



**Lao People's Democratic Republic**

**Peace Independence Democracy Unity Prosperity**

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**MINISTRY OF PUBLIC WORKS AND TRANSPORT**

**Department of Roads**

# **National Road 13 South Extension Improvement and Maintenance Project (NR13SE)**

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**Environmental and Social Impact Assessment (ESIA)**

**Volume A – Main Report**

**(Rev 3)**



**ລັດວິສະຫະກິດ ວິສະວະກຳ ຄົມມະນາຄົມ**

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## ACRONYMS AND ABBREVIATIONS

ADFD	Abu Dhabi Fund for Development
AIIB	Asian Infrastructure Investment Bank
BKX	Bolikhamxay (Province)
CE	Contracting Entity
COI	Corridor of Impacts
CR	Compensation and Resettlement
DBMOT	Design Build Maintenance Operate and Transfer
DESIA	Department of Environment and Social Impact Assessment
DMS	Detail Measurement Survey
DNREM	Department of Natural Resources and Environment Monitoring
DOE	Department of Environment
DONRE	District Office of Natural Resources and Environment
DoR	Department of Roads
DPWT(s)	Departments of Public Works and Transport (Provincial level)
DRC	District Resettlement Committee
ECC	Environmental Compliance Certificate
EDPD	Environmental and Disaster Prevention Division
EG	Ethnic Groups
EGEF	Ethnic Groups Engagement Framework
EGEP	Ethnic Groups Engagement Plan
EIA	Environmental Impact Assessment
EIB	European Investment Bank
ESIA	Environmental and Social Impact Assessment
ESP	Environmental and Social Policy
ESS	Environmental and Social Safeguards
ESU	Environmental and Social Unit
FGD	Focus Group Discussions
GoL	Government of Laos
GRC	Grievance Redress Committee

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GRM	Grievance Redress Mechanism
HHs	Households
IEE	Initial Environmental Examination
IR	Involuntary Resettlement
KM	Khammouan (Province)
LAK	Lao Kip
Lao PDR	Lao People's Democratic Republic
LFND	Lao Front for National Development
LOS	Level of Service
LRSP	Lao Road Sector Project
LWU	Lao Women Union
MAF	Ministry of Agriculture and Forestry
MOF	Ministry of Finance
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MPWT	Ministry of Public Works and Transport
NA	National Assembly
NR13S	National Road Number 13 South
NR13SE	National Road 13 South Extension
NTFPs	Non-Timber Forest Products
O&M	Operation and Maintenance
OPBRC	Output- and Performance-Based Road Contract
PAHs	Project Affected Households
PAPs	Project Affected Persons
PMU	Project Management Unit
PONRE	Provincial Office of Natural Resources and Environment
PPM	Project-affected People's Mechanism
PRC	Project Resettlement Committee
PRO	Provincial Resettlement Office
PTI	Public Works and Transport Institute
RMF	Road Maintenance Fund

RoW	Right of Way
RP	Resettlement Plan
RPF	Resettlement Policy Framework
SIA	Social Impacts Assessment
TC	Typical Cross-Section
VGC	Village Grievance Committee
VRC	Village Resettlement Committee
VTE	Vientiane Capital
WB	World Bank

## EXECUTIVE SUMMARY

### Introduction

Lao Transport Engineering and Transport Consultant and Connected Consulting, together referred to as the Consultant, were engaged by the Department of Road (DOR), Ministry of Public Works and Transport (MPWT) to update the Environmental and Social Impact Assessment (ESIA) for the National Road 13 South Extension Improvement and Maintenance Project, Section Km 21 – Km 71 (hereafter the ‘Project’).

The ESIA update was commissioned by DOR to reflect improvements and modifications to the Project design and re-alignment of some sections, fill in gaps in identified in the previous ESIA work and align the assessment with international standards, including the AIIB Environmental and Social Policy (ESP) requirements.

The proposed Project is an upgrade of existing National Road 13 South between Km 21 – Km 71 (50.530 Km) in Xaythany, Pak Ngum Districts of Vientiane Capital, and Thaphabath District of Bolikhamxay Province. The Project will be improved and/or upgraded in two different sub-sections, sub-section 1 will be improved as 4-lane 2-way divided and sub-section 2 will be improved as 2-lane 2-way undivided, technical standard shall be applied ASEAN Highway Standard in level terrain Class I and Class II respectively in the design. The proposed alternative pavements for the NR13SE include hot mix asphalt (HMA) and Portland cement concrete.

The Project proponent, MPWT through the DOR, is a government agency responsible for managing, maintaining and developing the national road network across the Lao PDR. The ESIA update identifies the likely types of environmental and social impacts associated with the construction and operation of the Project. It assesses the magnitude and likelihood of these impacts based on previous work commissioned by MPWT and current available Project information. Standalone management plans (e.g. RP, SEP, GAP) to address residual impacts are provided as part of the appendices to the ESIA. An update of the original Resettlement Plan has also been prepared.

### Project Implementation

The Project will be implemented through an Output- and Performance-Based Road Contract (OPBRC) similar to that being used for North, with a 10-year contract life. The OPBRC expands the role of the private sector from a simple execution of works to a management and maintenance of road assets and the contractor is paid through a combination of output payments for defined improvement works along with periodic performance-based lump-sum payments for bringing the road to a certain service level and then maintaining it at that level for a relatively long period. The 10-year OPBRC will comprise the first 2- or 3-year construction/periodic maintenance period (called the “Construction Phase”) and follow-up operations and maintenance (O&M) which may begin from the start of the contract and extend for 7 or 8 years beyond completion of the Construction Phase. The payments for the

Construction Phase will be made if the contractor meets or exceeds the performance indicators for defined fully finished road sections (“milestones”), and against works certification issued by the construction supervision consultant.

The Department of Roads (DOR), under MPWT, is responsible for implementation of this Project including overall technical oversight, execution, and management of the Project and has appointed a dedicated team (Project Management Unit - PMU) to be responsible for the day-to-day implementation, and operation of the project, including contracting and supervision of all consultants. The Environment Research and Natural Disaster Prevention Division (EDPD) of the Public Works and Transport Institute (PTI) under MPWT are responsible for monitoring and supervision of environmental and social safeguards (ESS) and providing technical assistance and capacity building.

## **Legislative Framework**

The ESIA has been carried out in accordance with applicable environmental and road construction policies, standards, regulations and legislation in Lao PDR as well as relevant international conventions and standards.

The key government agency responsible for environmental and social assessment of the Project via the ESIA process is the Department of Environment (DOE), and the Department of Natural Resources and Environment Inspection (DNREI), Ministry of Natural Resources and Environment (MONRE). The Decree on Environmental Impact Assessment (2022) and the Environmental Assessment Guidelines (2016) currently guides the environmental and social assessment process in Lao PDR, which has considerably strengthened the associated permitting requirements and applicable industry requirements. The Ministerial Instructions for the Conduct of ESIA's (No. 8030 – December 2013) outline the format and procedural requirements of this process.

According to the Decree on Environmental Impact Assessment (2022), MONRE is key agency on ESIA process in coordination with concerned ministries, government agencies, local authorities and project affected communities.

## **Summary of Key Impacts, Risks and Opportunities**

### ***Economic Development and Employment***

The development of the Project is considered necessary by the Government of Lao PDR to ease traffic congestion in NR13SE section, facilitate the movement of exports to and imports from the Vientiane to central and southern provinces regional countries, and improve the economic efficiency of the country.

The anticipated economic benefits of the NR14SE Project include direct economic benefits (e.g. capital expenditure, taxes, and salaries) and indirect economic benefits (e.g. flow on effects, training and skills development, infrastructure development).

An investment of approximately \$93.69 million in capital expenditure will be required for the Project. This expenditure will likely result in flow on effects to the Lao PDR economy, resulting in an increase in GDP and Foreign Direct Investments. For road users, the presence of the Project is expected to generate significant savings in transit times and vehicle operating costs. The Project will also generate significant employment through the creation of approximately 168 jobs during construction and 20 jobs during operations.

However, there will be environmental and social impacts and risks associated with the development of the NR13SE that will need to be effectively managed to ensure that the Project is delivered and operated successfully. The key environmental and social impacts and risks are detailed below.

### ***Displacement and Land Impacts***

The Project (NR13SE) is estimated to have direct impact to 21 villages, three Districts and two Provinces. The DMS indicates that the Project will affect 560 Project Affected Households (PAHs) with 3,096 Project Affected People (PAPs), including 1,380 females through various forms of land and asset losses such as housing structure, shops/restaurants, secondary structures and trees.

The Project COI will acquire 17,023 m<sup>2</sup> of land, much of this is rice paddies (10,688 m<sup>2</sup>), followed by residential land (5,960m<sup>2</sup>). The COI will also impact on partial housing structures (12 units), shops and restaurants (158 shops), secondary structures, public utilities and trees.

A number of community facilities were identified within the alignment, many of which have a structure or access significantly impacted by the COI. These facilities included: 1 ATM unit, 17 electric poles & transformer, 1 traffic light pole, CCTV camera stations, and several water supply systems.

Compensation will play a key role in transitioning affected people through the land acquisition process and assisting them in re-establishing their livelihoods and a place of residence. The Project's Resettlement Plan (RP) aims to achieve at minimum; pre-Project conditions for affected people, and where possible better conditions. Given the sensitivities associated with land tenure and vulnerability within informal settlements, the measures described in this RP aim to provide affected persons, especially those that are most vulnerable, with a better outcome for their wellbeing than they currently experience.

Given that many businesses will be impacted by the Project, it's important to ensure that these businesses are properly compensated for losses and assisted in their re-establishment as a way of mitigating commercial losses associated with the development.

MPWT/DOR has completed a detailed compensation assessment for the Project as required under Lao PDR laws. This has identified 3,096 individuals, 560 households requiring compensation amounting to a total payment of LAK25,552,376,570 (USD1,519,347)<sup>1</sup> which

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<sup>1</sup> Exchange Rate | BCEL on 31/3/2023: 1USD=16,849LAK

includes inflation rates. The details of the proposed expenditure are described in the RP (Volume C-2).

### ***Traffic, Transport and Accessibility***

The Project will relieve current congestion and cater for future growth between Xaythany to Thaphabath Districts. It will facilitate greater access to towns serviced by the road, thus promoting economic development. The Project will also help improve the amenity of the towns along the road through a reduction of noise, air pollution and visual impacts associated with a reduction in traffic congestion and the separation of local and through traffic.

The Project will facilitate greater accessibility to the industrial and economic hubs in Vientiane Capital, as well as to Bolikhamxay through the NR13 South. This is expected to have a positive impact on the economy through the reduction of costs arising from congestion and the longer than expected delivery times for goods and services.

As a result of the Project, road users are expected to experience the following benefits:

- ▶ Increased capacity, which would enable the road network to accommodate the expected future traffic volumes;
- ▶ Time travel savings through a reduction in the number of intersections, provision of continuous overtaking opportunities and removing the need to reduce speed when driving through towns;
- ▶ Reduced vehicle operating costs and fuel saving through a more efficient road network; and
- ▶ Improved efficiency and safety for national and international road freight.

The Project will also improve road safety by providing an alternative to the existing undivided roads, with a dual carriageway between Km21 – Km41, improved alignment geometry, more overtaking opportunities.

The construction of the Project would have short term impacts on the existing road network including reduced speed limits near construction sites and access routes. Construction of the Project would be staged and traffic management plans will need to be implemented to reduce these impacts.

Land acquisition for the Project will result in significant accessibility issues for residents and businesses in areas where the Projects alignment disrupts or cuts off local access routes for motorised vehicles and pedestrians. Provision of motorised vehicle and pedestrian crossings in over passes and under passes will partially mitigate this impact.

### ***Materials and Wastes***

The Project will generate a number of different waste streams, with the most significant waste expected to be generated during construction. The largest amounts of waste are likely to be demolition waste from land clearance and demolition activities during Project land acquisition,

and construction waste (e.g. concrete, asphalt, piping, scrap metal etc.) from the production and sourcing of materials for road construction.

An opportunity exists to sustainably manage Project resources and minimise the amount of waste generated from the Project through the re-use and recycling of recovered materials either for Project activities or within the local industry and community. This is particularly the case for demolition and construction waste where a number of materials such as excavated material, timber, bricks, concrete, asphalt and steel can be recycled or reprocessed.

This is expected to help avoid excessive waste from being channelled to landfill, thereby reducing potential environmental and social impacts associated with waste generation.

### ***Air Quality and Greenhouse Gases***

The Project will lead to a change of traffic patterns including current traffic congestion in the NR13SE section. There will be reduced air emissions associated with more efficient transportation, although traffic is expected to increase due to the more efficient transportation provided by the road (NR13SE). Air emissions especially during the dry season are a major issue in Lao PDR, especially as the city grows and the use of vehicles increases. In particular, the impacts of fine particulates from vehicle emissions is well known to affect the health of people living in proximity to major roads.

During construction of the Project, dust emissions from the unpaved road base may cause short-term impacts to near-field receptors. Maximum concentrations of CO, NO<sub>2</sub> and PM<sub>10</sub> generated by the Project are not predicted to exceed WHO or Lao PDR air quality criteria on any section of the existing NR13SE. However, PM<sub>2.5</sub> WHO guidelines are expected to be exceeded at several sections of each road. Receptor impacts are predicted to be relative to the angle of the road to the prevailing wind, with maximum concentrations predicted within 30 m of the roadside.

### ***Noise***

Noise generated by expressways is significant and measures will be required to protect people from the adverse impacts, especially in urban areas where there are a lot of dwellings close to the Project (e.g. <20m). In rural areas, the Project may add a new source of noise (e.g. where the alignment passes through communities). Noise mitigation via sound barriers will be required in certain sections of the road to ensure that noise emissions are within regulatory requirements, enabling remaining residences to not be severely impacted by the development.

Maximum noise levels remain relatively consistent along the NR13SE, but levels reduce with distance from the alignment section of the Project. Noise impacts from the Project include annoyances to community with maximum noise receptor impacts predicted to be typically within 50 m of the roadside.

Construction noise activities will primarily be associated with the clearing of land, earthworks and hauling of construction materials. Some noise and vibration are also expected during the



construction phase and this will be associated excavation of rock, road cuttings and construction of culverts, drainages. However, impacts will be localised and short-term.

### ***Geology, Geomorphology and Soils***

Residual impacts related to excavation of construction materials (rock, clay and sand) from local quarries and borrow areas are expected to be low to moderate in the quarry/borrow areas due to the large quantities of materials required. Residual impacts related to cuts and fills along the route will be moderate to low due to the existing pit facilities.

Deposition of road and vehicle derived pollutants on soils proximal to the roadside is considered to have a low impact due to the provision of a sufficient ROW and verge/drain zone to contain and attenuate pollutants.

The excision of soils in the right of way from usable agricultural land area is considered to have a high impact, which is expected to be offset by the economic benefits of the constructed road.

### ***Surface and Ground Water***

The key potential impact on water quality that will need to be managed during construction will be the potential for increased erosion and sedimentation from construction areas. Careful planning for development of drainage control measures will be required for the Project including appropriate technical systems for sedimentation ponds, vegetation swales and other runoff measures needed to deal with the predicted pollution and flow alteration to minimise the risk of impacting the water quality and potential impacts on wetlands and rivers. Water sources downstream in the form of springs, wells and open water affected by the Project need to be protected and monitored to ensure that unavoidable impacts are minimised, mitigated and managed appropriately in the short or long term by the NR13SE.

Once operational, the Project will result in a linear impervious area (where there was previously mixed pervious areas) which will increase surface water run-off. The stormwater drainage system of the Project will need to be designed to manage these increased flows throughout the Operation Phase and particularly during high rainfall events.

### ***Ecology and Biodiversity***

No natural habitat occurs within the ROW. Most land use types identified within the COI are existing road area (~98%) with a small proportion of wetland and residential land (refer to Table 6 15).

Vegetation clearance for the Project will result in removal of at least 458 trees of different sizes and species of planted and natural species. There are 13 Endangered (EN) species of the IUNC Red List of Threatened Burma Padauk Species (*Pterocarpus macrocarpus*) identified within the COI and 12 species of these will be directly lost, if cleared. Most of these species are relatively small in size with the largest diameter stand was measured approximately 60cm of diameter at breast height. However, this species is found common in the Project region with smaller stands Around 282 trees (fruit trees, industrial trees, bamboo trees and flower trees) of Project

Affected Household (PAH) will be affected by the project. However, during the Detailed Measurement Survey (DMS) PAHs agreed to donate as most of them are naturally growth. Removal of trees will need to be consulted with local authorities and impacted households. Natural terrestrial vegetation (e.g. scrub) within the ROW are highly fragmented. All-natural vegetation to be removed have been directly disturbed by anthropogenic sources in some way. The natural growth and shrubs will not be entitled for compensation.

No international protected areas such as sites on the World Heritage List or Ramsar Wetlands will be impacted by the Project. The Project will also not impact any protected areas of national significance such as National Parks, Wildlife Reserves or Wildlife Sanctuaries as no such areas occur in the vicinity of the Project. The Project alignment passes near Phou Khao KHouay National Park for a distance of 2 km between Km 68+000 to Km 71+300.

### ***Archaeology and Cultural Heritage***

The NR13 Project does not impact on any known archaeological sites of global or national significance. However, there are 14 temples, and 7 cremation / cemetery sites are located in adjacent to the NR13SE's RoW and proposed borrow pits. There are three spirit houses & statues identified within the COI and need to be removed. It is important that construction activities impacted cultural sites such as cemeteries is conducted in a participative way with involvement from local communities and local spiritual leaders.

Intangible heritage can include traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts. No intangible heritage values are expected to be significantly affected by the Project.

### ***Community Health and Safety***

The Project should help to reduce road traffic incidents in the region through the provision of a dedicated roadway with an improved alignment, which isolates vehicle traffic from pedestrians and non-motorised vehicles, provides a dual carriageway (Km 21 – Km41).

Aside from a potential improvement in the rate of road accidents, the largest impact on community health will be improvements in air quality in some areas. The air quality in Vientiane and Bolikhamxay is already heavily affected by traffic, cooking fuel and burning activities. Once operational, the Project should lead to more efficient motorised transport in Vientiane and Bolikhamxay and potentially a slight improvement in overall air quality due to reduced congestion. Improved fuel and car technology will be the biggest potential driver of air quality in Lao PDR in general.

Traffic on the NR13SE will generate significant traffic related noise for potential receptors in close proximity to the Project. Implementation of the outlined measures such as noise barriers will be important to minimise potential noise disturbance to acceptable levels in these areas.

Some short-term localised impacts on community health and safety may occur during the construction period including air emissions, noise disturbance and changes in accessibility. Construction of the Project is expected to be staged and construction management plans will be implemented to reduce these impacts.

Finally, ensuring that construction contractors interact positively with the local community is an aspect that will need to be carefully managed and monitored.

### ***Gender***

In the context of the Project, women are typically more vulnerable to livelihood changes due to fewer available education, employment and training opportunities, and a higher reliance on agricultural activities. Women tend to be employed in less lucrative economic sectors and have substantially less access to inputs such as land and credit. Gender discrimination may limit women's access to resources, opportunities, and public services necessary to improve the standard of living for themselves and their families. As a result, the livelihoods of women affected by the Project may be disproportionately impacted if not managed appropriately. There is also the potential for instances of Gender-Based Violence (GBV) to increase as result of changes to the community structure in and around the expressway, as well as from increased pressure on livelihoods, with a higher rate of GBV typically directed towards women than men.

Gender mainstreaming will be achieved in line with the principles defined in the AIIB ESP. The following key gender issues will be considered and addressed as appropriate: (i) the local circumstances that may affect the different participation of females and males in road project; (ii) the contribution that females and males each could make to achieving development objective of the proposed project; (iii) the ways in which the proposed project might be disadvantageous to one gender relative to the other; and (iv) the project's proposed mechanisms for monitoring the different impacts of road project on females and males. Gender Action Plan (GAP) is prepared as a standalone documents and the implementation of the GAP will be incorporated in the RP and SEP implementation.

### ***Occupational Health and Safety***

MPWT/DOR is committed to building a workforce that is motivated, healthy and has a good working ability, and to creating healthy and safe workplaces that are free from accidents and work-related disease, in compliance with the Lao PDR's Decree on Occupational Safety and Health Act (2019). The OHS program for the Project will also take into account the AIIB's ESF.

Workers on the Project will be exposed to a number of risks from dust, noise, traffic, and handling of hazardous materials. Appropriate precautions will need to be taken to avoid work-related accidents, injuries or illness. MPWT/DOR and the Contractor will work to: (i) identify potential hazards to workers, particularly those that may be life threatening; (ii) provide preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) train workers; (iv) document and report occupational

accidents, diseases, and incidents; and (v) organise for emergency prevention, preparedness, and response.

Key OHS measures for the Project have been outlined in the ESMP (Volume C-1). The construction contractor/concessionaire will also be required to develop, maintain and disseminate a detailed standalone OHS Plan for the Project, incorporating the measures outlined in the ESIA and other measures required to meet legislative requirements and relevant international standards.

## Stakeholder Consultation

Informal and formal consultations have been undertaken with relevant Government authorities, local communities and stakeholders between January – March 2023 during environmental and social investigations. These were undertaken in accordance with Lao PDR's ESIA Decree (2022) for seeking opinions and views on social and environmental aspects relating to the Project. The overall stakeholder consultation and engagement process focussed on:

- ▶ Identifying and notifying stakeholders of the proposed project activities and the ESIA;
- ▶ Establishing dialogue between the Project and stakeholders;
- ▶ Collect perceptions, concerns, and proposals from stakeholders relating to concerns with the development of the Project; and
- ▶ Making provisions for incorporating stakeholder feedback into the planning and design of the Project.
- ▶ In general, stakeholder feedback has been supportive of the Project provided fair compensation is paid to those who suffer loss as a result of the land acquisition for the Project. Most stakeholder feedback and concerns related to ensuring that Affected Persons are adequately and promptly compensated. Both the local community and local leaders had expectations for employment opportunities to be created for local people during the construction phase. The private sector stakeholders were primarily concerned with ensuring compensation for businesses affected (including impacts on access) and the potential for disruption of utility services for businesses. Consultations with villages and businesses affected by the Project have also allowed them to provide input into the development of livelihood restoration strategies for the Project through identifying key priorities.

The future program for priority stakeholder engagement activities will involve regular consultations with affected stakeholders, including: (i) Project affected communities, with consideration of vulnerable groups, and informal settlements; (ii) affected businesses and industries; (iii) service providers/infrastructure owners; and (iv) relevant governments and institutions. MPWT/PTI/DOR will be responsible for all communication activities related to the Project and will collate and document any comments and feedback associated with future activities in line with the Stakeholder Engagement Plan (Volume C-3).

## Management and Monitoring

A professional management and mitigation program has been developed in accordance with Lao PDR legislation and relevant international standards. The proposed management strategy for the construction and operation phases of the Project has been documented in the Environmental and Social Management and Monitoring Plan (ESMP, Volume C-1). This plan also outlines the framework for the overall environmental and social management system for the Project including responsibilities and implementation arrangements for management and monitoring activities. A Project grievance mechanism will be implemented and maintained throughout the life of the Project to manage and resolve any environmental and social issues or complaints raised by Project stakeholders.

A Resettlement Plan (RP, Volume C-2) for the Project has also been prepared to meet Lao PDR's requirements and international standards. The RP provides the necessary strategic framework for the social planning of the Project and encompasses compensation strategies. The RP identifies the potential needs for physical displacement and/or compensation resulting from the loss of land, livelihood and assets, and outlines the proposed institutional arrangements and cost estimates for the implementation of these measures.

Other management plans prepared as part of the ESIA include a Stakeholder Engagement Plan (SEP), which outlines the approach for ongoing consultation and engagement and a Gender Action Plan (Volume C-4) which outlines the proposed framework for gender diversity management and mitigation for all stages of the Project.

The effective implementation and regular updating of the ESMP and other management plans in response to changing needs will ensure that environmental impacts attributable to the Project are minimised and potential environmental and social benefits are maximised.

A number of key management strategies are recommended and will be important for ensuring that social and environmental impacts are appropriately mitigated. These include:

- ▶ Compensate affected communities and businesses as per the Resettlement Plan (RP, refer Volume C-2);
- ▶ Incorporate appropriately designed stormwater drainage and erosion/sediment control structures during the detailed design phase to manage erosion and sedimentation during construction and to be able to adequately control flow on a regular basis to prevent the risk of roadway flooding once the Project is operational.

Ongoing consultation with the local government agencies, regional communities and other stakeholders will be important to ensure stakeholder interests continue to be taken into account in the planning and development of the Project.

# 1. INTRODUCTION

## 1.1 Purpose of this Document

Lao Transport Engineering and Transport Consultant and Connected Consulting, together referred to as the Consultant, were engaged by the Department of Road (DOR), Ministry of Public Works and Transport (MPWT) to update the Environmental and Social Impact Assessment (ESIA) for the National Road 13 South Extension Improvement and Maintenance Project, Section Km 21 – Km 71 (hereafter the ‘Project’).

The ESIA update was commissioned by DOR to reflect improvements and modifications to the Project design and re-alignment of some sections fill in gaps in identified in the previous ESIA work and align the assessment with international standards, including the AIIB Environmental and Social Policy (ESP) requirements.

The update builds on the draft ESIA, initially undertaken in 2019 and guided by the new TOR in 2022 on the NR13SE. Further inception report was also prepared to provide preliminary information on methodology, team composition, outputs, work plan, tools/data collection questionnaires for the ESIA and the Resettlement Plan (Volume C-2). The current NR13SE ESIA Report, supporting documents, and management plans have been prepared in accordance with the *Decree on Environmental Impact Assessment (2022)* and take into account the other relevant government policies, laws and regulations relevant to road construction and environment.

The proposed Project is an upgrade of existing National Road 13 South between Km 21 – Km 71 (50.530 Km) in Xaythany, Pak Ngum Districts of Vientiane Capital, and Thaphabath District of Bolikhamxay Province. The Project will be improved and/or upgraded in two different sub-sections, sub-section 1 will be improved as 4-lane 2-way divided and sub-section 2 will be improved as 2-lane 2-way undivided, technical standard shall be applied ASEAN Highway Standard in level terrain Class I and Class II respectively in the design. The proposed alternative pavements for the NR13SE include hot mix asphalt (HMA) and Portland cement concrete.

The Project proponent, MPWT through the DOR, is a government agency responsible for managing, maintaining and developing the national road network across the Lao PDR. The ESIA update identifies the likely types of environmental and social impacts associated with the construction and operation of the Project. It assesses the magnitude of, and likelihood of these impacts based on previous work commissioned by MPWT and current available Project information. Standalone management plans to address residual impacts are provided as part of the appendices to the ESIA (refer to Volume C). An update of the original Resettlement Plan has also been prepared (refer to *Resettlement Plan*, Volume C-2).

## 1.2 Background

### 1.2.1 Project Benefits and Need

As a result of progressive economic growth over the last few decades, increased population and associated traffic in the region has led to capacity constraints on the existing NR13S, particularly between the Section NR13SE. This has led to delays and unreliability issues not only on the existing NR13S but also on the surrounding local road network. Congestion in these areas affects trade, road safety, commuting, the environment and vehicle operating costs. The capacity issues on the road network are such that if improvements are not implemented, the reliability of the transport network is forecasted to be severely affected by 2034 (LTEC, 2022).

As a regional and international transport corridor, the overall NR13SE Project will contribute to key strategic transport priorities for the regional and help meet the objectives of the regional integration, socio-economic development and investment in transport infrastructure outlined in key national policies such as the 9<sup>th</sup> National Socio-Economic Development Plan (2021-2025) and the National Transport Master Plan (refer to Chapter 3 – Legislative Framework).

The proposed NR13SE Project forms part of the National Road 13 (NR13) and a series of major infrastructure investments within Lao PDR. An extensive network of roads is being planned to facilitate vehicle movement throughout the National Road 13. This includes the improvement and maintenance of National Road 13 South from Km 71 to Km 346 as well as National Road 13 North from Sikeud to Phonhong (58 Km), which are both currently under construction. It also includes the planned Vientiane – Pakse Expressway Project, for which the route has recently been approved by the MPWT. These road developments are being constructed and planned in combination with other transport and logistics projects including the Lao-China Railway project.

The Project is needed to relieve traffic congestion, improve road safety and cater for the substantial economic growth planned in the region. Specially, the need for the NR13SE Project include:

- ▶ **International transport and regional trade** – as the principal road link in the region, the existing section of the NR13 South serves as the main national and regional transport corridor linking Vientiane Capital to southern and northern provinces and other regional countries (i.e. Vietnam and Thailand). NR13 is part of ASEAN Highway (AH) and the NR13 South from Vientiane to the border with Cambodia is AH11. As such, the road corridor is a major contributor to Lao PDR's economic activity and is one of the most heavily used roads in the country. Currently, heavy congestion and capacity constraints on the existing road have affected traffic flows and have also acted as a disincentive for efficient pricing of goods destined for Lao PDR. The NR13SE Project is needed to contribute to the national objectives of improving national traffic flows and facilitate improved business with neighbouring countries.
- ▶ **Local trade and enterprise** – the NR13 South provides access to major cities in central, southern and some northern provinces (i.e. Xieng Khouang and Houaphan). This has led to a net effect of concentrated traffic on this section of the road to Vientiane, resulting in

a very high usage on the NR13 South and severe congestions, delays in the transport of goods and services, and capacity constraints, particularly in peak times. The NR13SE Project is needed to facilitate greater access to these growth centres, reduce business operating costs and assist with the decentralization of business activities (through providing faster access to regional centres) and provide opportunities to develop the outskirts of the Vientiane Capital.

- ▶ **Traffic congestion around NR13 SE** – Currently, the primary road linking Vientiane and southern provinces is only the NR13 South. The urban development along the NR13SE is growing rapidly, particularly the intermediate localities. There are virtually no contiguous sections of reasonable quality roadway for lateral traffic between the outer suburbs and the Vientiane city centre. The current road is only two lanes to support all types of vehicles. The NR13SE is needed to provide high standard road that connects to the central, southern, and some northern provinces. When completed, the NR13SE will address issues of congestion in the growing traffic in the suburb areas of Vientiane.
- ▶ **Road conditions** – the combination of high road demand, lack of capacity and road traffic related accidents has led to severe current problems for public and commercial road users, with long delays, unpredictable journey times, high accident rates and high travelling costs. The NR13SE Project would relieve congestion, improve road safety and improve conditions for road users.

Transport infrastructure development is a critical element in the economic development policy of Lao PDR. The NR13SE Project is expected to provide a range of direct and indirect benefits at the national, regional and local levels. Direct benefits include government revenue through fees and taxes, increased direct public investment in the country and employment opportunities. Indirect benefits include flow on effects and infrastructure development. Benefits of the NR13SE include:

- ▶ Direct public investment of approximately US\$93.69 million in capital expenditure for the the NR13SE Project construction and additional US\$14.76 for operations based on the updated Project Feasibility Study (LTEC, 2019). This expenditure will likely result in flow on effects to the Lao PDR national economy, resulting in an increased GDP;
- ▶ Significant increase in regional and local employment opportunities with approximately 168 jobs created during construction and 20 jobs during operations.
- ▶ Increased overall efficiency of the road network with a consequent improvement of the national / international road freight traffic through improving the reliability of transportation;
- ▶ Improved conditions for road users through reduced vehicle-operating costs, time travel savings and fuel savings as a result of a more efficient road network. Road users will experience greater time savings of approximately 20-30mins between the NR13SE section;



- ▶ Improved road safety through a high standard road with dual carriageway (Km 21 – Km 41+500), improved alignment at sharp curves, improve road geometry, and more overtaking opportunities;
- ▶ Increased operations and maintenance efficiency along the road network;
- ▶ Skills development and capacity building in the field of road and bridge infrastructure management through a 10-year construction and maintenance periods; and
- ▶ Reduction in cost of doing business in the region through an improved road network and more reliable journey times.

## 1.3 Presentation of the Project

### 1.3.1 Project Overview

The Project assessed in this ESIA is the National Road 13 South, starting at km 21 junction in Xaythany District, Vientiane Capital to Km 71+500 in Ban Xaysavang in Thaphabath District, Bolikhamxay Province. The Project has a total length of 50.530 km, and the road section is mainly in the area of Vientiane Capital while only the last section, approximately 5 km length is in length, is in Bolikhamxay Province.

It is envisaged that the improvement to an ASEAN Highway standard class I and class II in level terrain, road works involve bringing the existing roads to a minimum width as below:

- ▶ First sub-section (could be classified as urban road) roadway width of 23 metres: traffic lanes 3.50x4, shoulders 1.70x2, sidewalks 1.50x2, and centre median 2.60 metres (included safety space);
- ▶ Second sub-section has designed for two standards including through community area and through non-community areas:
  1. In community area roadway width of 15 metres: traffic lanes 3.5x2, slow lanes 2.50x2, sidewalks 1.50x2; and
  2. In non-community area roadway width of 12 metres: traffic lanes 3.5x2, slow lanes 2.50x2, verges 0.35x2.

It will also include pavement strengthening, shoulder and sidewalk improvement, embankment improvement, provision and improvement of drainage structures.

The Project will use Output and Performance Based Road Contract (OPBRC) and apply Design Built Maintenance Operate and Transfer (DBOT) method for the construction and operation. The Project construction shall be completed in 36 months and the construction should be divided in sub-sections and substantially complete construction at each sub-section. The Project will include operation and maintenance over a 7-year period.

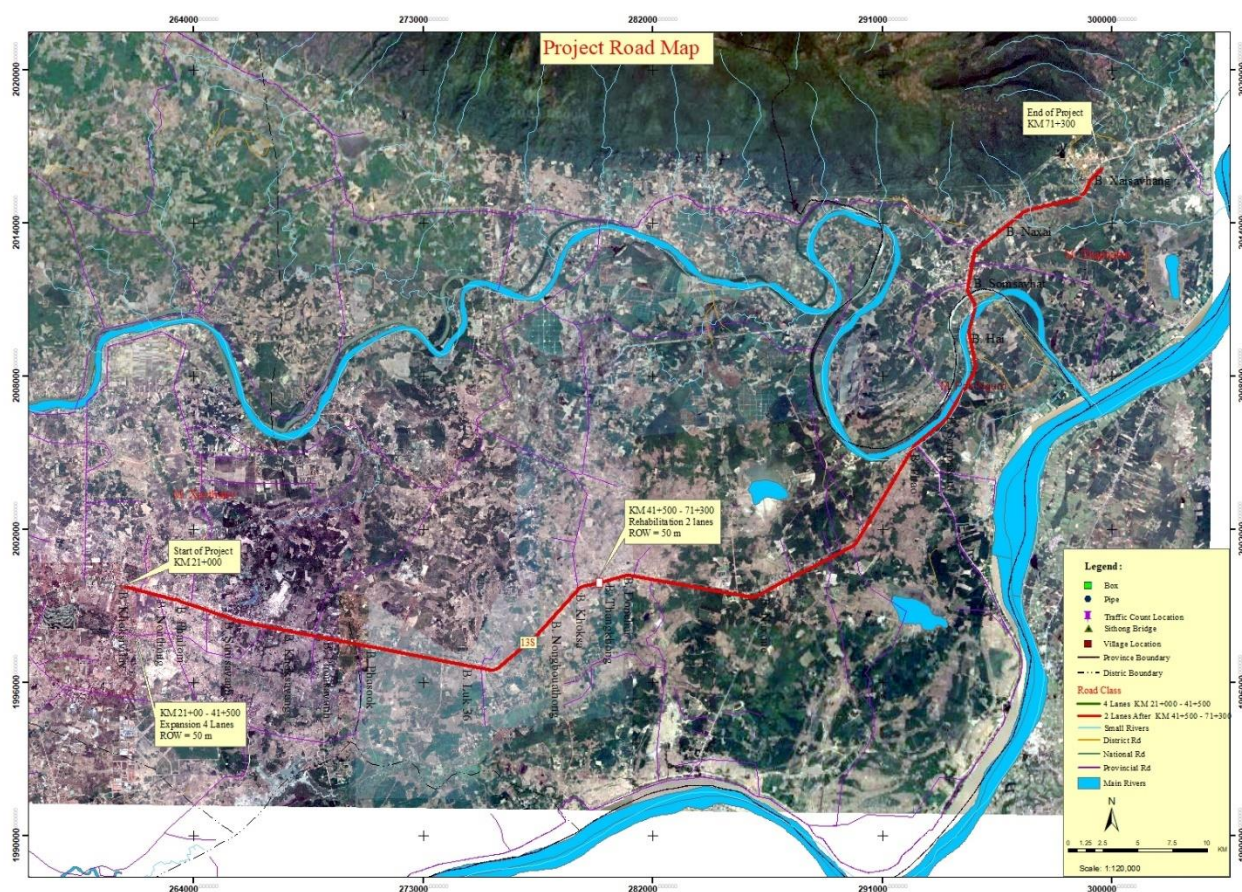


Figure 1-1: Project Overview

### 1.3.2 Purpose of the Project

The Project's primary objectives are to improve and maintain the existing national road to relieve traffic congestion and enhance the efficiency of the road network and transport in the Project area and southern region of the Lao PDR. The Project will improve socio-economic development, reduce road transport costs, reduce vehicle emissions and improve road safety. It will also improve connectivity to the sub-region and provide improved links between Thailand, China, Cambodia, Vietnam and Lao PDR.

#### 1.1.1.1 Socio-Economic Objectives

Socio-economic objectives of the Project are to:

- ▶ Support economic growth by enhancing economic and social development at the national level through development of a good quality road network;
- ▶ Support the local industry through enhanced job opportunities;
- ▶ Promote socio-economic sustainability through measures to protect and enhance existing livelihoods;
- ▶ Minimise potential impacts on social infrastructure and systems; and
- ▶ Develop the Project in a manner that minimises potentially negative impacts while promoting socio-economic benefits.

### 2.1.1.1 Environmental Objectives

The environmental objectives of the Project are to:

- ▶ Identify and mitigate potentially negative environmental impacts associated with the Project;
- ▶ Minimise adverse environmental impacts through adherence to Lao PDR and international environmental standards and regulations, and by the application of international best practice in road development;
- ▶ Align the Project with relevant international standards and guidelines as well as Lao PDR's policies and standards.

### 3.1.1.1 Commercial Objectives

The strategic objectives of the Project are to:

- ▶ Enhance capacity of the southern road corridor to cope with any planned or unplanned incidents;
- ▶ Improve the national road network and its performance;
- ▶ Support economic growth in the central and southern provinces of the country by improving accessibility; and
- ▶ Improve the local air quality particularly on the community areas.

### 1.3.3 Project Implementation

The Project will be implemented through an Output- and Performance-Based Road Contract (OPBRC) similar to that being used for North, with a 10-year contract life. The OPBRC expands the role of the private sector from a simple execution of works to a management and maintenance of road assets and the contractor is paid through a combination of output payments for defined improvement works along with periodic performance-based lump-sum payments for bringing the road to a certain service level and then maintaining it at that level for a relatively long period. The 10-year OPBRC will comprise the first 2- or 3-year construction/periodic maintenance period (called the "Construction Phase") and follow-up operations and maintenance (O&M) which may begin from the start of the contract and extend for 7 or 8 years beyond completion of the Construction Phase. The payments for the Construction Phase will be made if the contractor meets or exceeds the performance indicators for defined fully finished road sections ("milestones"), and against works certification issued by the construction supervision consultant.

The Department of Roads (DOR), under MPWT, is responsible for implementation of this Project including overall technical oversight, execution, and management of the Project and has appointed a dedicated team (Project Management Unit - PMU) to be responsible for the day-to-day implementation, and operation of the project, including contracting and supervision of all consultants. The Environment Research and Natural Disaster Prevention Division (EDPD) of the Public Works and Transport Institute (PTI) under MPWT are responsible for monitoring and supervision of environmental and social safeguards (ESS) and providing technical assistance and capacity building.

## 1.4 Project Proponent

The MPWT through DOR is the Project proponent and represents the GOL. As the Project executive agency, DOR's mandate is to develop and maintain the national road network in an efficient and sustainable manner. The MPWT/DOR will establish a Project Management Unit (PMU) to have adequate control over monitoring the Project implementation by the contractors.

The contact details for the Project proponent are as follows:

### Ministry of Public Works and Transport of Lao PDR

Lanxang Avenue, Vientiane Capital, Lao PDR

Contact: 856-21 412250 Fax: 856-21 412250

## 1.5 ESIA Consultant

MPWT has commissioned LTEC Consulting to be the lead for the conduct of feasibility study. LTEC with support from Connected Consultancy Co., Ltd – a licensed Environmental and Social Study consultant in Lao PDR prepared this ESIA and associated management plans for the Project.

### 1.5.1 LTEC's Experience

LTEC (formerly known as CDRI) is a multi - disciplinary consultancy firm, established in 1982. LTEC is specialized in transportation engineering works. LTEC has undergone active diversification over the year, playing pioneering role in many areas of services. In New York, June 2004 LTEC was recognized with the Gold Category Award from the Business Initiative Directions, an international organization representing worldwide business that promote successful and innovative management practices. The International Quality Summit Award selection criteria is based on principles of the T.Q.M, under the title of QC 100. In 2006 LTEC has been found to conform to the Quality Management System as ISO 9001: 2000; April 2015 - ISO 9001:2008 ; May 2018 - ISO 9001:2015, which valid for the following services range: topographical survey, soil investigation, traffic engineering, architecture, design, feasibility studies, construction supervision, and environmental and social studies.

Project team includes specialists in all the areas required to complete an ESIA, including:

- ▶ Project managers with environmental expertise and experience in conducting ESIA's of infrastructure projects;
- ▶ Social / socio-economics specialists;
- ▶ Health, safety, pollution and risk management experts;
- ▶ Traffic specialist;
- ▶ Topographic survey specialist;
- ▶ Geotechnical survey specialist;

- ▶ Road, bridge, and drainage design, drawing specialist; and
- ▶ GIS and mapping specialist.

### 1.5.2 LTEC's Contact Details

#### LTEC's Head Office

Lao Transport Engineering Consultant (LTEC)

Tha Deua Road KM 5

P.O.BOX: 7329, Vientiane capital, Lao PDR.

Tel: (+856 21) 313510, 313761, 312840

Fax: (+856 21) 314811

E-mail: ltec@laotel.com

website: www.ltec.com.la

## 1.6 ESIA Objectives and Structure

### 1.6.1 ESIA Objectives

The key objectives of the updated ESIA are to:

- ▶ Identify and evaluate environmental and social risks and impacts of the Project associated with construction and operation;
- ▶ Adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimise, and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment;
- ▶ Promote improved environmental and social performance of the Project through the effective use of management systems;
- ▶ To ensure that grievances from the affected communities and the external communications from other stakeholders are responded to and managed appropriately; and
- ▶ Promote and provide means for adequate engagement with the affected communities throughout the Project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.

### 1.6.2 ESIA Report Structure

The structure and content of the ESIA is consistent with the EIA requirements stipulated in the Lao PDR's EIA Guidelines for Development Projects and Activities (2016) and includes additional documentation to assist in meeting the relevant international standards.

The ESIA submission is comprised of the following documents:

- ▶ **Volume A: Main ESIA Report (this document)**
- ▶ **Volume B: Technical Appendices:**

1. Appendix 1: Description of National Applicable Legal Framework
2. Appendix 2: NR13SE Project ESIA Report Maps;
3. Appendix 3: Traffic Survey Report (LTEC, 2019);
4. Appendix 4: Road Safety Assessment Report (LTEC, 2019);
5. Appendix 5: Tree Species within the COI;
6. Appendix 6: Ambient Air, Noise, Water Quality, Wind and Vibration Monitoring Report (Phanthamit, 2023);
7. Appendix 7: References

► **Volume C: Management Plans:**

**1. Volume C-1: Environmental and Social Management and Monitoring Plan (ESMP):**

**2. Volume C-2: Resettlement Plan (RP):**

- Attachment 1: Signed Official Letters between DOR, PTI and the Consultant to confirm on the COI, with specific cross-section profiles
- Attachment 2-1: Mater List of PAHs
- Attachment 2-2: Mater List of Affected Public Structures and Utilities
- Attachment 2-3: List of Affected Poor Households
- Attachment 2-4: List of Affected Vulnerable Households
- Attachment 2-5: Maps of Affected Land
- Attachment 2-6: Maps of Affected Houses and Shops
- Attachment 2-7: Photos of Affected Assets
- Attachment 3-1: DMS Form for PAPs
- Attachment 3-2: DMS Form for Public Utilities
- Attachment 4-1: Decision of Major of Vientiane Capital on Compensation Unite Rates – to be added
- Attachment 4-2: Decision of Provincial Governor on Compensation Unite Rates – to be added
- Attachment 5A: 1st Cut-Off Date, No. 23733/MPWT Office, dated 28 September 2022
- Attachment 5B: 2nd Cut-Off Date – to be added
- Attachment 6-1: Provincial Resettlement and District Committees: VTE Capital, No. 1016/Major of VTE Capital, dated 30 November 2022;
- Attachment 6-2: Provincial Resettlement and District Committees: BKX Province, No. 698/Province Governor, dated 15 November 2022
- Attachment 7-1: Village Socio-Economic Form
- Attachment 7-2: PAP's Socio-Economic Census Form

**3. Volume C-3: Stakeholder Engagement Plan (SEP):**

- Attachment 1: Form to Submit Grievances
- Attachment 2: Grievance Log Form
- Attachment 3: Summary of stakeholder concerns from the village consultation and FGD

- Attachment 4: Project Information Poster
- Attachment 5: Focused Group Discussion Questionnaires
- Attachment 6: FPICon Form
- Attachment 7A: List of Participants at Village Level
- Attachment 7B: List of Participants on Compensation Unit Rate
- Attachment 7C: List of Participants on draft ESIA/ESMP, RP, SEP and GAP
- Attachment 8: Photos of Consultations
- Attachment 9: Additional FGDs on Road Safety

**4. Volume C-4: Gender Action Plan (GAP):**

- Attachment 1: Focused Group Discussion Questionnaires
- Attachment 1: Summary of stakeholder concerns from the village consultation and FGD

## 2. LEGAL AND ADMINISTRATIVE FRAMEWORK AND GAP ANALYSIS

This will discuss the policy, legal, and administrative framework within which the ESIA is carried out and identifies relevant international environmental agreements to which the country is a party. It will also discuss the AIIB ESP applicable to the project, the World Bank Group Environmental, Health and Safety Guidelines (ESHGs), and other relevant Good International Industry Practice (GIIP). This section will compare the country's existing environmental and social framework and the applicable safeguards policies and identifies the gaps between them.

The requirements stipulated in this framework encompass all phases of the Project including Project alignment and design; land acquisition; and development of the permanent infrastructure and other temporary facilities (e.g. construction workcamps, quarries, borrow pits, etc.).

### 2.1 Lao PDR Environmental Permitting and ESIA Process

#### 2.1.1 Primary Agencies

The key government agency responsible for environmental and social assessment of the Project via the ESIA process is the Department of Environment (DOE), and the Department of Natural Resources and Environment Inspection (DNREI), Ministry of Natural Resources and Environment (MONRE). The Decree on Environmental Impact Assessment (2022) and the Environmental Assessment Guidelines (2016) currently guides the environmental and social assessment process in Lao PDR, which has considerably strengthened the associated permitting requirements and applicable industry requirements. The Ministerial Instructions for the Conduct of ESIA's (No. 8030 – December 2013) outline the format and procedural requirements of this process.

According to the Decree on Environmental Impact Assessment (2022), MONRE is key agency on ESIA process in coordination with concerned ministries, government agencies, local authorities and project affected communities. Main duties and responsibilities of MONRE, line agencies and local authorities relevant to ESIA process include:

#### ***Main duties of MONRE in ESIA Process:***

- ▶ Reviewing and approving the scope of assessment and works for ESIA;
- ▶ Conducting field inspection and organizing consultation meetings during review of ESIA, ESMP and development plans;
- ▶ Engaging national or international specialist and/or establishing a panel of expert for the review of ESIA, ESMP and management plans for complex projects where necessary;
- ▶ Approving ESIA, ESMP and management plans;
- ▶ Issuing, suspending or withdrawing environmental compliance certificate;
- ▶ Monitoring the implementation of ESMP and management plans;



- ▶ Gathering grievance and complaints from project's affected people and related stakeholders with proposed resolutions;
- ▶ Conducting emergency and non-compliance issues in coordination with concerned ministries and local authorities; and
- ▶ Regularly summarizing and reporting the results of the management of ESMP and management plans to the GoL.

***Main duties of PONRE in ESIA Process:***

- ▶ Collaborating and facilitating project developers on the conduct of ESIA process;
- ▶ Conducting field inspection and organizing consultation meetings during the review of ESIA documents;
- ▶ Appointing a panel of expert at provincial level to review ESIA reports;
- ▶ Providing recommendation to MONRE to suspend or withdrawal ECC where necessary;
- ▶ Requesting provincial governor to establish ad hoc committee to monitor environmental issues of investment projects and activities in case of emergency and where necessary;
- ▶ Gathering comments, feedback and complaints/grievances from project's affected people, and proposed resolutions; and
- ▶ Regularly summarizing and reporting the implementation of ESMP, and management plans of projects and activities to MONRE.

***Main duties of DONRE in ESIA Process:***

- ▶ Participating in ESIA process and monitoring the ESMP implementation if investment projects and activities;
- ▶ Providing comments on ESIA, ESMP and management plans;
- ▶ Gathering comments, requests or complaints from people affected by development projects and activities and related stakeholders, and proposed solutions for any dispute;
- ▶ Coordinating with other stakeholders in ESIA process; and
- ▶ Regularly summarizing and reporting the implementation of environmental management activities to PONRE and local authorities.

***Rights and duties of sectoral agencies and local authorities in ESIA Process:***

- ▶ Coordinating with the natural resources and environment sectors and related agencies in preparation of plans, budgets for environmental monitoring and inspection of projects and activities;
- ▶ Overseeing the implementation of environmental and social management and mitigation measures of projects and activities; and
- ▶ Encouraging development projects to apply environmental-friendly approaches and technologies in construction and operations of projects.

### 2.1.2 ESIA Process

The current EIA and environmental permitting process in Lao PDR is described below and is illustrated in Figure 2-1. The first step is the screening process to determine whether the project is a Category 1 or Category 2 project. The definitions of Category 1 or Category 2 projects are articulated in the Decision on Categorisation of Investment Projects and Activities Requiring the Conduct of IEE or ESIA No. 0358/MONRE (2023).

**Table 2-1: Project Categories as defined by the Ministerial Agreement on List of Investment Projects and Activities Requiring for Conduct IEE or ESIA (2013)**

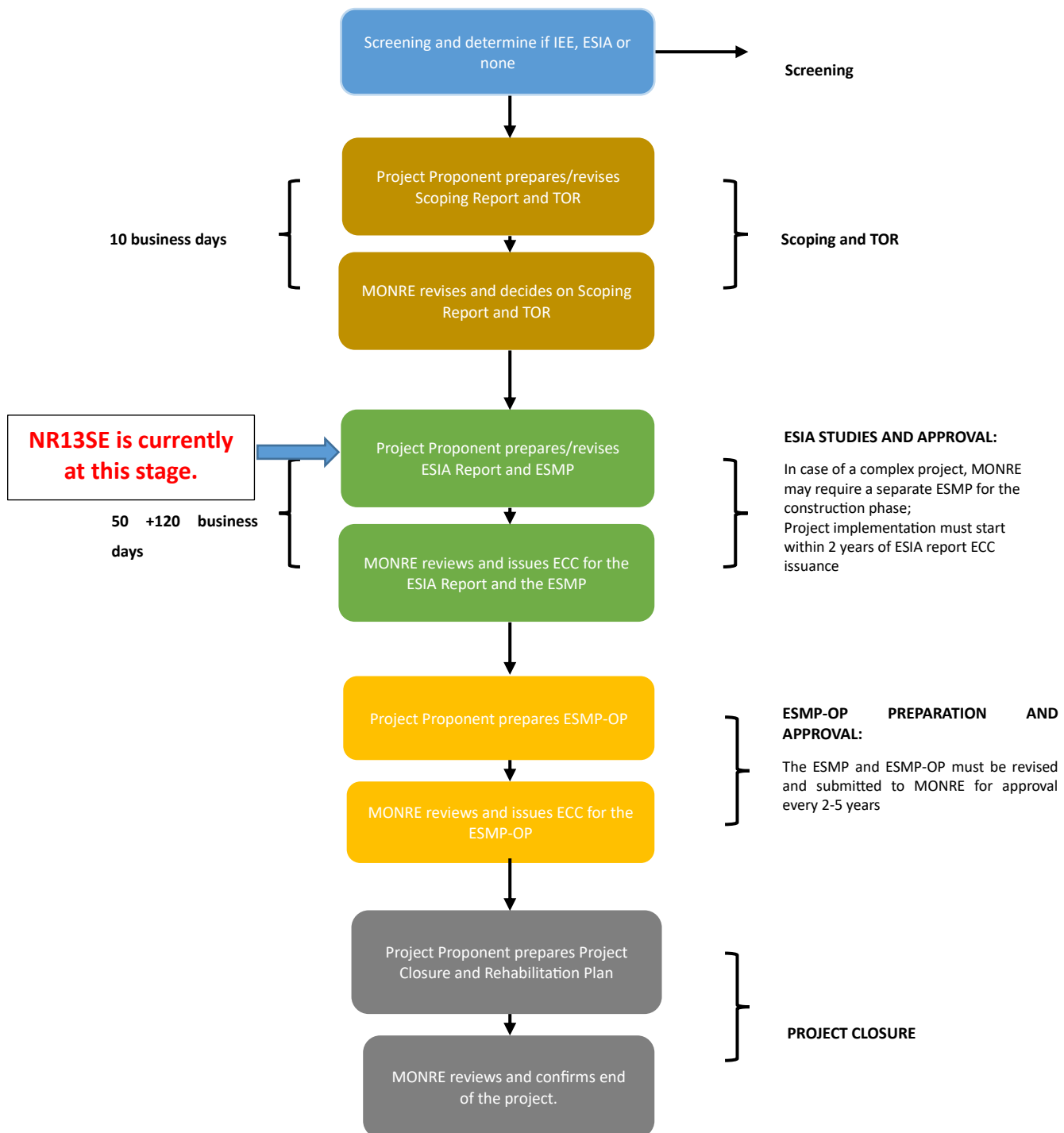
Category	Project
Category 1	Small scale investment projects with minor environmental and social impacts.
Category 2	Large scale investment projects which are complicated or create significant env. or social impacts.

Source: GOL, 2022

Category 1 projects require an Initial Environmental Examination (IEE), while the Category 2 projects require an Environmental and Social Impact Assessment (ESIA) to be undertaken.

During the project scoping phase, the Project Developer prepares a Scoping Report and detailed Terms of Reference (TOR) for the preparation of the ESIA. MONRE will revise, comment and approve the TOR to ensure the proposed ESIA approach satisfies GOL requirements.

The preparation of the ESIA Report and ESMP require consultations with local authorities and affected peoples. MONRE conducts administrative and technical reviews of the EIA Report and ESMP. The Project Developer is required to revise the ESIA Report and ESMP to comply with the consolidated comments provided by MONRE. Once MONRE is satisfied with the ESIA Report and ESMP (if applicable), the Environmental Compliance Certificate is issued with specific conditions, where required. Figure 2-1 provides a schematic representation of the current ESIA cycle in Lao PDR.



The NR13SE is subject to the conduct of ESIA according to the Decision No. 0358/MONRE.

Figure 2-1: ESIA process in Lao PDR (GOL, 2022)

## 2.2 Governance of Road Sector

Ministry of Public Works and Transport is key agency responsible for management of public works, urban development, and land and water transport including management of domestic water supply and sanitation in urban areas. It is relatively large and stable ministry and key agencies including the Department of Road (DoR), the Department of Waterways, the Department of

Housing and Urban Planning, Department of Transport, and the Public Works and Transport Research Institute (PTI). The DoR will be responsible for ensuring that relevant safeguard requirements are included in the planning, design and bidding/contract documents and that the contractors are aware of environmental and social obligations and agreed that it is part of the subproject cost.

The further planning and implementation of the Project will be undertaken through consultation with, and advice from, provincial and district government agencies, through the Resettlement Committee (RC). The main function of the RC is to represent the interest of the APs and stakeholders in dealing with project impacts and mitigation measures. The details of the roles and responsibilities of the RC are provided in Decree 84, Articles 19-20. The RC will appoint a management and an operational unit to be responsible for the overall process of resettlement and compensation. The RC will meet regularly and will have an inaugural meeting at least one month before the start of the Project and will operate during the construction of the subprojects and for up to two years after completion of construction activities (to monitor impacts and take action where necessary). The minutes of meetings and activities of RC will be incorporated into overall Project internal and external monitoring. The responsibilities of RC will be as follow:

- ▶ Coordination of relevant government organizations with ESMU to ensure that Resettlement Pan is properly implemented;
- ▶ Review and provide comments on valuation of land and assets (crops, production, market values, etc.) for compensation for APs;
- ▶ Organization of provincial and district level meetings and consultations as required;
- ▶ Monitoring and auditing funds that are earmarked for RP implementation; and
- ▶ Participation in resolution of, and follow through, of claims or complaints lodged via the established grievance redress procedures.

## 2.3 Policy and Legislation

The Project will be implemented in compliance with national regulatory requirements and align with applicable international standards and guidelines. Key legislation framework applies to this Project include;

- ▶ National Environmental Laws and Decrees (e.g. Decree No. 389/GoL, 2022; Decree No. 84/Gol, 2016);
- ▶ Institutional Framework for Environmental Management in Lao PDR;
- ▶ National Environmental Standards;
- ▶ AIIB Environmental and Social Framework;
- ▶ World Bank Group's Environmental Health and Safety Guidelines;
- ▶ International Environmental Agreements, Conventions and Treaties; and

In Lao PDR, there are many laws and regulations govern the utilization and management of natural resources management (land, forest, water, aquatic and wildlife, etc.) established in late 1990's and many have been updated and/or revised. The Environmental Protection Law (EPL) established in 1999 and revised in 2012, describes the principles, regulations and measures for managing, monitoring, restoring, and protecting the environment including the pollution control and the impact assessment processes. In late 2013, two regulations on the Environment and Social Impact Assessment (ESIA) and an Initial Environmental Examination (IEE) were established. However, they have been upgraded to a decree level and the decree has been approved by the Prime Minister (EIA decree No 21, date January 31, 2019) in early 2019. Similarly, the compensation and resettlement decree established in 2005 (Decree 192/PM) was also revised and approved in 2016 (Decree 84/PM). MONRE is the lead ministry responsible for implementation of the EPL and its regulations and/or guidelines. MONRE is also responsible for management of water, land, and environmental management while the Ministry of Agriculture and Forest (MAF) is responsible for management of protected area (PA) and protection forest area (PFA).

### 2.3.1 National Policy, Legal and Regulatory and Policy Framework

The National Socio-economic Development Plan 2021 - 2025 outlines the country's efforts to develop the sustainable and climate-resilient road infrastructure to facilitate socio-economic growth and regional and international integration.

Key laws, decrees and guidelines relevant to environmental and social management of road projects in Lao PDR are outlined in Table 2-2 while the details description are provided in Volume B – Appendix 1.

**Table 2-2: Key Lao PDR environmental and social legislation applicable to the Project**

Title	Year Issued
<b>Laws</b>	
Law on Disaster Management, No. 15/NA, dated 24/06/2019	2019
Law on Forestry, No. 08/NA, dated 13/06/2019	2019
Law on Resettlement and Vocation, No. 086/NA, dated 15/06/2018	2018
Law on Water and Water Resources, No. 23/NA, dated 11/05/2017	2017
Law on Urban Plans, No. 072/NA, dated 16/11/2017	2017
Law on Grievance Redress, No. 023/NA, dated 09/11/2016	2016
Law on Road Traffic, No. 021/NA, dated 08/11/2016	2016
Law on Public Road, No. 03/NA, dated 08/11/2016	2016
Law on National Heritage, No. 44/NA, dated, 24/12/2013	2013
Law on Labour Protection, No. 43/NA, dated 24/12/2013	2013
Law on Land Transport, No. 23/NA, dated, 12/12/2012	2012
Law on Environment Protection, No. 29/NA, dated 18/12/2012	2012
Law on Multi-Transports, No. 28/NA, dated 18/12/2012	2012
Law on Construction, No. 05/NA, dated 26/11/2009	2009
Law on Land, No. 04/NA, dated 21/10/2003	2003

<b>Decrees</b>	
Decree on Environmental Impact Assessment, No. 389/GOL, dated 20/10/2022	2022
Decree on Occupational Health and Safety, No. 22/GoL, dated 05/02/2019	2019
Decree on the Endorsement and Promulgation of National Environmental Standards, No. 81/PMO, dated 21 February 2017	2017
Decree on Compensation and Resettlement of People Affected by Development Projects, No. 84/GoL, dated 05/04/2016	2016
Decree on Public Road Maintenance Fund, No. 09/PM, dated 15/01/2001	2001
<b>Decisions, Directives, Regulations, and other Legislation</b>	
ESIA Technical Guidelines, No. 2796.1/MONRE.DESIA, dated 19/12/2016	2016
Ministerial Instruction on the conduct of ESIA for development projects and activities, No. 8030/MONRE, dated 17/12/2013	2013
Public Involvement Guidelines in ESIA Process, No. 707/MONRE, dated 05/02/2013	2013
Decision on Occupational Health and Safety at Construction Sites, No. 3006/MLSW, dated 21/08/2013	2013
Ministerial Order on Public Road Buffers Management, No. 00469/MPTW, dated 29/04/2013	2013
Ministerial Decision on Public Road Maintenance, No. 17179/MPWT, dated 28/12/2009	2009

Key laws and regulations relevant to environmental and social safeguards of the Project are outlined below:

***Law on Resettlement and Occupation (2018)*** applies for both government and private sector development projects. This law aims to define, regulate, manage and monitor resettlement and livelihood for Lao population of all ethnic groups to ensure that those who are in areas identified for resettlement and livelihood are provided with stabilized residential and production land and occupation with ultimate goals to address illegal relocation, eliminate poverty, improve livelihood, security and social order, develop small villages into rural small towns contributing to national socio-economic development and national security. Article 22.1 also states that people affected by settlement and livelihood program (governed under this law) will be provided with compensation for land and assets lost at a replacement cost, providing that she/he has official land (use or title) documents. The Article 22.4 recognizes customary land use that if certified by the local authority and concerned sector, the affected person is eligible for compensation as specified in the above Article. Article 22.5 discusses that if any persons affected by the Project do not have formal land documents (land title, land use documents, land use tax receipts, etc), she/he will not be entitled for land compensation. Displacement costs, however, are required to be provided for the loss of assets. Displacement costs for non-title landholders is not stipulated in this Law.

***Environment Protection Law (2012)*** is the overarching piece of environmental legislation in Lao PDR. The law specifies the principles, rules and measures to manage, protect, monitor and rehabilitate the environment, as well as to contribute to the socio-economic development of the nation and reduce the impacts of climate change and natural disasters (Article 1 and Article 20). Article 25 articulates impact mitigation measures derived from construction and renovation activities such as roads, bridges, buildings, etc.

***Road Law (2016)*** describes type of road works comprising construction of new road, road upgrading, road improvement, road rehabilitation, road maintenance, and emergency road works and assign the responsibility for development and management of road networks to DoR and other agencies within MPWT including the Provincial Department of Public Works and Transport (DPWT). The Road Law states that Ministry of Public works and Transport manages and uses the land for the road activity in conformity with the determination in the land law. Road width shall have the area consisting of the carriageway, shoulders, pathways, drainages, slope of road and Right of Way (Article 21, 22, 23, and 24). Within the Right of Way, it shall be banned all constructions and other activities. Article 30, 31 and 32 (new) states that conducting feasibility study of road construction, maintenance and rehabilitation shall perform environmental impact assessment. Reasonable compensation must be paid to individuals whose land is expropriated for roads, relocation of replacement structures, and loss of trees and crops (Article 38 and 39); and it states that it is prohibited to construct within the road reserve (Article 38).

***Law on Water and Water Resources (2017)*** specifies that the GoL is responsible for the prevention of adverse impacts from water and all acts that cause the depletion of water; water resources must be managed and used according to centralized, comprehensive and integrated management principles and according to the 'allocation plan' which gives individuals and organizations the right to use water. Article 4 defines rights, obligations, and procedures to gain approval for use of water resources. Article 18 stipulates that medium and large scale uses require feasibility studies, ESIA, and mitigation plans, before permission is granted for use of the resource. Article 22 stipulates that water resource development must be consistent with national and sector plans, must ensure preservation of the natural beauty of the resources, and must protect against harmful effects of water. Article 29 sets out regulations on water and water resources protection areas from development projects and activities through avoidance, mitigation and management of potential impacts on water quality, soil erosion, and water flow regime.

***Forestry Law (2019)*** sets fundamental principles, regulations and measures on management planning, conservation, and development and utilization of forest resources, promotion of tree plantation and increase forest resources. Forestland could be converted for public benefits, but it shall not have significant impact on forest, soil quality, and the environment (Article 77). Article 81 stipulates that forestland on transmission lines and road alignment is not required conversion.

***Law on Cultural, Historical and Natural Heritage (2013)*** addresses a number of environmental protection issues. It states that socio-economic development shall proceed side by side with protection and conservation of the national heritage. It defines cultural, historical and natural heritage, noting that natural heritage may have scenic or ecological value. The Law also sets out zoning and measures for protection of heritage sites. Areas of national natural heritage shall be registered, especially those containing heritage of high value, such as biodiversity areas, conservation forests, wetlands, caves, etc. Although it states that sources of biodiversity which have national natural heritage, e.g. wetlands, ponds and marshes, shall be administered by inspection and registration, as proposed by the concerned sectors. It also sets out regulations for protection of national heritage, such as the need to obtain prior approval for development in any

national natural heritage area from the Ministry of Information and Culture (MIC) and other concerned sectors.

***Land Law (2019)*** describes the system of land tenure, with all land recognised as the property of the nation and remaining under the control of the Government of the Lao PDR. However, the law recognises and protects private land use rights. These rights can be transferred, granted by the State, or inherited provided taxes on the land have been paid. Land is categorised in accordance with the form of use, and various principles are outlined in the legislation for respective land use. This law provides an important framework for any land compensation, as despite the lack of freehold title, the land use rights are a tradeable commodity. The land classification administration is also important for determining the various categories of land use within the Project area. The Land Law, 1997 was amended in 2003, and earlier 2019 to set out the main institutional responsibilities for land management and administration in Lao PDR and stipulates that the overall responsibility for land administration will, once established, belong to the National Land Management Authority (now part of MONRE).

***Decree on Environmental Impact Assessment (2022)*** outlines the regulatory framework for development projects and activities to undertake environmental and social impact assessment (ESIA). The current ESIA Technical Guidelines (No. 2796.1/MONRE.DESIA, 2016) sets out technical aspects, updated format and procedural requirements of this process. These regulatory documents have considerably strengthened in association with project permitting requirements.

***Decree on Compensation and Resettlement of People Affected by Development Projects (2016)*** defines principles, rules, and measures to mitigate adverse social impacts and to compensate damages that result from involuntary acquisition or repossession of land and fixed or movable assets, including changes in land use, restriction of access to community or natural resources affecting community livelihood and income sources. This Decree aims to ensure that project affected people are compensated and assisted to improve or maintain their pre-project incomes and living standards and are not worse off than they would have been without the project. The provisions will be applied during the preparation and implementation of the social impacts assessment (SIA), the social impact mitigation and monitoring plan, and/or the Resettlement Plan (RP). Technical Guideline for this Decree is being prepared and expected to be approved and launched before the end of 2019. While DNEP is responsible for review and approval of the SIA with consent from the province, the province under supervision of the Provincial Resettlement Committee (PRC) is responsible for overseeing the implementation of the Decree which will be carried out by the project owner. Discussion is underway on whether this Decree will be superseded by the new Law on Resettlement and Livelihood launched in August 2018 or will be revised in line with the new law, which is discussed in the below paragraph.

***Decree on Occupational Health and Safety (2019)*** defines principles, regulations and measures on occupational health and safety (OHS) to prevent potential incidents and diseases; build environmental-friendly at workplace without health risks; and promotes rights and interests of employees and employers as well as contributes to investments and national socio-economic development. The law defines rights and responsibilities of employees, employers and



organizations and personnel responsible for OHS. Article 16 stipulates the obligations of main contractor and sub-contractors on OHS management. Article 17 specifies the measures on provision and use of appropriate and sufficient personal protective equipment (PPE).

## 2.4 International Conventions and Agreements

Lao PDR is a signatory to several international conventions and treaties. The following are potentially relevant to the Project:

- ▶ UN Framework Convention on Climate Change (1992), Kyoto Protocol (2003) and Paris Agreement (2015);
- ▶ Convention on Biological Diversity (1996), Cartagena Protocol on Bio-safety to the CBD (2003) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (2004);
- ▶ Convention Concerning the Protection of World Cultural Heritage and Natural Heritage (1987);
- ▶ International Plant Protection Convention (1955);
- ▶ International Convention on the Elimination of All Forms of Racial Discrimination (1974);
- ▶ International Covenant on Economic, Social and Cultural Rights (2000);
- ▶ Mekong River Commission Agreement on the Cooperation for the Sustainable Development of the Basin (1995); and
- ▶ ASEAN Agreement on the Conservation of Nature and Natural Resources (1985).

## 2.5 International Standards and Guidelines

As the Project is being financed by the AIIB, ADFD Kuwait Fund, Road Fund and MCDF, it is expected that the Project will be developed in alignment with relevant international standards and guidelines as an example of international best practice in road development. Key applicable standards and guidelines for the ESIA and project development include:

- ▶ World Bank Group's Environmental, Health, and Safety Guidelines; and
- ▶ AIIB Environmental and Social Framework.

These are summarised in the sections below.

### 2.5.1 World Bank's Group/IFC Environmental Health and Safety Guidelines

General and industry-specific *Environmental Health and Safety (EHS) guidelines* have been developed by the IFC. The general guidelines provide examples of Good International Industry Practice (GIIP) with regards to road construction and development. General EHS guidelines relevant to the Project are presented in Table 2-3 below.

The IFC *Environmental Health and Safety Guidelines for Toll Roads (2007)* also provides specific guidance for the construction, operation and maintenance of large, sealed road projects including

associated bridges and overpasses. Relevant aspects of this guideline have been incorporated into the ESIA. The IFC *Environmental Health and Safety Guidelines for Construction Materials Extraction (2007)* also provide further guidance relevant to construction materials extraction activities, such as quarrying and the use of borrow pits.

**Table 2-3 IFC EHS Guidelines relevant to the Project**

<b>General EHS Guidelines</b>	<b>Aspects applicable to the proposed Project</b>
Environmental	Air Emissions and Ambient Air Quality; Energy Conservation; Wastewater and Ambient Water Quality; Water Conservation; Hazardous Materials Management; Waste Management; Noise; and Contaminated Land.
Occupational Health and Safety	General Facility Design and Operation; Communication and Training; Physical Hazards; Chemical Hazards; Biological Hazards; Radiological Hazards; Personal Protective Equipment; Special Hazard Environments; and Monitoring.
Community Health and Safety	Water Quality and Availability; Structural Safety of Project Infrastructure; Life and Fire Safety; Traffic Safety; Transport of Hazardous Materials; Disease Prevention; and Emergency Preparedness and Response.
Construction and Decommissioning	Environment; Occupational Health & Safety; and Community Health & Safety.

## 2.5.2 AIIB's Environmental and Social Policy

The proposed project is being financed by AIIB and therefore its Environmental and Social Policy and Environmental and Social Exclusion List will be applicable to the project.

### 4.1.1.1 Key Elements of Environmental and Social Policy

Overarching Policy. The objective of this overarching policy is to facilitate achievement of these development outcomes, through a system that integrates sound environmental and social

management into Projects. The overarching policy comprises Environmental and Social Policy (ESP), and Environmental and Social Standards (ESSs).

### ***Environmental and Social Policy***

The ESP sets out mandatory requirements for the Bank and its Clients relating to identification, assessment and management of environmental and social risks and impacts associated with Projects supported by the Bank.

### ***Environmental and Social Standards***

The environmental and social standards (ESSs) set out more detailed mandatory environmental and social requirements, as described below.

Environmental and Social Standard 1 (ESS 1). The ESS-1 aims to ensure the environmental and social soundness and sustainability of Projects and to support the integration of environmental and social considerations into the Project decision-making process and implementation. ESS 1 is applicable if the Project is likely to have adverse environmental risks and impacts or social risks and impacts (or both). The scope of the environmental and social assessment and management measures are proportional to the risks and impacts of the Project. ESS 1 provides for both quality environmental and social assessment and management of risks and impacts through effective mitigation and monitoring measures during the course of Project implementation. The ESS 1 defines the detailed requirements of the environmental and social assessment to be carried out for any project to be financed by the Bank.

Environmental and Social Standard 2 (ESS 2). The ESS 2 is applicable if the Project's screening process reveals that the Project would involve Involuntary Resettlement (including Involuntary Resettlement of the recent past or foreseeable future that is directly linked to the Project). Involuntary Resettlement covers physical displacement (relocation, loss of residential land or loss of shelter) and economic displacement (loss of land or access to land and natural resources; loss of assets or access to assets, income sources or means of livelihood) as a result of: (a) involuntary acquisition of land; or (b) involuntary restrictions on land use or on access to legally designated parks and protected areas. It covers such displacement whether such losses and involuntary restrictions are full or partial, permanent or temporary. The ESS 2 defines detailed requirements of resettlement planning of the projects involving involuntary resettlement.

Environmental and Social Standard 3 (ESS 3). The ESS 3 is applicable if Indigenous Peoples are present in, or have a collective attachment to, the proposed area of the Project, and are likely to be affected by the Project. The term Indigenous Peoples is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees: (a) self-identification as members of a distinct indigenous cultural group and recognition of this identity by others; (b) collective attachment to geographically distinct habitats or ancestral territories in the Project area and to the natural resources in these habitats and territories; (c) customary cultural, economic, social or political institutions that are separate from those of the dominant society and culture; and (d) a distinct language, often different from the official language of the country or region. In considering these characteristics, national legislation, customary law

and any international conventions to which the country is a party may be considered. A group that has lost collective attachment to geographically distinct habitats or ancestral territories in the Project area because of forced severance remains eligible for coverage, as an Indigenous People, under ESS 3. The ESS 3 defines the detailed requirements of People planning, in case such groups are present in the project area and are likely to be affected by the project.

#### 5.1.1.1 Applicability of ESF for Proposed Project

The applicability of ESP and ESSs for the proposed project is presented in Table 2-4.

**Table 2-4: The applicability of ESP and ESSs for the proposed project**

Environmental and Social Standards		Applicability	Triggering Status
ESS 1	Environmental and Social Assessment and Management	ESS 1 is applicable if the Project is likely to have adverse environmental risks and impacts or social risks and impacts (or both)	Yes, since the proposed project is likely to have negative environmental and social impacts. The present ESMP has been prepared in response to the ESS 1.
ESS 2	Involuntary Resettlement	ESS 2 is applicable if the project is likely to cause involuntary resettlement impacts.	Yes. The project involves land acquisition and disruption of economic activities during the construction phase of the roadway and pavement, which are temporary and reversible in nature. Given such impacts, though low intensity in nature, ESS 2 is triggered.
ESS 3	Indigenous Peoples	ESS 3 is applicable if Indigenous People are present in the project area and they are likely to be affected by the project.	Yes, ethnic groups as defined in the ESS 3 are present in the project area with about 3% of Khmu group in Somsavanh village village and 0.17% to 8.44% of Hmong in Somsavanh, Khoksivilay, Khoksavang, and Phailom villages). However, they are physically not affected by the Project in terms of loss of land acquisition and relocation; therefore, EGEP is not required. SEP is prepared to ensure meaningful engagement of ethnic groups throughout the Project implementation.

#### 6.1.1.1 Screening and Categorization Requirements

All AIIB-financed projects are required to be screened and categorized in order to determine the nature and level of the required environmental and social reviews and assessment, type of information disclosure and stakeholder engagements for the respective project. The project's

category is determined by the category of the project's component that presents the highest environmental or social risk, including direct, indirect, cumulative and induced impacts, as relevant, in the project area. AIIB assigns each proposed project to one of the four categories as described in Table 2-5 below.

**Table 2-5: Screening and Categorization of AIIB Projects**

Category		Applicability for the Proposed Project
Category A	A project is categorized as 'Category A' if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented.	Not applicable
Category B	A project is categorized as 'Category B' when it has a limited number of potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are irreversible or cumulative; they are limited to the project area; and can be successfully managed using good practice in an operational setting.	Considering the potential negative and positive environmental and social impacts of this proposed project and their management, it is appropriate to fit the Project into Category B under AIIB ESF categorization. This is because most of the impacts are temporary, reversible and bound to occur in the Project area and the impacts are manageable with proposed mitigation and monitoring measures.
Category C	A project is categorized as 'Category C' when it is likely to have minimal or no adverse environmental and social impacts.	Not applicable
Category FI	A Project is categorized FI if the financing structure involves the provision of funds to or through a financial intermediary (FI) for the project, whereby the Bank delegates to the FI the decision-making on the use of the Bank funds, including the selection, appraisal, approval and monitoring of Bank-financed sub-projects.	Not applicable

This NR13SE Project is rated as Category B Projects given that:

- ▶ It has a limited number of potentially adverse environmental and social impacts: The Detailed Measurement Survey (DMS) has been conducted during 16 January to 16 February 2023 based on the confirmed COI as presented in Section 2.2 above and Attachment 1. The COI indicates that the Project will affect 560 Project Affected Households (PAHs) with 3,096 Project Affected Persons (PAPs) including 1,380 females in 21 villages, three districts and two provinces by various forms of losses including land acquisitions, housing structures,

shops/restaurants, secondary structures and public utilities. Among the 560 PAHs (3,096 PAPs), there are 141 PAHs (141 shops) will have their lands, housing structures and shops to be affected by the Project.

- ▶ the impacts are not unprecedented: yes
- ▶ few if any of them are irreversible or cumulative: they are not cumulative PAHs
- ▶ they are limited to the Project area: yes
- ▶ they can be successfully managed using good practice in an operational setting. Efforts will be included in the project design to mitigate road safety and compensation issues. Good practices from existing NR13N and NR13S will be applied.

The Bank has determined that an ESIA with management plans including Environmental and Social Management and Monitoring Plan (ESMP), Settlement Plan (RP), Gender Action Plan (GAP) and Stakeholder Engagement Plan (SEP) is required.

## 2.6 Project Discharge and Emissions Targets

The Project will consider and comply with:

- ▶ Discharge / emissions guidelines for off-site releases of water, waste and potential airborne contaminants; and
- ▶ Ambient guidelines for the protection of beneficial uses and environmental values (e.g. aquatic fauna / fisheries protection, drinking water protection, etc.).

A list of relevant national and international standards is outlined in Table 2-6. Where standards or limits do not exist in Lao PDR's law, then guidelines, standards or limits used by international organizations (e.g. World Bank, WHO) are adopted in lieu.

**Table 2-6: Relevant air quality, noise and water quality standards and guidelines for the Project**

Source	Relevant Guidelines	Year Issued
<b><i>Waste / Wastewater Discharge and Monitoring</i></b>		
GOL	Decree on National Environmental Standards	2017
World Bank/IFC	General EHS Guidelines: Wastewater and Ambient Water Quality	2007
	General EHS Guidelines: Environmental	2007
<b><i>Air Quality</i></b>		
GOL	Decree on National Environmental Standards	2017
World Bank/IFC	General EHS Guidelines: Air Emissions and Ambient Air Quality	2007
WHO	Air Quality Guidelines – Global Update	2005
<b><i>Soil Quality</i></b>		
GOL	Decree on National Environmental Standards	2017
<b><i>Aquatic Fauna / Fresh Waters</i></b>		
GOL	Decree on National Environmental Standards	2017
<b><i>Drinking Water</i></b>		

GOL	Decree on National Environmental Standards	2017
WHO	Guidelines for Drinking Water Quality, forth edition	2017
<b>Noise and Vibration</b>		
GOL	Decree on National Environmental Standards	2017
WHO	Guidelines for community noise	1999
World Bank/IFC	Environmental Health and Safety Guidelines: Noise Management	2007

## 2.7 Gap Analysis: AIIB's ESSs and Laos Legislations

This Section builds upon the information on relevant legislations of the GOL and requirements of AIIB's ESSs. It summarizes significant gaps that are identified by comparing the requirements of AIIB's ESSs and relevant national legislations. Generally, the GOL has established a comprehensive regulatory framework including various laws, decrees, and instruction/regulation to govern the environment, and utilizing and conserving natural resources with explicit and implicit relevance for the ESIA and ESSs application. Many of them have been revised, updated, and amended more recently. For all ESS relevant to the NR13SE, national legislation exists, and no significant gaps have been identified. Table 2-7 summarizes the key requirements defined in the legislative and regulatory framework of Lao PDR and each relevant AIIB's ESSs.

**Table 2-7 Gap Analysis: AIIB’s ESSs and Laos Legislations**

Requirement	The AIIB’s ESS Requirements	Government of Lao PDR’s requirements	Gap/Project Measures
<b>ESS 1: Environmental and Social Assessment and Management</b>			
Assessment and management process	<ul style="list-style-type: none"> <li>Conduct an environmental and social assessment to identify direct, indirect, cumulative, and induced project-related risks to and impacts on physical, biological, socioeconomic, and cultural resources in the project’s area of influence. These include risks to and impacts on air and water quality, including (a) environmental health; (b) natural resources, including land, water, and ecosystems; (c) livelihoods; (d) vulnerable groups; (e) gender; (f) worker and community health and safety; and (g) cultural resources.</li> <li>Once the project’s risks and impacts are identified and the mitigation hierarchy has been applied, establish the measures to mitigate, monitor, and manage the impacts and reflect them in an ESMP.</li> </ul>	<ul style="list-style-type: none"> <li>A broad guidance for E&amp;S assessment is articulated in the Environmental Protection Law (2012), Article 21 (for IEE), and Article 22 (for EIA).</li> <li>Further guidance for the conduct of ESIA and ESMP is provided in the Decree on Environmental Impact (No. 389/GOL, dated October 20, 2022, articles 13, 23.) The preparation for an Environmental Management and Monitoring Plan is also provided in Article 24.</li> <li>The Decision on the Endorsement and Promulgation on the List of Investment Projects and Activities (No. 8056/MONRE, 2013) indicates that improvement or rehabilitation of existing national or provincial roads required only the conduct of IEE. However, the final clause of this Decision asserts that any projects that cause involuntary resettlement shall require the conduct of ESIA.</li> <li>Environmental and Social Operations Manual for Road Sector (2009) also provides additional E&amp;S requirements for road sector projects.</li> </ul>	<ul style="list-style-type: none"> <li>The Lao PDR’s regulation requires the conduct of IEE for national road improvement, not ESIA and less focus on social issues</li> <li>The EIA Decree did not cover the required to cover impact from climate change and issue related to greenhouse gases.</li> <li>ESIA, ESMP, RP, GAP and SEP are prepared to identify and mitigate the identified address E&amp;S risks and impacts of the Project.</li> <li>Capacity development and training programs on the implementation of E&amp;S management plans (ESMP, RP, GAP and SEP) including safety and mitigation of social impacts during construction for DOR, and DPWTs with the support from PTI are included in Project design and ESMP mitigation measures.</li> <li>Provide adequate budget supports to build MPWT E&amp;S capacity and facilitate effective E&amp;S management plans implementation with the support from EDPD/PTI</li> </ul>



Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
Environmental coverage	<ul style="list-style-type: none"> <li>• The assessment of the environmental coverage should include assessment of environmental risks and impact, biodiversity conservation, biodiversity impacts, critical habitat, natural habitats, ecosystem services, sustainability of land and water use, precautionary approach, pollution prevention, resources efficiency, climate change, greenhouse gasses, quantification of an reporting on greenhouse gases.</li> <li>• The assessment of the social coverage should include the assessment of social risks and impacts, vulnerable groups and discrimination, gender, gender-based violence, land and natural resource access, loss of access to assets or resources or restrictions on land use, cultural resources.</li> </ul>		
<b>ESS2: Involuntary Resettlement</b>			
<b>1. Land Property</b>			
1.1. Policy objectives	PAPs (Project Affected Persons) should be assisted to at least restore, the livelihoods in real term relative to pre-project level; to improve the overall socio-economic status of the displaced poor and other vulnerable groups; and to conceive and implement resettlement activities as sustainable development programs, providing sufficient	PAPs are compensated and assisted to improve or maintain their pre-project incomes and living standards, and are not made worse off than they would have been without the project.	ESP/ESS2 Policy Procedures will be applied.

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
	resources to enable the persons displaced by the Project to share in Project benefits.		
1.2. Support for affected households who have no recognizable legal right or claim to the land they are occupying	<p>The Bank does not endorse illegal settlement; however, it recognizes that significant populations already inhabit both urban and rural land without title or recognized land rights in its countries of operation. Given this situation, the Bank requires the Client to ensure that displaced persons without title to land or any recognizable legal rights to land, are eligible for, and receive, resettlement assistance and compensation for loss of non-land assets, in accordance with cut-off dates established in the resettlement plan, and that they are included in the resettlement consultation process.</p> <p>Persons without Title or Legal Rights - Ensure that persons displaced by the Project who are without title to land or any recognizable legal rights to land, are entitled for compensation at replacement cost for loss of assets, in accordance with cut-off dates established in the resettlement plan. Include them in the resettlement consultation process. Do not include compensation to these people for the illegally settled land. Conduct land survey and census as early as possible in Project preparation to establish clear cut-off dates for eligibility and to prevent encroachment. If</p>	<p>PAP who does not have legal land title, land use certificate or other acceptable documentation indicating their land use right, including customary and traditional land use right, only provides the right to claim compensation for their lost assets such as house/structures, trees and/or crops, and not land.</p>	<p>PAPs who do not have legal title, land use certificates or other acceptable documentation indicating their land use right will still be entitled to financial assistance to achieve the objective of the AIIB's ESP / ESS2 involuntary resettlement policy.</p> <p>AIIB's ESP / ESS2 Policy Procedures will be applied.</p>

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
	<p>claims have been made by these displaced persons that are currently under administrative or legal review, develop procedures to address these situations.</p>		
<b>2. Compensation</b>			
<p>2.1. Methods for determining compensation rates</p>	<p>Where functioning markets exist, replacement cost is the market value as established through independent and competent real estate valuation, plus transaction costs. Where functioning markets do not exist, replacement cost may be determined through alternative means, such as calculation of output value for land or productive assets, or the underappreciated value of replacement material and labor for construction of structures or other fixed assets, plus transaction costs. In all instances where physical displacement results in loss of shelter, replacement cost must at least be sufficient to enable purchase or construction of housing that meets acceptable minimum community standards of quality and safety. The valuation method for determining replacement cost should be documented and included in relevant resettlement planning documents. Transaction costs include administrative charges, registration or title fees, reasonable moving expenses, and any similar costs imposed</p>	<p>Article 2: The compensation shall be in the form of land, material or money for the land, agricultural products, livestock and incomes that are affected by development projects based on compensation value.                      Article 4: Compensation value means the value calculated in the form of material, money or land, constructed facilities, agricultural products, livestock and incomes which have been affected by development projects.                      Article 9: Project owners, in collaboration with the committee for compensation and resettlement at the local level, must estimate the value for compensation for land, constructed facilities, crop products, livestock and potential incomes and organize consultations with affected people by selecting the right and appropriate options based on prices applied by the state, market prices or average prices applicable for period of compensation and based on the types of properties and locations.</p>	<p>An independent appraiser conducts replacement cost study for all types of assets affected in order to establish appropriate compensation rate.                       Non-title holders for secondary structures will not be provided with replacement land; they will only be provided with compensation for affected structures.                       ESP/ESS2 Policy Procedures will be applied</p>

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
	on affected persons. To ensure compensation at replacement cost, planned compensation rates may require updating in Project areas where inflation is high or the period of time between calculation of compensation rates and delivery of compensation is extensive.	The prices applied by the state (middle prices) are the prices specified in a separate regulation which are identified and regulated by the Ministry of Natural Resources and Environment from time to time.	
2.2. Compensation for loss of income sources or means of livelihood	If these impacts are found to be significantly adverse at any stage of the Project, develop and implement a management plan to restore the livelihoods of affected persons to at least pre-Project level or better.	Article 9: Provision of agriculture land in appropriate ways including the creation of new livelihood options and stable income generation activities and promotion of local crafts/industry in addition to agricultural production activities for the affected people.	ESP/ESS2 Policy Procedures will be applied – loss of income will be restored to pre-displacement rates regardless of the legal status of the affected person
2.3. Livelihood restoration and assistance	If these impacts are found to be significantly adverse at any stage of the Project, develop and implement a management plan to restore the livelihoods of affected persons to at least pre-Project level or better.	Article 13: In parallel with the establishment of resettlement plan as prescribed in article 10 of this decree, the project owner must coordinate with the compensation and settlement committee at the local level to collect information on livelihood and income generation matters of the affected people in details to establish the livelihood rehabilitation plan to contribute to the management and monitoring social and environmental impacts within the project development framework.	Because the impacts are expected to be minor, income restoration will be addressed on a case by case basis.
2.4. Consultation	The consultation covers Project design, mitigation and monitoring measures, sharing of	Article 5: The compensation and resettlement shall be carried out in compliance with the	Extensive consultation and participation will be conducted at every stage of RP and

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
and disclosure	<p>development benefits and opportunities on a Project-specific basis, and implementation issues.</p> <p>Disclosure information on the environmental and social assessment reports, ESMPs, ESMPFs, resettlement plans, RPFs, Indigenous Peoples plans and IPPFs, or other approved forms of documentation. Post online</p>	<p>following principles:</p> <p>Protection of the rights and legitimate benefits of affected people;</p> <p>Ensure equality, correctness, transparency, disclosure and fairness;</p> <p>Ensure coordination, consultation and participation between the project owner, affected people, state agencies and other relevant stakeholders.</p>	<p>implementation.</p> <p>ESP/ESS2 Policy Procedures will be applied.</p>
<b>3. Grievance Redress Mechanism</b>			
Procedures for recording and processing grievances	<p>Project-level Grievance Redress -</p> <p>The grievance mechanism is scaled to the risks and impacts of the Project. The grievance mechanism may utilize existing formal or informal grievance mechanisms, provided that they are properly designed and implemented, and deemed by the Bank to be suitable for the Project; these may be supplemented, as needed, with Project-specific arrangements.</p> <p>The mechanism is designed to address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender-sensitive, culturally appropriate and readily accessible to all affected people. The grievance mechanism includes provisions to protect complainants from retaliation and to remain anonymous, if</p>	<p>Article 23: In case the affected view that the project owner does not comply with the plan for compensation, resettlement and rehabilitation of people's livelihood in accordance with this decree or other related plans that affect their interests, they are entitled to request to related authorities to solve the request(s) according to the procedures stipulated in paragraph 1, article 24 of this decree.</p>	<p>Grievances from PAP and PAHs in connection with the implementation of the RP will be handled through negotiation with the aim of achieving consensus. Complaints will go through three stages before they may be elevated to a court of law as a last resort.</p>

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
	<p>requested. The mechanism provides for maintenance of a publicly accessible case register, and reports on grievance redress and outcomes, which are disclosed in accordance with the applicable ESS.</p>		
<b>4. Consultation</b>			
<p>Stakeholder Engagement and Information Disclosure</p>	<ul style="list-style-type: none"> <li>Carry out meaningful consultations with persons to be displaced by the Project, host communities and nongovernmental organizations, and involve them in planning, implementation, monitoring and evaluation of the LARP/LAP/RP, with appropriate meeting times, transport, childcare support. Pay attention to the needs of people with disabilities, vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, Indigenous Peoples and those without legal title to land.</li> </ul>	<p>GOL's requirements are covered by various legislations, especially those on consultation and grievance including the Constitution, the Law on Government (amended 2016), the Law on Handling Petitions (amended 2016), as well as a sub-ordinate decrees such as the EIA Decree (2022) and the Compensation and Resettlement Decree (2016), as well as the Public Involvement Guideline (2012) and the Ethnic Group Consultation Guideline (2013).</p>	<ul style="list-style-type: none"> <li>There is a lack of clarity about when engagement activities can be considered meaningful. Those affected by a project can file grievances using the existing system, not a project-based system. There are also unclear procedures on public disclosure of E&amp;S documents, and on how to respond to concerns and grievances of project-affected parties</li> <li>The ethnic group consultation guideline (2013) is the sole document requiring consultation with ethnic groups. The EIA decree only requires dissemination of information to them.</li> <li>A SEP consistent with ESS1,2,3 has been prepared for this Project.</li> <li>The GRM must be accessible to all stakeholders, in particular vulnerable, ethnic group people, and women and suitable receive and respond to SEA/SH</li> </ul>
<b>5. Monitoring &amp; Evaluation</b>			

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
	<p>Monitoring. Using suitably qualified and experienced experts, monitor and assess resettlement outcomes under the Project, their impacts on the standards of living of displaced persons and whether the objectives of the resettlement plan have been achieved, by taking into account the baseline conditions and the results of resettlement monitoring.</p> <p>Client – Monitoring and Reporting and The Bank – Monitoring and Reporting.</p>	<p>Article 27: The project owner must set up a management unit of compensation and resettlement to take charge of monitoring and examination by himself other than other parties. The unit is obliged to make reports to the state audit-inspection organizations concerning the monitoring and examination of the implementation of the plan for compensation, allocation and relocation, and rehabilitation of people's livelihood of the development project as stipulated in the overall plan, at each period.</p>	<p>The PMU will conduct a regular monitoring to monitor progress in the implementation of the environmental and social measures agreed with the Bank; and verify the compliance with these specific measures and their progress toward intended outcomes;</p> <p>Safeguard Monitoring Working Group (SMWG) to be established by VTE and BKX. The SMWG will be chaired by DPWT of VTE and BKX and comprise representatives from key agencies responsible for ensuring compliance with GOL regulations during construction including key local communities to affected during construction and those to be involved during operations phase;</p> <p>The monitoring will include progress reports, status of the RP implementation, information on location and numbers of people affected, compensation amounts paid by item, and assistance provided to PAHs. The report of monitoring results will be prepared by client and submitted to IRC and AIIB on a quarterly basis.</p>
<b>ESS3: Indigenous Peoples</b>			
	<ul style="list-style-type: none"> <li>General requirements: If the Project's screening process determines that Indigenous Peoples are present in, or have</li> </ul>	<ul style="list-style-type: none"> <li>The Decree on Ethnicity (2020) confirms that the GOL has special policies for ethnic, vulnerable and disadvantaged groups.</li> </ul>	<ul style="list-style-type: none"> <li>The Land Law does not specifically mention customary to land used by ethnic and vulnerable groups who are</li> </ul>

Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
	<p>collective attachment to, the Project area, and are likely to be affected by the Project, the Client is required to prepare an Indigenous Peoples Plan )IPP(.</p> <ul style="list-style-type: none"> <li>• Social assessment: If the Project's screening process determines that Indigenous Peoples are present in, or have collective attachment to, the Project area, and are likely to be affected by the Project, the Client is required to prepare an Indigenous Peoples Plan )IPP(, as subsistence activities .Identify social and economic benefits for these affected Indigenous Peoples.</li> <li>• Proportionality: The degree of the impacts is determined by evaluating (a) the magnitude of the impacts on the indigenous people, (b) the vulnerability of the affected indigenous people and implement the IPP and IPPF (if applicable)</li> <li>• Stakeholder Engagement and Information Disclosure: Requires the Borrower to avoid adverse impacts on communities of indigenous peoples and to engage with affected communities to ensure they have given their Free Prior and Informed Consent.</li> </ul>	<ul style="list-style-type: none"> <li>• The National Social Protection Strategy (2020) states that ethnic groups, women, children, vulnerable people and those living in remote areas are specially promoted to access education, health care and equal economic activities.</li> <li>• Both EIA Decree No. 389/GOL, dated October 20, 2022, and The Decree on Compensation and Resettlement Management, in Development Project No. 84, dated May 5, 2016, provides board requirements for meaningful consultation with all stakeholders, including ethnic and vulnerable group.</li> </ul>	<p>often found to be present and have collective attachment to the forestlands in rural area in Laos. There is no sub-law registration with implementable procedures in place for registering communal and non-communal (individual) customary rights. This may negatively impact ethnic groups and other vulnerable communities, since excluding such communities from the benefits of land registration and overruling or replacing their actual customary land (e.g with smaller area or poorer quality of land) could increase inequality and their vulnerability.</p> <ul style="list-style-type: none"> <li>• Ethnic groups as defined in the ESS 3 are present in the project area with about 3% of Khmu group in Somsavanh village village and 0.17% to 8.44% of Hmong in Somsavanh, Khoksivilay, Khoksavang, and Phailom villages). However, they are physically not affected by the Project in terms of loss of land acquisition and relocation; therefore, EGEP is not required. To address indirect impacts on ethnic groups, SEP including GRM is prepared to ensure meaningful engagement of ethnic groups throughout</li> </ul>



Requirement	The AIIB's ESS Requirements	Government of Lao PDR's requirements	Gap/Project Measures
			<p>the Project implementation.</p> <ul style="list-style-type: none"> <li>• A SEP consistent with ESS1,2,3 has been prepared for this Project.</li> <li>• A SEP including GRM has been developed which details a GRM for the project covering all project aspects, including concerns about environmental and social impacts.</li> <li>• SEP includes requirements and process of engaging the ethnic groups in risks assessment, meaningful consultation, Free, Prior and Informed Consultation (FPICon) to identify risk management and benefit engagement measures.</li> <li>• The GRM must be accessible to all stakeholders, in particular vulnerable, ethnic group people, and women and suitable receive and respond to SEA/SH</li> </ul>

### 3. PROJECT DESCRIPTION

#### 3.1 Project Overview

The proposed Project is an upgrade of existing National Road 13 South between Km 21 – Km 71 (50.530 Km) in Xaythany, Pak Ngum Districts of Vientiane Capital, and Thaphabath District of Bolikhamxay Province. The Project will be improved and/or upgraded in two different sub-sections, sub-section 1 will be improved as 4-lane 2-way divided and sub-section 2 will be improved as 2-lane 2-way undivided, technical standard shall be applied ASEAN Highway Standard in level terrain Class I and Class II respectively in the design. The proposed alternative pavements for the NR13SE include hot mix asphalt (HMA) and Portland cement concrete.

The Project proponent, MPWT through the DOR, is a government agency responsible for managing, maintaining and developing the national road network across the Lao PDR. The ESIA update identifies the likely types of environmental and social impacts associated with the construction and operation of the Project. It assesses the magnitude and likelihood of these impacts based on previous work commissioned by MPWT and current available Project information. Standalone management plans (e.g. RP, SEP, GAP) to address residual impacts are provided as part of the appendices to the ESIA (refer to Volume C). An update of the original Resettlement Plan has also been prepared (refer to Volume C-2: Resettlement Plan).

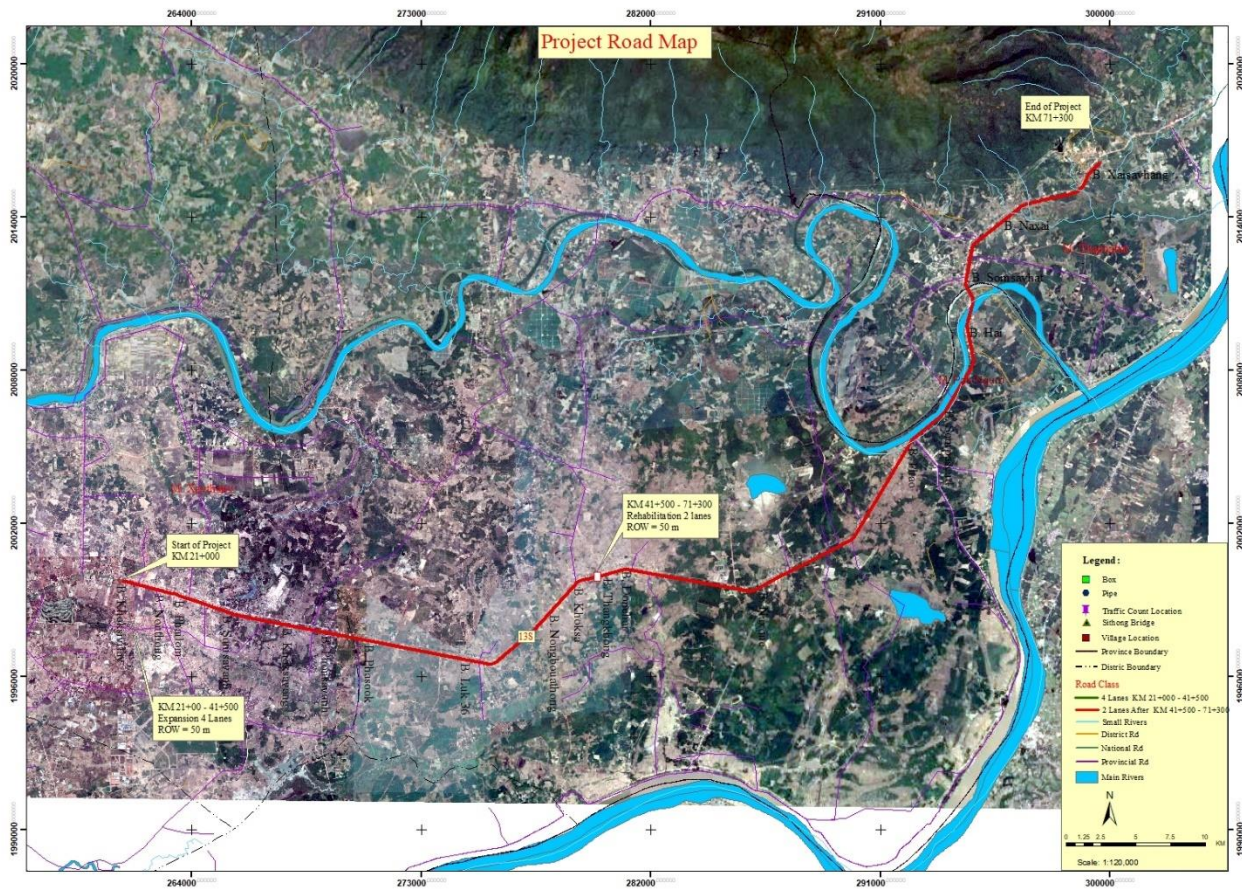


Figure 3-1: Project location

## 3.2 Project Components

Descriptions of each of the Project components are provided below. Refer to Section 3.2 for detailed description of each of the alignment sections with specific chainages referred to in the sections below.

### 3.2.1 Right of Way (ROW)

The right of way on NR13SE is defined under the Law on Public Roads 021/NA dated 08/11/2016 is 50m width for the improvement of an existing road. The Decree on Public Road Right of Way, No. 185/GoL (2022) also elaborate on the conservation of ROW (Article 7) for the national, provincial, district and rural roads. The demarcation of ROW along the NR13 including the NR13SE section was implemented between 1997 – 1999 by the DOR with the installation of concrete posts on each side of the ROW.

The Project's ROW consists of the area of road components/infrastructure that have been confirmed, where land will need to be acquired / cleared. This includes: the main road body (mainline) from one embankment to another, junctions, accessory/connector roads, and vehicular bridges. Other NR13SE infrastructure such as pedestrian crossings, bus stops, bridge and culverts.

### 3.2.2 Corridor of Impact

The Corridor of Impact (COI) has been determined based on the Memorandum on the Determination of Corridor of Impact of the NR13SE, issued by the Department of Road, dated 13<sup>th</sup> January 2023. This memorandum was issued following a consultation meeting between the representatives of the DOR, PTRI and the LTEC on 9<sup>th</sup> January 2023.

In principle the meeting concluded that the COI includes traffic lane and safe zone as per the descriptions below:

- ▶ The urban road standard with divided 4-lane carriageway will be applied at the first section of 20.5KM, from KM 21+000 to KM 41+500: runway width of 23m (4 traffic lanes of 3.50m, 2 shoulders of 1.350m, 2 lateral margins of 0.350, 2 sidewalks of 1.50m) plus the slope of 1.5-2.5m and 2 safe zones of 1.5m (refer to Figure 3-2);
- ▶ The 2-lane through community area: runway width of 15m (2 traffic lanes of 3.50m, 2 shoulders of 2.150m, 2 lateral margins of 0.350, 2 sidewalks of 1.50m) plus 2 border boxes of 0.750m, the slope of 1.5-2.5m, and 2 safe zones of 1.5m (refer to Figure 3-3); and
- ▶ The 2-lane through non-community area: runway width of 12m (2 traffic lanes of 3.50m, 2 shoulders of 2.50m) plus 2 lateral margins of 0.350, the slope of 1.5-2.5m, and 2 safe zones of 1.5m (refer to Figure 3-4).

A joint site inspection has been carried out on 11-12 January 2023 to confirm the COI. The joint site inspection team<sup>2</sup> agreed and confirmed the COI and realignment in some sections as defined in the

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<sup>2</sup> Include representatives from the Project Management Unit (PMU), PTI and E&S Consultant (LTEC).

Conceptual Design (2019) for road safety. The three realignment sections include KM35+000 – KM36+400 (T1); KM64+900 – KM65+400 (T2); and KM68+600 – KM70+000 (T3).

Based on the initial review of the Conceptual Design Review Consultant (CDRC), there was no significant changes in the alignment adjustment proposed in 2019 only minor deviation of alignment at all curve locations that are accommodated within the existing COI. Also, the number and location of bus and truck stops remain the same as proposed in Conceptual Design; however, Road Safety Audit Consultant (RSAC) recommended to move the bus stop at at the Km62+700, Km48+100 and other few bus stops away from the bottom of the concave curve for road safety as well as pedestrian crossing facilities were suggested to install at the Km48+100. There is no feedback from CDRC yet on the RSAC’s recommendations.

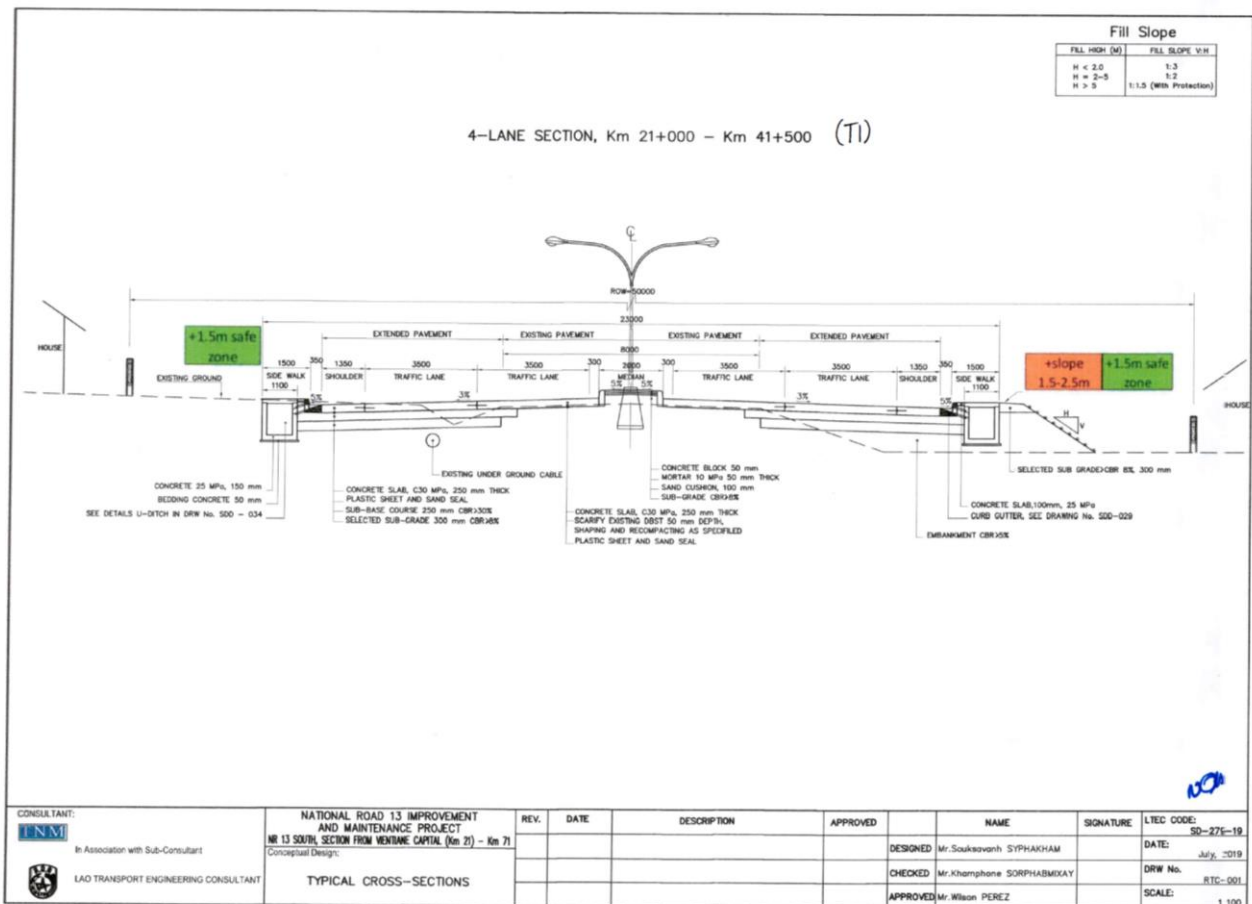


Figure 3-2: Typical Cross-Sections of 4-lane Section (T1)

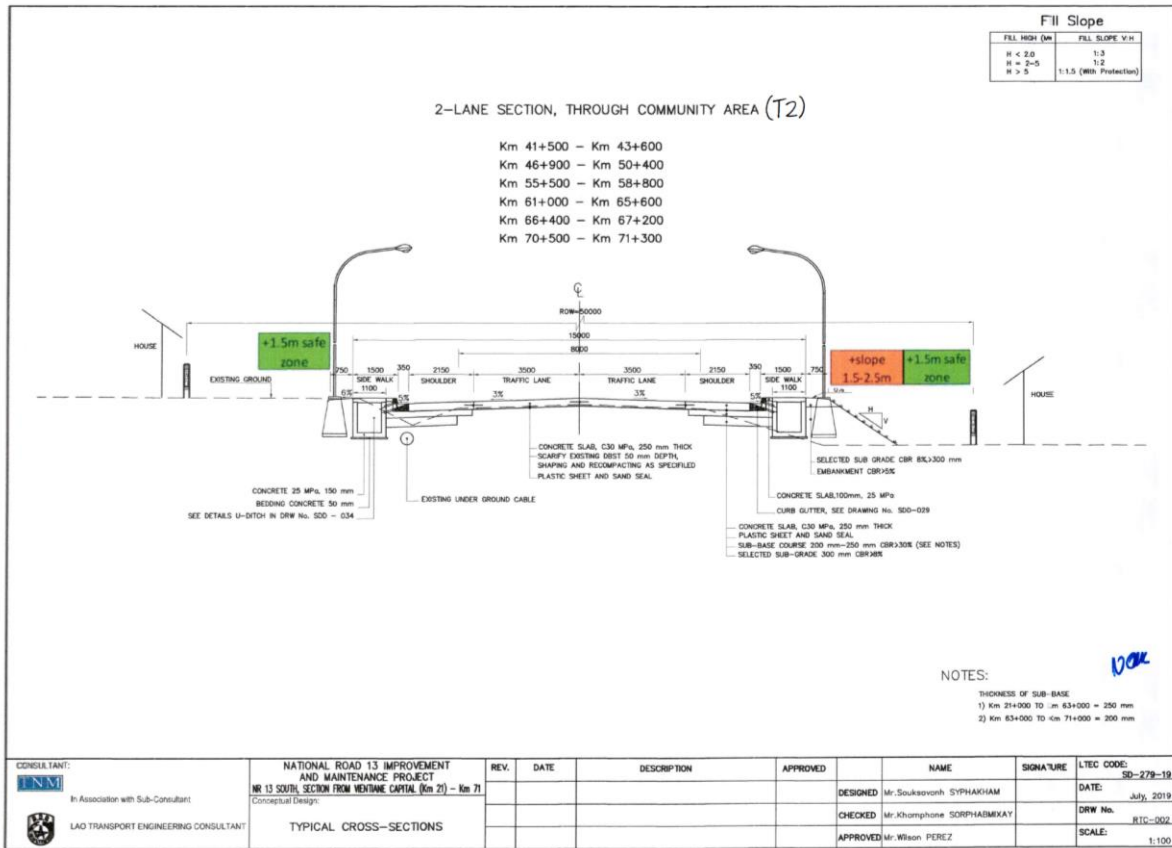


Figure 3-3: Typical Cross-Sections of 2-lane Section through Community Areas (T2)

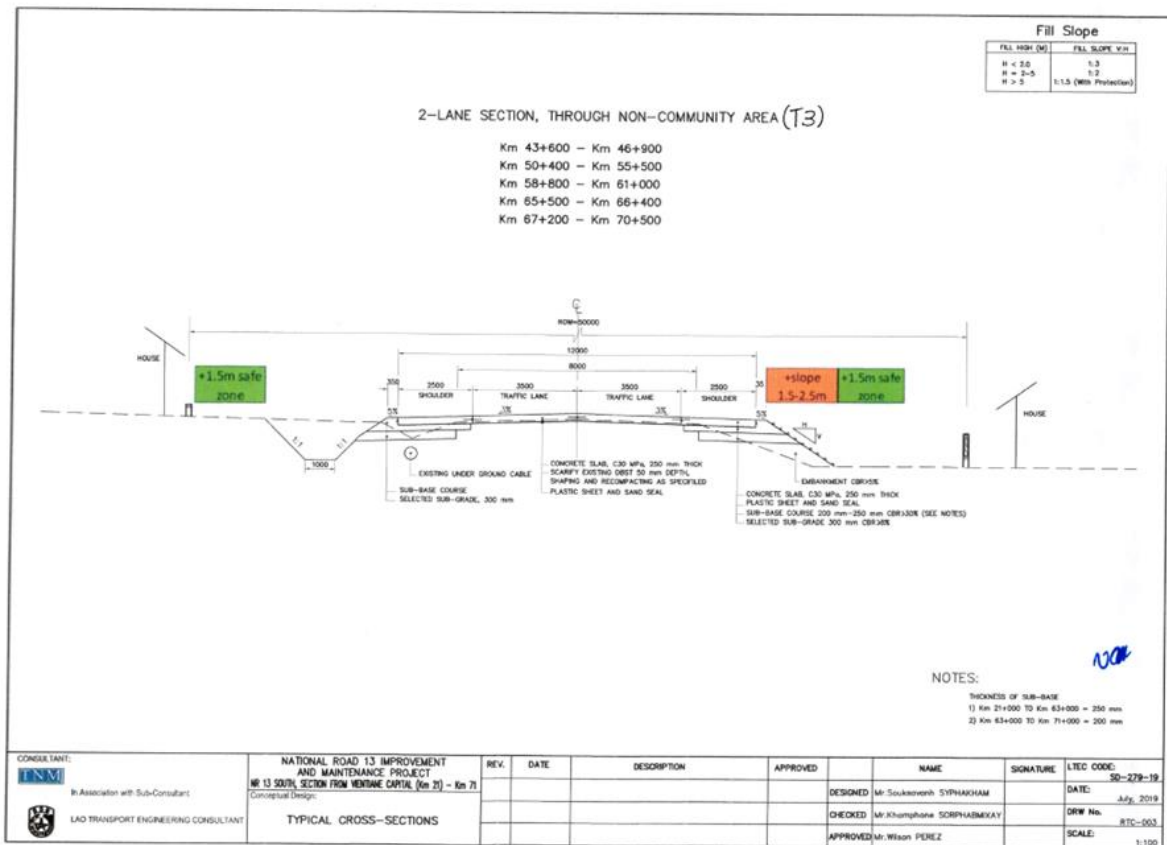


Figure 3-4: Typical Cross-Sections of 2-lane Section through Non-Community Areas (T3)

**Table 3-1: Typical Cross-Sections with 1.5m Buffer Zones**

Chainage (km)		Name of Village	Corridor of Impact of Final RP 1.5m buffer zone		Existing Pavement Structure Improvement
From	To		(Code)	COI	
<b>Vientiane Capital</b>					
<b>Xaythany District</b>					
21+000	22+575	Khoksivilay	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
22+575	23+400	Nonthong	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
23+400	25+025	Phailom	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
25+025	27+170	Somsavanh	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
27+170	28+600	Khoksavang	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
28+600	30+170	Phonsavanh	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
30+170	33+500	Naphasouk	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
33+500	38+050	Bolek	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
<b>PakNgum District</b>					
38+050	39+575	Noongbouathong	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
39+575	41+100	Khoksa	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
41+100	41+500	Thangkhong	4-Lane Section	26m	Scarify Existing DBST 50 mm Depth.
41+500	42+440	Donehai	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.
41+500	42+440	Donehai	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.
42+440	43+600	Donehai	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.
43+600	45+110	Donehai	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
45+110	46+900	Naxon	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
46+900	50+400	Naxon	2-Lane Section through non-community area	18m	Scarify Existing DBST 50 mm Depth.
50+400	53+620	Naxon	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
53+620	55+500	Phao	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
55+500	57+850	Phao	2-Lane Section through	18m	Scarify Existing DBST 50

Chainage (km)		Name of Village	Corridor of Impact of Final RP 1.5m buffer zone		Existing Pavement Structure Improvement
From	To		(Code)	COI	
			community area		mm Depth.
57+850	58+800	Sompaseuth	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.
58+800	59+850	Sompaseuth	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
59+850	61+000	Hai	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
61+000	63+400	Hai	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.
63+400	65+500	Somsavad	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.
65+500	65+790	Somsavad	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
<b>Bolikhambay Province</b>					
<b>Thaphabath District</b>					
65+790	66+400	Naxay	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
66+400	67+200	Naxay	2-Lane Section through non-community area	18m	Scarify Existing DBST 50 mm Depth.
67+200	69+420	Naxay	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
69+420	70+500	Xaysavang	2-Lane Section through non-community area	15m	Scarify Existing DBST 50 mm Depth.
70+500	71+300	Xaysavang	2-Lane Section through community area	18m	Scarify Existing DBST 50 mm Depth.

Source: LTEC - DMS, 2023

### 3.2.3 Bridges

There is an existing bridge in this project named Sithong Bridge across Nam Ngum River, which is composite bridge concrete deck and steel plate girder (I-Shape) consisted of 4 spans and length of 252m (42m+63m+84m+63m), deck width of 10.50 m (8m carriageway and sidewalk 1m x 2). This bridge was constructed by Russian, the construction had completed and opened to traffic in 1984.

Bridge condition survey conducted as visual inspection. It is generally in a good condition although some minor maintenance is required as periodic maintenance such as seal of cracks on concrete deck slab, replacement of expansion joint, painting, lubricant for steel bearing, etc.

### 3.2.4 Culverts

Most of the existing culverts were constructed at the same time as the road was constructed during the last of 1980s some of them were extended the old culverts were constructed before the latest improvement. In general, it is considered that almost of the existing culverts are adequately sized for their catchments as there is no evidence of historical flood, erosion to the road and

damaged to culverts at the outlet end, although some outlets or waterways are blocked by cumulative sediment and vegetation.

A summary of existing culvert condition is outlined in Table 3-2 and details on culvert design are provided in the drawings as part of the Conceptual Design Report.

**Table 3-2: List of existing Culverts on the NR13SE**

No.	Location	Size / Type	Length (m)	Structures In Let / Outlet	Condition	Remark
1	22+447	BC (1.0x1.0)	10.00	HW+HW	Good	Extend
2	23+346	PC,0.8 m	17.00	-	Remove	Replaced by new
3	24+791	BC (0.8x0.8)	16.00	HW+HW	Good	Extend
4	25+373	BC (1.0x1.0)	10.00	HW	Good	Extend
5	25+656	PC,0.8 m	18.00	DI	Remove	Replaced by new
6	26+226	BC (0.8x0.8)	14.00	HW	Good	Extend
7	27+021	PC,1 m	12.00	HW+HW	Good	Extend
8	27+563	PC,1 m	13.00	HW+DI	Not use	Remove
9	28+922	PC,0.8 m	10.00	HW+HW	Remove	Replaced by new
10	30+709	BC (1.0x1.0)	12.00	HW+HW	Good	Extend
11	31+470	BC (1.5x0.9)	11.00	HW+HW	Good	Extend
12	34+026	PC,0.8 m	16.00	-	Remove	Replaced by new
13	35+406	2PC,1.5 m	14.00	HW+DI	Good	Extend
14	36+264	PC,1 m	21.00	-	Not use	Remove
15	36+272	PC,0.8 m	21.00	-	Remove	Replaced by new
16	38+631	PC,0.8 m	18.00	-	Remove	Replaced by new
17	40+133	PC,0.8 m	17.00	-	Remove	Replaced by new
18	42+857	PC,0.8 m	19.00	-	Remove	Replaced by new
19	44+094	PC,0.8 m	17.00	-	Remove	Replaced by new
20	46+175	2PC,1 m	24.00	-	Good	Extend
21	47+842	3PC,1.5 m	23.00	-	Good	Extend
22	48+193	-	16.00	-	Existing irrigation	Remove
23	48+256	PC,0.8 m	19.00	-	Remove	Replaced by new
24	48+547	PC,0.8 m	19.00	-	Remove	Replaced by new
25	48+795	2PC,1.5 m	21.00	-	Good	Extend
26	49+125	PC,0.8 m	19.00	-	Remove	Replaced by new
27	49+260	2PC,1.5 m	22.00	-	Good	Extend
28	49+508	2BC (1.0x1.0)	16.00	HW+HW	Good	Extend
29	51+253	PC,1 m	24.00	-	Good	Use of existing pipe
30	51+468	PC,1 m	22.00	-	Good	Use of existing pipe
31	52+147	PC,0.8 m	22.00	-	Remove	Replaced by new
32	52+959	PC,0.8 m	18.00	-	Remove	Replaced by new
33	54+310	PC,0.8 m	20.00	-	Remove	Replaced By New
34	55+235	BC (1.0x1.0)	16.00	HW+HW	Good	Extend
35	55+607	PC,0.8 m	18.00	-	Remove	Replaced by new
36	56+124	PC,0.8 m	18.00	-	Remove	Replaced by new



No.	Location	Size / Type	Length (m)	Structures In Let / Outlet	Condition	Remark
37	56+260	PC,0.8 m	21.00	-	Remove	Replaced by new
38	56+381	PC,0.8 m	18.00	DI	Remove	Replaced by new
39	57+027	PC,1 m	21.00	-	Good	Extend
40	57+373	PC,1 m	18.00	-	Good	Extend
41	58+274	PC,0.8 m	18.00	-	Remove	Replaced by new
42	58+825	PC,0.8 m	19.00	-	Remove	Replaced by new
43	59+273	PC,0.8 m	18.00	-	Remove	Replaced by new
44	61+051	PC,0.8 m	17.00	-	Remove	Replaced by new
45	62+373	PC,0.8 m	18.00	-	Remove	Replaced by new
46	63+991	PC,1 m	18.00	-	Good	Extend
47	64+282	PC,0.8 m	18.00	-	Remove	Replaced by new
48	64+671	PC,1.5 m	33.00	-	Good	Use of existing pipe
49	65+246	PC,1 m	21.00	-	Good	Extend
50	65+959	PC,1 m	22.00	-	Good	Use of existing pipe
51	66+413	2PC,1 m	21.00	-	Good	Extend
52	67+269	2PC,1.5 m	24.00	-	Good	Use of existing pipe
53	67+854	2PC,1.5 m	20.00	HW	Good	Extend
54	68+237	PC,1 m	21.00	-	Good	Extend
55	68+745	PC,1 m	23.00	-	Good	Use of existing pipe
56	69+170	PC,1 m	37.00	-	Good	Use of existing pipe
57	70+008	4PC,1.5 m	19.00	HW+HW	Good	Extend
58	70+291	PC,1 m	20.00	-	Good	Extend
59	70+499	PC,1 m	24.00	-	Good	Extend

Source: Conceptual Design 2023

### 3.2.5 Pedestrian Crossings

Dedicated pedestrian crossings are also being planned to allow pedestrian access from one side of the ROW to another (Table 3-3). The Conceptual Design of NR13SE also includes pedestrian crossing bridges in four locations. The overpass pedestrian crossings have been considered to provide at a large school located beside the main road, market area, and other communities' area which have many people cross the road. The pedestrian crossing can protect the health and safety of community members. The staircase of the overpass should be set at the school entrance (where applicable) which will be the most convenient location for pedestrians. Physical isolations (e.g. barriers/fences) will be set up in median within a range of 100 – 200m before and after the overpass to prevent pedestrians from crossing. Pedestrians will also have the option to use 1.5m walkways along the urban and community areas (refer to Section 3.2.2). where applicable, guardrails with collision avoidance capabilities will be installed between the sidewalks and the motor vehicle lanes for pedestrians' safety.

There are four locations pedestrian crossings identified in the Conceptual Design at the following locations:

**Table 3-3: Pedestrian crossing planned as part of the NR13SE**

No.	Chainage	Type of Structure	Location	Remark
1	26+310	Overpass	Ban Phailom	School
2	35+885	Overpass	Ban Bolek	School
3	56+740	Overpass	Ban Phao	School
4	63+8373	Overpass	Ban Somsavanh	School

Source: Conceptual Design, LTEC 2023

### 3.2.6 Drainage Design

A detailed design of drainage infrastructure has been developed for the entire NR13SE alignment. This includes drainage ditches, culverts and channels. There are 59 culverts that need to be upgraded or replaced within the Project ROW. Detailed design calculations for pipe and box culverts are outlined in the Conceptual Design Report.

The Conceptual Design provides the design for installation of pipe and box culverts including single, double and triple cells. The design criteria for determining the classification for box and pipe culverts has been done based on the discharge and capacity of culvert, with a maximum of 3 cells 3.5x3.5m (HxW). If greater than this the cross drainage shall be considered as a bridge.

Any drainage channels associated with the Project facilities (e.g. workcamp, quarries, borrow pits, batching plants) will need to undergo due diligence environmental and social studies by the contractor to the satisfaction of DOR and in accordance with international standards (e.g. AIIB's ESF) to ensure potential impacts are avoided and minimized where possible.

### 3.2.7 Gantries, Signage and Lighting

Gantries and signs will be constructed along the NR13SE to provide directions, information and guidance to road users. Signs are also beneficial to the traffic authorities who depend on them for traffic control, enhancing road safety and to enforce traffic laws/regulations. Signs will be located along the entire length of the NR13SE but may be particularly concentrated in areas approaching junctions and/or community areas. The signs will include information on speed limits, lane usage, junctions, slip roads, turns in the road etc. Detailed information on traffic signs and road markings is provided in the Road Safety Inspection Report (2019).

Road signs in the Project are classified into four types including (i) regulatory signs, (ii) warning signs, (iii) prohibitory signs, and (iv) guide signs.

- ▶ Regulatory and prohibitory signs give drivers notice of traffic laws and regulations.
- ▶ Warning signs direct attention to condition of the road on or adjacent to a street that are potentially hazardous to traffic operation.
- ▶ Guide signs indicate road designations, directions/distances, village name, points of interest, and other geographic or cultural information.

- ▶ Road markings placed on the pavement, curb, or object to convey traffic regulation and warnings to drivers. The types of road markings proposed for this project are:
  1. road centrelines, and lane lines
  2. pavement edge markings to delineate separation of motor and bike traffic, and
  3. pedestrian crossings.

Streetlight will be provided along the entire 4-lane section (Km21+000 – Km 41+500) and sections through the community areas. The design includes the installation of lampposts in the middle sideroad. The exact nature of the lighting (e.g. solar/mains electricity) will be finalised by the construction contractors.

### **3.2.8 Construction Infrastructure**

All construction infrastructure that forms part of the Project will be developed and implemented in accordance with the *AIIB's ESF* and *World Bank Group's Environmental Health and Safety (EHS) Guidelines (2007)*. The *World Bank Group's Environmental Health and Safety Guidelines for Construction Materials Extraction (2007)* will also be applied to the quarries and borrow pits. Additional measures to avoid and minimise potential environmental and social risks and impacts of these components are also discussed throughout the ESIA and ESMP.

#### **3.2.8.1 Plant Equipment Storage and Accommodation Camps**

Sites will be required for the accommodation of workers and storage of plant equipment during the Construction Phase. Accommodation camps will include housing areas, catering areas and waste disposal facilities. The locations of these sites have not been finalised. The plant equipment and accommodation camp sites will need to undergo due diligence environmental and social studies by the contractor to the satisfaction of DOR and in accordance with international standards (e.g. AIIB's ESF and the World Bank Group's EHS Guidelines) to ensure potential impacts are avoided and minimised where possible.

It is expected that plant equipment storage areas will also be used for storage of other construction materials, including raw materials, chemicals and cement. Measures regarding the transport, storage and handling of hazardous materials are discussed in the ESMP (Volume C-1). Storage locations for hazardous materials and technical plant equipment such as the cement plant and asphalt plant will be carefully selected in consultation with DOR.

As there is generally fuel available in existing service stations close to work areas, limited fuel storage will be required for the Project. However, some fuel may be stored in appropriately banded tanks or containers at the areas used to store plant equipment.

Appropriate security measures will be applied to the equipment storages areas and accommodation camps where required (e.g. fencing, restrictions on access).

### 3.2.8.2 Quarries and Borrow Pits

Several quarries and borrow pits will be required to obtain the materials necessary for the construction of the Project. These will be spread out at locations within and surrounding the entire length of the Project ROW. The potential locations of these sites and the type of material that could be extracted are shown in Table 3-4 and Volume B: Appendix 2 – Figure 1-24 to Figure 1-27 and Plate 3-1, Plate 3-2, and Plate 3-3. The actual sites used will depend on the cost and availability of materials from the sites at the time of construction. Existing sites that meet national legislative requirements and standards will be preferentially used where practicable. As per the plant equipment and accommodation camp sites discussed above, any new quarries and borrow pits established for the Project will need to undergo due diligence environmental and social studies by the contractor to the satisfaction of DOR before submission to PONRE for approval in accordance with national and international standards (e.g. AIIB’s ESF and the World Bank Group’s EHS Guidelines) to ensure potential impacts are avoided and minimised where possible.



Plate 3-1: Borrow pit in Ban Nonthong



Plate 3-2: Borrow pit in Naxon, Pak Ngum District



Plate 3-3: Borrow pit in Ban Naxay, Pak Ngum District



Plate 3-4: Access road to a borrow pit in Ban Donyeng

Table 3-4: Material Sourcing sites planned as part of the NR13SE Project from Km 21 – Km 71

No.	Type of	Estimated	Distance (km)	Potential
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	Material	Location and Type of Land	Quantity (m <sup>3</sup> )	to subproject site	To nearest forest	Use
<b>Borrow Pit=BP</b>			<b>&gt;49,200</b>			
BP01	Silty laterites	B. Nonthong Village, Xaythany District Km22+500RHS Private Land	>200,000	5.8 km by NR13S	71 km Phou khao khouay	Embankment and Sub grade
BP02	Silty sands and laterites	B. Nongbuathong Village, Pakngum District Km38+300 LHS Private Land	>200,000	2.7 km by NR13S	55 km Phou khao khouay	Embankment and Sub grade
BP03	Clayey gravels and laterites	B. Naxone Village, Pakngum District Km46+900 RHS Private Land	>100,000	0.2 km by NR13S	43 km Phou khao khouay	Embankment , Sub grade and sub base
BP04	Clayey gravels and laterites	B. Donyeng Village, Pakngum District Km56+750 RHS Private Land	>100,000	6.15 km by NR13S	18 km Phou khao khouay	Embankment , Sub grade and sub base
BP05	Clayey gravels and laterites	B. Naxay Village, Pakngum District Km69+775 RHS Public Land	>30,000	0.05 km by NR13S	3 km Phou khao khouay	Embankment , Sub grade and sub base
<b>Quarry</b>			<b>&gt;140,000</b>			
Q01-S1	Sandstone	B. Nakaen Village, Thaphabat District Km74+000 LHS Public Land/Concession	500 cubic meters per day	4 km by NR13S	0.2 km Phou khao khouay	Sub base, Base course and concrete Work
<b>Sand</b>			<b>&gt;160,000</b>			
RS01-S1	Poorly graded sand trace gravelly sands	B. Thapha Village, Hadxaifong District Km30+000 RHS	600 cubic meters per day	19 km by NR13S	57 km Phou khao khouay	Soil cement base course and concrete work

No.	Type of Material	Location and Type of Land	Estimated Quantity (m <sup>3</sup> )	Distance (km)		Potential Use
				to subproject site	To nearest forest	
RS02-S1	Poorly graded sand trace gravelly sands	B. Simmano Village, Hadxaifong District Km30+000 RHS	500 cubic meters per day	11 km by NR13S	49 km Phou khao khouay	Soil cement base course and concrete work
RS03-S1	Poorly graded sand trace gravelly sands	B. Thinthiang Village, Pakngum District Km48+150 RHS	300 cubic meters per day	13 km by NR13S	35 km Phou khao khouay	Soil cement base course and concrete work
RS04-S1	Poorly graded sand trace gravelly sands	B. Thadeuasihom Village, Pakngum District Km48+150RHS	2000 cubic meters per day	18 km by NR13S	38km Phou khao khouay	Soil cement base course and concrete work
RS05-S1	Poorly graded sand trace gravelly sands	B. Nongkhied Village, Pakngum District Km64+555RHS	1200 cubic meters per day	13 km by NR13S	9.3km Phou khao khouay	Soil cement base course and concrete word
<b>Spoil Disposal</b>			<b>&gt;160,000</b>			

Source: LTEC, 2022

### 3.2.8.3 Material Stockpile Areas

During the construction process, it is likely that materials will be temporarily stockpiled in locations close to the main construction sites. This will include stockpiles of soil, sand, rocks and gravel. Although the locations of these material stockpiles are not currently known, general impacts associated with their development are discussed in this ESIA report and relevant monitoring and management measures outlined in the ESMP.

### 3.2.8.4 Water Supplies

The Project has not yet applied to establish boreholes in the Project Area. Consequently, water supplies for construction processes are currently planned to be drawn from surface water resources e.g. rivers, swamps among others. Nonetheless, the extraction of surface water is primarily used for watering the road before compacting and grading road surface. Workforce and camps are expected to access available piped water supply or boreholes along the NR13SE. The requirement for water uses sets out in the Law on Water and Water Resources (2017) and is summarized in Appendix 1.

### **3.2.8.5 Asphalt Plant**

A temporary asphalt plant will be developed as part of the Project. The location of this plant is yet to be confirmed. The asphalt plant will likely contain a batching plant and associated machinery, as well as vehicles for the transport of materials around the site. The site will also provide an area for aggregate materials (e.g. gravel, sand, bitumen) to be stockpiled, warehouses, as well as waste disposal facilities.

It is recommended the manufacture, storage and use of bitumen is conducted in accordance with the Bitumen Safety Code (Energy Institute, 2005). Bitumen is to be stored in tanks specifically designed for the purpose.

As there is generally fuel available in existing service stations close to work areas, limited fuel storage will be required for the Project. However, some fuel may be stored in appropriately bunded tanks at the asphalt plant for refuelling Project vehicles and equipment.

The asphalt plant site will need to undergo due diligence environmental and social studies by the contractor to the satisfaction of DOR and in accordance with international standards (e.g. AIB's ESF and the World Bank Group's EHS Guidelines) to ensure potential impacts are avoided and minimised where possible. Appropriate security measures will be applied to the plant (e.g. fencing, restrictions on access).

### **3.2.9 Output-and Performance-based Road Contract (OPBRC)**

The Project will be implemented through an Output- and Performance-Based Road Contract (OPBRC) similar to that being used for North, with a 10-year contract life. The OPBRC expands the role of the private sector from a simple execution of works to a management and maintenance of road assets and the contractor is paid through a combination of output payments for defined improvement works along with periodic performance-based lump-sum payments for bringing the road to a certain service level and then maintaining it at that level for a relatively long period. The 10-year OPBRC will comprise the first 2- or 3-year construction/periodic maintenance period (called the "Construction Phase") and follow-up operations and maintenance (O&M) which may begin from the start of the contract and extend for 7 or 8 years beyond completion of the Construction Phase. The payments for the Construction Phase will be made if the contractor meets or exceeds the performance indicators for defined fully finished road sections ("milestones"), and against works certification issued by the construction supervision consultant.

## **3.3 Project Phases**

The implementation of the Project is split into several phases which are described in more detail below. These phases are the:

- ▶ Pre-Construction phase;
- ▶ Construction phase; and
- ▶ Operations phase.

The 'Decommissioning Phase' is not covered by the ESIA as the overall Project is not expected to be decommissioned.

### **3.3.1 Pre-Construction Phase**

#### **7.1.1.1 Activities**

##### ***Conceptual Design***

The initial Project Conceptual Design has been developed in 2019 from a combination of desk-based research and on the ground surveys. A finalised Conceptual Design has now been produced by LTEC because of these studies which take into account engineering, economic, environmental and social considerations. Studies conducted included: traffic survey, detailed design drawings, land and asset surveys, topographical surveys and hydrology and drainage studies. This ESIA documentation is produced as part of these studies during the Pre-Construction phase.

##### ***Construction Materials Investigations***

Material investigations involve field visits and collection of intended construction material samples for laboratory tests. During the investigations, sub-grade soils, base material and sub-base materials under the existing road are tested.

The investigations also involve identification and collection of material samples from laterite gravel borrow pits and quarry sites, excavation and collection of materials from test pits along the three road alignments, collection and testing of materials, among other activities.

In the investigations of construction materials and their sources, the primary Project objective was to aid the implementation of technically and financially feasible and cost-effective measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with a focus on areas that are considered core business activities.

Such measures were tasked with integrating the principles of cleaner production into product design and production processes with the objective of conserving raw materials, energy, and water. This has been done and was the basis of selecting potential source areas for the construction materials.

##### ***Detailed Measurement Survey***

Detailed measurement survey (DMS) and inventory of loss have been conducted between 16<sup>th</sup> January – 16<sup>th</sup> February 2023 based on the COI outlined in Section 3.2.2. The COI documented all land, assets, crops and people affected by the Project's improvement. This included a full census of people affected by the Project. The DMS identified a total of 1,209 affected households (PAHs), 5,200 affected people (PAP), including 2,814 females in 21 villages, three districts and two provinces. The magnitude of impacts on land and assets of affected households and the public varies significantly including the loss of land, primary and secondary structures and other assets (e.g. trees and infrastructure).



The DMS for the NR13SE is outlined in more detail in the Resettlement Plan (RP, Volume C-2). The DMS informed the calculation of compensation and replacement costs required for the Project in line with the conditions set under AIIB's ESF.

### ***Traffic and Other Data Collection***

Traffic volume count was undertaken by LTEC survey team between 3<sup>rd</sup> to 17<sup>th</sup> March 2019 at 8 survey locations along the NR13SE (refer to Volume B: Appendix 3). This activity involves collection of all traffic count, patterns, loads and movements on the existing NR13SE that would directly impact during construction and operation. It also includes origin - destination studies (O&D), travel speed, and axle load surveys. Details on traffic survey are provided in the Conceptual Design and Part III of the Traffic Survey Data Report.

Despite the traffic survey was undertaken in 2019, the data remains valid given the condition of the road and traffic pattern remain unchanged.

### ***Resettlement Plan***

This Project will displace a sizeable number of people meaning that the development of a full Resettlement Plan is mandatory under national law and international guidelines. A Resettlement Plan (RP, Volume C-2) has been prepared outlining procedures and methodologies to follow to ensure the Project meets requirements set by the AIIB's ESF.. The plan outlines the necessary compensation measures, the size of the affected population, implementation timetable, consultations conducted and stakeholder opinions, and an estimate of the expected financial costs for compensation.

### ***Land Acquisition***

The land to be acquired includes all land within the COI. This will include land required for the widening of the existing road particularly between the 4-lane section and some minor sections in community and non-community areas. The amount of land acquisition varies depending on location along the COI. For example, between the 4-lane section and urban areas of land will have to be acquired. A comprehensive land acquisition information is provided in the RP (Volume C-2).

### ***Replacement / Resettlement***

The Project will not require a resettlement of affected people or households. However, where physical and economic displacement have been deemed unavoidable, the Project will assist the displaced person throughout the compensation process ensuring that there is no loss of livelihood as a result of the Project in accordance with national legislation and international best practices. The compensation strategies and implementation measures are outlined in more detail in the RP (refer to Volume C-2).

### ***Recruitment of Labour Force***

Before the start of the Construction phase, the contractors and workforce will need to be recruited to carry out the construction works. At the peak of the works it is expected that up to 168 people will be employed by the Project.

Project employment will be consistent with Lao PDR employment and labour policies and relevant international standards including:

- ▶ Lao National Labour Law (2013);
- ▶ AIB's ESF – Occupational Health and Safety; and
- ▶ World Bank Group/IFC Performance Standard 2: Labour and Working Conditions.

### **3.3.2 Construction Phase**

#### **8.1.1.1 Activities**

##### ***Land Clearance***

Once construction of the Project has begun, the land that has been acquired for road widening will need clearing of all trees, bushes, structures and other obstacles in the path of the COI. All material that is cleared will have to be disposed of in approved disposal areas. Impacted people/communities may be given the chance to salvage any materials generated as a result of this process.

##### ***Topsoil Removal***

Topsoil will be removed within the Project Footprint (COI). This activity will involve the excavation and transportation of topsoils (and other materials not suitable for construction) away from the main footprint. This material will be stockpiled and utilised for revegetating the embankments and slopes created by the Project.

##### ***Borrow Pit and Quarry Operations***

Contractor(s) will be responsible for engaging with construction material suppliers / sub-contractors. It is expected that the contractor(s) will source laterite soils and aggregates from an existing borrow pits and quarries. The operations of quarries and borrow pits in the Construction phase will require the excavation of material, the use of heavy machinery and if necessary, the use of explosives (if required) to extract the rock material. The operations of these quarries and borrow pits will be the responsibility of the suppliers.

Further details regarding environmental and social assessment requirements for quarries are provided in Section 3.2.8.2.

##### ***Staff Mobilisation***

At the peak of the construction works, it is thought that up to 168 people will be employed by the Project during construction and up to 20 during the Operations Phase (LTEC, 2019). These staff will need to be mobilised and managed as appropriate for the specific construction works taking place over the duration of the Construction Phase. This will also require the development of accommodation camps to house the construction workers near to the construction sites. The camps will need to be equipped with adequate power supply, catering and sanitation facilities to provide construction workers with satisfactory living standards whilst housed at the accommodation camps.

### ***Plant Set-up***

During the construction phase, all facilities and plants associated with the Project will require preparation and/or construction. This will include the setup of asphalt plants, accommodation camps and material and equipment storage areas.

### ***Drainage Works***

Drainage works will be undertaken as part of the Project and will be a vital component of road design and construction. This will include the repair / upgrade / construction of bridges, culverts, catch water drains, kerb drains, mitre drains and cut-off drains as well as the excavation of soil and rock materials required for their construction.

### ***General Earthworks***

The general earth works required for the Project will include:

- ▶ Clearing of vegetation and stripping of topsoil over the corridors where the carriageway(s) will be accommodated, and over areas that may be used for construction of workshops and workers camps (if required);
- ▶ Excavating the road formation in cuts and then using the material if suitable to form the compacted embankments layers;
- ▶ Excavating spoil material that is unsuitable to form the roadbed and replacing it with suitable materials from cuts or borrow areas;
- ▶ Filling of low areas and flat plains;
- ▶ Excavating side drains, catch water drains, offshoots, outfall drains and foundations of other drainage structures; and
- ▶ Scarifying and compacting the existing material if suitable to form the sub-grade in cuts or laying and compacting selected sub-grade materials.

### ***Surfacing***

This involves laying of an Asphaltic Concrete (AC) wearing course or surface dressing of both the carriageway and the shoulders. Prior to application of the AC surfacing, a bituminous binder course may be required on top of the primed base layer. The application of a binder course and an AC surfacing involves spraying a thin film of tar coat followed by the laying of a hot mixture of aggregates, filler, and bituminous binder prepared at predetermined proportions mostly in a stationary plant.

### ***Ancillary Works***

After the majority of construction is complete, ancillary works will still be required. These other activities may include the laying of road markings, placing of road signs, installation of fencing and guardrails, installations of street lights and electrical works etc.

### Restoration of Disturbed Sites

After the bulk of the construction process is complete, it will be necessary to restore some sites that have been degraded during the construction process. This may include revegetation work along embankments, removal of waste rock and other building materials and the removal of excess sediment from watercourses, wetlands and drains.

### Waste Management

Extensive amounts of construction waste will be produced during the construction process. This will include large amounts of filling material, borrow material, sand, packaging and hazardous materials. The waste will need to be adequately disposed of in accordance with the ESMP and will be addressed within contractors' erosion and sedimentation control specifications.

#### 9.1.1.1 Construction Materials

The construction of the Project will require the use of large amounts of construction materials including crushed rock, bituminous materials, cement, water, sand, fencing and signposts. An estimate of equipment and material costs for the NR13SE has been developed and is provided in Table 3-5.

**Table 3-5: Approximate Equipment and Material Requirements for the NR13SE Construction**

Material type	Unit	Amount	Source	Comment
<b>Materials</b>				
Laterite soils	m <sup>3</sup>	620,000	Existing borrow pits	Approximate quantities only
Crushed stones / gravel	m <sup>3</sup>	TBC	Existing quarries	
Sand	m <sup>3</sup>	TBC	Existing sand dredging areas	
Bituminous materials	m <sup>3</sup>	TBC	Imported bituminous materials	
Cement	m <sup>3</sup>	275,000	Locally produced	
Water	m <sup>3</sup>	110,000	Rivers, streams, ponds	
<b>Equipment</b>				
Dozers	Unit	3	Contractor	Approximate quantities based on similar scope of works.
Graders	Unit	5	Contractor	
Pavers	Unit	2	Contractor	
Heavy Compaction Equipment	Unit	8	Contractor	
Loading buckets (wheel and track loaders, etc)	Unit	3	Contractor	
Excavators (back hoes, back actors, etc)	Unit	15	Contractor	
Dump trucks	Unit	20	Contractor	
Water and fuel tankers	Unit	6	Contractor	

Source: LTEC, 2023

### **3.3.3 Operations Phase**

#### **3.3.3.1 Activities**

##### ***Construction Decommissioning***

Since the NR13SE improvement will result in core infrastructure that is maintained indefinitely, a detailed ESIA on decommissioning to the World Bank Group's EHS Guidelines is not necessary. However, after the completion of the Construction phase, decommissioning of several ancillary Project components will be required including the rehabilitation disturbed areas, the deconstruction of asphalt plants and accommodation camps. Degraded land areas resulting from construction works will be rehabilitated and revegetated where required to ensure stable landforms.

Activities such as the restoration of degraded areas and waste management during construction decommissioning are to be addressed in the contractors' Environmental and Social (E&S) specifications.

##### ***Road Operation and Maintenance***

During the operations phase, substantial levels of operations and maintenance work will be required to enable the continued functioning of the road. This work may include, but will not be limited to:

- ▶ Pothole patching;
- ▶ Cleaning of drainage facilities;
- ▶ Repairs of broken road items;
- ▶ Resurfacing;
- ▶ Revegetation / weeding activities;
- ▶ Maintenance of street lights and signs; and
- ▶ Installation of additional signs.

##### ***Enforcement of Traffic Rules***

The operations phase will also require the enforcement of local traffic laws on the NR13SE including:

- ▶ Enforcement of speed limits;
- ▶ Enforcement of maximum axle loading based on the Project design; and
- ▶ Enforcement of cleared areas surrounding the ROW in collaboration with local authorities.

##### ***Waste Management***

Waste management activities will be required to continue into the operations phase of the Project, although the amount of waste produced is likely to substantially reduce. This will include the

management of domestic wastes, hydrocarbon spills and waste produced during any repair or upgrade works.

### **Staffing**

It is estimated that 20 staff will be employed during the operations phase (LTEC, 2019). These staff will be required for road maintenance activities as well as manning the toll booths. Other staff may be required for management and logistics associated with the operation of the Project.

As per the Construction Phase, Project employment during Operations will be consistent with Lao PDR labour laws and regulations as well as relevant international standards including AIIB's ESF.

### **Environmental and Social Monitoring**

Ongoing environmental and social monitoring will be required throughout the life of the Project. For example, this may include regular inspections of drainage infrastructure, erosion levels and responding to community grievance issues. The approach to environmental and social management is summarised in Section 5.3 and recommended monitoring measures are outlined in the ESMP provided as part of this ESIA (refer to Volume C-1).

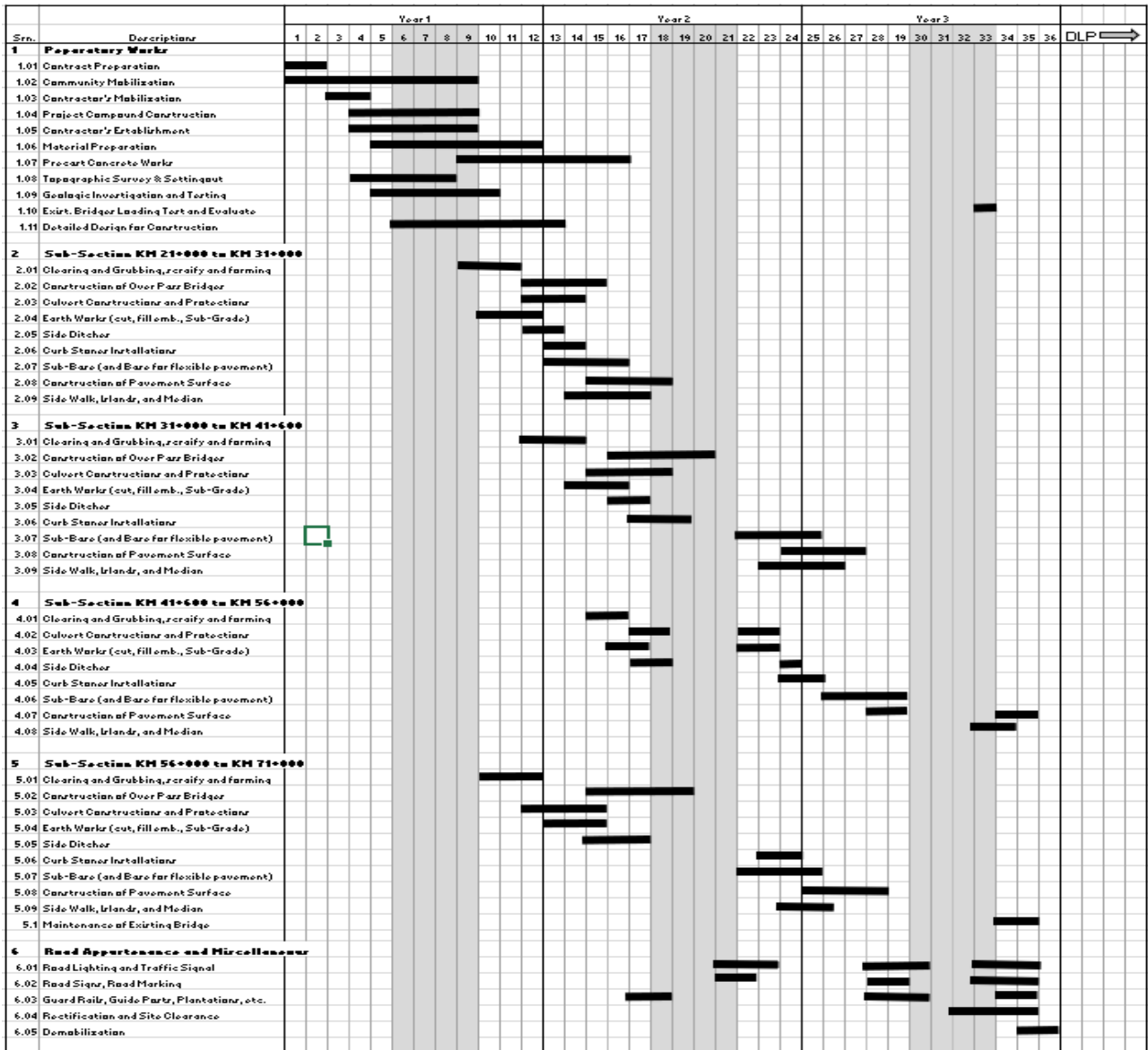
#### **3.3.4 Decommissioning**

The 'Decommissioning Phase' is not covered by the ESIA as the overall Project is not expected to be decommissioned. As per Section 4.3.3.1, 'construction decommissioning' will occur as part of the Operations phase.

#### **3.3.5 Project Schedule**

The length of the construction phase is expected to be 3 years (36 months) and operations and maintenance is 7 years. this schedule is proposed in the Conceptual Design as a tentative only. The contract shall develop detailed work schedule in consideration with other components, local context and contractor's capability. An indicative project schedule up to financial close is provided below (LTEC, 2023):

**Table 3-6: Project Schedule**



Source:

LTEC,

2023

## 4. PROJECT ALTERNATIVES

### 4.1 Overview

An analysis of Project alternatives is required to ensure that the road meets DOR-MPWT's objectives and complies with national legislation and international guidelines. DOR-MPWT require the analysis of alternatives to be conducted to assess the suitability of each re-alignment sections and pavement methods in meeting the following stated objectives:

- ▶ To improve the national road network and achieve better value for money strategy;
- ▶ To improve the NR13SE in meeting climate resilience road infrastructure;
- ▶ To improve safety conditions of the national road network (e.g. elimination of black spots);
- ▶ To support economic growth in the country;
- ▶ To minimise any adverse effects on the environment and the society; and
- ▶ To ensure where possible that any proposals are acceptable in principle to key stakeholders.

An analysis of alternatives is a key component required under the *Decree on Environmental Impact Assessment (2022)* and elaborated in the *Lao National Technical Guidelines on ESIA (2016)* This includes a systematically compares feasible alternatives to the proposed project sites, technology, design, and operation including the 'no project' or 'business as usual' alternative in terms of their potential environmental and social impacts.

### 4.2 Business as Usual vs Road Improvement

A 'Business as Usual' option was considered during the inception of the Project. This would involve leaving the existing NR13SE as it is currently – continuing to conduct maintenance activities routinely to ensure the road functions as smoothly as possible. However, with the current system, traffic levels are very high along much of the NR13SE road's length. Heavy congestion occurs throughout the urban and community areas on daily basis as well as traffic jams and increasing severity of road accidents. During peak traffic hours, the road's capacity is already exceeded. Under this Option, there would be no investment in road capacity improvements between Ban Khoksivilay in Xaythany District to Ban Xaysavang in Thaphabath District.

Traffic levels are expected to continue increasing in the future and it is likely that under this scenario congestion levels and road safety concerns along the alignment will become worse. Traffic has been growing at approximately 8% annually and almost up to 30,000 vehicles a day used at the Km21+300 intersection (Traffic Survey Report, 2019). The increased use of the road has also been accompanied by development of roadside settlements and commerce and increased use of this major transport link by pedestrians and slow vehicles, the latter of which has become a hazard to road users and community health and safety.



The 'business as usual' approach would likely lead to increased congestion levels between the major communities and therefore increased transportation costs and less efficient journey times, which will be detrimental to economic growth in the region.

From an environmental and social perspective, the increased use of this road section will lead to increased urban air pollution, noise pollution and present a severe risk to community health and safety. It has therefore been realised that something must be done but it was also recognised that new infrastructure developments can have large economic, social and environmental consequences. An analysis of alternative Project designs for the NR13SE improvement is provided below.

### **4.3 Black Spots**

An analysis of traffic safety assessment was conducted in 2019 as part of the Project Design. The assessment identified three locations of black spot which are the accident-prone locations with key causes of road accident that taken place previously. There had been several accident locations along the Project Road from the road accident report since 2014 – 2018 that had severe accidents with injuries and fatalities.

The project covered town provinces and three districts, refer to the Table 4-1 of accidents recorded in above had shown that, the total number of accidents for 5 years of Xaythany district is 61, people killed 3, injured 82, Paknguem district is 164, people killed 41, injured 237, Thaphabath district is 287, people killed 475, injured 60. After site surveyed of accidents data along the road project, finally could identify three black spot locations (for more details see in table 7; 8) as following:

- ▶ Km 38+900, total accidents recorded during the last five years is 17, people killed 10 and injured 38.
- ▶ Km 48+000, total accidents recorded during the last five years is 28, people killed 8 and injured 61.
- ▶ Km 38+900, total accidents recorded during the last five years is 23, people killed 6 and injured 41.

It has been revealed in this report that most of the accidents at black spots occurred due to speedy, aggressive driving of road users and geometric conditions have comparatively less contribution in accidents. Insufficient law enforcing agencies, improper road infrastructure, lack of proper warning signs, inadequate illumination on footpaths and cycle tracks, poor emergency response capability and injustice in the implementation of traffic laws are the main causes of road accidents and ignorance of some minor causes may result major accidents.







#### **Proposed mitigation measures**

Speed limits should be considered, taking into account traffic safety and operational efficiency. The design of speed limits (e.g. 50 km/hr in community areas and 80km/hr in non-community areas) should consider several factors such as function of the road, technical indicators, operational characteristics, roadside interference, environmental and social needs along the road.

On many of locations remedy measure can be done that very likely will reduce the injuries and fatalities. These remedy measures are mainly additional road furniture in the new design such as: visible road signs, guideposts, guardrail, chevrons etc... and also emphasizes the need to understand the importance of minor weakness and flaws in the road traffic system.

In order to have safe and smooth flow of traffic on urban road, encroachments within the right of way should be cleared off and separate service roads should be provided for local traffic.

**Table 4-1: Road safety recommendation**

Item	Location	Road geometry/Design characterize	Recommendations	Pictures	Remarks
1	Km 38+900 Nongbuathong village	-Curve with access road. -No speed limit sign.	-Install stop sign on access road. -Install speed limit sign. -Install warning sign -Install chevrons. -Install flashing light		
2	Km 48+000 Naxone village	-Horizontal curve in combination with vertical curve. -Lack of adequate sight distances. -No speed limit sign.	-Redesign and widening the curve. -Install speed limit sign. -Install warning sign. -Install chevrons.		
3	Km 56+200 Phao village	-Narrow road pass through community. -No speed limit sign. -Curve with junction.	-widening the road pass through all community. -Install speed limit sign. -Install calming sign at all community and school along the road. -Install stop sign on access road.		

Additional road safety requirements may be subject to update following the final review of the Conceptual Design.

## **Selection of Alternatives**

As outlined in the Road Safety Assessment Report (2019), the initial assessment of suitable design options for the black spots was undertaken. Following identification of the black spots, consultation with relevant stakeholders was conducted to discuss the different improvement options including realignment. The consultation highlighted the high risk of road accident within the black spot areas. The recommendations made for these black spots is provided in Table 4-1.

### **4.4 Re-alignment**

As part of the road safety assessment conducted in 2019, additional three locations of sharp curves were identified in KM35+000 – KM36+400 (T1); KM64+900 – KM65+400 (T2); and KM68+600 – KM70+000 (T3). The realignment aims to improve road safety conditions and minimize road accident. Therefore, alternatives consider include (i) realignment, and (ii) maintain the existing alignment.

#### **Selection of alternative**

Option 1 – the realignment in three sections of T1, T2 & T3 occur entirely within the ROW. Minor land acquisition will be required, and compensation is to be provided. Land use within the T1 section includes low-lying area / seasonal flood prone area and adjacent to a local fishpond. Similarly, the T2 is located in residential area and therefore minor residential land will be impacted. At T3, the road will require both geometric improvement as well as realignment. The realignment will require minor shrub land within the RoW.

Option 2 – maintain the existing alignment. This option will have further road safety impacts. Current road volume is already high congested due to continued increase in traffic. The existing road alignment is high risk and causes the majority of traffic accident.

Following the Conceptual Design (2019) these three re-alignment sections were selected and detailed design drawings have been provided to guide the environmental and social impacts, as well as estimate the construction costs.

Based on the initial review of the Conceptual Design Review Consultant (CDRC), there was no significant changes in the alignment adjustment proposed in 2019 only minor deviation of alignment at all curve locations that are accommodated within the existing COI. Also, the number and location of bus and truck stops remain the same as proposed in Conceptual Design; however, Road Safety Audit Consultant (RSAC) recommended to move the bus stop at at the Km62+700, Km48+100 and other few bus stops away from the bottom of the concave curve for road safety as well as pedestrian crossing facilities were suggested to install at the Km48+100. There is no feedback from CDRC yet on the RSAC's recommendations.

## 5. ENVIRONMENTAL AND SOCIAL BASELINE ANALYSIS

### 5.1 Overview

This road Project locates in flat zone (called Vientiane Floodplain) lays in between the Mekong River in the right side and Nam Ngum in the left side of corridor of further extent. The existing road is 2-lane 2-way road, formation width of 9 metres in non-community area and 10 metres in community area. The existing pavement is paved by DBST surface the latest improvement was done during the Year 1990s under the Road 13 South Improvement Project (Vientiane to Pakkading and Pakkading to Savannakhet). The condition of existing road surface is evaluated in the range of low level to medium level deteriorated. Side ditches are mainly filled by soil and vegetation, cross drain structures are mainly in a good condition but need the maintenance and extension the length of structures to accommodate with new road width for the section of widening to 23m, 15m and 12m in different sections. Some of those culverts are insufficient capacity, the structure is deteriorated need to be replaced by new. Traffic signs, traffic signal, road marking, guideposts, guard rails are needed to improve for traffic safety.

### 5.2 ESIA Scope

The scope of this ESIA Update is focused on the assessment of potential direct, indirect and cumulative impacts and risks associated with the pre-construction / construction, and operation of the NR13SE Project. Other ancillary components including borrow pits, quarries, asphalt plants, workcamps, etc., are also covered by this ESIA.

A detailed scope of the ESIA is outlined in the Project's Terms of Reference.

### 5.3 Approach

The key steps in the ESIA process are summarised below:

- ▶ Inception and consultation;
- ▶ Conduct of specialist studies and fieldwork to inform the ESIA, including modelling to help understand potential impacts;
- ▶ Development of the current physical, biological and socio-economic baselines;
- ▶ Identification and assessment of pre-mitigation risks and potential impacts associated with the preferred design for the Project, incorporating existing controls and best practices;
- ▶ Identification of mitigation measures including design solutions and management control measures, over and above those already in place, that will remove or reduce potentially significant adverse impacts and risks to acceptable levels or enhance benefits; and
- ▶ Detailed evaluation of each of the key issues identified and determination of the significance of residual impacts and risks after the application of proposed mitigation measures.

The ESIA uses both primary and secondary collected from the Project area discussed below. Primary data was collected by the LTEC field teams between January - February 2023. Key secondary data is based on the updated Project's Conceptual Design (LTEC, 2023) for the NR13SE and existing ESIA (TNM, 2019) and information collected from relevant local authorities. Additional discussion of secondary data is outlined in Section 5.6.

## 5.4 Study Area

The Study Area for this ESIA includes primarily the Project footprint (COI) and the area of influence for various physical, biological, and social aspects in relation to the NR13SE. The identification of area of influence requires an understanding of current and planned Project activities, assessment of satellite imagery analysis, secondary information, and information provided through interviews, focus group discussions / local knowledge surveys; and evaluation of the relative importance and likelihood of Project influence beyond the Project footprint. In some cases, this ESIA considers the Study Area in wider landscapes to help understanding the ecological components in the Project region.

### 5.4.1 Area of Influence

The area of land that is likely to be influenced by the construction and operation of the Project area considered as the Area of Influence (AoI). This includes not just the direct Project Footprint (COI) but also the surrounding land and neighbourhoods which will be impacted by the Project – either directly or indirectly.

The AoI will vary depending on the specific environmental and social aspects being considered. The Study Area discussed for each environmental and social aspect is based on the likely extent of Project impacts, the surrounding receptors and other activities with the potential to interact with the Project. For more information see the Study Area section in each respective section of the ESIA.

### 5.4.2 Social Area of Influence

The NR13SE encompasses 21 village in three districts and two provinces. The Social AoI is the area where social receptors are directly or indirectly affected by the Project. The 21 villages have direct impacts from the Project through loss of land and/or assets and economic displacement temporarily and/or permanently.

### 5.4.3 Sensitive Receptors

The sensitivity of the baseline conditions was defined according to the relative importance of existing environmental and social features (e.g. community areas, school, and markets) within or in the vicinity of the site, or by the sensitivity of receptors which would potentially be affected by the proposed NR13SE development (refer to [Table 5-1](#) below). There are 16 main settlements / villages are identified as social sensitive receptors given their locations are directly on the NR13SE. Maps of social receptors including main settlements, schools, temples, health centers and markets are provided in Appendix 2 (Figure 1-28, Figure 1-30, Figure 1-31 & Figure 1-32).

#### Table 5-1 List of School

No.	Chainage	Position	Distance to Road (m) (From New Alignment)	
			(To Fence)	(To School)
1	KM 26+425	RT	20.00	32.00
2	KM 26+500	RT	21.00	50.00
3	KM 29+840	RT	169.00	257.00
4	KM 31+225	RT	162.00	215.00
5	KM 35+900	LT	26.35	100.00
6	KM 39+075	LT	20.00	90.00
7	KM 42+700	RT	25.57	52.00
8	KM 48+645	LT	13.5	24.00
9	KM 56+800	LT	16.00	23.00
10	KM 58+325	LT	25.00	50.00
11	KM 63+850	RT	21.00	43.00
12	KM 64.175	RT	29.00	56.00
13	KM 66+600	LT	17.94	85.00
14	KM 68+665	LT	26.00	145.00

Table 5-2 List of Health Centre

No.	Chainage	Position	Distance to Road (m) (From New Alignment)	
			(To Fence)	(To Health Center)
1	KM 21+575	RT	15.87	27.00
2	KM 38+868	LT	18.62	30.00
3	KM 48+950	RT	14.60	19.17
4	KM 58+450	RT	24.82	84.60

Table 5-3 List of Market

No.	Chainage	Position	Distance to Road (m) (From New Alignment)
1	KM 22+485	RT	27.00
2	KM 24+650	RT	2600
3	KM 26+125	RT	20.00
4	KM 29+400	LT	18.50
5	KM 35+325	LT	30.00
6	KM 43+190	LT	18.22
7	KM 56+425	LT	13.83
8	KM 62+675	RT	30.88

**Table 5-4 List of Cultural Sites**

No.	Chainage	Position	Remark	Distance to Road (m) (From New Alignment)	
				(To Fence)	(To Temple)
1	KM 24+100	LT	Cemetery	24.296	46.787
2	KM 25+125	LT	Temple	20.781	50.000
3	KM 26+995	LT	Temple	Outside ROW	
4	KM 29+800	LT	Temple	Outside ROW	
5	KM 29+900	RT	Temple	18.541	92.000
6	KM 31+150	RT	Temple	29.000	85.430
7	KM 31+925	RT	Cemetery	Outside ROW	
8	KM 34+625	LT	Temple	Outside ROW	
9	KM 38+975	LT	Temple	20.000	45.290
10	KM 40+550	RT	Temple	35.985	68.030
11	Km 41+460	RT	Cemetery	Outside ROW	
12	KM 43+100	LT	Temple	16.949	37.280
13	KM 44+400	LT	Cemetery	22.000	80.000
14	Km 46+975	RT	Cemetery	37.000	100.000
15	KM 47+925	RT	Temple	32.982	67.220
16	KM 48+855	LT	Temple	56.000	92.000
17	KM 55+975	RT	Temple	32.609	67.350
18	KM 58+200	LT	Temple	26.438	114.750
19	KM 59+400	RT	Cemetery	26.000	70.000
20	KM 66+700	LT	Temple	23.178	24.970
21	KM 68+900	RT	Cemetery	25.000	130.000

## 5.5 Specialist Studies

### 5.5.1 Baseline

An extensive amount of environmental and social baseline data has been collected for the Project since 2019. This information has enabled DOR to evaluate design options and identify an alignment that avoids or minimises significant impacts to key environmental and social values. Extensive baseline work was also undertaken by the ESIA Consultants for the updated ESIA prepared for the NR13SE Project. This ESIA builds on the previous baseline work undertaken and includes information collected from further targeted investigations undertaken under the scope of the ESIA update for NR13SE.



## 5.5.2 Methodology for Physical Specialist Studies

### *Soils and Land Use*

The methodology for the soils and land use study of the Project Area included the following steps:

- ▶ Characterise catchment topographic information based on the GOL SRTM remote sensing topographic dataset for the Project Area;
- ▶ A literature review of physical soil characteristics and geological conditions within the Project Area;
- ▶ Inspection of aerial imagery to map and identify key geological feature of the landscape; and
- ▶ Site observations and inspection of imagery to identify / map key topographical features of the landscape.

### *Water Quality*

Water quality sampling was collected by Phanthamit Analytical Laboratory with support from LTEC team on 5<sup>th</sup> December 2022 to establish a pre-Project water quality baseline. Field water quality monitoring and sampling for laboratory analysis were taken from three locations. Water sampling was carried out in accordance with methods outlined in the Standard Methods for the Examination of Water and Wastewater, or in accordance with national standards complying with the requirements of method validation of ISO/IEC 17025:2005. After sampling, the water samples were delivered to Laboratory in Vientiane for analysis. The sampling locations, provided in Volume B: Appendix 2 – Figure 1-17, include:

- ▶ SW01 – Nam Ngum River, upstream of Sithong Bridge, Ban Hai, Pak Ngum District;
- ▶ SW02 – Houay Ver, downstream of NR13SE, Ban Naxay, Thaphabath District; and
- ▶ SW03 – Houay Phai – Downstream of NR13SE, Ban Xaysavang, Thaphabath District.

All parameters were analyzed using the procedures outlined in the Standard Analytical Procedure Manual for water samples, which is based on the APHA/AWWA Standard Methods for Water and Wastewater Examination, 23rd edition.



Plate 5-1: Water sampling at SW01



Plate 5-2: Water sampling at SW01



Plate 5-3: Water sampling at SW02



Plate 5-4: Water sampling at SW03

### **Ambient Air Quality**

Ambient air quality monitoring has been conducted in three most sensitive receptors (major community areas) in Ban Koksavang (AQ01), Ban Naxon (AQ02), and Ban Hai (AQ03) (refer to Appendix 2: Figure 1-13 – Figure 1-16) between 6 – 10 February 2023. The survey results were compared with Ambient Air Quality standard specified in Lao National Environmental Standards, Ministry of Natural Resources and Environment, No. 0832, 07/02/2017, as follows: PM<sub>10</sub> (average 24 hours:  $\leq 0.12$  mg/m<sup>3</sup>), PM<sub>2.5</sub> (average 24 hours:  $\leq 0.05$ mg/m<sup>3</sup>), TSP (average 24 hours:  $\leq 0.33$  mg/m<sup>3</sup>), Nitrogen dioxide (average 1 hour: 0.11 ppm), Carbon monoxide (average 1 hour: 30 ppm, average 8 hours: 9 ppm).

### **Particulate Matter (<10 microns) (PM<sub>10</sub>)**

The method used to measure particulate matter with a size less than 10 microns (PM<sub>10</sub>) was the gravimetric method by using the HVAS model. Sampler filters was transferred to a laboratory in Thailand for analysis employing the Pre and Post Weight Difference Method, as recommended by the PCD.

Sampling methods complied with ISO/IEC 17025 using the following procedures:

- ▶ Prepared and checked performance of the High-Volume Air Sampler and size selective head before undertaking field measurements;
- ▶ Desiccated the quartz filter papers (size 8x10 inches) for 24 hours in order to control humidity at between 30-50 %R.H.;
- ▶ The filter was weighed using a calibrated 4 decimal electrical balance, a number was stamped on each filter paper, and weight and numbers were recorded in the logbook. Flow chart papers were prepared for flow recording;
- ▶ The sampler was moved to the sampling station, with no obstructions within a 10-metre radius and no other point sources close to the sampler as recommended by the U.S.EPA. The filter holder was placed between 1.5-6.0 meters above the ground. The environmental conditions were recorded in a field logbook;

- ▶ The High-Volume Air Sampler was calibrated five times with Standard Certified Orifice at the sampling site before sampling, and results were recorded in the Field Data Sheet;
- ▶ Silicone Grease was sprayed on the Impactor for sampling of particulate with a size less than 10 microns;
- ▶ The air sampler was pumped with a flow rate of 1.13 m<sup>3</sup>/minute continuously for 24 hours through a quartz fibre filter. The sample filter, flow chart paper and field data sheet was then transferred to the laboratory for analysis;
- ▶ The flow rate was determined using Flow Chart Paper at 25°C temperature and 760 mm Hg pressure;
- ▶ Calculated and reported PM-10 result average for 24 hours as mg/m<sup>3</sup> by gravimetric method.

### **Particulate Matters (<2.5 Microns) (PM<sub>2.5</sub>)**

The method used to measure particulate matter with a size less than 2.5 microns (PM<sub>2.5</sub>) was the gravimetric method by using HVAS model Ambient Air Sampler Andersen Instruments RAAS-300, Thermo Andersen, Thermo Electron Corporation, Environmental Instruments, USA. The sample filter was then transferred to the laboratory for analysis using the Pre and Post Weight Difference Method as recommended by the USEPA.

Sampling complied with ISO/IEC 17025 using the following procedures:

- ▶ The Pre and Post Weight Difference method was used, using a six-point electronic balance;
- ▶ The Standards U.S. EPA, Code of Federal Regulation Search Results, 40 CFR-Part 50, Appendix L (Federal Reference Method, FRM).

### **Nitrogen Dioxide**

The method used consists in measuring Nitrogen Oxide Continuously by Chemiluminescence method. (Chemiluminescent Measurement of NO/NO<sub>x</sub> in Gas Analyzers). The chemiluminescence method for gas analysis of oxides of nitrogen relies on the measurement of light produced by the gas-phase titration of nitric oxide and ozone. NO is a relatively unstable molecule which will oxidize to NO<sub>2</sub> (especially) in the presence of O<sub>3</sub>. This reaction produces a quantity of light for each NO molecule which is reacted. This light can be measured using a photomultiplier tube or solid-state device. If the volumes of sample gas and excess ozone are carefully controlled, the light level in the reaction chamber is proportional to the concentration of NO in the gas sample.

Sampling complied with ISO/IEC 17025 using the following procedures:

- ▶ Analyzer Calibration
  1. Warm up the analyzer for at least 4 hrs;
  2. Check the status of analyzer of Electrical signal within the defined range;
  3. Connect the Zero Air with analyzer;
  4. Do span for 15 min. then check the number. If the Zero is not Zero, do calibration every 3-5 min. so that the number is close to zero;

5. Connect the calibration gas NO to analyzer;
  6. Do span for 15 min. then adjust the span value and analyzer value close to standard gas NO ( $\pm 5\%$ ).
- Analyzer Installation
1. Select the appropriate sample point;
  2. Connect the sampling probe at least 3 m (3m-15m) above the ground;
  3. Measure Nitrogen Dioxide for 24 hrs;
  4. Download data from the analyzer.

### **Carbon Monoxide**

The method used to measure Carbon Monoxide was the Non-Dispersive Infra-Red (NDIR) method. Non-Dispersive Infra-Red detectors are the industry standard method of measuring the concentration of carbon oxides (CO). Each constituent gas in a sample will absorb some infra-red at a particular frequency. By shining an infra-red beam through a sample cell (containing CO), and measuring the amount of infra-red absorbed by the sample at the necessary wavelength, a NDIR detector is able to measure the volumetric concentration of CO in the sample.

Sampling complied with ISO/IEC 17025 using the following procedures:

- Analyzer Calibration
1. Warm up the analyzer for at least 4 hrs;
  2. Check the status of analyzer of Electrical signal within the defined range;
  3. Connect the Zero Air with analyzer;
  4. Do span for 15 min. then check the number. If the Zero is not Zero, do calibration every 3-5 min. so that the number close to zero;
  5. Connect the calibration gas CO to analyzer;
  6. Do span for 15 min. then adjust the span value and analyzer value close to standard gas CO ( $\pm 5\%$ ).
- Analyzer Installation
1. Select the appropriate sample point'
  2. Connect the sampling probe at least 3 m (3m-15m) above the ground;
  3. Measure Carbon Monoxide for 24 hrs;
  4. Download data from analyze.

### ***Wind Speed and Wind direction measurement method***

Surface wind was measured using a wind vane and rotating anemometers. When the measurement of horizontal wind velocity by means of commercially available rotating anemometers and wind vanes attached to the earth's surface in the ambient atmosphere. Wind speeds can be measured in the range of 0.2 to 100 m/s using such anemometers.

Measuring the Wind speed and wind direction by using the following procedures:

- ▶ Wind speed and wind direction installation:
  1. Set up a vertical pillar and three concave cups, the anemometer captures the horizontal movement of air particles;
  2. Connect the wind direction and wind speed devices with data logger.
- ▶ Setting up measurement value and data logger:
  1. Prepare the battery backup 9V at the back side in order to backup power supply in case of back out of battery;
  2. Connect the 9V adapter with power junction box;
  3. Take about 1-3 min. the measurement function will be started. Then set up time and date;
  4. Connect the cable from sensor with weather computer.

#### ***Ambient Noise Level Survey Method***

The method used to measure ambient noise levels was in accordance with International Organization for Standardization (ISO1996) guidelines for noise measurement.

The following parameters were recorded by an integrated sound level meter:

- ▶  $L_{eq}$  is the average audible noise generated in the one-hour measurement period, from all noise sources - both natural and human activities.
- ▶  $L_{max}$  is the highest audible noise level recorded in the one-hour measurement period, from natural noises such as thunder or human activities.
- ▶  $L_{min}$  is the lowest audible noise level recorded in the one-hour measurement period.
- ▶  $L_{90}$  is the level of audible noise that exceeds 90%, during the one-hour measurement period.
- ▶  $L_{eq}$  24hours is computed from all recorded  $L_{eq}$  readings in a 24-hour period.

The noise level equipment used was RION (model NL-21/NL-42) integrated sound level meters with a ½ inch diameter condenser microphone and weighing network. Specifications of the meters comply with the IEC 61672 international standard for sound level meters.

The meters were calibrated with a RION (model NC-73) standard sound level generator. The calibrator generates 1000 Hz, 94 dB as a standard noise source. The meters were installed on tripods of about 1.2-1.5-meter height above the ground.

#### ***Vibration Measurement Method***

The method used to measure vibration levels was in accordance with the International Organization for Standardization (ISO4866) guidelines for the measurement of vibration.

The vibration meter used for the diagnostic of vibration consists of three precision components:

- ▶ Vibration Pickup;

- ▶ Preamplifier; and
- ▶ Display.

Vibration pickup, a kind of transducer that can measure both velocity and acceleration, was mounted or attached to the vibrating surface. The use of a transducer in vibration analyses is the most essential part of converting mechanical energy into an electrical signal, which is a function of mechanical vibration.

A preamplifier is the second part of the meter used to amplify the vibration that is picked up.

The display is the third part of the meter used for analyzing measured data and displaying results such as peak velocity, acceleration, and frequency.

The make of the vibration meters used was a Blastmate (model Minimate Plus or equivalent) meters. Specification of the selected meter complied with the recommendations of the International Organization for Standardization, ISO 4866.

The measurement of vibration was performed using the following procedures:

- ▶ Selecting the location to place the meter was based on the expected vibration sources. The base of a building structure is usually selected for the meter installation. However, as there were no suitable locations in the bases of buildings at the sampling locations, the meter was installed on the ground.
- ▶ The Vibration Pick Head was fixed to a permanent structure or to the ground. The Pickup Head were directed towards the expected vibration source(s).

Vibration waves occurring on the site were recorded for 24 hours consecutively.



Plate 5-5: Ambient air quality monitoring at AQ01

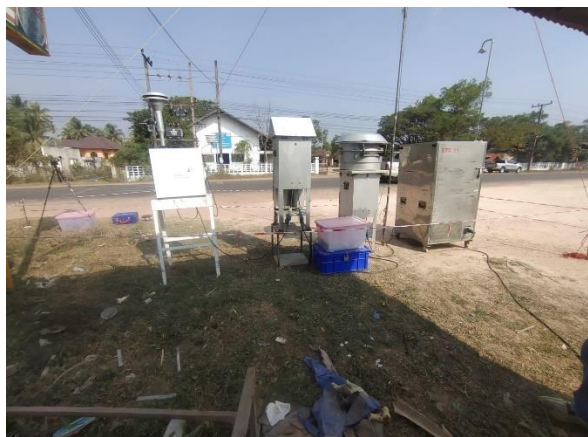


Plate 5-6: Ambient air quality monitoring at AQ02



Plate 5-7: Noise level monitoring at AQ01



Plate 5-8: Vibration monitoring at AQ02

### 5.5.3 Methodology for Biological Specialist Studies

The Study Area for the terrestrial and aquatic biodiversity baseline and impact assessment includes the Project footprint (COI) as well as surrounding areas potentially indirectly impacted by the Project. The approach undertaken for the biodiversity studies is summarised below.

#### *Terrestrial Biodiversity*

Given that the ROW occurs primarily within the existing alignment, the terrestrial biodiversity surveys focused on the potential impacts associated with the construction and operation of the Project. The methodology for the terrestrial biodiversity study of the Project area included the following steps:

- ▶ A review of publicly available studies and data regarding the ecological characteristics of the Study Area was undertaken with an aim of gathering information on habitats, species diversity and ecological communities in the Study Area, as well as best practices approaches to biodiversity management.
- ▶ Village consultation conducted in Project affected villages, followed by site observations within the Project Area and ancillary sites (e.g. borrow pits) and its surroundings undertaken by LTEC terrestrial biodiversity team. The assessment activities included:
  1. Review of literature and recent biological studies to assess threatened species and potential species of conservation significance existing within the broader area of influence;
  2. Local knowledge survey with men and women in 21 villages to identify the locally significant terrestrial fauna and flora species and to understand the forest resources use of the local communities; and
  3. An observation of the existing borrow pits and quarries which will be potentially sourced by the Project for construction materials, as well as its surrounding areas regarding the vegetation cover and species composition.
- ▶ A transect survey of flora species (trees) including native and planted/introduced species have been conducted within the COI and a GPS location was undertaken at each key species

of high conservation / commercial value species. Each species along the COI was recorded and photographed (refer to Appendix 5). Recorded information included scientific and Lao common names and location along the transect. Key literature sources include:

1. Existing Project documentation (e.g. ESIA and ESMP) and related studies of the NR13S (Km71 – Km346) project;
  2. Lao PDR fauna and flora-related legislation, policies and local development plans;
  3. Previous flora and fauna studies conducted in or near the Study Area by universities, research centres, non-governmental organisations (NGOs) and international organisations.
- ▶ A database search was also conducted using the IUCN Red List of Threatened Species.

### ***Aquatic Biodiversity***

Whilst the entire NR13SE alignment occurs within the Mekong and Nam Ngum catchment areas, much of this is not relevant to the aquatic ecology of the Project. Aquatic surveys were conducted within the ROW and the surrounding areas that will potentially be affected by the Project construction and operation. The Study Area includes the Project footprint and surrounding aquatic environments such as Nam Ngum River and streams intersected by the alignment, as well as nearby ancillary facilities (e.g. borrow pits and quarries).

The methodology for aquatic biodiversity assessment includes:

- ▶ Review of literature and recent biological studies to assess aquatic threatened species and potential species of conservation significance existing within the broader area of the Project;
- ▶ Local knowledge surveys in 21 villages across three districts in March 2023 to identify locally important fish species and to understand the aquatic resource use of local communities. Village representatives were invited to describe aquatic biodiversity in the Project area and provide information on fisheries, aquatic resource use and importance of aquatic resources to their livelihoods.
- ▶ Groups of men and women were invited to identify all fish species that are known to be caught in their region and the surrounding area. All species identified were recorded and assessed by the survey team in terms of their native / endemic status, IUCN status and fish guild status.
- ▶ Market survey in 7 local markets located along the NR13SE in March 2023. The local market surveys provided greater understanding regarding seasonal fish and aquatic species collected from the Nam Ngum River, its tributaries, and surrounding wetlands. Information was also obtained regarding fish catch quantities (on the days of each survey) and the seasonal price variations for each of the species observed.



## 5.5.4 Methodology for Social Specialist Studies

### *Socio-economic survey*

The methodology for the socio-economic study of the Project area included the following key steps:

#### **Provincial and District Consultations**

Socio-economic information was collected during meetings with Provincial and District governments at the beginning of this assessment. Interviews were also conducted with GoL authorities to obtain both quantitative and qualitative information on the socio-economic conditions within and around the Project area.

#### **Literature Review**

A comprehensive literature review of secondary information and statistics relating to the socio-economic and livelihood context of Vientiane Capital and Districts surrounding the Project was conducted for this assessment. This included government data (e.g. District, Provincial and National socio-economic data), key Project documents and relevant country reports (e.g. by the World Bank, World Food Program etc.).

#### **Village Surveys and Consultation**

Village level socio-economic surveys and interviews were undertaken in Project villages in January to February 2023 as part of the socio-economic, detailed measurement surveys conducted for the ESIA. These surveys have been undertaken in stages and included:

- ▶ Village authority surveys were conducted in 21 Project villages. Detailed interviews were held with representatives of village authorities to obtain insight into livelihood activities, village history, food security, land use, Project communication;
- ▶ Focus group discussions were conducted within community members of 21 project villages. The focus group discussion aimed at collecting further information on general community development, employment, natural resource use, perception of Project and other Project related topics. To ensure gender aspects were considered for the Project, Focus Groups were undertaken with men and women separately, as well as combined where there were not enough number of people;
- ▶ Land and asset surveys were conducted in 21 Project villages with residents who own or have use of land within the COI. The objective of the survey was to obtain detailed information of the land and assets that would potentially be affected by the Project. Land / asset owners were interviewed on land ownership, land use the number and type of assets on the potentially affected land.

### *Traffic Count Surveys*

The traffic counts at 08 survey stations (refer to Volume B: Appendix 2: Figure 1-21) has conducted traffic count manually for 12 hours, morning 6:00 - 12:00 and afternoon 12:00 - 18:00. Lao Transport Engineering Consultant (LTEC) carried out surveying all possible movements vehicles, all

vehicles direction and type of vehicles, this survey started from 5th March 2019 – 17th March 2019, total 03 supervisor and 38 surveyors. The surveyors used field forms, activity photo, selected intersections and survey data as shown in Appendix 6 of the Traffic Survey Report (2019). The locations and descriptions of traffic surveys are outlined in Table 5-5.

**Table 5-5: Locations of Traffic Survey**

No.	Chainage	Location	Survey Time	Duration
1	Km 21+300	Intersection	6:00AM – 6:00 PM	7 Day
2	Km 35+630	Ban Borlek T-Intersection	6:00AM – 6:00 PM	1 Day
3	Km 42+000	Straight Line	6:00AM – 6:00 PM	7 Day
4	Km 47+900	Ban Naxone T-Intersection	6:00AM – 6:00 PM	1 Day
5	Km 50+130	Ban Nongphouvieng T-Intersection	6:00AM – 6:00 PM	1 Day
6	Km 63+100	Bridge Sithong Straight Line	6:00AM – 6:00 PM	1 Day
7	Km 65+500	Ban Keun T-Intersection	6:00AM – 6:00 PM	1 Day
8	Km 71+000	Straight Line	6:00AM – 6:00 PM	7 Day

The types of vehicles were collected are as follows:

- ▶ Bicycles
- ▶ Hand Tractor
- ▶ Ox Cart (not available on this road)
- ▶ Motorbike
- ▶ Tuk Tuk (3-Wheeler)
- ▶ Saloon Car (Passenger Car)
- ▶ Pickup, Truck
- ▶ Minibuses ≤ 20 Seats
- ▶ Medium Truck 2 Axles
- ▶ Medium Bus < 30 Seats
- ▶ Heavy Truck 3 Axles
- ▶ Heavy Bus ≥ 30 Seats
- ▶ Semi-Trailer, Trailer ≥ 4 Axles.

## 5.6 Collection of Secondary Data

LTEC team collected and reviewed applicable secondary information from the following sources:

- ▶ Existing documents related to the NR13SE Project, including the updated Conceptual Design (LTEC, 2023) and its Appendices, existing ESIA Report (TNM, 2019);
- ▶ Secondary data provided by Provincial and District Government agencies, including on the natural resources and environmental sector, agriculture and forestry sector, education and sport sector, energy sector, and their local line agencies;
- ▶ Environmental and social studies conducted for other projects in the region;
- ▶ Published scientific papers and reports; and
- ▶ International biodiversity databases (e.g. IUCN).

## 5.7 Physical Baseline Settings

### 5.7.1 Topography, Geology and Soils

The Project lies within the Mekong catchment of the Central Lowland of Lao PDR, one of the three main physiographic units in the country and is characterized by floodplains with a large area of suitable land for permanent agriculture and for paddy rice cultivation. The landscape is generally largely flat / gently sloping areas with topography ranges between 163 m and 182 meters above sea level (refer to Conceptual Design, 2019).

The Mekong Corridor is dissected by several large rivers (i.e. Nam Ngum River), and many perennial streams, with associated river / stream valleys. Seasonal inundation is common throughout the lowland during the peak of the rainy season. Overbank flooding and soils with poor drainage (in some areas) contribute to significant areas of seasonal wetland conditions.

A comprehensive information on topography survey is provided in Part II – Topographic Survey Drainage Survey Data Report of the Conceptual Design.

### 5.7.2 Geology and Soils

#### *Geology*

Four dominant geological structures cover the majority of Lao PDR (Phommakaysone, 2012):

- ▶ The Sukhothai fold belt composed of Middle to Upper Paleozoic system and granitic rocks from the Late Paleozoic era;
- ▶ The Loei fold belt composed of Middle to Upper Paleozoic system, Lower Mesozoic system and granitic rocks of the Late Paleozoic era;
- ▶ The Truongson fold belt composed of Middle to Upper Paleozoic system and granitic rocks of the Late Paleozoic era; and
- ▶ The Khorat Plateau composed mainly of Mesozoic group to Paleogene system.

The Project Area is located on the Khorat Plateau which covers approximately 200,000km<sup>2</sup> over areas of north-east Thailand, central and south-east Lao PDR, and parts of Cambodia (Harnpattanapanich and Luddakul, 2011). The Khorat Plateau has an average elevation of 150-300 metres above sea level (masl) and is defined by the large area of Mesozoic continental sedimentary

rocks of the Khorat Group (Smith and Stokes, 1997). The Mesozoic and Cenozoic (most recent geological eras) stratigraphy of the Khorat is shown in Figure 5-1).

The Plateau is bound to the west and northwest by the Loei-Petchabun fold belt and in the east by the Annamite Mountains. The Khorat Plateau is divided by a mountain range called the Phu Phan mountains which divides the Plateau into the Sakhon Nakhon Basin in the north and the Man Basin to the south (EarthSnap, 2013). The southern limits of the Khorat Plateau is the Dangrek Escarpment (Carling, 2009). The Khorat Plateau Basin is not known to be seismically active and much of the basin is made up of stable continental block (MRC, 2010). There is no evidence of an active tectonic fault on the plateau (Harnpattanapanich and Luddakul, 2011).

ERA	SYSTEM PERIOD	SERIES EPOCHS	LITHOLOGY	FORMATION	GROUP	DEPOSITIONAL ENVIRONMENTS	TECTONIC EPISODES	
CENOZOIC	Quaternary		Gravel	Unnamed		Alluvial		
	Tertiary		Siltstone Mudstone	Phu Tok		Fluviatile	Inia collides with Asia-Folding of Khorat Plateau	
MESOZOIC	Cretaceous		Rock salt Mudstone	Maha Sarakham (Tagon)		Evaporitic		Interior Sag
			Sandstone Shale	Khok Kruat	K H O R A T	Fluviatile		
			Sandstone	Phu Phan		Fluviatile		
	Jurassic	Upper	Sandstone	Sao Khua		Fluviatile		
		Middle	Sandstone	Phra Wihan		Fluviatile		
		Lower	Sandstone	Phu Khradung		Fluviatile		
	Triassic	Upper	Rhaetian	Shale Sandstone		Nam Phong	Fluviatile	
			Norian-Camian	Shale Sandstone		Huai Hin Lat	Fluviatile	
Middle-Lower			L. S conglomerate	Triassic Fill		Fluvio-Lacustrine	Khorat Unconformity Indosinian Orogeny	

Figure 5-1: Mesozoic and Cenozoic stratigraphy of the Khorat Plateau (Ongkeo et al., 2015)

The Khorat Plateau is covered by several geologic units characterised by various lithologic properties and depths shown in (Appendix C: Figure 1-6).

The Project Area is situated in the QII-III unit which is formed of clay; surficial laterite; and sediments, gravel, sand, kaolin and black peat (Ministry of Energy and Mines, 2012). In areas adjacent the Project there are instances of the N2-Q1vc unit, which comprises the Vientiane formation made up of gravel, sand, clay and kaolin (Ministry of Energy and Mines, 2012). High elevation areas forming the boarder around the Vientiane Plains in the north, north-east, and north-west contains the K2cp geological unit comprising the Chamopa formation made of quartzite-sandstone and siltstone interbedded with sandstone (Ministry of Energy and Mines, 2012). The upper layer of this unit is white arkose-sandstone (Ministry of Energy and Mines, 2012). South-east of the Project Area where the Nam Ngum flows eastwards towards the confluence with the Mekong River, the geological unit is dominated by K2tn unit which comprises the Tha Ngon formation and is made up of fine-grained Na-salts bearing anhydrite and interbedded with gypsum

foliation (Ministry of Energy and Mines, 2012). The potassium-magnesium salt layer is overlain with claystone and limestone, as well as a layer of rhyolite, volcanic tuff and grey claystone (Ministry of Energy and Mines, 2012).

### **Soils**

The soil character and classification differ in accordance with the underlying baseline geology and geomorphology of the Mekong and Nam Ngum Basins. Soil characteristics have corresponding variability in key factors such as stability / erodibility and soil texture. Soils in the Project area have been classified using the FAO (2001) method for soil classification. The key soil formations evident in the Project Area are:

- ▶ Acrisols – the dominant soil type of undulating hills in the Project Area (and much of the upper Nam Ngum catchment);
- ▶ Cambisols – the depositional material along the Nam Lik and Nam Ngum river floodplains; and
- ▶ Fluvisols – the coarser grained sands, gravel, and cobble beneath the rivers and along river banks.

### **Acrisols**

The Acrisols are strongly weathered acid soils with low base saturation. They are most extensive on acid rock weathering, particularly in strongly weathered clays which are in the process of degradation (FAO, 2001). Acrisols mostly occur in old land surfaces with undulating topography and in regions with a monsoonal climate such as that which occurs in the Vientiane Plains.

Acrisols are extensive in Southeast Asia and are typically the dominant soil group on old erosional or depositional surfaces (FAO, 2001). Acrisols are also found on ancient shield landscapes in humid tropics in flatter areas that receive weathered material from basin uplands (FAO, 2001). Slaking / crusting and high susceptibility to erosion impose restrictions on land uses of Acrisols (FAO, 2001). The profile of Acrisols is AEBt-C (FAO, 2001).

Generalised mineralogical, hydrological, physical and chemical characteristics suggest that Acrisols:

- ▶ Have little weatherable minerals left and have less Fe, Al and Ti oxides compared to Ferralsols. The  $\text{SiO}_2/\text{Al}_2\text{O}_3$  ratio is  $<2$  and the clay fraction consists mostly of well-crystallized kaolinite and gibbsite;
- ▶ Have porous surface soils under a protective forest cover. The A-horizon can degrade and slake to form a hard surface crust if the forest is cleared, which can result in insufficient penetration of water during precipitation events and low structural stability (e.g. surface erosion);
- ▶ Have weak microstructure and massive macrostructure especially in the surface and shallow subsurface soil depleted of sesquioxides; and

- ▶ Are characterised by poor chemical properties, low levels of plant nutrients, aluminium toxicity and P-sorption are limitations. Biological activity is low and natural regeneration is slow.

### ***Cambisols***

The Cambisols are derived from parent materials of medium and fine-texture materials derived from a range of rocks which are mostly colluvial, alluvial or aeolian deposits. Cambisols are characterised by slight or moderate weathering of parent material and typically have an absence of illuviated clay, organic matter, aluminium and / or iron compounds (FAO, 2001).

When present in the humid tropics (e.g. Lao PDR), Cambisols tend to occur at medium altitudes in hilly regions, but also occur in eroding landscapes alongside genetically mature residual soils such as Acrisols and Ferralsols (FAO, 2001).

Typically the Cambisols have an ABC soil horizon sequence with ochric, mollic, or umbric A-horizon overlaying a cambic B-horizon of yellowish-brown or red (FAO, 2001). Soil texture of Cambisols is loamy to clayey (FAO, 2001).

### ***Fluvisols***

The Fluvisols are developed in alluvial depositions of the Nam Ngum River and are predominately derived from recent, fluvial environments (FAO, 2001). Fluvisols typically occur in periodically flooded areas (e.g. the Vientiane Plains) of alluvial plains, river fans, valleys and marches in a variety of climate zones (FAO, 2001). The profile of Fluvisols are AC-profiles with evidence of stratification and weak horizon differential (FAO, 2001).

- ▶ Are saturated in all or part of the profile due to the stagnating of groundwater and / or the inundation from river flooding;
- ▶ Are porous and well drained on river levees and coastal sand ridges compared to soils on low landscape positions; and
- ▶ Have neutral or near-neutral pH values.

## **5.7.3 Climate Conditions**

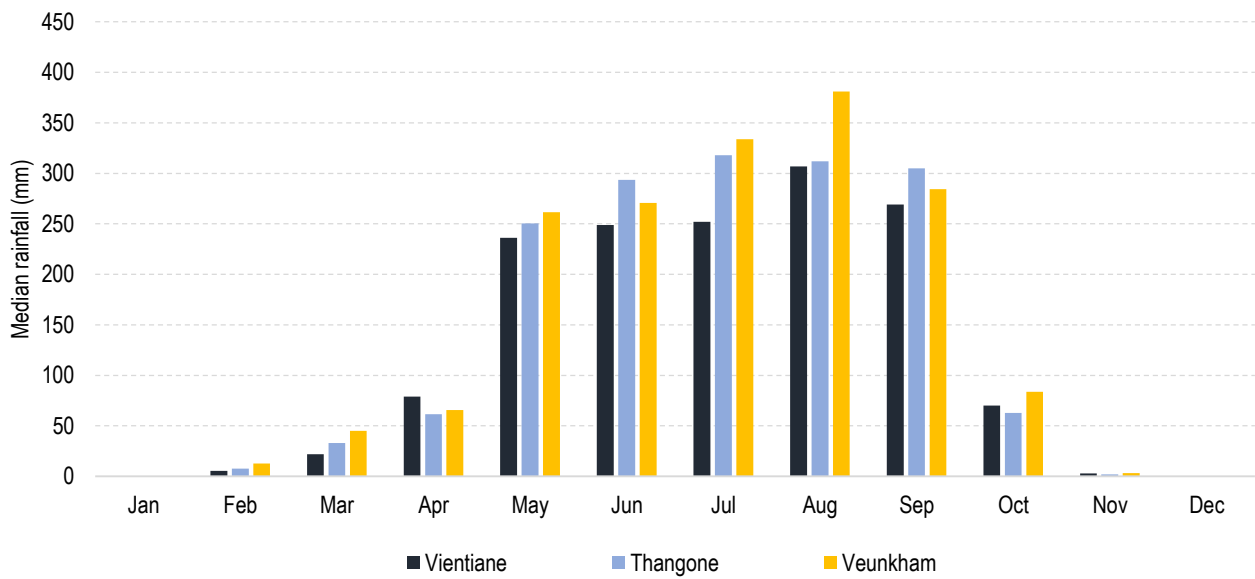
Climate and rainfall in Lao PDR are strongly influenced by large scale atmospheric circulations, including the El Niño - Southern Oscillation and the Interdecadal Pacific Oscillation (IPO). The climate in the Project Area is sub-tropical to tropical with extremes of wet and dry seasons associated with the passage of the East Asian and Indian Monsoons. The dry season (November to April) has prevailing winds from the North-East Monsoon, associated with cool and dry air, with January and February being the driest months. The wet season (May to October) has prevailing winds from the South-West Monsoon from the Indian Ocean. On average 80% of the annual regional rainfall occurs during the wet season, with July – August typically the wettest period.

### ***Precipitation***

Long-term daily rainfall within and proximal to the Project Area is recorded at Vientiane, Veunkham, and Thangone rainfall monitoring stations. The majority of rainfall records are available

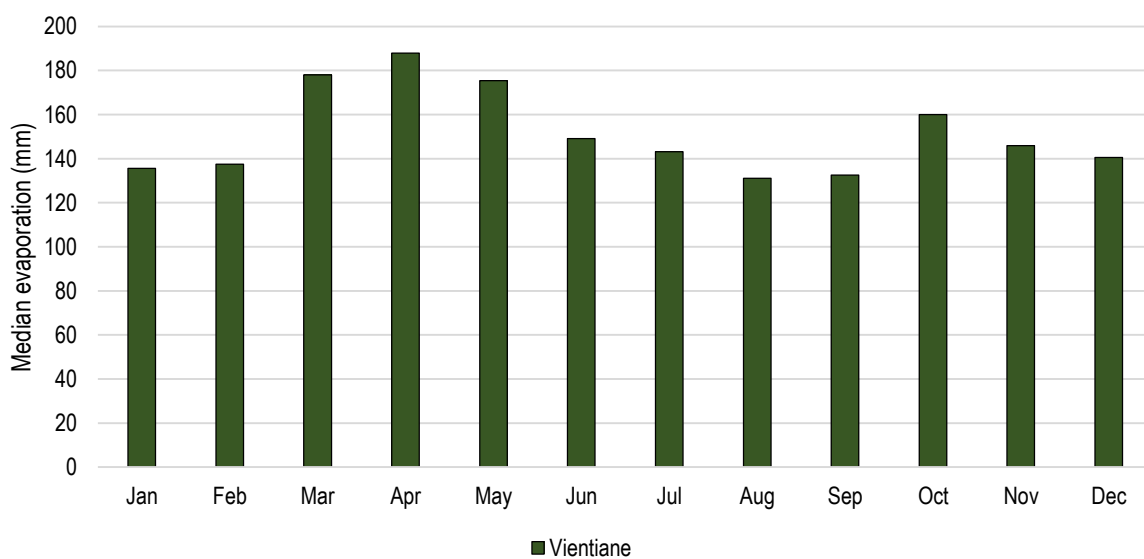
from 1999 to 2019. Rainfall in the Project Area averages approximately 2,000 mm / year. Average rainfall in the Vientiane Plain is approximately 1,780 mm / year (Perttu et al., 2011).

Rainfall varies seasonally with an average wet season rainfall of 303 mm / month compared and a dry season rainfall of 28 mm / month. July and August are the wettest months in the Project Area and rainfall in excess of 400 mm is received at Vientiane rainfall stations during this period. January and December are the driest months with no rainfall frequently received during this period (refer to Figure 5-2). On average, 66% of precipitation is received within the peak rainy months of July, August and September, which individually account for 25%, 21% and 20% of annual rainfall, respectively.



**Figure 5-2: Median monthly rainfall in Vientiane**

Data Source: Lao Department of Meteorology and Hydrology (2020)



**Figure 5-3: Median monthly evaporation at Vientiane climate station**

Data Source: Lao Department of Meteorology and Hydrology (2020)

## Wind

Baseline conditions for wind, rain, evaporation, and relative humidity are provided, as each affect air quality directly (wind) or indirectly (rain, evaporation and relative humidity).

The general wind directions in the Project area are determined by the Asian Monsoons, with generally easterly winds in the dry season and south-easterly and south-westerly winds in the wet season. The mean winds indicate the direction in which dust particulates or pollutants may be dispersed. Available data from Vientiane and regional meteorological stations suggest that wind direction is fairly consistent across the Project area, with exception of Paksan which shows a local bias for Northerly winds (refer to Table 5-6).

**Table 5-6: Typical seasonal wind direction in the Project area**

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vientiane	SE	SE	SE	S	SW	SW	S	S	SSW	S	S	SSE
Paksan	N	N	N	N	N	S	S	S	NE	N	N	N

## Temperature

Average annual temperature in the Vientiane Plains is 27oC with a standard deviation of 2.04 oC. Temperature in the Project Area is highest in April to June, which spans the hot /dry season and the first month of the wet season (refer to Figure 5-4). Temperature is lowest in December to February during the cool / dry north-east monsoon season. Mean monthly temperature is roughly correlated with mean monthly rainfall (correl = 0.59). Figure 5-4 shows the mean monthly temperature in the Vientiane Plains and the national. Temperature in the Plains region exceeds the national average at all points in the year, with the exception of December and the difference is particularly pronounced during the cool / dry season.

Maximum temperatures throughout the Project Area are relatively constant throughout the year and range between 28 and 35 degrees Celsius with a decrease in minimum temperature during dry season (refer to Figure 5-4). Humidity follows a comparable seasonal pattern with a decline in minimum humidity during the dry season and a relatively constant maximum humidity throughout the year.



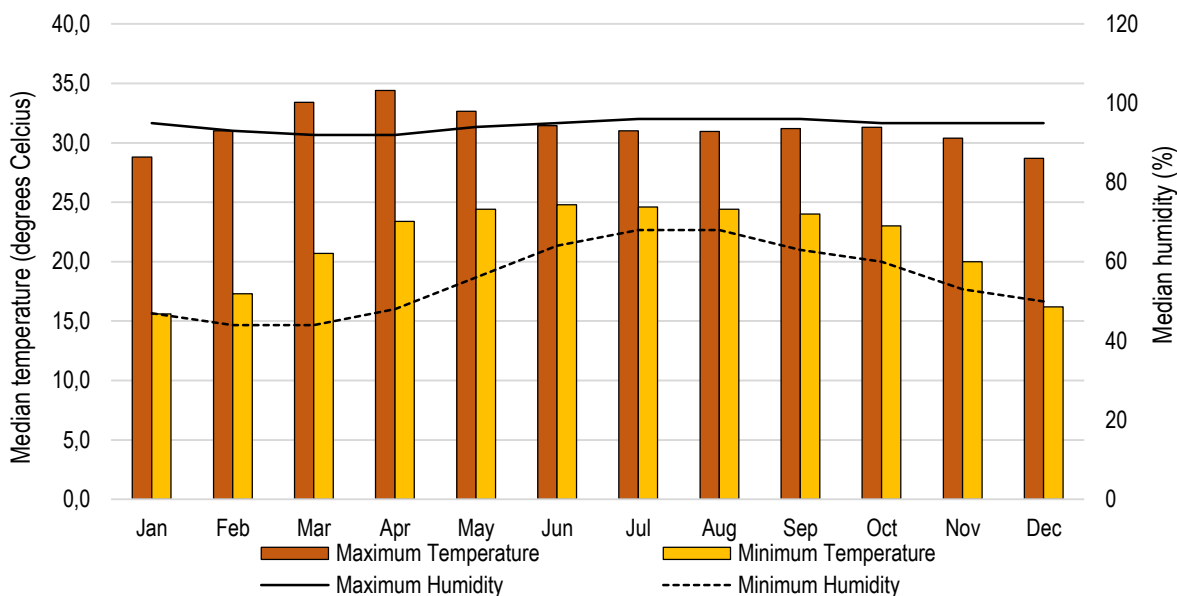


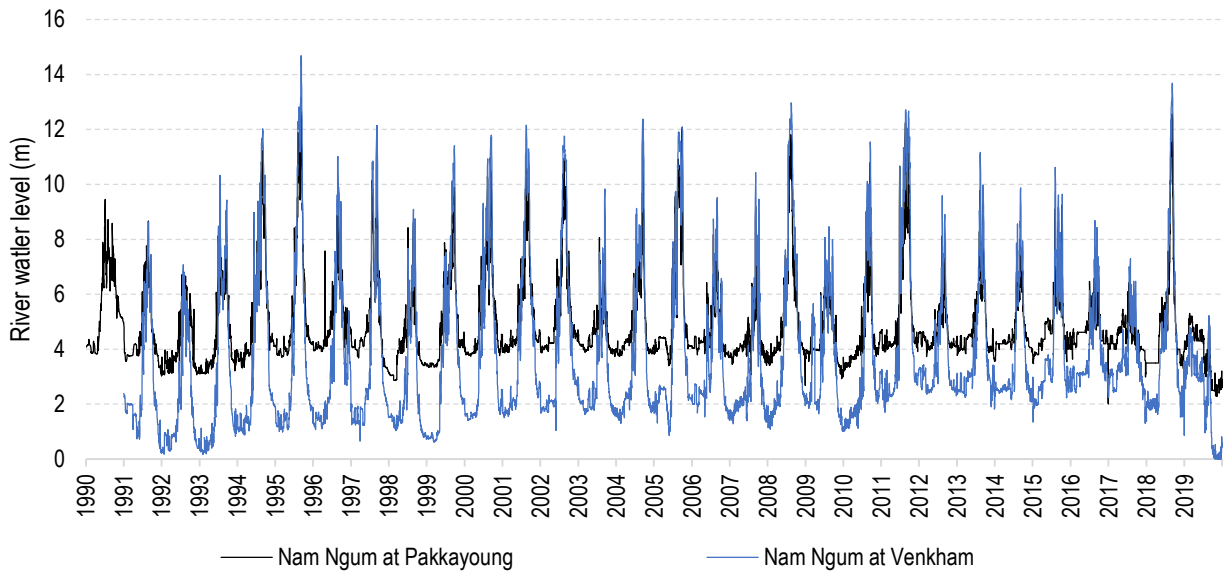
Figure 5-4: Median monthly temperature and humidity across the Project Area

Data Source: Lao Department of Meteorology and Hydrology (2020)

#### 5.7.4 Hydrology

The hydrology of the Nam Ngum River is effectively regulated by the current major hydropower projects in operation including the Nam Ngum 1 and Nan Ngum 2 hydropower projects (approximately 60 km and 70 km respectively upstream via air distance from the NR13SE). Hydrology in the lower Nam Ngum River Basin is influenced by the annual monsoon cycle and is characterised by high flows in the wet season and relatively low flows in the dry season (MRC, 2010). High flows typically occur towards the end of the wet season following high daily rainfalls, and low discharges occur at the end of the dry season.

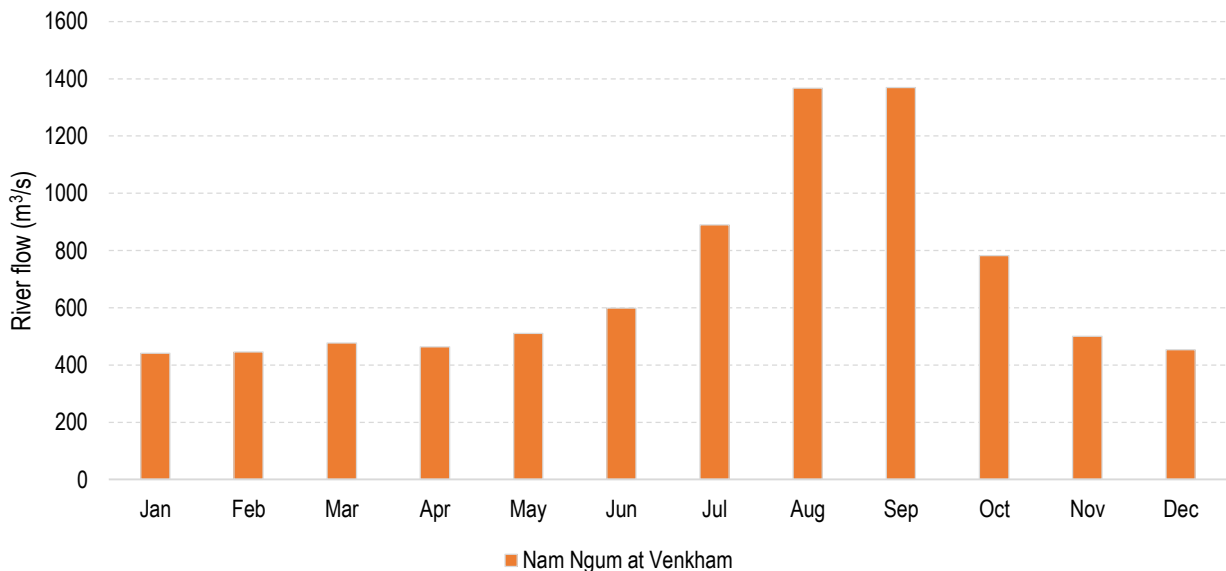
Daily stream stage (river level) is recorded for the Nam Ngum at Pakkayoung and Veunkham river stations. Records are available from 1990 to 2019. Figure 5-5 shows daily river levels in the Nam Ngum at Pakkayoung and Veunkham gauging station. River levels at Pakkayoung (the most downstream river gauge in the basin) range between two and 13 meters with strong seasonal variation. Peak water levels occurred during widespread flood events in 1995 and 2011 which affected northern and central provinces of Lao PDR (FAO, 1998; OCHA, 2011). Low river levels evident in 2019 and are associated with sustained low rainfall with a delayed arrival and earlier departure of the monsoon rain leading to sustained drought conditions during this period (MRC, 2019).



**Figure 5-5: Daily Nam Ngum River levels at Pakkayoung and Veunkham river gauging station**

Data Source: Lao Department of Meteorology and Hydrology (2020)

Figure 5-6 shows seasonal flows in the Nam Ngum River at Veunkham gauging station, approximately 15km upstream via air distance from the NR13SE closest point. River flows in the Nam Ngum River at Veunkham river gauging station range between 500 m<sup>3</sup>/s during the dry season to nearly 1,400 m<sup>3</sup>/s during the peak wet season in July and August. The flow conditions in Figure 5-6 represent current development conditions including flow regulation downstream of the Nam Ngum 1 hydropower reservoir.



**Figure 5-6: Median monthly flow in the Nam Ngum River at Veunkham river gauging station**

### 5.7.5 Ambient Surface Water Quality

The sampling locations for ambient surface water quality monitoring are shown in Appendix 2: Figure 1-17 to Figure 1-20. Monitoring site SW01 is located in Nam Ngum River, upstream and

adjacent to Sithong bridge. Monitoring sites SW02 and SW03 are located in Houay Ver in Ban Naxay and Houay Phai in Ban Xaysavang in adjacent to the NR13SE alignment.

The water quality parameters sampled for each location are provided in

Table 5-7 and descriptions of results are provided below. Ambient surface water quality samples were analysed by Phanthamit Analytical Lab Co., Ltd in Vientiane in February 2023. The analytical procedures used Phanthamit have been developed from established internationally recognised procedures.

It was noted that COD and DO concentrations in all monitoring locations exceeded the national standard values which were likely due to low flow observed during dry season particularly at SW02 and SW03 identified in rice paddy/grazing area. Low baseflows combined with growing algae in SW02 and SW03 could affect the DO and COD levels. A number of surface water quality parameters were not detected due to the detection limits.

#### ***SW01 at Ban Hai***

The ambient surface water quality of Nam Ngum was conducted upstream of the bridge in Ban Hai. The Concentration of Ammonia Nitrogen was not detected, BOD was less than 1.45 mg/L, COD was 13.7 mg/L higher than standard value, Color was 13.6 Pt.Co, DO was 9.80 mg/L, Hexavalent Chromium was not detected, Iron was 0.26 mg/L, Nitrate was 1.24 mg/L, Oil and Grease was not detected. pH was 6.6, water temperature was 27.40 OC. Manganese was 0.04 mg/L. Arsenic, Calcium, Copper, Cyanide, Lead, Mercury, Nickel and Zinc was not detected. Coliform Bacteria and Fecal Coliform Bacteria was 33 MPN/100mL and less than 1.8 MPN/100mL respectively. Odor was odorless.

#### ***SW02 at Naxay Village***

Ambient surface water quality monitoring was conducted at perennial Houay Ver in Naxay village (Site: SW02). Some parameter was not detected such as Ammonia Nitrogen, Oil and Grease, Arsenic, Calcium, Copper, Cyanide, Mercury, Nickel and Zinc. For the parameter of BOD was 7.25 mg/L, COD was 28.6 mg/L higher than standard value, Color was 36.2 Pt.Co, DO was 9.40 mg/L, Hexavalent Chromium was less than 0.05 mg/L, Iron was 2.27 mg/L, Nitrate was 0.37 mg/L, pH was 6.5, water temperature was 29.0 OC, Lead was 0.010 mg/L, Manganese was 0.13 mg/L, Coliform Bacteria and Fecal Coliform Bacteria was 11 MPN/100mL and less than 1.8 MPN/100mL respectively. Odor was odorless.

#### ***SW03 at Xaysavang Village***

Ambient surface water quality monitoring was conducted in Houay Phai, a perennial stream in Xaysavang village (SW03) survey point. Water quality of BOD was 4.20 mg/L, COD was 28.6 mg/L higher than standard value, Color was 35.9 Pt.Co, DO was 8.90 mg/L, Iron was 2.26 mg/L, Nitrate was 0.28 mg/L, pH was 6.3, water temperature was 26.0 OC, Lead was less than 0.010 mg/L, Manganese was 0.21 mg/L, Zinc was 0.03 mg/L, Coliform Bacteria and Fecal Coliform Bacteria was 79 MPN/100mL and less than 2.0 MPN/100mL respectively. Odor was odorless. Parameter of Ammonia Nitrogen, Hexavalent Chromium, Oil and Grease, Arsenic, Calcium, Copper, Cyanide, Mercury and Nickel was not detected.

**Table 5-7: Summary of surface water quality monitoring results**

Item	Parameter	Unit	Standard <sup>/1</sup>	Result		
				SW01	SW02	SW03
				Hai Village	Naxay Village	Xaisavang Village
1	Ammonia Nitrogen	mg/L as NH <sub>3</sub> - N	0.5	ND	ND	ND
2	Biochemical Oxygen Demand (BOD)	mg/L	-	1.45	7.25	4.20
3	Chemical Oxygen Demand (COD)	mg/L	5-7	13.7	28.6	28.6
4	Color	Pt.Co	n'	13.6	36.2	35.9
5	Dissolved Oxygen	mg/L	6.00	9.80	9.40	8.90
6	Hexavalent Chromium	mg/L as Cr <sup>6+</sup>	0.05	ND	<0.050	ND
7	Iron	mg/L	-	0.26	2.27	2.26
8	Nitrate (NO <sub>3</sub> -)	mg/L as NO <sub>3</sub> <sup>-</sup> - N	5.0	1.24	0.37	0.28
9	Oil and Grease	mg/L	-	ND	ND	ND
10	pH		6.0-8.0	6.6	6.5	6.3
11	Temperature	oC	n'	27.40	29.0	26.0
12	Arsenic	mg/L	0.01	ND	ND	ND
13	Cadmium	mg/L	0.003	ND	ND	ND
14	Copper	mg/L	1.5	ND	ND	ND
15	Cyanide	mg/L as HCN	0.07	ND	ND	ND
16	Lead	mg/L	0.010	ND	0.010	<0.010
17	Manganese	mg/L	1	0.04	0.13	0.21
18	Mercury	mg/L	0.001	ND	ND	ND
19	Nickel	mg/L	0.1	ND	ND	ND
20	Zinc	mg/L	1	ND	ND	0.03
21	Coliform Bacteria	MPN/100mL	5000	33	11	79
22	Fecal Coliform Bacteria	MPN/100mL	1000	<1.8	<1.8	2.0
23	Odor		n'	Odorless	Odorless	Odorless

Remark: /1 Lao Environmental Standard, Ministry of Natural Resources Environment, No 81, Date 07/02/2017 Standard for Waste Water

ND = Not Detected

### 5.7.6 Ambient Air Quality

The Project area ranges from the moderate to high-populated communities residing in proximity to the ROW. The current alignment traverses densely populated areas in and around the Xaythany and Pak Ngum Districts. Several existing and proposed businesses facilities, industrial areas, markets and small to large independent businesses are also present along the alignment. Ambient air quality conditions therefore reflect both anthropogenic and natural sources in these areas. Naturally occurring particulates include dusts due to prevailing winds during dry season, smoke particles, pollen grains and fungal spores.

Smoke due to burning activities regionally can be a major source of particulates. Uncontrolled fires are generally associated with high temperatures, high winds, and low precipitation. Most of fires in the region are for clearing of land for agricultural purposes (e.g. shifting cultivation and weed control). Unofficial waste burning to manage uncollected waste also contributes to the deterioration of air quality in Lao PDR Dust from unpaved roads also contributes to the prevailing air quality.

#### *Sensitive Receptors*

The Study Area for the air quality assessment is comprised of 21 villages residing along the NR13SE as well as surrounding potential community receptors and ecologically sensitive areas. To assess

emission impacts in the air quality models, receptors were placed at 10 m intervals across 100 m either side of the mid-point of the alignment.

### **Baselines**

#### **AQ01 at Ban Khoksavang**

As shown in Table 5-8 and Figure 5-7, Figure 5-8 and Figure 5-9, average PM<sub>10</sub>, PM<sub>2.5</sub> and TSP concentrations were 0.131 mg/m<sup>3</sup>, 0.007 mg/m<sup>3</sup> and 0.273 mg/m<sup>3</sup> respectively. The survey result of PM<sub>10</sub> also higher than standard value same as survey point of Naxon Village (AQ02) and Hail Village (AQ03) at this point the dust concentration along the road was high as the result of road condition and automobile transportation.

The monitoring result of average nitrogen dioxide 1-hour was 0.0000-0.0002 ppm, which complied with the standard value of 0.11 ppm shown in A relative exceedance of the PM10 was observed at all three monitoring sites when compared to both national standards (2019) and WHO guidelines (2021). The poor air quality likely reflects the dry season and the primary sources of ambient air pollution include dust from unsealed road and ground surface. Smoke from agricultural and vegetation / waste burning which are typically practiced widely across the Project region can be a major sources of respirable particles PM10, exceeding national standards and international health criteria.

Table 5-9 and Figure 5-10. Monitoring results for average 1 hour carbon monoxide were 0.005-0.008 ppm and average 8 hours were 0.006 ppm. All the values complied with the standard of 30 ppm (average 1 hour standard) and 9 ppm (average 8 hours standard), as shown in A relative exceedance of the PM10 was observed at all three monitoring sites when compared to both national standards (2019) and WHO guidelines (2021). The poor air quality likely reflects the dry season and the primary sources of ambient air pollution include dust from unsealed road and ground surface. Smoke from agricultural and vegetation / waste burning which are typically practiced widely across the Project region can be a major sources of respirable particles PM10, exceeding national standards and international health criteria.

Table 5-9 and Figure 5-11.

#### **AQ02 at Ban Naxon**

The average particulate matters of PM<sub>10</sub>, PM<sub>2.5</sub> and TSP concentrations were 0.166 mg/m<sup>3</sup>, 0.002 mg/m<sup>3</sup> and 0.209 mg/m<sup>3</sup> respectively, as shown in Table 5-8 and illustrated in Figure 5-7, Figure 5-8 and Figure 5-9. PM<sub>10</sub> levels during the 24-hour period exceeded the Ambient Air Quality standard specified in Lao National Environmental Standards (2017), this might be the same result as at Hai village survey point due to the dusty road condition and the dust dispersion on the road when cars pass.

#### **AQ03 at Ban Hai**

Particulate matters of PM10, PM2.5 and TSP averages were 0.142 mg/m<sup>3</sup>, 0.010 mg/m<sup>3</sup> and 0.232 mg/m<sup>3</sup> respectively, as shown in Table 5-8 and illustrated in Figure 5-7, Figure 5-8 and Figure 5-9.

The survey result of PM<sub>10</sub> slightly higher than the standard value, the higher PM<sub>10</sub> due to existing road condition with dust and the dispersion of dust on the road when a car pass through.

The monitoring result of average 1-hour nitrogen dioxide was 0.0000-0.0002ppm, which complied with standard value of 0.11ppm, as shown in A relative exceedance of the PM10 was observed at all three monitoring sites when compared to both national standards (2019) and WHO guidelines (2021). The poor air quality likely reflects the dry season and the primary sources of ambient air pollution include dust from unsealed road and ground surface. Smoke from agricultural and vegetation / waste burning which are typically practiced widely across the Project region can be a major sources of respirable particles PM10, exceeding national standards and international health criteria.

Table 5-9 and Figure 5-10.

The monitoring result of average 1-hour carbon monoxide was 0.01-0.02ppm and average 8 hours was 0.009ppm. All the values complied with the standard of 30ppm (average 1 hour standard) and 9ppm (average 8 hours standard), as shown in A relative exceedance of the PM10 was observed at all three monitoring sites when compared to both national standards (2019) and WHO guidelines (2021). The poor air quality likely reflects the dry season and the primary sources of ambient air pollution include dust from unsealed road and ground surface. Smoke from agricultural and vegetation / waste burning which are typically practiced widely across the Project region can be a major sources of respirable particles PM10, exceeding national standards and international health criteria.

Table 5-9 and Figure 5-11.

**Table 5-8: Ambient air quality monitoring results (average 24 hours PM<sub>10</sub>, PM<sub>2.5</sub> and TSP)**

Monitoring Site		RESULTS		
		Average 24 Hours PM <sub>10</sub> (mg/m <sup>3</sup> )	Average 24 Hours PM <sub>2.5</sub> (mg/m <sup>3</sup> )	Average 24 Hours TSP (mg/m <sup>3</sup> )
AQ03	Hai Village	0.142	0.010	0.232
AQ02	Naxon Village	0.166	0.002	0.209
AQ01	Koksavang Village	0.131	0.007	0.273
<b>National Standard (2017)</b>		<b>≤ 0.12*</b>	<b>≤ 0.05*</b>	<b>≤ 0.33*</b>
<b>WHO Standard (2021)</b>		<b>0.045</b>	<b>0.015</b>	-

Note: \*AQ03: 06-08/02/2023, AQ02: 08-09/02/2023, AQ01: 09-10/02/2023

A relative exceedance of the PM10 was observed at all three monitoring sites when compared to both national standards (2019) and WHO guidelines (2021). The poor air quality likely reflects the dry season and the primary sources of ambient air pollution include dust from unsealed road and ground surface. Smoke from agricultural and vegetation / waste burning which are typically practiced widely across the Project region can be a major sources of respirable particles PM10, exceeding national standards and international health criteria.

**Table 5-9: Ambient air quality monitoring results (average 24hours NO<sub>2</sub>, CO)**

Monitoring Site	RESULTS
-----------------	---------

		Average 24 Nitrogen Dioxide (mg/m <sup>3</sup> )	Average Hours Carbon monoxide (ppm)
AQ03	Hai Village	0.0000	0.009
AQ02	Naxon Village	0.0001	0.007
AQ01	Koksavang Village	0.0001	0.006
<b>National Standard (2017)</b>		<b>0.21</b>	<b>9</b>
<b>WHO Standard (2021)</b>		<b>0.025</b>	<b>0.004</b>

**Note:** AQ01: 06-08/02/2023, AQ02: 08-09/02/2023, AQ03: 09-10/02/2023  
 Lao National Environmental Standard, Ministry of Natural Resources and Environment, No.81, Date 07/02/2017 (Average 24 Hours Standard).

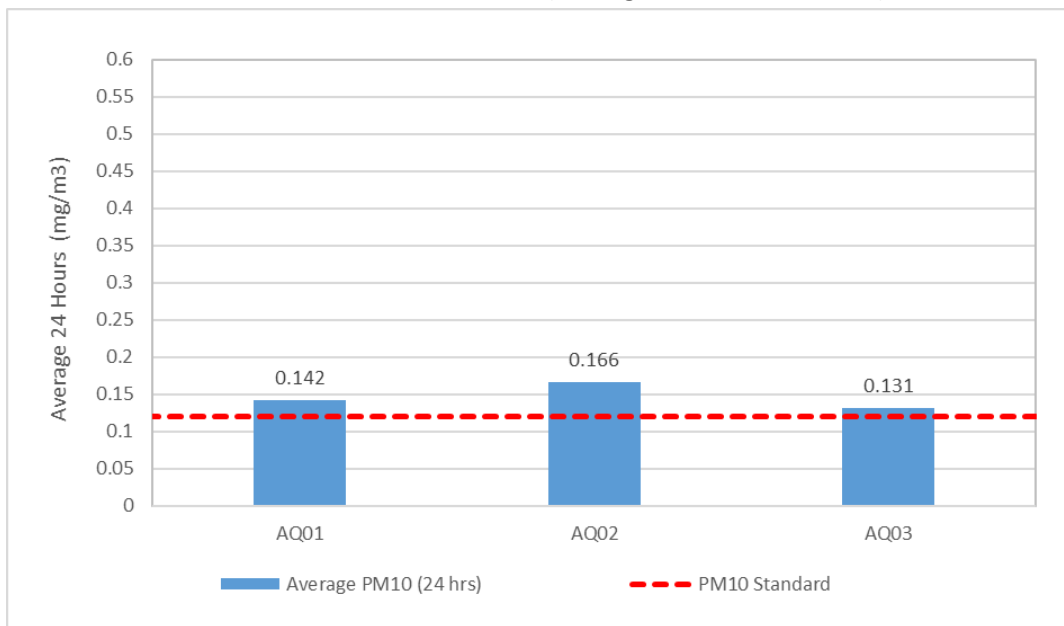


Figure 5-7: Air Quality Monitoring Results of Average 24 Hours PM<sub>10</sub>

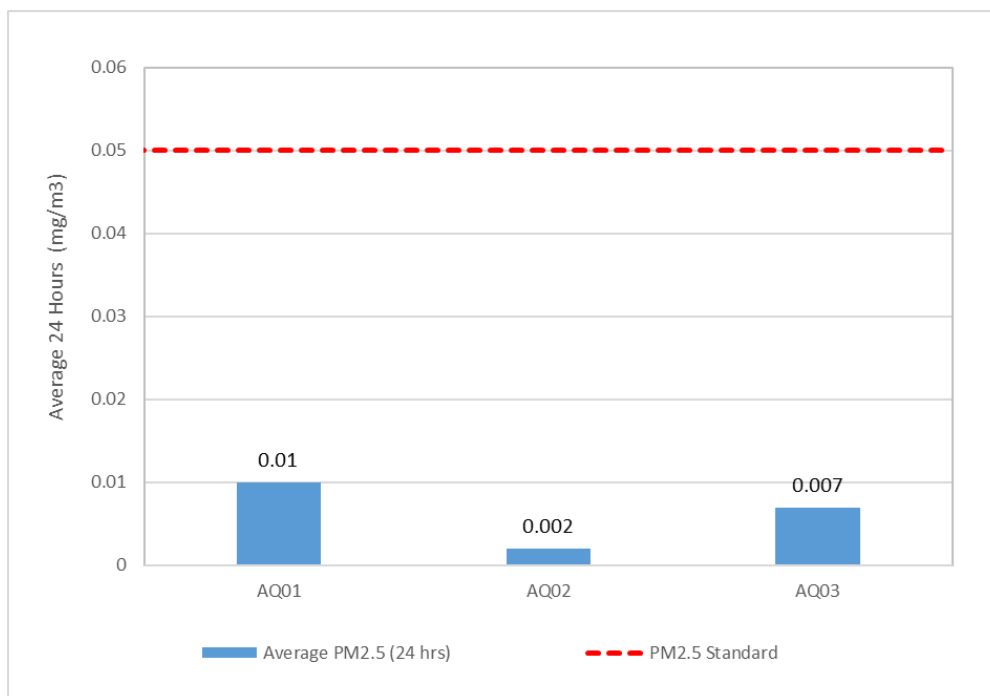


Figure 5-8: Air Quality Monitoring Results of Average 24 Hours PM<sub>2.5</sub>



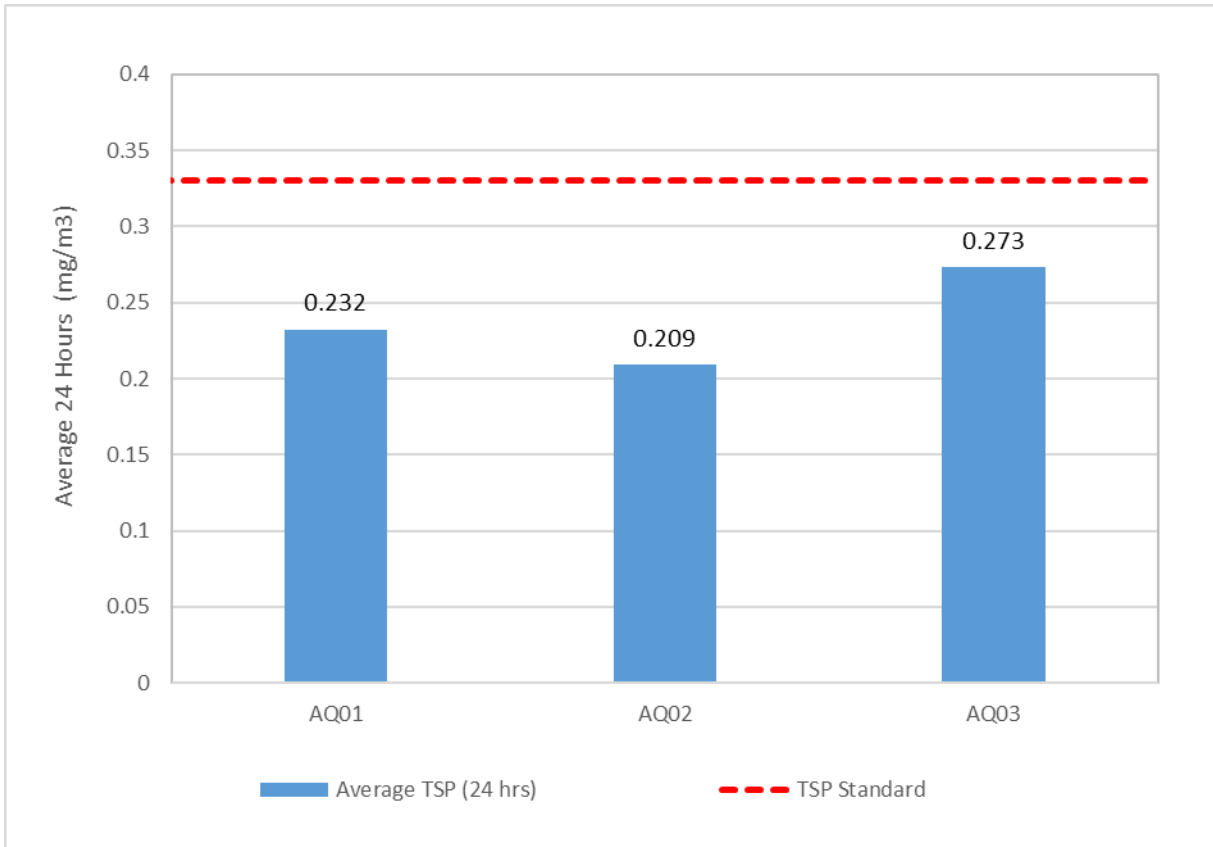


Figure 5-9: Air Quality Monitoring Results of Average 24 Hours TSP

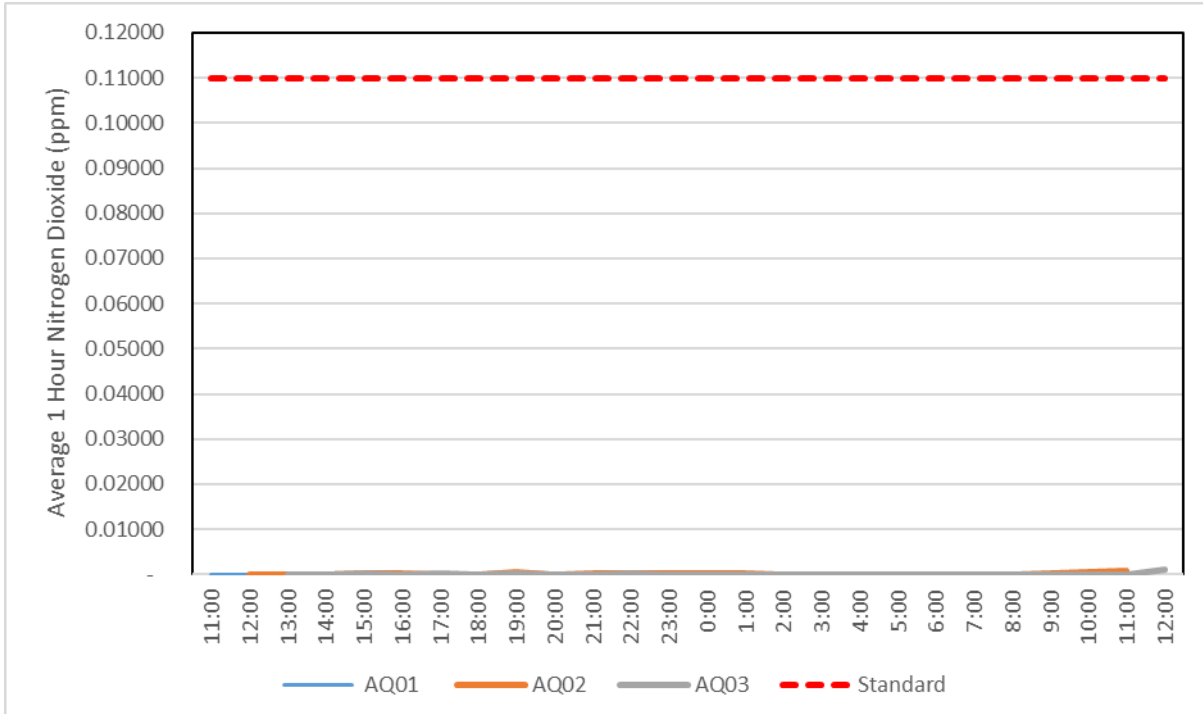


Figure 5-10: Air Quality Monitoring Results of Average 1 Hour Nitrogen Dioxide

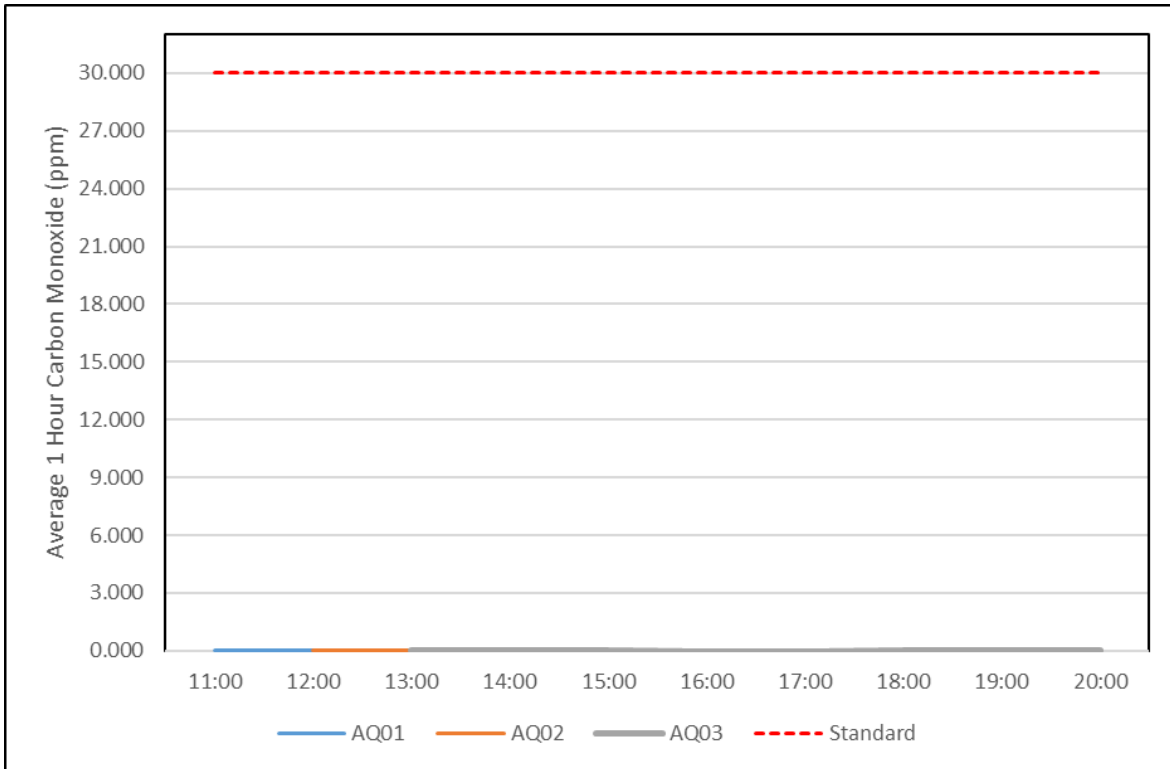


Figure 5-11: Air Quality Monitoring Results of Average 1 Hour Carbon Monoxide

### 5.7.7 Wind Speed and Wind Direction

The measurement of wind speed and wind direction was monitored at the same location of ambient air quality monitoring point. The wind speed measured at three locations; Hai village (AQ03) windspeed was 0.9-1.8 m/s, at Naxon Village (AQ02) was 0.4-1.8 m/s and at Koksavang Village (AQ01) was 0.9-2.8 m/s. The wind speed and wind direction diagram are shown in Figure 5-12, Figure 5-13 and Figure 5-14.

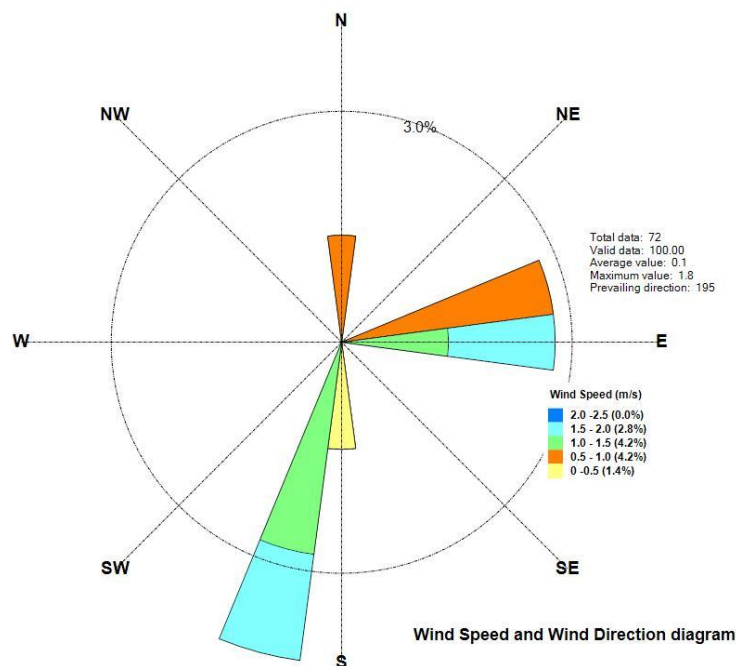


Figure 5-12: Wind Speed and Wind Direction Diagram

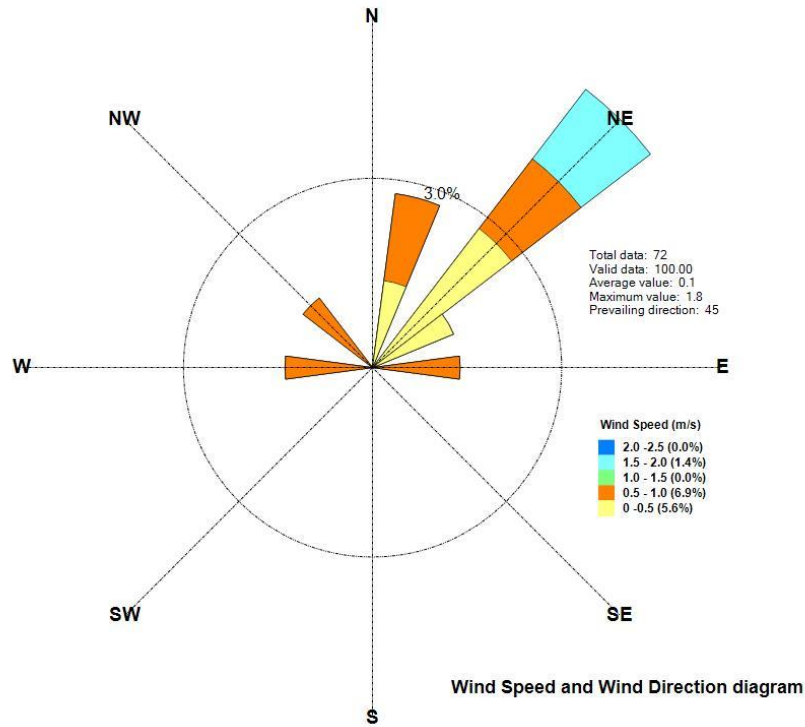


Figure 5-13: Wind Speed and Wind Direction Diagram

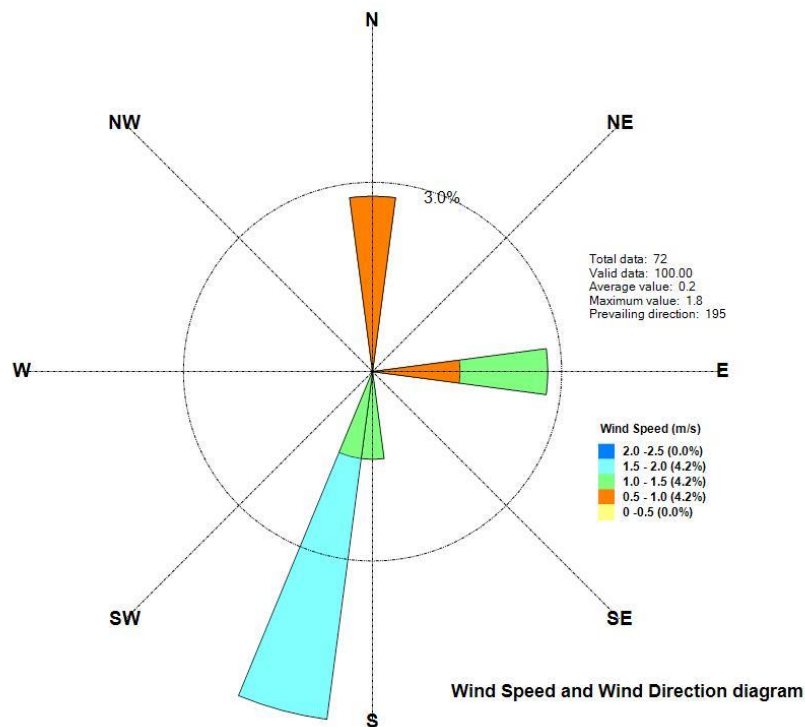


Figure 5-14: Wind Speed and Wind Direction Diagram

### 5.7.8 Ambient Noise

Ambient noise levels were recorded at five locations:

- ▶ AQ01: Khoksavang Village
- ▶ AQ02: Naxon Village

► AQ03: Hai Village

The noise level monitoring consisted of measuring  $L_{eq}$ ,  $L_{eq\ 24hours}$ ,  $L_{max}$ ,  $L^{min}$ ,  $L_{90}$ .

The noise level results were compared with noise standard limits specified in the Lao Environmental Standard, Ministry of Natural Resources and Environment, No 0832, 07/02/2017 for  $L_{eq\ 24hours}$  ( $\leq 70\text{ dB(A)}$ ) and  $L_{max}$  ( $\leq 115\text{ dB(A)}$ ).

**Ambient noise monitoring at AQ01 in Ban Khoksavang**

At Khoksavang Village monitoring point AQ01, the ambient noise levels from 10:00 am 09 February to 09:00 am 10 February 2023 are shown in Figure 5-15. The  $L_{eq\ 24hr}$  and  $L_{max}$  was 63.5 dB(A) and 83.0 dB(A) respectively. When comparing with standard, the  $L_{Aeq\ 24\text{ hours}}$  levels comply with standard value of 70 dB(A).  $L_{Amax}$  results comply with Lao National Noise Standard of 115 dB(A).

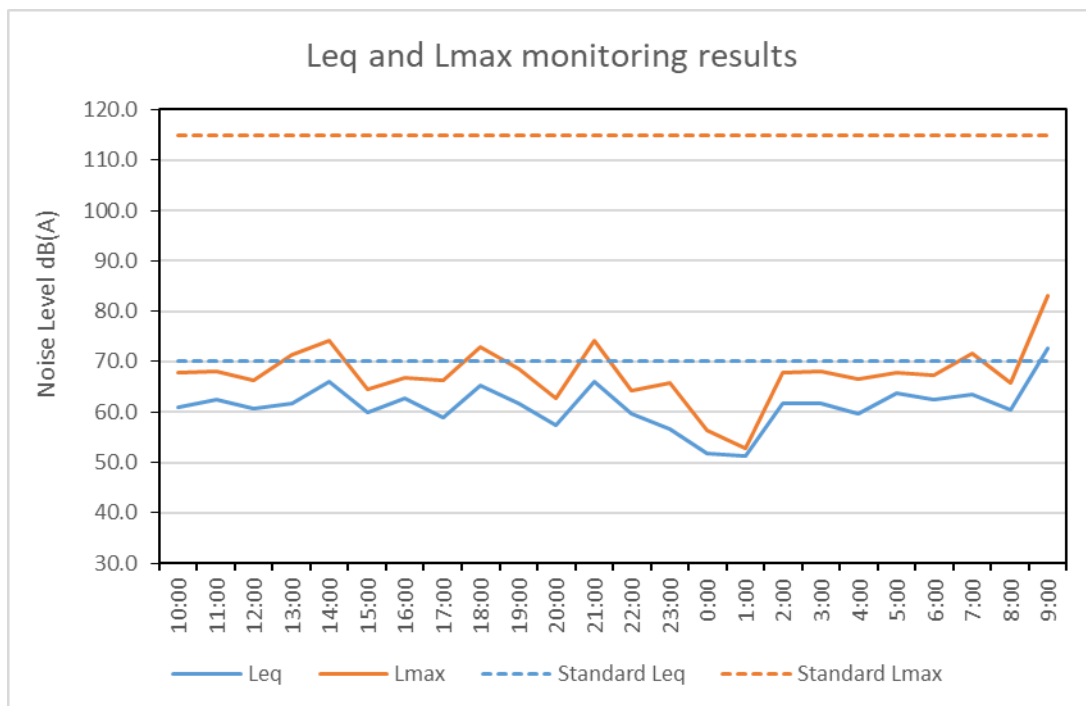


Figure 5-15: Results of Ambient Noise Level Monitoring at AQ01: Koksavang Village

**Ambient noise monitoring at AQ02 in Ban Naxon**

As shown in Figure 5-16, ambient noise levels at monitoring point AQ02 were measured between 10:00 am 08 February and 09:00 am 09 February 2023.  $L_{eq\ 24hr}$  and  $L_{max}$  was 66.0 dB(A) and 86.9 dB(A) respectively. When comparing with standard, the  $L_{Aeq,24\text{ hours}}$  levels comply with standard value of 70 dB(A).  $L_{Amax}$  results comply with Lao National Noise Standard of 115 dB(A).

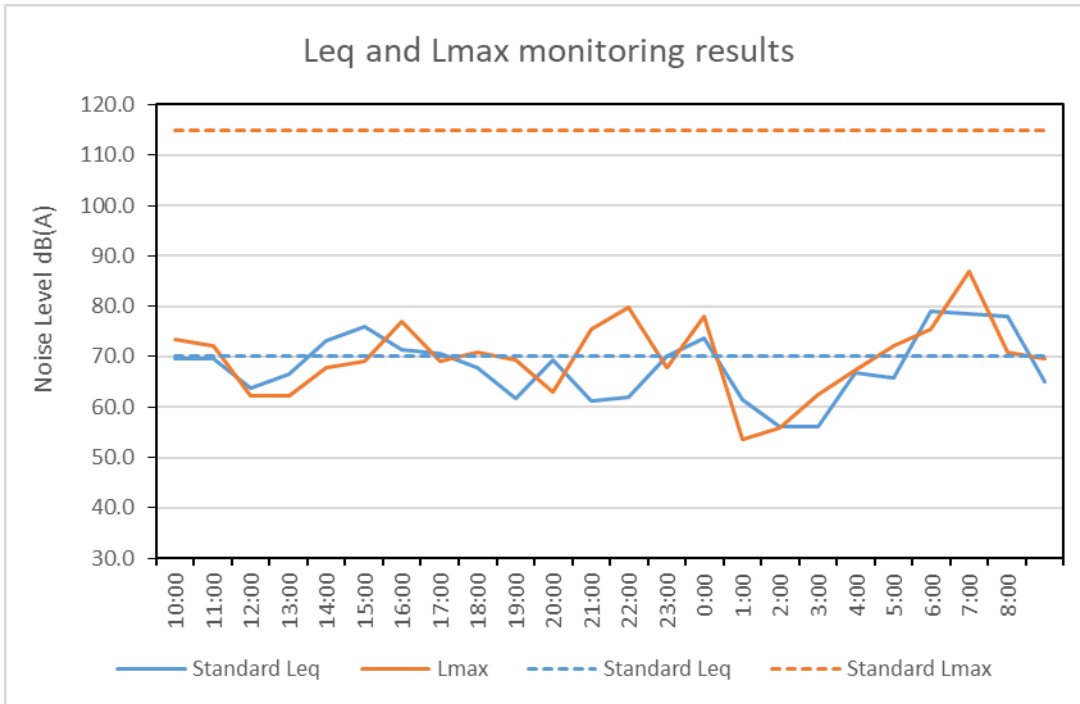


Figure 5-16: Results of Ambient Noise Level Monitoring at AQ02: Naxon Village

**Ambient noise monitoring at AQ03 in Ban Hai**

The results of ambient noise levels at monitoring point AQ01, from 11:20 am 06 February to 10:20 am 07 February 2023 are shown in Figure 5-17. Leq 24hr and Lmax was 55.6 dB(A) and 76.2 dB(A) respectively. When comparing with standard, the LAeq,24 hours levels comply with standard value of 70 dB(A). Lmax results comply with Lao National Noise Standard of 115 dB(A).

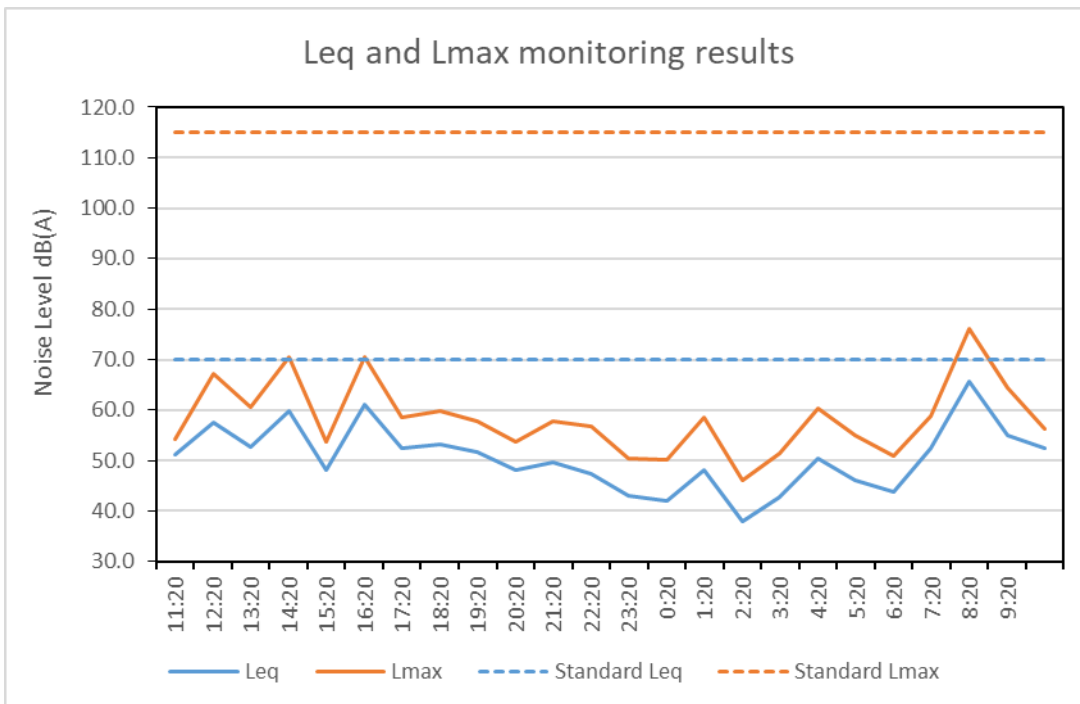


Figure 5-17: Results of Ambient Noise Level Monitoring at AQ03: Hai Village

Table 5-10: Baseline noise emissions at Project ambient monitoring sites, February 2023

Parameter	AQ01	AQ02	AQ03	Guideline Levels		
				WBG Noise Guideline (daytime) (dBA)	WBG Noise Guideline (Night-time) (dBA)	Lao PDR ambient noise standard (24 hr) (dBA)
Maximum dB(A)	76.2	86.9	83.0	55.0	45.0	70.0
Average dB(A)	39.0	51.7	51.9			
Leq (dBA)	55.6	66.0	63.5			

Currently, average noise levels exceed the WBG's guidelines and Lao PDR noise standards at two of the three monitoring locations. Peak noise levels (measured as Lamax) were above the WBG and Lao national guidelines at all three sites. Noise monitoring results indicate the primary noise source for sensitive receptors along the Project settlements is road traffic noise, with the highest noise levels recorded at the monitoring Site AQ02 due to a larger community and higher numbers of vehicles using the road.

Village activities, which were seen to include daily activities, livestock, conversation, music, etc are additional contributors to ambient noise at the nearest monitoring locations.

### 5.7.9 Vibration Measurement Results

The results of vibration levels at Ban Hai, Site: AQ03, from 11:00 on 06 February to 10:00 on 07 February 2023 are shown in Table 5-11. Peak particle velocity in Transverse (X-axis) was 0.410 mm/s, in longitudinal (Y-axis) was 0.883 mm/s and in vertical (Z-axis) was 1.608mm/s. Base on the standard values for vibration velocity to be used when evaluating the effects of short-term vibration on building structures, DIN 4150-3: 1990-02 (Less than 2 mm/s). The result of vibration level in Transverse higher than standard for the longitudinal and vertical was complied with standard value.

**Table 5-11: Vibration measured result at Hai Village AQ01**

Date :	Time :	Transverse		Vertical		Longitudinal	
		Velocity (mm/s)	Frequency (Hz)	Velocity (mm/s)	Frequency (Hz)	Velocity (mm/s)	Frequency (Hz)
06/02/2023	11:00	0.189	14	0.434	9.8	0.646	10
06/02/2023	12:00	0.221	13.7	0.497	8.5	0.481	8.3
06/02/2023	13:00	0.221	13.8	0.268	10.3	0.544	10.8
06/02/2023	14:00	0.236	10.9	0.339	10.8	0.607	10.6
06/02/2023	15:00	0.197	9.8	0.426	9.4	0.544	10.3
06/02/2023	16:00	0.166	9.9	0.473	9.7	0.749	10.2
06/02/2023	17:00	0.189	13.5	0.378	10.0	0.552	10.8
06/02/2023	18:00	0.166	9.1	0.323	9.6	0.599	9.9
06/02/2023	19:00	0.197	10.9	0.323	10.8	0.528	10.3
06/02/2023	20:00	0.260	8.8	0.552	6.2	0.331	6.8
06/02/2023	21:00	0.292	13.0	0.426	11.4	0.938	12.0
06/02/2023	22:00	0.205	15.8	0.410	7.1	0.536	9.3
06/02/2023	23:00	0.229	9.3	0.426	9.1	0.599	10.9
07/02/2023	0:00	0.276	10.6	0.323	10.6	0.615	10.1
07/02/2023	1:00	0.410	12.2	0.883	11.4	1.608	10.9
07/02/2023	2:00	0.268	10.3	0.355	9.7	0.504	10.4
07/02/2023	3:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
07/02/2023	4:00	0.378	9.8	0.426	9.5	0.654	9.7

Remark: standard values for vibration velocity to be used when evaluating the effects of short-term vibration on building structures, DIN 4150-3: 1990-02 (Less than 2 mm/s).

The results of vibration levels at Ban Naxon, Site: AQ02, measured from 09:00 on 08 February to 08:00 on 09 February 2023 are shown in

Table 5-12. Peak particle velocity in Transverse (X-axis) was 0.323 mm/s, in longitudinal (Y-axis) was 0.520 mm/s and in vertical (Z-axis) was 0.701 mm/s. Base on the standard values for vibration velocity to be used when evaluating the effects of short-term vibration on building structures, DIN 4150-3: 1990-02 (Less than 2 mm/s). The result of vibration level in Transverse higher than standard for the longitudinal and vertical was complied with standard value.



**Table 5-12: Vibration measured result at Naxon Village AQ02**

Date :	Time :	Transverse		Vertical		Longitudinal	
		Velocity (mm/s)	Frequency (Hz)	Velocity (mm/s)	Frequency (Hz)	Velocity (mm/s)	Frequency (Hz)
08/02/2023	9:00	0.236	23	0.481	19.3	0.512	26
08/02/2023	10:00	0.284	22	0.520	18.3	0.701	26
08/02/2023	11:00	0.197	25	0.307	15.3	0.536	28
08/02/2023	12:00	0.213	31	0.307	31	0.504	31
08/02/2023	13:00	0.189	26	0.394	15.8	0.512	28
08/02/2023	14:00	0.166	24	0.331	20	0.497	29
08/02/2023	15:00	0.205	28	0.457	18.3	0.670	28
08/02/2023	16:00	0.221	45	0.418	12.2	0.552	31
08/02/2023	17:00	0.213	29	0.481	18.3	0.497	29
08/02/2023	18:00	0.166	28	0.434	20	0.591	27
08/02/2023	19:00	0.236	22	0.481	19.0	0.512	22
08/02/2023	20:00	0.213	33	0.410	17.4	0.497	39
08/02/2023	21:00	0.181	26	0.489	14.4	0.512	35
08/02/2023	22:00	0.150	38	0.197	20	0.583	35
09/02/2023	23:00	0.150	28	0.244	18.0	0.504	31
09/02/2023	0:00	0.142	43	0.189	19.0	0.497	39
09/02/2023	1:00	0.244	30	0.355	16.8	0.583	32
09/02/2023	2:00	0.268	33	0.449	22	0.607	34
09/02/2023	3:00	0.292	35	0.363	15.5	0.575	37
09/02/2023	4:00	0.221	28	0.481	19.7	0.504	33
09/02/2023	5:00	0.189	38	0.292	21	0.654	39
09/02/2023	6:00	0.284	34	0.465	19.0	0.583	35
09/02/2023	7:00	0.244	28	0.481	20	0.528	35
09/02/2023	8:00	0.323	26	0.410	18.0	0.497	37

Remark: standard values for vibration velocity to be used when evaluating the effects of short-term vibration on building structures, DIN 4150-3: 1990-02 (Less than 2 mm/s).

The results of vibration levels at the Koksavang Village AQ01 site, from 11:00 on 09 February to 10:00 on 10 February 2023 are shown in

Table 5-13. Peak particle velocity in Transverse (X-axis) was 0.623 mm/s, in longitudinal (Y-axis) was 0.110 mm/s and in vertical (Z-axis) was 0.307 mm/s. Base on the standard values for vibration velocity to be used when evaluating the effects of short-term vibration on building structures, DIN 4150-3: 1990-02 (Less than 2 mm/s). The result of vibration level in Transverse higher than standard for the longitudinal and vertical was complied with standard value.

**Table 5-13: Vibration measured result at Koksavang Village AQ01**

Date :	Time :	Transverse		Vertical		Longitudinal	
		Velocity (mm/s)	Frequency (Hz)	Velocity (mm/s)	Frequency (Hz)	Velocity (mm/s)	Frequency (Hz)
09/02/2023	11:00	0.300	47	0.087	51	0.615	47
09/02/2023	12:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	13:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	14:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	15:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	16:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	17:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	18:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	19:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	20:00	0.623	85	0.110	>200	0.307	>200
09/02/2023	21:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	22:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
09/02/2023	23:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	0:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	1:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	2:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	3:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	4:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	5:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	6:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	7:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	8:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	9:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A
10/02/2023	10:00	< 0.5	N/A	< 0.5	N/A	< 0.5	N/A

Remark: standard values for vibration velocity to be used when evaluating the effects of short-term vibration on building structures, DIN 4150-3: 1990-02 (Less than 2 mm/s).

N/A = Not Applicable

### 5.7.10 Traffic Survey

To establish a traffic baseline in the Project Area, LTEC conducted a traffic survey between 5<sup>th</sup> – 17<sup>th</sup> March 2019 by LTEC team in eight monitoring locations including at the intersections, T-intersections and straight-line alignment sections. The survey observed both north-bound and south-bound traffic movement and different vehicle categories.

The existing NR13SE road consists of an all-weather bitumen single carriageway road in fairly good condition. The road is part of the ASEAN highway, the north-south corridor that connects Vientiane to southern provinces and regional countries. This international highway is also the primary transit corridor for the transportation of impacted goods and commodities. The road is characterised by:

- ▶ Significant encroachment of the right-of-way by vendors and small businesses right up to the edge of carriageway;
- ▶ Utility services, most notably fibre optic cables and electricity transmission lines;
- ▶ Extensive use of the shoulder for parking of vehicles and collection points for buses especially in the built up busy areas;
- ▶ Numerous side roads (both formal and informal);

- ▶ A noticeable conflict between pedestrian movements and vehicular movements with a lack of formally demarcated pedestrian rights of way and generally few formalized pedestrian crossing points;
- ▶ A typical single carriageway without any form of physical separation between opposing traffic flows; and
- ▶ A visible encroachment on the road reserve through the community areas.

The existing alignment ranges from fairly straight/gentle curves to some sharp horizontal curves, reflective of the flat terrain in which the road passes through. Although a regular road improvement carried out in selected black spots along the road, some sharp curves still remain along the road.

With consistent economic growth in the country, Vientiane Capital has become a flourishing business hub and clusters of specialist activities have emerged along the existing road, including financial services and industrial parks that would traditionally have been located in central suburb of Vientiane. This has generated increased traffic in the region, resulting in pressures on the capacity of the road network. A number of interchanges along the existing road from Xaythany to Thaphabath Districts provide access to the surrounding road network.

#### **10.1.1.1 Traffic Volumes and Capacity**

The existing NR13SE is the one of the most heavily utilised national roads in Lao PDR with some section experiencing up to 30,000 vehicles per day in an intersection (refer to

Table 5-13). The road also carries a high percentage of international cargo traffic to north-south of Lao PDR, Thailand, Vietnam and China.

Detailed Traffic Survey Report (2019) is available in Volume B: Appendix 3.

#### **5.7.11 Road Accidents**

Traffic road accident data was obtained from the Traffic Police Office of Xaythany, Pak Ngum and Thaphabath Districts between 2010 – 2018 within the section of Project road pass through, and obtain from the Department of Transport, MPWT. Additional data was also provided by Thaphabath District between 2019 – early 2023, recording all road accidents occurring across the district. The data of road accident recorded is outlined in Table 5-14.

**Table 5-14: Accident Record on the Project Road, Year 2010 – 2018**

Year	Xaythany District			Pakngum District			Thaprabath District			Total		
	Accident Cases	Casualties	Fatalities	Accident Cases	Casualties	Fatalities	Accident Cases	Casualties	Fatalities	Accident Cases	Casualties	Fatalities
2010				43	89	15						
2011				21	34	1						
2012				46	98	10						
2013	10	18	1	42	71	8						
2014	19	25	0	28	52	6	57	109	15	104	186	21
2015	13	22	1	39	71	8	53	103	9	105	196	18
2016	13	18	0	20	35	8	64	97	12	97	150	20
2017	5	4	0	28	53	11	55	112	10	88	169	21
2018	11	16	2	49	67	8	58	114	14	118	197	24
Total:	71	103	4	316	570	75	287	535	60	512	898	104

Source: Conceptual Design, 2023

### 5.7.12 Natural Hazards and Climate Change

National risk profile of Lao PDR has identified seven major natural hazards which include: tropical storms / cyclones, flooding, droughts, as well as earthquakes, landslides and unexploded ordinances (UXOs) (NDMC, 2010; cited in UNDRR, 2019). Other natural hazards are further described below.

#### *Tropical Storms, Cyclones and Flooding*

Tropical cyclones originating from the South China Sea frequently occur in the Vientiane Region from June through to October, bringing intense rainfall, high winds and floods. The tropical cyclones bring short duration, high intensity rainfall, with streams and rivers commonly overflowing their banks. The intensity and frequency of these cyclones vary. According to CFE-DM (2021), more than 10 major tropical storms and cyclones have been recorded in Lao PDR over the last decade between 2010 and 2020.

Climate change is expected to increase the frequency of extreme river flows in almost all Asian countries (Paltan et al., 2018; cited in WBG, 2021). The observed trend indicates that what would have historically been a 1 in 100-year flow could become a 1 in 50-year or 1 in 25-year event in most of South, Southeast, and East Asia. There is good agreement among climate change models on this trend and the increased potential for major disaster level events requiring adaptation. Most vulnerable areas of Lao PDR are the low-lying floodplains along the Mekong River and its major tributaries in the central and southern parts of Lao PDR (UNDRR, 2019). In addition, projections show an increase of up to 23% under the highest emissions pathway in the amount of rainfall accumulated during extreme rainfall events. This trend may increase the risk of flash or surface flooding, and associated issues such as landslide (WBG, 2021). The potential for flooding in the Project area is further discussed in Section 5.7.4.

The Vientiane Plains flooded frequently under natural conditions and minor – moderate flood volumes began to be attenuated after the construction of the NN1 Reservoir (FAO, 1999). At the peak of a flood event in August and September 2018, outflow from the Nam Ngum 1 Hydropower (NN1) spillway gates was 1,720.6m<sup>3</sup>/s (Vientiane Times, 2018c). At the time of this measurement,

the discharge at Ban Pakkagnoung gauging station (downstream of NN1) was 3,646.6 m<sup>3</sup>/s and discharge from the Nam Lik River was 723.2 m<sup>3</sup>/s.

### **Wildfires**

Uncontrolled fires are generally associated with high temperatures, high winds, and low precipitation. Most of fires in the region are for clearing of land for agricultural purposes (e.g. shifting cultivation and weed control) and for conversion of forests to cropland / plantations and grazing land (Mueller and Suess, 2011). Fires are more common in December to May and throughout the dry season.

The Project region is well-known for extensive agriculture and plantation development; and fires are commonly used for vegetation clearing and weed control to make way for agriculture / plantations. During the January 2023 site visit, vegetation, grass, bushes along the NR13SE were recently burnt – either accidentally or deliberately by smallholder farmers. Fires in the region are also reportedly ignited to clear vegetation ahead of other agricultural practices, hunting, providing cattle forage, and cultivating mushrooms (FAO, 2003).

### **Earthquake**

The risk of earthquake in Lao PDR ranges from low to moderate risk. Most historical earthquakes were in the Northern and Western parts of the country. According to the Asia Disaster Preparedness Centre (APDC, 2012), the Vientiane floodplain region falls within the Low-risk zone between V1 rating on the Modified Mercalli Scale. The ADPC's report identified that approximately 67.9% of Vientiane capital and 94.7% of Bolikhamxay Province fall into a low-risk area. Since 1990, Vientiane Capital experienced 64 quakes up to magnitude 4.6. The strongest and closest point of earthquake was about 4.6 Richter recorded in February 2011; more than 139 km north-west from Vientiane.

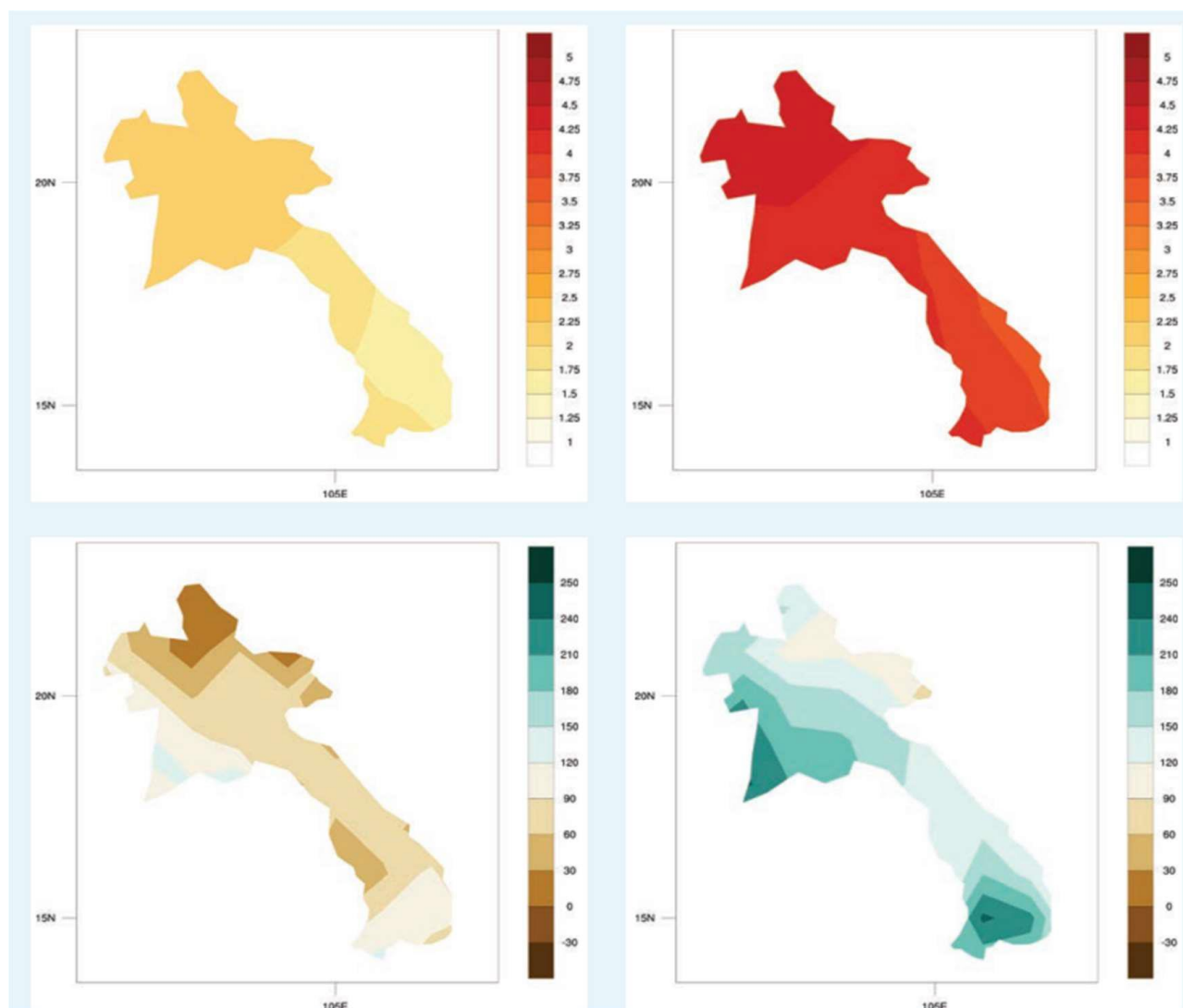
#### **5.7.13 Climate Change**

The Lao PDR is strongly influenced by the southeast monsoon, which contributes to approximately 70% of the annual rainfall and leads to high levels of humidity. The country experiences two well-defined seasons. The rainy season, commonly known as the monsoon, spans from May to mid-October, while the dry season prevails from mid-October to April, as indicated in the most recent climatology data (1991-2020).

A detailed climate change analysis for the NR13SSE Project has been conducted by LEA Consulting (2023). A summary of the future climate projections for the NR13SE Project area includes:

#### **Temperature**

The LEA's analysis shows a trend of consistent warming and an increase in the intensity of heavy precipitation periods and extreme events for Lao PDR. Table 1 provides information on temperature projections and anomalies for the four RCPs over two distinct time horizons; presented against the reference period of 1986–2005. These projections of future temperature change are presented in three primary formats of changes (anomalies) in daily maximum and daily minimum temperatures over the given time period, as well as changes in the average temperature.



**Figure 5-18: CMIP5 ensemble projected changes (32GCMs) in annual temperature (top) and precipitation by 2040-2059 (left) and by 2080-2090 (right) relative to 1986-2005 baseline under RCP8.5**

Source: LEA Consulting 2023

Temperature increase in Lao PDR is projected to align broadly with the global average. According to the CCKP model ensemble, under the highest emissions pathway (RCP8.5), a temperature rise of approximately 4.1°C is anticipated by the 2090s compared to the baseline of 1986-2005. This temperature rise diminishes to 1.2°C under the lowest emissions pathway (RCP2.6). The increase in annual minimum and maximum temperatures is expected to occur at a faster rate than the rise in average temperature, with monthly minimum temperatures experiencing a 10-20% faster increase. While there is considerable uncertainty regarding the seasonal variations in temperature rise, the CCKP model ensemble suggests that the greatest increases may occur during the hottest months of April and May.

**Table 5-15: Projection anomaly for maximum, minimum, and average daily temperatures in Lao PDR for 2040-2059 and 2080-2099, from the reference period of 1986-2005 for all RCPs. The table is showing the median of the CCKP model ensemble and the 10-90th percentiles in brackets.**



Scenario	Average Daily Maximum Temperature		Average Daily Temperature		Average Daily Minimum Temperature	
	2040–2059	2080–2099	2040–2059	2080–2099	2040–2059	2080–2099
<b>RCP2.6</b>	1.2 (-0.5, 3.1)	1.2 (-0.5, 3.2)	1.6 (-0.3, 2.7)	1.3 (-0.2, 2.7)	1.1 (-0.2, 2.5)	1.2 (-0.2, 2.6)
<b>RCP4.5</b>	1.5 (-0.3, 3.5)	2.0 (0.2, 4.3)	1.5 (-0.1, 3.1)	2.0 (0.4, 3.8)	1.5 (0.0, 2.9)	2.1 (0.5, 3.8)
<b>RCP6.0</b>	1.2 (-0.6, 3.0)	2.4 (0.4, 4.7)	1.2 (-0.4, 2.6)	2.4 (0.6, 4.3)	1.2 (-0.2, 2.5)	2.4 (0.6, 4.2)
<b>RCP8.5</b>	1.9 (0.1, 4.0)	3.9 (1.7, 6.6)	1.9 (0.3, 3.6)	3.9 (2.0, 6.3)	1.9 (0.3, 3.5)	4.1 (2.0, 6.2)

Source: LEA Consulting 2023

### **Rainfall**

In Lao PDR, rainfall is generally projected to increase during rainy seasons while dry seasons may witness longer drought periods. The average cumulative 5-day rainfall in the highest emissions pathway (RCP8.5) is expected to rise by approximately 10%, while the amount of accumulated rainfall during extreme rainfall events is projected to increase by 23%. Thus, a 15 % increase in rainfall is considered adequate supporting RCP6.5 and RCP8.5 scenarios. The areas currently affected by flooding and drought will face even greater exposure to these hazards in the future, with a likelihood of expanded geographical coverage and increased and frequent extreme weather events. Negative climate impacts heavily affect several local roads in the region. Prevention, preparedness, and climate-proofing of infrastructure are key to mitigating damage caused by climate change, and this report provides comprehensive descriptions of suitable methods for addressing various negative climate impacts on physical infrastructure. It also includes supporting financial analyses and cost-benefit assessments.

#### **5.7.14 Unexploded Ordnance**

Unexploded ordnance (UXO) refers to explosive devices that have failed to detonate. Throughout the Second Indochina War (1964-1973) over two million tons of ordnance were dropped in Lao PDR. Approximately 25% of Lao PDR’s 10,000 plus villages are UXO contaminated (NRA, 2020). The Project alignment is considered very low bombed area (refer to Volume B -Appendix 2: UXO Map).

Unexploded ordinances (UXO) continue to have lethal impact on human and livestock (UNDP, 2010). The presence of UXOs can also impede infrastructure development and prohibit access to areas of land and interrupting transport routes.

The density of UXOs are unequally distributed across Lao PDR with the majority of UXOs found along the border of Lao and Vietnam in the Khammouane, Savannakhet, Saravane, Sekong and Attapeu Provinces.

As the NR13SE interventions proposed are essentially surface road upgrade works with no horizontal or vertical re-alignment required, it is assumed that unexploded ordnance is unlikely to be a concern.

## 5.8 Biological Baseline Settings

### 5.8.1 Terrestrial Biodiversity

The COI for the Project is dominated by existing road alignment (approximately 98%), followed by residential land. At least 551 standing trees of different species have been identified within the COI including planting and natural grow. There are 13 smaller sizes of Mai Dou (*Pterocarpus macrocarpus*) identified as Endangered according to the IUCN Red List (2017) and Category I of the National Conservation, and 12 of these species will be removed for road expansion and safety. Seven teak species (*Tectona grandis*) were also identified as Endangered; however, these species are planted/introduced. Two species of planted Critically Endangered *Aquilaria malaccensis* were also identified within the COI. In addition, three species of Near Threatened (*Dipterocarpus obtusifolius*) were found in the COI which will be cleared. Several mature and larger size species (e.g. *Samanea saman*) were also identified within the COI and most of these species will be removed as required. A Detailed list of trees identified within the COI is provided in Appendix 5 of this ESIA.

Habitats adjacent to the COI along the Project ROW are mainly modified types fragmented between settlement, commercial and agricultural areas. A significant proportion of the ROW lies between Xaythany to Pak Ngum Districts, a densely populated communities with an estimated population. However, a large proportion of dwellings within and surrounding the ROW are considered to be part of widespread informal settlements, where sprawling, temporary structures are common. The Project devoid of natural habitats, however small fragments of modified habitats (i.e. vegetation, along road verges, parks, gardens, waste land, and culverted watercourses) provide refuge for wildlife.

In local knowledge survey conducted in early 2022, a total of 61 species, representing 7 mammal species, 34 bird species, 14 reptile species and 6 species of amphibians, were identified as occurring within the Project region (refer to Table 5-16: Terrestrial fauna species identified in the Project region by local knowledge surveys). Species identified are generally commonly occurring species. Due to poor habitat, no species of conservation significance were reported inhabiting around the Project area.

**Table 5-16: Terrestrial fauna species identified in the Project region by local knowledge surveys**

Scientific Name	Local Name	English name	IUCN Conservation Status
<b>Mammals</b>			
<i>Mus musculus</i>	Nou wai	House mouse	LC
<i>Mus sp.</i>	Nou deng	Mouse	-
<i>Bandicota indica</i>	Nouphouk	Mice banicota	LC
<i>Rattus Rattus koratensis</i>	Nou thong khao	Mouse	LC
<i>Tupaia glis</i>	Ka tae	Common treeshrew	LC
<i>Gallus gallus</i>	Kai pah	Red junglefowl	LC

Scientific Name	Local Name	English name	IUCN Conservation Status
<i>Sus scrofa</i>	Mau pah	Central Asian boar	LC
<b>Birds</b>			
<i>Centropus sinensis</i>	Nok kod	Greater coucal	LC
<i>Glaucidium cuculoides</i>	Nok khao tou	Asian barred owlet	LC
<i>Acridotheres tristis</i>	Nok lieng	Common myna	LC
<i>Alcedo meninting</i>	Nok ten siew	Blue-eared kingfisher	LC
<i>Amauromis phoenicurus</i>	Nok kai na	White breasted waterhen	LC
<i>Ardeola bacchus</i>	Nok chao	Chinese pond heron	LC
<i>Athene brama</i>	Nok khao noi	Spotted owlet	LC
<i>Brythipicus pyrrhotis</i>	Nok sai	Bay woodpecker	LC
<i>Centropus sinensis</i>	Nok kod	Greater coucal	LC
<i>Chalcophaps indica</i>	Nok khao khiew	Emerald dove	LC
<i>Clamator coromandus</i>	Nok kod hone	Chestnut winged cuckoo	LC
<i>Circaetu sgalicus</i>	Nok leo	Short-Toed snake eagle	LC
<i>Corvus macrorhynchos</i>	Nok ka	Large-billed crow	LC
<i>Cuculus canorus</i>	Nok kod hoy	Eurasian cuckoo	LC
<i>Cuculus poliocephalus</i>	Nok mark fai	Lesser cuckoo	LC
<i>Dicrurus annectans</i>	Nok seo	Croe-billed drongo	LC
<i>Egretta egretta</i>	Nok yang	Little egrets	NA
<i>Eurostopodus macrotis</i>	Nok ka ba	Great eared nightjar	LC
<i>Francolinus pintadeanus</i>	Nok ka tha	Chinese pangolin	LC
<i>Gallicrex cinereal</i>	Nok toum	Watercock	LC
<i>Hirundo smithii</i>	Nok aen	Wire-tailed swallow	LC
<i>Jynx torgulla</i>	Nok sai lai	Eurasian wryneck	LC
<i>Ketupa flavipes</i>	Nok khao hou	Tawny fish owl	LC
<i>Lophura diardi</i>	Kai khouay nin	Siamense fireback	LC
<i>Medalaima heemecephala</i>	Nok khon dok noi	Coppersmith	NA
<i>Medalaima incognita</i>	Nok khon dok yai	Mounstached	NA
<i>Nyctiomis atherioni</i>	Nok kew	Blue-bearded-bee-eating	NA
<i>Orthotomus sutorius</i>	Nok ka chip	Common tailor bird	LC
<i>Spizaetus cirrhatus</i>	Nok leo	Changeable hawk-eagle	LC
<i>Spizixos canifrons</i>	Nok khouak	Crested finchbill	LC
<i>Stigmatopelia chinensis</i>	Nok khao tou	Spotted dove	LC
<i>Treron pompadora</i>	Nok pau	Sri-Lankan green pigeon	LC
<i>Tumix sylvatica</i>	Nok khoum	Small battonquail	NA
<i>Vanellus indicus</i>	Nok ka tae	Red-wattled lapwing	LC
<b>Reptiles</b>			
<i>Calotes emma</i>	Ka porm	Lizard	NA

Scientific Name	Local Name	English name	IUCN Conservation Status
<i>Elaphe radiata</i>	Ngou sa (Ngou sing kan tao)	Radiated Rat snake	NA
<i>Gekko gekko</i>	Kub kae	Gecko	LC
<i>Hemidactylus sp.</i>	Jee jiem	House lizard	NA
<i>Naja sp.</i>	Ngou hao	Cobra species	NA
<i>Ophiophgus hannah</i>	Ei la khor lueam	King cobra	VU
<i>Psammophis condanorus</i>	Ngou lak seuak	Psammophis snake	NA
<i>Python reticulata</i>	Ngou lueam	Reticulated python	LC
<i>Rhaphdophis subminiatus</i>	Ngou dang hae	Red-necked keelback	LC
<i>Sphenomorphus maculatus</i>	Jee koc	Lizard	NA
<i>Tremesurus sp.</i>	Ngou ka ba (Ngou phao)	Kaba snake	NA
<i>Trimeresurus albolabris</i>	Ngou khiew	Green snake	LC
<i>Varanus bengalensis</i>	Laen	Bangal Monitor	LC
<i>Zamenis sp.</i>	Ngou sing	Zamenis	NA
<b>Amphibians</b>			
<i>Fejervarya limnocharis</i>	Khiet na	Rice frog	LC
<i>Hoplobatrachus rugulosus</i>	Kop na	Chinese edible frog	LC
<i>Sylvirana nigrovittata</i>	Khiet ta eod	Hylaran frog	LC
<i>Microhyla pulchra</i>	Sa ae/Ljiet noi	Pygmy frog	LC
<i>Polypedates leucomystax</i>	Ka pard	Common tree frog	LC
<i>Calluella guttulata</i>	Eung	Frog	LC
<i>Fejervarya limnocharis</i>	Khiet na	Rice frog	LC

LC= Least Concern; VU = Vulnerable; NT = Near Threatened; CR = Critically Endangered; NA = Not Assessed

### 5.8.2 Habitats Located in the Surround Landscapes

The majority of habitat types located in close proximity to the Project footprint are categorised as modified habitat. These habitats are listed and described as follows:

- ▶ Agro-pastoral land – areas used for grazing and cultivation, including rice, one of the main principle crop species in the region;
- ▶ Plantations – A number of existing plantations in the surrounding landscapes including eucalyptus, cassava, acacia, rubber banana, agarwood and others;
- ▶ Fallow forest – As described above;
- ▶ Shrub land – Areas of degraded habitat dominated by woody shrub less than 5 m in height. Dominant woody species include *Mitragyna rotundifolia*, *Combretum quadrulangare*, *Syzygium cuminii*, *Alstonia scholaris*, *Catunaregam tomentose* and *Canthium berberidifolium*. Mid-storey species include *Hymenocardia punctate*, *Lagerstroemia macrocarpa*, *Glochidion fagifolium* and *Lagerstroemia sp.* Understorey species include *Themeda arundinacea*, *Casearia grewiaefolia*, *Alsomitra sarcophylla*, *Olax scadens*, *Chromolaena odorata*, *Mallotus*

*barbatus*, *Lygodium flexuosum*, *Crotalaria sp.*, *Chrysopogon aciculate* and *Ludwigia octovalvis*.

- ▶ Roads and tracks; and
- ▶ Settlements and urban areas.

### 5.8.3 Aquatic Biodiversity

A local knowledge surveys conducted in 21 villages identified fish species harvested by local fishermen (refer to Table 5-17). Fishing occurs both dry and wet season in rice paddies, streams, ponds, and Nam Ngum River using traditional fishing gears including gillnets, lift nets, pole-and-line, cast nets, scoop nets, fishing traps, hooks, fishing spears. Dominated fish species include *Cyprinidae* family which adapt to different aquatic habitats in the various sections of the river. However, Nam Ngum River also supports several globally rare and threatened fish species, namely: the Pa Falai (*Urogymnus polylepis*; IUCN 2017 listed Endangered and listed Category I species in the national conservation status), Pa Tong (*Chitala blanci*; near threatened); and Pa Khao (*Wallago attu*; Vulnerable).

**Table 5-17: Recorded or reported aquatic species during LKS, and their conservation status in the Project Villages**

Lao Name	Family Name	Scientific Name	Dry Season	Wet Season	National Conservation Status*	IUCN Conservation Status
Pa Khao	Cyprinidae	<i>Puntius chola</i>	✓	✓	-	Least Concern
Pa Kha yeng	Bagridae	<i>Mystus atrifasciatus</i>	✓	✓	-	Least Concern
Pa Kaderd	Osphronemidae	<i>Macropodus opercularis</i>	✓	✓	-	Least Concern
Pa Kod	Bagridae	<i>Hemibagrus nemurus</i>	✓	✓	-	Least Concern
Pa Khor	Channidae	<i>Channa striata</i>	✓	✓	-	Least Concern
Pa Douk	Clariidae	<i>Clarias batrachus</i>	✓	✓	-	Least Concern
Pa Kheng	Anabantidae	<i>Anabas testudineus</i>	✓	✓	-	Least Concern
Pa Nin	Cichlidae	<i>Oreochromis niloticus</i>	✓	✓	-	Least Concern
Pa Nai	Cyprinidae	<i>Cyprinus carpio</i>	-	✓	-	Least Concern
Pa Khae	Sisoridae	<i>Bagarius lica</i>	-	✓	-	Least Concern
Pa Joke	Cyprinidae	<i>Cosmochilus harmandi</i>	-	✓	-	Least Concern
Pa Kheung	Bagridae	<i>Hemibagrus wyckioides</i>	✓	✓	II	Least Concern
Pa Siew	Danionidae	<i>Rasbora borapetensis</i>	✓	✓	-	Least Concern
Pa Park	Cyprinidae	<i>Barbonymus gonionotus</i>	✓	✓	-	Least Concern
Pa Tong	Notopteridae	<i>Chitala blanci</i>	-	✓	-	Near Threatened
Pa Lod	Mastacembelida	<i>Macrogathus</i>	-	✓	-	Least Concern

Lao Name	Family Name	Scientific Name	Dry Season	Wet Season	National Conservation Status*	IUCN Conservation Status
	e	<i>siamensis</i>				
Pa Lard	Mastacembelidae	<i>Mastacembelus armatus</i>	✓	✓	-	Least Concern
Pa Phia	Cyprinidae	<i>Labeo chrysophekadion</i>	-	✓	-	Least Concern
Pa Khaoh	Siluridae	<i>Wallago attu</i>	✓	✓	-	Vulnerable
Pa Seum	Siluridae	<i>Ompok siluroides</i>	✓	✓	-	Least Concern
Pa Bou	Butidae	<i>Oxyeleotris marmorata</i>	✓	✓	-	Least Concern
Pa Kharbkhong	Ambassidae	<i>Parambassis siamensis</i>	✓	✓	-	Least Concern
Pa Lod	Mastacembelidae	<i>Macrogathus siamensis</i>	✓	-	-	Least Concern
Pa Hak Kouay	Nemacheilidae	<i>Schistura magnifluvis</i>	✓	-	-	Least Concern
Pa Soi	Cyprinidae	<i>Henicorhynchus caudimaculatus</i>	✓	✓	-	-
Eel	Synbranchidae	<i>Monopterus albus</i>	-	✓	-	Least Concern
Pa Sakang	Cyprinidae	<i>Puntioplites falcifer</i>	✓	✓	-	Least Concern
Pa Ethai	Cyprinidae	<i>Osteochilus hasselti</i>	✓	✓	-	Least Concern
Pa Soud	Cyprinidae	<i>Hampala macrolepidota</i>	✓	✓	-	Least Concern
Pa Ka	Pristolepididae	<i>Pristolepis fasciata</i>	✓	✓	-	Least Concern
Pa Falai	Dasyatidae	<i>Urogymnus polylepis</i>	-	✓	l	Endangered
Pa Vienfai	Cyprinidae	<i>Barbodes altus</i>	✓	✓	-	-

\*Decision on Endorsement of the List of Aquatic and Wildlife Species for Conservation and Management No. 08/PM (2021).

#### 5.8.4 Protected Areas and Watershed Reserves

Lao PDR has an extensive network of National Biodiversity Conservation Areas (NBCA) / National Protected Areas and Parks, covering more than 21% of the country's land cover. The closest and most relevant NBCA to the Project are listed as follows:

##### **Phou Khao Khouay National Park**

located approximately 20 km northeast of Vientiane and covers an area of 2,000 km<sup>2</sup>. Phou Khao Khouay National Park encompasses a large stretch of mountain range (the Phou Khao Khouay massif) with sandstone cliffs, river gorges and three large rivers with tributaries which flow into the Mekong River. Dry Dipterocarp Forest and bamboo scrub dominate gentle sloping sandstone shelves and stands of Mixed Deciduous Forest occur near pools and streams. The area is of

importance for its bird life and is known to support a significant population of the globally Endangered Green Peafowl (*Pavo muticus*) (Birdlife International, 2017).

According to the Decree on Conservation Forest (2015), the conservation forests are ‘forests and forest lands classified for the purposes of conserving nature, preserving plant and animal species, forest ecosystems and other valuable sites of natural, historical, cultural, tourism, environmental, educational and scientific research experiments’. The National Conservation Forest (National Park) covers an area of greater than 50,000 ha, identified as rich of naturally native species of terrestrial and aquatic fauna and flora. The National Park intends to provide homes for diversified ecosystems such as fauna, flora, aquatic resources, high value, rare, endangered species. There are five categories of conservation forests as follows:

- ▶ Conservation forests as national park – rich of natural ecosystems, significant values for educational research;
- ▶ Conservation forests as natural heritage – unique and naturally significant at national, regional and global levels;
- ▶ Conservation forests as historical and cultural sites;
- ▶ Conservation forests to protect fauna, flora and aquatic species determined to be rare and endangered species;
- ▶ Conservation forests for management of natural resources.

Zoning of the National Park is divided into four zones including:

- ▶ Absolutely prohibited areas;
- ▶ Utilization areas under management are areas located in adjacent to ‘absolutely prohibited areas’. This area must be protect like the ‘absolutely prohibited areas’ but allow people to use TFPs and NTFPs in accordance with allocation program;
- ▶ Corridor areas – within the same protected area or between other protected areas for wildlife movements. Prohibition to logging and other activities;
- ▶ Buffer zones are forests and watercourses or other land areas located around the conservation forests within a radius of 100 – 500 m to prevent human encroachment to the conservation forests.

#### **5.8.5 Important Bird Areas (IBA)**

In total 27 Important Bird and Biodiversity Areas (IBAs) have been designated in Lao PDR with a total surface area of 2,384,985 ha. These sites have been awarded IBA status in recognition of their international significance for the conservation of birds and other biodiversity. Many sites support globally threatened birds, restricted range and biome-restricted birds and congregatory species of bird. Furthermore, a total of 47 Key Biodiversity Areas (KBA) have been designated in Lao PDR which are ‘sites contributing significantly to the global persistence of biodiversity’, in terrestrial, freshwater and marine ecosystems. IBAs and Key Biodiversity Areas are not statutory designated sites and as such are not offer legal protection in Lao PDR unless they overlap nationally protected areas.

The Project NR13SE from Km 21 to Km71 lies entirely outside the boundaries of IBAs and KBAs. The closest and most relevant IBAs and KBAs to the Project are listed as follows:

- ▶ Phou Khao Khouay IBA - located in the south-western periphery of Phou Khao Khouay National Park and designated Key Biodiversity Area. The nearest Phou Khao Khouay IBA to the Project alignment is approximately 500m on the north.

## 5.9 Socio-Economic Baseline Settings

### 5.9.1 Context

### 5.9.2 Population and Demographics

The project covers 21 villages which are home to a total of 36,010 people from 7,352 households. Somsavanh Village has the highest density of populations and households with figure equal to 5,198 people and 1,165 households while Bolek Village is the second largest, which has populations and households equal to 3,242 and 658 respectively. Please see the following Table 5-18 for more detail information.

**Table 5-18: Demographic information in the Project Affected Villages**

Village Name	# of HHs	# of Population		Avg. HH Size	# of Male
		Total	Female		
<b>Vientiane Capital</b>	<b>6,908</b>	<b>33,446</b>	<b>16,906</b>	-	<b>16,540</b>
<b>Xaythany District</b>	<b>3,818</b>	<b>18,168</b>	<b>9,292</b>		<b>8,876</b>
1. Khoksivilay	365	1,703	912	4.7	791
2. Nonthong	174	625	318	3.6	307
3. Phailom	533	2,803	1,432	5.3	1,371
4. Somsavanh	1,165	5,198	2,645	4.5	2,553
5. Khoksavang	180	967	489	5.4	478
6. Phonsavanh	132	656	329	5.0	327
7. Naphasouk	220	1,236	581	5.6	655
8. Dongkhouay	391	1,738	855	4.4	883
9. Bolek	658	3,242	1,731	4.9	1,511
<b>Pak Ngum District</b>	<b>3,090</b>	<b>15,278</b>	<b>7,614</b>		<b>7,664</b>
10. Nongbouathong	230	1,370	659	6.0	711
11. Sangxay	257	1,437	704	5.6	733
12. Khoksa	86	460	227	5.3	233
13. Thangkhong	193	1,003	513	5.2	490
14. Donehai	408	2,113	1,107	5.2	1,006
15. Naxon	451	1,622	786	3.6	836
16. Phao	558	2,583	1,274	4.6	1,309
17. Sompaseuth	122	597	291	4.9	306
18. Hai	370	1,791	885	4.8	906
19. Somsavad	415	2,302	1,168	5.5	1,134
<b>Bolikhamxay province</b>	<b>444</b>	<b>2,564</b>	<b>1,336</b>	-	<b>1,228</b>
<b>Thaphabath District</b>	<b>444</b>	<b>2,564</b>	<b>1,336</b>		<b>1,228</b>



Village Name	# of HHs	# of Population		Avg. HH Size	# of Male
		Total	Female		
20.Naxay	227	1,412	738	6.2	674
21.Xaysavang	217	1,152	598	5.3	554
<b>Total</b>	<b>7,352</b>	<b>36,010</b>	<b>18,242</b>	-	<b>17,768</b>

Source: LTEC, 2023

According to the table below, in the past 12 months, Somsavanh Village has the highest number of live births (89 people) and number of deaths (34 bodies). The next village that has the largest number of live births and deaths is Bolek Village with number equal to 40 and 30 respectively. Phonsavanh Village has the least number of live births (3 people) and Khoksavang and Khoksa Village has the least number of death each with one death in the past 12 months (refer to Table 5-19).

**Table 5-19: Natural Population Characteristics in the Project Affected Villages**

Village Name	# of HHs	# of Population	# of Live Births in Past 12 Months	No. of Deaths in Past 12 Months
<b>Vientiane Capital</b>	<b>6,908</b>	<b>33,446</b>	<b>370</b>	
<b>Xaythany District</b>	<b>3,818</b>	<b>18,168</b>	<b>269</b>	
1. Khoksivilay	365	1,703	37	14
2. Nonthong	174	625	25	7
3. Phailom	533	2,803	30	14
4. Somsavanh	1,165	5,198	89	34
5. Khoksavang	180	967	7	1
6. Phonsavanh	132	656	3	2
7. Naphasouk	220	1,236	13	12
8. Dongkhouay	391	1,738	25	15
9. Bolek	658	3,242	40	30
<b>PakNgum District</b>	<b>3,090</b>	<b>15,278</b>	<b>101</b>	
10.Nongbouathong	230	1,370	5	11
11.Sangxay	257	1,437	11	13
12.Khoksa	86	460	9	1
13.Thangkhong	193	1,003	12	4
14.Donehai	408	2,113	11	25
15.Naxon	451	1,622	5	11
16.Phao	558	2,583	16	15
17.Sompaseuth	122	597	4	2
18.Hai	370	1,791	15	11
19.Somsavad	415	2,302	13	9
<b>Bolikhambxay Province</b>	<b>444</b>	<b>2,564</b>	<b>33</b>	
<b>Thaphabath District</b>	<b>444</b>	<b>2,564</b>	<b>33</b>	
20.Naxay	227	1,412	17	15
21.Xaysavang	217	1,152	16	3

Source: LTEC, 2023

### 5.9.3 Ethnicity and Religion

Table 5-20 below provides information on the population by ethnic group in the affected villages. Majority of affected village are Lao-Tai linguistic group except four villages that has some ethnic minority groups. Those villages include Khoksivilay Village (0.55% Hmong), Phailom Village (8.44% Hmong), Somsavanh Village (3% Khmu and 0.17% Hmong), and Khoksavang Village (0.56% Hmong).

The main religion adopted in the affected villages is Buddhism. Only 0.5% in Khoksivilay Village, 2% in Phailom Village, 10% in Somsavanh Village and 1% in Khoksavang Village practiced Animist. Others include 1% in Phonsavanh Village and 2% in Dongkhouay Village believed in Christian (refer to Table 5-20).

**Table 5-20: Ethnicity and Religions in the Project Affected Villages**

Village Name	# of HHs	# of Population		Avg. HH size	Ethnicity (% of people)			Religion (% of people)		
		Total	F		Lao Tai	Khmu	Hmong	Buddhist	Animist	Christian
<b>Vientiane Capital</b>	<b>6,908</b>	<b>33,446</b>	<b>16,906</b>							
<b>Xaythany District</b>	<b>3,818</b>	<b>18,168</b>	<b>9,292</b>							
1. Khoksivilay	365	1,703	912	4.7	99	0	0.55	99.5	0.5	0
2. Nonthong	174	625	318	3.6	100	0	0	100	0	0
3. Phailom	533	2,803	1,432	5.3	92	0	8.44	98	2	0
4. Somsavanh	1165	5,198	2,645	4.5	97	3	0.17	90	10	0
5. Khoksavang	180	967	489	5.4	99	0	0.56	99	1	0
6. Phonsavanh	132	656	329	5.0	100	0	0	99	0	1
7. Naphasouk	220	1,236	581	5.6	100	0	0	100	0	0
8. Dongkhouay	391	1,738	855	4.4	100	0	0	98	0	2
9. Bolek	658	3,242	1,731	4.9	100	0	0	100	0	0
<b>Pak Ngum District</b>	<b>3,090</b>	<b>15,278</b>	<b>7,614</b>							
10. Nongbouathong	230	1,370	659	6.0	100	0	0	100	0	0
11. Sangxay	257	1,437	704	5.6	100	0	0	100	0	0
12. Khoksa	86	460	227	5.3	100	0	0	100	0	0
13. Thangkhong	193	1,003	513	5.2	100	0	0	100	0	0
14. Donehai	408	2,113	1,107	5.2	100	0	0	100	0	0
15. Naxon	451	1,622	786	3.6	100	0	0	100	0	0
16. Phao	558	2,583	1,274	4.6	100	0	0	100	0	0
17. Sompaseuth	122	597	291	4.9	100	0	0	100	0	0
18. Hai	370	1,791	885	4.8	100	0	0	100	0	0
19. Somsavad	415	2,302	1,168	5.5	100	0	0	100	0	0
<b>Bolikhamxay</b>	<b>444</b>	<b>2,564</b>	<b>1,336</b>							
<b>Thaphabath District</b>	<b>444</b>	<b>2,564</b>	<b>1,336</b>							
20. Naxay	227	1,412	738	6.2	100	0	0	100	0	0
21. Xaysavang	217	1,152	598	5.3	100	0	0	100	0	0
<b>Total</b>	<b>7,352</b>	<b>36,010</b>	<b>18,242</b>							

Source: LTEC, 2023

### 5.9.4 Migration

Number of population in the affected villages not only depended on the number of live births and deaths but also depend on the number of migration move in and out of the villages. Table below shows number of migration move in and out of the project affected villages during the past 12 months. Khoksavang Village has the most number of people moving into the village with figure equal to 105 people and Bolek Village is the second largest (76 people) while Somsavanh Village has the highest number of people moving out of the village with figure equal to 78 people (refer to Table 5-21).

**Table 5-21: Migration in the Project Affected Villages over the past**

Village Name	# of HHs	# of Population	In-migration		Out-migration		Net Migration Rate (No. People)
			No. HHs	# of People	# of HHs	# of People	
<b>Vientiane Capital</b>	<b>6,908</b>	<b>33,446</b>	<b>88</b>	<b>368</b>	<b>30</b>	<b>87</b>	<b>281</b>
<b>Xaythany District</b>	<b>3,818</b>	<b>18,168</b>	<b>86</b>	<b>358</b>	<b>29</b>	<b>79</b>	<b>279</b>
1. Khoksivilay	365	1,703	6	18	-	-	18
2. Nonthong	174	625	4	18	-	-	18
3. Phailom	533	2,803	-	-	-	-	-
4. Somsavanh	1,165	5,198	22	66	29	78	-12
5. Khoksavang	180	967	21	105	-	-	105
6. Phonsavanh	132	656	-	-	-	-	-
7. Naphasouk	220	1,236	-	-	-	1	-1
8. Dongkhouay	391	1,738	15	75	-	-	75
9. Bolek	658	3,242	18	76	-	-	76
<b>PakNgum District</b>	<b>3,090</b>	<b>15,278</b>	<b>2</b>	<b>10</b>	<b>1</b>	<b>8</b>	<b>2</b>
10. Nongbouathong	230	1,370	1	5	-	-	5
11. Sangxay	257	1,437	-	-	-	-	-
12. Khoksa	86	460	-	-	-	-	-
13. Thangkhong	193	1,003	1	5	1	4	1
14. Donehai	408	2,113	-	-	-	-	-
15. Naxon	451	1,622	-	-	-	-	-
16. Phao	558	2,583	-	-	-	-	-
17. Sompaseuth	122	597	-	-	-	4	-4
18. Hai	370	1,791	-	-	-	-	-
19. Somsavad	415	2,302	-	-	-	-	-
<b>Bolikhamsay Province</b>	<b>444</b>	<b>2,564</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Thaphabath District</b>	<b>444</b>	<b>2,564</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
20. Naxay	227	1,412	-	-	-	-	-
21. Xaysavang	217	1,152	-	-	-	-	-
<b>Total</b>	<b>7,352</b>	<b>36,010</b>	<b>88</b>	<b>368</b>	<b>30</b>	<b>87</b>	<b>281</b>

Source: LTEC, 2023

### 5.9.5 Land, Assets, and Infrastructure

The following tables describe characteristic of existing infrastructure and facilities available in the affected households. It informs accessibility of households to different types of facilities such as

pharmacy, market, shop, temple, village office, company, factory, hotel/guesthouse and all weathered road as indicated in Table 5-22.

The survey shows that all affected villages have relatively good infrastructure and public utilities. Among them, there are a total of 30 companies, 9 main market, 598 small shops, 18 guesthouses, 37 pharmacies, 11 health centers, 30 temples and 46 all weathered roads in the project villages. In addition, all affected villages have at one office village, small shops and all weathered road. The details can be seen in following Table 5-22.

Each village has a temple for conducting traditional and cultural practices. During the consultation with local communities, the project was recommended to conduct traditional ceremony asking permission from the land and water spiritual before starting construction activities and working on the big Buddha day is not allowed. Other than that, the project is not expected to create any impacts on any local and national archaeological, paleontological or cultural significance. However, there is a possibility for (as yet undiscovered) sites of local cultural significance (i.e., artifacts, sacred sites, cemeteries) in subproject areas during construction. Nonetheless, a “Chance Finds Procedure” in the ECOP describing the process to be followed when any artifacts are found.

Table 5-22: Summary of Infrastructure in the Project Affected Villages

Village Name	# Village office	# Temple/church	# Company	# Industry/factory	# Market	# Health Center	# Pharmacy	# Small shop	# Hotel and guesthouse	# all weathered road
<b>Vientiane Capital</b>	<b>20</b>	<b>29</b>	<b>28</b>	<b>43</b>	<b>9</b>	<b>11</b>	<b>36</b>	<b>568</b>	<b>18</b>	<b>43</b>
<b>Xaythany District</b>	<b>9</b>	<b>12</b>	<b>11</b>	<b>35</b>	<b>5</b>	<b>9</b>	<b>21</b>	<b>260</b>	<b>12</b>	<b>18</b>
1. Khoksivilay	1	1	5	-	1	5	3	33	3	3
2. Nonthong	1	1	-	5	1	1	3	42	2	1
3. Phailom	1	1	4	-	1	0	-	12	2	4
4. Somsavanh	1	2	-	2	1	1	7	82	1	-
5. Khoksavang	1	1	2	-	-	0	-	20	1	1
6. Phonsavanh	1	2	-	9	-	0	-	14	1	2
7. Naphasouk	1	1	-	16	-	0	1	4	2	4
8. Dongkhouay	1	1	-	2	-	2	2	24	-	1
9. Bolek	1	2	-	1	1	0	5	29	-	4
<b>PakNgum District</b>	<b>11</b>	<b>17</b>	<b>17</b>	<b>8</b>	<b>4</b>	<b>2</b>	<b>15</b>	<b>308</b>	<b>6</b>	<b>25</b>
10. Nongbouathong	1	2	-	1	-	0	1	26	1	10
11. Sangxay	1	2	1	-	-	0	1	13	-	2
12. Khoksa	1	1	4	2	-	0	-	5	-	1
13. Thangkhong	1	1	1	1	-	0	-	24	1	1
14. Donehai	2	1	-	-	1	0	3	51	-	1
15. Naxon	1	2	4	1	1	1	3	36	-	3
16. Phao	1	3	6	1	1	0	3	86	1	2
17. Sompaseuth	1	1	-	-	-	1	-	8	1	3
18. Hai	1	3	-	-	1	0	3	35	2	1
19. Somsavad	1	1	1	2	-	0	1	24	-	1
<b>Bolikhambay Province</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>-</b>	<b>0</b>	<b>1</b>	<b>30</b>	<b>-</b>	<b>3</b>
<b>Thaphabath District</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>-</b>	<b>0</b>	<b>1</b>	<b>30</b>	<b>-</b>	<b>3</b>
20. Naxay	1	1	1	3	-	0	1	17	-	2
21. Xaysavang	1	-	1	-	-	0	-	13	-	1
<b>Total</b>	<b>22</b>	<b>30</b>	<b>30</b>	<b>46</b>	<b>9</b>	<b>11</b>	<b>37</b>	<b>598</b>	<b>18</b>	<b>46</b>

Source: LTEC, 2023

### 5.9.6 Land Use

The Table 3-10 shows the land use in the affected villages which categorized into seven different types of agricultures: lowland rainfed rice, irrigated rice, upland rice, cassava, maize, sweet potato and green vegetables. Majority of villages used land for lowland rainfed rice (7,113 ha) and for irrigated rice (1,286 ha). The least used of land is for sweet potato and green vegetables with 2 ha and 4 ha respectively and this type of agriculture is only performed at Khoksavng Village (refer to Table 5-23).

**Table 5-23: Land Use in the Project Affected Villages**

Villages	Lowland rainfed rice (ha)	Irrigated rice (ha)	Upland rice (ha)	Cassava (ha)	Maize (ha)	Sweet Potato (ha)	Green Vegetables (ha)
<b>Vientiane Capital</b>	<b>6,473</b>	<b>1,286</b>	<b>254</b>	<b>669</b>	<b>43</b>	<b>2</b>	<b>4</b>
<b>Xaythany District</b>	<b>2,185</b>	<b>1,114</b>	<b>254</b>	<b>480</b>	-	<b>2</b>	<b>4</b>
1. Khoksivilay	37	-	-	-	-	-	-
2. Nonthong	-	-	25	-	-	-	-
3. Phailom	-	-	42	435	-	-	-
4. Somsavanh	121	-	-	-	-	-	-
5. Khoksavang	98	-	15	28	-	2	4
6. Phonsavanh	-	-	172	17	-	-	-
7. Naphasouk	129	-	-	-	-	-	-
8. Dongkhouay	643	450	-	-	-	-	-
9. Bolek	1,157	664	-	-	-	-	-
<b>PakNgum District</b>	<b>4,289</b>	<b>172</b>	-	<b>189</b>	<b>43</b>	-	-
10. Nongbouathong	397	-	-	-	-	-	-
11. Sangxay	506	52	-	45	-	-	-
12. Khoksa	177	-	-	-	-	-	-
13. Thangkhong	303	-	-	4	-	-	-
14. Donehai	596	-	-	-	-	-	-
15. Naxon	1,024	81	-	-	-	-	-
16. Phao	1,153	34	-	100	43	-	-
17. Sompaseuth	72	5	-	5	-	-	-
18. Hai	12	-	-	10	-	-	-
19. Somsavad	50	-	-	25	-	-	-
<b>Bolikhambxay Province</b>	<b>640</b>	-	-	<b>16</b>	-	-	-
<b>Thaphabath District</b>	<b>640</b>	-	-	<b>16</b>	-	-	-
20. Naxay	142	-	-	16	-	-	-
21. Xaysavang	498	-	-	-	-	-	-
<b>Total</b>	<b>7,113</b>	<b>1,286</b>	<b>254</b>	<b>685</b>	<b>43</b>	<b>2</b>	<b>4</b>

Source: LTEC, 2023

#### *Land use in the COI*

Land use types identified within the COI include existing road (approximately 98%) followed by wetland / rivers or streams and then residential land. A total land impacted is approximately 100 ha (refer to Table 5-24).

Table 5-24: Land use in the Project COI

No	Name of Villages	Total (Ha)	Government Land (Ha)		Private Land (Ha)		
			River / Wetland	Existing Road	Residential Land	Rice Paddy	Other Agri. Land
	<b>Vientiane Capital</b>						
	<b>Xaythany Dist.</b>						
1	Ban. Khoksivilay	5.103	0.136	4.947	0.020		
2	Ban. Nonthong						
3	Ban. Phailom	4.263		4.263			
4	Ban. Somsavanh	3.149		3.068	0.081		
5	Ban. Khoksavang	3.063		3.063			
6	Ban. Phonsavanh	3.480	0.113	3.367			
7	Ban. Naphasouk	7.152		7.129	0.023		
8	Ban. Dongkhouay	0.037					0.037
9	Ban. Borlek	6.141	0.460	5.585	0.096		
	<b>Pakngum Dist.</b>						
1	Ban. Nongbouathong	4.775	0.071	4.666	0.038		
2	Ban. Sangxay						
3	Ban. Khoksa	3.210		3.116	0.076	0.018	
4	Ban. Thangkhong	2.282	0.045	2.237			
5	Ban. Donehai	6.536		6.523	0.013		
6	Ban. Naxone	12.252		12.215	0.037		
7	Ban. Phao	11.696	0.510	11.135	0.051		
8	Ban. Sompaseuth	4.697		4.697			
9	Ban. Hai	4.909		4.898	0.011		
10	Ban. Somsavath	4.296		4.289	0.007		
	<b>Bolikhamsay Province</b>						
	<b>Thaphabath Dist.</b>						
1	Ban. Naxay	7.163		7.163			
2	Ban. Xaysavang	6.522		6.510	0.012		
<b>Total = 21 Villages</b>		<b>100.726</b>	<b>1.335</b>	<b>98.871</b>	<b>0.465</b>	<b>0.018</b>	<b>0.037</b>

Source: LTEC, 2023

### 5.9.7 Water Resources and Water Use

Majority of project affected villages can access to clean water through bottled water, borehole, pipe water supply system, borehole with electric pump and shallow well with electric pump. In term of accessing to bottled drinking water, 6 villages (Khoksa, Donehai, Sompaseuth, Somsavanh, Naxay and Xaysavang village) can access 100% while Naxon Village has the least access percentage of 76%. Only 16% of household in Nongbouathong Village used borehole. All households in Naxon Village have pipe water supply system while 7 villages (Dongkhouay, Khoksa, Sompaseuth, Hai, Somsavanh, Naxay, and Xaysavang Village) cannot access to the system. The highest household percentage that uses the borehole with electric pump is Dongkhouay and Xaysavang Village each with 100% and the least is Naxon Village with none. In addition, Naxay Village depends 99% on

shallow well with electric pump while 14 other villages don't use such a system (refer to Table 5-25).

**Table 5-25: Water use in the Project Affected Villages**

Village Name	Drinking (%)		Cleaning / Bathing / Washing (%)		
	Bottled Water	Borehole	Nam Papa (Pipe water supply system)	HH borehole with electric pump	HH with shallow well with electric pump
<b>Vientiane Capital</b>					
<b>Kaythany District</b>					
1. Khoksivilay	95	-	95	5	-
2. Nonthong	84	-	28	72	-
3. Phailom	96	-	60	35	5
4. Somsavanh	95	-	12	86	2
5. Khoksavang	98	-	10	90	-
6. Phonsavanh	97	-	2	98	-
7. Naphasouk	98	-	10	90	-
8. Dongkhouay	98	-	-	100	-
9. Bolek	86	-	90	10	-
<b>PakNgum District</b>					
10. Nongbouathong	87	16	25	75	-
11. Sangxay	98	-	60	40	-
12. Khoksa	100	-	-	10	-
13. Thangkhong	96	-	5	95	-
14. Donehai	100	-	15	85	-
15. Naxon	76	-	100	-	-
16. Phao	86	-	37	60	3
17. Sompaseuth	100	-	-	70	30
18. Hai	83	-	-	20	80
19. <b>Somsavad</b>	100	-	-	54	46
<b>Bolikhambay Province</b>					
<b>Thaphabath District</b>					
20. Naxay	100	-	-	10	99
21. Xaysavang	100	-	-	100	-

Source: LTEC, 2023

### 5.9.8 Housing Infrastructure

The types of housing in the project affected villages mostly are one floor cement house with number equal to 5,139 houses following by 1,974 houses of two floors cement/wood house. The other types of housing include concrete/cement house (2 floors or more) and wood house (tin/tile roof) as detail stated in Table 5-26.



**Table 5-26: Types of Housing**

Villages	# of of HHs	# of of Concrete/cement house (2 floors or more)	# of of cement house (1 floor)	# of of cement/wood house (2 floors)	# of of wood house (tin/tile roof)
<b>Vientiane Capital</b>	<b>6,908</b>	<b>122</b>	<b>4,786</b>	<b>1,885</b>	<b>115</b>
<b>Xaythany District</b>	<b>3,818</b>	<b>94</b>	<b>3,110</b>	<b>591</b>	<b>23</b>
1. Khoksivilay	365	6	327	22	10
2. Nonthong	174	9	158	6	1
3. Phailom	533	13	486	34	-
4. Somsavanh	1,165	55	1,026	73	11
5. Khoksavang	180	2	165	13	-
6. Phonsavanh	132	2	116	13	1
7. Naphasouk	220	3	205	12	-
8. Dongkhouay	391	2	260	129	-
9. Bolek	658	2	367	289	-
<b>PakNgum District</b>	<b>3,090</b>	<b>28</b>	<b>1,676</b>	<b>1,294</b>	<b>92</b>
10. Nongbouathong	230	5	87	88	50
11. Sangxay	257	-	180	77	-
12. Khoksa	86	-	45	41	-
13. Thangkhong	193	3	169	21	-
14. Donehai	408	3	150	255	-
15. Naxon	451	3	225	220	3
16. Phao	558	5	244	279	30
17. Sompaseuth	122	-	56	58	8
18. Hai	370	4	250	115	1
19. Somsavad	415	5	270	140	-
<b>Bolikhambxay Province</b>	<b>444</b>	<b>2</b>	<b>353</b>	<b>89</b>	<b>0</b>
<b>Thaphabath District</b>	<b>444</b>	<b>1</b>	<b>153</b>	<b>73</b>	<b>-</b>
20. Naxay	227	1	200	16	-
21. Xaysavang	217	1	153	73	-
<b>Total</b>	<b>7,352</b>	<b>124</b>	<b>5,139</b>	<b>1,974</b>	<b>115</b>

Source: LTEC, 2023

### 5.9.9 Education and Literacy

There are 23 primary schools, with a total of 129 classrooms, and oversight by 190 teachers. The total number of lower secondary schools are 12 with 52 classrooms and 121 teachers, and 4 upper secondary schools with 34 classrooms and 91 teachers those are available to provide the services to the public (refer to Table 5-27). These facilities will not be affected by the Project due to land requisition; however, during the consultation with communities, the Project was recommended not to transport construction materials during the students commuting to schools and pay attention to mitigation measures of noise and dust as well as regularly communication with the school and health officials on the construction activities and schedule.

It is noticed majority of population in the affected villages can read and write since 99% of them are at least have a primary education level except 1% in Somsavad Village are uneducated. There

are many levels of schooling from primary school up to university level. Bolek Village has the highest percentage of university graduates with number equal to 15%. However, for the higher diplomas, Khoksa Village is the highest (50%) and Dongkhouay Village has the highest percentage (40%) of finished primary school and the highest percentage of finished secondary level of education is Thangkhong Village with 42%. Additional information is provided in Table 5-28.

**Table 5-27: Access to Education Services in the Project Affected Villages**

Village Name	Primary School			Lower Secondary School			Upper Secondary School			Tertiary/Vacational
	# of School	# of Classroom	# Teacher	# of School	# of Classroom	# Teacher	# of School	# of Classroom	# Teacher	# of School
<b>Vientiane Capital</b>	<b>22</b>	<b>124</b>	<b>183</b>	<b>12</b>	<b>52</b>	<b>121</b>	<b>4</b>	<b>34</b>	<b>91</b>	<b>0</b>
<b>Xaythany District</b>	<b>12</b>	<b>69</b>	<b>123</b>	<b>4</b>	<b>29</b>	<b>63</b>	<b>2</b>	<b>22</b>	<b>50</b>	<b>0</b>
1. Khoksivilay	5	13	59	2	9	30	1	6	20	0
2. Nonthong	0	0	0	0	0	0	0	0	0	0
3. Phailom	1	13	12	1	12	23	1	16	30	0
4. Somsavanh	1	13	14	0	0	0	0	0	0	0
5. Khoksavang	1	3	10	0	0	0	0	0	0	0
6. Phonsavanh	1	5	3	0	0	0	0	0	0	0
7. Naphasouk	1	5	6	0	0	0	0	0	0	0
8. Dongkhouay	1	7	7	0	0	0	0	0	0	0
9. Bolek	1	10	12	1	8	10	0	0	0	0
<b>PakNgum District</b>	<b>10</b>	<b>55</b>	<b>60</b>	<b>8</b>	<b>23</b>	<b>58</b>	<b>2</b>	<b>12</b>	<b>41</b>	<b>0</b>
10. Nongbouathong	1	6	6	2	12	35	1	8	35	0
11. Sangxay	1	6	7	0	0	0	0	0	0	0
12. Khoksa	1	5	3	0	0	0	0	0	0	0
13. Thangkhong	1	5	10	4	0	0	0	0	0	0
14. Donehai	1	5	5	0	0	0	0	0	0	0
15. Naxon	1	5	5	1	3	5	1	4	6	0
16. Phao	1	10	10	1	8	18	0	0	0	0
17. Sompaseuth	1	3	1	0	0	0	0	0	0	0

Village Name	Primary School			Lower Secondary School			Upper Secondary School			Tertiary/Vacational
	# of School	# of Classroom	# Teacher	# of School	# of Classroom	# Teacher	# of School	# of Classroom	# Teacher	# of School
18. Hai	2	10	13	0	0	0	0	0	0	0
19. Somsavad	0	0	0	0	0	0	0	0	0	0
<b>Bolikhamxay Province</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Thaphabath District</b>	<b>1</b>	<b>5</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
20. Naxay	0	0	0	0	0	0	0	0	0	0
21. Xaysavang	1	5	7	0	0	0	0	0	0	0
<b>Total</b>	<b>23</b>	<b>129</b>	<b>190</b>	<b>12</b>	<b>52</b>	<b>121</b>	<b>4</b>	<b>34</b>	<b>91</b>	<b>0</b>

Source: LTEC, 2023

Table 5-28: School completion in the Project Affected Villages

Village Name	Uneducated (%)		Primary school (%)		Secondary school (%)		High school (%)		Higher diploma (%)		University (%)	
	Total	Female	Total	F	Total	F	Total	F	Total	F	Total	F
<b>Vientiane Capital</b>												
<b>Xaythany District</b>												
Khoksivilay	0	0	3	1	10	5	35	18	32	12	20	5
Nonthong	0	0	8	3	30	12	35	20	17	8	10	6
Phailom	0	0	5	2	35	15	30	16	20	8	10	4
Somsavanh	0	0	5	2	5	3	40	25	20	10	30	15
Khoksavang	0	0	20	12	25	10	35	19	15	9	5	3
Phonsavanh	0	0	20	13	20	8	35	18	15	9	10	7
Naphasouk	0	0	10	6	20	10	50	28	10	4	10	5
Dongkhouay	0	0	40	22	20	12	30	16	5	3	5	2
Bolek	0	0	8	2	22	15	30	18	25	15	15	7
<b>PakNgum District</b>												

Village Name	Uneducated (%)		Primary school (%)		Secondary school (%)		High school (%)		Higher diploma (%)		University (%)	
	Total	Female	Total	F	Total	F	Total	F	Total	F	Total	F
Nongbouathong	0	0	18	8	32	10	40	25	7	2	3	2
Sangxay	0	0	10	6	30	25	50	39	7	4	3	2
Khoksa	0	0	6	3	12	4	26	15	50	30	6	2
Thangkhong	0	0	2	1	42	10	50	20	4	1	2	1
Donehai	0	0	5	3	40	35	30	25	20	20	5	2
Naxon	0	0	5	3	20	13	60	40	5	1	10	3
Phao	0	0	10	5	30	20	48	30	7	3	5	2
Sompaseuth	0	0	10	6	40	30	40	28	8	5	2	1
Hai	0	0	0	0	10	7	75	50	10	5	5	2
Somsavad	1	0.5	10	6	25	20	48	28	12	5	4	2
<b>Bolikhambay Province</b>												
<b>Thaphabath District</b>												
Naxay	0	0	10	6	8	4	52	30	20	9	10	5
Xaysavang	0	0	10	5	20	10	35	15	30	10	5	1
<b>Total</b>												

Source: LTEC, 2023

### 5.9.10 Health Services

According to the field survey, there is no malnutrition issue in the last two years. When people feel sick, they use services from the public hospital and health center nearby (Table 3-5). Some of them may buy medicine from a clinic or pharmacy to treat their illness. However, there was the COVID-19 pandemic that had impacted the socio-economic conditions as a whole. The provincial health authorities as well as the provincial authorities from other sectors had implemented the mitigation measures based on the relevant Prime Minister Instructions and Orders. During the past pandemic, there were 2,606 cases of COVID-19 (945 males and 1661 females) and no death was reported in the affected villages. As table below shows that the COVID-19 is the top illness in the project affected villages and the second highest illness in villages is common flu with 1,580 illnesses (825 males and 755 females). Other type of illnesses are stated in Table 5-29.

The overall cause of death in the project affected village over the last 12 months is by old age with total number equal to 172 deaths (91 males and 81 females). The next highest cause of death are other types of cancer (21 deaths) and liver cancer (17 deaths). Refer to Table 5-30 for additional detail on other cause of deaths.

Table 5-29: Ranking of Top Illness in Project Affected Villages

Village Name	Pop.	Malaira		Covid-19		Diarrhea		Flu		All types of cancer		Lung Infection	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
<b>Vientiane Capital</b>	<b>33,446</b>	<b>87</b>	<b>106</b>	<b>940</b>	<b>1,650</b>	<b>2</b>	<b>5</b>	<b>745</b>	<b>634</b>	<b>18</b>	<b>4</b>	<b>2</b>	<b>0</b>
<b>Xaythany District</b>	<b>18,168</b>	<b>50</b>	<b>69</b>	<b>884</b>	<b>1,596</b>	<b>2</b>	<b>5</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
1. Khoksivilay	1,703	3	4	23	12	0	0	0	0	0	0	0	0
2. Nonthong	625	0	2	1	7	0	0	0	0	0	0	0	0
3. Phailom	2,803	2	2	2	14	1	2	1	2	0	0	0	0
4. Somsavanh	5,198	0	0	810	1,500	0	0	0	0	0	0	0	0
5. Khoksavang	967	0	0	1	0	1	3	2	1	0	0	0	0
6. Phonsavanh	656	0	2	0	0	0	0	0	0	0	0	0	0
7. Naphasouk	1,236	2	3	6	8	0	0	0	0	0	0	0	0
8. Dongkhouay	1,738	42	50	6	55	0	0	0	0	0	0	0	0
9. Bolek	3,242	1	6	35	0	0	0	0	0	0	0	0	0
<b>PakNgum District</b>	<b>15,278</b>	<b>37</b>	<b>37</b>	<b>56</b>	<b>54</b>	<b>0</b>	<b>0</b>	<b>742</b>	<b>631</b>	<b>18</b>	<b>4</b>	<b>2</b>	<b>0</b>
10. Nongbouathong	1,370	20	25	0	0	0	0	110	120	4	0	0	0
11. Sangxay	1,437	0	0	2	0	0	0	90	120	3	1	0	0
12. Khoksa	460	0	0	1	4	0	0	7	4	0	0	0	0
13. Thangkhong	1,003	0	0	10	5	0	0	50	20	3	0	0	0
14. Donehai	2,113	15	12	35	45	0	0	50	20	5	3	0	0
15. Naxon	1,622	2	0	0	0	0	0	25	17	1	0	2	0
16. Phao	2,583	0	0	0	0	0	0	100	120	0	0	0	0
17. Sompaseuth	597	0	0	0	0	0	0	120	80	0	0	0	0
18. Hai	1,791	0	0	1	0	0	0	70	50	0	0	0	0
19. Somsavad	2,302	0	0	7	0	0	0	120	80	2	0	0	0
<b>Bolikhamsay Province</b>	<b>2,564</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>11</b>	<b>2</b>	<b>4</b>	<b>80</b>	<b>121</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>
<b>Thaphabath District</b>	<b>2,564</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>11</b>	<b>2</b>	<b>4</b>	<b>80</b>	<b>121</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>
20. Naxay	1,412	0	0	5	10	2	4	40	46	0	0	0	0
21. Xaysavang	1,152	1	0	0	1	0	0	40	75	0	1	0	0
<b>Total</b>	<b>36,010</b>	<b>88</b>	<b>106</b>	<b>945</b>	<b>1,661</b>	<b>4</b>	<b>9</b>	<b>825</b>	<b>755</b>	<b>18</b>	<b>5</b>	<b>2</b>	<b>0</b>

Source: LTEC, 2023

Table 5-30: Causes of Death Over the last 12 Months

Village Name	Pop.	Old age		Liver Cancer		Diabetes		Lung Infection		Other types of cancer		Malaria	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
<b>Vientiane Capital</b>	<b>33,446</b>	<b>88</b>	<b>80</b>	<b>11</b>	<b>6</b>	<b>9</b>	<b>7</b>	<b>0</b>	<b>1</b>	<b>15</b>	<b>8</b>	<b>1</b>	<b>1</b>
<b>Xaythany District</b>	<b>18,168</b>	<b>37</b>	<b>39</b>	<b>11</b>	<b>4</b>	<b>9</b>	<b>7</b>	<b>0</b>	<b>1</b>	<b>7</b>	<b>7</b>	<b>1</b>	<b>1</b>
1. Khoksivilay	1,703	2	8	1	1	1	0	0	1	0	0	0	0
2. Nonthong	625	5	2	1	1	1	1	0	0	0	0	0	0
3. Phailom	2,803	0	0	0	0	2	1	0	0	3	2	0	0
4. Somsavanh	5,198	5	5	9	0	5	5	0	0	0	0	1	1
5. Khoksavang	967	0	0	0	1	0	0	0	0	0	0	0	0
6. Phonsavanh	656	0	1	0	0	0	0	0	0	0	0	0	0
7. Naphasouk	1,236	5	6	0	0	0	0	0	0	0	0	0	0
8. Dongkhouay	1,738	3	4	0	0	0	0	0	0	4	4	0	0
9. Bolek	3,242	17	13	0	1	0	0	0	0	0	1	0	0
<b>PakNgum District</b>	<b>15,278</b>	<b>51</b>	<b>41</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>1</b>	<b>0</b>	<b>0</b>
10. Nongbouathong	1,370	0	5	0	0	0	0	0	0	3	0	0	0
11. Sangxay	1,437	4	5	0	0	0	0	0	0	3	1	0	0
12. Khoksa	460	1	0	0	0	0	0	0	0	0	0	0	0
13. Thangkhong	1,003	3	3	0	0	0	0	0	0	0	0	0	0
14. Donehai	2,113	9	11	0	0	0	0	0	0	0	0	0	0
15. Naxon	1,622	8	3	0	1	0	0	0	0	0	0	0	0
16. Phao	2,583	8	6	0	1	0	0	0	0	0	0	0	0
17. Sompaseuth	597	1	0	0	0	0	0	0	0	0	0	0	0
18. Hai	1,791	10	5	0	0	0	0	0	0	0	0	0	0
19. Somsavad	2,302	7	3	0	0	0	0	0	0	2	0	0	0
<b>Bolikhambxay Province</b>	<b>2,564</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>
<b>Thaphabath District</b>	<b>2,564</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>
20. Naxay	1,412	3	1	0	0	0	0	0	0	0	0	0	0
21. Xaysavang	1,152	0	0				1	0	0	0	1	0	0
<b>Total</b>	<b>36,010</b>	<b>91</b>	<b>81</b>	<b>11</b>	<b>6</b>	<b>9</b>	<b>8</b>	<b>0</b>	<b>1</b>	<b>15</b>	<b>9</b>	<b>1</b>	<b>1</b>

Source: LTEC, 2023



### 5.9.11 Vulnerable Populations

As per the given definition above, vulnerable groups are distinct groups of people who might suffer disproportionately or face the risk of being further marginalized by the effects of resettlement and specifically include: (i) households headed by women, the elderly people or people with disability and households with no labors, (ii) households living below the poverty threshold, (iii) the landless, and (iv) ethnic groups.

Vulnerable households, as defined by Decree 348/GOL, dated 16/11/2017 on the Criteria for Poverty Graduation and Development, Article 4 of this Decree defined criteria for graduation of families from poverty as following:

- ▶ Have safe and strong housing;
- ▶ Have assets and equipment necessary for their livelihoods and income generation;
- ▶ Have labor, stable income or employment;
- ▶ School age family members receive lower secondary school education;
- ▶ Have access to clean water and stable sources of energy; and
- ▶ Have access to primary public health services.

In order to put this decree into implementation, the government also issued a Guideline number 0830/MAF, dated 06/04/2018 on guideline for implementation the decree on the Criteria for Poverty Graduation and Development. Section 4 of this guideline indicated that families that graduated from poverty are the families that achieved six criteria for graduation of families' from poverty defined in the Decree 348/GOL, but still do not have stabilization, and vulnerable to development, risk to fall back to poverty family due to those families are not yet achieved the majority of criteria for developed families such as: political aspects, education, cultural, environmental, and national defense-peace keeping. Importantly, although members of family have occupations, they remain at subsistence income. They do not have saving for families to ensure economic stabilities of their families. Average income per person should not be less than 5.6 million kip or USD700 per person per year.

Table 3-18 indicates that Somsavanh Village has the highest rate in term of single female head of the family and disabled people with figure equal to 50% and 10% respectively. The next highest rate is Phailom Village with percentage of single female head of family equal to 30%. See the following table for more information.

**Table 5-31: Number of Vulnerable Households in Affected Villages**

Village Name	# of HHs	# of Population	Single Female Head (%)	Elderly Infirm (no labour) (%)	Landless (%)	Disabled (%)
<b>Vientiane Capital</b>	<b>6,908</b>	<b>33,446</b>				
<b>Xaythany District</b>	<b>3,818</b>	<b>18,168</b>				
1. Khoksivilay	365	1.703	5	-	1	-
2. Nonthong	174	625	-	1	-	-

Village Name	# of HHs	# of Population	Single Female Head (%)	Elderly Infirm (no labour) (%)	Landless (%)	Disabled (%)
3. Phailom	533	2.803	30	-	-	1
4. Somsavanh	1.165	5.198	50	2	-	10
5. Khoksavang	180	967	10	3	-	1
6. Phonsavanh	132	656	8	-	-	1
7. Naphasouk	220	1.236	9	-	-	1
8. Dongkhouay	391	1.738	25	-	-	-
9. Bolek	658	3.242	20	2	1	5
<b>PakNgum District</b>	<b>3,090</b>	<b>15,278</b>				
10. Nongbouathong	230	1.370	6	2	2	-
11. Sangxay	257	1.437	15	1	-	2
12. Khoksa	86	460	1	-	5	1
13. Thangkhong	193	1.003	10	1	-	3
14. Donehai	408	2.113	12	-	-	-
15. Naxon	451	1.622	9	1	6	4
16. Phao	558	2.583	13	-	1	1
17. Sompaseuth	122	597	7	2	-	4
18. Hai	370	1.791	18	-	-	-
19. Somsavad	415	2.302	5	-	-	-
<b>Bolikhambay Province</b>	<b>444</b>	<b>2,564</b>				
<b>Thaphabath District</b>	<b>444</b>	<b>2,564</b>				
20. Naxay	227	1.412	15	-	0	1
21. Xaysavang	217	1.152	10	1	0	0
<b>Total</b>	<b>7,352</b>	<b>36,010</b>				

Source: LTEC, 2023

### 5.9.12 Electricity and Energy Use

From 21 project affected villages, most of them can access to fuel that used for cooking either through electricity, wood, charcoal or gas. The demands for type of fuels are fluctuated from one village to another. For instance, Somsavanh Village has the highest percentage use of electricity (20%) while the highest percentage use of wood as fuel is Phonsavanh Village (50%). Nonthong Village and Xaysavang Village have the highest rate of use on gas with 30% each whereas Dongkhouay Village depends 100% on charcoal for cooking fuel. Additional details are stated in the Table 5-32.

**Table 5-32: Sources of Fuel used for Cooking in the Project Affected Villages**

Village Name	# of HHs	Electricity (%)	Wood (%)	Charcoal (%)	Gas (%)
<b>Vientiane Capital</b>	<b>6,908</b>				
<b>Xaythany District</b>	<b>3,818</b>				
1. Khoksivilay	365	10	40	40	10
2. Nonthong	174	9	7	54	30
3. Phailom	533	10	25	60	5
4. Somsavanh	1,165	20	20	50	10
5. Khoksavang	180	5	25	65	5

6. Phonsavanh	132	0	50	40	10
7. Naphasouk	220	5	15	70	10
8. Dongkhouay	391	0	0	100	0
9. Bolek	658	2	12	76	10
<b>PakNgum District</b>	<b>3,090</b>				
10. Nongbouathong	230	8	42	41	9
11. Sangxay	257	10	5	80	5
12. Khoksa	86	5	5	80	10
13. Thangkhong	193	4	3	90	3
14. Donehai	408	10	5	80	5
15. Naxon	451	5	5	90	0
16. Phao	558	7	0	90	3
17. Sompaseuth	122	5	10	80	5
18. Hai	370	2	43	50	5
19. Somsavad	415	0	15	80	5
<b>Bolikhamxay Province</b>	<b>444</b>				
<b>Thaphabath District</b>	<b>444</b>				
20. Naxay	227	5	10	80	5
21. Xaysavang	217	5	5	60	30
<b>Total</b>	<b>7,352</b>				

Source: LTEC, 2023

### 5.9.13 Agriculture

#### Domestic Animal Husbandry

Table 5-33 below shows the number of domestic animals in affected villages. The majority of villagers raise poultry as main sources of food and incomes followed by cow, goat, pig and buffalo respectively.

Table 5-33: Domestic Animals in Project Affected Villages

Village Name	Buffalo		Cow		Goat		Pig		Poultry	
	# of animal	# of HH	# of animal	# of HH	# of animal	# of HH	# of animal	# of HH	# of animal	# of HH
<b>Vientiane Capital</b>	<b>784</b>	<b>68</b>	<b>9,086</b>	<b>744</b>	<b>2,698</b>	<b>275</b>	<b>2,304</b>	<b>143</b>	<b>79,346</b>	<b>2,470</b>
<b>Xaythany District</b>	<b>278</b>	<b>30</b>	<b>6,075</b>	<b>352</b>	<b>1,721</b>	<b>140</b>	<b>513</b>	<b>66</b>	<b>57,156</b>	<b>727</b>
1. Khoksivilay	0	0	247	18	114	14	25	3	3,913	45
2. Nonthong	2	1	87	7	10	3	6	2	9,500	36
3. Phailom	0	0	480	60	300	30	0	0	4,200	130
4. Somsavanh	67	3	1,610	30	510	30	272	50	20,857	55
5. Khoksavang	3	1	350	19	78	6	0	0	2,250	20
6. Phonsavanh	0	0	375	15	160	20	10	1	1,152	20
7. Naphasouk	12	3	220	8	64	8	65	8	2,700	116
8. Dongkhouay	134	17	1,206	130	105	18	0	0	6,336	185
9. Bolek	60	5	1,500	65	380	11	135	2	6,248	120
<b>PakNgum District</b>	<b>506</b>	<b>38</b>	<b>3,011</b>	<b>392</b>	<b>977</b>	<b>135</b>	<b>1,791</b>	<b>77</b>	<b>22,190</b>	<b>1,743</b>
10. Nongbouathong	100	6	200	15	120	20	35	7	2,230	100
11. Sangxay	7	2	470	180	161	50	0	0	2,520	200
12. Khoksa	7	1	250	5	50	10	20	3	570	86
13. Thangkhong	17	1	270	70	150	20	180	10	1,000	150

Village Name	Buffalo		Cow		Goat		Pig		Poultry	
	# of animal	# of HH	# of animal	# of HH	# of animal	# of HH	# of animal	# of HH	# of animal	# of HH
14. Donehai	50	5	350	35	150	6	500	10	1,500	275
15. Naxon	86	5	176	16	71	3	171	7	2,870	225
16. Phao	11	1	600	20	100	4	0	0	3,800	334
17. Sompaseuth	35	3	85	10	35	9	565	30	3,500	85
18. Hai	25	4	240	20	80	4	270	5	2,500	148
19. Somsavad	168	10	370	21	60	9	50	5	1,700	140
<b>Bolikhambay Province</b>	<b>373</b>	<b>25</b>	<b>944</b>	<b>95</b>	<b>183</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>6,625</b>	<b>260</b>
<b>Thaphabath District</b>	<b>373</b>	<b>25</b>	<b>944</b>	<b>95</b>	<b>183</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>6,625</b>	<b>260</b>
20. Naxay	298	18	674	45	128	9	0	0	4,125	150
21. Xaysavang	75	7	270	50	55	5	0	0	2,500	110
<b>Total</b>	<b>1,157</b>	<b>93</b>	<b>10,030</b>	<b>839</b>	<b>2,881</b>	<b>289</b>	<b>2,304</b>	<b>143</b>	<b>85,971</b>	<b>2,730</b>

Source: LTEC, 2023

#### 5.9.14 Economic, Livelihood and Resource Use

##### *Employment*

Occupations of people in the affected villages includes government officials (including teachers, soldiers, general public services in provincial and district government departments) with Nonthong Village has the highest percentage at 52% and large number of people in Sangxay Village (95%) are farmers. Other of this population is currently engaged in private sector employment, farming, family business and general workers. This is similarly to the occupation and income sources of affected households (refer to Table 5-34) for more detail).

Table 5-34: Main Occupation in the Project Affected Villages

Village Name	Farmer		Business and Service provider		State official		State enterprise / private sector employee		Worker	
	% Total	% Female	% Total	% Female	% Total	% Female	% Total	% Female	% Total	% Female
<b>Vientiane Capital</b>										
<b>Xaythany District</b>										
1. Khoksivilay	10	2	15	12	50	22	5	2	20	15
2. Nonthong	3	1	10	4	52	23			35	15
3. Phailom	5	2	20	15	20	10	15	5	40	15
4. Somsavanh	10	5	5	3	13	3	5	3	67	40
5. Khoksavang	29	20	15	11	5	3	1		50	45
6. Phonsavanh	30	30	10	5	18	8			15	9
7. Naphasouk	60	25	5	2	10	6			25	10
8. Dongkhouay	82	42	2	1	5	2			11	4
9. Bolek	75	30	15	10	4	1			6	4
<b>PakNgum District</b>										
10. Nongbouathong	60	36	2	0.3	1	0.2	0.3	0.1	35.7	16
11. Sangxay	95	40	3	2	2	1				
12. Khoksa	90	50	3	3	5	3				2
13. Thangkhong	90	40	1	1	2	1	1		6	3
14. Donehai	90	40	1		2				7	
15. Naxon	80	35	5	1	10	4			5	2
16. Phao	90	50	2	1	7	2			1	
17. Sompaseuth	90	5	5	1	9	3	0	0	7	2
18. Hai	80	50	5	3	3	1	0	0	7	2

Village Name	Farmer		Business and Service provider		State official		State enterprise / private sector employee		Worker	
	% Total	% Female	% Total	% Female	% Total	% Female	% Total	% Female	% Total	% Female
19. Somsavad	50	25	21	12	8	4	1	0	20	2
<b>Bolikhambay Province</b>										
<b>Thaphabath District</b>										
20. Naxay	70	35	5	3	12	5	0	0	13	4
21. Xaysavang	30	20	5	3	30	28			10	4

Source: LTEC, 2023

### 5.9.15 Wealth and Poverty

The Guideline number 0830/MAF, dated 06/04/2018 on guideline for implementation the decree 384, 2017 sets the Criteria for Poverty Graduation and Development. Section 4 of this guideline indicates that families that graduate from poverty are the families that have achieved six criteria for graduation of families' from poverty defined in the Decree 348/GOL, but still do not have stabilization, and are vulnerable with risk to fall back into poverty as they have not yet achieved the majority of criteria for developed families such as: political aspects, education, cultural, environmental, and national defence-peace keeping. Importantly, although members of a family have occupations, they remain at subsistence income. They do not have savings to ensure economic stability of their families. Average income per person should not be less than 5.6 million kip or USD700 per person per year.

The results provided in Table 5-35 show that the majority of households in termsA of wealth in Project affected villages are sufficiently well-off. Except one percent of households in Khoksivilay Village that is poor without land. 11% of households in Sangxay Village and 3% each from Hai and Somsavad Villages are poor but have some land.

**Table 5-35: Perceptions on Wealth in Project Affected Villages**

Villages	# of HHs	Very Well-Off		Sufficiently Well-Off		Poor with Some Land		Poor with No Land	
		% of HHs	Avg. HHs p. a. income (mill LAK)	% of HHs	Avg. HHs p. a. income (mill LAK)	% of HHs	Avg. HHs p. a. income (mill LAK)	% of HHs	Avg. HHs p. a. income (mill LAK)
<b>Vientiane Capital</b>	<b>6,908</b>								
<b>Xaythany District</b>	<b>3,818</b>								
1. Khoksivilay	365	4	900	99	45	0	0	1	1
2. Nonthong	174	0	0	100	30	0	0	0	0
3. Phailom	533	0	0	100	25	0	0	0	0
4. Somsavanh	1,165	1	300	100	20	0	0	0	0
5. Khoksavang	180	0	0	100	25	0	0	0	0
6. Phonsavanh	132	1	300	99	35	0	0	0	0
7. Naphasouk	220	0	0	100	20	0	0	0	0
8. Dongkhouay	391	0	0	100	28	0	0	0	0
9. Bolek	658	5	600	95	32	0	0	0	0
<b>PakNgum District</b>	<b>3,090</b>								
10. Nongbouathong	230	3	500	97	25	0	0	0	0
11. Sangxay	257	0	0	89	30	11	12	0	0
12. Khoksa	86	3	150	97	30	0	0	0	0
13. Thangkhong	193	5	200	95	20	0	0	0	0
14. Donehai	408	2	300	98	25	0	0	0	0
15. Naxon	451	0	0	100	25	0	0	0	0
16. Phao	558	1	128	99	25	0	0	0	0
17. Sompaseuth	122	0	0	100	15	0	0	0	0

18. Hai	370	4	300	98	20	3	3	0	0
19. Somsavad	415	0	0	99	20	3	3	0	0
<b>Bolikhambay Province</b>	<b>444</b>	<b>4</b>	<b>400</b>		<b>70</b>	-	-	-	-
<b>Thaphabath District</b>	<b>444</b>	<b>4</b>	<b>400</b>		<b>70</b>	-	-	-	-
20. Naxay	227	0	0	100	20	0	0	0	0
21. Xaysavang	217	4	400	99	50	0	0	0	0
<b>Total</b>	<b>7,352</b>								

Source: LTEC, 2023

### 5.9.16 Food Security

Rice is the main staple crop for local people in affected villages and the nation in general. Most of households in Thangkhong and Sompaseuth Villages are cultivating rice 100% and followed by Donehai and Dongkhouay villages with 50% and 46% respectively. Percentage of households with rice in the past 12 months indicated that Hai Village has the highest percentage (100%) and followed by Khoksa Village (95%). See Table 3-17 below for more details.

**Table 5-36: Rice Sufficiency in the Project Affected Villages**

Village Name	# of of HHs	Percentage (%) of HHs cultivating rice	Percentage (%) Households with Rice			
			12 Months	9-11 Months	6-8 Months	≤ 5 Months
<b>Vientiane Capital</b>	<b>6,908</b>					
<b>Xaythany District</b>	<b>3,818</b>					
1. Khoksilay	365	5%	95%	0%	0%	0%
2. Nonthong	174	0%	0%	40%	35%	25%
3. Phailom	533	0%	70%	20%	10%	0%
4. Somsavanh	1,165	10%	85%	5%	0%	0%
5. Khoksavang	180	3%	82%	15%	0%	0%
6. Phonsavanh	132	0%	80%	15%	5%	0%
7. Naphasouk	220	10%	60%	20%	10%	0%
8. Dongkhouay	391	46%	34%	20%	0%	0%
9. Bolek	658	10%	85%	5%	0%	0%
<b>PakNgum District</b>	<b>3,090</b>					
10. Nongbouathong	230	10%	90%	0%	0%	0%
11. Sangxay	257	5%	80%	8%	5%	2%
12. Khoksa	86	2%	95%	3%	0%	0%
13. Thangkhong	193	100%	0%	0%	0%	0%



Village Name	# of of HHs	Percentage (%) of HHs cultivating rice	Percentage (%) Households with Rice			
			12 Months	9-11 Months	6-8 Months	≤ 5 Months
14. Donehai	408	50%	40%	10%	0%	0%
15. Naxon	451	5%	90%	5%	0%	0%
16. Phao	558	2%	80%	17%	1%	0%
17. Sompaseuth	122	100%	80%	10%	0%	0%
18. Hai	370	0%	100%	0%	0%	0%
19. Somsavad	415	0%	50%	20%	30%	0%
<b>Bolikhamxay Province</b>	<b>444</b>					
<b>Thaphabath District</b>	<b>444</b>					
20. Naxay	227	50%	40%	10%	0%	0%
21. Xaysavang	217	30%	70%	0%	0%	0%
<b>Total/Mean</b>	<b>7,352</b>	-	-	-	-	-

Source: LTEC, 2023

## 6. IMPACT ASSESSMENT AND MITIGATION MEASURES

### 6.1 Assessment Methodology

The ESIA process involves identification and prediction of potential impacts, and assessment of the risk level associated with those impacts.

The assessment of potential impacts associated with the Project incorporates the following steps:

1. **Baseline assessment** of the environmental and social setting by building on the extensive information available on the KJE Project, detailed spatial analysis and further definition of baseline conditions that may be impacted by the Project including physical, biological, cultural and socio-economic environment through targeted field investigations;
2. **Risk assessment** based on internationally accepted risk assessment methodologies to rate the significance of potential environmental and social risks (refer Chapter 6).
3. **Assessment of potential impacts** on receptors based on the Project design;
4. **Mitigation of impacts** by integrating into the Project design measures to avoid, reduce, mitigate or compensate for adverse impacts and to enhance benefits (as per the mitigation hierarchy below); and
5. **Assessment of residual impacts** after implementation of mitigation measures.

Typically, expected impacts and risks to sensitive receptors (physical, biological or social) are characterised in terms of the following aspects:

- ▶ Nature (direct, indirect or induced; positive or negative);
- ▶ Duration (permanent or temporary / reversible or irreversible); and
- ▶ Geographical extent (local, regional or national).

The ESIA predicts the impacts and assesses the risks associated with the project. The impacts/risks may be a direct result of the Project (e.g. generation of dust, and health and safety, and land acquisition) or may be indirect (e.g. pressure on local resources caused by an influx of migrants attracted by the Project and other regional opportunities).

### 6.2 Mitigation Hierarchy

The mitigation hierarchy involves a series of steps to avoid or minimise the impact and risk to the environment and surrounding communities. As per the process outlined in Figure 6-1, the hierarchy of options for mitigation is applied to identify the preferred approach for significant negative impacts or risks identified in the ESIA process. The mitigation hierarchy includes:

- i. **Avoidance:** Involves removing the source of the impact, or 'designing out' an impact or risk (e.g. relocating a project component, avoiding a harmful activity, employing a new

- technology etc.). Avoidance should be considered for where there are features that are particularly rare, vulnerable, difficult to restore to their former structure and function, and/or are recognised as the highest priority for conservation.
- ii. **Minimisation:** Minimising or reducing the impact by controlling the source of the impact or risk (e.g. road spraying, vehicle speed restrictions) or creating a barrier between the impact source and the receptor (e.g. noise screens). Minimisation aims to reduce the severity, duration and/or likelihood of impacts that cannot be prevented by avoidance.
  - iii. **Restoration / Rehabilitation:** Some activities will result in unavoidable impacts to resources (e.g. loss of land use due to road construction). Restoration measures aim to return a resource or livelihoods to their initial state, while rehabilitation measures aim to create safe, stable landforms and protect water quality. Secondary objectives for rehabilitation are based on stakeholder consultation and may include water resource protection and re-establishment of land uses.
  - iv. **Compensate / Offset:** If other mitigation measures are not possible or fully effective, compensation or offset measures may be required to address the residual impact (i.e. those impacts that remain after avoidance and mitigation measures have been implemented).

Where possible, environmental and social impacts are avoided by making changes to the project design in an iterative manner (e.g. re-alignment of road sections to avoid a key environmental and/or social features).

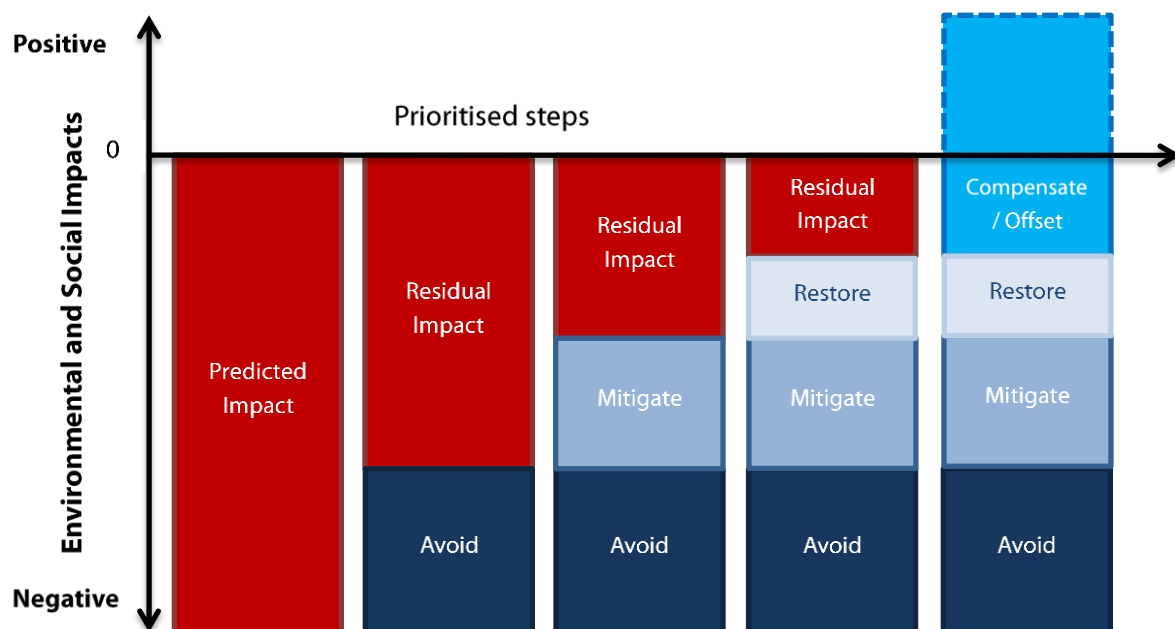


Figure 6-1: Application of the mitigation hierarchy

### 6.3 Overall Impacts

The overall impacts of the proposed Project will be positive in improving road accessibility, road safety, flooding resilience, and well-being of the local people. Spot improvements of critical

sections aim to improve the road's climate resilience that include elevating flood prone road sections, paving road sections with steep gradients and sections passing through large communities, drainage improvement/construction, and slope improvement/ stabilization. The Project will also provide significant capacity building through on-the-job training, the introduction and implementation of OPBRCs on road improvement, and the environmental and social planning and management that goes along with the Project activities.

This impact assessment and mitigating measures cover the entire cycle of the Project activities, from design, pre-construction, construction and operation and maintenance. The coverage of the project phases is defined as follows:

- Preparation phase including time for preparation of Project activities and investment, preparation of the ESMP, RP, GAP and SEP including detailed measurement survey (DMS) and determination of compensation unit rate is completed as well as the mobilization of construction supervision consultant, detailed engineering design (DD) and preparation of bidding documents (BD) and contract document (CD) including all AIB clearances.
- Pre-Construction Phase is the time before the 'Notice to Proceed' is given to the contractor to commence the construction covering the beginning time for bidding and implementation of RP, GAP and SEP. Payment of compensation for project affected people as per RP and GOL issuance of the ECCs and other necessary approval must be completed before construction can begin.
- Construction Phase is the period from the completion of the Pre-construction activities time until the issuing of the 'Certificate of Completion'. Implementation and compliance monitoring and reporting of the ESMP, GAP and SEP including ECC conditions.
- Operation and Maintenance (O&M) Phase is the time from completion of works (including site clearance) and maintenance activities during the OPBRC period. It is expected that after the OPBRC, the O&M responsibility will be under the responsibility of the DPWT of VTE and BKX.

Potential impacts of the Project can be classified as:

- Direct Impacts - i.e., those directly due to the Project itself such as the conversion of land previously used for agricultural purposes to transport use. Direct impacts also include the impact of construction expenditures in the local economy.
- Indirect Impacts – i.e., those resulting from activities prompted by the Project, but not directly attributable to it. The use of rock for the improved roadbeds, for example, has an indirect impact of increasing the demand for crushed rock and increased borrow operations.
- Cumulative Impacts – i.e., impacts in conjunction with other activities. A single road improvement may not exert a significant environmental impact, but if several roads comprising a network are developed in the same area, or are combined with agricultural

reform programs in the same general area, the cumulative or additive effect could be large.

The nature of risks and impacts on local community and local environment is assessed according to key Project activities on physical, biological, and sociological characteristics of local conditions while the level of impacts can be categorized as short-term or long-term. Both short-term and long-term impacts may be either beneficial or adverse. Short-term positive impacts will include, for example, the generation of employment opportunities during construction period. Long-term benefits will include enhanced development opportunities, improved transport services, easier access to commercial and service facilities; faster communications and commodity transport; improved access to markets and growth centers and increased services and commercial facilities.

Table 6-1 summarizes the risk assessment matrix for impacts significance of the NR13SE.

**Table 6-1 Risk Assessment Matrix for Impacts Significance**

Aspect	Physical Characteristic					Biological Characteristic			Socio-economic Characteristic							
	Geology	Topography	Soils	Climate and Air Quality	Hydrology	Flora	Fauna	Protected Areas	Infrastructure	Land Use	Waste Management	Socio-economic	Health and Safety	Educational / Health Facilities	PCR	Noise
Land Acquisition										D/L		D/L				
Borrow Pits / Quarries		D/L	D/S	D/S	D/S	D/S			D/S	D/S			D/L			D/S
Asphalt Plants / Batching Plants			D/S	D/S	D/S	D/S			D/S	D/S	D/S		D/S			D/S
Construction Camps			D/S	D/S	D/S	D/S			D/S	D/S	D/S	D/S	D/S			D/S
Storage / Lay down Areas			D/S		D/S	D/S			D/S	D/S	D/S		D/S			D/S
Haulage Routes/transport of construction materials				D/S					D/S			D/S	D/S	D/S		D/S
Site Clearance			D/L		D/S	D/L	D/L			D/L	D/S		D/S		D/L	D/S
Pavement construction				D/S	D/S				D/S		D/S		D/S			D/S
Culverts & Site drains			D/S	D/S	D/S	D/S					D/S		D/S			D/S
Earthworks/excavation		D/L	D/L	D/S	D/S	D/L	D/S		D/S	D/S	D/S		D/S			D/S
Removal of Trees			D/L		D/L	D/L	D/L			D/L		D/S				D/S
Relocation of Services									D/S	D/S		D/S				D/S
Increased traffic				D/L								D/L	D/L	D/L		D/L
Road maintenance			D/S	D/S	D/S						D/S	D/S	D/L			D/S

D = Direct Impact	S =	Short-term Impact		Potential Positive Impact		Potential Impact	Low/Medium		Potential High Impact
	L	Long term impact							

## 6.4 Positive Impacts

1. **Social benefits:** These include (1) Improvement of the economic conditions of beneficiary households; (2) Increase household income and hence, reduce poverty due to (a); potential commercialization of agricultural and non-agricultural production expected to increase in the areas; (b) The buyers can come to collect and buy local products in place with reasonable prices thanks to the improved condition of road; (3) Savings on labor, time and local materials for the beneficiary households from the frequent repair of the road particularly during the wet season; (4) Increased empowerment of women through their representation in other committees that will be established through the project implementation and project activities.

2. **Individual households (HH) benefits:** Beneficiary households and local people are expected to save time spent to access public services such as health centers, high schools, banks, agricultural technical service center located in the district and provincial towns. The road users could also benefit from improved access to economic domains as they would transport their agricultural and non-agricultural products (such as cassava, rice, maize, cardamom, jobs tea, galangal, ground nuts and variety of vegetables, non-timber products and animal products) to the districts and the provinces market. Their children also can come back from school in the same day or more quickly to help parent do domestic works due to improved condition of the road. They also can use tracks, bikes or carts to carry to the local markets. All those positive impacts mentioned will contribute HHs' improved livelihood and income to finance education for children and HH member health care.

3. In addition, the Project will also support community engagement in road operations and maintenance (O&M) through: (i) establishment and capability development of a road maintenance group that will be responsible for the rehabilitated/improved road system; (ii) collection of funds for the road O&M; (iii) improved management of the road maintenance; and (iv) institutionalized grievance redress mechanism into GoL system. During the consultation, all the participants agreed that the road upgraded is their dream. They all support this project for many positive reasons such as the new and standard road will show a good image of the community as well as the country, better road equals to better transportation, possibly reduces the issues of road accident and better road safety conditions.

## 6.5 Physical Impacts and Mitigation Measures

### 6.5.1 Topography, Soils and Land Capability

#### *Issues and Findings*

#### **Pre-Construction and Construction Phases**

The Project will predominantly occur within the existing alignment except for a few minor re-alignment Sections (Km 36, Km 65 & Km 70). Pre-construction and construction activities will include site preparation activities such as vegetation clearance, stripping of topsoil, removing of existing road surface, land levelling and grading, and earthworks; construction of site drainage,

erosion and sediment control structures; and road surface pavement. Anticipated impacts are expected to be localised within the construction area of the Project Footprint.

The Project lies on flat terrain and will involve significant earthworks in the form of fills for road widening along the entire road section. It is estimated that filling will require at least 200,000 m<sup>3</sup> of laterite soils which will be sourced from five locally existing borrow pits owned and operated by individuals or entity (refer to Appendix 2, Figure 1-24 to 1-27). The potential sources are summarized in Table 3-4 for existing borrows and quarries. The excavation of material from all sites has the potential to impact on the local environment of the sites. This is highly dependent on the methods used to excavate the material such as excavation, stockpiling and transporting of material along the haulage routes. The potential impacts of material excavation include:

- ▶ Exposure of soil that has the potential to lead to increased erosion and discharge of sediment into waterways;
- ▶ Exposed faces and slopes that may be at risk of landslide or collapse;
- ▶ The dewatering of some areas within source sites has potential to impact on flow activation of potential plumes;
- ▶ Discharge of effluents from aggregate washing and crushing has potential to impact on water quality; and
- ▶ Increased noise, dust and vibrations in the local area surrounding the source sites.

At these locations, erosion is a significant risk due to both earthworks and the exposure of large areas of soil and subsoil following vegetation clearance and soil stripping. The removal of vegetation exposes soils, which are then highly susceptible to erosion by surface runoff. Significant downstream transport of soils and sediment is possible during this phase, which can result in the loss of fertile soils and the smothering of downstream waterways and adjacent land. It is recommended that the development and implementation of comprehensive erosion and sediment measures for each relevant road section, including construction of drainage controls and sedimentation ponds, deployment and maintenance of sediment control devices such as silt fences and jute netting, and planting and maintenance of stabilising vegetation.

Quarrying for aggregate, sand and fill will likely result in permanent geomorphological changes in the quarry/borrow areas and the surrounding area. Soils in the areas where construction material will be sourced will be stripped to expose construction materials, which will be susceptible to erosion with the potential for significant downstream sediment transport.

It is recommended that prior to any quarrying, a full environmental assessment is undertaken for each site. Each quarry must have the development and implementation of comprehensive erosion and sediment measures including construction of drainage controls and sedimentation ponds, daily deployment and maintenance of sediment control devices such as silt fences and jute netting, and planning of quarrying operations to minimise long-term exposure of erosive materials. It is expected that each quarry will also have a rehabilitation strategy for the closure of the site after the sourcing of materials.

## **Operations**



The final fills and embankment slopes are highly susceptible to erosion due to their relatively high (unnatural) slope angles and the erosive character of exposed materials (clays and unconsolidated gravel fill). Erosion has the potential to degrade geotechnical stability of slopes over time (which can lead to rock falls and slope failures), impact road accessibility, and transport significant quantities of sediment into downstream environments resulting in impacts on downstream water quality, land and water/land users.

It is recommended that these areas are geotechnically monitored for structural stability to ensure that all potential risks are minimised and that the risk of landslides or collapses are minor after construction. The installation of safety measures for road sections with potential for slope stability issues, such as drainage controls, rock bolting, concrete reinforcement and gabions must be considered for all locations.

### ***Avoidance, Management and Mitigation Measures***

Key avoidance, management and mitigation measures for topography, soils and land capability include:

- ▶ Minimise land clearance to only the land required for the Project;
- ▶ Provide appropriate erosion and sediment controls at strategic locations including for steep slopes and near local watercourses, e.g. sediment traps, seed soil-binding grass, vegetation buffers, etc;
- ▶ Conduct progressive rehabilitation / revegetation of disturbed areas as soon as possible to prevent soil and wind erosion;
- ▶ Implement regular maintenance and inspection schedule for erosion and sediment controls;
- ▶ To the extent practical, avoid undertaking earthworks during the wet season and periods of heavy rain, unless earthworks are needed to prevent erosion; and
- ▶ Implement relevant measures for erosion and sediment transport provided in Section 7.1.2 – Water Quality and for dust generation in Section 7.1.3 – Air Quality.

### ***Conclusions***

The primary impact will consist of the permanent widening of the road and adjacent landforms within the existing alignment. The anticipated residual impact will be low to negligible due to limited additional land acquisition. Similarly, the residual impact to soil quality and potential for soil contamination will be medium during wet season and negligible during dry season. However, with the implementation of proper Compensation Plan set out in Volume C-2 and ESMP, the anticipated loss of land and associated livelihoods will be low.

Project planning / design, construction and maintenance methods will need to carefully consider erosion and sedimentation impacts throughout the operational life of the Project.

## **6.5.2 Surface Water**

### ***Issues and Findings***

#### **Pre-Construction and Construction Phases**

Results from baseline monitoring indicate water quality in the Project area within normal range for most water quality parameters. The exceptions were nitrate chemical oxygen demand (COD), total and faecal bacteria coliforms which were slightly higher than the National Standards (2017) in all monitoring locations. The results indicated current low baseflow and bacterial contamination from agricultural and domestic animals using the watercourses.

The NR13SE will involve numerous construction zones that have the potential to contaminate water quality. Solid waste from associated camp activities such as human scraps, packaging and waste paper along with spills or leaks of hydrocarbons, oils, greases, tar, asphalt and other pollutants have the potential to contaminate surface and groundwater. This pollution would be transported by surface runoff into waterways, and has the potential to significantly impact water quality. Consequentially, this would have implications on aquatic resources, domestic animals and some local households who rely on boreholes and wells.

Due to the precipitation regime in the region (e.g. moderately high seasonal volume and high intensity rains during the height of the rainy season) and proposed works (e.g. vegetation clearance, earthworks, leveling and compaction) during the construction phase of the Project, the site will be susceptible to disturbance, erosion and season accelerated water and sediment runoff.

Erosion resulting from construction activities and major earthworks may result in adverse impacts to water quality if not effectively managed. Land clearing and the stripping of topsoil as proposed during the Pre-Construction and Construction Phases is likely to increase the risk of erosion impacts, especially to the nearest watercourse to the Project site. Contaminated runoff from the Project footprint may be at risk of entering nearby tributaries following fuel spills or leaking septic systems if stormwater and wastewater treatment and management procedures and mitigation strategies are not enacted.

The location of accommodation camps will be determined by the preferred construction contractor during the detailed design stage for the Project. However, these sites will produce several waste streams including sewage waste. Detailed measures for the management of wastewater from accommodation camps have been included in the ESMP (Volume C-1).

Sewage from accommodation camps may provide a potential source of nutrients and/or pathogens that may be released into receiving waters downstream in the absence of appropriate sewage treatment and management. Adequate provision of portable toilet facilities for project workers on construction sites will also be required to help prevent soil and water contamination from sewage.

The potential surface water quality impacts associated with the Pre-Construction and Construction Phase which require careful management include:

- ▶ Erosion and increased sedimentation following earthworks, land clearing and topsoil removal;
- ▶ Oil, grease and hydrocarbon pollution associated with vehicles and heavy machinery; and
- ▶ Release of pathogen and nutrient pollution associated with human activity, accommodation, improper sewage treatment and putrescible waste.

## **Operation Phase**

The NR13SE will possibly contribute to erosion and transport of sediment due to the higher runoff generated within Project corridor. Higher runoff could lead to possible changes in stormwater flow, and consequently result in downstream bank erosion and associated sediment transport within wetlands. Erosion in the highest energy parts of the stormwater drainage system (in downhill channels and in exit flow channels) can be significant if not managed appropriately, resulting in localised scouring and degradation of land, and downstream transport of sediment related to this erosion. It is recommended that the drainage system flows into existing water networks that have the capacity to deal with higher runoff flows or alternatively affected wetlands can be improved.

There is likely to be erosion from the exposed surfaces areas and slopes created, leading to the increase of sediment content in surface waters that will eventually settle within the main drainage channels. The creation of stockpiles and use of material from external sources (quarries) during this process will potentially be eroded by relevant storm water flows and the introduction of culverts as required for the NR13SE alignment will also increase the sediment load in water bodies affected by the Project.

### ***Avoidance, Management and Mitigation Measures***

The Project will minimise erosion and sediment transport from the site through implementation of appropriate scheduling and phasing, stormwater, erosion, and sediment controls.

#### **Scheduling and Phasing**

Construction and maintenance works will be scheduled and phased to reduce the volume and duration of soil exposed to erosion by wind and rain and subsequent runoff / emissions and transport of sediment off-site. General phasing requirements should consider the following:

- ▶ The sequence of erosion and sediment control (ESC) installation and removal in relation to the scheduling of earth disturbing activities should be identified prior to, during and after construction to ensure the proper functioning of all stormwater, ESC measures and facilities;
- ▶ Construction of surface water diversion channels and installation of ESC facilities will be scheduled for completion in advance of ground disturbing activities for primary controls (i.e. sedimentation ponds and water diversion structures) to the extent practical and in advance of the rainy season to minimise sheet erosion from upstream / upslope sources;
- ▶ Soil disturbing activities will be phased in such a way that critical areas (areas adjacent to receiving waters) are not disturbed during the rainy season to the extent practicable. Critical areas should be protected through the development of suitable stormwater management measures and erosion / sediment control facilities;
- ▶ Minimise the length of time between initial soil exposure and final earthworks / grading;
- ▶ The optimal time for road and facilities construction is during the dry season;
- ▶ Regular monitoring and routine maintenance of stormwater channels, and erosion / sediment control facilities will be scheduled prior to the onset of major earthworks; and

- ▶ A regular monitoring and maintenance program that provides an inspection schedule, maintenance requirements, timeframes, and directions for sediment removal will be developed.

### **Stormwater Control**

Effective ESC for the protection of downstream surface waters requires stormwater management in combination with ESC measures and facilities. Effective stormwater management requires significant analysis and planning prior to designing primary facilities. LTEC design engineers are in the process of designing stormwater management with full consideration of peak discharge events, historic precipitation and flooding analysis. Stormwater channel dimensions and boundary roadside locations have been determined to adequately control and convey water from peak storm events to two-celled sedimentation pond(s) / passive water treatment facility. Stormwater will be managed as follows:

- ▶ Temporary diversion channels / swales will intercept and direct 'clean' water upslope of disturbed areas and convey it to a stabilised outlet at a non-erosive velocity (refer to below);
- ▶ Additional channels will intercept and direct sediment-laden runoff from disturbed areas and convey water from the Project footprint to the two-celled settling basin(s) / passive treatment structure;
- ▶ Stormwater channels will be constructed to convey water along the road, via concrete channel, with a riprap apron at the discharge point to watercourses;
- ▶ Long-term and temporary drainage channels have been designed and constructed such that the water volume and flow velocity do not exceed the capacity.

### **Conclusions**

Impacts to water quality during the Pre-Construction and Construction Phases of the Project are predicted to arise from increased sedimentation resulting from earthworks, land clearing, and construction activities. Additional impact may arise due to fuel or chemical spills from heavy machinery; however, these are considered to be of low likelihood. Impacts to water quality during the Operational Phase could be positive due to good road surface that minimise sedimentation and contamination in downstream waters.

The residual impacts from construction activities and operation after the implementation of strategies are assessed as being Low. Residual impacts during the Operational Phase are also predicted to be Low. Further discussion on water quality monitoring can be found in ESMP - Water Quality.

### **6.5.3 Air Quality**

#### **Issues and Findings**

##### **Pre-Construction and Operation Phases**

No significant air quality impacts are expected to occur during the Pre-Construction Phase as no major activities with air emissions will occur for the Project during this phase.

Sources of air quality impacts from the Project during construction are expected to include:

- ▶ Dust and vehicle exhaust emissions at construction sites;
- ▶ Emissions from power generation at work sites;
- ▶ Laying of bituminous surface (potential for (VOCs);
- ▶ Smoke from burning of cleared vegetation and wastes (if conducted); and
- ▶ Vehicle exhaust emissions from transport of construction materials and equipment.

The primary issue for air quality during construction is expected to be related to dust emissions from construction areas. The dispersal of dust emissions due to road construction will be dependent on factors such as the prevailing wind conditions and rainfall. Up to 90% of construction road dust typically impacts within 50 m of the road. Sensitive receptors located close to the NR13SE alignment and general road users may be at risk of experiencing low air quality from dust particulate matter during high-risk meteorological periods such as during thermal inversions.

The health impacts of construction road dust on nearby residents and workers depend greatly on the amount and size of the dust particles. Depending on the composition, visible particles can be inhaled without any health impacts. However, high levels of large-suspended particles reduce visibility significantly, and may therefore become a safety hazard for road users' safety. Fine particle exposure (PM10) may lead to short-term health impacts, including respiratory symptoms such as irritation of the lung way.

Due to the road's close location to densely populated areas, in the absence of appropriate management there is the potential for more people with lower sensitivity thresholds to be affected negatively during periods of intense construction, or when air quality are poor. Appropriate mitigation measures such as wetting the surface will decrease the annual total suspended particles significantly, and thus greatly reduce the health impacts of particulates on the many nearby residents, road users and construction workers by keeping the particulate levels below or near the WHO air quality guideline levels.

### **Operation Phase**

Operational emissions consist of vehicle exhaust emissions that impact near-field air quality where sensitive residential and ecological receptors are located. There is potential of underestimation of exhaust emissions due to age and efficiency of vehicles in Lao PDR. Note that model simulations do not include assumed ambient background, which is variable, to isolate vehicle emissions only.

During Project operations, there will be overall benefit to air quality due surfacing of the road that reduces exposure to dust generation.

### ***Avoidance, Management and Mitigation Measures***

An *Environmental and Social Management and Monitoring Plan* (ESMP) has been prepared for the Project which includes management measures for air quality impacts (refer to Volume C-1). Proposed avoidance, management and mitigation measures for each Project phase are summarised below.

- ▶ Disturb only the minimum area necessary for construction, or areas flagged for immediate use
- ▶ Tarps/covers to be used on trucks for all Project-related transport to avoid dust and debris on roads
- ▶ Dust suppressants may be used to conserve water.
- ▶ Apply water or chemical dust suppressants (e.g. chloride solutions) on exposed rock, soil and ground in construction areas
- ▶ Monitor PM10, PM2.5 and dust deposition
- ▶ Progressively rehabilitate/revegetate cleared areas as soon as practicable
- ▶ Do not overload heavy trucks
- ▶ Maintain highway surface

### **Conclusions**

The greatest impact to air quality from the Project is predicted to occur during the Construction Phase and will therefore occur over a short-term period. Impacts to air quality during the Operations Phase will be less than during the previous phase as construction activities are considered to be the dominant risk factor. Appropriate management and mitigation strategies to minimise exhaust emissions and dust generation will reduce the risk to air quality. With appropriate mitigation and management measures in place, residual impacts from the Project are predicted to be moderate and the long-term benefits of the Project will be less exposure to dust generation. However, residual impacts are also dependent on the effectiveness of dust management and revegetation strategies to minimise the impact of wind erosion.

### **6.5.4 Noise and Vibration**

#### **Issues and Findings**

The ambient noise level at a particular location is the overall environmental noise level caused by all anthropogenic and natural noise sources in the area. The human ear has a wide sound-sensitivity range, and thus the decibel (dB) is a unit that uses a logarithmic scale that allows human hearing to be compressed into a comprehensible range. The human ear is less sensitive to low frequency sound than high frequency sound. Thus the “A-weighted” decibel scale dB(A) is used to approximate the human loudness response. The LAeq, (logarithmic A-weighted equivalent sound pressure level), is the most commonly used indicator for noise over a specified time-interval.

Road noise, is a significant contributor to the ambient noise environment, particularly in the urban and community areas. Sound waves can interfere with natural background sound waves in the same environment, and are generally considered noise pollution where the noise is loud, unpleasant or repetitive. Sounds are considered noise pollution if they adversely affect wildlife, human activity, damage structures or disturb natural processes. Noise and vibration management and mitigation measures can be implemented to reduce these impacts.

The expected noise and vibration sources for each stage of Project development are outlined below, and management measures with respect to each type of emission are provided in the following sections

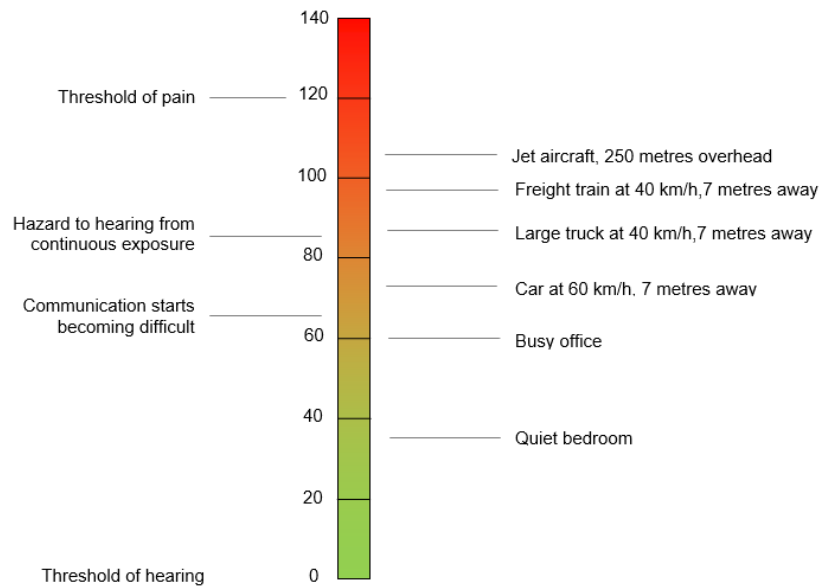


Figure 6-2: Level of common sounds on the dB(A) scale

### Pre-Construction

Very limited noise and vibration impacts are expected to occur during the Pre-Construction Phase as very little activities with noise and vibration emissions will occur for the Project during this phase.

### Construction Phase

Noise emissions from construction of the Project will primarily be associated with the clearing of land, earthworks and transport of construction materials. Some noise is expected during the construction phase associated with excavation of rock, road cuttings and construction of road. Source noise levels for typical earthworks and road construction are listed in

Table 6-2 . Construction noise is anticipated to be localised and short-term, and will progress with the construction of the Project road.



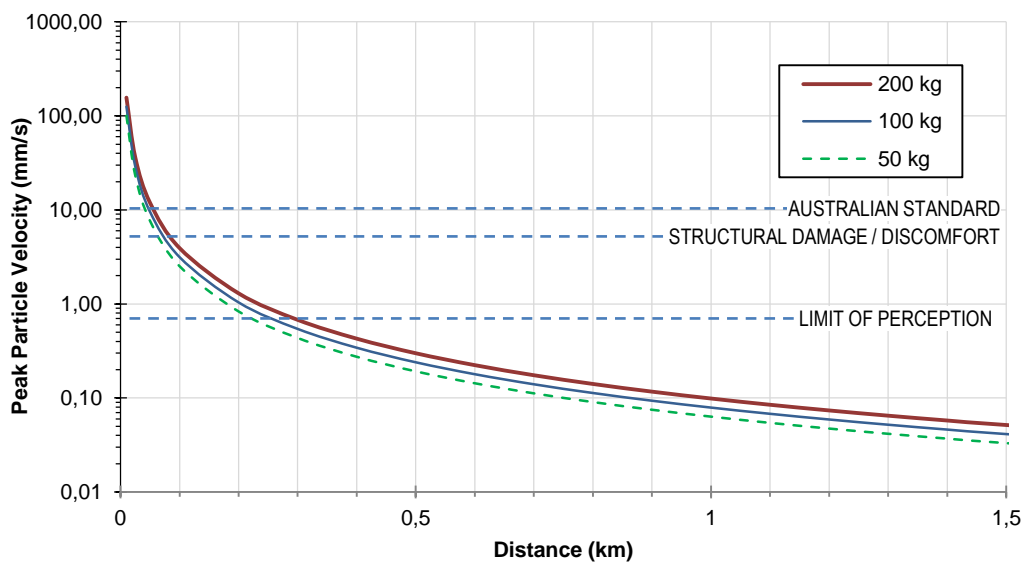
**Table 6-2: Construction noise levels**

Equipment	Maximum noise power levels at source (dB)	Maximum noise at source dB(A)	Maximum at 10 m dB(A)	Maximum at 50 m dB(A)	Maximum at 100m dB(A)
Dump trucks	120.8	113	93	79	73
Excavator	126.6	119	99	85	79
Dozer	117.2	109	89	75	69
Grader	115.4	107	87	73	67
Wheeled loader	115.2	107	87	73	67

**Ground Vibration**

Ground-borne vibrations during construction are expected to be generated by the following Project activities:

- ▶ Grading, excavation, dozing, etc.;
- ▶ Heavy vehicle traffic;
- ▶ Pumps and generators; and
- ▶ Blasting (assumed to be limited).



**Figure 6-3: Estimated blasting ground vibration with distance from source**

**Operation Phase**

During operations, the factors that will affect noise emissions from road traffic will include;

- ▶ The volume of traffic;
- ▶ The speed of traffic; and
- ▶ The composition of traffic (number of heavy vehicles versus light vehicles).

Generally, heavier traffic volumes, higher speeds and a larger number of heavy vehicles results in more traffic noise. The main sources of vehicle noise are their engines, exhaust systems and tyres (refer to Figure 6-4). Increased traffic levels (and associated noise levels) are likely to result in nuisance and other health impacts in the vicinity of the Project Roads. The health impacts of noise are shown in the Figure 6-5.

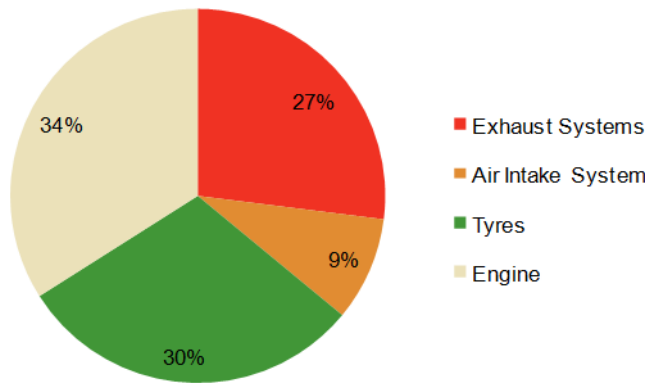


Figure 6-4: Noise source distribution of passenger cars at speeds below 70 km/hr (DPTI SA, 2016)

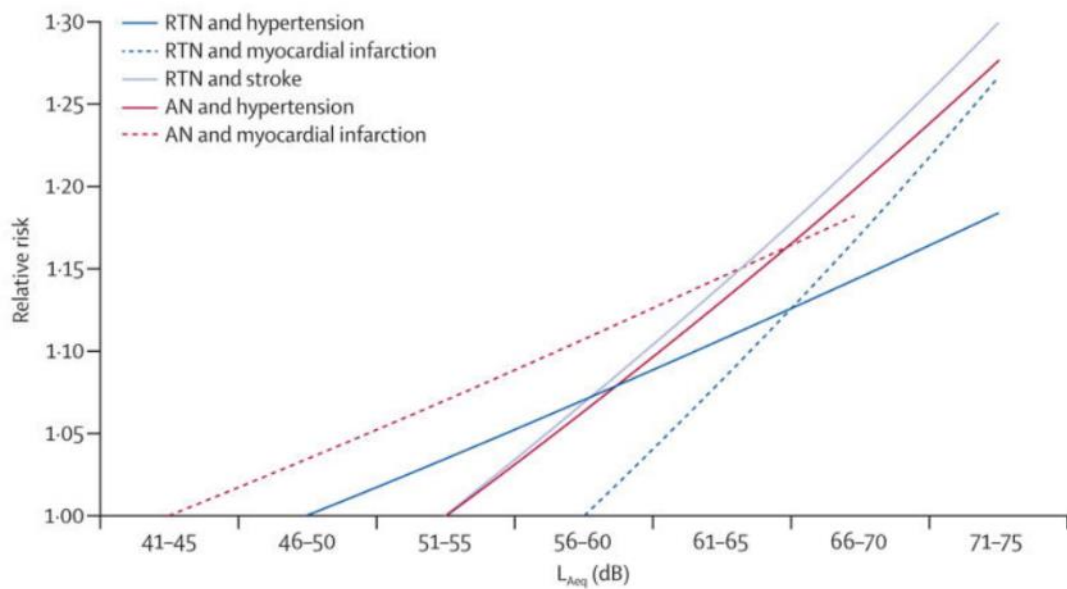


Figure 6-5: Exposure-response curves of road traffic noise (RTN) and aircraft noise (AN), and cardiovascular impacts (Basner et al., 2013)

Operational noise emissions consist of vehicle noise that impacts near-field where sensitive residential and ecological receptors are located. Note that model simulations do not include assumed ambient background noise, which is variable, to isolate vehicle noise emissions only.

The potential noise impacts of the NR13SE were examined with the TNM model, adopting projected traffic flows and speeds in community and non-community areas (50km/hr in urban and 80km/hr in non-urban areas). Table 6-3 summarizes the predicted roadside noise maximum with an assumption of maximum peak traffic between 1,250 vehicles per hour on average particularly between community areas.

Table 6-3: Predicted maximum noise from the NR13SE LAeq 1-hr dB(A)

Section	Roadside maximum	Maximum at 50 m distance	Maximum at 100 m distance
Community areas	75.3	64.7	58.3
Non-community area	78.5	68.0	61.6
WHO Daytime Guideline	55	55	55
Lao National Standard (2017)	70	70	70

The community / urban sections of the NR13SE will be located in highly trafficked areas where traffic noise may be a community issue. Increase road-side noise levels were predicted relative to the current condition, exceeding WHO and Lao National daytime noise standards. Maximum noise levels were predicted within 30m of the road, where both commercial and local receptors would be impacted. Continued exposure to high levels of noise within 50m of the road may lead to multiple long-term health impacts. Schools and offices may also be affected throughout the day, and especially during peak hours traffic. Night-time noise may also lead to health impact, such as sleep disturbance.

### ***Avoidance, Management and Mitigation Measures***

An *Environmental and Social Management and Monitoring Plan* (ESMP) has been prepared for the Project which includes management and mitigation measures for noise and vibration impacts (refer Volume C-1). The key management measures are summarised below.

- ▶ Limit the hours of operation of noisy activities to daylight where practical (eg; tree felling, saws, grinding).
- ▶ Maintain unpaved access roads to prevent vehicle vibrations from surface rutting.
- ▶ Select equipment with lower noise and vibration levels where practical.
- ▶ Conduct laying and vibration rolling during daylight hours if feasible
- ▶ Do not overload heavy trucks
- ▶ Maintain road surface
- ▶ Prohibit use of truck hydraulic braking in community areas
- ▶ Regularly monitor noise and vibration

### ***Conclusions***

Project construction is predicted to emit the peak noise and vibration profile for the Project. Therefore, this period is estimated to require the most mitigation and management strategies to minimise noise and vibration impacts. The Operations Phase is estimated to have minimal noise and vibration activities due to the smooth of the road surface.

The Pre-Construction and Construction Phases were assessed as low risk for noise impact and low risk for vibration impacts to surrounding sensitive receptors. Residual impacts from construction activities after the implementation of strategies outlined in the ESMP are assessed as being Low and short-lived for any nuisance disturbances to potential sensitive receptors. Residual impacts during the Operations Phase are predicted to be Low.

## **6.5.5 Materials and Wastes**

### **6.5.5.1 Land Clearance and Demolition of Structures**

Establishment of the Project will require land acquisition and the clearance of existing road surface, vegetation and topsoil within the Project footprint. This is likely to be a key source of waste from the Project, resulting mainly in demolition waste and green waste. All material that is cleared will have to be disposed of in approved disposal areas or within the Project Footprint itself. Management and re-use of demolition waste will depend on the particular type of waste, the level of recovery and market demand in the area. Impacted people/communities may be given the chance to salvage any materials generated by this process.

### **6.5.5.2 Groundworks and Road Construction**

The groundworks required for the Project may generate significant waste streams including stockpiles of excess borrow materials, topsoil and vegetation.

The construction of the road infrastructure will also generate waste streams including excess steel, concrete (solids and washouts) and asphalt as well as packaging materials, metals and electrical cabling and solvents (e.g. paints) among others.

### **6.5.5.3 Accommodation Camps**

The location of accommodation camps will be determined by the preferred construction contractor during the detailed design stage for the project. However, these sites will produce several waste streams including sewage waste, food waste and general refuse waste. Detailed measures for the management of waste from accommodation camps have been included in the ESMP (Volume C-1).

### **6.5.5.4 Project Waste Streams**

Construction of the Project and maintenance activities during operations will require or generate hazardous and non-hazardous materials. The Project has been designed to specifically address potential risks associated with hazardous / non-hazardous materials during transport, storage, handling and disposal.

Potentially hazardous materials that will be stored and handled by the Project during construction and operations include:

- ▶ Oils, solvents, diesel and tyres from Project vehicles;
- ▶ Waste oil;
- ▶ Medical waste including sharps, bandages, etc;
- ▶ Sewage from construction compounds;
- ▶ Asbestos (if uncovered during demolition);
- ▶ Batteries; and
- ▶ Paint and solvents.

General (non-hazardous) and solid waste materials will be generated from Project construction activities, administration, procurement, accommodation camps and maintenance activities during operations include:

- ▶ Excavation waste (e.g. rock and soil);
- ▶ Demolition waste;

- ▶ Construction waste;
- ▶ Timber and green waste;
- ▶ Packaging materials; and
- ▶ General waste from office and camp compounds.

Potential Project waste streams are presented in Table 6-4.

**Table 6-4: Potential waste streams associated with the Project and suggested methods for re-use, recycling and disposal**

Area	Type of Waste	Classification	Suggested methods for re-use, recycling and disposal
Demolition/Site Clearing	Vegetation (logs, mulched timber, weeds)	General solid waste (non-putrescible)	Harvest millable timber for re-use offsite, use mulch for revegetation works, landscaping or erosion and sedimentation control Provide local communities with opportunity to salvage timber resources where practicable The District Office of Agriculture and Forestry should oversee salvage of timber where appropriate.
	Concrete, asphalt and gravel	General solid waste (non-putrescible)	Crushed and used as backfill or as road base Concrete parts should be re-used to fill up used borrow pits.
	Asbestos	Special waste	Offsite disposal by licenced waste handlers
	Scrap metal	General solid waste (non-putrescible)	Re-use or send for offsite recycling (e.g. into steel products)
Earthworks	Excavated materials	General solid waste (non-putrescible) – if not contaminated	Beneficial reuse onsite (such as landscape and noise mounds) Balance cut and fill earthworks where possible, to optimise reuse on the Project
		Potentially contaminated soil (e.g. near service stations)	Method will depend on results of soil testing, and may include: <ul style="list-style-type: none"> <li>• Offsite disposal by licenced hazardous waste handlers</li> <li>• Offsite reuse as engineering fill or used in earthworks</li> <li>• On site remediation</li> </ul>
Road Construction	Steel	General solid waste (non-putrescible)	Offsite recycling such as at steel rolling mills
	Concrete (solids and washouts) and asphalt	General solid waste (non-putrescible)	Crushed and used as backfill or as road base or recycled offsite
	Packaging materials, including wood, plastic, cardboard and metals	General solid waste (non-putrescible)	Offsite recycling
	Metals and electrical cabling	General solid waste (non-putrescible)	Offsite recycling
	Pesticides, herbicides, spill clean ups, paints and other chemical	Hazardous waste	Offsite disposal by licenced waste handlers
Construction sites, workshops, camp	Tyres	Special waste	Offsite disposal / recycling by licenced waste handlers. Where practicable, tyres can be taken for retreading at a facility in Km36 Landfill and the vehicle batteries can potentially be recycled by a battery manufacturer in
	Oils, grease, fuel, chemicals and other fluids	Liquid waste	

Area	Type of Waste	Classification	Suggested methods for re-use, recycling and disposal
compounds	Batteries	Hazardous waste	Vientiane.
	Radiator fluid, hydraulic fluid	Hazardous waste	
	Domestic waste generated by workers	General solid waste (putrescible)	Offsite disposal at Km 36 landfill
	Sewerage	General solid waste (putrescible)	Offsite disposal by licenced waste handlers and/or treated and reused on site
Office / Administration	Paper, cardboard and plastic	General solid waste (non-putrescible)	Offsite recycling
	Glass bottles and aluminium cans	General solid waste (non-putrescible)	Offsite recycling
	Food Waste	General solid waste (non-putrescible)	Offsite disposal at Km 36 landfill, or composting onsite (including the use of food composting equipment)
	Effluent	Liquid waste	Offsite disposal by licenced waste handlers, or treatment onsite

#### 6.5.5.5 Impact Assessment

Waste that is improperly stored or disposed of may lead to adverse effects on human health, habitat, biodiversity and the receiving environment. Other potential impacts include excessive waste to Km36 Landfill, incorrect disposal or misclassification of waste on site.

Further details on the waste stream, potential impacts and management approaches are presented in the sections below.

#### *General and Solid Waste (Non-Hazardous)*

##### **Pre-Construction Phase**

No impacts associated with general and solid waste are expected to occur during the Pre-Construction Phase as no waste will be generated during this phase.

##### **Construction Phase**

##### ***Timber and Green Waste***

It is estimated that construction of the Project would require the clearing of approximately 458 trees, bushes and grass. Potential wastes from tree removal include logs, processed timber, vegetation and weeds. Improper management of green waste physically impacts the environment through increased greenhouse gas emissions (if anaerobic decomposition or burning occurs), impaired visual amenity and could result in fire risk or spread of invasive weeds without management controls. The amount of vegetative waste and timber produced from land clearance activities will be greatest in forested areas along the alignment, as these areas will have the highest amounts of biomass.

Where possible, timber and green waste will be re-used through providing local communities with an opportunity to salvage useful timber, and utilisation of native vegetation waste for biodiversity measures such as fauna habitat. Weeds will need to be managed appropriately to prevent the spread of invasive species, though implementation of the measures proposed in the ESMP (Volume C-1). The District Agriculture and Forestry Office (DAFO) will have a critical role in overseeing forest clearance to ensure proper management of timber and green waste.

##### ***Demolition Wastes***

A significant source of waste from the Project will be demolition waste produced as a result of land clearance activities and the removal of structures, road pavement and utilities within the Project footprint.

Based on the spatial analysis conducted for the Project, it is anticipated that 12 housing structure, 158 shops and restaurants, 179 porches of house/shop and other smaller structures including huts, guardhouse, ATM machine, signs, walls, gates, fences etc (refer to Table 6-9) within the COI will require removal and demolition. The COI will also potentially impact public infrastructure such electricity distribution and transmission lines, water pipeline infrastructure and telecommunications infrastructure such as fibre optic cables.

The main demolition waste materials expected to be generated include:

- ▶ Concrete and bricks;
- ▶ Asphalt;
- ▶ Gravel;
- ▶ Scrap metal / cables;
- ▶ Processed timber; and
- ▶ Road base.

Where practicable, the deconstruction of structure and services, rather than their demolition, will assist in allowing as much material as possible to be salvaged for reuse offsite. Demolition waste is likely to be the most significant where the Project traverses through main community areas such as in Ban Khoksivilay, Ban Somsavanh (Xaythany District), Ban Donehai, Ban Naxone, Ban Phao, Ban Hai and Ban Somsavad (Pak Ngum District) and requires relocation of a larger number of structures and services.

During demolition, there is also the potential for asbestos to be uncovered which could result in potential health risks to workers and the local community if not appropriately managed. Any asbestos materials encountered would need to be removed by certified contractors and appropriately disposed of.

Unmanaged, demolition waste may result in significant amounts of waste being sent to landfill. Appropriate management and re-use of demolition waste will depend of the particular type of waste, the level of recovery and market demand in the area. Where possible re-use and recycling for recovered materials will be encouraged. For example:

- ▶ Concrete – can be reprocessed concrete into products that are commercially competitive with quarry products;
- ▶ Bricks and crushed concrete – can be used in all-weather applications (such as low-grade roads), and in pavement sub-bases (such as roads and non-structural applications) as a substitute for virgin crushed rock;
- ▶ Metals can be extracted and recycled; and
- ▶ Timber – can be salvaged and re-used for various applications. Impacted communities will be given an opportunity to salvage these materials. Infrastructure timber such as power poles may be able to be used in landscaping applications.

### ***Excavated Materials***

Excavation wastes comprising of mainly inorganic material (primarily soil) will be generated from earthworks. Improperly managed, waste material generated from excavations has the potential to cause water pollution if not stockpiled and re-used effectively.

As far as practicable, earthworks material generated from the Project would be re-used for the construction of embankments, pavements and as verge material. Development of an earthworks balance will be important to help reduce the amount of materials unsuitable for road construction that may be generated during construction activities and to encourage the re-use of these materials in noise or visual barriers and landscaping.

Where excavated materials have not been subjected to potentially contaminated sources, it is expected that these will be reused within the road corridor. For excavated materials that are potentially contaminated (e.g. land near service stations, land within industrial areas, or showing visual signs of contamination) testing and classification of these materials will be required to ensure appropriate management.

During stakeholder consultations it was noted that excess materials (e.g. gravel, soil, etc.) excavated during the construction of the ongoing NR13S was left on site for long time periods following the completion of construction. These stockpiled materials were observed to be utilised by local residents for the infilling of wetland areas and promoted the further degradation of the wetland habitats. Thus, careful management of the waste materials will be required to avoid detrimental effects on wetland habitats in the Project footprint.

### ***Construction Wastes***

A number of different construction wastes will be generated from road construction activities. These include steel, concrete, asphalt, timber and piping, paints, scrap metal, electrical cabling and chemicals. Where possible these left-over materials should be re-used on the Project for another road section, or reprocessed for use as road base or backfill. Materials that are not suitable for re-use will need to be recycled or disposed of at a licensed waste facility.

The operation of concrete and asphalt plants have the potential for generating significant waste if quality specifications during the production process are not met for a particular batch. Where possible this material should be re-used for non-structural elements, minor roads or tracks in construction sites to avoid unnecessary waste from being sent to Km 36 landfill.

Construction activities where the Project alignment traverses through swamps areas or wetlands are likely to generate large quantities of fine silty material, which, if not managed appropriately, have the potential of causing water pollution. Where suitable, the sediment and topsoil removed from these areas should be stockpiled and reused for wetland revegetation activities.

The construction of access roads into wetlands will require the use of large amounts of fill material. On completion of construction of viaducts, these access routes will then need to be decommissioned and the areas rehabilitated and restored to their original condition, to prevent this material being used for reclamation of wetlands for agriculture or other uses post construction.

### ***Sewage and General Waste from Construction and Workforce Facilities***



Sewerage and general waste would be generated from construction camp facilities such as amenities and offices. Waste types include domestic waste from workers, sewage, office wastes (paper, cardboard, plastic, bottles, cans, paper) and food wastes. These will need to be reused and recycled where possible.

Sewage from accommodation camps may provide a potential source of nutrients and/or pathogens that may be released into receiving waters downstream in the absence of appropriate sewage treatment and management. Adequate provision of portable toilet facilities for project workers on construction sites will also be required to help prevent soil and water contamination from sewage.

For general wastes that cannot be recycled, leachate (potentially including heavy metals and persistent organic particles (PoP) / compounds) may discharge and accumulate. Also improper storage and disposal of the waste could lead to:

- ▶ Contamination of receiving surface water (e.g. due to inappropriate disposal of chemicals);
- ▶ An increase in populations of scavenging wildlife due to food wastes, including rats, birds and monkeys and other potential vectors for disease; and/or
- ▶ Impacts on visual amenity (e.g. from general littering).

### **Operation Phase**

During operations, waste generation would be much less significant than during the construction period and will result mainly from road maintenance activities and general use of the NR13SE by road users. Solid waste generation as a result of these activities may include road resurfacing waste (e.g. removal of the old road surface material), road litter, or general solid waste from rest areas, animal carcasses, vegetation waste from ROW maintenance, and sediment and sludge from stormwater drainage system maintenance.

Waste will also be produced by vehicle users along the road who may dispose of rubbish out of car windows. This waste may include food packaging, cigarettes, water bottles, plastic bags etc and can have a significant environmental impact if allowed to build up on road embankments. A smaller waste stream may be created from vehicles utilising the road where structural parts may accidentally come off of the vehicles travelling at high speed. This may include shredded tyres, metal bumpers, rubber trim and hub caps.

### ***Hazardous Materials and Special Waste***

#### **Pre-Construction Phase**

No impacts associated with hazardous materials and waste are expected to occur during the Pre-Construction Phase as no use of hazardous materials will occur during this phase.

#### **Construction Phase**

The following hazardous materials are expected to be generated, stored or handled during Construction and/or Operations.

#### ***Hydrocarbons***

Diesel fuel will be utilised for construction vehicles and equipment. Accidental release of hydrocarbons would potentially impact receiving environments such as waters (ground and surface water) and soil. Hydrocarbons are also a fire hazard which threatens occupational health and

safety as well as air quality in general. Spills may be most likely at refuelling stations, equipment servicing workshop, on active construction sites and at equipment storage areas.

### **Paints / Solvents**

Paint waste may also be generated from road markings or painting of bridges and structures.

### **Asphalt / Bitumen**

The Project will require a significant amount of asphalt and bitumen for roadway construction. Hot and ready to use liquid bitumen and asphalt coating present a number of health hazards including the risk of severe burns from skin contact. During preparation of asphalt mixes (at asphalt plants) there is also the risk of bitumen spills which could potentially result in local water quality impacts if it occurs near a waterway or wetland.

Bitumen spills may also occur during the transportation of asphalt between sites and on active sites where surfacing activities are being conducted.

### **Operation Phase**

Waste generation during operations will be much less significant than during construction. Most waste is likely to be general solid waste from road maintenance activities and general use of the NR13SE by road users. The main hazardous waste that will be generated during operations is hydrocarbons from vehicle oils, grease and fuel used in maintenance vehicles.

Construction waste will also be produced during road maintenance work, especially during repair works on the road surface or embankments (e.g. asphalt, concrete, soils, solvents).

### **Avoidance, Management and Mitigation Measures**

An *Environmental and Social Management Plan* (ESMP) has been prepared for the Project which includes management measures for material use and waste (refer to Volume C-1).

Management and mitigation measures to minimise impacts of hazardous materials and waste from the Project are summarised below.

- ▶ Apply the waste management hierarchy (in decreasing order of preference):
  1. Minimize the production of waste
  2. Maximize waste recycling and reuse
  3. Treatment of waste
  4. Ensure safe waste disposal
- ▶ Establish a waste management system and comprehensive waste inventory that identifies, tracks and quantifies major waste streams generated at the Project.
- ▶ Collect and segregate solid waste into different categories as per the ESMP.
- ▶ Install colour-coded bins with weatherproof lids and appropriate signage at designated locations around the Project site (e.g. workforce accommodation camps, construction sites) for collection and segregation of waste. Waste collection to occur frequently to avoid overflowing of bins.
- ▶ Where waste needs to be moved, tarps will be used on trucks to prevent dust and debris on roads.
- ▶ Use available project cutting material and verge material for the construction of embankments and verge within that section to the extent that it is suitable.

- ▶ Project sections with a deficit in material should import surplus material from other project sections in preference to external sources.
- ▶ Any unsuitable material for road construction should be used for rehabilitation/restoration, landscaping or disposed of within each project section, either for batter flattening or noise mounds or placed in stockpile.
- ▶ Construction waste – left over materials should be re-used by Project where possible or re-processed. E.g use sediments onsite for landscaping etc, waste from asphalt production could be used for non-structural elements such as minor roads.
- ▶ Materials to be stockpiled should be stored at designated material stockpile locations.
- ▶ Access roads into wetland areas should be dismantled after the completion of viaduct construction.
- ▶ Any waste construction materials (e.g. borrow / gravel / rocks) should be removed from the construction site following completion of the road section. The use of these materials by the local communities should be prohibited for the infilling of wetlands.
- ▶ Monitor construction areas to avoid community use of materials.
- ▶ Hazardous materials will be managed in compliance with all relevant Lao PDR statutory obligations, licenses and other requirements;
- ▶ An up-to-date register of hazardous materials and dangerous goods stored on site will be compiled and maintained on-site. The register will include the types, quantities, location and current Material Safety Data Sheets (MSDS).
- ▶ Provide and enforce use of appropriate personal protective clothing and equipment (i.e. gloves, plastic coveralls, safety glasses and self-contained respirators), emergency information posters, and clean-up spill kits at strategic locations where hazardous chemicals are handled.
- ▶ Where waste cannot be re-used or recycled, district landfill sites will be used for the disposal of general Project wastes. Hazardous wastes will be disposed of in the appropriate manner according to waste type.
- ▶ Burial of hazardous wastes, liquid or semi-solid wastes (including sewage, medical waste, solvents, hydrocarbon products, hydrocarbon or chemical contaminated soils) will be prohibited. Disposal of these wastes will comply with statutory obligations and will not adversely impact human health or the environment. Licenced contractors will be used wherever possible.

## **Conclusions**

The Project will generate a number of different waste streams, with the most significant amount of waste expected to be generated during construction. The largest amounts of waste are likely to be demolition waste from land clearance and demolition activities during Project land acquisition and construction waste (e.g. concrete, asphalt, piping, scrap metal etc) from the production and sourcing of materials for road construction.

An opportunity exists to sustainably manage Project resources and minimise the amount of waste generated from the Project through the re-use and recycling of recovered materials either for Project activities or within the local industry and community. This is particularly the case for demolition and construction waste where a number of materials such as excavated material, timber, bricks, concrete, asphalt and steel can be recycled or reprocessed. This is expected to help

avoid excessive waste from going to landfill and reduce potential environmental and social impacts associated with waste generation.

With diligent implementation of management measures, no significant impacts are expected to result from the transportation, storage and use of hazardous wastes, however a low risk of soil and water contamination from spills of chemicals (e.g. fuels, paints) will remain for the Construction and Operations Phases. Risks will be minimised with the implementation of measures outlined in the ESMP (Volume C-1).

## **6.5.6 Occupational Health and Safety**

### ***Issues and Findings***

#### **Pre-Construction and Construction Phases**

During pre-construction and construction, hazards associated with Project traffic and movement of heavy machinery on site for land clearance, site preparation and construction. In addition, Project workers may be exposed to excessive dust and noise from construction activities. To prevent potential injury or accidents during Project construction, workers will be required to adhere to relevant OHS procedures, safety signage and use of personal protective equipment (PPE) specific to their work duties. Unexploded Ordnance (UXO) poses a very low to negligible risk to workers as the Project will occur in the existing alignment in most sections of the road where UXO has already been cleared.

Due to a temporary increase of non-local workers required during pre-construction and construction, the Project has the potential to increase the prevalence of disease. Without proper management, in particular at the temporary accommodation camp, this may result in an increase in sexually transmitted infections (STIs), malaria and other illnesses in the surrounding area. Increased prevalence of these diseases may occur through the introduction of new diseases, increased transmission of existing diseases or a combination of both. The magnitude of this risk may depend to a considerable extent on the number of outside workers arriving, the extent to which the workers have moved from job to job and place to place, and the demographic characteristics and cultural mores of the local population.

The addition of non-local workers can also increase pressure on access to local health and education services in the surrounding area including nearby hospitals and health clinics.

Key OHS measures for the Project have been outlined in the ESMP (Volume C-1). The construction contractor/concessionaire will also be required to develop, maintain and disseminate a detailed standalone OHS Plan for the Project, incorporating the measures outlined in the ESIA and other measures required to meet legislative requirements and relevant international standards.

#### **Operation Phase**

The number of Project workers will reduce during the operations phase and the risks associated with road maintenance, vegetation clearance, and other construction activities will be minimal. However, hazards associated with operational maintenance and working directly with construction activities will be the key potential risk during maintenance.

### ***Avoidance, Management and Mitigation Measures***

An ESMP (Volume C-1) has been prepared detailing the proposed OHS avoidance, management and mitigation measures under 'normal operating conditions' (i.e. business as usual) for the Project. Key avoidance, management and mitigation measures for occupational health and safety (OHS) include:

- ▶ Prepare a Project phase-specific Occupational Health and Safety Plan and provide related training and instructions to workers and contractors during induction;
- ▶ Install security fencing and demarcate safety zones around high-risk areas (e.g. construction sites) to prevent unauthorised access;
- ▶ Provide first aid treatment on site and have evacuation procedures in place to transport any injured workers to the nearest hospital;
- ▶ Implement a system to record health incidents / accidents / near-miss / fatalities for Project OHS performance monitoring and reporting;
- ▶ Assess safety risks and implement OHS protocols for high-risk activities including the safe handling, storage and transportation of hazardous materials; electrical works, working at heights, etc.;
- ▶ Danger and warning signs of hazards to be installed where necessary, including for traffic management;
- ▶ Provide appropriate PPE to all relevant workers in accordance with international industry practices;
- ▶ Implement site inductions and training to all staff and contractors on OHS and environmental emergency preparedness and response procedures and measures.

### **Conclusions**

The Project should help to reduce road traffic incidents in the region through the an improved road conditions. Aside from a potential improvement in the rate of road accidents, the largest potential impact on community health through motorised transport is air emissions and resulting air quality. Once operational, the Project should lead to a more efficient motorised transport in in the NR13SE section and potentially a slight improvement in air quality.

Every site worker should be provided with a suitable site induction. The induction should be site specific and highlight any particular risks and control measures that those working on the Project need to know about. Site requirements should be communicated and could include topics such as the Project's OHS Plan, use of mandatory specific PPE, restricted areas, traffic safety systems, site tidiness, fire prevention and emergency arrangements.

Provided the Project is constructed and maintained to expected standards, Occupational Health and Safety training are provided prior to the commencement of Project construction, and vegetation maintenance is conducted as per requirements, key residual impacts and risks relating to OHS are expected to be **Low**.

### **6.5.7 Climate Change**

As the NR13S is the major South route in Laos, the climate resilience design aims to ensure that the road is open to traffic at all times, including rainy season, episodes of intense rain and in case of major climate-related events.

### **Issues and Findings**

For Laos, scientists predict generally that temperatures will continue to rise and that dry seasons will get longer. Rainfall, storms, droughts, and floods will become more severe and frequent. Rainfall will become more erratic and weather events such as droughts or floods will become more extreme.

A detailed climate change analysis for the NR13SSE Project has been conducted by LEA Consulting (2023). A summary of the future climate projections for the NR13SE Project area includes:

### Temperature

The Lao PDR is projected to experience a warming of 3.6°C by the 2090s compared to the baseline conditions of 1986-2005 under the highest emissions pathway (RCP8.5). For our area of interest, the mean annual temperatures are projected to increase by 1.9 to 4.1°C by 2100 (RCP8.5), with similar projected rates of warming for all seasons.

The Lao PDR has extremely high exposure to flooding, including riverine and flash flooding. Lao PDR also has some exposure to tropical cyclones and their associated hazards. Drought exposure is lower but must be monitored as hydropower development on the Mekong River significantly alters the hydrology of the region (WBG, 2021).

### Rainfall

Extreme events reflect rare (weather) events and therefore represent different characteristics of climate than the long-term means. Compare the maps to recognize potentially contrasting trends and different magnitudes of change between mean precipitation (top left) and the largest event during the period (top right) with the extreme statistics indicators for different return periods for the globe (bottom left) and country (bottom right).

An overall increase in the number of wet days across the southern area of the Mekong River is projected. Mean annual rainfall is projected to increase, with the most significant increases expected in the wet season. Potential increases in extreme and cumulative rainfall are projected to be +10-23% by 2100 under highest RCP8.5 Scenario.

### Screening of climate change issues, exposure, sensitivity and vulnerability

The following climate events and related impacts are likely to appear on the project road:

**Table 6-5: Impacts of Climate Change on the project road**

Climate change event	Potential impact on road infrastructure	Exposure	Sensitivity		Consequence
			Vulnerability		
Increase in very hot days and heat waves	<ul style="list-style-type: none"> <li>– Deterioration of pavement surface, such as softening, traffic bleeding</li> <li>– Thermal expansion of bridge expansion joints and paved surfaces</li> </ul>	High	Moderate	Moderate	Moderate <ul style="list-style-type: none"> <li>– Deteriorated service level of the road</li> <li>– Increase Road User cost</li> <li>Increased need for routine and periodic maintenance of pavement</li> </ul>
Increase in intense precipitation events	<ul style="list-style-type: none"> <li>– Damage to roads and drainage systems due to flooding</li> <li>– Increase in scouring of roads, bridges, and support structures</li> <li>– Damage to road infrastructure due to</li> </ul>	High	High	High	Important <ul style="list-style-type: none"> <li>– Possible disruption of the road during intense events</li> <li>– Possible failure</li> </ul>

Climate change event	Potential impact on road infrastructure	Exposure	Sensitivity Vulnerability		Consequence
	landslides and erosion – Overloading of drainage systems – Deterioration of structural integrity of roads and bridges due to increased soil moisture levels				of bridge structures before end of their design life – Early decrease in asset value and reduced life of road pavement – Increased need for routine and Periodic maintenance
Increases in drought conditions	– Damage to infrastructure due to increased susceptibility to fires – Damage to infrastructure from mudslides in areas deforested. – Deterioration of structural integrity of	Low	Moderate	Low	Moderate - Reduced service level due to local defects and deformation
Increase of storm intensity	– Damage to road infrastructure and increased probability of infrastructure failures – – Increased threat to stability of bridge decks – Increased damage to signs, lighting fixtures, and supports	High	High	High	Important – Possible disruption of the road during intense events – Possible failure of bridge structures before the end of their design life – Increased need for routine and periodic maintenance
Increase in wind speed	Signs, canopies and tall structures at risk from increasing wind speeds	Moderate, unless linked to storm	High	Moderate	Moderate - Increased need for maintenance

Climate change event	Potential impact on road infrastructure	Exposure	Sensitivity Vulnerability	Consequence
		intensity		of road furniture

Source: LEA Consulting 2023

### Climate Change Mitigation

To ensure the all-year pass ability, the following design criteria were applied for the designing:

- ▶ Bridges: flood return frequency of 100 years;
- ▶ Box culverts and short bridges ≤ 10 m span: flood return frequency of 50 years;
- ▶ Road and pipe culvert < 2 m diameter: flood frequency of 25 years;
- ▶ Side drains and ditches: flood frequency of 10 years.

Climate change is a macroscopic and global issue, and, as outlined above, there is confidence in the project's changes in hydrology and rainfall. Therefore, the measures outlined in the Road Design Manual of MPWT (2018) are applied for dealing with the issue of climate change for road drainage design for local road in the project.

- ▶ Use new calculated IDF curves, constructed based on the series of rainfall measurements from 2002 to 2022;
- ▶ Adding a 15 % increase (RCP6.5-RCP8.5) to the calculated 10, 25, 50 or 100-year return storm events in order to react to increases in short duration rainfall intensities.

Regarding the raising in the flood plains or back flood, in accordance with MPWT and following the international practice, the road bed was set to be above the calculated flood level, the edge of road shoulder is placed 50 cm (minimum) above the flood level. But in conceptual design phase for NR13S, mostly of the road elevation is still follows with the existing elevation, due to there is no data of annual high-water level of each river, which this is applied to flood frequency analysis.

**Table 6-6: Envisaged and implemented measures for Climate Change adaptation on the project road**

Asset	Risk	Possible Adaptation Measures	Implemented / Envisaged (infrastructure)
Road alignment	Disruption due to overtopping during intense rain	The raising of flood-prone areas above the calculated flood levels, for "NR13S" only back floods from Nampark and Namkor river during August 2022	Included in the earlier concept Design for the location of the bridge approach, but for the road, the segment is still based on existing road elevation.
Pavement	Cracking and early deterioration through water ingress	Improve the surface integrity by using stronger surface courses	All Sections to be paved using 2 layers of asphalt concrete mixes.
	Rutting and bleeding due to hot climate	Use of harder-grade bitumen Improved asphalt mixes to resist rutting (mix design using asphalt rutting test)	Appropriate Asphalt mix design to be implemented.
	Deformation due to	Lime or cement stabilization of	Not envisaged if the



Asset	Risk	Possible Adaptation Measures	Implemented / Envisaged (infrastructure)
	moisture variations	sub-base and base	pavement subbase is placed above the design flood level.
Bridges	Bleeding of sealed joints	Use of modified joint sealant materials	Requested as part of specifications
	Increased scour due to debris flows	Scour protection of piers	Included in the earlier concept design.
	Overtopping during intense rainfall	The hydraulic capacity of Bridges and resulting opening of bridges calculated with 15% safety coefficient	Included in the earlier concept design.
Bridge supports and foundations	Settlement due to insufficient bearing capacity of the foundations	Deep foundation included in concept design	The bridge foundation design is Included in the earlier concept design.
Culverts	Overloading during intense rainfall	The hydraulic capacity of culverts calculated with 15% safety coefficient and considering 25 / 50- year flood return periods	Included in the earlier concept design.
Drainage	Overtopping during intense rainfall	The hydraulic capacity of culverts calculated with 15% safety coefficient and 10-year flood return period	Included in the earlier concept design.
Side slopes	Erosion due to intense rainfall, the section of unstable slope	Vetiver planting for slope stabilization, slope protection by wall, rip- rap and etc.,	Not included, as with climate and fast-growing plantations in Lao, it is naturally achieved to be incorporated during implementation.
Side slopes near the river bank	Scouring during high river levels	River Bank protection considered in selected locations	Identified at constructed bridge location and included in the earlier concept design.

Source: LEA Consulting 2023

## 6.6 Biological Impacts and Mitigation Measures

### 6.6.1 Terrestrial Biodiversity

#### *Issues and Findings*

#### **Pre-Construction and Construction Phases**

Pre-construction and construction activities will include site preparation activities such as vegetation clearance and earthworks. A significant impact to remnant natural and planted vegetation (e.g. trees) and flora is expected to occur during the construction phase when vegetation within the COI will be cleared. Most vegetation within the direct footprint of Project will be removed resulting in the permanent loss of existing vegetation in this area.

No natural habitat occurs within the ROW. Most land use types identified within the COI are existing road area (~98%) with a small proportion of wetland and residential land (refer to Table 5-24). Natural terrestrial vegetation (e.g. scrub) within the COI are highly degraded and fragmented. All-natural vegetation to be removed have been directly disturbed by anthropogenic sources in some way.

Vegetation clearance for the Project will result in removal of at least 458 trees of different sizes and species of planted and natural species. There are 13 Endangered (EN) species of the IUNC Red List of Threatened Burma Padauk Species (*Pterocarpus macrocarpus*) identified within the COI and 12 species of these will be directly lost, if cleared (refer to Table 6-7). Most of these species are relatively small in size with the largest diameter stand was measured approximately 60cm of diameter at breast height. However, this species is found common in the Project region with smaller stands.

Other species identified in the IUCN Red List include two planted agarwood (*Aquilaria malaccensis*) species (Critically Endangered), and 10 planted teak (*Tectona grandis*) species (EN). Planted of high conservation / commercial value species are found common across the Lao PDR such as teak, agar wood and even Burma Padauk (*Pterocarpus macrocarpus*). Two species of Near Threatened (*Dipterocarpus obtusifolius*) were also identified in the COI and one of these will be removed (refer to Table 6-7).

Around 282 trees (fruit trees, industrial trees, bamboo trees and flower trees) of Project Affected Household (PAH) will be affected by the project. However, during the Detailed Measurement Survey (DMS), consultations with PAHs concluded that planted/natural tree species owned by individuals are not required for compensation as they voluntarily contribute to the Project (refer to Volume C-3: Stakeholder Engagement Plan). However, removal of trees will need to be consulted with local authorities and impacted households. The District Agriculture and Forestry Office (DAFO) should provide oversight the vegetation clearing activities. Where practical, the high conservation value HCV) species should be transplanted in appropriate locations with support from the Project Management Unit. The affected households who own these tree species should be given opportunities to harvest timbers in advance of clearing activities provided that they have appropriate personal safety equipment (PPE).

The vegetation clearance for the NR13SE upgrade will also result in the removal of at least 16 individual species of Mai Samsa (*Samanea saman*), a least concerned species of the IUCN Red List of Conservation Species which were identified within the designed carriageway (refer to Appendix 5 of the Volume B. This tree species is a fast-growing species and is found common across the region. The retention of this species and other species identified within the safe zone would create obstacles and impair visibility.



Plate 6-1: *Samanea saman* species identified in Km 26+125 – Km26+430



Plate 6-2: *Samanea saman* species identified in Km 55+700



Plate 6-3: *Samanea saman* species identified in Km 56+600



Plate 6-4: Acacia at Km 25+916

No international protected areas such as sites on the World Heritage List or Ramsar Wetlands will be impacted by the Project. The Project will also not impact any protected areas of national significance such as National Parks, Wildlife Reserves or Wildlife Sanctuaries as no such areas occur in the vicinity of the Project. The Project alignment passes near Phou Khao KHouay National Park for a distance of 2 km between Km 68+000 to Km 71+300.

Table 6-7: High conservation value species identified in the COI

No.	Lao Name	Scientific Name	Family Name	IUCN Red List Status	Comment	Diameter at Breast Height (DBH)	GPS Waypoint		Photo Number	Remove
						(cm)	Easting	Northing		
<b>Ban Somsavanh</b>										
1	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	15	265878.09	1998522.89	9073-9075	Yes
<b>Ban Naphasouk</b>										
2	ຕົ້ນໄມ້ສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	20	270975.782	1997532.034	9245-9246	No
<b>Ban Dongkhouay</b>										
3	ຕົ້ນຊາດ	<i>Dipterocarpus obtusifolius</i>	<i>Dipterocarpaceae</i>	NT	Natural	20	272496.103	1997244.302	9285-9286	Yes
4	ຕົ້ນໄມ້ສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	15	272604.236	1997220.881	9292-9294	Yes
5	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	20	272644.87	1997209.785	9297-9299	Yes
<b>Ban Borlek</b>										
6	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	20	275916.769	1996764.899	9411-9412	Yes
7	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	20	275933.772	1996773.739	9415-9416	Yes
8	ຕົ້ນຊາດ	<i>Dipterocarpus obtusifolius</i>	<i>Dipterocarpaceae</i>	NT	Natural	20	275976.691	1996807.023	9417-9418	Yes
<b>Ban Nongbouathong</b>										
9	ຕົ້ນຊາດ	<i>Dipterocarpus obtusifolius</i>	<i>Dipterocarpaceae</i>	NT	Natural	25	277735.211	1998338.118	9436-9437	Yes
<b>Ban Khoksa</b>										
10	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	20	279622.199	2000018.9	9497-9498	No
<b>Ban Donehai</b>										
11	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	10	282712.638	2000039.676	9553-9554	Yes
12	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	10	285812.52	1999487.272	9569-9570	Yes
13	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	25	288232.483	2000705.368	9638-9639	Yes
<b>Ban Sompaseuth</b>										
14	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	15	293495.871	2006589.809	9717-9718	Yes
15	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	15	293600.608	2006768.793	9729-9730	Yes

No.	Lao Name	Scientific Name	Family Name	IUCN Red List Status	Comment	Diameter at Breast Height (DBH)	GPS Waypoint	Photo Number	Remove	
<b>Ban Hai</b>										
16	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	20	294516.958 2010690.179	9818-9819	Yes	
17	ຕົ້ນເກດສະໜາ	<i>Aquilaria malaccensis</i>	<i>Thymelaeaceae</i>	CR	Planted	20	294530.634 2010731.998	9822-9823	Yes	
18	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	25	294522.686 2010889.464	9835-9836	Yes	
19	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	25	294466.491 2011007.027	9843-9844	Yes	
20	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	25	294498.786 2011008.025	9848-9850	Yes	
21	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	60	294523.03 2010955.579	9851	Yes	
22	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	15	294517.581 2010963.642	9852-9853	Yes	
23	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	20	294536.549 2010942.283	9857	Yes	
24	ຕົ້ນເກດສະໜາ	<i>Aquilaria malaccensis</i>	<i>Thymelaeaceae</i>	CR	Planted	10	294536.549 2010942.283	9857	Yes	
25	ຕົ້ນສັກ	<i>Tectona grandis</i>	<i>Lamiaceae</i>	EN	Planted	30	294539.642 2010909.349	9859	Yes	
26	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	50	294547.181 2010887.547	9862	Yes	
<b>Ban Somsavath</b>										
27	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	22	294544.534 2013010.255	9885	Yes	
<b>Ban Naxay</b>										
28	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	15	295804.865 2014065.421	9891	Yes	
<b>Ban Naxaysavang</b>										
29	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	25	298988.415 2015662.787	9909	Yes	
30	ຕົ້ນດູ່	<i>Pterocarpus macrocarpus</i>	<i>Faboideae</i>	EN	Natural	20	298988.415 2015662.787	9909	Yes	

CR = Critically Endangered; EN = Endangered; NT = Near Threatened.

## Operation Phase

No additional direct habitat loss is expected to occur for the Project during Operations. However, many of the adverse impacts to some flora species which occur during the Construction Phase will continue in varying degrees and intensities into the Operation Phase of the Project.

- ▶ Increased accessibility to the forest areas which may stimulate illegal exploitation of timber and non-timber forest products;
- ▶ Increased runoff generation from the road improvement may exacerbate local erosion and sediment runoff leading to localised terrestrial habitat loss and degradation in the vicinity of the road;
- ▶ The risk of spread and introduction of alien invasive species will be reduced due to a significant reduction in earth works, although greater vehicle use along the NR13SE may promote the spread of some flora species.

Ongoing rehabilitation and revegetation activities, including establishment of vegetation along the roadsides, will assist in compensating for losses during the Construction Phase, and provide habitat from some fauna species.

## Avoidance, Management and Mitigation Measures

Key avoidance, management and mitigation measures for terrestrial biodiversity include:

- ▶ Limit the vegetation clearance to the minimum necessary during construction to prevent the loss of natural habitats and associated species;
- ▶ Design Project to strictly minimise disturbance to priority flora species by clearly marking the tree species that need to be retained and liaise with the construction contractor on the requirements;
- ▶ Sensitive habitats near construction areas (e.g. riparian forest) should be designated and clearly marked as 'no go' areas where they can be avoided;
- ▶ Conduct progressive rehabilitation / revegetation of disturbed areas using native and non-invasive species for rehabilitation works as well as soil, mulch and vegetation debris containing natural seed to facilitate the revegetation of the disturbed areas;
- ▶ High conservation value species including larger sized trees (e.g. *Samanea saman*) will be retained where possible with a consideration of road safety. Regular pruning and trimming of tree branches should be conducted to maintain visibility of road users.
- ▶ Environmental education and awareness programs should be conducted for Project staff and contractors (e.g. through staff inductions) to ensure that the prohibitions and penalties regarding the collection of forest resources are widely known;
- ▶ Pre-clearance detailed flora surveys should be conducted, and where species of conservation significance are identified mitigation measures to minimise impacts on species should be implemented (e.g. translocation of threatened flora if small enough);

- ▶ Contractor prepares and implements plan for site clearance, excavation, restoration, tree replantation, etc. ISMC will review and approve the plan and monitor its implementation and report to PMU/DOR and DPWT;
- ▶ Removal of trees will need to be consulted with local authorities and impacted households. The District Agriculture and Forestry Office (DAFO) should provide oversight the vegetation clearing activities. Where practical, the high conservation value HCV) species should be transplanted in appropriate locations with support from the Project Management Unit. The affected households who own these tree species should be given opportunities to harvest timbers in advance of clearing activities provided that they have appropriate personal safety equipment (PPE); Cleared areas should be progressively revegetated and rehabilitated throughout the life of the Project to restore vegetated areas where possible; and
- ▶ Support local authorities and communities to plant and/or maintain native trees especially the high conservation value species along the Project alignment during the operation to offset biodiversity loss due to the Project;
- ▶ Wash down the vehicles before entering the designated site to prevent the introduction and spread of invasive species into the area and ensure a regular weed management and monitoring.

## Conclusions

The key Project impact to terrestrial biodiversity is the loss of 13 *Pterocarpus macrocarpus* which is listed as Endangered in the IUNC Red List of Threatened Species and the loss of at least 458 tree stems of planted and natural growth species during the construction phase. Limiting the vegetation clearance to the minimum area necessary, avoiding priority flora species and rehabilitation of cleared areas with native and non-invasive species will minimise these impacts to Medium.

The risk of increased exploitation of timber and non-timber products is likely to be greatest around existing settlements and any other settlements that arise to take advantage of potential economic opportunities such as provision of goods and services to the Project. Forest stands are most likely to be targeted for hunting and timber collection. Minimising potential impacts on fauna habitat and prohibiting construction site staff and contractors from hunting, buying or trading of wildlife will be important for minimising risks to wildlife population in the area, and will reduce the associated impacts to Low.

### 6.6.2 Aquatic Biodiversity

#### Issues and Findings

The Project is not located within or near any international recognised aquatic areas of conservation importance such as Ramsar sites or Key Biodiversity Areas. Most of the fish species identified in the Project area consider 'Least Concern' by the IUCN that were caught in local streams, rice paddies, ponds and rivers such as Nam Ngum and Mekong River. A giant freshwater stingray (*Urogymnus polylepis*) species was identified during the local knowledge survey (LKS) (refer to Section 5.8.3 and Table 5-17). This species is listed as Endangered in the IUCN Red List of

Conservation and in Category I of the National Conservation Species (2021). One Near Threatened species (*Chitala blanci*) and a Vulnerable species (*Wallago attu*) were also identified during the LKS. These species are often caught in larger rivers such as Nam Ngum and Mekong Rivers where it is unlikely to have significant impacts from the Project construction activities.

Clearance of the Project footprint is likely to result in increased erosion and sedimentation in waterways. Direct impacts of suspended sediments on fish and other aquatic fauna include clogging of fish gills, increasing stress and compromising fish health, avoidance (of the section of affected river) and decreased foraging efficiency (Greer et al., 2015). Increased sediment and nutrient loads can cause eutrophication which can negatively impact benthic organisms (Wang et al., 2021).

### Pre-Construction and Construction Phases

The Project alignment intersects the Houay Ver, Houay Phai and Nam Ngum River, therefore the Project development is expected to result in indirect impact or have some level of disturbance on aquatic habitat associated with the construction activities. The stream area impacted by the Project is small, therefore there is unlikely to be significant concentrations of aquatic flora and fauna species impacted.

**Table 6-8: Location of streams and river**

No.	Name	Chainage
1	STREAM	km 47+842
2	STREAM	km 48+785
3	STREAM	Km49+260
4	STREAM	km 49+508
5	STREAM	km 55+235
6	NAMNGUM RIVER	km 63+200
7	STREAM	km 66+413
8	Houay Ver	km 67+270
8	STREAM	km 67+854
10	Houay Phai	km 70+008

### Operation Phase

Turbidity and sedimentation in the nearby aquatic habitats would be less likely during operation phase compared to the construction phase. The potential impacts on aquatic biodiversity occurring in this phase would be due to accidental release of lubricants, oils and other contaminants from the machinery and associated facilities.

### Avoidance, Management and Mitigation Measures

The following key mitigation measures to protect aquatic biodiversity are provided for NR13SE and construction contractors:



- ▶ Reduce the potential increase of sediment loading in receiving water by implementing erosion and stormwater runoff control;
- ▶ Retain riparian vegetation on each side of the stream channels or revegetate those areas in case there is minimal riparian vegetation along the stream;
- ▶ Minimise the consumption of surface water flows for the Project by using alternative sources of water or road watering. Monitor changes in flows during the life of the Construction may be conducted;
- ▶ Have proper spill containment and clean-up materials in place and avoid using heavy machinery and herbicides / pesticides near waterways.

### **Conclusions**

The primary impact to surface water quality and therefore aquatic habitats and fauna will likely be suspended sediments generated from increased erosion and sediment transport during construction activities. Clearance of the Project footprint is likely to cause suspended sediment impacts to affected drainages. Implementation of mitigation measures such as minimising disturbance to riparian habitats and progressive rehabilitation of cleared areas will reduce the residual impact to Low.

## **6.7 Social-Economic Impacts and Mitigation Measures**

### **6.7.1 Socio-Economic Assessment**

#### **Issues and findings**

The key potential socio-economic and livelihood impacts of the Project are as follows:

- ▶ Temporary or permanent disruption and loss of access to properties, social and commercial services, facilities and natural resources along the alignment;
- ▶ Improvements in regional accessibility, connectivity and travelling times, facilitating regional economic development;
- ▶ Displacement of residents and loss of their land, assets and livelihoods;
- ▶ Loss of revenue, assets, structures, land and employee incomes for businesses from small vendors to industrial establishments. Small or informal businesses which are not registered or have secure land tenure are particularly vulnerable;
- ▶ Provision of employment to local communities in the construction phase and, to a lesser extent, in the operation phase;
- ▶ Risks associated with labour in-migration during construction, including potential violence or harassment of women and children (as experienced and documented for the Lao PDR's Transport Sector Development Project);
- ▶ Potential change of land use patterns throughout the area with associated livelihood and business impacts (e.g. shops, restaurants, and other services); and

- ▶ Impacts to utilities (e.g. power and water distribution services) and community property (e.g. temples, local markets, cemeteries and schools).

### **Pre-Construction and Construction Phases**

During construction, the Project will provide a range of direct and indirect economic benefits at the local, regional and national levels. Direct benefits include government revenue through fees and taxes, as well as increased direct foreign investment in the country. The construction of the Project represents a total Investment of approximately \$93.69billion in capital expenditure. Indirect benefits include flow on effects, training / skills development and infrastructure development. The capital expenditure will likely result in flow on effects to the Lao PDR national economy, and its estimated to result in an increased GDP and Foreign Direct Investments. There will also be significant economic opportunities for local businesses to provide goods and services to support the construction activities. The associated injection of cash into the local economy through local salaries and procurement will have flow-on benefits for local economic development and general increased consumption.

The construction works have the potential to result in significant local employment and training opportunities. It is estimated that 168 staff will be employed during construction. Occupational health and safety are a key aspect of the Project and is addressed in the ESMP (refer Volume C-1).

### **Operation Phase**

During Operation, the improvement of the NR13SE expected to result in significant benefits to economic development at the national, district and local levels. The Project will contribute to improving access and trade between districts/provinces and improve transportation of goods across the country. A number of developments are currently planned within the Vientiane – Southern provinces and regional countries, which will benefit from the improved traffic management and access the NR13SE will provide. Likewise, communities will benefit from having access to existing and planned developments, which will enhance job opportunities. The NR13SE will also significantly increase the accessibility of services such as markets and education facilities, which will contribute to livelihoods and local economic development opportunities.

During the 7-year operation, it is estimated that NR13SE will employ a total of 20 employees. Most of the jobs will work on road maintenance activities. Due to the geographic extent of the Project, it is anticipated that attendants will be locally recruited from communities situated near the Project alignment.

### ***Avoidance, Management and Mitigation Measures***

A summary of key mitigation measures for potential impacts on livelihoods will aim are outlined below. Specific measures for impacts due to land and asset acquisition are discussed in detail in the Resettlement Plan (RP, Volume C-2).

For affected livelihoods conducted in urban areas, income and livelihood restoration will include:

- ▶ Conduct ongoing consultation with key stakeholders in accordance with a Stakeholder Engagement Plan (SEP) to be prepared for the Project ahead of Construction Phase commencing;

- ▶ Develop and implement a 'local first' procurement and supply policy which favours sourcing of local products and services;
- ▶ Preferential employment opportunities during Project construction;
- ▶ Skills training to improve current skillset or re-skilling to take on new employment opportunities. Affected Persons choosing this option will be provided assistance to find local training opportunities and programs.

### **Conclusions**

The Project will generate direct and indirect employment through the creation of jobs during construction and operations. Other significant Project benefits include taxation and royalty benefits to the GoL and flow-on economic benefits and effects such as local supplier and service opportunities. The Project will also bring in the region road improvement to ASEAN standard which will improve accessibility.

With the implementation of the Resettlement Plan (Volume C-2) for the Project, residual socio-economic impact is expected to be reduced to a low impact.

### **6.7.2 Land, Assets, and Infrastructure**

#### **Issues and Findings**

##### **Pre-Construction and Construction Phases**

Land impacts due to the Project will primarily be associated with the acquisition of land for the Project ROW, construction of new access routes, and siting of construction infrastructure and ancillary facilities. This will include both temporary and permanent loss of access to land. Potential indirect impacts may also result through a loss of access to land, associated livelihood and economic impacts, fragmentation of land areas and severance of existing access routes and roads.

26. The Detailed Measurement Survey (DMS) has been conducted during 16 January to 16 February 2023 based on the confirmed COI as presented in Section 2.2 above and Attachment 1. The DMS indicates that the Project will affected 560 Project Affected Households (PAHs) with 3,096 Project Affected Persons (PAPs) including 1,380 females in 21 villages, three districts and two provinces by various forms of losses including land acquisition, housing structure, shops/restaurants, secondary structures and trees. Among the 560 PAHs (3,096 PAPs), there are 209 PAHs (929 PAPs) will have their lands, housing structures and shops to be affected by the Project as presented in Table 2-2 below.

- ▶ **Affected private land:** 17,023m<sup>2</sup> of private-owned land belongs to 56 PAHs. This includes 5,960m<sup>2</sup> (53 PAHs) of residential land; 10,688m<sup>2</sup> (2 PAHs) of paddy field land; and 375m<sup>2</sup> of garden land (1 PAH).
- ▶ **Affected housing structures:** 12 housing structures of 12 PAHs with affected area of 562m<sup>2</sup> ranking from 9% to 100%. The affected area over 40% (7 housing structures);

- ▶ **Affected shops/restaurants:** 158 shops/restaurants of 141 PAHs with affected area of 5,541m<sup>2</sup> ranking from 2% to 100%. The affected area over 40% (82 shops) will be considered as entirely affected structure and will be fully compensated;
- ▶ **Affected secondary structures** include 7,890m<sup>2</sup> of porch of house/shop, movable store, hut, spiritual house, guardhouse, ATM machine, signs, wall and gate; 1,887m of fence; and 914 poles of fence, and 7 electricity poles;
- ▶ **Affected trees:** 282 affected trees including 175 fruit trees, 17 industrial trees, 4 bamboo trees and 86 flower trees/naturally growth;
- ▶ **Affected public structures and trees:** 2 housing (offices) structures 39m<sup>2</sup>, 2,128m<sup>2</sup> of secondary structures and 161 trees.
- ▶ **Relocation of public utilities:** water supply system (4m<sup>2</sup> water supply storage, 2 water supply gates, and 2,988m of water supply piping system); electricity network (2 transformers, 30,163m of electricity cable, and 292 of electric light poles); 2 traffic light pole; and 1 CCTV camera and 4 CCTV camera poles.

As outlined in the RP (Volume C-2), there are three types of land use are directly impacted by the Project land acquisition. These include residential land (17,023 m<sup>2</sup>), rice paddy (10,688 m<sup>2</sup>), and agricultural land (375 m<sup>2</sup>). These land use types are owned by 56 households in 13 villages (refer to Table 6-9. Other types of impacted assets include housing structures, shops and restaurants, secondary structure and trees.

**Table 6-9: Summary of losses**

No.	Type of Loss	# of Village	# of PAH	# of Affected Structure	Affected #	Unit
<b>1</b>	<b>Land</b>	<b>14</b>	<b>56</b>		<b>17,023</b>	
1.1	Residential land	11	53		5,960	m2
1.2	Paddy land	2	2		10,688	m2
1.3	Garden land	1	1		375	m2
<b>2</b>	<b>Housing Structures</b>	<b>9</b>	<b>12</b>	<b>12</b>	<b>562</b>	
2.1	Two-story house (concrete+wooden)	1	1	1	9	m2
2.2	One-story house (concrete)	6	9	9	513	m2
2.3	Wooden house	2	2	2	40	m2
<b>3</b>	<b>Shops and Restaurants</b>	<b>17</b>	<b>141</b>	<b>158</b>	<b>5,541</b>	
3.1	Shops and Restaurants	17	141	158	5,541	m2
<b>4</b>	<b>Secondary Structures</b>					
4.1	Porch of house/shop	18	166	179	3,690	m2

No.	Type of Loss	# of Village	# of PAH	# of Affected Structure	Affected #	Unit
4.2	Store	4	4	4	45	m2
4.3	Movable shops	5	5	5	125.5	m2
4.4	Huts	5	6	6	61.5	m2
4.5	Spiritual house & statues	3	3	3	6	m2
4.6	Guardhouse	3	3	3	68	m2
4.7	ATM Machine	1	1	1	4	m2
4.8	Water well	2	2	2	50	m2
4.11	Signs	20	232		1,980	m2
4.12	Wall	14	47		1,724	m2
4.13	Gate	8	12		136	m2
4.14	Fence	18	44		1,887	m
4.16	Fence pole		53		914	pole
4.17	Electricity pole	4	6		7	pole

Source: Detailed Measurement Survey (DMS), 16 January to 16 February 2023

### ***Avoidance, Management and Mitigation Measures***

Management and mitigation measures to minimise land, asset and infrastructure impacts posed by Project activities during construction and operation are presented in the Resettlement Plan (RP, Volume – C 2) and summarised below.

An Environmental and Social Management and Monitoring Plan (ESMP) for the Project has also been prepared which includes further management and mitigation measures for land impacts (refer to Volume C-1).

- ▶ Provide compensation to affected people as per the RP. This should include special measures to assist vulnerable persons.
- ▶ Lack of formal legal rights to assets lost will not deprive any Affected Person from receiving compensation and entitlements. Distinctions will not be made between Affected Persons “with” and “without” formal legal land titles.
- ▶ For severely impacted residences where it is not feasible to establish pedestrian or vehicle crossings, provide compensation as per the RP;
- ▶ Carefully conduct construction activities to ensure existing infrastructure and utilities are not unnecessarily disturbed;
- ▶ Where removal / relocation is inevitable, consult and collaborate with service provider during the removal/relocation process and provide advance notice (at least a few months).

Provide compensation as per the RP (in advance and in a phased manner to reduce potential impacts on end users avoid disruption to civil works and service provision).

- ▶ Where possible, ensure road design accounts for major infrastructure (such as transmission lines) to avoid the requirement for relocation.
- ▶ To avoid damage to signposts and road furniture, work with the contractor and owners to ensure their careful removal, storage and relocation to a safe site.
- ▶ Compensate and assist local market vendors as per the RP. This includes assistance for the relocation of stalls or the provision of alternative livelihood opportunities, where relocation is not possible. Consider working with authorities to temporarily waive market related taxes during the time of relocation, to avoid further impacts on livelihoods.
- ▶ Establish and implement a grievance mechanism to manage community complaints.

### **Conclusions**

The widening of the NR13 COI will result in unavoidable impacts on land and assets. The Project ROW will acquire land, comprising 17,023 m<sup>2</sup> of residential, rice paddies and other agricultural land identified within the COI. Other assets include housing structure (562 m<sup>2</sup>), shops and restaurants (5,541 m<sup>2</sup>), secondary structure and trees. Most of the land and asset loss are located within the RoW. With suitable compensation strategies provided to Project Affected Households as required, the direct Project impacts should be adequately minimised to residual low impact.

### **6.7.3 Traffic, Transport and Accessibility**

#### **Issues and Findings**

The Project is expected to create a number of transport and accessibility benefits that will help facilitate economic growth and development in the region, including:

- ▶ Decongestion of the existing road network by diverting traffic to the NR13SE;
- ▶ Increasing road capacity, which will enable the region to accommodate the expected future traffic volumes;
- ▶ Facilitating greater accessibility to areas serviced by the NR13SE, as well as improving regional and international connectivity;
- ▶ The generation of travel time savings through continuous overtaking opportunities, a reduction in the number of intersections and removing the need to reduce speed through townships;
- ▶ Increased road safety through providing a new route with improved alignment, more overtaking opportunities, controlled access via interchanges and treatment of road hazards; and
- ▶ Improved efficiency and safety for freight.

Unmanaged, the Project is expected to create some adverse impacts including:

- ▶ Loss of local accessibility to properties and services as a result of land acquisition for the Project alignment; and
- ▶ Temporary localised impacts on road network as a result of construction activities and additional construction traffic.

### **Pre-Construction Phase**

No impacts associated with traffic and transportation are expected to occur during the Pre-Construction Phase as no significant transport activities for the Project will occur during this phase.

### **Construction Phase**

Traffic generated by the construction of the Project will predominately be associated with the transport of construction machinery, equipment and materials to site. Traffic will also be generated by worksite contractors accessing the site during the period of work. It is expected that the construction of the Project would be staged to minimise disruptions and maintain traffic flow.

Overall, the addition of construction traffic to the road network as a result of Xaythany to Thaphabath Districts is expected to have a significant impact on the network as the entire Project occurs within existing alignment where road construction activities would be temporarily closed off to minimise any disruptions. Entrances to local premises would have been temporarily closed for a period of construction works such as roadside drainage systems.

Some higher localised, but temporary impacts on the road network may occur as a result of changed road conditions in the vicinity of access routes and construction sites. These include temporary disruptions to local houses, restaurants, shops and other public facilities and services.

Potential changes in the road environment include Project heavy vehicles entering or existing access routes, and additional road hazards, variable speed limits and unfamiliar conditions in the vicinity of construction areas. This may impact road users by changing trip patterns and increasing travel times, leading to temporary disruptions and delays in accessibility during the construction period. Road users that may be potentially impacted include private vehicles, public transport vehicles, two or three wheeled motorised vehicles, non-motorised vehicles and pedestrians.

Unmanaged, the addition of construction vehicles to these areas may exacerbate the existing high density of traffic and result in reduce travel efficiency and road safety risks. The development and implementation of Traffic Management Plans (TMPs) with measures such as speed controls and secure working areas will help minimise these impacts.

### **Operation Phase – Traffic Volume**

The Project is expected to have a significant positive impact on relieving traffic congestion between Xaythany to Thaphabath Districts, through the improve road condition especially between the 4-lane section, resulting in decongestion of the existing road and surrounding network.

Decongestion of the road network is expected to be achieved through:

- ▶ Management of traffic demand during peak times, through additional road capacity and road tolls;

- ▶ Reduction of hazards associated with the existing road that contribute to the current congestion such poor road conditions and maintenance issues;
- ▶ Improving the reliability of journey times across the network;
- ▶ Avoiding the side friction that occurs from having numerous developments and access points along the existing road, through having limited access points on the expressway and encouraging the free flow of traffic.

### **Operation Phase – Regional Accessibility and Connectivity**

The proposed NR13SE Project forms part of the National Road 13 (NR13) and a series of major infrastructure investments within Lao PDR. An extensive network of roads is being planned to facilitate vehicle movement throughout the National Road 13. This includes the improvement and maintenance of National Road 13 South from Km 71 to Km 346 as well as National Road 13 North from Sikeud to Phonhong (58 Km), which are both currently under construction. It also includes the planned Vientiane – Pakse Expressway Project, for which the route has recently been approved by the MPWT. These road developments are being constructed and planned in combination with other transport and logistics projects including the Lao-China Railway project.

One of the key benefits of the proposed Project is that it is expected facilitate greater accessibility to areas serviced by the NR13SE, as well as improve regional and international connectivity, thus facilitating economic development (refer to Section 1.2.1).

Transport infrastructure development is a critical element in the economic development policy of Lao PDR. The Project will support the Government's goals of improving transport connectivity, effectiveness and efficiency to stimulate economic development, urbanisation and the reduction of transport cost. Through the decongestion of traffic, particularly between the most heavily affected stretch between Km 21 – Km 36, and an improved road service that can accommodate increased traffic volumes in the future, the Project is expected to have a significant positive impact.

### **Operation Phase – Capacity and Improved Travel Times**

A key benefit of the Project is expected to be the alleviation of current and future capacity constraints on the existing NR13SE (particularly between Km 21 – Km 40) and alleviation of the resulting reliability issues on the surrounding road network.

Implementation of the Project is expected to result in improved transit times and reduced vehicle operating costs for regional and national traffic. Once operational, the road is expected to save up to 15 - 20 minutes of journey time from Km 21 – Km 71. These time savings would be achieved through increasing speed limits to a maximum of 80 km / hr on some sections of the NR13SE (which is not normally permitted on all-purpose roads in urban zones);

This is expected to result in improved travel times and traffic flow, creating more consistent travel speeds and reliable journey times which will benefit road freight, passenger transportation and general road users.

### **Operation Phase – Road Safety**



One of the primary benefits of the Project is expected to be an improvement in road safety and a potential reduction in crash rates. The Project would improve road safety by providing an alternative to the existing undivided roads between Km 21 – Km 41 with a 4-lane dual carriageway, with improved alignment, and more overtaking opportunities. Specifically this includes:

- ▶ Provision of central medians to reduce occurrence of head-on collisions;
- ▶ Ability for vehicles to safely overtake along the length of the road;
- ▶ Improved horizontal and vertical alignments;
- ▶ Avoidance of black spots on the existing road.

The Project design considers road safety in hotspot locations including minor realignment in three sections of relatively sharp curves (KM35+000 – KM36+400 (T1); KM64+900 – KM65+400 (T2); and KM68+600 – KM70+000 (T3). The realignment of sharp curves is expected to reduce the road related risks and accidents.

The installation of roadside lighting, traffic lights (where applicable), signage, speed bumps, gantries, and other road safety measures will significantly improve road safety conditions. Similarly, the Project consider installing four pedestrian crossing (overpass) facilities at sensitive receptors (schools). If these are implemented, it is expected to reduce risks for school children when crossing the road. These features are expected to eliminate a proportion of existing road safety risks and provide a higher standard of road safety compared to current levels. Detailed traffic management requirements are provided in ESMP (Volume C-1).

### ***Avoidance, Management and Mitigation Measures***

An Environmental and Social Management and Monitoring Plan (ESMP) has been prepared for the Project which includes management measures for potential traffic, transport and accessibility impacts and risks (refer Volume C-1).

Management and mitigation measures to minimise community health and safety risks posed by Project activities during construction and operation are summarised below. The Project will result in an overall benefit to traffic, transport and accessibility in the region.

- ▶ Conduct ongoing consultation and engagement with affected communities.
- ▶ For severely impacted residences where it is not feasible to establish pedestrian or vehicle crossings, provide compensation as per the RP.
- ▶ Ensure appropriate signage is installed regarding diversions or alternative access routes.

### ***Conclusions***

The NR13SE Project are considered necessary by the Lao PDR government to relieve current congestion and cater for future growth within the Vientiane and Bolikhamxay to improve the transportation of materials in the region. This will relieve traffic congestion on the NR13SE road and facilitate greater access to towns serviced by the NR13 South in general. The upgrade of the road will provide significant benefits to local communities, regional and national economy through improve accessibility and connectivity.

## 6.7.4 Community Health and Safety

### Issues and Findings

#### Pre-Construction Phase

The Project will result in full and partial loss of land, assets and businesses, which may result in temporary short-term increases in mental stress and anxiety among the resettled population. Moving house is known to be a significant stressor on individual health as it temporarily disrupts family life. Relocation can also cause temporary disruption to social networks and community relationships which may also add some level of stress and anxiety.

Whilst the potential for stress and anxiety associated with relocation cannot be completely avoided, potential impacts can be minimised through an open, transparent and participatory resettlement process. Recommendations regarding the compensation process are provided in the Resettlement Plan (refer Volume C-2).

The assessment of social impacts associated with land acquisition for the Project and associated relocation of affected households is provided in the Resettlement Plan (refer Volume C-2).

Apart from the health impacts of displacement discussed above, no other significant impacts on community health and safety are expected for the Pre-Construction Phase. Potential impacts associated with the Construction and Operations phases are discussed below.

#### Construction Phase

##### Access and Safety

During Project construction, a number of access routes will be used to facilitate the transportation of construction materials, equipment, fuel, general supplies and construction workers to the various construction sites, quarries, borrow areas and construction camps to be used for the Project. Where possible, the Project will utilise existing road infrastructure. The Project is also expected to generate a number of light and heavy vehicle movements during the construction period. Local marketplaces identified in adjacent to the ROW are also exposed to high community health and safety risk. Often these market facilities are not well-organized for parking and vendor establishments which pose higher road accident. The distances from the NR13SE alignment to these market range approximately 14 m – 30m (refer to Table 6-10).

**Table 6-10: Locations of local marketplace**

No.	Chainage	Position	Distance to Road (m) (From New Alignment)
1	KM 22+485	RT	27.00
2	KM 24+650	RT	26.00
3	KM 26+125	RT	20.00
4	KM 29+400	LT	18.50
5	KM 35+325	LT	30.00
6	KM 43+190	LT	18.22
7	KM 56+425	LT	13.83
8	KM 62+675	RT	30.88

The NR13SE alignment also traverses several community health facilities including district hospitals. The distance from the road to these facilities ranges between 19m – 84m. The health facilities and patients may be sensitive to construction activities including dust, air and noise emissions.

**Table 6-11: Locations of health facilities**

No.	Chainage	Position	Distance to Road (m) (From New Alignment)	
			(To Fence)	(To Health Center)
1	KM 21+575	RT	15.87	27.00
2	KM 38+868	LT	18.62	30.00
3	KM 48+950	RT	14.60	19.17
4	KM 58+450	RT	24.82	84.60

Unmanaged, a key community health and safety issue during the construction period is likely to be an increase in road safety risks in settlement areas around construction sites and access routes, as a result of a temporary change in the road environment and traffic conditions associated with the Project. Potential changes in the road environment include an increase in the number of heavy vehicles through the addition of Project vehicles on the road network, additional road hazards around construction sites, variable speed limits and unfamiliar conditions. Unmanaged, this could impact community health and safety through an increased risk of vehicle collisions, resulting in personal injury or death. A key vulnerable group will be pedestrians (particularly children) near construction sites and in villages along Project transportation routes. A number of pedestrian diversions will need to be implemented during construction to protect community safety and provide alternative access routes. Safety fencing/barriers around construction sites in community areas will also assist in separating pedestrians from construction vehicles and equipment.

Impacted road users will include private vehicles, public transport, two or three wheeled vehicles, non-motorised vehicles and pedestrians. This risk will be higher for people living or travelling near the construction sites and access routes used by Project vehicles. These include existing roads, construction access routes or the accessory roads being built or upgraded as part of the Project.

Community risks may also be exacerbated where the quality of existing road infrastructure is low or has been damaged, if night-time transportation is required, or where there is a high prevalence of existing road hazards such as pedestrians (particularly children), livestock and slow-moving vehicles (such as tractors and bicycles). Children are likely to be at greatest risk of road accidents, as they commonly play by the roadside, and use the roads to walk/ride to and from school.

In addition, traffic safety awareness, particularly in rural areas (where Project vehicles pass through existing roads or where new access roads are created) may be more limited than in urban areas, which could increase the risks of road hazards.

Other accidents may occur from unauthorised access to construction sites. Security measures such as security fences and signage around construction sites in populated areas will be required to minimise risks of unauthorised access. Ensuring alternative access is provided for pedestrians where existing access routes are blocked will also assist in reducing the likelihood of trespass

through construction areas. Additional risks associated with labour influx during construction, including potential violence or harassment of women and children.

#### Labour Influx

The Project has the potential to result in an increase in the prevalence of vector related, respiratory, soil and water borne and sexually transmitted diseases. Increased prevalence may be through introduction of new disease, increased transmission of existing diseases or a combination.

Minor Project-related in-migration is expected to occur during the Construction Phase due to the influx of the Project workforce and others seeking economic opportunities to provide goods and services to support construction activities. One of the major health issues raised by Project construction is the potential for increased rates of STI infection and transmission – in particular HIV/AIDS – among the local community. In particular, the influx of Project workers to the area during construction has the potential to result in an increase in STIs. The construction workforce is expected to be approximately 168 workers at peak – a majority of which are likely to migrate to the area from outside. The Project could potentially indirectly contribute to the spread of STIs and HIV/AIDS in the following ways:

- ▶ A likely in-migration of people (mainly young men) to the Project area in search of employment and business opportunities is expected to increase the local male to female ratio and lead to an increase in prostitution.
- ▶ The local economic stimulation as a result of the Project is likely to result in an increase in a further rate of in-migration of immigrant workers who migrate to the villages in the vicinity of the Project construction area to provide goods and services to support construction activities.
- ▶ In-migration associated with Project works in areas where there are limited testing facilities currently available could have an increased risk for the spread of HIV/AIDS other STIs due to low rates of medical treatment and screening of local populations.

#### Operation Phase

One of the primary benefits of the Project is expected to be an overall improvement in general road safety and a potential reduction in crash rates in the region. The Project is expected to improve road safety in the region by providing an alternative to the existing undivided road from Xaythany to Thaphabath Districts, especially between Km 21 – Km 41 with a multiple lane dual carriageway, with improved alignment, more overtaking opportunities and controlled access via interchanges. Specific improvements in road safety as a result of the Project are likely to include:

- ▶ Implementation of a dual carriageway (Km 21 – Km41) with central medians to divide oncoming traffic which is expected to reduce the risk of collisions compared to an undivided road where oncoming traffic is not physically separated;
- ▶ Provision of traffic lights which ease visibility during night time driving.

Whilst motorways are generally considered to be safer compared to normal roads in built up areas, they present a different set of community health and safety issues, which could impact road users utilising the NR13SE. These include:

- ▶ Less experienced drivers may have a poorer understanding of the risks associated with driving on the road conditions, and be more susceptible to the risk of accidents;
- ▶ Road accidents, should they occur on the NR13SE, could be more severe due to the high speeds travelled on the improved road.

### ***Avoidance, Management and Mitigation Measures***

An Environmental and Social Management and Monitoring Plan (ESMP) has been prepared for the Project which includes management measures to minimise risks to community health and safety, as well as occupational health and safety (refer Volume C-2). Key related management and mitigation measures for community health and safety for the Project are summarised below. The residual risks and impacts after implementation of the measures is also presented. Whilst some adverse risks (e.g transportation and road safety) cannot be entirely avoided, implementation of the measures outlined will help minimise risks to acceptable levels.

- ▶ Implement a transparent compensation process as per the RLRP (Volume C-2).
- ▶ During construction works, ensure access routes are in good condition.
- ▶ Prevent members of the public from accessing construction areas through appropriate fencing and barriers. Signage should also be used to deter unauthorised entry.
- ▶ Implement speed controls and provide access traffic with appropriate signalling and direction around construction areas.
- ▶ Carryout road safety campaigns to schools and communities which are close to the ROW.
- ▶ Reduction of maximum vehicle speeds around work zones;
- ▶ Ensure Project workers are adequately briefed and trained regarding the required public safety precautions for specific construction activities
- ▶ Ensure that plants and vehicle operators are properly licensed and trained.

It is expected that a detailed stand-alone OHS Management Plan will also be prepared for the Project prior to work commencement, based on the measures outlined in the ESMP.

### ***Conclusions***

The Project should help to reduce road traffic incidents in the region through the provision of a dedicated roadway with an improved alignment, which isolates vehicle traffic from pedestrians and non-motorised vehicles, has a dual carriageway with central medians (Km 21 – Km41).

Aside from a potential improvement in the rate of road accidents, the largest potential impact on community health through motorised transport is air emissions and resulting air quality. The air quality in Lao PDR is already heavily affected by traffic, cooking fuel and vegetation burning. Once operational, the Project should lead to a more efficient motorised transport in the Project Districts and potentially a slight improvement in air quality. Improved fuel and car technology is also the biggest potential driver of air quality in Lao PDR.

Traffic on the NR13SE will also generate significant traffic related noise for potential receptors in close proximity to the Project. Implementation of the outlined measures such as noise barriers and

retrofitting of households will be important to minimise potential noise disturbance to acceptable levels in these areas.

## 6.7.5 Cultural Heritage and Archaeology

### Issues and Findings

#### Pre-Construction Phase

No impacts on archaeology and cultural heritage values are expected to occur during the Pre-Construction Phase.

#### Construction Phase

The NR13 Project does not impact on any known archaeological sites of global or national significance. However, there are 14 temples, and 7 cremation / cemetery sites are located in adjacent to the NR13SE's RoW and proposed borrow pits. The nearest distance from the alignment to the cultural site is approximately 24.970m (Km66+700) (refer to Table 6-12). In addition, there are three spirit houses & statues located within the COI that need to be removed. It is important that construction activities impacted cultural sites such as cemeteries is conducted in a participative way with involvement from local communities and local spiritual leaders.

**Table 6-12: Locations of local cultural sites**

No.	Chainage	Position	Remark	Distance to Road (m) (From New Alignment)	
				(To Fence)	(To Temple)
1	KM 24+100	LT	Cemetery	24.296	46.787
2	KM 25+125	LT	Temple	20.781	50.000
3	KM 26+995	LT	Temple	Outside ROW	
4	KM 29+800	LT	Temple	Outside ROW	
5	KM 29+900	RT	Temple	18.541	92.000
6	KM 31+150	RT	Temple	29.000	85.430
7	KM 31+925	RT	Cemetery	Outside ROW	
8	KM 34+625	LT	Temple	Outside ROW	
9	KM 38+975	LT	Temple	20.000	45.290
10	KM 40+550	RT	Temple	35.985	68.030
11	Km 41+460	RT	Cemetery	Outside ROW	
12	KM 43+100	LT	Temple	16.949	37.280
13	KM 44+400	LT	Cemetery	22.000	80.000
14	Km 46+975	RT	Cemetery	37.000	100.000
15	KM 47+925	RT	Temple	32.982	67.220
16	KM 48+855	LT	Temple	56.000	92.000
17	KM 55+975	RT	Temple	32.609	67.350
18	KM 58+200	LT	Temple	26.438	114.750
19	KM 59+400	RT	Cemetery	26.000	70.000
20	KM 66+700	LT	Temple	23.178	24.970
21	KM 68+900	RT	Cemetery	25.000	130.000

Intangible heritage can include traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts. No intangible heritage values are expected to be significantly affected by the Project.

### **Operation Phase**

The primary impact on archaeology and cultural heritage values during the Operations Phase is expected to be noise from traffic on the NR13SE section which may result in nuisance noise impacts for nearby cultural sites such as temples (which are not relocated for the Project). Air quality may also be reduced at some cultural sites close to the ROW.

In addition, impacts on the local accessibility of some cultural sites resulting from the ROW will continue during the Operations Phase. However, the improvement of the NR13SE will also increase the accessibility of many cultural sites near the alignment, which compensates for the local impacts on accessibility to some degree.

### ***Avoidance, Management and Mitigation Measures***

An Environmental and Social Management and Monitoring Plan (ESMP) has been prepared for the Project which includes management measures to minimise impacts on archaeology and cultural heritage (refer Volume C-1). Key related management and mitigation measures for the Project are summarised below. The residual risk or impact after implementation of the measures is also presented.

- ▶ Avoid construction activities during the lunar calendar (the day/night of 15) to respect the cultural and traditional beliefs of the ancestors.
- ▶ Ensure that inductions and training covering the protection of cultural / natural heritage values are conducted for all staff and contractors on site.
- ▶ The contractor will support the conduct of appeasement ceremonies if noise or worker presence from Project activities is considered a disturbance for sites close to the Project Footprint.

### ***Conclusions***

No known sites of archaeological or cultural heritage significance are located within or immediately adjacent to the Project's COI. In addition, given the road lies within existing alignment, there is a low probability of chance finds during the pre-construction and construction phases of the Project and therefore residual impacts are overall expected to be Low to Very Low.

Implementation of proposed measures outlined in the Project ESMP (Volume C-1) including the Chance Find Procedure, ongoing stakeholder engagement and implementation of the Project Grievance Mechanism will help to ensure any potential community and stakeholder dissatisfaction due to adverse Project impacts on sites of archaeological or cultural heritage importance are minimised.

## 6.7.6 Visual Amenity

### *Issues and Findings*

#### **Impacts on Landscape Character and Visual Amenity**

The main potential impacts on visual amenity and landscape character are likely to occur where the Project alignment that occurs in contrast to natural topography and relief of the landscape, requiring major fill sites which will be different to the surrounding terrain in terms of height, length and incline of slopes.

Negligible to minor impacts are expected where the Project:

- ▶ Follows the natural topography and relief of the landscape, as visual disturbance in these areas will be minimised; and
- ▶ Passes through modified landscapes where visual amenity is already influenced by other factors, such as in densely urban areas.

#### **Lighting Impacts**

No lighting impacts are expected to occur during the Pre-Construction Phase as no activities with lighting requirements will occur for the Project during this phase.

During construction, it is likely that some night lighting will be required at certain locations. It is likely that Project construction sites would require some form of security lighting at specific locations (e.g. entrances and exits, storage areas etc.) to ensure safety and security of personnel and property. In addition to security lighting requirements, lighting would also be required in the event that night-time construction activities are undertaken. Some lighting from these locations may be visible from sensitive receptor locations. Although lighting would be focussed over the particular points of interest within the construction sites, some light trespass would be likely. The level of impact is likely to vary depending on the type of construction site and location of nearby receptors.

Once operational, some sections of the NR13SE particularly in community areas will require lighting for safety considerations. Lighting on roadways is known to reduce the risks of accidents for vehicles. The main lighting effects that could be experienced from the Project include:

- ▶ Direct effects – where the light source is directly visible and would be experienced if there is a direct line of sight between a viewing location and the light sources; and
- ▶ Sky glow – which results from light of sufficient strength being reflected back into the atmosphere. This would create a strong local focal point, although the effect would vary with distance and atmospheric conditions.

Potential lighting impacts will vary for receptors will vary due to local topographic features and distance from the Project. The main lighting impacts are expected to occur where the Project passes through areas that are naturally darker at night, such as non-community areas.



### ***Avoidance, Management and Mitigation Measures***

An Environmental and Social Management and Monitoring Plan (ESMP) has been prepared for the Project which includes management and mitigation measures to minimise visual amenity and lighting impacts (refer to Volume C-1). Key related management and mitigation measures are summarised below.

- ▶ Lighting design will incorporate the minimum wattage required for a safe working environment
- ▶ Lights pointed downward and toward operational areas, minimising light egress
- ▶ Vegetation clearance restricted to the minimum extent practicable for Project construction. Where possible, retain existing roadside vegetation
- ▶ Establish screening vegetation in areas with views from affected dwellings.
- ▶ Shielded lighting utilised in built up areas to minimise night-time light egress from operational areas and skyglow.
- ▶ The use of artificial lighting in low wattage bulbs in ecologically sensitive areas.

### ***Conclusions***

The Project is primarily located through a floodplain and is therefore not expected to have any major visual impact in community areas. These landscapes have a high capacity for accommodating visual change and the Project would not significantly diminish the landscape character in these areas. In natural habitat areas such as wetland areas, the presence of the Project will be prominent and will certainly have an effect on landscape character and the ambience of the area. Other key areas where landscape character is likely to be affected includes areas where the Project does not follow the natural topography, requiring significant fill sections. The lighting associated with the Project is necessary for safety. While impacts of light spill and sky glow will be minimised via the mitigation measures proposed, the lighting will be prominent and will result in low impacts on visual amenity for local dwellings.

## **6.8 Cumulative and Induced Impacts**

### ***Issues and Findings***

#### **Cumulative Impacts**

A cumulative impact can be described as: “the combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project. Induced impacts can be described as: Adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur at later or at a different location. No other existing, proposed and anticipated future road projects have been identified that may result in cumulative impacts to the Project area. In addition, construction and operation of the road has not been identified as a key factor for the future development of projects that may have significant environmental and social impacts, e.g. construction of a new

industrial park. The project is a rehabilitation project which intends only to upgrade the existing road.

### **Induced Impacts**

It is anticipated that road improvement would result in improving connectivity, communities access to public services and markets, reduced vehicle operating costs and travel time, enhanced accessibility of enterprises, increased labor productivity, and reduced road fatality rates. Improved access to markets, jobs and services along the major transport corridor will benefit a larger share of population and contribute to inclusive growth. As a result of climate resilience measures, there will be positive effects on accessibility to markets and public services during rainy season. Induced positive impacts to the community, including possible increase in land values, and development of more business opportunities and jobs. These support the Eighth National Socio-Economic Development Plan (NSEDPP) 2016-2020, goals of achieving sustained and inclusive economic growth, while reducing the effects of natural shocks as well as the national efforts to achieve Sustainable Development Goal (SDG) 9 to build resilient infrastructure and SDG 13 to address the impacts of climate change. However, Potential adverse induced impacts may include:

- ▶ Conversion of agricultural land to commercial, industrial factory and residential property, this in turn may lead to:
  - Increased population living within the corridor which may lead to stress on social services, such as schools, hospitals, etc.
  - Required upgrading or expansion of utilities, such as electricity supply.
  - Stresses on water availability, specifically groundwater.
- ▶ Expansion of development towards the Phou Khao Khoay National Park.

### **Compliance Impacts**

In addition to the impacts associated with the construction and operation phases of the Project several compliance impacts have also been identified as follows:

- ▶ Lack of Environmental Clauses in Contracts -The ESIA is an environmental statement by the DoR. While it is prepared by the ESIA consultant the ESIA defines the commitment by the GoL through the proponent and its contractors and consultants, to implement the mitigation and monitoring actions listed in the ESIA. For the measures proposed in the ESIA's ESMP to be taken seriously, they must become legally binding through inclusion as environmental clauses in the loan agreement between the GoL and the WB as well as the specifications in the contract-bid documents. This will be achieved by integrating the ESMP into the contract specifications as a clause and using the ESMP to prepare Contractor ESMP defining specific steps to be taken by the contractors and the government during the project construction phase. References to the ESMP will be made in the loan agreement between the GoL and AIB. It will be the Engineers responsibility to review the environmental mitigation and monitoring activities undertaken by the Contractor, with payments made only after verification that each work component has been completed as prescribed.

- ▶ Lack of Construction Compliance Inspection Services and Environmental Training - While the ESMP and the environmental covenants can be very clear and specific, if there is no one knowledgeable to undertake compliance monitoring, inspection and regular reporting, little of the ESMP will be implemented or completed. The Engineer, through his Environmental Manager or International/Regional Environmental Specialist, will ensure that compliance inspections are undertaken on a regular basis. In addition, the Engineers International/Regional Environmental Specialist will also provide training to the Contractor and his HSE team in the correct implementation of the C-ESMP prior to the commencement of works.

### ***Avoidance, Management and Mitigation Measures***

The ESIA has identified several beneficial and adverse induced impacts that may occur in the future as a result of the road improvement as described earlier. The potential adverse induced impacts may be arised from unplanned development along the road corridor and from potential change of land use including the potential expansion of development (all types) towards the Phou Phanang Protected area. Such impacts may include: i) stress on social services, such as schools, hospitals, etc.; ii) required upgrading or expansion of utilities, such as electricity supply; and iii) stresses on water availability, specifically groundwater, etc. However, the project will have less adverse induced impacts comparing to green field development. In Lao PDR, provincial authorities have mandate to manage relevant measures to address such induce impacts. Typically, such aspects are addressed by relevant legal framework and sector strategy including urban planning regulations, Land law, Agriculture law, National Land Policy, etc. Under the agriculture law individual or entities are not allowed to convert agriculture land to other propose unless receive permission from agriculture authorities. The national land policy also has similar requirements in term of protecting protected areas and forestry. These are also included in Five Years Provincial Socio-Economic Development Plan (Provincial SEDP). Under this project, the MPWT will establish the Project Steering committee, chaired by the Minister and consist of relevant provincial authorities and representative from relevant lines ministries. This expects to bring about an improved inter-agency coordination. To address unplanned ribbon development along the project road, the MPWT, through steering committee, should encourage provincial authorities and lines ministries to take into account potential impacts from these induced growths in the next Five years SEDP and respective development plans/strategies. Also, the DoR and DPWTs should strictly implement its policy to control.

### ***Conclusions***

The environmental health of communities residing along the NR13SE is affected by a complex urban and commercial development feature. It is critical that the construction of the NR13SE takes into account the protection of other developments which are impacted by several other planned Projects and urbanisation across the three Districts. The Project should also consider the indirect impacts of land acquisition in a city already experiencing land pressures. Provision of appropriate resettlement sites is critical to ensure that wetlands are not further 'reclaimed' for residential uses and thus decreased in size and quality further.

## 7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Environmental and Social Management Plan (ESMP) is prepared as a standalone document (Volume C-1). The key elements of ESMP will include the following:

- **Institutional Mechanism.** An institutional mechanism for the implementation and monitoring of ESMP has already been established through the Project Management Unit (PMU) under the Department of Road and its line agencies at provincial and district levels, including their roles and responsibilities for ESMP and management plans implementation, monitoring and inspection. The Consultant shall assess the institutional capacity of Client pertaining to the projects. Based on the assessment, the Consultant shall propose appropriate Institutional arrangement for effective environmental and social management of the Project, ie organizational setup from provincial department down to the implementation level, their respective responsibilities and staffing for environmental and social management. A detailed institutional capacity building strategy shall be proposed for the Client, Consultants and contractors. Mitigation plans, including measures for managing and mitigating various risks and impacts of each proposed project activity identified, with responsibilities assigned for their implementation and monitoring/supervision, along with monitoring indicators. These include but should not be limited to Occupation Health and Safety Plan (OHSP) and Community Health and Safety Plan (CHSP) and LMP and COC, ECOP, site specific ESMPs.
- **Internal monitoring and external monitoring arrangements** with roles and responsibilities, monitoring methodology and frequency, and documentation requirements. Two types of monitoring will be described: compliance monitoring and effects monitoring.
- **Capacity building requirements** for various entities of the project.
- **Documentation and reporting system.**
- **Cost of ESMP implementation.**

## 8. RESETTLEMENT POLICY FRAMEWORK (RPF)

Given the proposed Project activities, the Project will not involve major physical relocation of permanent structure and/or involve major resettlement of peoples. The civil works will focus on provincial and district routine and periodic road maintenance, including spot improvement in order to improve climate resilience and road safety of provincial and district road networks. It is envisaged that all activities would be carried on the existing carriageway within the existing right of ways (RoW). However, there is a possibility of minor re-alignments to improve road safety and/or strengthening road climate resilience. Investment activities may include elevating flood prone road sections, paving road sections with steep slope and the sections passing through big communities, drainage improvement/ construction, slope improvement/stabilization etc. The environmental impacts from these activities will be minor, localized, temporary, and can be mitigated. Potential impacts include dust dispersion, noise, traffic obstruction and access, construction and road safety, etc.

The AIIB's ESS2 (Involuntary Resettlement) policy is triggered because the Project will involve minor land acquisition for road maintenance work in some areas where minor realignments and adjustment will be necessary to ensure stability, safety of road works and climate resilience. Most of the works will be conducted in existing roads and will not involve major expansion that could significantly affect trees and other roadside private assets and/or lands. However, there is a possibility of impacts related to temporary land acquisition including potential restriction of access.

AIIB recognizes that environmental and social sustainability is a fundamental aspect of achieving development outcomes consistent with its mandate to support infrastructure development and interconnectivity. The Environmental and Social Framework of AIIB (2016), includes an Environmental and Social Policy (ESP) and Environmental and Social Standards (ESS). The Environmental and Social Policy specifies that AIIB conduct environmental and social due diligence as an integral element of its appraisal of the project, and in a manner, that is:

- ▶ Appropriate to the nature and scale of the Project; and
- ▶ Proportional to the level of the Project's potential environmental and social risks and impacts.

For this Project, Environmental and Social Standard 1 (Environmental and Social Assessment and Management) and Environmental and Social Standard 2 (Involuntary Resettlement) will be applicable.

The resettlement impacts anticipated from the works will mainly be within the existing right of way with a Corridor Impacts (COIs) ranging from 12m (non-community area) to 23m (urban area). However, the proposed works will still require acquisition of private and government land.

As summarized under Section 6.7.2 above, the Detailed Measurement Survey (DMS) has been conducted during 16 January to 16 February 2023 based on the confirmed COI as presented in Section 2.2 above and Attachment 1. The DMS indicates that the Project will affect 1,209 Project

Affected Households (PAHs) with 5,200 Project Affected Persons (PAPs) including 2,814 females in 21 villages, three districts and two provinces by various forms of losses including land acquisitions, housing structures, shops/restaurants, secondary structures and trees. Among the 1,209 PAHs (5,200 PAPs), there are 209 PAHs (929 PAPs) will have their lands, housing structures and shops to be affected by the Project as summarized in Section 6.7.2 and in details are provided in Volume C-2: a standalone Resettlement Plan (RP) .

Basic objectives of the RP are to: (i) serve as a binding document to ensure a fair and disclosed process for participation, identification and mitigation of Involuntary Resettlement (IR) impacts, and payment compensation and assistance to PAPs; (ii) guide the Project Management Unit (PMU) in the Department of Roads (DOR) of MPWT in clearly identifying, compensating, and restoring the livelihoods of PAP; and (iii) provide direction to the PMU in updating/finalizing, implementing and monitoring the RP.

The RP identifies measures to ensure that PAPs are, (i) informed about, and consulted on, the proposed project and agree in principle with the Project; (ii) informed about their options and rights pertaining to IR impacts; (iii) consulted on, offered choices among, and provided with suitable compensation and/or resettlement alternatives; and (iv) provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the Project.

The RP for the NR13SE complies with the AIIB's Environmental and Social Standard 2 (ESS2) on Involuntary Resettlement, some provisions of Decree 84 of the Lao Government, and the Decree on Environmental Impact Assessment (2022) in consultation with the relevant national legislations including Road Law, 2016 and the Land Law, 2019. Wherever, gaps and discrepancies exist between the AIIB's ESS2 and the GoL policies, the former (the AIIB policy) will prevail.

The project resettlement policy has been developed in compliance with AIIB ESS2 and the laws of the Government of Lao PDR, principally the Constitution (1991), Decree of the Prime Minister on Compensation and Resettlement of People Affected by Development Project, No.192/PM, dated 7 July 2005, as amended by Decree No. 84, dated 5 April 2016.

The draft Unit Rate of compensation for affected land, assets and trees have been established based on the principle of "Replacement Cost". The Compensation Unit Rate will be consulted with and agreed upon by PAPs and will be endorsed by Major of Vientiane Capital and Governor of Bolikhamxay Province.

## 9. STAKEHOLDER ENGAGEMENT

### 9.1 Introduction

Active and ongoing stakeholder engagement ensures the Project's development, potential impacts, and management measures are communicated to the public while ensuring an avenue for stakeholders to participate in the decision-making process through public meetings, feedback and via grievance mechanisms. Extensive consultations have been undertaken for NR13SE Project, and build on existing community and government relationships (e.g. line-sectoral agencies) formed through the work completed by LTEC with support from DOR and PTI. Throughout the ESIA process, consultations and disclosure of Project information has been undertaken with government officials (at local and national levels), the local community, Affected Persons and a range of other key stakeholders.

Public Consultation and Disclosure (PCD) for NR13SE Project are crucial for achieving an informed decision making. PCD is also a core requirement of the ESIA process in Lao PDR under the *Decree on Environmental Impact Assessment (2022)*. According to the World Bank Group's Good Practice Manual (2007), PCD is a *'tool for managing two-way communication between the project sponsor and the public with the goal of improving decision-making and building understanding by actively involving individuals, groups, organisations with a stake in the project'*. In addition to these regulatory obligations, an open and consultative approach makes good business sense by reducing costs, reducing risks, and enhancing benefits.

Throughout the ESIA process, formal and informal consultations were undertaken with national, provincial and district government officials, as well as the local communities that are participating or otherwise may have been affected by Project implementation. Informal consultation has included regular discussions and the dissemination of Project information to local residents and government staff. Formal consultations have included meetings with relevant government authorities and environmental and socio-economic studies at the village level. Structured consultation workshops were also conducted with government, communities and other stakeholders to present the draft ESIA, share information about the Project, and obtain feedback from Project stakeholders.

This chapter summarises the consultation and disclosure activities undertaken and the associated outcomes before and during the ESIA process. Strategies for ongoing consultation throughout the life of the Project, as well as a description of the proposed grievance mechanism. Further details of the approach to stakeholder engagement to support construction and operations of the Project is presented in the *Stakeholder Engagement Plan (SEP, Volume C-3)*.

### 9.2 Objective

The overall goal of stakeholder consultation and public involvement for the NR13SE is to improve decision-making, build understanding to ensure the long-term viability of the Project, and to enhance potential Project benefits. The specific objectives of the stakeholder consultation for the Project are to:

- ▶ Provide a structured means for the local community and government to have input into the ESIA and Project development process;
- ▶ Ensure that Project affected communities and other stakeholders are well informed of the Project;
- ▶ Actively seek community input into the assessment of potential environmental and social impacts of the proposed Project activities and identification of management/mitigation measures to ensure consideration of stakeholder interests in the planning and development of the Project; and
- ▶ Collect relevant information for the Project area from key stakeholders for use in the ESIA and associated management plans as well as development of the Project;
- ▶ Ensure stakeholder feedback on the Project and its impacts is gained through simple and effective communication processes;
- ▶ Reduce the potential for community disaffection that can result from a lack of understanding of the Project and the Project development process; and
- ▶ Promote inclusive and informed decision-making on the development and management of the Project.

### 9.3 Consultation To Date

A series of initial consultations have been conducted during the ESIA process. These include meetings with central, provincial and district level representatives; village meetings and surveying; technical studies and site visits. The purpose of these engagements was to introduce the Project; collect information on the Project area; and seek feedback from key stakeholders.

The consultation with local communities and FGD were conducted with village authorities including representatives of the affected people (men, women, ethnic minorities, and disadvantaged people) in 21 villages, three districts and two provinces in January 2023 with a total of 785 participants (350 females and 435 males). Table 9-1 below provides number of participants while the list of participants is provided in [Attachment 7A](#) and photos of consultations are provided in [Attachment 8](#) of SEP. The objectives of the stakeholder engagement activities were to:

- ▶ Define corridor of impact, update about Project progress.
- ▶ Obtain and verify information related to socio-economic conditions of affected communities and people affected households.
- ▶ Collect environmental and social condition/baseline to inform the development of ESIA, ESMP, RP, GAP and SEP reports.
- ▶ Attain feedback or perceptions about the Project development and recommendation for stakeholder groups on the ESIA, ESMP, RP and SEP development.
- ▶ Get acceptance and support from the government agencies to conduct the survey in the area.



Participatory focus group discussion at the village level: After the presentations and open group discussion at the Public /Village Consultation Meeting. The ethnic group participants were divided into two groups (male and female groups) to have in-depth focus groups discussion with male and female groups to ensure that women ethnic group could express their idea freely without intervention of males.

Details of the consultations are provided in Table 9-1 and a description of the meetings is provided in the Sections below.

**Table 9-1: A summary of consultation participants**

No	Village	Consulted Date	Total Participants	Female	Male
<b>Vientiane Capital</b>			<b>624</b>	<b>251</b>	<b>373</b>
<b>Xaythany District</b>			<b>284</b>	<b>120</b>	<b>164</b>
1	Ban. Khoksivilay	22.01.2023	44	17	27
2	Ban. Nonthong	18.01.2023	17	7	10
3	Ban. Phailom	18.01.2023	19	9	10
4	Ban. Somsavanh	19.01.2023	41	23	18
5	Ban. Khoksavang	19.01.2023	18	13	5
6	Ban. Phonsavanh	20.01.2023	23	9	14
7	Ban. Naphasouk	23.01.2023	26	17	9
8	Ban. Dongkhouay	21.01.2023	59	12	47
9	Ban. Borlerk	21.01.2023	37	13	24
<b>PakNgum District</b>			<b>340</b>	<b>131</b>	<b>209</b>
1	Ban. Nongbouathong	18.01.2023	15	5	10
2	Ban. Sangxay	18.01.2023	25	5	20
3	Ban. Khoksa	19.01.2023	28	14	14
4	Ban. Thangkhong	20.01.2023	32	9	23
5	Ban. Donehai	20.01.2023	39	15	24
6	Ban. Naxone	19.01.2023	44	22	22
7	Ban. Phao	23.01.2023	64	35	29
8	Ban. Somphaseuth	23.01.2023	25	10	15
9	Ban. Hai	24.01.2023	53	14	39
10	Ban. Somsavanh	24.01.2023	15	2	13
<b>Bolikhamsay Province</b>			<b>161</b>	<b>99</b>	<b>62</b>
<b>Thaphabath District</b>			<b>161</b>	<b>99</b>	<b>62</b>
1	Ban. Naxay	16.01.2023	75	50	25
2	Ban. Xaysavang	16.01.2023	86	49	37
<b>Total</b>			<b>785</b>	<b>350</b>	<b>435</b>

## 9.4 Consultation Outcomes

Key issues and concerns raised by the local government, community, affected households and individuals are discussed in detail in the Stakeholder Engagement Plan (Volume C-3). Full records of the consultations are also presented in the Table 9-2 below.

In general, stakeholder feedback has been supportive of the NR13SE and request fair compensation to those experiencing losses as a result of the land acquisition for the Project. Most stakeholder feedback and concerns related to ensuring that Affected Persons are adequately and promptly compensated. Both the local community and local leaders had expectations for employment opportunities to be created for local people during the construction phase. The private sector stakeholders were primarily concerned with ensuring compensation for businesses affected (including temporary impacts on access) and the potential for disruption of utility services for businesses.

**Table 9-2: Summary of consultation results**

Consultations	Positive Impacts	Negative Impacts	Recommendations/ Comments
Village level	<ul style="list-style-type: none"> <li>Village authorities and villagers are strongly support the project as the project will have significant positive impacts on improvement of the local livelihood activities, business and economic, health and well-being such as more convenience and saving time for travelling to other villages, districts, provinces, work, school, agriculture farms, transportation of agriculture products as well as reduction in road accidents, and etc.</li> </ul>	<ul style="list-style-type: none"> <li>However, there are also negative impacts such as acquisition of private land; loss of houses and shops;</li> <li>Other issues are construction waste and solid waste from worker camps.</li> <li>Community health and safety from transportation of construction materials, noise and dust emissions, solid waste and waste water from worker camps, and risks of Covid-19 infection.</li> <li>Social issues from labour influx such as thieves, drunk, violence including gender and child violence and abuses.</li> <li>Road safety due to people might drive with high speed.</li> <li>Improper placement or lack of warning sign during construction may cause accidents.</li> </ul>	<ul style="list-style-type: none"> <li>The design shall be designed to minimize the impacts on people lands and properties.</li> <li>The loss and compensation amount data shall be checked and confirmed with PAPs.</li> <li>Compensation should be paid for all affected lands and assets with fair prices and consultation with PAPs. The compensation shall be completed before starting any construction activities.</li> <li>Notify village authorities and villagers 2 months in advance of construction takes place.</li> <li>Implement measures to prevent community health and safety such as control of driving speed limit, water spraying, noise control, and cover the truck when transporting construction materials to prevent falling on the road and so on.</li> <li>Implement good solid waste and waste water management for worker camp and storage areas.</li> <li>Implement measures to avoid social issues and risks on COVID-19 infection such as having vaccination to prevent COVID-19 outbreak before coming to work.</li> <li>Request to recruit local people</li> </ul>

Consultations	Positive Impacts	Negative Impacts	Recommendations/ Comments
			<p>for construction works both men and women.</p> <ul style="list-style-type: none"> <li>Request to not working on Buddha Day “Van Sin”.</li> </ul>
FGD Women	<ul style="list-style-type: none"> <li>All participants agreed with the project development plan.</li> <li>The project should start as soon as possible.</li> <li>Easy to travel, more convenient for transportation, safe time to travel to pick up kid and go to work.</li> </ul>	<ul style="list-style-type: none"> <li>Request to not working on Buddha Day “Van Sin”.</li> <li>Loss of income as they might have to close their shops during the construction.</li> <li>Loss of their properties, fair compensations, road safety, and security during the construction phase.</li> <li>Road safety after finish the construction, people might drive with high speed.</li> <li>Waste from the construction and from worker camp.</li> <li>Waste water from the camp.</li> <li>Water stagnant during the rainy season.</li> <li>Difficulty to access the house, shops or village during construction due to construction object blocking or lack of access.</li> <li>Dust, noise, and vibration create by construction.</li> </ul>	<ul style="list-style-type: none"> <li>The loss and compensation amount data shall be checked and confirmed with PAPs.</li> <li>Compensation should be paid for all affected lands and assets with fair prices and consultation with PAPs. The compensation shall be completed before starting any construction activities.</li> <li>Notify village authorities and villagers 2 months in advance of construction takes place.</li> <li>Implement measures to prevent community health and safety such as control of driving speed limit, water spraying, noise control, and cover the truck when transporting construction materials to prevent falling on the road and so on.</li> <li>Implement good solid waste and waste water management for worker camp and storage areas.</li> <li>Implement temporary access way to the effected houses, stores and villages.</li> <li>Regularly watering the road morning, afternoon, evening or as frequently when needed.</li> </ul>
FGD Men	<ul style="list-style-type: none"> <li>All participants agreed with the project</li> </ul>	<ul style="list-style-type: none"> <li>Should continue the construction and have a clear timeline</li> </ul>	<ul style="list-style-type: none"> <li>Implement measures to prevent community health and safety such as control of driving speed</li> </ul>

Consultations	Positive Impacts	Negative Impacts	Recommendations/ Comments
	<p>development plan.</p> <ul style="list-style-type: none"> <li>• Easy to travel; more convenience for transportation</li> <li>• Will help increase trade and livelihood along the main road.</li> <li>• Increase the better living condition for the villagers.</li> </ul>	<p>to complete the construction?</p> <ul style="list-style-type: none"> <li>• Worry about the compensation policy and whether it will be fair and appropriate. How will the house, land, and fence be repaid?</li> <li>• Difficult to access to village and house.</li> <li>• Connection of main drainage to the household drainage.</li> <li>• Install temporarily of connection pipe to village and house.</li> <li>• Dust, noise, and vibration create by construction.</li> <li>• Potholes and improper road warning signs may lead to accidents especially for the motorbikes.</li> </ul>	<p>limit, water spraying, noise control, and cover the truck when transporting construction materials to prevent falling on the road and so on.</p> <ul style="list-style-type: none"> <li>• Implement good solid waste and waste water management for worker camp and storage areas.</li> <li>• The loss and compensation amount data shall be checked and confirmed with PAPs.</li> <li>• Compensation should be paid for all affected lands and assets with fair prices and consultation with PAPs. The compensation shall be completed before starting any construction activities</li> </ul>

## 10. GRIEVANCE REDRESS MECHANISM

A grievance redress mechanism (GRM) is provided in Section 7 of the Stakeholder Engagement Plan (SEP). GRM describes an arrangement for receiving, evaluating and facilitating the resolution of workers and affected people's concerns, complaints, and grievances about the borrower/client's social and environmental performance on a project. A GRM is important for development projects where adverse impacts or risks are ongoing or anticipated. GRMs for affected people including non-title landholders (e.g. premise tenants), and workers respectively, the setups, operating modalities and procedures, taking into account availability of judicial recourse and traditional community dispute settlement mechanisms as well as how to ensure equitable access for men and women and different groups of population.

A grievance redress mechanism (GRM) will be established and functioning during the implementation of the ESMP and RP for the NR13SE. The GRM, covering four types of grievances, is in place since pre-construction until construction and operation of the Project. These include grievances from a) community members including general public; b) households affected by land acquisition; c) SH/SEA victims; and d) contractor's workers. To achieve the above objective, the following key elements are incorporated into the subproject's GRM:

- **Channels.** Different channels are established to enable complainant to submit their grievances, including submission to village committee, as well as district and provincial levels. Grievance can also be submitted to PMU/PIU via designated email or phone administered by PMU/PIU GRM focal points. The project will also establish user friendly and easily accessible means of communication such the hotline phone call, social media, WhatsApp or Facebook, if and where technologically feasible to facilitate efficient GRM process. GRM procedures and contact detail of responsible staff will be provided in a Project Information Leaflet (PIL) to be prepared and distributed to all project affected villages during the GRM training for village mediation committees for their references.
- **Forms.** Grievances can be submitted in writing and verbally, and either directly by the complainants, or by person delegated by the complainant who are sick, the elderly, or people with physical disabilities, or with vision or hearing impairment, etc. **See Attachment 1 Form to Submit Grievances.**
- **Documentation.** A grievance logbook will be maintained at village, PIU and PMU as well as contractor and construction supervision consultant (CSC) offices to record all Project related grievances registered in writing and verbally. A grievance database will be established and maintained by PMU/PIU (through GRM focal point within PMU/PIU). See **Attachment 2 Form for GRM Logs.**
- **Disclosure.** GRM procedures are disclosed in public domain (e.g. websites of PMU, or at public notice board located at village hall). GRM procedure will be explained to people attending consultation meetings, and provided to consultation participants in hard copy (through subproject's information leaflet). The GRM procedures to be followed have been translated into Lao language and it will be prepared in local language as needed so that

they are easily accessible to all stakeholders and made available by the PMU. Information on the steps to be followed in handling grievances has been incorporated into the consultation process with local community.

- **Predictability.** Where possible, GRM procedures specify length of time complainant may expect to wait for acknowledgement, response, and outcome for the resolution of their grievances.
- **Transparency.** The grievance procedures include steps, expected time frame grievance resolution for each step, notification to complainants, how decision is made, decision makers, mediation options, and
- **Appeal.** Complainant may resort court of law at any stage of grievance resolution if unsatisfied with grievances resolution decision issued by the agency in charge.
- **Monitoring.** All grievances received are processed in the given timeframe, and are monitored by those in charge of grievance resolutions, and by PMU/PIU.

## 11. CONCLUSIONS

The ESIA has identified the potential impacts of the Project and a professional management and mitigation program has been developed in accordance with Lao PDR legislation and relevant international standards. The ESIA investigations have identified that the Project has the potential to result in a variety of benefits for local communities and the national economy, however, there will be environmental and social impacts and risks that will need to be effectively managed to ensure that the Project is delivered and operated successfully.

Being an integral part of a regional and international transport corridor, the NR13SE Project will contribute to key strategic transport priorities for the region and help meet the objectives of regional integration, socio-economic development and investment in transportation infrastructure outlined in key national policies. The Project is expected to provide a range of direct and indirect benefits at the national, regional and local levels. Direct benefits include; government revenue through fees and taxes, increased foreign direct investment in the country and new employment opportunities. Indirect benefits include flow on effects, training / skills development and infrastructure development. For road users, the Project will significantly reduce transit times and is expected to help to improve community safety and reduce road traffic accidents in the region through the provision of a dedicated roadway which isolates vehicle traffic from pedestrians and non-motorised vehicles.

While some impacts on land, assets, water quality and biodiversity will not be able to be avoided due to the widening of the COI and associated construction activities, impacts can be minimised and potential benefits maximised through appropriate management and mitigation as outlined in this ESIA. If mitigation and management measures identified in the ESMP, Resettlement Plan and other ESIA management plans (refer to Volume C) are implemented diligently and successfully, the Project is expected to deliver a net socio-economic benefit to Lao PDR as a whole without significantly compromising the key environmental values of the surrounding environment. Ongoing consultation with the Government of Lao PDR agencies, regional communities and other stakeholders will be important to ensure stakeholder interests continue to be taken into account in the planning and development of the Project.

AIIB's requirements for the Project to be developed in accordance with international standards such as those of the AIIB's ESF provides significant opportunities to develop the Project in line with industry best practice for environmental and social sustainability. If implemented successfully this project could set a benchmark for the environmental and social management of future major road developments in Lao PDR and other parts of ASEAN countries.

## **12. APPENDICES**

Technical Appendices provided in Volume B include:

1. Appendix 1: Description of National Applicable Legal Framework
2. Appendix 2: NR13SE Maps;
3. Appendix 3: Traffic Survey Report (LTEC, 2019);
4. Appendix 4: Road Safety Assessment Report (LTEC, 2019);
5. Appendix 5: Tree Species within the COI;
6. Appendix 6: Ambient Air, Noise, Water Quality, Wind and Vibration Monitoring Report (Phanthamit, 2023);
7. Appendix 7: References