Initial Environmental Examination

Project Number: 41924-014
May 2015

Nam Ngiep 1 Hydropower Project
(Lao People's Democratic Republic)

Biodiversity Status Report on 230 kV Transmission Line Construction Area (Dam Site to Tower 54)

Prepared by Earth Systems on behalf of Nam Ngiep 1 Power Company Limited for the Asian Development Bank

Biodiversity Status Report on 230 kV Transmission Line Construction Area (Dam site to Tower 54)

FINAL

Prepared for

NAM NGIEP 1 POWER COMPANY

By

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Contents

1 INTRODUCTION

1.1 Background

The Nam Ngiep 1 Power Company (NNP1) is developing the Nam Ngiep 1 Hydropower Project (NNP1) in central Lao PDR. The distribution of electricity from NNP1 requires the development of a 230 kV transmission line to export electricity from the Project to Thailand.

An Initial Environmental Examination (IEE) of this transmission line was conducted by Environmental Research Institute, Chilalongkorn University (ERIC) (2012) and updated by Environmental Resource Management (ERM) (May 2014). The updated IEE (including a standalone Biodiversity Assessment Report) provided an assessment of potential impacts on biodiversity values considering ADB Safeguards Policy Statement (2009) and IFC Performance Standard 6.

Key findings of the IEE include:

- Key threats to biodiversity as a result of the transmission line relate to permanent loss of habitat, disturbance and displacement of species, creation of barriers to fauna movement, degradation of habitat due to edge effects and fragmentation, and fauna mortality;
- In general the significance of these impacts to biodiversity and priority biodiversity values is considered to be minor or negligible;
- The Project will impact both modified and Natural Habitats including the unavoidable loss of approximately 151 ha of Natural Habitat and 247 ha of Modified Habitat. The majority (94%) of vegetation within these habitats is considered low or moderate condition. A small percentage (5%) of the corridor is considered 'high condition' – mostly concentrated in the northern segment of the Line (Dam site to tower 54); and
- The Project is unlikely to be associated with habitat considered to be critical habitat as priority biodiversity values and potential impacts can be managed.

The ADB, during a safeguards review mission conducted in December 2014, requested that an environment assessment of biodiversity values within the northern segment of the alignment (i.e. 'high condition habitat') be conducted.

1.2 Assessment Objectives

The objectives of this Assessment are to:

- Confirm and refine the findings of the previous study regarding biodiversity values and commercial timber present along the proposed alignment of the transmission line;
- Conduct a conservation needs assessment of the biodiversity values identified, based on their conservation status and potential direct and indirect impacts associated with the transmission line;
- Confirm Type of the forest area with respect to definitions in SPS Appendix 1 Section 8.
- Develop corrective actions for any significant biodiversity values identified, in line with the mitigation hierarchy (avoid, minimise, restore, offset); and
- Conduct a predictive assessment of potential commercial timber within the ROW (Tower 86 to Dam site).

1.3 Methodology

Earth Systems conducted the following activities to complete the Assessment:

- Review of existing information on biodiversity values, potential impacts and recommended mitigation measures outlined in the revised IEE (ERM May 2014);
- Detailed desk-based analysis of biodiversity values within the section of the transmission corridor utilizing high-resolution satellite imagery (2014) to map land use and habitat; identify areas of potential high biodiversity value; assess the likelihood of presence of threatened communities and species based on known distributions; and quantify expected losses for each vegetation/habitat type within the ROW;
- Consultation with local government (PONRE) to gain necessary permissions and glean background information about areas along the TL alignment; and
- Conduct of a four (4) day field exercise between the dam site and tower 54 including ground truthing of satellite analysis; assessment of vegetation and species identification in nine (9) sample plots; use of village guides to help navigate the TL alignment and provide detailed local knowledge to inform the study; and a rapid assessment of commercial timber within each vegetation type present within the ROW.

Note: The original IEE assessed vegetation cover utilising Rapid-eye imagery (with 5 metre resolution) to determine Normalised Difference Vegetation Index (NDVI) for vegetative type and condition. NDVI is a simple graphical indicator used to assess the presence of 'live green vegetation'. This Assessment used higher resolution satellite imagery (0.5 metre) and visual interpretation to identify forest type and condition. Results of this analysis were then ground-truthed and updated accordingly.

2 DESCRIPTION OF THE PROJECT

2.1 Project Location

The 230 kV transmission line will extend approximately 125 km from the NN1 Dam site in Bolikhamxay Province to Nabong substation in Vientiane Capital with a right of way (ROW) of 35 metres. The scope of this Assessment covers the section of the line between the Dam site and Tower 54 (see Figure 2-1).

2.2 Project Description

Information on transmission line components is provided in the main IEE. A summary of information relevant to this Assessment is outlined in Table 2-1.

Table 2-1 Project Components (Dam site to Tower 54)

Design Features	Description
Line voltage	230 kV
Line length	21.2 km
Type	50 Hz, 3 phase, double circuit line on self-supporting lattice steel structures.
Number of towers	55 towers
Tower height	Suspension towers: 46.78m and 46.18m; Tension towers: 46.04 (see IEE Annex A)
Right of way (Row)	35 metres (Vegetation suppressed to 3m)
Workers camps	No main workers camp – instead workers will set up temporary shelters on site);
Access roads	Access roads provided within the ROW (flat areas); External access roads (5m width) required in steeper areas.
Other ancillary infrastructure	No quarries (rock purchased from local supplier); No permanent spoil areas (spoil used as backfill and embankments at tower sites)
Stations	No information on switching station at dam site / powerhouse.

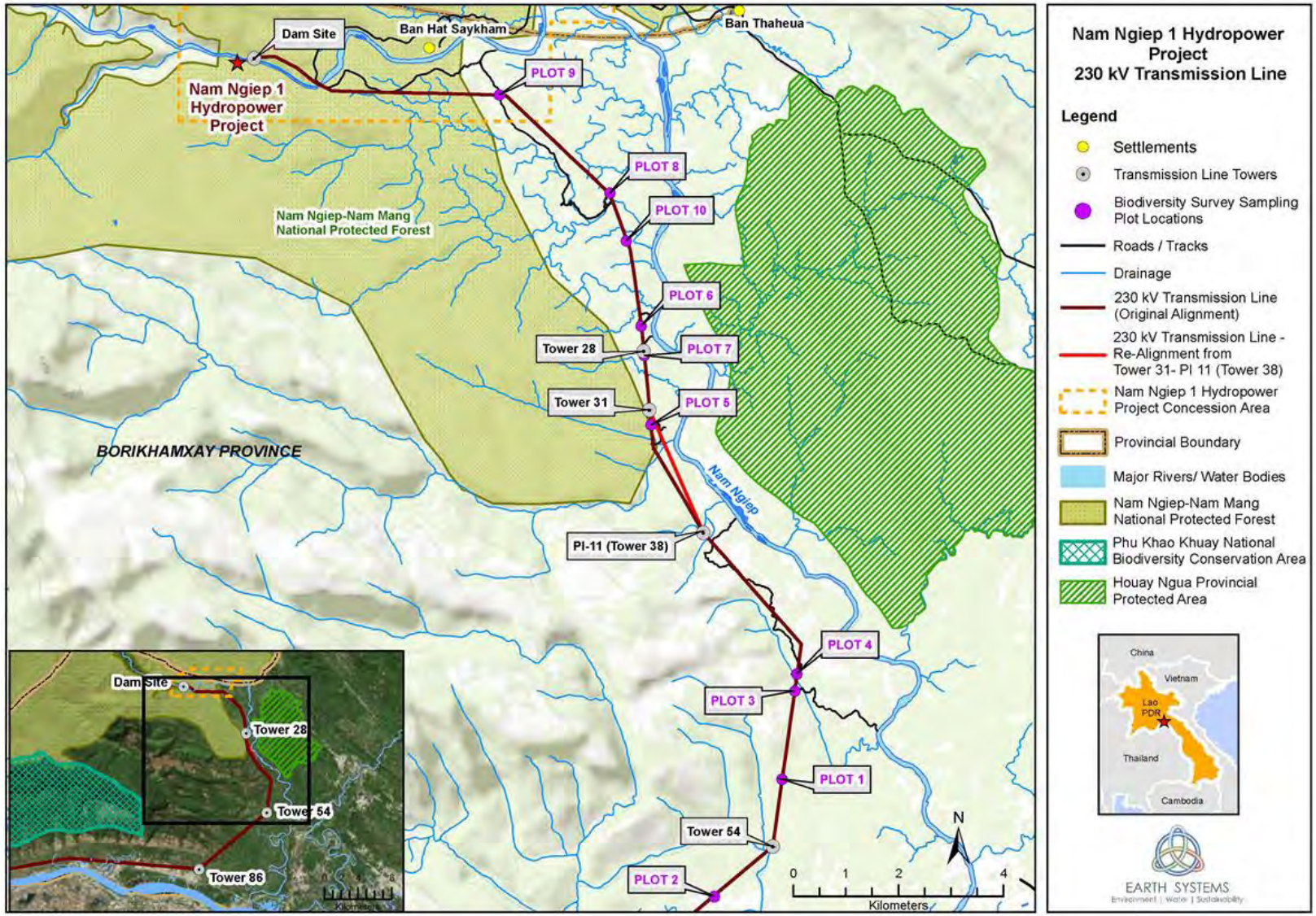

Figure 2-1 Project location

3 DESCRIPTION OF THE ENVIRONMENT

3.1 Biological Resources

3.1.1 Protected Areas and Forests

The transmission line ROW does not intersect any internationally or nationally protected areas (e.g. Ramsar sites). However the transmission line was found to pass through the Nam Ngiep-Nam Mang National Protected Forest (PFA) at PI-10 (Tower 33). PFA's are located in watershed areas, catchments and are managed to protect water resources and reduce soil erosion. In response to this finding, NNP1 has developed an alternative alignment (see Figure 2-1).

3.1.2 Vegetation/Habitat Types

Previously Identified Land Cover Types

Natural and modified land cover types occurring in the vicinity of the whole alignment (including the southern section not assessed in the current report) identified in the IEE (ERM, May 2014) are as follows:

Natural Habitat types:

- Deciduous forest (DF)
- Evergreen forest (EF)
- Bamboo (B)
- Scrub, Heath (SR)
- Swamp (SW)

Modified Habitat types:

- Agriculture Plantation (AP)
- Old fallow land (OFL)
- Young fallow land (YFL)
- Rice paddy (RP)
- Slash and burn (SB)

Field Survey Results

In the survey area for this Assessment, three vegetation types were identified which could provide habitat for a variety of fauna and flora species. These were:

- Upper Mixed Deciduous (UMD) forest;
- Old fallow – left to regenerate > 8 years; and
- Young fallow – left to regenerate < 8 years.

Only one possible Natural Habitat type was identified during field and imagery analysis:

- Upper Mixed Deciduous (UMD) forest.

Natural Habitat, as defined by the ADB Safeguard Policy Statement (2009) refers to "Land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions."

The field survey results indicated that, in the survey area, all land cover types present along the proposed alignment were significantly altered by human activity (e.g. selective logging) and other disturbance (e.g. fragmentation, weeds and altered fire regimes), and should therefore be considered as Modified Habitat. No Natural Habitat types (i.e. with lesser levels of disturbance), were identified.

Descriptions of each land cover type identified in the field are provided below.

Upper Mixed Deciduous Forest

This forest type occurred in a number of areas of the surveyed part of the alignment in small patches that are highly fragmented in the broader landscape which is dominated by fallow (see below). The average canopy cover of the UMD Forest in the ROW was 25%. This is significantly lower than in undisturbed forest where Upper Mixed Deciduous Forest can have a largely continuous canopy. Deciduous tree species represented more than 50% of the stand. Common canopy species were Bombax anceps, Cratoxylum formosum pruniflorum and Terminalia elliptica. Bamboo species were dominant in the mid-storey and understorey, with Oxytenanthera albociliata and O. parvifolia were common in the lower layers (see Table 3-1). Native and non-native species have become weeds in the habitat type, including Chromolaena odorata, which is considered as one of the world's worst invasive species (ISSG, 2015). The fast growing perennial shrub, C. odorata, is an aggressive competitor and forms dense stands that prevent other species from establishing. Other evidence of disturbance observed within the UMD patches included selective logging and fire disturbance, particularly around the boundaries. While significantly disturbed, UMD forest was the most species rich habitat type in the proposed ROW.

Table 3-1 UMD forest most common species within the three structural layers in the proposed ROW

Structural Component/Layer	***Scientific Name***	
Canopy Height >4 m Average 25% cover	*Bombax anceps*	*Hopea ferrea*
	Cratoxylum formosum pruniflorum	*Irvingia malayana*
	Crypteronia paniculata	*Lagerstroemia sp.*
	Diospyros sp.	*Lithocarpus sp.*
	Dipterocarpus turbinatus	*Memecylon edule*
	Ficus altissima	*Ormosia pinnata*
	Glochidion sphaerogynum	*Schima wallichii*
	Grewia paniculata	*Terminalia elliptica*
Mid-storey: Height 1 m - 4 m Average 10% cover	*Alangium kurzii*	*Oxytenanthera albociliata*
	Aporosa cascarilliioides	*Oxytenanthera parvifolia*
	Croton eluteria	*Rinorea bussei*
	Eurycoma longifolia	*Streblus asper*
	Gonocaryum lobbianum	*Trema orientalis*
	Grewia paniculata	*Uvaria macrophylla*
	Millettia pulchra	
Understorey: Height 0 m - 1 m Average 10% cover	*Ardisia helferiana*	*Dracaena angustifolia*
	Aspidistra sp.	*Drynaria quercifolia*
	Calamus javensis	*Forrestia griffithii*
	Caryota mitis	*Oxytenanthera parvifolia*
	Catimbium bracteatum	*Scleria terrestris*
	*Chromolaena odorata**	*Thysanolaena maxima*
	Curculigo orchioides	*Uvaria macrophylla*
	Cyclea sp.	

Structural Component/Layer	*Scientific Name*	
Most Common Weed (native and non-native) Species	*Aspidistra sp.*	*Drynaria quercifolia*
	*Chromolaena odorata**	*Forrestia griffithii*
	Curculigo orchioides	*Scleria terrestris*
	Dracaena angustifolia	*Uvaria macrophylla*

Plate 3-1 UMD forest in between Tower 26 and PI-09

Plate 3-2 Dipterocarpus turbinatuts in UMD forest near PI-09

Old Fallow

Old fallow is where secondary regrowth dominates; where native and non-native species have regenerated for at least 8 years after disturbance. The forest may retain structural and floristic similarities to the above categories, but is not readily classified as a particular recognised forest type. Although old fallow forest has been highly modified, it retains many native species and provides habitat for wildlife. Old fallow was particularly species rich, with many similar species to upper mixed deciduous forest (Table 3 2).

Table 3-2 Old fallow land most common species within the three structural layers in the proposed ROW

Structural Component/Layer	*Scientific Name*	
Canopy Height >4 m Average 15% cover	*Aporosa ficifolia*	*Lagerstroemia sp.*
	Cratoxylum formosum pruniflorum	*Ormosia pinnata*
	Crypteronia paniculata	*Peltophorum dasyrrhachis*
	Glochidion sphaerogynum	*Sapium discolor*
	Gonocaryum lobbianum	*Schima wallichii*
	Grewia paniculata	*Vitex tripinnata*
	Irvingia malayana	
Mid-storey: Height 1 m - 4 m Average 25% cover	*Alangium kurzii*	*Hymenocardia punctata*
	Aporosa ficifolia	*Oxytenanthera albociliata*
	Cephalostachyum virgatum	*Oxytenanthera parvifolia*
	Croton eluteria	*Peltophorum dasyrrhachis*
	Gonocaryum lobbianum	*Pterospermum semisagittatum*

Structural Component/Layer	*Scientific Name*	
	Grewia paniculata	
Understorey: Height 0 m - 1 m Average 5% cover	*Alpinia galangal*	*Dracaena angustifolia*
	Ancistrocladus tectorius	*Forrestia griffithii*
	Ardisia helferiana	*Lygodium flexuosum*
	Catimbium bracteatum	*Rinorea bussei*
	Curculigo orchioides	*Scleria terrestris*
	Cyclea barbata	*Thysanolaena maxima*
	Dioscorea triphylla	*Uvaria macrophylla*
Most Common Weed (native and non-native) Species	*Cratoxylum formosum pruniflorum*	*Peltophorum dasyrrhachis*
	Oxytenanthera albociliata	*Scleria terrestris*
	Oxytenanthera parvifolia	*Thysanolaena maxima*

Plate 3-3 Old fallow near Tower 51

Plate 3-4 Young fallow near Tower 33

Young Fallow

Young fallow was where the land has been cleared recently (<8 years), and native and non-native species have begun to regenerate. As with old fallow, the forest may retain similarities to Natural Habitat, but cannot be considered as natural. Young fallow is highly modified, but it may provide habitat for native species and was relatively species rich (Table 3 3).

Table 3-3 Young fallow land most common species within the three structural layers in the proposed ROW

Structural Component/Layer	*Scientific Name*	
Canopy Height >4 m <1% cover	*Aporosa ficifolia*	*Grewia paniculata*
	Cratoxylum formosum pruniflorum	*Lagerstroemia sp.*
	Crypteronia paniculata	*Ormosia pinnata*
	Glochidion sphaerogynum	*Schima wallichii*
Mid-storey: Height 1 m - 4 m Average 45% cover	*Alangium kurzii*	*Gonocaryum lobbianum*
	Aporosa ficifolia	*Mallotus barbatus*
	Casearia grewiifolia	*Oxytenanthera albociliata*

Structural Component/Layer	*Scientific Name*	
	Cephalostachyum virgatum	*Trema orientalis*
	Croton eluteria	
Understorey: Height 0 m - 1 m Average 10% cover	*Caryota mitis*	*Lygodium flexuosum*
	Catimbium bracteatum	*Mallotus thorelii*
	*Chromolaena odorata**	*Sauropus androgynus*
	Curculigo orchioides	*Scleria terrestris*
	Cyclea barbata	*Thysanolaena maxima*
	Dracaena angustifolia	
Most Common Weed (native and non-native) Species	*Aporosa ficifolia*	*Croton eluteria*
	Cratoxylum formosum pruniflorum	*Grewia paniculata*
	*Chromolaena odorata**	*Scleria terrestris*

Key - * One of world's worst invasive species (ISSG, 2015)

Update of Definition of Deciduous Forest / Mixed Decidious Forest

Based on the results of the field survey, it is recommended that the definition of the Deciduous forest (DF) identified in the IEE (ERM, May 2014) (or 'Mixed Deciduous forest' as it is identified in this Assessment) is updated to account for the level of disturbance.

Previous desktop assessments of the alignment identified Deciduous forest (DF) as Natural Habitat. The description of Deciduous forest (DF) in the IEE (ERM, May 2014) is:

> *"Deciduous forest occurs when deciduous tree species represent more than 50% of the stand. The forest storeys are not as dense as those of evergreen type. Most often bamboo occurs in this type of forest. Deciduous Forest includes both Upper and Lower deciduous forest types and this definition is based on relative altitude, forest occurring above 200 m is classified as Upper Mixed deciduous Forest and deciduous forest occurring at an altitude 200 m and below is classified as Lower Deciduous Forest".*

The above definition is consistent with the results of the current survey, however it is recommended that Deciduous Forest / Mixed Deciduous forest be distinguished as either low disturbance (Natural Habitat) or moderate/high disturbance (Modified Habitat) as per the following table.

Table 3-4 Descriptions of different 'Deciduous forest' land cover types

Structural Component/Layer	*Scientific Name*
Deciduous Forest / Mixed Deciduous Forest – low disturbance (Natural Habitat)	Deciduous forest occurs when deciduous tree species represent more than 50% of the stand. The forest storeys are not as dense as those of evergreen type. Most often bamboo occurs in this type of forest. Deciduous Forest includes both Upper and Lower deciduous forest types and this definition is based on relative altitude, forest occurring above 200 m is classified as Upper Mixed deciduous Forest and deciduous forest occurring at an altitude 200 m and below is classified as Lower Deciduous Forest. This forest type is considered 'low disturbance' when the majority of the following criteria are met: Tree canopy dominated by trees with greater than 30cm DBH. Tree canopy cover greater than 50%; Alien species rare (e.g. represent less than 5% of the stand); Level of disturbance from factors such as selective logging and fire is relatively low;

Structural Component/Layer	*Scientific Name*
Deciduous Forest / Mixed Deciduous Forest - moderate/high disturbance (Modified Habitat)	Deciduous forest occurs when deciduous tree species represent more than 50% of the stand. The forest storeys are not as dense as those of evergreen type. Most often bamboo occurs in this type of forest. Deciduous Forest includes both Upper and Lower deciduous forest types and this definition is based on relative altitude, forest occurring above 200 m is classified as Upper Mixed deciduous Forest and deciduous forest occurring at an altitude 200 m and below is classified as Lower Deciduous Forest. This forest type is considered 'moderate/high disturbance' when: Tree canopy dominated by trees with less than than 30cm DBH. Tree canopy cover greater than 10% but less than 50%; Alien species can be widespread (e.g. represent > 10% of the stand); Level of disturbance from factors such as selective logging and fire is high.

Aquatic Habitat

The proposed ROW is intersected by several waterways, minor tributaries and small creeks. These waterways provide ample habitat for permanent and migratory aquatic species adapted to their seasonal flows.

During the dry season, the aquatic habitats of the proposed ROW are characterised by lower water levels, extensive riffle zones, dry river banks and exposed sand and gravel river beds. The high rainfall events of the wet season result in fast flowing and moderately deep rivers and tributaries. Habitat quality and biodiversity generally increase with healthy stream conditions, which become more prevalent with increasing distance from human settlements, industries and agricultural activity.

Plate 3-5 Houay Poung Xang near tower 52

Plate 3-6 Houay Keng Khai near tower 33

3.1.3 Land Use and Habitat Distribution and Quality

The vegetation within and surrounding the proposed ROW is generally of average to poor quality and has been highly disturbed by a long history of human activities such as agriculture and logging. It is assumed that the forests have also been degraded selective logging by local villagers over many years. These practices have not ceased and remain as significant pressures on the remnant forested areas. Additionally, much of the vegetation has been modified or cleared between towers 1 and 9 for Project activities, such as the construction of roads.

By far, the most widespread vegetation types were old and young fallow forest/land where the vegetation had regrown following clearance for previous agricultural activities (Table 3-5)

Over 85% of the proposed ROW was composed of fallow forest types. No primary forest was observed in the ROW or surrounds. Primary forest is typified by old, large trees and intact canopy and shrub layer, which was absent. Large trees greater than 20 years old were rare.

Upper mixed deciduous forest was patchy and contributed less than 10% of the land coverage. Several small patches overlap the transmission line ROW, but it are significantly disturbed and much of it has been selectively harvested (see Figure 3.1 to 3.4). The greatest density of patches appears to be between tower 26 and 30 (Figure 3-2). There was a larger patch of upper mixed deciduous forest between towers 46 and 47 (Figure 3-4)

Native and non-native weed species were identified in all locations. These species are considered locally invasive species (non-indigenous) and/or should not be found within the habitat types identified. Many species are quick to invade areas that have been disturbed. The number of common weed species recorded in the Upper mixed deciduous forest confirms that the floristic assemblage has been altered and disturbed.

All habitat types identified are common in the region and also occur in other parts of Lao PDR. Since none of these vegetation types are exclusive to the ROW they are not range-restricted. Within Laos, areas with similar vegetation can be found in the Annamite mountain range (Khamkeut District) in Bolikhamsay Province and on the Boloven Plateau of Champassak Province. Similar vegetation composition and types are also found outside of Laos, including parts of northern Vietnam, northern Thailand and southern China.

Table 3-5 Land use and habitat types present within the proposed ROW

Land Use / Habitat Types	Section 1 (Dam - 54)	
	Area (ha)	Area (%)
Upper Mixed Deciduous Forest	6.29	8.46
Old Fallow	32.06	43.13
Young Fallow	33.69	45.33
Cultivated Land	1.47	1.98
Water	0.22	0.29
Road / Tracks	0.60	0.80
Total area (ha)	**74.33**	**100.00**

An analysis of the proposed re-alignment to avoid the Nam Ngiep-Nam Mang National Protected Forest (PFA) was conducted (See Table 3-6). This indicates that the overall impact on biodiversity will be reduced, with the majority of vegetation affected being classified as young fallow.

Table 3-6 Land use and habitat types present within between towers 32 and P1-11

Land Use / Habitat Types	Original	Re-alignment
Upper Mixed Deciduous Forest	0.03	-
Old Fallow	4.27	2.39
Young Fallow	4.68	6.34
Cultivated Land	-	-
Water	0.10	0.12
Road / Tracks	0.01	0.08
Total area (ha)	**9.09**	**8.92**

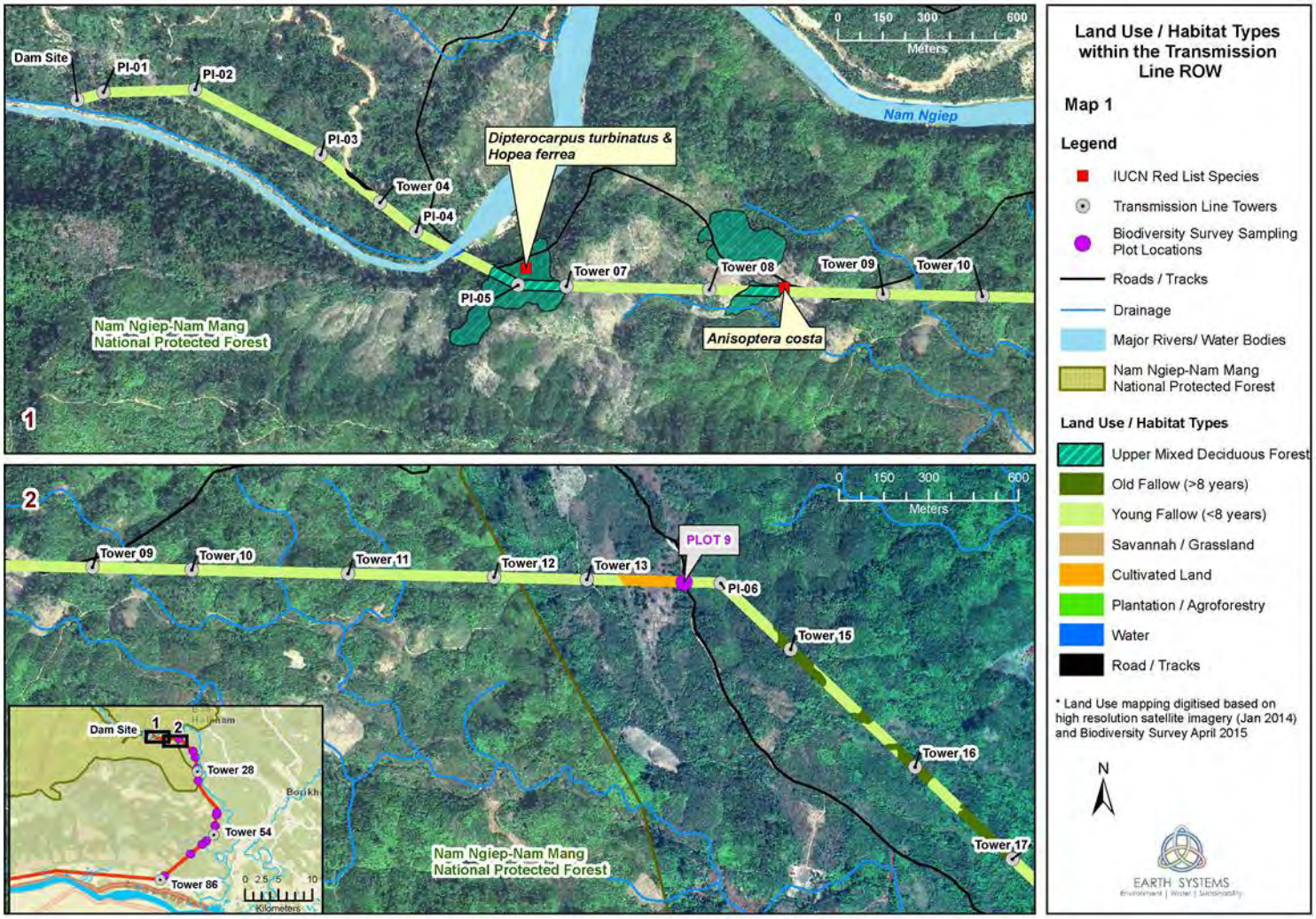

Figure 3-1 Land use and habitat types within the transmission line ROW (Tower 01 -17), including location and habitat types of IUCN threatened trees, with mapped patches of upper mixed deciduous forest to indicate likely boundaries of threatened tree habitat

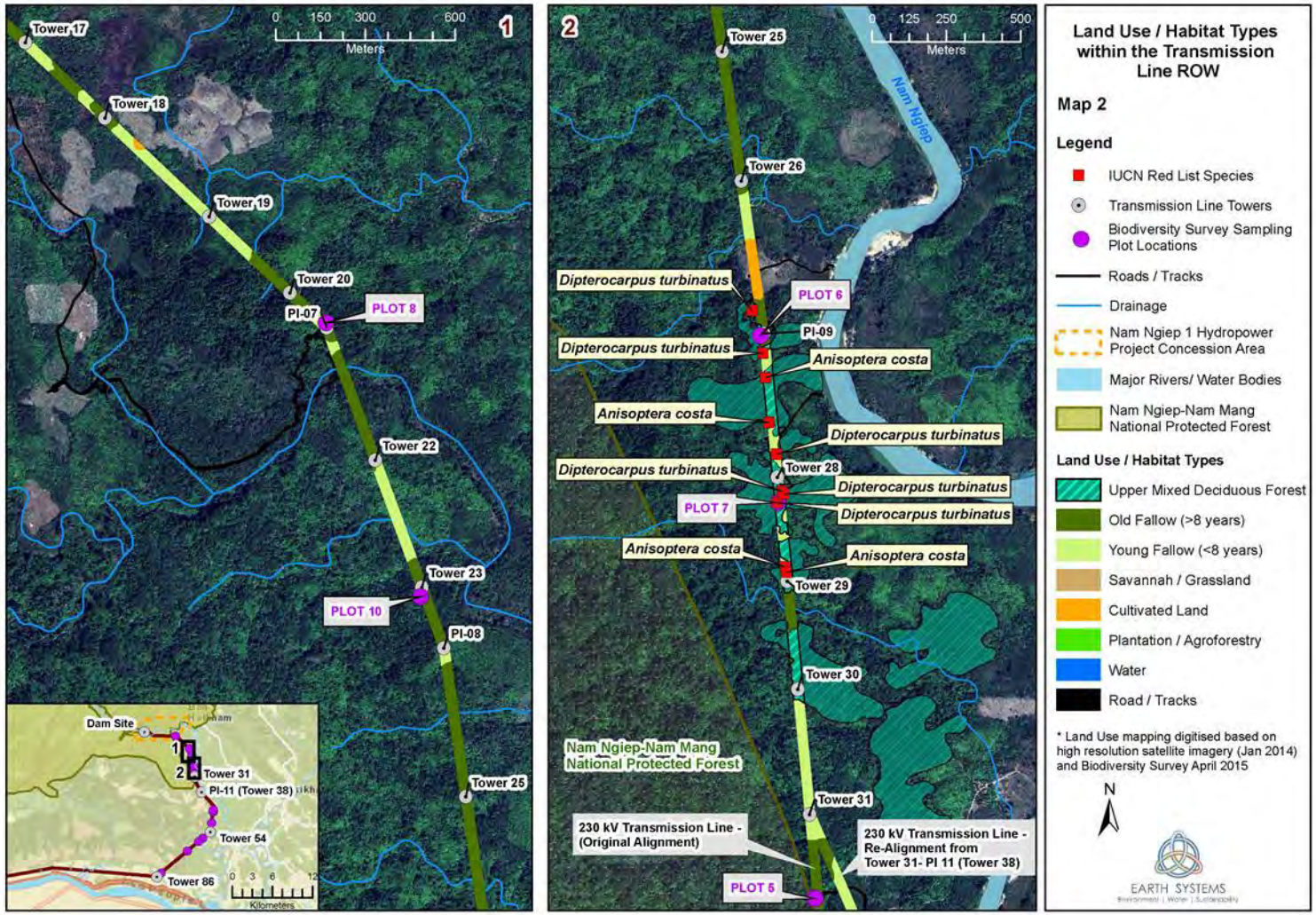

Figure 3-2 Land use and habitat types within the transmission line ROW (Tower 17 -31), including location and habitat types of IUCN threatened trees, with mapped patches of upper mixed deciduous forest to indicate likely boundaries of threatened tree habitat

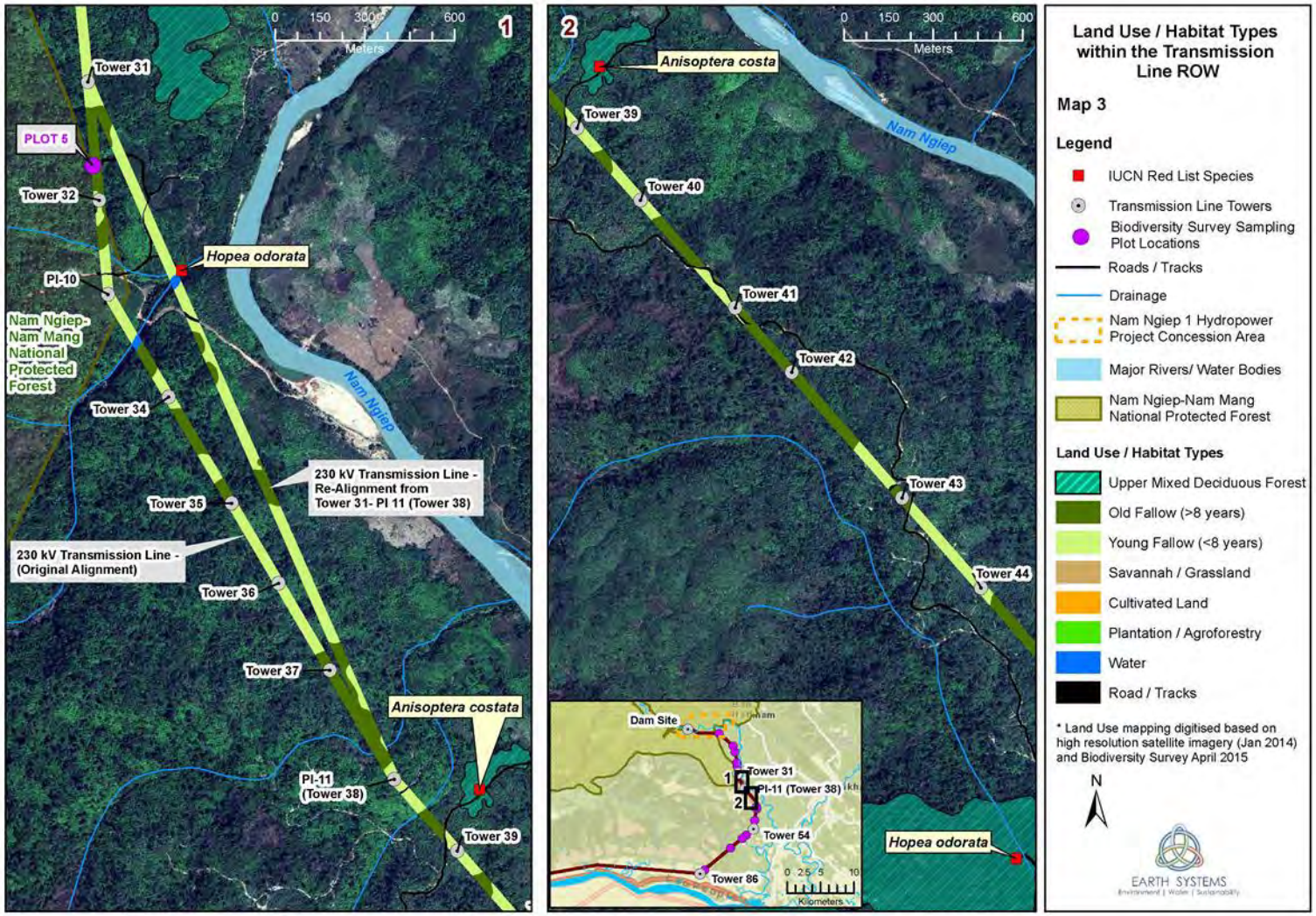

Figure 3-3 Land use and habitat types within the transmission line ROW (Tower 31 -44), including location and habitat types of IUCN threatened trees, with mapped patches of upper mixed deciduous forest to indicate likely boundaries of threatened tree habitat

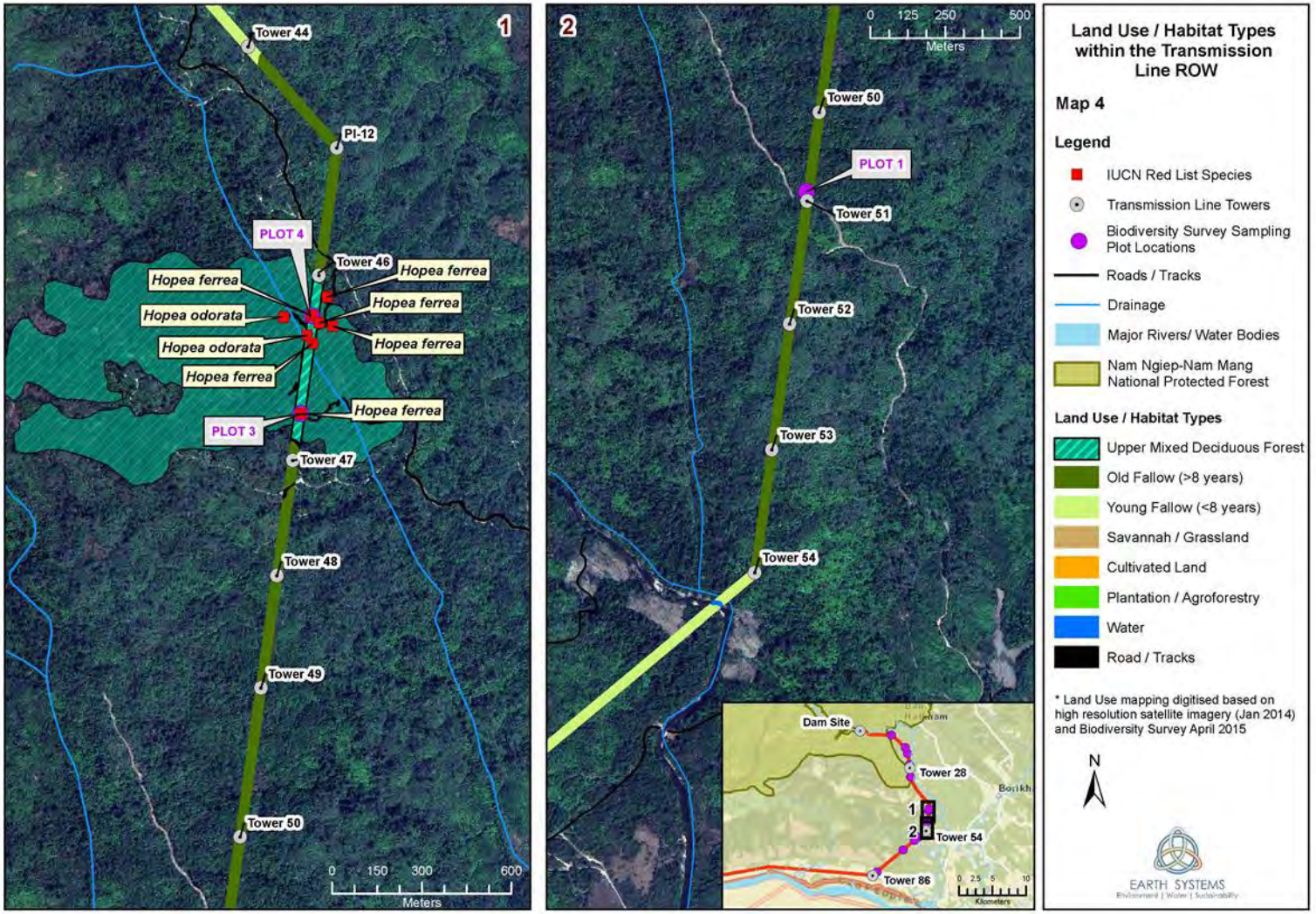

Figure 3-4 Land use and habitat types within the transmission line ROW (Tower 44-54), including location and habitat types of IUCN threatened trees, with mapped patches of upper mixed deciduous forest to indicate likely boundaries of threatened tree habitat

3.1.4 Flora

Common Species

Overall, over 80 flora species were identified as being the most common species within the habitat types identified overlapping the proposed ROW (Table A1). Therefore it is assumed there are considerably more species that occur within the proposed ROW. These species were from three Classes, 28 Orders, 48 Families and 71 Genera. Most species are commonly recorded in Laos and the greater region, yet most have not been assessed for their specific abundance and/or distribution.

Two species that are "globally important" invasive species were found in several locations. Both *Chomolaena ordorata* and *Imperata cylindrica* are on the "100 of the World's Worst Invasive Alien Species" (ISSG, 2015).

Presence of Conservation Important Species

Five globally threatened species were identified inside and outside of the ROW (Table 3-5; Figures 3-1 to 3-4). One Critically Endangered (CR), two Endangered (EN) and two Vulnerable (VU) tree species were identified, four of which are from the Family Dipterocarpaceae.

Dipterocarpus turbinatus (CR) is native to South-east Asia and western India and is often cultivated for its timber. The species is globally threatened, particularly due to habitat loss and over-exploitation, and has been assessed based on the rate of habitat loss (IUCN, 2015). The large tree was only found in upper mixed deciduous but is also found in evergreen and semi-evergreen forest. Although globally threatened, the tree can be locally common in patches, particularly in protected areas.

Anisoptera costata (EN) is a large tree of semi-evergreen, evergreen and humid lowland forest, but was found predominantly in upper mixed deciduous forest. The species can be very rare in some parts of its range and hence is considered as globally threatened.

Hopea ferrea (EN) was found mostly in upper mixed deciduous forest and in one patch of young fallow. This dipterocarp is a commercially important tree and its range and abundance has presumably suffered from over-exploitation as well as habitat loss.

Dalbergia cochinchinensis (VU) can be known as Siamese rosewood, Thailand rosewood or Tracwood and has become threatened due to illegal logging and habitat loss. Only one specimen of this large tree was identified in old fallow land, but is normally found in open semi-deciduous and evergreen forests.

Hopea odorata (VU) was exclusively found in upper mixed deciduous forest, but can often be found in riparian and moist evergreen forests. The species has become threatened due to logging and habitat loss.

Table 3-7 The habitat and location of globally threatened flora identified within and alongside the ROW (according to the IUCN Red List)

Scientific Name	IUCN Red List Status	Habitat	X	Y
Anisoptera costata	EN	YF	346910	2061666
		UMD	351932	2057059
		UMD	351944	2056910
		UMD	351977	2056426
		UMD	352002	2056408
		UMD	353392	2053232
Dalbergia cochinchinensis	VU	OF	352634	2045794
Dipterocarpus turbinatus	CR	UMD	346048	2061733
		UMD	351887	2057285
		UMD	351923	2057141
		UMD	351969	2056803

Scientific Name	IUCN Red List Status	Habitat	X	Y
		UMD	351972	2056641
		UMD	351987	2056678
Hopea ferrea	EN	UMD	346048	2061733
		YF	350952	2044000
		UMD	354846	2050260
		UMD	354882	2050589
		UMD	354885	2050495
		UMD	354907	2050565
		UMD	354934	2050651
		UMD	354953	2050553
Hopea odorata	VU	UMD	352393	2054967
		UMD	354788	2050583
		UMD	354867	2050495
		UMD	354867	2050523

Key: CR – Critically Endangered, EN – Endangered, VU – Vulnerable

3.1.5 Fauna

Common Species Present

Common fauna species were identified during discussions with guides from local villages during field work exercises. The most commonly seen species in the proposed ROW were:

- Wild pig/boar (Sus scrofa);
- Common palm civet (Paradoxurus hermaphroditus);
- Wild chicken (Gallus gallus);
- Greater coucal;
- Crested finchbill (Spizixos canifrons);
- Eastern spotted dove (Spilopelia chinensis);
- Changeable hawk-eagle (Nisaetus cirrhatus); and
- Wire-tailed swallow (Hirundo smithii).

All of these species are considered as globally not threatened and generally common and widespread. However greater coucals are Restricted in Laos and wire-tailed swallows are Potentially At Risk (Duckworth et al. 1999).

Presence of Conservation Important Species

The potential presence/absence of threatened species was assessed within the habitat of the proposed ROW to determine which species may be impacted by habitat removal. Threatened status was determined using the IUCN Red List of Threatened Species (2015) and Lao PDR criteria (Duckworth et al. 1999).

The most Likely species to be present include the greater coucal (Centropus sinensis) and Siamese fireback (Lophura diardi; Table A 2). Five species to be considered as of conservation importance are likely residents and/or users of the habitat within the proposed ROW. None of these species are of global conservation importance, but are of national, regional and/or local importance.

A further seven species have Potential to be present, such as leopards (Panthera pardus) and sambar (Rusa unicolor). The seven includes four Vulnerable, two Near Threatened and one species that has not been assessed by the IUCN, but is considered Potentially At Risk in Laos. These species are disturbance tolerant and their larger ranges have the potential to overlap with the ROW. In addition, these two species (in particular) have adapted to living in close proximity to humans and human-altered environments. If hunting in and around the ROW is restricted, these species are more likely to use the ROW's habitat.

All other species are considered as Unlikely to Highly Unlikely to occur. Overall the habitat is too disturbed and open for these species and many species are restricted to protected or densely forested areas due to habitat loss and hunting persecution. Some species, such as the Asian elephant (Elephas maximus) have been recorded in nearby protected areas and are known to migrate in and around these areas. However, these species are more likely to use the denser and better habitat to the north-west as movement/migration corridors.

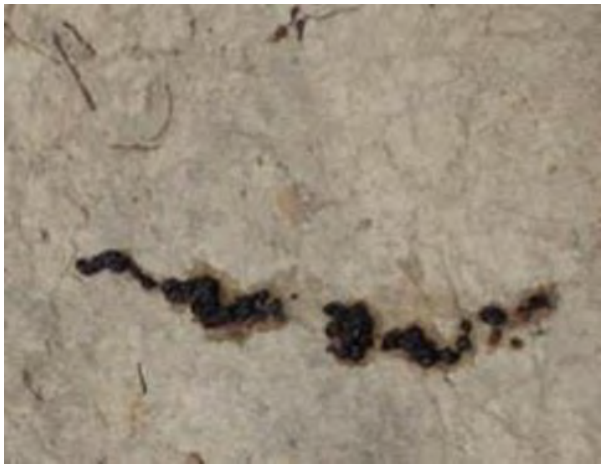

Plate 3-7 Common palm civet dung near tower 46

Plate 3-8 Wild pig/boar footprint near Tower

3.2 Commercial Timber Resources

A rapid assessment of commercial timber resources occurring in the transmission line ROW was conducted. This included field surveys with the assistance of local guides to record the number and size of locally recognised commercial trees above 10 cm diameter at breast height (DBH) in 13 sample plots (see Annex B) and analysis of this information against land use and habitat data to estimate commercial timber resources across the Project Area.

Table 3-7 provides estimates of commercial timber resources in the ROW between the dam site and Tower 54. An estimated 11,785 commercial trees are present in the ROW, with the majority existing in old fallow forests. Basal area (the average area occupied by tree stems) has been calculated as 9.8 m2 per hectare or 301.7 m2.

Table 3-8 Estimated Commercial Timber Resources: Dam site to Tower 54

Forest Type	Total Area in ROW (ha)	Commercial Trees			Basal Area (m2)	
		Average # per Ha	Estimated Total # in ROW	Average DBH	Estimated Area per Ha	Estimated Area in ROW
Upper Mixed Deciduous	6.29	268.57	1,689.58	27.19	12.88	81.00
Dry Dipterocarp	-	-	-	-	-	-
Old Fallow	32.06	300.00	9,617.94	16.52	6.88	220.68
Young Fallow	33.69	-	-	-	-	-
Total	**72.04**	**-**	**11,307.53**	**21.86**	**9.88**	**301.68**

Table 3-8 provides information on the type and number of commercial tree species recorded in nine (9) plots within the ROW between the dam site and tower 54. A total of 23 commercial tree species were identified in the nine (9) plots. Most common species include Crypteronia paniculata, Ormosia pinnata, Peltophorum dasyrrhachis and Schima wallichii – occurring in both UMD and old fallow forests.

Upper Mixed Deciduous

As outlined in Section 3.1.2, the majority of UMD forest affected by the ROW is found between Towers PI-09 and 30; and Towers 46 and 47. UMD sample plots were found to have an average of 18.8 commercial trees ranging from as low as four (4) in plot number four (4) (Tower 46) and as high as 36 in plot number six (6) (Tower P1-09). Local guides reported that these areas had been subject to selective logging over the last 15 years. Average size (DBH) of these trees is 27.19 cm ranging from 9.6 cm up to 82.8 cm (see Annex B). Average minimum and maximum DBH are 21.39 and 33.53 respectively. Basal area per ha has been calculated at 6.9 m2 per hectare.

Fallow Forests

A total of 15 commercial trees were recorded in each of the three (3) old fallow forest plots. These trees are generally small with an average DBH of 16.52 cm. Basal area per ha has been calculated at 12.9 m2 per hectare (Table 3-7). Few to no commercial trees were recorded in young fallow forest plots.

Table 3-9 Commercial Tree Species Present in the ROW

No.	Common Name (Lao)	Species	Family	Forest Type and Plot Number									
				Upper Mixed Deciduous				Old Fallow			Young Fallow		Total
				3	4	6	7	1	5	10	8	9	
1	Muad kieng	Aporosa ficifolia	Phyllanthaceae							1			1
2	Mai ngiw pah	Bombax anceps	Malvaceae	1									1
3	Mai tieu deng	Cratoxylum formosum pruniflorum	Guttiferae	1		2		4				1	8
4	Mai ka arm	Crypteronia paniculata	Crypteroniaceae			21				6			27
5	Mai yang dong	Dipterocarpus turbinatuts	Dipterocarpaceae				3						3
6	Mai euria	Eurya tonkinensis	Simaroubaceae	2									2
7	Ton hai	Ficus altissima	Moraceae	1									1
8	Khee mod	Glochidion sphaerogynum	Phyllanthaceae			7							7
9	Khom som	Grewia paniculata	Malvaceae			1		1		1			3
10	mai khaen hin	Hopea ferrea	Dipterocarpaceae	1	2								3
11	Mai ka bok	Irvingia malayana	Irvingiaceae				1			1			2
12	Ka ka lau	Lagerstroemia macrocarpa	Lythraceae										0
13	Mai peuay	Lagerstromia sp.	Lythraceae	3				1					4
14	Mai Ko ta mou	Lithocarpus sp.	Fagaceae				2						2
15	Mai ka tang	Mesua ferrea	Calophyllaceae				1						1
16	Mai khee mou	Ormosia pinnata	Fabaceae		1	4	4		3	3			15
17	Mai phok	Parinari annamensis	Chrysobalanaceae			1							1
18	Mai saphang	Peltophorum dasyrrhachis	Fabaceae					9	6				15
19	Mai sa mee	Phoebe sp.	Lauraceae							1			1
20	Ham ao	Pterospermum semisagittatum	Malvaceae		1		1						2

No.	Common Names (Lao)	Species	Family	Forest Type and Plot Number									
21	Mai leung keo	Rinorea bussei	Violaceae	2									2
22	Mai mee	Schima wallichii	Theaceae				12			2			14
23	Mai sa khang	Vitex tripinnata	Lamiaceae						6				6
TOTAL				11	4	36	24	15	15	15	0	1	121
Plot Average (20 x 35)				18.75				15			0.5		
Average per Hectare				267.9				214.3			7.1		

4 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

4.1 Consultations for Preparation of May 2014 IEE

Consultations relating to the TL alignment took place with relevant stakeholders between 2008 and 2011 as outlined in the May 2014 IEE (Table 6.1). Stakeholders have included local villagers, district, provincial and national government representatives and international financiers. The consultation activities have helped to identify potential impacts, including impacts to significant historical/ archaeological sites, such as the Wat Prabat Phonsan. The result has been a realignment of the transmission line corridor in order to minimise the potential impacts.

4.2 Consultations for this Assessment

During the conduct of this assessment a meeting was held with local government officials (PONRE) to gain necessary permissions and glean background information about areas along the TL alignment. In addition, In addition, village chiefs from Ban Hatsaykham and Ban Somseun were informed about this assessment. Local guides were engaged to help navigate the TL alignment and provide detailed local knowledge to inform the study such as identification of local streams and other geographical features, history and current usage of the area along the ROW.

5 CONCLUSIONS AND RECOMMENDED MITIGATION AND MANAGEMENT MEASURES

5.1 Biological Resources

5.1.1 Key Findings

The Assessment of biological resources within the ROW between the dam site and Tower 54 indicates the following:

- The proposed transmission line alignment does not pass through any areas of very high biodiversity significance such as NBCA areas or Ramsar Wetland Sites.
- The proposed transmission line alignment will pass through the Nam Ngiep-Nam Mang National Protected Forest (PFA) at PI-10 (Tower 33). In response to this finding, NNP1 has developed an alternative alignment to avoid this impact. This alignment also reduces overall impact on biodiversity values.
- Approximately 6 ha of Upper Mixed Deciduous forest will be removed for the alignment. the habitat is not pristine and has been disturbed by human activity (e.g. selective logging) and other factors such as weeds. This vegetation type should be considered as *modified habitat* due to the significant level of disturbance;
- Approximately 68 ha of *modified habitat* will be removed be removed for the alignment. This includes: Old fallow – left to regenerate > 8 years; and Young fallow – left to regenerate < 8 years;
- No vegetation types were recorded in the survey area that are considered *Natural Habitat*;
- Significant impact on areas of *critical habitat* within the alignment is unlikely. While the presence of Critically Endangered and Endangered tree species in some parts of the ROW could potentially qualify these areas as critical habitat, the removal of such a small amount of habitat is not expected to significantly affect the global distribution of these species. There is also the potential for threatened species to be re-established in forest replacement areas as part of the offset program for the Project (see Recommendations below);
- Five globally threatened tree species were identified within or in close proximity to the proposed ROW and were most frequently in upper mixed deciduous forest and to a lesser extent, old fallow: *Dipterocarpus turbinatus* (CR) ; *Anisoptera costata* (EN); *Hopea ferrea* (EN); *Dalbergia cochinchinensis* (VU); *Hopea odorata* (VU);
- No globally threatened fauna were observed, however Laos Restricted greater coucals and Potentially At Risk wire-tailed swallows were commonly seen; and
- Although the *IEE* and the current assessment have indicated that other globally threatened species are unlikely to occur or that the "*Project area not of significant importance*", there is the potential for additional threatened species to occur in the area that were not recorded in the current studies.

5.1.2 Recommendations

It is recommended that definition of the Deciduous forest (DF) identified in the previous IEE (ERM, May 2014) (or 'Mixed Deciduous forest' as it is identified in this Assessment) is updated to account for the level of disturbance in some Deciduous Forest. The following categories are recommended (with definitions are provided in Section 3.1.2):

- Deciduous forest / Mixed Deciduous forest classed as low disturbance (Natural Habitat)
- Deciduous forest / Mixed Deciduous forest classed as moderate/high disturbance (Modified Habitat)

The following next steps are recommended before clearance activities commence to ensure the Project does not negatively impact on local biodiversity in the long-term:

1. Implement mitigation and management measures identified in the May 2014 IEE (Table 8.2) to avoid, mitigate, manage, restore and offset impacts on biodiversity (i.e. Mitigation Hierarchy).
2. Ensure that the contractor follows steps outlined in the SSESMMP CP for 230 kV Transmission line to enable recommendations to be realised.

Avoid

3. Select the proposed alternative alignment which avoids impact on the Nam Ngiep-Nam Mang National Protected Forest (PFA) at PI-10 (Tower 33).

Minimise

4. Ensure an EMO compliance officer with forestry experience or suitably qualified specialist is present during vegetation clearance preparation activities in UMD Forest and old fallow forest habitats to ensure clear delimitation of the ROW and identify and record important species within the ROW.

Mitigate and Restore

5. Develop and implement specific management measures for the IUCN threatened tree species that have been identified within the ROW, noting that some of which are commercially important trees and this should be considered in their management. Measures should include:
   a. Propagate from cuttings and seeds and plant in close proximity;
   b. Identify and mark threatened species in close proximity to the transmission line and incorporate management of these species into the wide Biodiversity Management and Offsets Plan (see below).

Offset

6. As no natural vegetation types were identified in this section of the transmission line no offsets are required to be implemented for vegetation clearance within this area as per the ADB safeguard requirements (Biodiversity Offset Design ERM 2014).
7. Revegetation of areas temporarily disturbed for construction activities should be conducted.

5.2 Commercial Timber Resources

5.2.1 Key Findings

The rapid assessment of commercial timber resources within the ROW between the dam site and Tower 54 indicates the following:

- An estimated 11,785 commercial trees with a basal area of 301.7 m2 are present in UMD and old fallow forest habitats within the ROW;
- The size of most commercial tree is relatively small with average DBH trees in UMD and old fallow forest habitats 27.19 cm and 16.52 cm respectively; and
- The majority of UMD habitats have been subject to selected logging over the last 15 years although some pockets, particularly between Towers PI-09 and 30 may hold increased numbers and larger commercial trees.

5.2.2 Recommendations

The following management and mitigation measures for commercial timber resources within the ROW are recommended before clearance activities commence:

1. Immediately conduct meetings with the Provincial Agriculture and Forestry Office and local residents to ensure that they are aware of the potential commercial timber resources in the area and discuss / agree to a process for collection of stockpiled logs.
2. Conduct commercial timber harvesting in parallel to vegetation clearance activities:
   a. Engage local forestry expert / GOL official to be present during vegetation clearance preparation and clearance activities in UMD and old fallow forest habitats.
   b. Ensure that all commercial trees above 10 cm DBH are identified, marked and recorded during the vegetation clearance preparation phase.
   c. Ensure that all commercial trees above 10 cm DBH are stockpiled during clearance activities
3. Ensure that appropriate health and safety measures are implemented to manage potential hazards to community and government officials involved in the collection of harvested timber during clearance activities.

5.3 Action Plan

An action plan for the implementation of the above recommendations is outlined in Table 5-1.

Table 5-1 Recommendation Action Plan

Recommendation	Responsibility	Timeline
Biological Resources		
Implement mitigation and management measures identified in the May 2014 IEE to avoid, mitigate, manage, restore and offset impacts on biodiversity (i.e. Mitigation Hierarchy).	NNP1	Construction and Operation
Ensure that the contractor follows steps outlined in the SSESMMP CP for 230 kV Transmission line to enable recommendations to be realised.	NNP1	Construction and Operation
Select the proposed alternative alignment which avoids impact on the Nam Ngiep-Nam Mang National Protected Forest (PFA) at PI-10 (Tower 33).	NNP1	Pre-construction
Ensure an EMO compliance officer with forestry experience or suitably qualified specialist is present during vegetation clearance preparation activities in UMD Forest and old fallow forest habitats to ensure clear delimitation of the ROW and identify and record important species within the ROW.	NNP1	Construction
Develop and implement specific management measures for the IUCN threatened tree species that have been identified within the ROW.	NNP1	Construction and Operation
Revegetation of areas temporarily disturbed for construction activities should be conducted.	NNP1	Construction
Commercial Timber		
Conduct meetings with the Provincial Agriculture and Forestry Office and local residents to ensure that they are aware of the potential commercial timber resources in the area and discuss / agree to a process for collection of stockpiled logs.	NNP1	Pre-construction
Conduct commercial timber harvesting in parallel to vegetation clearance activities.	GOL	Construction
Ensure that appropriate health and safety measures are implemented to manage potential hazards to community and government officials involved in the collection of harvested timber during clearance activities.	Contractor	Construction

ANNEX A: RESULTS OF BIODIVERSITY FIELD

Table A-1 Most common flora species identified in habitat types

Scientific Name	Family	Habit	IUCN Status
Alangium kurzii	Cornaceae	T	N/A
Alpinia galangal	Zingiberaceae	H	N/A
Ancistrocladus tectorius	Ancistrocladaceae	C	N/A
Anisoptera costata	Dipterocarpaceae	T	EN
Aporosa cascarilliioides	Phyllanthaceae	TL	N/A
Aporosa ficifolia	Phyllanthaceae	TL	N/A
Aporosa villosa	Phyllanthaceae	TL	N/A
Ardisia crispa	Primulaceae	H	N/A
Ardisia helferiana	Primulaceae	TL	N/A
Aspidistra sp.	Asparagaceae	H	N/A
Bambusa arundinacea	Poaceae	H	N/A
Bauhinia racemosa	Leguminosae	Sh/T	N/A
Bombax anceps	Malvaceae	T	N/A
Buchanania siamensis	Anacardiaceae		N/A
Calamus javensis	Palmae	H	N/A
Careya arborea	Lecythidaceae	T	N/A
Caryota mitis	Arecaceae	H	N/A
Casearia grewiifolia	Salicaceae	TL	N/A
Catimbium bracteatum	Zingiberaceae	H	N/A
Catunaregam tomentosa	Rubiaceae	TL	N/A
Cephalostachyum virgatum	Poaceae	H	N/A
Chromolaena odorata*	Asteraceae	H	N/A

Scientific Name	Family	Habit	IUCN Status
Chrozophora tinctoria	Euphorbiaceae	TL/H	LC
Cratoxylum formosum	Guttiferae	T	LR/LC
Cratoxylum formosum pruniflorum	Guttiferae	T	LR/LC
Croton eluteria	Euphorbiaceae	TL	N/A
Crypteronia paniculata	Cryteroniaceae	T	N/A
Curculigo orchioides	Hypoxidaceae	H	N/A
Cyclea barbata	Menispermaceae	C	N/A
Cyclea sp.	Menispermaceae	C	N/A
Derris sp.	Fabaceae		N/A
Dioscorea triphylla	Dioscoreaceae	C	N/A
Diospyros sp.	Ebenaceae	T	N/A
Dipterocarpus obtusifolius	Dipterocarpaceae	T	LR/LC
Dipterocarpus turbinatus	Dipterocarpaceae	T	CR
Dracaena angustifolia	Asparagaceae	H	N/A
Drynaria quercifolia	Polypodiaceae	Fern	N/A
Eurya tonkinensis	Pentaphylacaceae		N/A
Eurycoma longifolia	Simaroubaceae	TL	N/A
Ficus altissima	Moraceae	T	N/A
Forrestia griffithii	Commelinaceae	H	N/A
Glochidion eriocarpum	Phyllanthaceae	TL	N/A
Glochidion sphaerogynum	Phyllanthaceae	T	N/A
Gonocaryum lobbianum	Stemonuraceae	TL	N/A
Grewia paniculata	Malvaceae	T	N/A

Scientific Name	Family	Habit	IUCN Status
Hopea ferrea	Dipterocarpaceae	T	EN
Hymenocardia punctata	Phyllanthaceae	TL	N/A
Imperata cylindrical*	Poaceae	H	N/A
Irvingia malayana	Irvingiaceae	T	LR/LC
Lagerstroemia macrocarpa	Lythraceae	T	N/A
Lagerstroemia sp.	Lythraceae	T	N/A
Lithocarpus sp.	Fagaceae	T	N/A
Lygodium flexuosum	Lygodiaceae	Fern	N/A
Mallotus barbatus	Euphorbiaceae	TL	N/A
Mallotus thorelii	Euphorbiaceae	TL	N/A
Memecylon edule	Melastomataceae	TL	N/A
Mesua ferrea	Calophyllaceae		N/A
Millettia pulchra	Leguminosae	TL	LC
Ormosia pinnata	Fabaceae	T	N/A
Oxytenanthera albociliata	Poaceae	H	N/A
Oxytenanthera parvifolia	Poaceae	H	N/A
Parinari annamensis	Chrysobalanaceae		N/A
Peltophorum dasyrrhachis	Fabaceae	T	N/A
Phoebe lanceolata	Lauraceae		N/A
Phoebe sp.	Lauraceae		N/A
Phyllanthus emblica	Phyllanthaceae	TL	N/A
Pterospermum semisagittatum	Malvaceae	T	N/A
Rinorea bussei	Violaceae	TL	N/A

Scientific Name	Family	Habit	IUCN Status
Sapium discolor	Euphorbiaceae	T	N/A
Sauropus androgynus	Phyllanthaceae	H	N/A
Schima wallichii	Theaceae	T	N/A
Scleria terrestris	Cyperaceae	H	LC
Streblus asper	Moraceae	TL	N/A
Streptocaulon griffithii	Apocynaceae	C	N/A
Terminalia elliptica	Combretaceae	T	N/A
Tetracera scandens	Dilleniaceae	H	N/A
Thysanolaena maxima	Poaceae	H	N/A
Trema orientalis	Cannabaceae	TL	N/A
Uvaria macrophylla	Annonaceae	TL	N/A
Vitex tripinnata	Lamiaceae	TL	N/A

Key: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LR – Lower Risk, LC – Least Concern, N/A – Not Assessed, * World's worst invasive species (ISSG, 2015), T – Tree, TL – Treelet, Sh – Shrub, H – Herb, C - Climber

Table A-2 Likelihood of fauna species presence in or near proposed ROW; species identified in the IEE, particularly globally and nationally threatened species

Common Name	Scientific Name	Family	IUCN Red List Status	LPDR Status	Likelihood	Justification	Habitat Requirements
Birds							
Eastern imperial eagle	*Aquila heliaca*	Accipitridae	VU	LKL	Unlikely	Undergoing population declines and although may winter in the area, is more likely to forage in better habitat to the north-west; may be seen flying over	Winters at wetlands in Asia
White-winged duck	*Asarcornis scutulata*	Anatidae	EN	ARL	Unlikely	Habitat largely absent, transmission line will pass over small streams and rivers, but surrounding habitat unlikely to be of	Inhabits stagnant or slow-flowing natural and artificial wetlands, within or adjacent to evergreen,

Common Name	Scientific Name	Family	IUCN Red List Status	LPDR Status	Likelihood	Justification	Habitat Requirements
						sufficient quality; may be seen flying over	deciduous or swamp forests
Great hornbill	*Buceros bicornis*	Bucerotidae	NT	ARL	Potential	Some habitat present, though large trees mostly absent, but more likely to use the habitat to the north-west	Wet evergreen and mixed deciduous forests; abundance correlated with density of large trees, most common in unlogged forest
Greater coucal	*Centropus sinensis*	Cuculidae	LC	✓	Likely	Individuals may be resident in parts of the forest and fallow land	Wide range of habitats, including forests (disturbed and undisturbed)
Siamese fireback	*Lophura diardi*	Phasianidae	LC	PARL	Likely	Individuals may be resident in parts of the forest	Evergreen, semi-evergreen and bamboo forest, secondary growth and scrub, often near roads and tracks through the forest; tolerate considerable degradation of its forest habitat
Silver pheasant	*Lophura nycthemera*	Phasianidae	LC	✓	Likely	Individuals may be resident in parts of the forest	Found mainly in forests, usually montane forests
Green peafowl	*Pavo muticus*	Phasianidae	EN	ARL	Unlikely	Habitat mostly absent, more likely to be seen in less disturbed forest to the north-west, but it is possible that individuals may forage along the transmission line	Occurring mostly in dry deciduous forests, with the highest densities occurring near undisturbed rivers and wetlands. Main threats are widespread hunting for meat and feathers, and collection of eggs and chicks, habitat modification and human disturbance.
Grey peacock-pheasant	*Polyplectron bicalcaratum*	Phasianidae	LC	✓	Likely	Individuals may be resident in parts of the forest and fallow land	Lowland and hilly forests
Red-breasted parakeet	*Psittacula alexandri*	Psittacidae	NT	✓	Likely	Individuals may be resident in parts of the forest and fallow land, some may be kept as pets	Variety of forest and woodland habitats, including modified habitat
Mammals							

Common Name	Scientific Name	Family	IUCN Red List Status	LPDR Status	Likelihood	Justification	Habitat Requirements
Dhole	*Cuon alpinus*	Canidae	EN	ARL	Highly unlikely	Habitat essentially absent; most likely restricted to protected areas; probably not sufficiently dense to provide cover	Found in a wide variety of vegetation types, including primary, secondary and degraded forms of tropical dry and moist deciduous forest; and evergreen and semi-evergreen forests. Major threats to the dhole are depletion of prey, hunting, habitat loss and disease from domestic dogs.
Asiatic golden cat	*Catopuma temminckii*	Felidae	NT	LKL	Unlikely	Habitat probably not sufficiently dense to provide cover, may occasionally range south from better habitat to the north-west	Ranges from tropical and subtropical evergreen to mixed and dry deciduous forest; less frequently found in more open habitats (e.g. shrub and grasslands)
Clouded leopard	*Neofelis nebulosa*	Felidae	VU		Highly unlikely	Habitat essentially absent; probably not sufficiently dense to provide cover	Forest-dependent, particularly primary evergreen tropical forest; also records from dry and deciduous forest, as well as secondary and logged forests. Major threats are habitat loss and hunting, illegal trade in its skin and bones.
Leopard	*Panthera pardus*	Felidae	NT	ARL	Potential	Some habitat present, there may be sufficient cover for leopards to range through site, wild pigs are common and would be the most likely prey item if present	Now confined to more remote montane and rugged foothill areas; important prey species in South-East Asia include hog badger, muntjac and wild pig
Fishing cat	*Prionailurus viverrinus*	Felidae	EN	LKL	Highly unlikely	Habitat essentially absent; probably not sufficiently dense to provide cover	Widely distributed but concentrated primarily in wetland habitats, which are increasingly being settled, degraded and converted.
Asian small-clawed otter	*Aonyx cinerea*	Mustelidae	VU	ARL	Highly unlikely	Habitat essentially absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Found in large wetlands, rivers and lakes, peat swamp forests, mangroves, and paddies. Major threats are habitat destruction and fragmentation

Common Name	Scientific Name	Family	IUCN Red List Status	LPDR Status	Likelihood	Justification	Habitat Requirements
Sun bear	*Helarctos malayanus*	Ursidae	VU	ARL	Highly unlikely	Habitat mostly absent, more likely to be seen in less disturbed forest to the north-west	Sun bears rely on tropical forest habitat but can use selectively logged areas and oil palm plantations near forest edges. Major threats are habitat destruction and hunting for pet trade and body parts.
Asiatic black bear	*Ursus thibetanus*	Ursidae	VU	ARL	Highly unlikely	Habitat mostly absent, more likely to be seen in less disturbed forest to the north-west	Occupy a variety of forested habitats, both broad-leaved and coniferous, and can use regenerating forests. Habitat loss and hunting for skins, paws and especially gall bladders are the main threats to this species.
Large-spotted civet	*Viverra megaspila*	Viverridae	VU	PARL	Potential	Some habitat present, there may be sufficient cover for civets to occasionally use site, likely to be hunted if present	Occurs in lowland evergreen and deciduous forest, and dry dipterocarp forest; the most significant threat to this species is from heavy hunting, particularly with snares and dogs
Gaur	*Bos gaurus*	Bovidae	VU	ARL	Highly unlikely	Habitat essentially absent; most likely restricted to protected areas	Forested habitat in mostly low-lying areas. Rare outside of protected areas. The species is hunted for food, medicinal products and handicrafts products, but habitat loss is also a major threat.
Sambar	*Rusa unicolor*	Cervidae	VU	PARL	Potential	Habitat present, disturbance tolerant and likely to be present if hunting is low	Occurs in dense evergreen closed-canopy forest, but is highly tolerant of forest degradation, if hunting is controlled. Hunted for sport, food, medicinal products and other purposes
Sunda pangolin	*Manis javanica*	Manidae	CR	ARL	Unlikely	Habitat present, disturbance tolerant and likely to be present if hunting is low; but hunting has probably restricted population	Found in primary and secondary forest, and in cultivated areas including gardens and plantations near human settlements
Northern pig-tailed macaque	*Macaca leonina*	Cercopithecidae	VU	PARL	Unlikely	Habitat mostly absent, more likely to be seen in less disturbed forest to the north-west, but it is possible that individuals may sporadically forage along the transmission	Occupies tropical evergreen and semi-evergreen forest, tropical wet evergreen forest, tropical moist deciduous forest, coastal forest, swamp forest, and montane forest, including degraded forests.

Common Name	Scientific Name	Family	IUCN Red List Status	LPDR Status	Likelihood	Justification	Habitat Requirements
						line	
Phayre's leaf-monkey	*Trachypithecus phayrei*	Cercopithecidae	EN	ARL	Unlikely	Habitat mostly absent, more likely to be seen in less disturbed forest to the north-west	Prefers primary and secondary evergreen and semi-evergreen forest, mixed moist deciduous forest, but is also found in bamboo-dominated areas, light woodlands, and near tea plantations
Northern white-cheeked gibbon	*Nomascus leucogenys*	Hylobatidae	CR	PARL	Highly unlikely	Habitat essentially absent; most likely restricted to protected areas	Tall primary and heavily degraded evergreen and semi-evergreen forest
Bengal slow loris	*Nycticebus bengalensis*	Lorisidae	VU	LKL	Unlikely	Habitat probably not sufficiently dense to provide cover, may occasionally range south from better habitat to the north-west	Arboreal, nocturnal species inhabiting tropical evergreen rainforest, semi-evergreen forest, and moist deciduous forest. Major threats are vehicle collision, habitat loss and hunting for food, medicine, sport or as pets
Asian elephant	*Elephas maximus*	Elephantidae	EN	ARL	Unlikely	Habitat of insufficient quality to support the large mammal; more likely to be restricted to nearby protected areas; possible presence of captive individuals	Primarily found in small, scattered populations in grassland, tropical evergreen forest, semi-evergreen forest, moist deciduous forest, dry deciduous forested and dry thorn forest, in addition to cultivated and secondary forests and scrublands. Major threats are hunting for ivory, food, leather and other products and are caught for labour in forestry operations and for ceremonial purposes
Reptiles							
Black and white spitting cobra	*Naja siamensis*	Elapidae	VU		Potential	Habitat present, disturbance tolerant and likely to be present if hunting is low	Inhabits lowland and upland forest, cultivated areas, including rice paddies, deciduous, disturbed and open forest. Heavily harvested for

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							both domestic use and export to China, being used in traditional medicine.
Reticulated python	*Broghammerus reticulatus*	Pythonidae	N/A	PARL	Potential	Habitat present, disturbance tolerant and likely to be present if hunting is low	Rainforests, woodlands and grasslands; they can also swim and can be found in areas near streams and lakes
Mekong snail-eating turtle	*Malayemys subtrijuga*	Geoemydidae	VU	PARL	Highly unlikely	Habitat essentially absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Freshwater streams, small lakes, marshes and rice paddies, with slow-moving current, muddy substrate and benthic vegetation
Big-headed turtle	*Platysternon megacephalum*	Platysternidae	EN	ARL	Highly unlikely	Habitat essentially absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Nocturnal spends much of day underwater burrowed into gravel deposits or hidden in rock crevices, generally at the stream edge or behind a waterfall
Impressed tortoise	*Manouria impressa*	Testudinidae	VU	ARL	Potential	Little information available regarding this species' requirements	Montane forests; thought to inhabit evergreen forests and bamboo thickets
Asiatic softshell turtle	*Amyda cartilaginea*	Trionychidae	VU	PARL	Highly unlikely	Habitat essentially absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Occurs in a wide variety of lowland freshwater habitats, including muddy slow-moving rivers and streams, lakes, marshes and swamps; may occur in fast-flowing streams at higher altitudes
Fish							
Jaguar loach	*Yasuhikotakia splendida*	Cobitidae	VU		Highly unlikely	Habitat largely absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Rocky rapids in large streams and rivers
Giant carp	*Catlocarpio siamensis*	Cyprinidae	CR		Highly unlikely	Habitat largely absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Inhabits floodplains and main river habitats feeding on algae, phytoplankton, plant matter, and small fish

Common Name	Scientific Name	Family	IUCN Red List Status	LPDR Status	Likelihood	Justification	Habitat Requirements
Yellow tail brook barb	*Poropuntius deauratus*	Cyprinidae	EN		Highly unlikely	Habitat essentially absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Occurs in medium size and small rivers and streams, usually found in clear water with rapid current
Thicklipped barb	*Probarbus labeamajor*	Cyprinidae	EN		Highly unlikely	More likely to be in larger rivers	Mainstream of large rivers, with sand or gravel substrates and abundant mollusc populations; can occur in deep slow reaches
Bandan sharp-mouth barb	*Scaphognathops bandanensis*	Cyprinidae	VU		Highly unlikely	More likely to be in larger rivers	Migratory between streams and main rivers, Mekong River
Striped catfish	*Pangasianodon hypophthalmus*	Pangasiidae	EN		Highly unlikely	Habitat largely absent, transmission line will pass over small streams and rivers, but unlikely to be of sufficient quality to support the species	Inhabits main channels and floodplains of large rivers and seasonally moves up to floodplains and marshland for feeding and nursing; large, fecund, relatively slow growing catfish; omnivore, feeding primarily on algae, plants, insects, fruits, and fish

Key: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concern, N/A – Not Assessed, ARL – At Risk in Laos, PARL – Potentially At Risk in Laos, LKL – Little Known in Laos, ✓ - No. 0360 MAF "Restricted"

ANNEX B: RESULTS OF COMMERCIAL TREE ASSESSMENT

No.	Common Name (Lao)	Species	Family	Forest Type and Plot Number													Total
				Upper Mixed Deciduous					D. Dip	Old Fallow				Young Fallow			
				3	4	6	7	12	13	1	5	10	11	2	8	9	
1	Muad kieng	*Aporosa ficifolia*	Euphorbiaceae									1	7				8
2	Muad ngai	*Aporosa villosa*	Euphorbiaceae						3								3
3	Mai Wan	*Bauhinia racemosa*	Leguminossae/ Caesalpinioideae											1			1
4	Mai ngiw pah	*Bombax anceps*	Bombacaceae	1													1
5	Phi man	*Buchanania siamensis*	Anacardiaceae						2								2
6	Ka don	*Careya arborea*	Lecythidaceae						3								3
7	Mai tiw som	*Cratoxylum formosum*	Hypericaceae										2				2
8	Mai tieu deng	*cratoxylum formosum var. Pruniflorum*	hupericaceae	1		2				4			4			1	12
9	Mai ka arm	*Crypteronia paniculata*	Crypteroniaceae			21						6	11				38
10	Mai sa ngon	*Derris*	Leg./Papilionoideae					2									2
11	Maim nang dam	*Diospyros*	Ebenaceae					1									1
12	Mai yang dong	*Dipterocarpus turbinatuts*	Dipterocarpaceae				3										3
13	Mai euria	*Eurya tonkinensis*	Theaceae	2													2
14	Ton hai	*Ficus altissima*	Moraceae	1													1
15	Khee mod	*Glochidion sphaerogynum*	Euphorbiaceae			7			2								9
16	Khom som	*Grewia paniculata*	Tiliaceae			1				1		1					3
17	mai khaen hin	*Hopea ferrea*	Dipterocarpaceae	1	2			6									9
18	Mai ka bok	*Irvingia malayana*	Irvingiaceae				1					1					2
19	Ka ka lau	*Lagerstroemia macrocarpa*	Lythraceae						2								2
20	Mai peuay	*lagerstromia*	lythraceae	3				4		1			6				14
21	Mai Ko ta mou	*Lithocarpus sp.*	Fagaceae				2										

No.	Common Name (Lao)	Species	Family	Forest Type and Plot Number													Total
				Upper Mixed Deciduous					D. Dip	Old Fallow				Young Fallow			
				3	4	6	7	12	13	1	5	10	11	2	8	9	
22	Mai muad ae	*Memecylon edule*	Melastomataceae					1									1
23	Mai ka tang	*Mesua ferrea*	Calophyllaceae				1										1
24	Mai khee mou	*Ormosia pinnata*	Leg./Papilionoideae		1	4	4	1			3	3					16
25	Mai phok	*Parinari annamensis*	Rosaceae			1											1
26	Mai saphang	*peltophorum dasyrrhachis*	leg / caesalp.							9	6		9	1			25
27	Mai phai ven	*Phoebe lanceolota*	Lauraceae					1									1
28	Mai sa mee	*Phoebe sp.*	Lauraceae									1					1
29	Ham ao	*Pterospermum semisagittatum*	Sterculiaceae		1		1										2
30	Mai leung keo	*Rinoria boisseui*	*Violaceae*	2				1									3
31	Mai mee	*Schima wallichii*	Theaceae				12					2					14
32	Mai peuy lerd	*Terminalia elliptica*	Combretaceae					2									2
33	Mai sa khang	*Vitex tripinnata*	Verbenaceae								6						6
TOTAL				**11**	**4**	**36**	**24**	**19**	**12**	**15**	**15**	**15**	**39**	**2**	**0**	**1**	**193**
Plot Average (20 x 35)				**18.8**					**12**	**21**				**1**			
Average per Hectare				**268.6**					**171.429**	**300.0**				**14.3**			