles and heavy machinery of all types which are used in the construction of the project	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Vehicles transporting construction materials must be properly covered, particularly the transportation of soil, sand, and gravel to the construction site	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Conduct pre-construction soil sampling in accordance with the approved Soil Sampling Plan to identify the potential presence of Persistent Organic Pollutants (POPs), which may include PCBs, dibenzofurans, and dioxins. If POPs are identified in the soil, the spoil will be treated as hazardous waste and will need to be managed and disposed of according to country requirements and Project hazardous waste management plan	Sampling locations refer to the soil sampling plan.	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Have a wheel washing facility on exit from the site for vehicles to prevent the vehicles from carrying mud or sediment to outside construction site and communities	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Training should be organized and staff and workers to be prohibited from burning rubbish and wastes that will cause potential air pollution	N.A	EPC Contractor, HSE Team	Site Audit	Prior to Construction	Audit Reports	Included in HSE Team costs.
		■ Prioritise materials to be supplied by local suppliers (Laos suppliers)	N.A	EPC Contractor	Site Audit	Prior to Construction	Audit Reports	Included in EPC costs.
		■ Water sprays should be applied at land preparation area, access roads and any other exposed surfaces which could be source of dust are to be watered	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Construction material at the storage area will be covered to minimize dust dispersion during construction	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ No open burning of and materials including cleared vegetation. Cleared vegetation will either be composed or reused for stabilization purposes	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Vehicles transporting materials within or outside the construction site will not to be overloaded	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Vehicle engines need to be properly maintained to ensure minimization in vehicular emissions	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Use of modern equipment and vehicles meeting appropriate emissions standards, and regular preventative maintenance	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Minimizing stockpiling by coordinating excavations, spreading, and regrading and compaction activities. Stockpile is to be covered if materials are stored over a period exceeding a week or two weeks	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ No waste is to be burnt	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Prepare and Implement and Air Quality Management Plan prior to construction.	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	Air Quality Management Plan	Included in EPC costs.
		■ Conduct air quality monitoring as per recommendations in the local ESIA (2020)	Monitoring the air quality at sensitive area (e.g. TSP, PM-10, SO_2, NO_2 and CO_2) as per the requirements of the Local EIA (EIA, 2022).	HSE Team / Third Party	Monitoring results	During Construction – monthly.	Air Quality Management Plan	Estimated in local EIA (2020) at 20,000 USD for 3 years.
9.3.5	**Ambient Noise**							
	Impact to noise due to site preparation, installation of WTGs, and transmission lines, and vehicle use.	■ Conduct noise monitoring as per the recommendations in the local EIA report (EIA, 2022).	Use standard equipment for noise and vibration measurement. For the determination of measurement points, it is required to take the place of heavy work, area of heavy transportation, village areas surrounding the project.	HSE Team / Third Party	Monitoring results	During Construction – monthly.	Audit Reports	Estimated in local EIA (EIA, 2022) at 20,000 USD for 3 years.
		■ 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:	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		- Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		- 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	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		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	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		- Prepare and Implement and Noise and Vibration Management Plan	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	Noise and Vibration Management Plan	Included in EPC costs.
		■ 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	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Ensure the appropriate personal protective equipment (PPE) and necessary response supplies are available at the construction site, in good condition, and workers are trained in their proper use and maintenance.	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ EPC contractor shall place the machine with high noise level to avoid sensitive receptor. The machine layout plan will be prepared by EPC Contractor and the noise monitoring at sensitive receptors shall be conducted as per ***Table 9-23***.	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ High noise-generating construction works and activities should be limited to the daytime period (7 AM to 10 PM), and work should be avoided on Sundays or public holidays if possible. In the case that Project activities necessarily have to be conducted on Sundays or public holidays, the Project will consult with village heads for approval	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		Any works that are required during the night-time period (10 PM to 7 AM) should be justified and task-specific noise mitigation and management measures should be implemented to reduce noise impacts to acceptable levels. These additional measures should consider the potential for sleep disturbance impacts that could occur during the night-time period due to “peak” or “maximum” noise level events e.g. metal on metal contact, or general clangs and bangs. In the case that Project activities necessarily have to be conducted during night-time period, the Project will consult with village heads for approval	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ 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	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ 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	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ 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	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
9.3.6	**Surface Water Quality**							
	Potential impacts during construction phase from civil construction, and waste management on nearby water sources	■ Control of sedimentation and water turbidity: the project must avoid undertaking construction and installation near water sources, where possible; and proper drainage management plan diverting upstream clean runoff from disturbed areas should be implemented. Install sediment retention ponds or other measures to manage dirty runoff	N.A.	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ No washing vehicles of all types and construction equipment at rivers or streams in the project area	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Toilets for workers should be provided. A proper wastewater treatment system should be installed for batching plants and camp sites and complies with the environmental engineering techniques and will be located far from the river to avoid and reduce contaminated water released into the river	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ EPC contractor will implement systematic sewage treatment measures as follows: - The implementation of package treatment system of adequate proportion to the maximum anticipated wastewater production rates; - EPC contractor will hire professional environmental companies or contractors (If any) to design local sewage treatment facilities to meet the local sewage discharge standards; - After the completion of the sewage treatment design and construction, EPC contractor will test and monitor the discharged sewage to confirm/satisfy the discharge standard; - Experienced environmental engineers will be assigned to manage and monitor sewage discharge to avoid the complication with the requirement of the contract. - - Comply with the waste management requirements outlined in the ESMF and ESMP	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ A drainage system ould be installed and collected wastewater into the wastewater treatment system	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ All sources of water supply will be surveyed and identified particularly those close to project facilities or will be traversed by the internal road system which will be constructed. Any impact on water supply due to project activities should be compensated/replaced. All details of the survey will be updated in Water Quality Management Plan.	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ In case it is necessary for the project to pump water from the streams, rivers, lakes and groundwater in the Project area, the Project should prepare and implement a water use plan. This plan must be communicated and agreed with the local people and with the District and Provincial Authorities. Additionally, the Project will comply with the requirements outlined in the sub-plan in the ESMF and the EPC's Water Quality Management Plan.	N.A	EPC Contractor, HSE Team	Water Use Plan	Prior to Construction	Water Use Plan	Included in EPC costs.
		■ A Waste Management Plan will be prepared for the Project	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	Waste Management Plan (WMP)	Included in EPC costs.
		■ A Drainage management plan will be prepared by EPC for the Project that should be included diversion of clean runoff from "dirty" or disturbed areas, containment, treatment and reuse of wastewater from batching plants	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Construction workers will be given training about water conservation and encouraged for optimal use of water	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Optimum use of water during sprinkling on roads for dust settlement, concrete mixing for WTG foundation, etc.	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Regular inspection for identification of water leakages and preventing wastage of water from water tankers	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Recycling and reusing water to the extent possible	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Conduct water quality monitoring as per the recommendations of the local EIA Report (EIA, 2022)	Conduct monitoring for temperature, pH, Dissolved oxygen (DO), Biological Oxygen Demand (BOD5), Total Suspended Solid (TSS), Total and Total Dissolved, Oil and Grease, and Faecal coliforms	HSE Team / Third Party	Monitoring results	During Construction – every 3 months.	Audit Reports	Estimated in local EIA (EIA, 2022) at 20,000 USD for 3 years (combined with Water Monitoring).
9.3.7	**Landscape Values and Visual Amenity**							
	Impacts from installation of WTG and transmission lines on visual amenity and landscape value	■ Demarcate construction boundaries and minimize areas of surface disturbance	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Where possible, locate laydown areas and construction camps in areas that are already disturbed or cleared of vegetation	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ For the construction site maintenance, conduct good housekeeping on site to avoid litter and minimize waste	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Use existing tracks/roads for access, where possible	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Within the environmental management system, prepare a restoration management plan including replanting indigenous species, and landscaping and rehabilitating construction yards	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Where possible, locate laydown areas and construction camps in areas that are already disturbed or cleared of vegetation	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		■ Minimize night lighting while guaranteeing the minimum safety level	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		▪ Use of materials that will minimize light reflection should be used for all Project components	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		▪ Bright patterns and obvious logos should be avoided on WTG	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
		▪ Existing vegetation should be retained to the greatest extent possible. Vegetation should be retained along roads, and other Project infrastructure.	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in EPC costs.
9.4	**Biodiversity**							
	Impacts to forest vegetation and habitat: *includes direct and indirect transformation and/or disturbance and loss of ecosystem services*	▪ Demarcate areas to be cleared in advance with tape or fencing, to avoid inadvertent additional clearing. Monitor habitat clearance closely during construction to minimise risk of inadvertent additional clearing.	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in HSE Team costs
		▪ ECoW[152] accompanied by an ecologist to follow a pre-clearance procedure to undertake re-siting or, if not feasible, micro-siting of all cleared areas (e.g., construction camps, batching plants, turbines, substations and roads) to avoid or - if not feasible - minimize loss of Natural Habitat and of areas where Critical Habitat-qualifying species are actually or likely to be present. Where there is limited room for movement of pre-agreed infrastructure locations such as wind turbines, or roads between them, the focus will be on identification of opportunities for micro-siting (i.e., movement of infrastructure <300m). Where infrastructure is far more location-flexible - as is the case, for example, with powerline routes, camps, laydown areas, spoil areas, batching plants, production areas and quarries - full opportunities will be considered for micro- and larger-scale resiting of such infrastructure. Where full avoidance of Natural Habitat and of areas with Critical Habitat-qualifying species is not possible, constraints that make micro-siting impossible (e.g., topography) will be clearly documented	Natural forest habitat	HSE Team	Site Audi	Prior to construction	Audit Reports	Included in HSE Team costs

[152] An Ecological Clerk of Works (ECoW) oversees construction activities in ecologically sensitive areas to ensure that construction works follow a pre-determined methodology designed to prevent significant ecological impacts. Competent ECoWs can effectively oversee the management of the risks on construction sites associated with managing biodiversity and can help to ensure a smooth and cost-efficient construction process.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Closely align powerlines to follow existing road/powerline corridors, in order to avoid or minimize additional loss of Natural Habitat.	Natural forest habitat	HSE Team	Site Audi	Prior to construction	Audit Reports	Included in HSE Team costs
		■ Pylons in the AZE Phou Ahyon are to be located in sufficient distance (50 m) to the stream within the AZE[153].	Natural forest habitat	HSE Team	Site Audi	Prior to construction	Audit Reports	Included in HSE Team costs
		■ Avoid locating construction camps and material/equipment laydown areas within 200 m of a Natural Habitat	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Compile and implement Construction Method Statement for working in natural habitats.	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Prior to construction During construction	Audit Reports Construction Method Statement for working in natural forests	Included in EPC / HSE Team costs
		■ Compile and implement a post-construction rehabilitation plan for temporary areas used during construction.	N.A	EPC Contractor / HSE Team	Site Audit	Post-construction	Audit Reports Post-construction Rehabilitation Plan	Included in EPC / HSE Team costs
		■ Use existing access roads wherever possible.	N.A	EPC Contractor	Site Audit	During construction	Audit Reports	Included in EPC costs
		■ Limit the clearing of natural vegetation to the absolute minimum necessary to complete the works.	N.A	EPC Contractor	Site Audit	During construction	Audit Reports	Included in EPC costs
		■ Demarcate the construction zone or servitude for corridors on a map and on the ground clearly using high visibility tape for instance, to avoid impacting on sensitive areas outside of the permitted construction area	N.A	EPC Contractor	Site Audit	Prior to construction	Audit Reports	Included in EPC costs
		■ Creation of suitable alternative habitats or enhancement of existing ones to support displaced species.	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports Access Management Plan	Included in EPC / HSE Team costs

153 Initially, a 20m conservation buffer zone was advised by ERM, based on the available information on the species (i.e. found occurring within 15m of steep mountain streams - Stuart et al., 2012). However, given the cryptic nature of this species and with little available information on its behaviour and ecological/habitat requirements, a more conservative and precautionary buffer width of 50 m was advised by ADB and has been included in the BAP mitigation.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Rehabilitate and revegetate temporary-use, construction site camps and lay down areas as soon as reasonably practicable after construction activities have been completed.	N.A	EPC Contractor	Site Audit	Post-construction	Audit Reports	Included in EPC costs
		■ Develop and implement appropriate access management plans and suitable control measures to restrict access and unnecessary disturbance of natural habitat. Access restrictions will need to be in place from the earliest stages of construction in order that local people do not become accustomed to using new roads which will later be closed and rehabilitated.	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports Access Management Plan	Included in EPC / HSE Team costs
		■ Rehabilitate edges of natural habitat impacted and exposed to disturbance.	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Post-construction	Audit Reports	Included in EPC / HSE Team costs
		■ Adhere to applicable national laws regarding impacts to the environment and ensure any relevant permitting/licensing processes are followed.	Natural forest habitat	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Where known known CH-qualifying species, CR/EN species and any species potentially 'new to science' occur and are at risk of being destroyed, prepare and implement a protected plant rescue and translocation plan and programme.	Natural forest habitat	HSE Team	Site Audit	Prior to construction	Audit Reports Protected plant rescue and translocation plan	Included in HSE Team costs
	Impacts to watercourses (streams/rivers)	■ Avoid locating pylons supporting transmission lines within stream/river beds, rather place these away from the stream banks and ensure the line is suspended across the stream/river channel for the entire span of the stream/river. Place pylons above known river floodlines or flood risk areas.	Watercourses (stream/river crossings)	MWPCL	Site Audit	Design phase	Audit Reports	Included in design costs
		■ Implement relevant construction standards to minimise risk of erosion and sedimentation (e.g. DEFRA, 2009).	Watercourses (stream crossings) DEFRA (Department of Environmental, Food and Rural Affairs). (2009). Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Available online[154])	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs

[154] https://www.assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Remediate any soils, watercourses or habitats where spills take place.	Remediate any soils, watercourses or habitats where spills take place.	Watercourses (stream crossings)	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Implement best practice stream crossing design and construction, taking into account the sizing of any pipe culverts and placement on the channel bed and not at height. This is to be informed by good practice guidelines for the design of river crossings, such as SEPA (2010).	Watercourses (stream crossings) SEPA: Scottish Environmental Protection Agency. (2010). Engineering in the Water Environment: Good Practice Guide: River Crossings. Second Edition. November 2010. (Available online[155])	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Compile and implement appropriate Construction Method Statement for working in watercourses (for implementation at all stream crossings). This is to be informed by good practice guidelines on construction methods, such as SEPA (2009).	Watercourses (stream crossings) SEPA: Scottish Environmental Protection Agency. (2009). Engineering in the Water Environment: Good Practice Guide: Temporary Construction Methods. First Edition. March 2009. (Available online[156])	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports Construction Method Statement for working in watercourses (streams)	Included in EPC / HSE Team costs
		■ The TL at the stream crossing location will span the entire width of the stream channel and associated instream/riparian vegetation and potential habitat for freshwater frog species, and that pylons be positioned outside of the stream and adjacent areas	Watercourses (stream crossings)	HSE Team	Site Audi	Prior to construction	Audit Reports	Included in HSE Team costs
		■ A pre-construction survey be undertaken at the stream crossing location to search for the presence of *L. xanthops* and document locations and potential habitat for this species	Watercourses (stream crossings)	HSE Team	Site Audi	Prior to construction	Audit Reports	Included in HSE Team costs
		■ Compile and implement a suitable post-construction rehabilitation plan for stream beds and banks modified but not entirely transformed by construction activities. Any bare soil	Watercourses (stream crossings)	EPC Contractor / HSE Team	Site Audit	Post-construction	Audit Reports	Included in EPC / HSE Team costs

155 https://www.sepa.org.uk/media/ 151036/wat-sg-25.pdf
156 https://www.sepa.org.uk/media/150997/wat_sg_29.pdf

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		surfaces need to be revegetated as soon as practically possible to reduce erosion risk.						
		■ Implement relevant construction standards (e.g. '[Construction Code of Practice for the Sustainable Use of Soils on Construction Sites': publishing.service.gov.uk](publishing.service.gov.uk)).	Watercourses (stream crossings)	EPC Contractor / HSE Team	Site Audit	Post-construction	Audit Reports	Included in EPC / HSE Team costs
		■ Roads to cross streams at right-angles only.	Watercourses (stream crossings)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Do not place more fill material within the stream channel than what is necessary. Remove any excess fill or material from the channel bed, taking care not to disturb the natural channel bed and bank profiles.	Watercourses	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Only one road crossing to be constructed at a time as the construction front progresses.	Watercourses (stream crossings)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Avoid any unnecessary crossings of streams/rivers and stick to only the planned and agreed to crossings.	Watercourses (stream crossings)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Any bare soil surfaces need to be revegetated as soon as practically possible to reduce erosion risk.	Watercourses (stream crossings)	EPC Contractor / HSE Tea	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Install sufficient drainage works under all access roads, to reduce freshwater habitat fragmentation, avoid flooding land and damaging nearby waterbodies.	Watercourses (stream crossings)	EPC Contractor / HSE Tea	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
	Impacts to fauna (wildlife): *includes direct impacts, collisions, reduced habitat connectivity, barriers to species movement and increased hunting pressure*	■ Sweep through areas prior to construction to flush animals from habitats likely to be directly affected. The ECoW will need to be accompanied by relevant faunal ecologists/experts to advise on the approach and methods to flushing out wildlife sensibly without causing additional impacts. ■ Monitor impact of vehicle traffic on local wildlife, including recording collisions leading to fatality/injury or near collisions and the circumstances leading up to incidents and investigate further ways to reduce risk of impact.	Fauna (wildlife)	EPC Contractor / HSE Team / Faunal ecologists or experts	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Access controls to be implemented along access roads which enter areas of natural habitat, with a particular focus on restricting uncontrolled access to the lesser-impacted primary forest habitat.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Schedule habitat clearance, grading and road construction activities outside of CH-qualifying and CR/EN species' breeding periods where known.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Enforce good conduct by construction workers, including prohibition of hunting, trapping, fishing, possession or trading of wild plants or animals and general harassment of wild animals, subject to a penalty of immediate dismissal or similar.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Illegal activities such as hunting of wildlife or collecting of forest species is to be discussed with construction workers and such activities are to be prohibited.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Implement safe transmission and distribution lines, with anti-electrocution measures (insulation and spacing of conductors) that eliminate electrocution risk for birds. ■ Allow for a minimum spacing of 1m between power cables to safeguard known bat species from electrocution risk. ■ Install bird flight diverters (BFDs: hanging or spiral diverters) along conductors of all project transmission lines in the vicinity of natural forest habitat and between larger forest patches where birds are likely to move locally, with spacing according to GIIP guidance (e.g. APLIC, 2012). This is initially estimated to comprise 20-25km of lines. ■ Provide deterrents at key positions along the transmission lines where visibility is poor and particularly where less disturbed, larger forest habitats are encountered (e.g. line markers / flight diverters at 15m intervals where hornbill activity has been recorded associated with Wet Evergreen Forest habitat). This will also be based on an adaptive management approach and implemented on a case-by-case basis for specific sections of powerline where high fauna mortalities due to collisions are recorded in long-term annual monitoring. ■ An adaptive management approach is recommended to refine measures where necessary based on collisions/mortalities recorded in long-term annual monitoring.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Shepherding protocol to be prepared and implemented where road construction takes place, to check areas to be worked in prior to construction and remove or shepherd wildlife to safety in adjoining forest or habitat. Species considered to be dangerous or poisonous/venomous to be handled by professionals. Workers are to be trained in the identification of common dangerous/poisonous/venomous wildlife such as snakes, spiders, etc. and measures to avoid hazards associated with these species, as part of the EPC contractors site inductions and training plan.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Implement an annual monitoring plan focused on investigating fatalities during period of heightened bird/bat activity (seasonally relevant).	Fauna (wildlife)	HSE Team	Site Audit	Prior to completion of construction	Audit Reports , Monitoring Reports	Included in EPC / HSE Team costs
		■ Given the constraints in predicting bat fatality impacts prior to operation of the WF (see Table 8.48), it will be necessary to undertake further operational monitoring to confirm operational impacts and to inform appropriate mitigation options.	Fauna (wildlife)	HSE Team	Site Audit	Prior to completion of construction	Audit Reports , Monitoring Reports	Included in EPC / HSE Team costs
		■ Prepare and implement a precautionary and adaptive management plan to be informed by long-term annual bat/bird carcass monitoring, to determine where additional mitigation may be necessary for specific turbines/clusters of turbines, such as: adjusting turbine cut-in speeds (increased) for site-specific and seasonal bat activity peaks, feathering of turbine blades, auditory deterrents and/or painting of alternate turbine blades to increase visibility for birds. An ecologist / biodiversity specialist will need to be appointed to develop the adaptive management plan	Fauna (wildlife)	HSE Team	Site Audit	Prior to completion of construction	Audit Reports , Monitoring Reports	Included in EPC / HSE Team costs
		■ Use existing access roads or upgrade existing roads wherever possible before considered new access road construction.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Limit vehicle speed to 15km/hr on site for all contractor and subcontractor vehicles, as well as any non-Project vehicles allowed on access roads, to reduce risk of vehicular collisions with wildlife.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Place appropriate limits on the number of vehicle movements to and from the wind farm (e.g. maximum of 5 vehicles allowed within a 1-hour window).	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Restrict vehicles to the use of only authorised access roads	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Restrict activities to daytime hours when visibility is good and to limit risk of impact to nocturnal species of fauna.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Aim lights downwards and away from forest habitats. Use appropriate lighting that minimises ecological effects on wildlife and also limits attraction of insects e.g. use of long-wavelength (warm white, orange, red and infra-red) light instead of short-wavelength (UV, cool white, blue and green LEDs).	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Maintain vehicles and equipment in good working condition.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Maintain connectivity around or across linear infrastructure (roads primarily) through use of appropriate animal crossings suitable for small mammals and slow-moving reptiles such as tortoises in particular. ■ An ecologist / biodiversity specialist will be appointed to advise on where appropriate animal crossings for new access roads could be considered necessary and to provide recommendations for design of wildlife crossings. ■ Piped or box culverts, for example at crossings of stream channels, can also have the dual function as wildlife underpasses. Arboreal crossings may be used to facilitate primate movement across roads and between forest patches. ■ Where there are key connections between forest habitats that access roads may sever, these will be key locations for considering wildlife crossings, which will be confirmed during pre-construction survey.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Consider alternative wind farm layouts to minimise barriers to species movement. The alignment of turbines parallel to and not across known bird flight paths or general flight directions should be investigated. ■ Arrange turbines in clusters to reduce overall footprint. ■ Maintain connectivity around or across linear infrastructure (roads primarily) through use of appropriate animal crossings suitable for small mammals and slow-moving reptiles such as tortoises in particular. ■ Look at a single construction camp, sited in a least sensitive and already disturbed area and avoid developing multiple camp sites. ■ Use existing access roads or upgrade existing roads wherever possible before considered new access road construction. ■ Develop protocols for capturing or herding animals found in construction areas where these unable to exit by themselves. Species considered to be dangerous or poisonous/venomous to be handled by professionals.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Sequencing of construction activities to avoid construction activities and multiple teams at multiple sites, to reduce the impact spread and rather concentrate temporary impacts at key	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		points and advance to new areas only once construction at the previous site has been completed.						
		■ Avoid placing impermeable fences that could interfere with species movement.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	During construction	Audit Reports	Included in EPC / HSE Team costs
		■ Any temporary excavations, fences or stockpiles of soil and materials must be removed from site once construction is complete.	Fauna (wildlife)	EPC Contractor / HSE Team	Site Audit	Post-construction	Audit Reports	Included in EPC / HSE Team costs
		For works withiin the Phou Ahyon AZE: - Undertake pre-construction amphibian survey focusing on *L. xanthops* at the TL stream crossing location within Phou Ahyon KBA and AZE. - Position of transmission towers outside of the identified stream crossing habitat (50 m from stream channel either side) to avoid direct impacts. - Use the existing access roads and avoid new crossings of the stream channel and avoid widening of any existing crossings where practically possible and without comprising health and safety requriements. - - Mitigation to be detailed in the initial BAP, with actions required, timeframes and key roles and responsibilities clarified.	Fauna (wildlife)	EPC Contractor / HSE Team / Faunal ecologists or experts	Site Audit	Prior to construction	Pre-construction survey report(s) Audit Reports	Included in EPC / HSE Team costs
	Invasive Alien Plant impacts	■ Compile and implement a suitable Invasive Alien Plant (IAP) species control plan and programme to eradicate dense colonies of alien plants and control the spread of minor species and weeds. This plan must include wash stations to remove seeds from vehicle tyres and underbody.	N.A	EPC Contractor / HSE Team	Site Audit	Prior to construction	Audit Reports	Included in EPC / HSE Team costs
		■ Monitor IAPs using a suitable plan.	N.A	EPC Contractor / HSE Team	Site Audit	Post-construction	Audit Reports Monitoring Plan for IAPs	Included in EPC / HSE Team costs
9.5.2	**Economic Opportunities**							
	Job creation and training from the project	A Local Content and Influx Management Plan will be prepared to maximise the local employment and training opportunities afforded to the affected villagers. ■ The responsibilities and management practices associated with the management of labour during construction and operation of the Project. ■ A hiring policy that reinforces the Project's preference to employ local workers and undertake procurement from local businesses,	N.A	HSE Team / EPC Contractor	ESMS	Prior to construction	Local Content and Influx Management Plan	Included in EPC costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		where possible. The policy will be a tiered system where the hiring preference will be as follows: – Villagers from within the AoI; – Villagers from the Dakcheung District or Sanxay District; and – Villagers from the Sekong Province or Attapeu Province. ■ A training program targeting skills required for affected villagers to participate in unskilled, and potentially semi-skilled, work for the Project. ■ A communications strategy to notify affected villagers of employment and procurement opportunities in advance. This will enable villagers and businesses to be prepare for the application process (e.g. contracting requirements, assistance with application, etc.).						
		■ A Community Development Plan (CEGDP), which incorporates the Ethnic Group Development Plan (as the majority of the affected villagers are ethnic minorities) will be prepared to guide the implementation of suitable programs to support affected villagers.	N.A	MWPCL	ESMS	Prior to Construction	Community Development Plan	Included in EPC costs
		■ The management of increased access within the Dak Cheung and Sanxay Districts, and restriction to high biodiversity areas, will be managed via the ESMS.	N.A	HSE Team / EPC Contractor	ESMS	Prior to Construction	Local Content and Influx Management Plan	Included in EPC costs
9.5.3	**Economic Displacement and Livelihoods**							
	Impacts to livelihoods and economy from the Project	■ The Project layout (including access road and transmission line routes) has been optimised to avoid physical displacement of villagers. Agricultural land and NTFP collection area were also considered in the design process, and while unable to be avoided, the Project has minimised the magnitude of land acquisition and resettlement.	N.A	HSE Team	N.A	During Design Phase	N.A	N.A
		■ A Resettlement Plan will be developed in response to the Project causing economic displacement and impacts to livelihoods. The Resettlement Plan will be prepared in consultation with the Government of Laos, and will define persons entitled to compensation, principles of compensation, methods of valuing affected assets, resettlement process and tools, grievance process, institutional arrangement for resettlement planning and implementation.	N.A	HSE Team	ESMS	Prior to Construction Construction	Local Content and Influx Management Plan	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
9.5.4	**Community Health and Safety**							
	Impacts to communities from construction of the Project facilities	A Stakeholder Engagement Plan (SEP) will be prepared: The SEP will describe how Project stakeholders will be engaged throughout the Project lifecycle. The SEP will establish a systematic approach to stakeholder engagement that will help the Project build and maintain a constructive relationship with stakeholders. It will also ensure that Project information on environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format. An example of a program to be implemented as part of the SEP is a community environmental and safety awareness program, which seeks to enable villagers to understand and identify construction risks, and how to stay safe.	N.A	HSE Team / EPC Contractor	ESMS	Prior to construction	SEP	Included in EPC costs
		A Community Health and Safety Management Plan will be prepared**:** Sets out the agreed controls and mitigation measures to protect the health and safety villagers in the AoI The Plan will also include provisions for: ■ Fencing and/or security to prevent community members from accessing the construction site; ■ Identifying and being aware of traffic hazards involving villagers; ■ Requirements for construction workers to notify villager heads of key construction activities such as: - Deliveries of wind turbines and other large objects; - High volumes of truck movements; and ■ Activities potentially causing noise, vibrations and/or dust. ■ Potential presence of UXO including chance find procedure	N.A	HSE Team / EPC Contractor	ESMS	Prior to construction	Community Health and Safety Management Plan	Included in EPC costs
		■ An Occupational Health and Safety Management Plan will be prepared**:** Sets forth the agreed controls and mitigation measures to protect the health and safety of workers. This will include: - Screening of migrant workers prior to entering Laos to ensure they are fit to undertake their relevant tasks/roles. - Safety audits which will occur during the construction and operation of the Project, to ensure safety procedures are complied with. - Induction and Training requirements for all workers, including site-specific induction and training to highlight safety risks and mitigations, and task-specific training (e.g. complying with speed limits, etc.).	N.A	HSE Team / EPC Contractor	ESMS	Prior to construction	Occupational Health and Safety Management Plan	Included in EPC costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		- Measures to mitigate against the spread of COVID-19 amongst workers, and from workers to other villagers.						

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
9.5.5	**Worker Influx**							
	Influx of workers can affect local communities with increase in diseases and safety issues.	■ A number of legislative requirements exist to protect local and migrant workers, which all employers must comply with	N.A	EPC Contractor, HSE Team	Site Audit	During Construction and Operation	Employment Contracts	Included in HSE Team costs
		■ Local Content and Influx Management Plan: - Set out the responsibilities and management practices associated with the management of labour during construction and operation of the Project. This will include the Workers Code of Conduct, which identifies behavioural standards and cultural awareness requirements for all workers (including security personnel) to comply with - Workers Code of Conduct, and the Project will establish advisory services on safe sex for workers as well as health care provision (incorporated within typical health checks and on an as needs basis).	N.A	EPC Contractor, HSE Team	Site Audit	During Construction and Operation	Employment Contracts	Included in HSE Team costs
		■ The EPC Contractor plans to have a healthcare facility at each camp, which includes a nurse/doctor to treat workers directly whenever possible (specified in the EPC contractor contracts). These healthcare personnel workers will be recruited from outside the AoI to avoid impacting existing providers. This will reduce pressure on the local healthcare facilities.	N.A	EPC Contractor	Site Audit	During Construction	N.A	Included in EPC costs
		■ Prepare a Workers' Camp Management Plan: The operation of the workers' accommodation facility will be governed by the Workers' Camp Management Plan, and will include aspects such as details of the services and facilities available, hygiene standards, and healthcare provision for Project workers. The audit requirements of the accommodation facilities will also be outlined.	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	SEP	Included in EPC costs
9.5.7	**Ethnic Groups**							
	Impacts to ethnic groups from the construction and operation of the Project	■ The Project places a strong emphasis on respecting the cultures and customs of the villagers, and has been participating in various rituals as part of granting access and permission to undertake technical studies to support the ESIA. This will be formalised as part of a management plan to apply to all workers.	N.A	HSE Team	Site Audit	During Construction and Operation	Audit Reports	Included in HSE Team costs
		■ Promote ethnic cultures through Project activities in collaboration with the Project affected communities	N.A	MWPCL	Site Audit	During Construction and Operation	Engagement records	Included in HSE Team costs
		■ Implement CEGDP to improve the livelihoods of ethnic groups including providing ethnic women with economic development opportunities	N.A	MWPCL	Site Audit	During Construction and Operation	Development programs	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Implement measures to remove obstacles for ethnic minorities to participate in Project activities and decision-making, including impact mitigation and benefits	N.A	MWPCL	Site Audit	During Construction and Operation	Audit Reports	Included in HSE Team costs
		■ Provide a grievance redress mechanism and appeal process for the Project-affected persons that is culturally appropriate.	N.A	MWPCL	Site Audit	During Construction and Operation	Grievance Mechanism	Included in HSE Team costs
		■ The Local Content and Influx Management Plan will include the Workers Code of Conduct that will include cultural awareness requirements for all workers	N.A	EPC Contractor	Site Audit	During Construction	N.A	Included in EPC costs
9.5.8	**Cultural Heritage**							
	Impacts to local culture(tangible and intangible)	A cultural heritage Management Plan will be prepared to guide the workers on the protection of cultural heritage sites, structures and values that may be impacted by the Project. In the first instance, the cultural heritage protocol will require: ■ Pre-construction survey. This will build on existing field data, to identify the presence of tangible and intangible cultural heritage resources ■ Project design to avoid and minimize impacts to cultural heritage resources. Workers camps, spoil disposal sites, laydown areas and other ancillary facilities will be located away from any cultural heritage sites. ■ Further consultation with the villagers and seek permission from the village leaders, elders and the broader community to enter and utilise the sacred areas that overlap with the Project footprint. Document the consent process and the consent itself. ■ The Project will perform required rituals or provide budget for the villages to perform rituals prior to accessing Phou Koungking and Dak Bong cemetery ■ The Project will plan Project activities to avoid activities that involve the use of large equipment and machinery which may cause noise and dust disturbance to the nearby villages during their ceremonies and festivals.. ■ Sacred sites, burial grounds in the forest, cemeteries, sacred trees and will be marked and labelled prohibited for entry (no-go zones) by workers ■ Establish a Chance Finds Procedure that will guide workers in the event that potential cultural heritage is encountered.	N.A	HSE Team / EPC Contractor	ESMS	Prior to Construction	Cultural Heritage Management Plan	Included in EPC costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
9.6.1	**Climate Change**							
	Impacts on climate change	■ During construction phase, avoid burning in area clearance activities that may lead to occurrence of fire which may, in turn, lead to burning of forests	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Land preparation and construction work to avoid cutting of trees or removal of plant species within and outside of the concession area	N.A	EPC Contractor	Site Audit	During Pre-Construction	Audit Reports	Included in HSE Team costs
		■ Ensure the maintenance of construction machinery and equipment to keep them in good conditions to ensure efficiency, as lower efficiency machineries generally emit higher CO_2	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Avoid emissions of CO_2 in excessive of specified standards	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Issue the rules to prevent staff and workers from burning waste within construction area	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ The planned area for vegetation clearance plan linked to the construction works need to be clearly determined and demarcated by landmark to avoid accidental clearance. Site clearance plan should be prepared to identify areas that will be retained with natural vegetation within the Site's boundaries.	N.A	EPC Contractor	Site Audit	During Pre-Construction	Audit Reports	Included in HSE Team costs
		■ Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged or associated with the Project, with sanctions, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation	N.A	EPC Contractor	Site Audit	During Pre-Construction	Audit Reports	Included in HSE Team costs
		■ The Project should consider carbon offsetting for lost vegetation to the Project forest clearing such as re-forestation in other areas	N.A	EPC Contractor	Site Audit	During Pre-Construction	Audit Reports	Included in HSE Team costs
		■ Use high fuel-efficient machineries and engines, lowest sulphur diesel commercially available and develop and implement preventive maintenance plan for machines, and engines to ensure combustion efficiency	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Develop vehicle maintenance plan and transport planning for construction to avoid unnecessary trips	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Ensure that construction work is done within designated construction areas and avoid trees removal outside of construction area	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Develop rules to prevent burning of waste within the construction area by Project workers	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
9.6.2	**Risks from Climate Change**							
	Water Availability	■ Whenever the project is required to pump water from the stream in the Project area for construction, a water use plan will be required and notified to the local people. This should be coordinated with the State agency of the district and provincial levels	N.A	EPC Contractor	Site Audit	During Construction	Engagement Records	Included in HSE Team costs
		■ Provide clean water for use for consumption to construction workers	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ The water availability related issues should be monitored and tracked closely	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Implement water saving technologies for domestic water usage within project	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
	Riverine Floods	■ When a rainstorm warning is received, consider suspending operations and transfer personnel to safe location	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
		■ Review meteorological information regularly, and take precautions against possible floods, landslides, mudslides, and other disasters	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
		■ Monitor flood situation at the Site. If any significant floods events affecting the physical infrastructure, operations, and health and safety are observed in future, detailed studies may be considered for flood mitigation measures	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
	Landslides	■ Review meteorological information regularly, and take precautions against possible floods, landslides, mudslides, and other disasters	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs
		■ Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms	N.A	EPC Contractor, HSE Team	ESMS	Prior to Construction	ERP	Included in EPC and HSE Team costs
		■ Avoid undertaking earthwork during heavy rainfall that can cause erosion; perform backfilling and compacting work after completing the construction; replantation in suitable areas where possible	N.A	EPC Contractor	Site Audit	During Construction	Audit Reports	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
	Extreme Heat	■ Worker's resting areas, on-site offices, worker's quarters should be constructed with heat resisting material to keep the indoor temperature lower.	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
		■ A heat stress management plan should be prepared as part of standard operations and safety procedures.	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
		■ Train workers to identify the symptoms of heat stress and first aid.	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
		■ Make appropriate considerations while designing the cooling systems (if required).	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
	Wild Fire	■ Ensure lightning protection grounding of the wind turbine. A metal air termination system is installed at the blade tip. A copper conductor is used to reliability connect the air termination system to the lightening lead on hub	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC and HSE Team costs
		■ Develop and maintain fire lines around the important assets	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Report	Included in EPC and HSE Team costs
		■ Develop and maintain vegetation clearances with respect to prevailing standards and regulations	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Report	Included in EPC and HSE Team costs
	Lighting and Storms	■ Ensure design according to IEC-61400-24 to achieve Grade I lighting protection to wind turbine the cross-sectional area of blade lighting protection copper conductor should not be less than 50mm^2	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Design information	Included in EPC and HSE Team costs
9.7	**Unplanned Events**							
	General	■ The Project will implement the SEP and a robust stakeholder engagement program 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	N.A	EPC Contractor, HSE Team	ESMS	Prior to construction	SEP	Included in EPC costs
		Prepare and implement an Emergency Preparedness and Response Plan (EPRP) to cover accidental and emergency situations. This Plan will include leaks and spill, collisions, natural hazards, and fire and explosions (including UXO) and will also 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; and	N.A	EPC Contractor, HSE Team	ESMS	Prior to construction	EPRP	Included in EPC costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Training: employees and contractors will be trained in emergency response procedures. ■ Auditing: audit records will be maintained on how the Plan is being implemented.						
	Leaks and Spills	■ 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)	N.A	EPC Contractor, HSE Team	Site Audit	Prior to Construction	Audit Reports	Included in HSE Team costs
		■ Ensure good inspection and maintenance procedures for large mobile construction plant to minimize small leaks and spills	N.A	EPC Contractor, HSE Team	Site Audit	During Pre-Construction	Audit Reports	Included in EPC and HSE Team costs
		■ Monthly monitoring the implementation of all proposed mitigation measures specified in Emergency Preparedness and Response Plan should be conducted properly	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
		■ Daily inspection of any secondary containment of oil/chemical on site and ensure good maintenance procedures to minimize small leaks and spills.	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
	Vehicle Collisions	Developed and implemented a Traffic Management Plan (TMP). This should include measures such as: ■ Active traffic controls (e.g. flaggers to direct traffic at the Project site entrance); and ■ Schedule construction deliveries and employee shift changes to minimize traffic congestion and delay	N.A	EPC Contractor, HSE Team	ESMS	Prior to construction	TMP	Included in EPC costs
		■ Design an H&S plan and good safety practices for the transportation (e.g. alcohol policy, good driving practice).	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
		■ Upgrade the access road to the Project site	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
		■ Monthly monitoring the implementation of all proposed mitigation measures specified in the Traffic Management Plan (TMP) should be conducted	N.A	EPC Contractor, HSE Team	ESMS	Prior to construction	TMP	Included in EPC costs
		■ Regular road condition monitoring along the transportation route to understand road quality during construction phase	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
	Fire and Explosions	■ Contact relevant authority bodies and conduct the UXO clearance	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Engagement Records	Included in EPC costs
		■ Implement on-site prevention measures such as (i) Equip the site with proper equipment (such as fire extinguishers, proper communication equipment) and regularly inspect and maintain	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		them; (ii) Prepare the Fire prevention and Fighting Plan that ensure compliance and Fighting; (iii) Conduct firefighting training to the emergency support team, contractors and workers on site and camping areas						
	Natural Hazards	■ Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
		■ Implement periodic routine inspection and maintenance procedures (in line with international best practice)	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs
		■ Install warning system, signal boards, flood prevention systems.	N.A	EPC Contractor, HSE Team	Site Audit	During Construction	Audit Reports	Included in EPC costs

Table 10.3: Outline of Project Operational Environmental and Social Management and Monitoring Plan (OESMMP)

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
9.3.5	**Ambient Noise**							
	Impact to noise due to site preparation, installation of WTGs, and transmission lines, and vehicle use.	■ Noise monitoring should be conducted regularly, particularly during the night time, to check compliance with the noise criteria, and where exceedance are detected, additional mitigation measures should be implemented	Use standard equipment for noise and vibration measurement. To be conducted in nearest receptor.	HSE Team / Third Party	Monitoring results	During Operation – monthly at start of operations.	Audit Report	Estimated in local EIA (EIA, 2022) at 50,000 USD for 25 years.
9.3.6	**Surface Water Quality**							
	Potential impacts during construction phase from civil construction, and waste management on nearby water sources	■ Toilets for workers should be provided. A proper wastewater treatment system should be installed for batching plants and camp sites and complies with the environmental engineering techniques and will be located far from the river to avoid and reduce contaminated water released into the river	N.A	HSE Team (MWPCL)	Site Audit	During Operation	Audit Report	Included in HSE Team costs.
		■ A drainage system should be installed and collected wastewater into the wastewater treatment system	N.A	HSE Team (MWPCL)	Site Audit	During Operation	Audit Report	Included in HSE Team costs.
		■ All sources of water supply will be surveyed and identified particularly those close to project facilities or will be traversed by the internal road system which will be constructed. Any impact on water supply due to project activities should be compensated/replaced. All details of the survey will be updated in Water Quality Management Plan.	N.A	HSE Team (MWPCL)	Site Audit	During Operation	Audit Report	Included in HSE Team costs.
		■ In case it is necessary for the project to pump water from the stream in the Project area, the Project should prepare and implement a water use plan. This plan must be communicated and agreed with the local people and with the District and Provincial Authorities. Additionally, the Project will comply with the requirements outlined in the sub-plan in the ESMF and the EPC's Water Quality Management Plan.	N.A	HSE Team (MWPCL)	Water Use Plan	Prior to Operation	Water Use Plan	Included in HSE Team costs.
		■ A Waste Management Plan will be prepared for the Project	N.A	HSE Team (MWPCL)	Site ESMS	Prior to Operation	WMP	Included in HSE Team costs.
9.3.7	**Landscape Values and Visual Amenity**							

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
	Impacts from installation of WTG and transmission lines on visual amenity and landscape value	■ Minimize night lighting while guaranteeing the minimum safety level	N.A	HSE Team (MWPCL)	Site Audit	During Operation	Audit Report	Included in HSE Team costs.
		■ Use of materials that will minimize light reflection should be used for all Project components	N.A	HSE Team (MWPCL)	Site Audit	During Operation	Audit Report	Included in HSE Team costs.
		■ The replacement of wind turbines with visually different wind turbines can result in visual clutter, therefore wind turbines with the same or a visually similar model should be used for replacements	N.A	HSE Team (MWPCL)	Site Audit	During Operation	Audit Report	Included in HSE Team costs.
9.3.8	**Shadow flicker**							
	Impact of operation of WTGs causing shadow flicker to nearby receptors	■ Visual Screening (Natural) – Continuously assess identified and any potentially sensitive receptors, where shadow flicker modelling indicates the amount could exceed 30 hours per year and 30 minutes per day, to ascertain the extent of existing natural visual screening in place. If not existing, the occurrence of shadow flickering during operation could be further investigated, and if confirmed, natural screening could be implemented to minimize the effect.	N.A	HSE Team	Site Audit	During Operation	Grievance Mechanism / Engagement Reports	Included in HSE Team costs.
		■ Visual Screening (Architectural/Structural) - If grievances will be received or if natural visual screening at potentially 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.	N.A	HSE Team	Site Audit	During Operation	Grievance Mechanism / Engagement Reports	Included in HSE Team costs.
		■ Control - Use of turbine control strategies which shut down turbines when shadow flicker is likely to occur.	N.A	HSE Team	Site Audit	During Operation	Grievance Mechanism / Engagement Reports	Included in HSE Team costs.
9.4	**Biodiversity**							
	Impacts to forest vegetation and habitat: *includes direct and indirect transformation and/or disturbance and*	■ Develop and implement appropriate access management plans and suitable control measures to restrict access and unnecessary disturbance of natural forest habitat. This may include the use of secure access gates with guard control on access roads to limit unauthorized vehicle and pedestrian access. MWPCL	Natural forest habitat	MWPCL / EPC Contractor	Site Audit	During operation	Audit Reports	Included in HSE Team costs.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
	loss of ecosystem services	would need to work together with the appointed EPC Contractor to develop access control plans.						
		■ Compile biodiversity action plan (BAP) with offset strategy to compensate for residual forest impacts.	Natural forest habitat	MWPCL / Biodiversity Specialist	Site Audit	Pre-operation	Audit Reports Biodiversity Action Plan & Offset Plan	Unknown at this stage.
		■ Compile and appropriate biodiversity offset plan and implement biodiversity offset. See BAP for the initial offset strategy further recommendations and guidance on developing the offset plan.	Offset site(s)	MWPCL / contractor	Site Audit	Construction Operation	Audit Reports	Unknown at this stage.
		■ Monitor biodiversity offset implementation success according to an offset monitoring plan to be developed as part of the offset planning process (above) and informed by the biodiversity indicators and metrics recommended in the BAP. Review and update the BAP and offset plan annually based on the findings of monitoring.	Offset site(s)	MWPCL / Independent specialist	Offset monitoring plan Site Audit	During and after offset implementation	Audit Reports Offset Monitoring Reports	Unknown at this stage.
	Impacts to watercourses (streams/rivers)	■ Monitor and maintain stream crossings as necessary to ensure continued access road operation, including clearing debris and/or sediment from culverts.	Watercourses (stream crossings)	HSE Team	Site Audit	During operation	Audit Reports	Included in HSE Team costs.
	Impacts to fauna (wildlife): *includes direct impacts, collisions, reduced habitat connectivity, barriers to species movement and increased hunting pressure*	■ Enforce good conduct by operational and maintenance support staff, including prohibition of hunting, trapping, fishing, possession or trading of wild plants or animals, subject to a penalty of immediate dismissal or similar.	Fauna (wildlife)	HSE Team	Site Audit	During Construction	Audit Report	Included in HSE Team costs.
		■ Prepare and implement a precautionary and adaptive management plan to be informed by long-term annual bat/bird carcass monitoring, to determine where additional mitigation may be necessary for specific turbines/clusters of turbines, such as: adjusting turbine cut-in speeds (increased) for site-specific and seasonal bat activity peaks, feathering of turbine blades, auditory deterrents and/or painting of alternate turbine blades to increase visibility for birds157. An ecologist / biodiversity	Fauna (wildlife)	MWPCL / biodiversity specialist	Monitoring	Pre-operation During operation	Operational Biodiversity Monitoring Plan Operational Biodiversity Monitoring Report	Unknown at this stage.

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- Blade feathering and increasing cut-in wind speeds during periods of low wind speed and higher average night-time temperatures are currently the only proven ways to reduce bat fatalities at operating wind farms through turbine design and operation. Blade feathering and raising cut-in speeds is to be considered for the high risk areas for bats, during low wind speeds and higher night time temperatures and this would therefore likely be seasonal (summer) curtailment.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		specialist will need to be appointed to develop the adaptive management plan based on the outcomes of operational bird/bat carcass monitoring.					Adaptive Management Plan	
		■ Species encountered on the operational site that need to be removed, and which are considered dangerous or poisonous/venomous, are to be handled by professionals.	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Limit vehicle speed to 15km/hr on site for all contractor and subcontractor vehicles, as well as any non-Project vehicles allowed on access roads, to reduce risk of vehicular collisions with wildlife.	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Place appropriate limits on the number of vehicle movements to and from the wind farm (e.g. maximum of 5 vehicles allowed within a 1-hour window).	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Creation of suitable alternative habitats or enhancement of existing ones to support displaced species. The need for specific requirements will be informed by the outcomes of operational monitoring. Where deemed necessary, an ecologist / biodiversity specialist will need to be appointed to advise on the location and type of habitat enhancement required.	Fauna (wildlife)	MWPCL	Site Audit	During operation	Audit Report	Unknown at this stage.
		■ Restrict vehicles to the use of only authorised access roads.	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.

- Installation of acoustic deterrent devices on the turbines, that emit high frequency sounds within the range of bat call frequencies to mask echo perception, or create an airspace around the rotor swept area that bats might avoid, could also be considered as precautionary mitigation.
- MWPCL has indicated that they would not be looking to implement a broad-blanket approach to turbine curtailment, but that rather this will be implemented where necessary. It is acknowledged in the literature (Behr et al., 2017) that pre-construction survey estimates of bat collision risk at wind project sites is methodologically extremely difficult and with high levels of prediction uncertainty. Therefore, any in depth understanding of collision risk would need to be informed by operational carcass monitoring and through an adaptive management programme whereby monitoring and modelling during operation can be used to inform interventions such as the recommendation of detailed and site-specific curtailment measures.
- Authors such as Behr et al. (2017) also acknowledge that carcass monitoring can have several limitations, such as removal rates by scavengers that can be typically high and searching conditions which are often poor. Predicting collision rates form variables such as acoustic activity or wind speed are easier to measure and somewhat more appropriate for many sites, including forested areas. Behr et al. (2017) recommend that operational monitoring and modelling of bat collision risk should be implemented to inform more efficient operational mitigation that incorporates additional variables (e.g. time of night, wind speed, temperature, associated bat activity) to define operation rules that are turbine-specific and maximize energy production with the lowest possible collision risk for bats. It is therefore recommended that carcass monitoring during operation be accompanied by monitoring of acoustic activity and wind speed through static detectors.
- An example that could be looked into further for the project is that of Korner-Nievergelt et al. (2013) who published a model-based approach to predict the collision rate of bats at wind turbines based on carcass monitoring (fatality searches), wind speed, temperature, time of night, time of year and acoustic activity. Statistical modelling is used to predict bat activity from predictive variables such as wind speed and/or temperature. Once the model has been calibrated based on a sufficiently large data set, its predictors can be used to assess collision rate for new turbines with no need for carcass searches and to develop turbine-specific curtailment algorithms.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Restrict any maintenance activities to daytime hours when visibility is good and to limit risk of impact to nocturnal species of fauna.	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Aim operational lights downwards and away from forest habitats. Use appropriate lighting that minimizes ecological and physiological effects on wildlife whilst not attracting insects as far as possible. According to the research of Longcore et al. (2018158), filtered yellow-green and amber LEDs are recommended and predicted to have lower ecological and physiological effects on wildlife (compared with high pressure sodium lamps, while blue-rich lighting would have greater effect). Also, as a general rule insects are more sensitive or attracted to short-wavelength (UV, cool white, blue and green LEDs)_than long-wavelength light which is recommended (warm white, orange, red and infra-red).	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Maintain vehicles and equipment in good working condition.	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Implement access controls including the use of gates, security cameras and security guards at sites of key infrastructure such as substations and the main access roads to turbine clusters, to limit unauthorized vehicle and pedestrian access as far as possible.	Fauna (wildlife)	HSE Team	Site Audit	During operation	Audit Report	Included in HSE Team costs.
		■ Support local villagers with the training, tools and finances needed to startup small-scale animal operations, such as chicken farms, etc. to support local livelihoods, to alleviate some of the local hunting pressures. A social specialist will need to be appointed to advise on the approach and measures.	Fauna (wildlife)	MWPCL	Site Audit	During operation	Audit Report	Unknown at this stage.
	Water and soil pollution caused by potential accidental spills of hazardous substance	■ Employ best practice measures in handling and storing fuels, oils and chemicals liable to spillage. ■ Always use drip trays when temporarily storing or handling fuels or when servicing/repairing vehicles on site.	Habitat / Plant & Animal species	EPC Contractor	Site Audit	During Operation	Audit report	Inlcuded in EPC cost

158 Longcore T., Rodríguez, A., Witherington, B., Penniman, J.F., Herf, L. and Herf M. (2018). Rapid assessment of lamp spectrum to quantify ecological effects of light at night. J Exp Zool A Ecol Integr Physiol. 2018 Oct;329(8-9):511-521. doi: 10.1002/jez.2184. Epub 2018 Jun 12. PMID: 29894022.

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Pollution monitoring plan to be compiled and implemented, with a focus on watercourse monitoring. ■ Prepare an emergency spill response plan. Clean-up any spills immediately. ■ Emergency spill kit provision and training. ■ Remediate any soils, watercourses or habitats where spills take place. ■ Inform the relevant authorities as soon as any significant or major spill event takes place. ■ Disposing of waste into the environment is prohibited. Waste products to be transported to registered waste facilities only for proper disposal. ■ Burial or burning of waste to be prohibited.						
	Invasive Alien Plant impacts	■ Compile and implement a suitable Invasive Alien Plant (IAP) species control plan and programme to eradicate dense colonies of alien plants and control the spread of minor species and weeds. An ecologist / biodiversity specialist will need to be appointed to develop the IAS control plan and programme.	N.A	HSE Team	Site Audit	Post-construction During operation	Audit Report	Included in HSE costs.
9.5.2	**Economic Opportunities**							
	Job creation and training from the project	A Local Content and Influx Management Plan will be prepared to maximise the local employment and training opportunities afforded to the affected villagers. ■ The responsibilities and management practices associated with the management of labour during construction and operation of the Project.	N.A	MWPCL	N.A	Prior to operation	Local Content and Influx Management Plan	Included in HSE Team costs
		■ A hiring policy that reinforces the Project's preference to employ local workers and undertake procurement from local businesses, where possible. The policy will be a tiered system where the hiring preference will be as follows: 1. Villagers from within the AoI; 2. Villagers from the Dakcheung District or Sanxay District; and 3. Villagers from the Sekong Province or Attapeu Province.	N.A	HSE Team	N.A	Prior to operation	Hiring Policy	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ A training program targeting skills required for affected villagers to participate in unskilled, and potentially semi-skilled, work for the Project. ■ A communications strategy to notify affected villagers of employment and procurement opportunities in advance. This will enable villagers and businesses to be prepare for the application process (e.g. contracting requirements, assistance with application, etc.).						
		■ A Community and Ethnic Group Development Plan (CEGDP), which incorporates the Ethnic Group Development Plan (as the majority of the affected villagers are ethnic minorities) will be prepared to guide the implementation of suitable programs to support affected villagers.	N.A	MWPCL	ESMS	Prior to operation	CEGDP	Included in EPC costs
9.5.4	**Community Health and Safety**							
	Impacts to communities from construction of the Project facilities	■ A Stakeholder Engagement Plan (SEP) will be prepared: The SEP will describe how Project stakeholders will be engaged throughout the Project lifecycle. The SEP will establish a systematic approach to stakeholder engagement that will help the Project build and maintain a constructive relationship with stakeholders. It will also ensure that Project information on environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format. An example of a program to be implemented as part of the SEP is a community environmental and safety awareness program, which seeks to enable villagers to understand and identify construction risks, and how to stay safe.	N.A	HSE Team	Site Audit	Prior to operation	SEP	Included in HSE Team costs
		■ A Community Health and Safety Management Plan will be prepared**:** Sets out the agreed controls and mitigation measures to protect the health and safety villagers in the AoI	N.A	HSE Team	ESMS	Prior to Operation	Community Health and Safety Management Plan	Included in HSE Team costs
		■ An Occupational Health and Safety Management Plan will be prepared**:** Sets forth the agreed controls and mitigation measures to protect the health and safety of workers. This will include:	N.A	HSE Team	ESMS	Prior to Operation	Operational Health and Safety Management Plan	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		- Screening of migrant workers prior to entering Laos to ensure they are fit to undertake their relevant tasks/roles. - Safety audits which will occur during the construction and operation of the Project, to ensure safety procedures are complied with. - Induction and Training requirements for all workers, including site-specific induction and training to highlight safety risks and mitigations, and task-specific training (e.g. complying with speed limits, etc.). ■ Measures to mitigate against the spread of COVID-19 amongst workers, and from workers to other villagers.						
9.5.5	**Worker Influx**							
	Influx of workers can affect local communities with increase in diseases and safety issues.	■ A number of legislative requirements exist to protect local and migrant workers, which all employers must comply with	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Employment Contracts	Included in HSE Team costs
9.5.7	**Ethnic Groups**							
	Impacts to ethnic groups from the construction and operation of the Project	■ The Project places a strong emphasis on respecting the cultures and customs of the villagers, and has been participating in various rituals as part of granting access and permission to undertake technical studies to support the ESIA. This will be formalised as part of a management plan to apply to all workers.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in HSE Team costs
		■ Promote ethnic cultures through Project activities in collaboration with the Project affected communities	N.A	MWPCL	Site Audit	During Operation	Engagement records	Included in HSE Team costs
		■ Implement development programs to improve the livelihoods of ethnic groups including providing ethnic women with economic development opportunities	N.A	MWPCL	Site Audit	During Operation	Development programs	Included in HSE Team costs
		■ Implement measures to remove obstacles for ethnic minorities to participate in Project activities and decision-making, including impact mitigation and benefits	N.A	MWPCL	Site Audit	During Operation	Audit Report	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Provide a grievance redress mechanism and appeal process for the Project-affected persons that is culturally appropriate.	N.A	MWPCL	Site Audit	During Operation	Grievance Mechanism	Included in HSE Team costs
9.5.8	**Cultural Heritage**							
	Impacts to local culture(tangible and intangible)	A cultural heritage protocol will be prepared to guide the workers on the protection of cultural heritage sites, structures and values that may be impacted by the Project. In the first instance, the cultural heritage protocol will require: ■ Further consultation with the villagers who reside close to the sacred forest to ensure the communities have a good understanding of Project activities and potential impacts on the sacred forest. ■ Consultation with village leaders, and elders on ceremonies and rituals to be undertaken to seek permission from the ghost to enter the forest for construction and ongoing maintenance purposes. ■ Seek permission from the village leaders, elders and the broader community to enter the sacred forest. Document the consent process and the consent itself, taking a precautionary approach, to address the potential for ADB Indigenous People Safeguards to be triggered in terms of consent for Project impacts on IP cultural resources.	N.A	HSE Team	Site Audit	During Operation	Cultural Heritage Protocol	Included in HSE Team costs
9.6.1	**Climate Change**							
	Impacts on climate change	■ Replant trees in the areas where land clearance and levelling works are undertaken	N.A	EPC Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
		■ Participate in the protection of forests and green areas in Dakcheung District and Sanxay District. These forests and green areas in the two districts will help maintain the overall climate condition and meteorology in the Project area and in the localities	N.A	EPC Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
		■ Replantation in areas around the wind turbine towers, office building, and sub-station of the Project to allow the Project area	N.A	EPC Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
		■ It is proposed to undertake an annual GHG inventory to monitor the GHG emissions according to the applicable requirements (i.e. ADB SPS, EP III and IFC)	N.A	EPC Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Replant trees in area where clearance and levelling work were undertaken during pre-construction and construction	N.A	EPC Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
9.6.2	**Risks from Climate Change**							
	Riverine Floods	■ When a rainstorm warning is received, consider suspending operations and transfer personnel to safe location	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ Review meteorological information regularly, and take precautions against possible floods, landslides, mudslides, and other disasters	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ Ensure an Emergency Response Plan (ERP) is in place covering floods, landslides, wildfires, cyclones, and thunderstorms	N.A	EPC Contractor, HSE Team	ESMS	Prior to Operational	ERP	Included in EPC and HSE Team costs
		■ Monitor flood situation at the Site. If any significant floods events affecting the physical infrastructure, operations, and health and safety are observed in future, detailed studies may be considered for flood mitigation measures	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
	Landslides	■ Review meteorological information regularly, and take precautions against possible floods, landslides, mudslides, and other disasters ■ Regular geotechnical field inspection to check for any signs of landslide risks	N.A	EPC Contractor	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ Ensure an Emergency Response Plan is in place covering floods, landslides, wildfires, cyclones, and thunderstorms	N.A	EPC Contractor, HSE Team	Site Audit	Prior to Operation	ERP	Included in EPC and HSE Team costs
	Extreme Heat	■ Ensure designed operation temperature range ~30-40°C	N.A	HSE Team Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
		■ Worker’s resting areas, on-site offices, worker’s quarters should be constructed with heat resisting material to keep the indoor temperature lower.	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ A heat stress management plan should be prepared as part of standard operations and safety procedures.	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		■ Train workers to identify the symptoms of heat stress and first aid.	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ Make appropriate considerations while designing the cooling systems (if required).	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
	Cyclone and Wind Speed	■ Ensure designed operational wind turbines at wind speed ranges between ~24 to 26 m/s	N.A	HSE Team Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
		■ Design to consider wind turbine's impeller lock process for wind speeds	N.A	HSE Team Contractor	Site Audit	During Operation	Audit Report	Included in HSE Team costs
	Wild Fire	■ Ensure lightning protection grounding of the wind turbine. A metal air termination system is installed at the blade tip. A copper conductor is used to reliability connect the air termination system to the lightening lead on hub	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ Develop and maintain fire lines around the important assets	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
		■ Develop and maintain vegetation clearances with respect to prevailing standards and regulations	N.A	EPC Contractor, HSE Team	Site Audit	During Operation	Audit Report	Included in EPC and HSE Team costs
	Lighting and Storms	■ Ensure design according to IEC-61400-24 to achieve Grade I lighting protection to wind turbine the cross-sectional area of blade lighting protection copper conductor should not be less than $50mm^2$	N.A	EPC Contractor, HSE Team	Site Audit	During Pre-Construction and Operation	Design information	Included in EPC and HSE Team costs
9.7	**Unplanned Events**							
	General	■ 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	N.A	EPC Contractor, HSE Team	ESMS	Prior to Operation	SEP	Included in EPC and HSE Team costs
		■ Prepare and implement an Emergency Preparedness and Response Plan to cover accidental and emergency situations. This Plan will include leaks and spill, collisions, natural hazards, and fire and explosions (including UXO) and will also detail: ■ Planning coordination: including procedures for informing local communities about emergency	N.A	EPC Contractor, HSE Team	ESMS	Prior to Operation	Emergency Response and Preparedness Plan (ERP)	Included in EPC and HSE Team costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
		response, documentation and first aid / medical treatment; ■ Emergency equipment: including equipment in the project design and any additional emergency equipment; and ■ Training: employees and contractors will be trained in emergency response procedures. ■ Auditing: audit records will be maintained on how the Plan is being implemented.						
	Leaks and Spills	■ 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).	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Soil, absorbents and other materials contaminated by leaks or spills of hazardous material such as hydrocarbons shall be treated as hazardous waste and stored in hazardous waste containment areas awaiting the opportunity for disposal in accordance with the waste management plan.	N.A	HSE Team	ESMS	Prior to Operation	ERP	Included in EPC costs
		■ Monthly monitoring the implementation of all proposed mitigation measures specified in ERP should be conducted properly;	N.A	HSE Team	ESMS	Prior to Operation	ERP	Included in EPC costs
		■ Daily inspection of any secondary containment of oil/chemical on site and ensure good maintenance procedures to minimize small leaks and spills.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
	Fire and Explosions	■ Implement routine inspection and maintenance procedures (in line with international best practice) for any hazardous substances' storage vessels and WTGs	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Install warning system, signal boards, lighting protection system where risks of fire and explosion exposed	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Provide regularly safety and fire prevention & fighting drills.	N.A	HSE Team	Site Audit	During Operation	ERP	Included in EPC costs
		■ A monthly audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs

ESIA Ref. No.	Potential Impact	Mitigation Measures	Specific Actions (parameters, locations, standards, thresholds)	Responsibility for ensuring commitment/monitoring implemented	Means of verifying that commitment has been met	Timing	Reporting requirements	Estimated cost
	Blade Ejection	■ 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;	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Implement periodic routine inspection and maintenance procedures (in line with international best practice).	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ 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.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ A quarterly audit program shall be established to check the implementation of regular technical inspection of the WTGs and blades' safety. Any identify gaps or areas of opportunity will be followed up after the inspection until resolved. The auditing records will be kept onsite for future review and supervision.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
	Transmission line snapping	■ 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	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Implement periodic routine inspection and maintenance procedures (in line with international best practice)	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Install warning system, signal boards, lighting prevention system, anti-climbing devices on the tower.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ A quarterly audit program shall be established to check the implementation of regular technical inspection of the transmission lines and transmission pylons' safety.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
	Natural Hazards	■ Incorporation of siting and safety engineering criteria to prevent failures due to natural disasters.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Implement periodic routine inspection and maintenance procedures (in line with international best practice)	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs
		■ Install warning system, signal boards, flood prevention systems.	N.A	HSE Team	Site Audit	During Operation	Audit Report	Included in EPC costs

10.8 Environmental and Social Monitoring Program

Monitoring is a means of verifying overall effectiveness of the management and mitigation measures contained within the management plans listed above. Key objectives of the monitoring process are to:

- Confirm effectiveness of management and mitigation measures;
- Ensure compliance with Applicable Standards (Laos standards, ADB SPS, WGB EHS, and Guidelines);
- Monitoring the status of, and impacts on, identified sensitive receptors;
- Provide an early warning that any of the control measures or practices are failing to achieve their desired performance and ensure changes can be implemented to remedy these practices;
- Determine whether environmental and social changes are attributable to Project activities, or as a result of other activities or natural variation; and
- Provide a basis for continual review and improvements to Project design and execution.

10.8.1 Performance Indicators and Monitoring Schedule

Physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator has been prepared for all phases of the Project and is presented in ***Table 10.4.***

This includes the tentative parameters to be measured, methods to be utilised, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

However, it is to be noted that the detailed and specific monitoring measures will be developed and included within the relevant management plans. The monitoring components of the various management plans will be refined and finalised during plan development.

Impact monitoring will be undertaken during the life of the Project to verify the predicted levels of residual impacts from the Project and the effectiveness of the various management plans.

10.8.2 Reporting Mechanism for Environmental and Social Monitoring Program

A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will ensure regular flow of information from the Project site to the Project headquarters and, as necessary, to regulatory authorities and funding agencies. The reporting system will provide a mechanism to ensure that the measures proposed in the Project's ESMP are implemented.

Prior to the commencement of the construction activities, MWPCL will finalise the format and frequency for reporting on the status and progress of environmental and social monitoring.

During construction and operation phases, it is recommended that the report shall be submitted to the relevant authorities and funding agencies on a regular basis. Frequency will be agreed with relevant authorities and funding agencies.

However, it is recommended that EPC submit the report to the relevant authorities and funding agencies on three-monthly basis during construction and on annually basis during operation.

The format will be designed to meet all the compliance conditions associated with the local and international requirements. The contractor will be required to submit the duly filled up reporting form on the agreed frequency to MWPCL.

The monitoring measures for the Project are summarised in ***Table 10.4***.

Table 10.4: Environmental and Social Monitoring Programme

Project Stage/ Affected Component	Objective	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Construction Phase						
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and as specified in EPC Contractor Manual	Project activity areas and construction workers camp	Visual inspection of all active work areas	Daily	HSSE Team of EPC Contractor
Air quality	Monitoring of ambient air quality	Implementation of mitigation measures	• Areas of Project construction activities	As per Maintenance Regime Plan requirements	As Maintenance Regime Plan requirements	EPC Contractor
		TSP, PM-10, PM-2.5, CO, SO_2 and NO_2 as per the requirements of the Local EIA (EIA, 2020)	■ A1: Ban Xiengluang, Dak Cheung District, Sekong Province (72°43'87N, 16°96'54.1E (UTM WGS 1984 Zone 48N)); and ■ A2: Ban Dak Run, Dak Cheung District, Sekong Province (741488N, 1704935E (UTM WGS 1984 Zone 48N)).	As per Laos and WBG EHS standards	Monthly	Air Quality licensed company (or specialist)
Noise	Monitoring of ambient noise	Sound levels (dB)	Heavy work, area of heavy transportation, village areas surrounding the project.	ISO 1996 – 1:2016 As per Laos and WBG EHS standards	Monthly	Third Party
Water	Monitoring of effluents / discharges from construction sites/camps/batching plants	Depends on the water sources, the parameters may include (but not limited to): Colour, taste & odour, turbidity, residue chlorine, pH, Ammonium, total Fe, permanganate, total hardness, Chloride, Fluoride, As, Total coliform, E.coli, Nitrate, Phosphate, Ammoniac, Oil & Grease, Total coliform	Wastewater treatment system from construction sites/camps/batching plants	As per Laos and WBG EHS standards	Monthly	Third Party
Water	Monitoring surface water quality	Temperature pH, Dissolved oxygen (DO), Biological Oxygen Demand (BOD5), Total Suspended Solid (TSS), Total and Total Dissolved, Oil and Grease, and Faecal coliforms	■ SW01: Houay Nam Ngon in Ban Nam Ngon, Sanxay District, Attapeu Province (73°10'03N, 16°84'39.9E (UTM WGS 1984 Zone 48°N)); ■ SW02: Houay Joon in Ban Dak Padou, Sanxay District, Attapeu Province	As per Laos and WBG EHS standards	Monthly	Third Party

Project Stage/ Affected Component	Objective	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
			(736057N, 1690997E (UTM WGS 1984 Zone 48N)); ■ SW03: Houay Preed in Ban Xiengluang, Dak Cheung District, Sekong Province (722427N, 1692294E (UTM WGS 1984 Zone 48N)); ■ SW04: Houay Air in Ban Sieng Mai, Dak Cheung District, Sekong Province (722309N, 1701964E (UTM WGS 1984 Zone 48N)); and ■ SW05: Houay Nheung in Ban Dak Dor, Dak Cheung District, Sekong Province (738037N, 1700351E (UTM WGS 1984 Zone 48N));			
Soil	Monitoring soil quality for Persistent Organic Pollutants (POPs),	■ Parameters refer to the soil sampling plan.	Sampling locations refer to the soil sampling plan.	As per Laos and WBG EHS standards	Once prior to construction commencement	Third Party
Occupational Health and Safety	Monitoring of accidents or incidents due to construction activities, workers' health	■ Number of incidents and accidents ,near misses, visits to project's medical centre by employees, lost time injury rate, and fatalities. ■ Number of staff receiving H&S training or refreshers ■ Number of staff working who have not received H&S training ■ Summary of worker grievances relating to occupational H&S ■ Summary of status of accommodation facilities against the benchmarks	Project activity areas and construction workers camp	As defined in construction phase Health & Safety Plan to be prepared by EPC contractor	As defined in H&S Plan	HSSE Team of EPC Contractor
Waste	Monitoring of non-hazardous wastes storage, transport and disposal activities	■ Waste classification condition ■ Amount of waste transfer to Waste Vendors ■ Total amount of domestic waste (kg) and non-hazardous industrial solid waste (kg)) generated in the report week ■ Other requirements outlined in Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Weekly	HSSE Team of EPC Contractor
	Monitoring of hazardous wastes storage, transport and disposal activities	■ Waste classification condition ■ Amount of waste transfer to Waste Vendors/Medical Service (for collection and transportation days) (i.e. kg/type of waste); ■ Total amount of hazardous waste (kg) generated in the report week; ■ Checking the operability of emergency systems ■ Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Regular rotation of inspections across all sites with frequency of inspections (not exceeding monthly) proportionate to the size of the site/ number of workers/level of risk and Unplanned audit twice a year.	HSSE Team of EPC Contractor

Project Stage/ Affected Component	Objective	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
	Monitoring of hazardous materials handling	■ Inventory of all hazardous materials used or stored at the site for the project ■ Number and volume of accidental spills and leaks and their resolution ■ Types of materials, status of corrective action plan resulting from root cause analysis and critical analysis of any trends that may inform the need of refresher or improved training ■ Hazardous materials facilities and hazardous waste storage ■ Implementation of Hazardous Material Management	Hazardous material storage, hazardous waste storage, Project activity areas, transport assets and disposal areas	Compliance to the WMP and Hazardous Material Management	Monthly	HSSE Team of EPC Contractor
	■					
Biodiversity	Impacts to forest habitat	Records of training, rehabilitation plan monitoring	Project activity areas	Compliance to Biodiversity Action Plan (BAP)	Quarterly basis during construction	HSSE Team of EPC Contractor
	Impacts to watercourses	Spill records and clean-up, rehabilitation plan monitoring	Watercourse crossings by new access roads	Compliance to BAP	Monthly during construction	HSSE Team of EPC Contractor
	Impacts to fauna (wildlife)	Fauna Shepherding protocol and accidents	Project activity areas, access roads, workers camps, laydown areas	Compliance to BAP	Monthly	HSSE Team of EPC Contractor
	Invasive Alien Plant (IAP) impacts	Preparation and implementation of IAP control plan, IAP monitoring plan	Project activity areas and construction workers camps, laydown areas	Compliance to BAP	Monthly	HSSE Team of EPC Contractor
Social	Local employment	Number of people employed from the local area, % of total workforce, ratio of local workforce versus expatriate workforce	Project activity areas	Compliance against the Local Content and Influx Management Plan	Quarterly	HSSE Team of EPC Contractor MWPCL HR Manager
	Economic displacement and impacts to livelihood	Livelihood restoration target; Improvement of status of poor and vulnerable to national minimum standards	Villages within the SAoI	Compliance with compensation and livelihood restoration plan and CEGDP	Semi-annual monitoring and reporting during construction and annual monitoring and reporting during	Social Specialist Social Management Office of the ESMO Third Party
	Stakeholder Engagement	Number or frequency of engagement	Villages within the SAoI	Compliance against the Stakeholder Engagement Plan	Monthly	HSSE Team of EPC Contractor
	Grievance Mechanism	Number and resolution of grievances	Neighbouring communities around the Project activity areas	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	HSSE Team of EPC Contractor
	Impact to traffic	■ Status of vehicle ■ Weather forecast ■ No. of traffic incidents, near misses ■ No. of workers receiving traffic training	Construction area and roads used for transport of workers and construction material	■ Unplanned Compliance audit against worker Code of Conduct ■ Compliance against Traffic	■ Daily/Monthly/Quarterly depends on monitoring activities ■ During large mobilization of vehicles or equipment.	HSSE Team of EPC Contractor

Project Stage/ Affected Component	Objective	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
		■ Inspection and registration licenses		Management Plan ■ Proactively engage with village administration and district officials where the frequency or size of Project transport has a potential to impact on local traffic.		
	Impact to existing facilities	State of Public infrastructures	Roads used for construction	Capacity to use the infrastructure safely	Monthly	HSSE Team of EPC Contractor
	Impacts to health and safety of the community	Worker training, grievances, accident log, implementation of Community H&S monitoring and surveillance programme, implementation of worker code of conduct, implementation of Local Content and Influx Management Plan	Project activity areas	Compliance against Community Health and Safety Plan	■ Bi monthly review of training log; ■ Monitoring and review of accidents due to construction (daily monitoring and monthly review). ■ Community health and safety monitoring and surveillance program. ■ Daily monitoring of construction area, worker camp and surrounding; ■ Regular unplanned audit on worker code conduct; ■ Monthly visual inspection of first aid facilities and records. ■ Weekly review of grievance log.	HSSE Team of EPC Contractor
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Roads used for transport of workers and construction material	Incidents, accidents and community complaints	Based on occurrence and yearly	HSSE and/or Community Liaison Officer of EPC Contractor
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Project Grievance Redress Unit (PGRU) Social Management Office of the ESMO

Project Stage/ Affected Component	Objective	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Operation Phase						
Noise	Monitoring ambient noise	Sound levels (dB)	At nearest receptor	As per Laos and WBG EHS standards	Monthly at start of operations	Third Party
Waste	Impact to soil, groundwater, surface water, biodiversity and human receptors	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Compliance to the WMP	Unplanned audit yearly	HSSE team
Social	Local employment	Percentage of local (directly from the Project Social AoI) employed during operation	Villages within the SAoI	Compliance against the Sourcing, Procurement and Recruitment Management Plan	Start of operation and yearly after.	MWPCL HR Manager Social Specialist Social Management Office of the ESMO
	Economic displacement and impacts to livelihood	Livelihood restoration target; Improvement of status of poor and vulnerable to national minimum standards	Villages within the SAoI	Compliance with compensation and livelihood restoration plan and CEGDPt	annually	Social Specialist Social Management Office of the ESMO Third Party
	Grievance Mechanism (all impact)	Number and resolution of grievances	Neighbouring communities around the Project activity areas	Compliance of resolution duration of grievance with Grievance Mechanism	Weekly	Project Grievance Redress Unit (PGRU) Social Management Office of the ESMO HSSE team
	Impacts to health and safety of the community	Worker training, grievances, accident log, implementation of Community H&S monitoring and surveillance programme, implementation of worker code of conduct, implementation of Local Content and Influx Management Plan	Project activity areas	Compliance against Community Health and Safety Plan	■ Bi-yearly review of training log. ■ Bi-yearly review of compliance against community health and safety monitoring and surveillance programme. ■ Conduct regular unplanned audit of the worker code of conduct. ■ Bi-yearly unplanned audit of waste management activities. ■ Monthly visual inspection of first aid facilities and record, review of employment records and health insurance subscription records.	xHSSE team
	Impact to occupational health and safety	Accidents or incidents due to operation activities, workers' health Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and worker camps	As defined in operation phase Health & Safety Plan	As defined in operation phase Health & Safety Plan	DoE HSSE team
Biodiversity	Impacts to fauna (wildlife): bird/bat collisions	Operational biodiversity monitoring plan, including bird/bat carcass monitoring focused on investigating fatalities during period of heightened bird/bat activity (seasonally relevant)	Wind turbines and transmission lines	Compliance against protocols	Annual (seasonal) Pre-operation During operation	Third party
	Impacts to forest habitat	Monitoring implementation of biodiversity offset plan	Biodiversity offset site(s)	Compliance against success criteria of offset plan	Annual	Third party

Project Stage/ Affected Component	Objective	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
	Impacts to watercourses	Monitoring road culverts for debris/blockage	Watercourse crossings by access roads	Debris/blockages present to be cleared	Monthly during the rainy season	DoE HSSE team
	Invasive Alien Plant (IAP) impacts	IAP monitoring plan	Habitats adjacent to operational areas (WTs, roads, transmission line corridors, etc.)	Compliance against protocols	Twice annually	DoE HSSE team
	Monitor biodiversity offset implementation success.	Offset site(s)	Offset site(s)	Offset Monitoring Report	Annual During and after offset implementation	Third party

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Impact Assessment Conclusions

The Supplemental ESIA report has been prepared based on the technical information provided by MWPCL, local EIA (EIA, 2022), existing studies and reports relevant to the Project, site visits, baseline environmental and social data collection and the stakeholder engagement.

Through this process, the assessment has been conducted of the potential environmental and social impacts attributable to the construction and operation phases of the Project. Qualitative and quantitative (where relevant) assessments of impacts have been presented, significance of each potential impact has been identified, and mitigation measures to minimise and reduce the impacts have been recommended. Cumulative impacts, particularly on community health and safety and biodiversity, have also been assessed. ***Table 11.1*** presents a summary of residual impact significance and ***Table 11.2*** presents a summary of risks from climate change.

All impacts have been mitigated to **Moderate** at worst case, and have a range of mitigation, management and monitoring measures to ensure no significant impacts to the environment or people.

Table 11.1: Summary of Residual Impact Significance

Impact Type	Residual Impact Significance	
	Construction	Operation
Physical Environment Impact Assessment		
Impacts on Topography	**Moderate**	**Moderate**
Impacts on Geology and Soil	**Minor**	**Minor**
Impacts on Air Quality	**Minor**	**Scoped out of the assessment**
Impacts on Noise	**Minor**	**Minor**
Impacts to Surface Water Quality	**Minor**	**Negligible**
Impact to Water Resources	**Minor**	**Minor**
Impacts to Landscape Values	**Moderate**	**Moderate**
Impacts to Visual	**Negligible to Moderate**	**Moderate**
Impacts Associated with Shadow Flicker	Not Applicable	**Minor**
Biological Environment Impact Assessment		
Physical destruction and/or disturbance of vegetation	**Moderate**	Not Applicable
Reduction in habitat for supporting key globally threatened species	**Moderate**	**Moderate**
Illegal hunting/poaching and collection of forest resources	**Minor**	Negligible
Bird & bat collisions with wind turbines resulting in injury or mortality	Not Applicable	Negligible
Bird & bat collisions with transmission lines resulting in injury or mortality	Not Applicable	Negligible
Vehicular collisions with wildlife	Negligible	Negligible

Impact Type	Residual Impact Significance	
	Construction	Operation
Dust pollution caused by earthworks and vehicle/machinery operation	Negligible	Negligible
Water and soil pollution caused by potential accidental spills of hazardous substances	Negligible	Negligible
Soil erosion and sedimentation of watercourses	Negligible	Negligible
Disturbance and nuisance caused by increased noise, light and/or vibrations	Negligible	Negligible
Barriers or interference with species movement	**Minor**	**Minor**
Increased susceptibility of forest habitat to disturbance	**Minor**	**Minor**
Introduction of alien plant species and/or disturbance leading to invasion by alien plants and weeds	**Minor**	**Minor**
Reduced habitat connectivity caused by fragmentation of habitat	**Minor**	**Minor**
Loss of ecosystem services	Negligible	Negligible
Increased hunting/harvesting pressure due to enhanced accessibility to the area	**Moderate**	**Moderate**
Increased fire risk	Scoped out of the assessment	Scoped out of the assessment
Trophic cascade impacts	Scoped out of the assessment	Scoped out of the assessment
Social Impact Assessment		
Impacts on Economic Opportunities	**Positive**	**Positive**
Economic Displacement and Impacts to Livelihoods	**Moderate**	**Moderate**
Impacts on Community Health and Safety	**Negligible**	**Not Applicable**
Impacts on Occupational Health and Safety	**Negligible**	**Negligible**
Impacts Associated with Influx	**Minor**	**Not Applicable**
Impacts of Wind Farm Operation on Local Amenity	**Not Applicable**	**Negligible to Moderate**
Impact on Ethnic Groups	**Negligible**	**Not Applicable**
Impact on Cultural Heritage (Tangible and Intangible)	**Minor**	**Minor**
Climate Change Risk and Impact Assessment		
Impacts on Climate Change	**Negligible**	**Negligible**

Impact Type	Residual Impact Significance	
	Construction	Operation
Unplanned Events		
Leakage and Spill Incidents	**Minor**	**Minor**
Traffic Accidents	**Moderate** for workers and communities **Minor** for communities (livestock)	**Not Applicable**
Fire and Explosion	**Minor**	**Moderate** for workers and communities **Minor** for the environment
Unexploded Ordnances (UXOs)	**Moderatr**	**Moderate** for workers and communities **Minor** for the environment
Natural Hazards (Flood and Landslide)	**Moderate**	**Moderate**
Blade Ejection Failure	Not Applicable	**Minor**
Transmission Line Snapping and Transmission Pylon Collapse	Not Applicable	**Moderate**
Cumulative Impacts		
Cumulative Impact 1: *Avifauna collisions*	Not Applicable	**Minor**
Cumulative Impact 2: *Regional loss of important forest habitat*	**Moderate**	Not Applicable
Cumulative Impact 3: *Forest habitat fragmentation and reduced connectivity*	**Minor**	**Minor**
Cumulative Impact 4: *Regional loss of RDL species*	**Minor**	**Moderate**
Cumulative Impact 5: *Reduction in ecosystem services*	**Minor**	**Minor**
Cumulative Impact 6: *Impact on biodiversity offset receiving area*	**Moderate**	**Moderate**
Cumulative Impact 7: *Contribution to clean energy sector and move away from non-renewables (positive impact)*	Not Applicable	**Positive**

Table 11.2: Risks from Climate Change

Hazard Type	Hazard Level	
	2030	**2050**
Water Availability	**Low**	**Low**
Riverine Floods	**None**	**None**

Landslides	**High**	**High**
Extreme Heat	**High**	**High**
Cyclone and Wind Speed	**High**	**High**
Lightning	**No direct projections**	**No direct projections**

11.2 Social and Engagement Considerations

In terms of social aspects, the major concerns raised through the supplemental stakeholder engagement were unfair and inappropriate compensation to agricultural land loss due to Project land acquisition and impacts of noise and shadow flicker. Despite some concerns, the supplemental engagement indicate that the Project has received factorable support from local people and other stakeholders. Local people appreciate that the Project will provide several benefits such as supporting economic growth in the region, potential employment (direct and indirect), provide assistance to the local communities to improve agricultural and livestock husbandry practice, particularly coffee plantation and processing and improve infrastructures and public services in the villages such as healthcare centres and school facilities.

11.3 Recommendations

For all the impacts identified in the study, mitigation measures have been proposed and included in the ESMP chapters, including the schedule for monitoring. If any impacts result in more severe significance that assess in this report, actions to be taken by the Project proponent or its contractors are also described.

The effective implementation of the ESMP and adherence with the Laos standards and WBG guidelines will assist in minimising the environmental impacts to acceptable levels. With continued engagement with local stakeholders and monitoring as proposed in the ESMP of impact significance, the environmental and social assessment of the Project ascertains that the Project is unlikely to cause any significant environmental and social impacts and will bring benefits to local stakeholders and increased access to reliable supply of electricity to the region.

Standalone management plans will be required for the Project. These will include:

- Community Health and Safety Management Plan
- Occupational Health and Safety Management Plan
- Traffic Management Plan
- Worker's Camp Management Plan
- Construction Material Sourcing Plan
- Air Quality Management Plan
- Water Quality Management Plan
- Hazardous Materials Management Plan
- Waste Management Plan
- Noise and Vibration Management Plan
- Spoil Management Plan
- Soil Erosion and Sediment Control Management Plan
- Site Restoration Management Plan

- Local Content and Influx Management Plan (including Labour Management Plan and Local Procurement Management Plan)
- Cultural Heritage Management Plan
- Emergency Preparedness and Response Plan
- Stakeholder Engagement Plan
- Resettlement Plan
- Community and Ethnic Group Development Plan
- Initial Biodiversity Action Plan
- Unexploded Ordinance Survey and Clearance Plan
- Baseline Soil Sampling Plan
- Biodiversity Monitoring and Evaluation Plan
- Invasive Species Management Plan

The monitoring measures have been proposed during construction and operation of the Project (***Table 11.3***).

Table 11.3: Environmental and Social Monitoring Programme

Project Stage/ Affected Component	Parameters to be Monitored	Location	Frequency
Construction Phase			
General	General compliance with mitigation measures presented in the ESMP and as specified in EPC Contractor Manual	Project activity areas and construction workers camp	Daily
Air quality	Implementation of mitigation measures	Project activity areas and construction workers accommodation	As Maintenance Regime Plan requirements
	TSP, PM-10, SO_2, NO_2 and CO_2) as per the requirements of the Local EIA (EIA, 2022)	Sensitive Receptors	Monthly
Noise	Sound levels (dB)	Heavy work, area of heavy transportation, village areas surrounding the project.	Monthly
Water	Temperature, pH, Dissolved oxygen (DO), Biological Oxygen Demand (BOD5), Total Suspended Solid (TSS), Total and Total Dissolved, Oil and Grease, and Faecal coliforms	Nearby water courses	3 monthly
Occupational Health and Safety	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	As defined in H&S Plan
Waste	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Unplanned audit twice a year

Project Stage/ Affected Component	Parameters to be Monitored	Location	Frequency
	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Unplanned audit twice a year
Biodiversity	Records of training, rehabilitation monitoring	All Project activity areas	Quarterly
	Spill records and clean-up, rehabilitation monitoring	Watercourse crossings by new access roads	Monthly
	Fauna shepherding protocol and accidents	All Project activity areas, access roads, worker camps, laydown areas	Monthly
	IAP (Invasive Alien Plant) monitoring plan	All Project activity areas, access roads, worker camps, laydown areas	Monthly
Social	Percentage of local (directly from the Project SAoI) employed during construction	Project activity areas	Start of construction and bi-monthly after.
	Number or frequency of engagement	Villages within the SAoI	Monthly
	Number and resolution of grievances	Neighbouring communities around the Project activity areas	Weekly
	Permit and code of conduct	Construction area and roads used for transport of workers and construction material	Every 4 months. During large mobilization of vehicles or equipment.
	State of Public infrastructures	Roads used for construction	Monthly
	Worker training, grievances, accident log, implementation of Community H&S monitoring and surveillance programme, implementation of worker code of conduct	Project activity areas	■ Bi monthly review of training log; ■ Monitoring and review of accidents due to construction (daily monitoring and monthly review). ■ Community health and safety monitoring and surveillance program. ■ Daily monitoring of construction area, worker camp and surrounding;

Project Stage/ Affected Component	Parameters to be Monitored	Location	Frequency
			■ Regular unplanned audit on worker code conduct; ■ Monthly visual inspection of first aid facilities and records. ■ Weekly review of grievance log.
Community Health and Safety	Accidents, incidents and complaints	Roads used for transport of workers and construction material	Based on occurrence and yearly
	Complaints from community	Neighbouring communities around the Project activity areas	Continuous
Operation Phase			
Noise	Sound levels (dB)	At nearest receptor	Monthly at start of operations
Waste	Implementation of Waste Management Plan (WMP)	Project activity areas and construction workers camp, transport assets and disposal areas	Unplanned audit yearly
Social	Percentage of local (directly from the Project Social AoI) employed during operation	Villages within the SAoI	Start of operation and yearly after.
	Number and resolution of grievances	Neighbouring communities around the Project activity areas	Weekly
	Compliance with operation plans	Project activity areas	■ Bi-yearly review of training log. ■ Bi-yearly review of compliance against community health and safety monitoring and surveillance programme. ■ Conduct regular unplanned audit of the worker code of conduct. ■ Bi-yearly unplanned audit of waste management activities. ■ Monthly visual inspection of first aid facilities and record,

Project Stage/ Affected Component	Parameters to be Monitored	Location	Frequency
			review of employment records and health insurance subscription records.
	Accidents or incidents due to operation activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	As defined in operation phase Health & Safety Plan
Biodiversity	Operational biodiversity monitoring plan, including bird/bat carcass monitoring	Wind turbines and transmission lines	Annual (seasonal)
	Monitoring implementation of biodiversity offset plan	Biodiversity offset site(s)	Annual
	Monitoring road culverts for debris/blockage	Watercourse crossings by access roads	Monthly during the rainy season
	IAP monitoring plan	Habitats adjacent to operational areas (WTs, roads, transmission line corridors, etc.)	Twice annually

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