



**14 September 2014**

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Dear Cliff,

***Re: Environmental impact audit findings for the 22 kV Distribution Line Upgrade – Paksan to Ban Nonsomboun***

Earth Systems has undertaken an audit on behalf of Nam Ngiep 1 Power Company (NN1PC) to supplement an Audit Report and Corrective Action Plan (ARCAP) that NN1PC will provide to the Asian Development Bank (ADB). The ARCAP is in response to the NN1PC sub-contractor implementing construction and upgrade works for a 22 kV distribution line (DL) in advance of intended environmental and social assessment.

Earth Systems was engaged by NN1PC to conduct an assessment of environmental impacts and a preliminary assessment of social impacts associated with the upgrade of the existing 22 kV DL from Paksan Substation to Ban Nonsomboun (the Project) and to provide recommendations for corrective action, where applicable.

The information contained herein summarises the following:

- Project description;
- Description of post-construction environmental and social impacts observed on-site;
- Observed mitigation and management measures applied to impacted areas, where applicable;
- Recommendations for corrective actions in response to environmental or social impacts; and
- Recommendations for ongoing maintenance in the DL Right-of-Way (ROW).

## **1. Project overview**

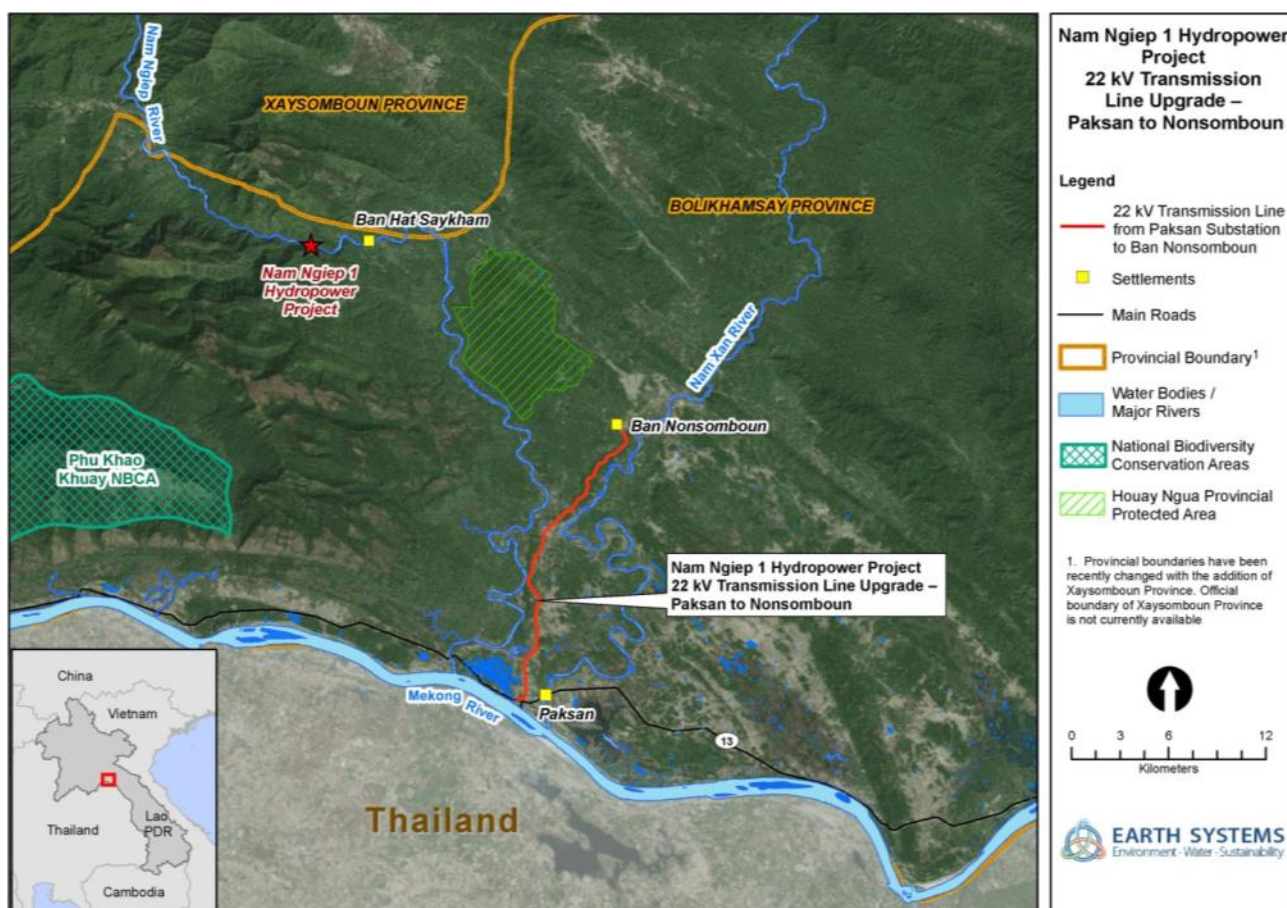
### **1.1. Background**

This Project comprises the upgrade of an existing 22 kV line currently owned and operated by Electricité du Lao (EDL) from the existing Paksan Substation to Ban Nonsomboun for a distance of approximately 20.8 km. The Project distribution line is one of four sections that will be constructed or upgraded to supply power for construction of the Nam Ngiep 1 Hydropower Project (NN1HPP) in Bolikhamsay Province, Central Lao PDR.

### **1.2. Project location**

The Project DL runs primarily along the existing Road 4B between Paksan and Ban Nonsomboun (refer to Figure 1), intersecting the land of eight villages in two districts: Ban Anousonexay, B. Phonxay, B. Hongxay, B. Thong Yai, and B. Thong Noy in the Paksan district; and B. Houay Khoun, B. Phiengdy, and B. Nonsomboun in the Bolikhan District.

In addition, 46 villages in the greater Bolikham and Thathom districts were indirectly affected during Project construction due to planned power outages as the existing DL provides power beyond the immediate vicinity of the Project area.



**Figure 1: Project location**

### 1.3. Project design

The Project comprises the following key components (refer to Figure 2):

- Upgrades along the existing EDL 22 kV right-of-way (ROW) for approximately 19 km, or 93% of the total length of the Project, including:
  - Addition of a single new 22 kV DL cable, poles and reinforcement of existing poles on EDL's existing 22 kV line; and
  - Addition of a single new 22 kV DL cable on the existing village distribution power network.
- Two new sections of DL ROW and infrastructure:
  - 1.12 km section where the new ROW starts on the east side of 4B Road, at the outskirt of Paksan, where it deviates from the existing EDL line and runs for approximately 1.1 km before crossing Road 4B to reconnect to the existing EDL ROW. Twenty-five new poles were required for this section.
  - 120 m new DL ROW section starting at Paksan Substation on four poles in the existing EDL ROW.

Table 1 summarises the key design features of the Project against the existing EDL DL.

**Table 1: Overview of Project distribution line design**

Aspect	Existing EDL distribution line design features	Project distribution line design features
Line voltage	22 kV distribution line; three-phase power	22 kV; three-phase power
Type	Towers: Pole structures with concrete foundations Cable: ACSR 50 mm <sup>2</sup> aluminium/steel cable	Towers: Pole structures with concrete foundations Cable: ACSR 150 mm <sup>2</sup> aluminium/steel cable
Number of poles	Unconfirmed number of existing towers	39 reinforced poles 273 additional new poles
Average span between towers	70-80 m	45 m
Average tower height	12-16 m (12 m above ground with 2 m burial depth)	10 m (12 m length with 2 m burial depth)
Right-of-way (ROW)	8 m	8 m
Tower impacted land area	0.3 m <sup>2</sup> pole 1 m <sup>2</sup> for pole foundations	0.3 m <sup>2</sup> pole 1 m <sup>2</sup> for pole foundations
Transformer substation	115 kV/22 kV Paksan substation	Paksan substation provides enough space for new connection bays to be added

Notable features of the Project design based on the construction works conducted to-date included:

- Low voltage distribution lines connecting to households and businesses are co-located within the ROW for long sections of the existing DL ROW. In some instances, the new 22 kV DL cable is installed on the existing village distribution line poles;
- Smaller EDL low voltage distribution line poles have been removed at several locations and larger poles were installed to handle the added weight of the 22 kV lines;
- The length of the DL alignment was measured to be 20.2 km by the survey team as mapping was based on GPS locations of new poles only; whereas actual DL length is anticipated to be 20.8 km based on Project detailed design; and
- Only 217 new poles were surveyed as part of the completed works (compared to 273 poles proposed in the detailed design). The survey team followed the entire Project alignment and can confirm the existence of only 217 new poles.

## 1.4. Project standards

Lao PDR law requires consideration of environmental and social impacts for construction and operation of 22 kV TL projects. However, current Government of Lao PDR (GOL) legislation and guidelines regarding environmental and social assessment and management of DLs are focused on high voltage (i.e. 230 kV and 115 kV) projects and do not outline specific requirements for 22 kV DL projects.

The Rural Electrification Programme 2 (REP2), implemented by EDL and financed by the World Bank, provides some Guidelines that have been adopted as de facto standards in Lao PDR in the absence of specific legislation for 22 kV DL. They are considered a benchmark for environmental / social Best Practices for 22 kV DL projects in Lao PDR.

According to the Lao Electrical Power Technical Standards (MIH 2004) (refer to Annex C), safe clearance from a live conductor (22 kV distribution lines) requires the following maintenance of the following clearances:

- Common place ground clearance: 5.5 m;
- Mountainous area: 5.0 m;
- Navigable river: 2.0 m above mast height;
- Unnavigable river: 5.0 m;
- Road crossing: 6.0 m; and

- Built-up Area: DL construction is permitted when:
  - » Stranded wire has a tensile strength of no less than 30 kN;
  - » Span is no longer than 75 m;
  - » Tower height is 10 m (8 m when insulated conductors are used); and
  - » Appropriate signage indicating potential danger is used.

As stipulated by the Lao Electric Power Technical Standards, trees should be pruned to ensure that overhead distribution lines cannot be damaged by falling trees. Similarly, the positioning of electrical conductors should be of sufficient height to avoid damage by falling trees. A clearance of 2.0 m is required for 22 kV lines.

There is some uncertainty regarding clearance area requirements for 22 kV distribution lines from structures. According to Lao Electric Power Technical Standards (refer to Annex C), minimum clearance requirements for distribution lines of <35 kV falls between 1 - 3 m from structures (refer to Article 116). Clearance requirements are dependent on technical specifications of the cable (e.g. insulation, tensile strength, etc.).

## **1.5. Operations and maintenance**

Routine, special and emergency maintenance works planned along the Project will include:

- Trimming and/or clearing trees along the ROW;
- Inspection of electric meters and replacement where required;
- Inspection and maintenance of the electric lines and transformers; and
- Inspection and replacement of fuses.

It is understood that NN1PC will own / operate the DL for five years from B. Hasaykham to the construction site (Sections 3 and 4) following commissioning of the new infrastructure, after which EDL will become the owner responsible for ongoing maintenance. However, for the section from Paksan to B. Hatsyakham, all the assets will be transferred to EDL after its completion and thereafter EDL will become the owner and responsible for maintenance works.

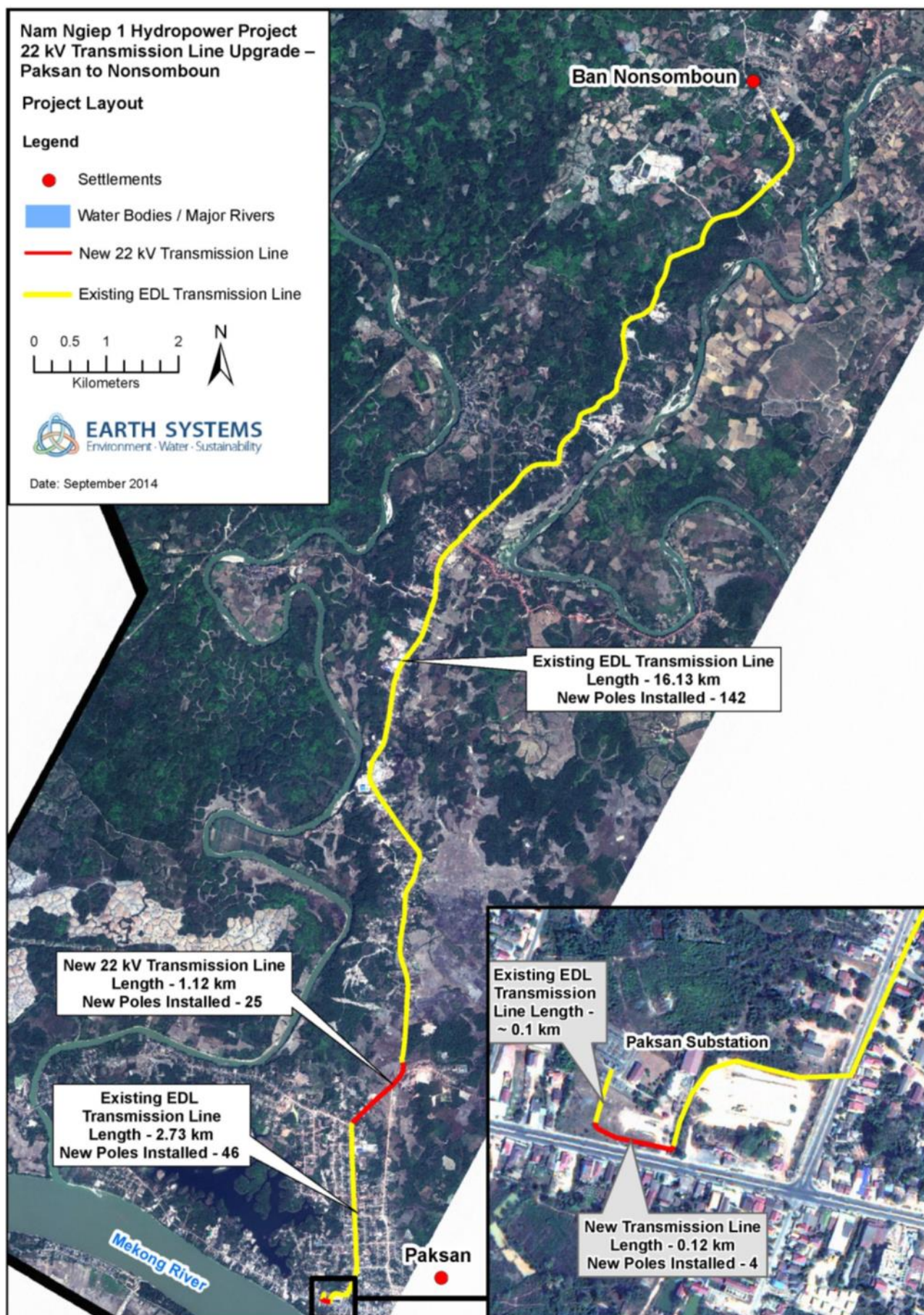


Figure 2: Project layout

## 2. Methodology

Earth Systems reviewed background information, met with relevant stakeholders, and conducted an audit of the Project worksite along the entire Project DL alignment during a four-day site visit from 10 to 13 September 2014.

The following tasks were undertaken:

- Reviewed information provided by NN1PC and EDL including Project description and planned outage schedule;
- Identified and reported key issues and impacts associated with completed construction works;
- Assessed the mitigation and management measures implemented onsite; and
- Provide recommendations for further corrective actions, where necessary.

Environmental representatives from NN1PC conducted a separate field inspection on the 4th and 9th of September 2014, to gather information for an interim environmental impact audit report to ADB.

## 3. Summary of findings

The findings of this environmental impact audit are presented below as follows:

- Summary of work conducted to-date and work yet to commence;
- Existing land use in the DL ROW;
- Summary of environmental impacts from Project works conducted to date;
- Summary of social (community/business) impacts from Project works conducted to date; and
- Mitigation measures employed for Project works conducted to date.

### 3.1. Work conducted to date

The environmental / social audit confirmed that approximately 90% of the Project has been completed to-date with all further construction currently on-hold. Completed works include vegetation clearance within the existing and new ROWs (minimal), tower / pole foundation construction, tower erection, and distribution line stringing. Vegetation clearance was minimised to that required for an 8 m wide ROW. Approximately 217 of 273 new poles were installed to support the existing DL from Paksan Substation to B. Nonsomboun, and 39 existing poles were reinforced to support the new cable design (refer to Figure 2).

The majority of the new poles installed were placed in-between existing poles throughout the existing EDL ROW to reduce the average span between towers from 70 m to 45 m to allow for additional cable loading. The majority of structures installed were single pole towers.

The cable for the new 22 kV DL was installed accordingly:

- New conductors strung together in a gang (clustered in a support frame) and suspended by a fourth wire along the existing EDL poles. Support arms were also installed to support the gang. This gang set-up is used within the existing EDL ROW along 4B Road outbound from Paksan for a distance of approximately 2.9 km; and
- Three separate conductors were strung along the top cross-span of each pole for the remaining section of the Project.

On average, up to 10 new poles could be erected daily, with each turning point requiring heavier engineering.

### 3.2. Power outage schedule

The following steps were undertaken by Provincial EDL as part of their standard communication strategy for notifying and implementing the schedule of power outages associated with DL construction / upgrades:

1. The sub-contractor submits the request to Provincial EDL with proposed dates for power outages;
2. Provincial EDL sends official letter(s) to district authorities for consideration and approval; and
3. Provincial EDL prepares letter of notice to inform the public following district authority approval, through various communication channels including local media, village and district authorities, businesses, and telecommunication service providers.

During construction, the relevant district authorities approved planned power outages and letters of notice were issued to the public in accordance with the communication strategy.

EDL has confirmed that planned power outages occurred from the Paksan substation across the Borikhan district from 8:00 am to 5:00 pm (9 hours) for the following days:

- June 2014: 21-22 and 28-29;
- July 2014: 5-6, 12-13, 19-20 and 26-27; and
- August 2014: 2-3, 9-10, 16-17, 23-24 and 30-31.

There were no unplanned outages during construction and power was available from 5:00 pm on every occasions.

### 3.3. Work to be conducted

The remaining construction for the Project will comprise additional cable stringing for a distance of approximately 530 m in the vicinity of Paksan Substation, and vegetation clearance near distribution lines.

### 3.4. Land use in the Right-of-Way

The land uses along the new and existing ROWs for the Project are primarily comprised of urban settlement and light industry areas (56%) interspersed by rural grassland / vegetated areas (30%) and cultivated land / plantation (e.g. rice paddies) (9%) (refer to Table 2). Local cultivation is dominated by lowland rice cropping in paddy fields. However, much of the rice paddy fields viewed from the Project ROW appear to be disused or semi-retired.

**Table 2: Primary land uses along the Project DL ROW**

Land Use	Percentage of the Project distribution line ROW (%)
Residential/commercial	56
Grassland / vegetated areas	30
Cultivated land / plantation	9
Public / village land	4
Road / track	1
Total	100%

### 3.5. Summary of environmental impacts

Environmental impacts associated with Project construction conducted to-date in the new and existing DL ROW were found to be minimal, temporary, and of short duration in rural areas and negligible in villages. Permanent vegetation loss / disturbance required in the new 1.12 km DL ROW required approximately 25 m<sup>2</sup> of land required for pole foundations (25 new poles x 1m<sup>2</sup>), some of which was vegetated prior to pole implementation. Approximately 12 trees appeared to have been removed for this Project given their respective location and apparent recent timeline for felling (based on visual assessment of stump/area). The trees were comprised of the following (refer Photos 1-3):

- Four Mai Xard trees;
- Three Mai Kathinnalong trees; and
- Five introduced *Eucalyptus* sp. trees – as not conducive to simple pruning due to growth habit.

Additional minor impacts included:

- Vegetation loss / disturbance in existing ROW - vegetation clearance associated with foundation and tower installation was considerably less than the maximum 2.73 hectares of land required for new poles (1 m<sup>2</sup> x 273 new poles) as the majority of works were conducted on un-vegetated roadside areas. Several trees encountered along the existing ROW had been pruned for operational safety clearance (refer Photo 3). A number of large trees also require pruning in the near future to maintain vegetation safety clearance and should be monitored closely (refer Photo 4).
- Localised soil erosion and dust – were assumed to be minimised as wet season conditions provided natural dust suppression and aided vegetation regrowth for site stabilisation and recovery to the extent that there were no long-term impacts observed onsite.

Construction did not affect environmental values such as biodiversity, natural watercourses and water quality, which were unchanged from pre-construction conditions. Further details of the environmental impacts recorded for each of the surveyed DL infrastructure is summarised in Table 3, Annex A.



**Photo 1: Unidentified species of trees removed.**



**Photo 2: Introduced *Eucalyptus* sp. trees removed.**



**Photo 3: Tree pruning to maintain operational safety clearance.**



**Photo 4: Large trees requiring pruning for operational safety clearance.**

### 3.6. Summary of social and community impacts

Community and business impacts associated with the DL upgrade works conducted to-date include the following:

- Minor and temporary impacts from power outages likely occurred during construction. Impacts may include limited revenue loss for large businesses reliant on continuous power for operations (e.g. sawmills) and potential food spoilage in restaurants and households due to loss of refrigeration. Small business and household impacts were likely minimised with prior notification to affected people. The total duration of each power outage was less than 9 hours, and was restricted to weekends in accordance with the Project schedule procedure outlined in Section 3.2.
- 22 kV line was added to existing low voltage distribution power lines and in some cases, a handful of structures may be within clearance zone applicable for 22 kV DLs. None of these structures appeared to enable a person to reach live wires, so the risk for potential electrocution is low. However, there is some potential for greater operational safety risks. The distance of the distribution line from structures appears to be consistent with the applicable clearance requirements prescribed in the Lao Electrical Power Technical Standards (MIH 2004a) (refer to Article 116, Annex C). However, some of the structures may be within 3 m of the distribution line (which would be non-compliant if cables are uninsulated). Further investigation is required (e.g. technical specifications of conductor and measurement of structures from DL) to determine whether the DL poses a safety risk. Refer to Photos 5-8 and Annex B for a non-exhaustive list of sites with potential safety hazards recorded.
- Some trees occur within 2 m of the 22 kV DL (refer to Photo 4 and Annex B), creating a potential fire hazard.

Minor impacts to communities / businesses included:

- Temporary ground disturbance to rice paddies and other land uses for laydown areas, site access and equipment mobilisation were minimal. Impacts were minor, localised and of short duration.
- Noise disturbance was likely an issue during construction works, particularly for residences and shops located within the ROW. However, disturbance was of short duration and during daylight hours only; and
- Visual amenity impacts occurred but are considered minor as the new DL infrastructure is located within an existing distribution line ROW for 93% of its length and is surrounded by other power supply and distribution networks.

Site-specific business and social impacts associated with the completed construction works are further discussed in Table 3, Annex A.

Annex B contains photographs of existing commercial / residential structures and vegetation that may exceed operational safety clearances as stipulated in the Lao Electrical Power Technical Standards (MIH 2004). The list is non-exhaustive and additional sites have been recorded for further investigation.



**Photo 5: Saw mill structures potentially within operational safety zone of 22 kV DL**



**Photo 6: House rooftop within the operational safety clearance zone of the 22 kV line**



**Photo 7: Suan Born restaurant underneath the 22 kV DL and very close to distribution power lines.**



**Photo 8: Extended pole with new 22 kV DL and shop below exceeding the operational safety zone**

### 3.7. Mitigation measures employed

A range of mitigation and management measures were employed during upgrade of the DL, which effectively mitigated or minimised the anticipated environmental and social impacts. Measures included:

- Notification in advance of planned power outages to affected residents and businesses in accordance with EDL's communication strategy (refer to Section 3.2) to mitigate impacts associated with electricity disruptions;
- Implementation of new DL infrastructure within existing DL ROW and road corridor;
- Locating poles to avoid direct impact to existing physical structures (e.g. residential / commercial buildings);
- Siting poles on road verges, unvegetated areas, or next to existing pole / tower to minimise impacted area;
- Where practicable, existing power DL and distribution poles were extended to support the additional 22 kV line instead of placing new poles;

- Minimising vegetation clearance to within the 8 m wide ROW and restricting permanent impact area to 1 m<sup>2</sup> for new foundation and pole; and
- Pruning and removal of vegetation as appropriate to meet operational safety requirements.



**Photo 5: Existing pole was strengthened to avoid crop disturbance and land use impact.**



**Photo 6: Co-location of new pole with existing one to minimise disturbance and land use impact**

## 4. Conclusions and Corrective Action Recommendations

The audit found that the scale of environmental impacts from completed construction works was minor in rural areas and negligible in commercial / village areas. Vegetation clearance was minimal and generally occurred in previously cleared areas (e.g. existing and maintained DL ROW).

Impacts to community and businesses appear to have been similarly minor. Temporary impacts from power outages were minimised by restricting outages to weekends and <9 hours per event. The schedule for power outages was communicated to villages and businesses in advance. However, the implementation of the distribution line may increase safety hazards in built-up areas due to the proximity of structures and vegetation to the 22 kV DL.

A number of environmental and social mitigation and management measures employed during construction assisted in effectively mitigating some of the more significant anticipated environmental and social impacts.

### 4.1. Corrective Actions

The following corrective actions are recommended in response to works conducted to-date (refer to Table 3 for specific locations):

1. Investigate clearance requirements for the 22 kV distribution line from structures in the Project ROW (refer to Article 116, Annex C). The clearance requirement varies according to technical specifications of the cable (e.g. insulation, tensile strength), but is likely 3.0 m for structures (e.g. rooftops) that can be accessed by a person;
2. Undertake a risk analysis regarding safe clearance of the new and existing 22 kV cables from existing buildings / infrastructure to ensure that the DL cannot be reached by an individual on a roof-top or other structure;
3. Communicate applicable building height restriction within ROW to property owners currently constructing physical structures within the new and existing 22 kV DL ROW;
4. Continue tree pruning operations to ensure at least 2 m clearance from 22 kV lines;
5. NN1PC should be informed of all future construction and planned power outage schedules for the Project in advance;

6. Evaluate compensation requirements for villages/businesses affected by power outages and for properties that were encroached by tower construction; and
7. Investigate the discrepancy with the sub-contractor on the number of new and strengthened poles installed for the overall Project. Only 217 new poles were surveyed as part of the completed construction works whereas 273 additional poles have been proposed in the detailed design.

#### **4.2. Recommendations for ongoing works and maintenance**

Recommended actions for ongoing Project implementation and future maintenance requirements include:

1. New tower / pole locations should provide a minimum of 3.0 m clearance for live cables from structures that are accessible and vegetation that can support a ladder;
2. Communicate applicable building height restriction within ROW to property owners of structures within the new and existing 22 kV DL ROW;
3. Ensure contractor informs villages / businesses utilising the 22 kV network in advance of all planned power outages;
4. Regularly monitor trees for pruning and conduct periodic vegetation maintenance, if necessary;
5. Avoid use of herbicides to control vegetation along the ROW. If required, select appropriate herbicides and carefully follow the use instructions;
6. Maintain forest cover as close as possible to the edge of the DL components;
7. Only use native, non-invasive plant species in re-vegetation work;
8. Schedule maintenance activities during the dry season (low rainfall), where possible;
9. Minimise dust generation in the immediate vicinity of a residential or commercial premise if work is conducted during dry conditions (e.g. road wetting clearance areas); and
10. Avoid burning where possible. If needed, fires should be carefully controlled to ensure they do not impact areas outside of the ROW.

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## **Annex A:**

# **Summary of impacted areas**

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**Table 3: Summary of impacted areas from the completed 22 kV distribution line upgrade works**

Site Location			Village (Ban)	Land Use Type	Description of Impacts	Corrective actions recommended
GPS WP	GPS Coordinates*	Project structure				
676	356803.87688; 2036749.66288	New Pole	Hongxay	Commercial	<ul style="list-style-type: none"> <li>Minor land use impact – new pole inside land of Bounthavy Petrol Station.</li> <li>No physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>None.</li> </ul>
698	356769.133887 ; 2036567.75646	New Pole	Hongxay	Residential	<ul style="list-style-type: none"> <li>New pole on private land adjacent to private fence.</li> <li>Two house roofs potentially within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
629	356803.876889 ; 2036749.66288	New DL ROW	Hongxay	Residential	<ul style="list-style-type: none"> <li>A house is potentially within the operational safety clearance zone.</li> <li>No physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
630	356801.806930 ; 2036741.26728	New DL ROW	Hongxay	Residential	<ul style="list-style-type: none"> <li>A house is potentially within the operational safety clearance zone.</li> <li>No physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
641	357121.712535 ; 2037055.95315	New DL ROW	Hongxay	Cultivated land	<ul style="list-style-type: none"> <li>Minor land use impact – small impacted area on the boundary of a rice paddy field, although no physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> </ul>
642	357156.367033 ; 2037084.91201	New DL ROW	Hongxay	Cultivated land	<ul style="list-style-type: none"> <li>Minor land use impact – small impacted area on the boundary of a rice paddy field, although no physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> </ul>
643	357188.182534 ; 2037115.66284	New DL ROW	Hongxay	Cultivated land	<ul style="list-style-type: none"> <li>Minor land use impact – small impacted area on the boundary of a rice paddy field.</li> <li>Tree pruned within this section of the DL ROW for safety purposes.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> <li>Monitor tree and conduct periodic vegetation maintenance.</li> </ul>
644	357224.286804 ; 2037140.73747	New DL ROW	Hongxay	Cultivated land	<ul style="list-style-type: none"> <li>Minor land use impact – small impacted area on the boundary of a rice paddy field.</li> <li>Tree pruned within this section of the DL ROW for safety purposes.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> <li>Monitor tree and conduct periodic vegetation maintenance.</li> </ul>
645	357258.264260 ; 2037178.11260	New DL ROW	Hongxay	Cultivated land	<ul style="list-style-type: none"> <li>Minor land use impact – small impacted area on the boundary of a rice paddy field.</li> <li>Tree pruned within this section of the DL ROW for safety purposes.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> <li>Monitor tree and conduct periodic vegetation maintenance.</li> </ul>
646	357294.185920 ; 2037207.06223	New DL ROW	Hongxay	Cultivated land / Public infrastructure	<ul style="list-style-type: none"> <li>DL ROW crosses unsealed local road intersection.</li> <li>New pole located between the road corridor and the boundary of a rice paddy field.</li> <li>Minimal clearance of long grasses surrounding foundation area; regrowth and soil stabilisation is already evident.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> </ul>

Site Location			Village (Ban)	Land Use Type	Description of Impacts	Corrective actions recommended
GPS WP	GPS Coordinates*	Project structure				
649	357396.786498 ; 2037309.77601	New DL ROW	Hongxay	Residential / commercial	<ul style="list-style-type: none"> <li>Private fence, tree, signpost and guardhouse of Khanmany guesthouse are directly underneath the new DL, although no physical disturbance to adjacent areas observed.</li> <li>Physical structures belonging to the guesthouse may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Monitor tree and conduct periodic vegetation maintenance.</li> </ul>
651	357453.360630 ; 2037388.48509	New Pole	Thong Yai	Residential / commercial	<ul style="list-style-type: none"> <li>New pole immediately adjacent existing roadside house/shop and tree, although no physical disturbance to adjacent areas observed.</li> <li>Structures may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Monitor tree and conduct periodic vegetation maintenance.</li> </ul>
707	357462.698377 ; 2037592.71581	New Pole	Thong Yai	Cultivated land	<ul style="list-style-type: none"> <li>New pole located in rice paddy field, although no physical disturbance to adjacent areas observed and field appears to be inactive.</li> <li>Minimal vegetation clearance for foundation area; regrowth and soil stabilisation is already evident.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> </ul>
726	357498.541845 ; 2038845.47643	New Pole	Thong Yai	Cultivated land / forest	<ul style="list-style-type: none"> <li>New pole next to existing pole in disturbed vegetated area (bamboo and tall grasses), just next to a rice paddy field.</li> <li>No other physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Avoid further encroachment into rice paddy land.</li> <li>Conduct periodic vegetation maintenance.</li> </ul>
734	357438.014762 ; 2039227.96723	New Pole	Thong Yai	Residential	<ul style="list-style-type: none"> <li>New pole and existing pole located in front of local produce shop and private fence.</li> <li>House roof touches the village distribution line and is likely within the operational safety clearance zone of the 22 kV DL.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the 22 kV DL within the ROW.</li> </ul>
736	357475.712382 ; 2039453.23593	New Pole	Thong Yai	Residential	<ul style="list-style-type: none"> <li>Private fence and other physical structures located within DL ROW and may be within the operational safety clearance zone of the 22 kV DL.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the 22 kV DL within the ROW.</li> </ul>
737	357490.190278 ; 2039525.06488	New Pole	Thong Yai	Residential	<ul style="list-style-type: none"> <li>New pole and existing pole located inside fence of private house.</li> <li>Several large trees may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW and prune trees, where appropriate.</li> </ul>
740	357503.956857 ; 2039770.76497	New Pole	Thong Noy	Residential	<ul style="list-style-type: none"> <li>Large tree located underneath the DL ROW and may be within the operational safety clearance zone of the 22 kV DL in the near future.</li> </ul>	<ul style="list-style-type: none"> <li>Monitor and prune tree when appropriate.</li> </ul>
742	357528.578373 ; 2039928.17855	New Pole	Thong Noy	Residential	<ul style="list-style-type: none"> <li>Two houses are next to the new pole and may potentially be within the operational safety clearance zone.</li> <li>New pole located on the outside boundary of private fence to one of the houses, although no physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW</li> <li>Enforce applicable building height restriction, if required.</li> </ul>

Site Location			Village (Ban)	Land Use Type	Description of Impacts	Corrective actions recommended
GPS WP	GPS Coordinates*	Project structure				
747	357661.129299 ; 2040225.23114	New Pole	Thong Noy	Residential	<ul style="list-style-type: none"> <li>Two houses and another house under construction surround the new and existing poles and may potentially be within the operational safety clearance zone.</li> <li>New pole located on the boundary of private fence to one of the houses, although no physical disturbance to adjacent areas observed.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Consider informing households / village of applicable building height restriction (for home under construction).</li> </ul>
749	357677.823246 ; 2040296.93302	New Pole	Thong Noy	Residential	<ul style="list-style-type: none"> <li>New and existing pole located immediately adjacent to a two-storey house; it is likely the house is within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
752	357530.743604 ; 2040686.37718	New Pole	Thong Noy	Residential	<ul style="list-style-type: none"> <li>New and existing poles located immediately adjacent to a shed structure and house, which are likely within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Enforce applicable building height restriction, if required</li> </ul>
782	357622.656661 ; 2043282.28513	New Pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>Shop located underneath the DL and may potentially be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Enforce applicable building height restriction, if required</li> </ul>
794	357937.402045 ; 2044195.86403	New Pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>Double-storey house located underneath the DL and is likely within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Enforce applicable building height restriction, if required</li> </ul>
813	358774.053597 ; 2045306.33335	New Pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>New pole located within 2 m of a house on private land, which may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Enforce applicable building height restriction, if required</li> </ul>
815	358872.541832 ; 2045402.11016	New Pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>Mango trees growing under the new 22 kV DL on private land.</li> </ul>	<ul style="list-style-type: none"> <li>Monitor and conduct periodic vegetation pruning, where required.</li> </ul>
826	359539.887727 ; 2045832.23292	New Pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>New pole located close to existing double-storey house (&lt;2 m), which is within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> </ul>

Site Location			Village (Ban)	Land Use Type	Description of Impacts	Corrective actions recommended
GPS WP	GPS Coordinates*	Project structure				
						<ul style="list-style-type: none"> <li>Enforce applicable building height restriction, if required.</li> </ul>
827	359632.421227 ; 2045908.91087	New Pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>New pole located approximately 1 m from existing pole and house under construction.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
849	362534.755179 ; 2049683.87739	New Pole	Nomsomboun	Commercial	<ul style="list-style-type: none"> <li>Two sawmill structures occur within the DL ROW, and may potentially be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
848	362587.591103 ; 2049734.95766	New Pole	Nonsomboun	Commercial	<ul style="list-style-type: none"> <li>New wall and building structure associated with sawmill factory within DL ROW but unlikely to be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
841	362855.141539 ; 2050180.24795	New Pole	Nonsomboun	Plantation	<ul style="list-style-type: none"> <li>New pole located in plantation (Aka), although no physical disturbance to adjacent areas observed for new pole installation.</li> </ul>	<ul style="list-style-type: none"> <li>Monitor and conduct period vegetation pruning, where required.</li> </ul>
839	362744.803142 ; 2050440.23548	New Pole	Nonsomboun	Commercial	<ul style="list-style-type: none"> <li>Sawmill building structure along DL ROW with existing structures beneath the new 22 kV line, although they are well below the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
728	357470.806013 ; 2038936.54476	Extended pole	Thong Yai	Cultivated land	<ul style="list-style-type: none"> <li>Existing pole was strengthened as it is located in the middle of an active rice paddy field. This avoided disturbance to crop and land use impacts associated with installation of a new pole and foundation.</li> </ul>	<ul style="list-style-type: none"> <li>None.</li> </ul>
748	357666.412417 ; 2040239.68985	Extended pole	Thong Noy	Commercial	<ul style="list-style-type: none"> <li>Shop located underneath DL ROW and roof very close to distribution line; may be within the operational safety clearance zone of 22 kV line.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW as different operational safety requirements apply compared to existing village distribution line.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
759	357282.562907 ; 2041043.26554	Extended pole	Thong Noy	Commercial	<ul style="list-style-type: none"> <li>Extended pole located inside a sawmill factory fencing. Two building structures are located underneath the DL but appear to be below operational safety clearance zone.</li> <li>Large tree within ROW may require pruning.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate building height restriction within ROW to property owner.</li> <li>Monitor tree and conduct periodic vegetation pruning, when required.</li> </ul>
763	357050.883074 ; 2041388.08183	Extended pole	Thong Noy	Commercial	<ul style="list-style-type: none"> <li>Existing fence and guardhouse associated with sawmill factory within ROW; appears to be below operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate building height restriction within ROW to property owner.</li> </ul>

Site Location			Village (Ban)	Land Use Type	Description of Impacts	Corrective actions recommended
GPS WP	GPS Coordinates*	Project structure				
774	357311.193658 ; 2042514.77311	Extended pole	Houay Khoun	Residential/ commercial	<ul style="list-style-type: none"> <li>Three shops/houses underneath the new 22 kV DL and may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
775	357327.688511 ; 2042616.35784	Extended pole	Houay Khoun	Residential/ commercial	<ul style="list-style-type: none"> <li>A small shop underneath the 22 kV DL may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
777	357451.594737 ; 2043058.45414	Extended pole	Houay Khoun	Commercial	<ul style="list-style-type: none"> <li>Old sawmill building and fence underneath the 22 kV DL but well below the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
781	357567.203414 ; 2043210.09775	Extended pole	Houay Khoun	Commercial	<ul style="list-style-type: none"> <li>Fence of sawmill and small temporary house underneath the 22 kV DL but well below the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Communicate building height restriction within ROW to property owner.</li> </ul>
789	357881.911746 ; 2043877.20885	Extended pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>Extended pole situated within 2 m of a house on the corner of a village access road crossing.</li> <li>Large tree within ROW may require pruning.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> <li>Monitor tree and conduct periodic vegetation pruning, when required.</li> </ul>
790	357918.969152 ; 2043989.48665	Extended pole	Houay Khoun	Commercial	<ul style="list-style-type: none"> <li>Large tree within ROW may require pruning.</li> </ul>	<ul style="list-style-type: none"> <li>Monitor tree and conduct periodic vegetation pruning, where required.</li> </ul>
796	357943.773053 ; 2044314.01469	Extended pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>A house is underneath the 22 kV DL and may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
803	358186.056966 ; 2044717.05128	Extended pole	Houay Khoun	Residential / commercial	<ul style="list-style-type: none"> <li>Approximately six shops underneath the 22 kV DL and may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
804	358255.341422 ; 2044775.63523	Extended pole	Houay Khoun	Residential / commercial	<ul style="list-style-type: none"> <li>Approximately two shops underneath the 22 kV DL and may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>

Site Location			Village (Ban)	Land Use Type	Description of Impacts	Corrective actions recommended
GPS WP	GPS Coordinates*	Project structure				
806	358317.645106 ; 2044861.16464	Extended pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>Extended pole approximately 1 m from fence and very close to house and shop; also underneath the 22 kV DL and may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
821	359178.696229 ; 2045736.51056	Extended pole	Houay Khoun	Residential	<ul style="list-style-type: none"> <li>A house is underneath the 22 kV DL and may be within the operational safety clearance zone.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Enforce applicable building height restriction, if required.</li> </ul>
838	362723.320356 ; 2050476.69065	Extended pole	Nonsomboun	Commercial	<ul style="list-style-type: none"> <li>Extended pole located inside fencing of sawmill factory.</li> <li>A structure is currently being constructed within DL ROW.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct operational safety risk analysis of the DL ROW.</li> <li>Communicate building height restriction within ROW to property owner.</li> </ul>

\* GPS Coordinates are in meters (UTM zone 48N).

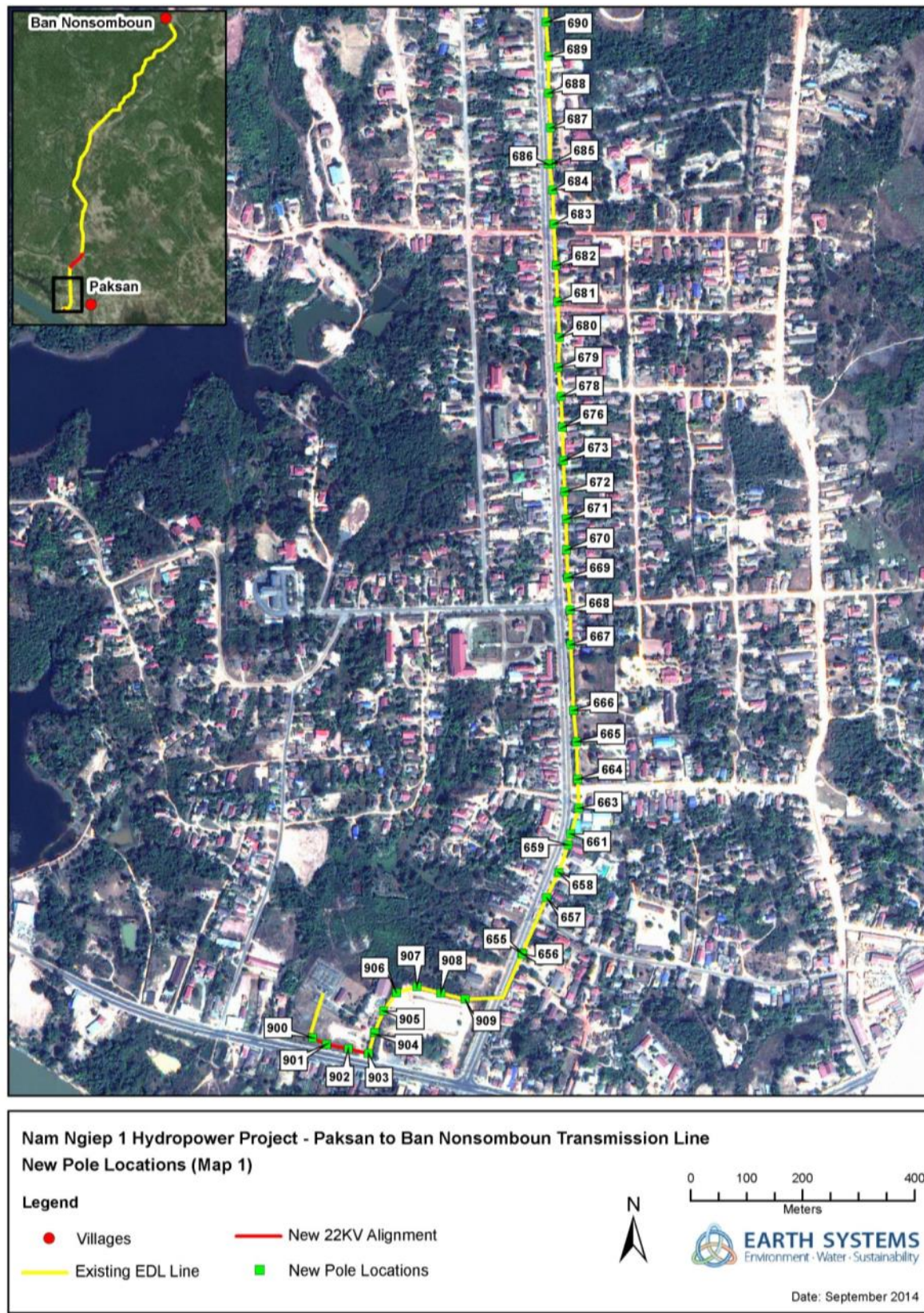


Figure A: New pole locations with GPS waypoint reference number (Map 1 of 8).

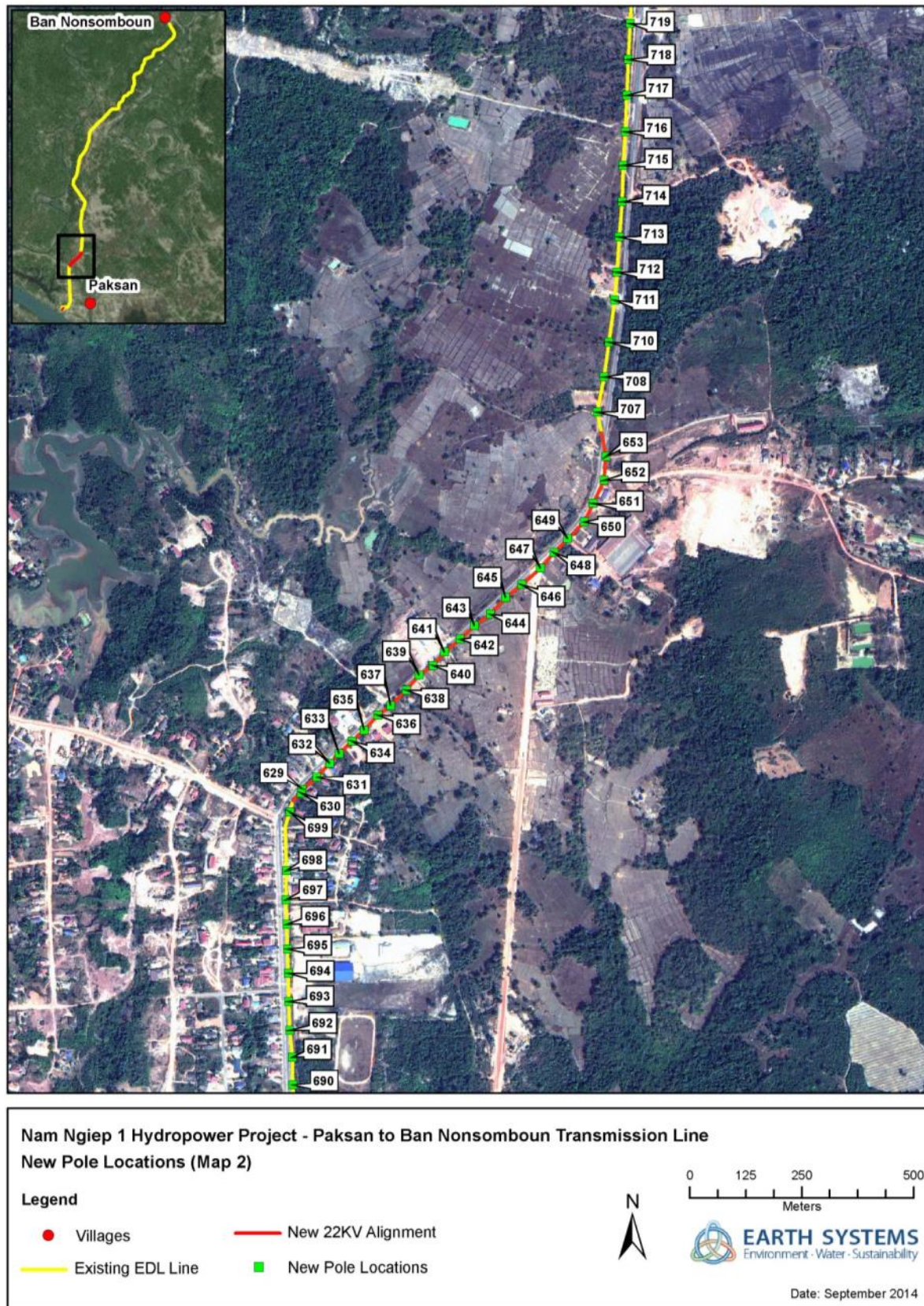


Figure B: New pole locations with GPS waypoint reference number (Map 2 of 8).

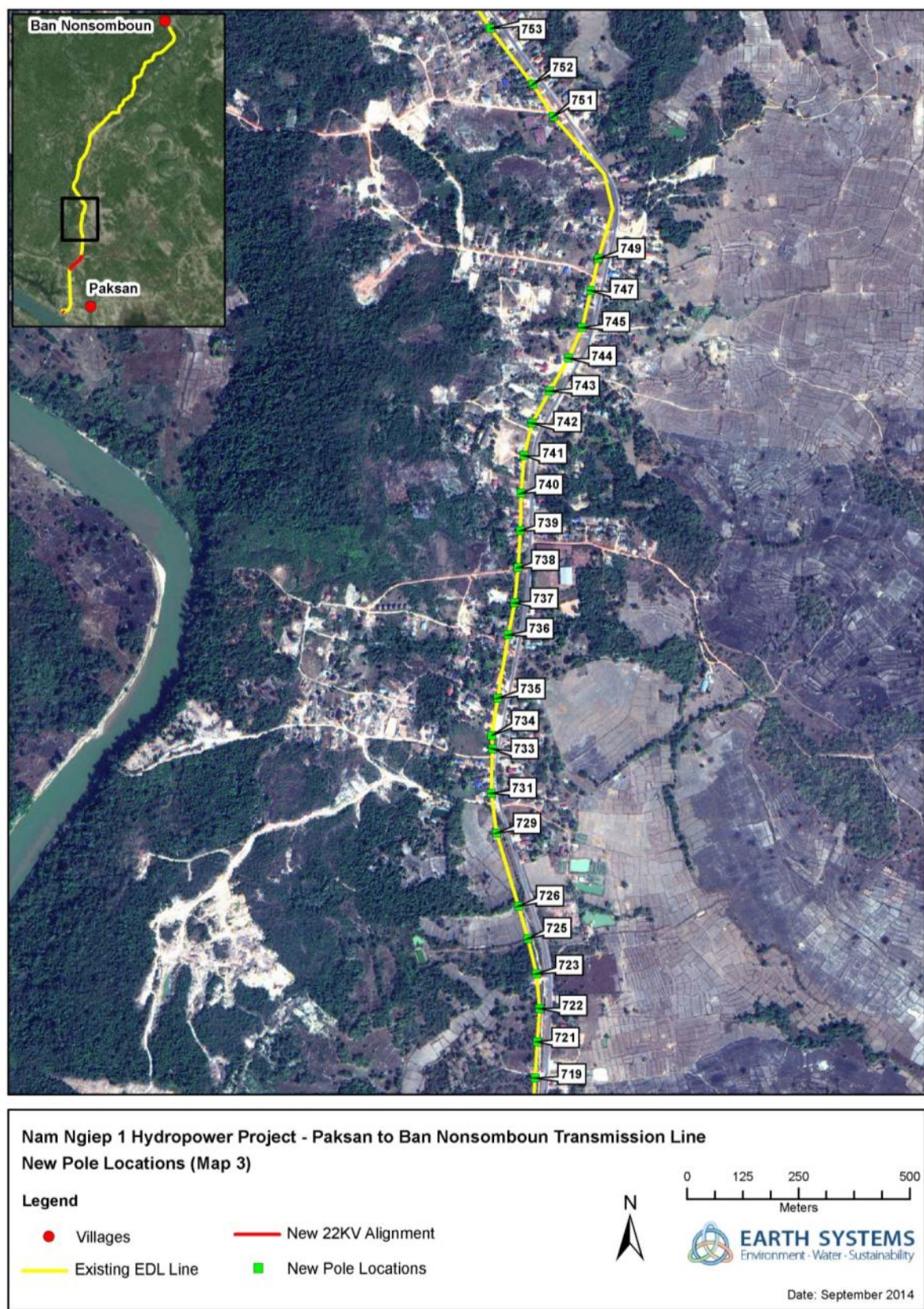


Figure C: New pole locations with GPS waypoint reference number (Map 3 of 8).

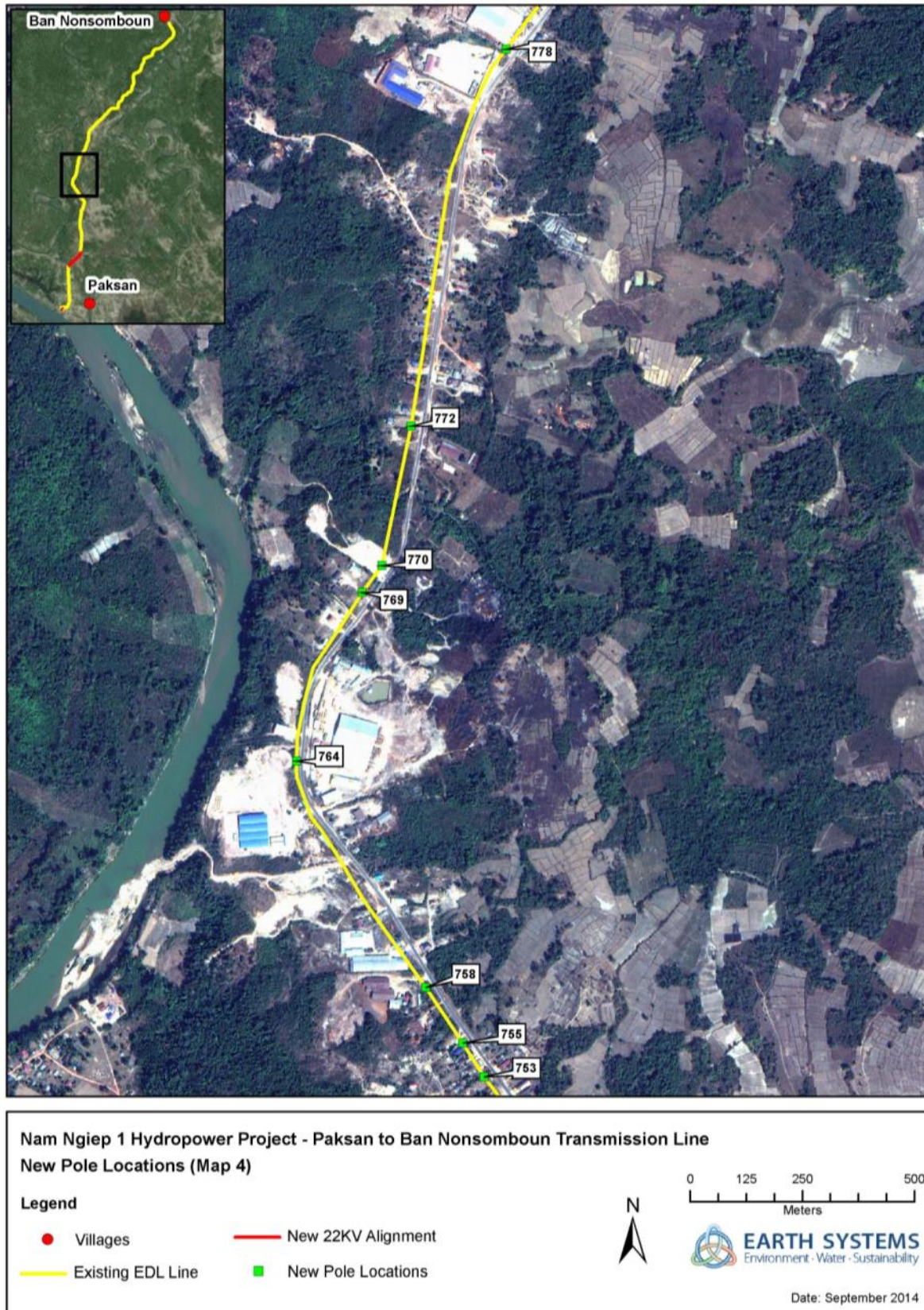


Figure D: New pole locations with GPS waypoint reference number (Map 4 of 8).

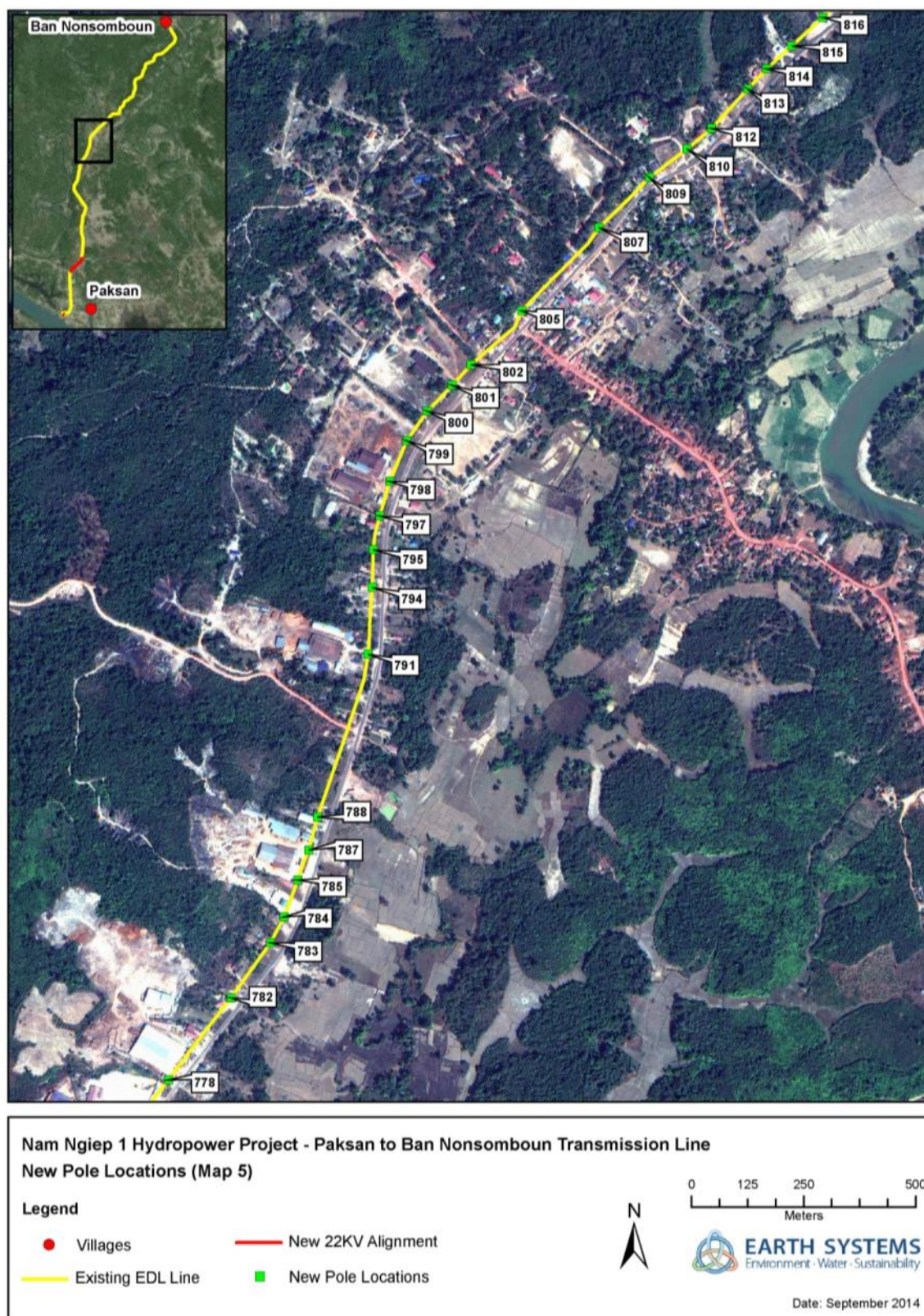


Figure E: New pole locations with GPS waypoint reference number (Map 5 of 8).

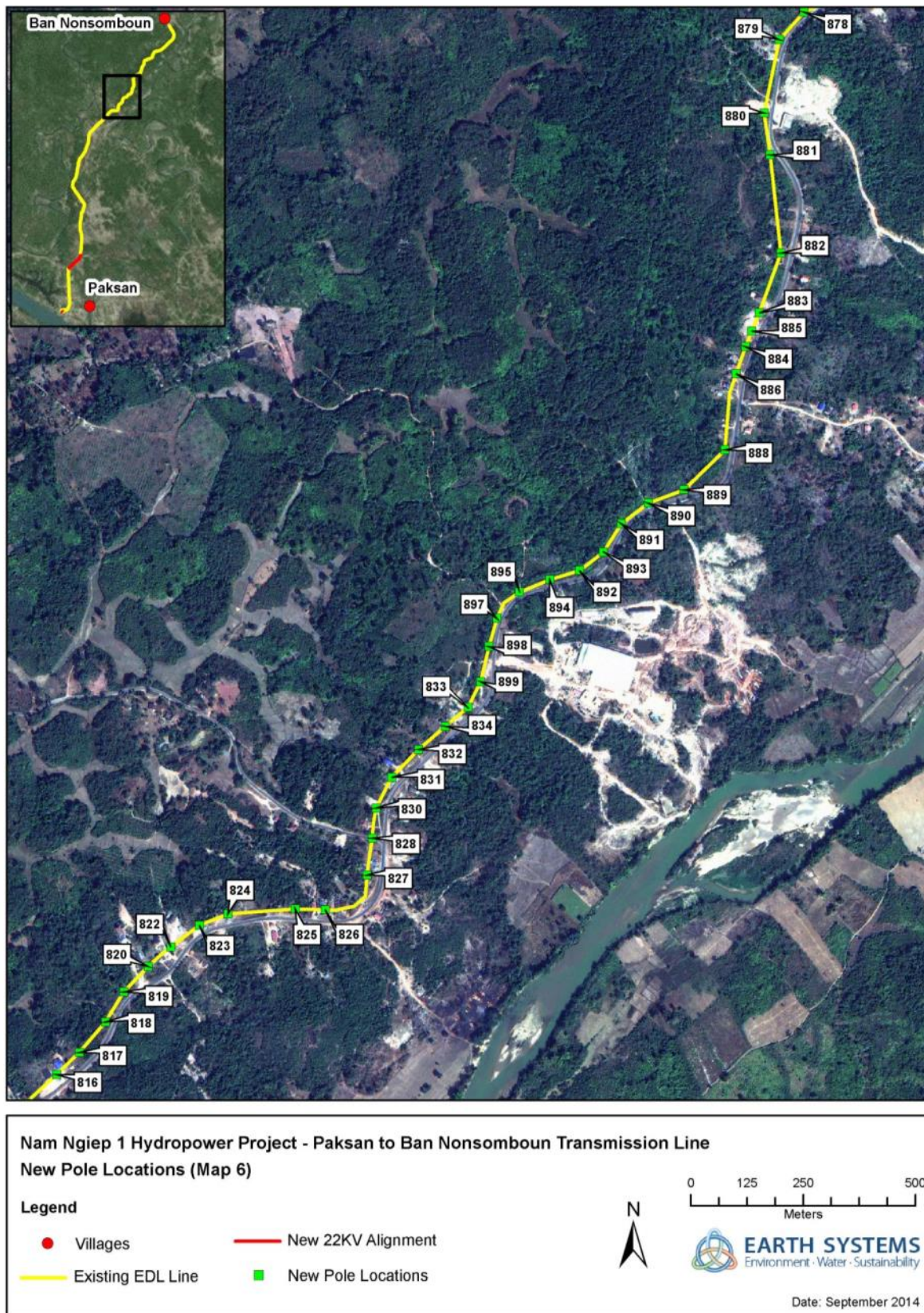


Figure F: New pole locations with GPS waypoint reference number (Map 6 of 8).

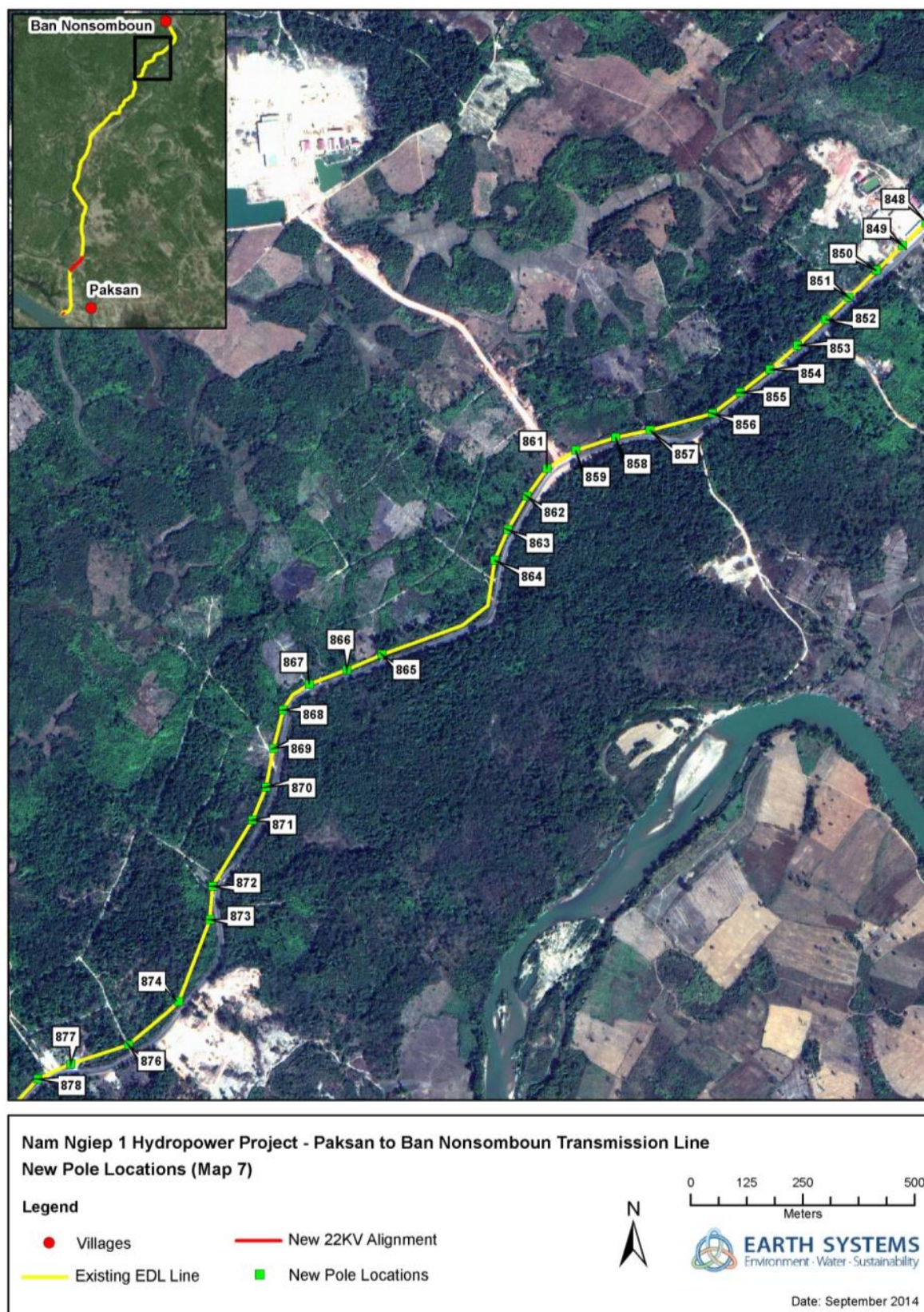


Figure G: New pole locations with GPS waypoint reference number (Map 7 of 8).



Figure H: New pole locations with GPS waypoint reference number (Map 8 of 8).

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## **Annex B:**

# **Photos of potential safety hazards for new 22 kV distribution line**

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Trees/shrubs potentially within operational safety clearance zone (2 m) of the live 22 kV distribution line conductor



GPS waypoint 700, B. Hongxay, Paksan District



GPS waypoint 694, B. Hongxay, Paksan District



GPS waypoint 673, B. Hongxay, Paksan District



GPS waypoint 680, B. Hongxay, Paksan District



GPS waypoint 683, B. Hongxay, Paksan District



GPS waypoint 684, B. Hongxay, Paksan District

N.B. List is non-exhaustive, additional trees within the operational safety clearance have been recorded along the Project alignment.

Physical residential/commercial structures potentially within 5.5 m (operational safety clearance zone) of the live 22 kV distribution line conductor



GPS waypoint 675, Ban Thong Yai, Paksan District - Restaurant



GPS waypoint 734, B. Thong Yai, Paksan District – House



GPS waypoint 720, B. Thong Yai, Paksan District – Suanborn Restaurant



GPS waypoint 662, B. Phonxay, Paksan District – Construction material workshop



GPS waypoint 674, B. Hongxay, Paksan District - Shop



GPS waypoint 630, B. Hongxay, Paksan District – House

Physical residential/commercial structures potentially within 5.5 m (operational safety clearance zone) of the live 22 kV distribution line conductor



GPS waypoint 732, B. Thong Yai, Paksan District – Shop



GPS waypoint 668, B. Hongxay, Paksan District – Shops



GPS waypoint 671, B. Hongxay, Paksan District - Shop



GPS waypoint 679, B. Hongxay, Paksan District – Temporary shops



GPS waypoint 697, B. Hongxay, Paksan District - Shops



GPS waypoint 698, B. Hongxay, Paksan District - Houses

N.B. List is non-exhaustive, additional residential/commercial structures within the operational safety clearance have been recorded along the Project alignment.

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## **Annex C:**

# **Lao Electric Power Technical Standards, 2004**

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