

# NAM NGUM 5 HYDROPOWER PROJECT



## UPDATE OF ENVIRONMENTAL IMPACT ASSESSMENT

(EIA)



**SINOHYDRO CORPORATION LTD.**



**DONGSAY COMPANY LTD.**

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# CHAPTER I

## INTRODUCTION

### 1.1. General

The Initial Environmental Examination (IEE) of Nam Ngum 5 Hydroelectricity project was carried out by Dongsay Co Ltd in May-June 2005; the IEE report was approved by STEA in May 2006, with the condition, that further detailed study- *Environmental Impact Assessment (EIA), Environmental Management Plan (EMP) and Social Action Plan (SAP) including Resettlement Action Plan (RAP)* were to be carried out, despite the IEE report's conclusion that the project as proposed had "No Significant Impact" to social and environmental conditions of the project area. The additional ESIA study has been conducted in May 2006 which was focused on socio-economic impacts generated by the project especially affected assets within the proposed reservoir area were assessed and confirmed.

This EIA report (main report), EMP and SAP (includes RAP) which are in separate volumes, present the findings of the detailed study, reflecting STEA's regulatory requirement as well as local and international Environmental Protection Laws, Regulations and Guidelines for power project development in the Lao PDR.

The main report consists of seven chapters which can be summarized as follows:

**Chapter I** provides the introduction, the background of the project, particular details of the project owner as well as the author of this report. This chapter includes relevant institutional framework, laws and regulations.

**Chapter II** provides the description of the project and project implementation schedule and project cost.

**Chapter III** provides the description of the project areas and baseline data of the physical, biological as well as social economic environment of the area as well as project components, social economic conditions with regards to natural resources, health and livelihood of the affected or adjacent communities with the project area.

**Chapter IV** identifies and provides evaluation of reasonable alternatives for achieving the project goal, while at the same time ensuring that the envisaged impacts are minimized or appropriately addressed.

**Chapter V** identifies an anticipated environmental impacts and mitigation measures.

**Chapter VI** deals with the Environmental Management Plan (EMP). However, the full report of EMP is presented in separate volume. The summary describes compensation measures, environmental monitoring procedure, including specification of budgets as well as institutional arrangement.

**Chapter VII** provides conclusions and recommendation based on investigative, consultative results and others relevant laws and regulations.

## 1.2. Background

Nam Ngum 5 Hydroelectricity project is one of several hydroelectricity schemes in Lao PDR and as the name indicates, it is one of the six (*there is Nam Ngum 4A and 4B*) and the last of the hydroelectricity projects in the Nam Ngum river networks. Nam Ngum 3 just immediately down stream from Nam Ngum 5 is currently under investigation for construction and its full supply level is 720 meters above sea level (masl) in comparison with 1,100 masl of Nam Ngum 5. The development of these projects, once completed the Lao People Democratic Republic (Lao PDR) will be relatively self-sufficient in energy consumption, in particular in the Northern region of the country where current electricity shortfall is supplemented by importing from Vietnam at nearly 20% higher rate than the export tariff (to Thailand).

Lao PDR has one of the least developed economies in Southeast Asia, and according to the World Bank president Mr. James D Wolfensen in his recent statement on approving of Guaranty fund for NT2 hydropower project said “*Lao PDR has an average income level of less than a dollar a day, and in many rural areas, it is considerably less than that children still suffer malnutrition in many parts of the country, and too many young people receive little or no formal education ...*”

Lao PDR also has one of the lowest per capita rates of electricity consumption in all of Southeast Asia; however in comparison with its neighboring countries Lao PDR has considerable potential for hydroelectricity generation. Lao PDR at its current state of development only 623 Megawatts (MW) of an estimated 18,000 MW of hydropower potential has so far been developed; these hydro electricity developments, however small, have already been a major contributing factor to the country’s economic output for the last decades.

Recognizing the disparities and potentials the Lao government is determined to address its socio economic problems –implementing its poverty eradication program and achieving its goal of being out of the *Less Developed Country List* by the year 2020, by capitalizing on its Hydroelectricity as well as its mineral resource potential. The development concentrates both on export earnings as well as fostering domestic economic activities by electrification expansion (targeted to attain 90% electrification by 2020) in tandem with other infrastructural development throughout the country. As identified in NGPES. 2004, the development of the country’s hydro electrical potential in particular “the rural electrification is essential and shall be an integral part of the national development framework”.

The Nam Ngum 5 Hydropower Development Project is identified among others-Nam Mang 3 (completed 2004) and Xeset 2 (started June 2005) and Nam Ngum 3 etc.,in “*POWER SYSTEMS DEVELOPMENT PLAN FOR LAO PDR*”, as one such potential that can be realized. The pre-feasibility of Nam Ngum 5 was prepared for the Ministry of Industry and Handicrafts, Department of Electricity, and World Bank, by Maunsell Limited of New Zealand, in association with Lahmeyer International of Germany in 1997.

## 1.3. Name and Address of the Project Owner

In accordance to the contract signed on the 22<sup>nd</sup> April, 2005 and the Amended Contract signed on the 16<sup>th</sup> March, 2006 the author of the report is:

**SINOHYDRO CORPORATION,**

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#### **1.4. Name, Address and Affiliation of the Author**

In accordance to the contract signed on the 22<sup>nd</sup> April, 2005 and the Amended Contracted signed on the 16<sup>th</sup> March, 2006 the author of the report is:

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#### **1.5. Project Location**

The Nam Ngum 5 Hydropower Project is located on the Nam Ting, into which Nam Phat and Nam Sout flow. Nam Ting is one of the main tributary of Nam Ngum where the confluence is approximately 15 Km down stream from the proposed dam site, 300 km north of Vientiane Capital City in Lao PDR. Refer to maps *in Annex 1-1*.

At the time of the survey, the proposed dam site was only accessible by foot or by boat (during the wet months) from Ban Chim which situates on the upper middle reach of Nam Ting of some 35 Km from Phou Khoun.

Powerhouse area locates approximately 12km due east of the dam site on the right bank of Nam Ngum into which the water from the powerhouse is discharged. The powerhouse area is currently accessible (on foot) only via Ban Xiengdet from the main road to Xieng Khouang. Ban Xiengdet situates on the left bank of Nam Ting approximately 10km down stream from the proposed dam site.

Ban Xiengdet according to Nam Ngum 3 proposal and from our villagers' interview will be inundated and the villagers had officially been informed by the authority that they are required to be relocate within a couple of years.

#### **1.6. Purposes of the Project**

The "Nam Ngum 5 Hydroelectricity Project" among other Hydroelectricity projects throughout Lao PDR, is part of the Lao government Power Development Strategy which plan to achieve 90% electrification target throughout the country by the year 2020.

The development of Nam Ngum 5 Hydropower Project, and their associated sub-stations and transmission line, once completed will supplement electricity supply for Central and Northern region of the country; in part it will replace or lessen the high cost power import from Vietnam, in particular in Xiang Khouang province.

It will play a significant role in fostering the rural economic activities including facilitating agriculture and aquaculture production, as well as rural industries. In addition to providing low cost electricity throughout the region it will also provide “waterway” access for communities living within the reservoir basin which would not otherwise be possible by land access; hence forming a vital contribution to the government’s endeavor in the implementation of its poverty eradication programs.

## 1.7. Need for the Project

According to the study on “*Pre-Feasibility Study on Nam Ngum 5 Hydropower Project in Lao PDR*” carried out in February 1997 by Lahmeyer International (Germany), in association with ENERGY EQUITY Corporation LTD of Australia, headed by Dr. Muir (Project Director), Dr. Negrassus (Hydropower Planning Engineer), Dr. Drabik (Water Resource Engineer), Mr. Burns (Geologist of Worley International); and the “*Preliminary Review of Environmental Issues on Nam Ngum 5 Hydropower Project in Lao PDR*” carried out in December 1997 by Melkyma Pty Ltd (Australia), the Nam Ngum 5 Hydropower Development Project can meet the current power demands of Central and Northern region of the country.

After the completion, the Nam Ngum 5 Hydropower Development project will provide:

Annual energy production for domestic consumption and indirectly for export, estimated to be 507 GWh in an average year. The project has been designed to optimize the economic output and minimize its impact on the local environment.

- Increase in annual foreign exchange earnings (either in the form of import replacement) of Lao PDR by approximately US\$20 Million which make significant contribution to overall economic output of the Lao PDR.
- Further benefits from the project will include such as,

### *Community development programs:*

- Fisheries and other aquaculture enhancements and development in the reservoir basin,
- Increase Rural electrification,
- Improved access- waterway and land access
- Health and educational facilities,
- Improved livestock ,crop and other agriculture production,
- Village water supply and irrigation

### *Private or Individual development potentials:*

- Recreational service facilities
  - Small medium enterprise (garage, general store, handicrafts, fish processing industry etc..,)
  - Tourist service activities as well as tourist business industry
- In addition it will offer employment opportunities for the locals during construction and to a lesser extend during the operation phase.

## 1.8. Regulatory and Policy Framework

### 1.8.1. Institutional and Legal/regulatory Framework

Key organizations and agencies involved in the IEE and EIA process include: the Government of Lao PDR (GoL); the Prime Minister's Office (PMO); the Science Technology and Environment Agency (STEA) which now is restructured and changed into the new authority namely "Water Resource and Environment Agency" (WREA); the Ministry of Agriculture and Forestry (MAF); the Water Resources Committee; the Ministry of Energy and Mines (MEM); the Environmental Management Unit of MEM' Hydropower Department; the Ministry of Finance; the Department of Land Development and Planning which is under the National Land Management Agency, Prime Minister Office; the Ministry of Education; the Provincial and District Governor(s) Offices of the project location.

Measures for monitoring and managing potential environmental and socio-economic impacts have been developed based on Lao PDR legislation, regulations, decrees, standards and guidelines. The following legislation now in force, and supporting regulations (promulgated or in draft) in Lao PDR are relevant to ensuring environmental and socio-economic issues are addressed during design, construction, and operation of the project:

#### a. Related Laws

- 1) **The Lao PDR Constitution (1991)** acknowledges the need for environmental protection in Lao PDR and requires that Environmental Assessment give particular attention to the assessment of potential positive and negative socio-economic impacts of project development and to prevention and/or mitigation of harmful impacts.
- 2) **Environmental Protection Law No.02/99/NA, (1999)** does the following:
  - Assigns the Science, Technology and Environmental Agency<sup>1</sup> (STEA or WREA now) the rights and primary responsibilities for protection, mitigation and restoration of the environment in Lao PDR.
  - Defines the environmental conservation responsibilities of other GOL agencies such as the Department of Electricity, Department of Forestry, etc.
  - States that environmental conservation comes before mitigation and restoration
  - Stipulates that those who generate an environmental impact are responsible for the resulting damage caused
  - Directs that environmental management and monitoring units (EMMUs) be established at all levels of government, with responsibilities to include such things as: establishing and enforcing sector environmental plans; taking action to mitigate environmental damage; issuing orders to adjust, suspend, remove or close down activities that cause negative impacts
- 3) **Water and Water Resources Law (1997)** does the following:
  - Classifies all catchment's areas for various uses

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<sup>1</sup> Created by Decree No. 63/PM, which was superseded by Decree No. 68/PM in 1999.

- Promotes protection and rehabilitation of forests, fishery resources and the environment
- Suggests that EIA should be carried out on large-scale water development projects, and requires that funds be provided for protecting and enhancing catchment area resources, and for resettlement compensation

**4) Forestry Law (No. 13/NA-2005) defines:**

- Principles and regulations on the use, management, protection, conservation and regeneration of forest resources with the aim of making forest resources a sustainable support to national economic and social development, ensuring protection and conservation of watersheds, guarding against soil erosion, protecting plant and wildlife species and the environment.
- Five categories of forest (Protection, Conservation, Production, Regeneration, and Degraded) were identified.
- Implementation responsibilities of the Ministry of Agriculture and Forestry (MAF) at the national level, provincial and district forestry offices, including responsibility for issuing land-use certificates at the district level.
- That forest and forest land can be converted to other uses (e.g., for transmission line rights-of-way, etc.) when necessary and if in the public interest, and subject to approval from responsible authorities.
- An individual or organization given permission to convert forest to another use is responsible for payment of a conversion fee, land reclamation and tree planting.
- Provision for allowing long practiced activities such as collecting wood for fences and fuel, non-timber forest products (NTFP), hunting and fishing for non-protected species for household consumption, and other customary uses.
- Provision for setting up a fund for activities such as protection and conversion of forests, tree planting, and forest regeneration to protect and conserve watersheds, the environment and wildlife.

The Forestry Law also states that:

- Compensation is based on the volume of timber (m<sup>3</sup>) of a given class or species of tree that will be cut down. Compensation is only paid for timber removed from private forestry plantations. No compensation is paid for timber removed from natural forests on public lands. Nor is any compensation paid for removal of any kind of natural NTFPs, except for villagers' planted NTFPs such as bamboo, etc..
- There is no requirement to replant trees on degraded land located away from a transmission line corridor, as compensation for removing trees to create a transmission line right-of-way. Such forms of compensation only apply to reservoir clearing projects, where it is necessary to plant trees to stabilize slopes that could otherwise fail through a process of mass wasting.
- Compensation rates range from US\$23/m<sup>3</sup> for lesser qualities and grade of timber species, up to a maximum of US\$999/m<sup>3</sup> for superior qualities of timber species. These rates are established by the Government of Lao PDR (GOL) as a schedule within regulations under the Forestry Law.
- During the alignment survey, the Provincial or District forest office staff will assess the volume of natural or plantation forest that will be removed by a project. An assessment report is prepared and sent to the Department of Forestry in Vientiane, which is responsible for evaluating requests for timber removal and providing approvals.



- Timber removed from a transmission line right-of-way by Electricite du Laos will be sold according to the regulations concerned under the Industry and Commerce Sector. Where timber is removed from a private tree plantation, then EDL is responsible for compensating the owner of the plantation.
- During transmission line construction, the Provincial Forestry Section or District Agriculture and Forestry staff will scale and mark all timber cut from the right-of-way. Fines will be levied against the contractor for any timber that is cut and does not receive a timber mark from the forestry department. This is aiming to protect illegal logging.
- EDL is responsible for paying for all costs incurred by the Department of Forestry, including costs of preparing timber cutting assessments during alignment surveys, and timber scaling and marking during construction.

**5) Land Law (1997) states that:**

- Land within Lao PDR is the property of the national community, and individuals are assigned to effectively use the land, but not treat it as a tradable commodity.
- Rights of those who have been allocated land, including the right to transfer that land, are protected by the State.
- Individuals have a duty to preserve land in good condition.
- A District may grant the right to use agricultural land and forest land within its jurisdiction for other land uses.
- An individual's right to use land can be terminated if the State expropriates the land to use in the public's interest, but the State must pay appropriate compensation damages.

**6) Road Law (1999) states that:**

- Environmental protection is required during road activities.
- National and provincial authorities of the Ministry of Communications, Transport, Post and Construction are responsible for environmental protection on road projects.
- Reasonable compensation must be paid to individuals whose land is expropriated for road rights-of-way, relocation of replacement structures, and loss of trees and crops.

**7) The Electricity Law (1997) requires that:**

- EIAs need to be carried out on larger hydroelectric dam projects (as a minimum).
- Electricity projects, including transmission and distribution projects, be licensed by the GOL, and as a precondition to the granting of a license, the project demonstrate that national socio-economic development objectives will be satisfied, and that there will be no detrimental environmental impacts
- The licensee (in this case EdL) is responsible for ensuring that the environment is protected or damages paid for environmental degradation, and that residents are compensated in cash or in kind for lost properties, diminished living conditions, relocation or resettlement.
- Inspection and enforcement be carried out for project activities.

**b. Decrees, Regulations and other International Conventions concerned**

1) **Prime Minister's Decree No. 164/1993** established eighteen protected areas and required that the government develop management plans for each area. Two additional protected areas, referred to now as National Biodiversity Conservation Areas (NBCAs), have since been added. The current area totals 3.4 million hectares or 14.3% of the country's area. In addition, provinces and districts have also designated their own conservation areas and protection forests bringing the overall national total to 5.3 million hectares or 22.6% of the total land area.

2) **Decree on the Preservation of Cultural, Historical and Natural Heritage** requires that in order to prevent exploitation of relics and antiquities, any person who discovers archaeological relics or a cultural site must inform the provincial and district offices within three days.

In addition to the above Lao PDR statutes and regulations, the GOL is also a signatory of the following international conventions that may have a bearing on transmission and distribution projects:

- **UN Convention on Biological Diversity (1996)** under which Lao PDR agrees to:
  - Develop a national biodiversity conservation and sustainable use strategy
  - Develop legislation for protecting species and populations that are threatened
  - Integrate conservation and sustainable use of biological resources into national decision making
  - Conduct EA of proposed development projects with a view to minimizing negative impacts

3) **PM Decree No. 102/PM on the Implementation of the Environmental Protection Law (2001)** defines that:

Development projects and all development activities that related to the environment shall be conducted as follow:

- ♦ All development projects, including State and private owned, shall have an environmental impact assessment (EIA) before the establishment and operation of those projects. They shall also have method and protecting or mitigating measures to protect social and natural environment that can be approved by the government.
- ♦ The owners of the development projects shall have an obligation to bear the cost occurred in any process of EIA.

4) **PM Decree No. 192/PM on the Compensation and Resettlement (2005)**

The decree comprises six sections and nineteen articles.

Section I is the general section sets out the objective and fundamental principle for compensation, and relocation of project affected people. It also provides instructions and measurement procedure for mitigation and compensation for all potential negative impacts on socio-economic and livelihood of the affected people within or in the vicinity of the project areas. Defines and classifies affected groups eg. the vulnerable and ethnic groups of affected people.

Section II states and defines the right of affected person in receiving compensation.

Section III states and defines the compensation requirement and procedure, assistance measure during the relocation, settlement and livelihood development.

Section IV defines resettlement and compensation components which states and emphasizes the significant of local culture and tradition, community participation in the process, grievance measure and budgetary consideration.

Section V refers to enforcement procedure for both violator and complier.

Section VI sets out the implement procedure as well as sets out the institutional frame work of responsibility.

## 5) **Regulation on Environment Assessment No: 1770/STEA dated 3/10/2000**

Key features of the Regulation are included:

- Each Development Project Responsible Agency (DPRA) must ensure that any development project in the Lao PDR carries out Environmental Assessment (EA) in accordance with the content determined in this Regulation, and any regulation of its own line ministry.

The Environment Assessment must include at least a Project Description to enable DPRA to perform a project environment screening under Article 7 of this Regulation. If the project is not exempt under Article 8 of this Regulation, the EA must include an Initial Environment Examination (IEE) as specified in Article 9 of this Regulation. For some projects, through the findings of the IEE, an Environmental Impact Assessment (EIA) is required as specified in Articles 11, 12, 13, and 14 of this Regulation.

- All project proposals that are submitted to the DPRA by a project owner, and all project proposals that are prepared by a DPRA must be included a brief description of the project, which include some following information:
  - Project owner.
  - Type of the project.
  - Scope of the project.
  - Project location.
  - Intended product.
  - Raw materials to be used.
  - Estimate of the quantity and quality of any solid, liquid, or air-borne wastes resulting from project construction or operation.
  - Number and origin of project's intended labour force for construction and operation.
  - Anticipated positive and negative environmental and social impacts of the project.
  - Environmental mitigation measures that will be implemented during the project construction, operation and closure (if applicable).
- The DPRA must circulate the project proposal document to relevant government sectors and local authorities, and must consider their comments in its environmental screening decision. Line ministries may specify additional information to be required in project descriptions in their internal EA procedures.
- Within 30 days of receiving a project description, the DPRA must complete the screening and explain the screening decision in writing to STEA (which now WREA) in the case of national projects or to the Provincial Science, Technology and Environment Office (STEO) for local projects. Within 15 days of receiving the screening findings the respective environment office referred to above shall either notify the DPRA that it concurs with the decision, or shall instruct the DPRA to reconsider, taking into account relevant information or guidance. Within 7 days after receiving the record of decision from the respective environment office, the DPRA must notify project owners of the result of the project screening to abide by the record of decision. The DPRA must also notify the Environmental Management and Monitoring Unit (EMMU) of the concerned line ministries or local administration authorities for information and monitoring purposes.

- For those projects found by screening to be exempt from further EA, STEA (which now WREA) must issue an environmental compliance certificate within 15 days after receiving the screening record of decision from DPRA. There are two types of certificate; one with conditions and another without conditions. Those projects determined to be non-exempt from EA must proceed to conduct IEE.
- For foreign investment projects, the IEE report must be written in Lao and English. Line ministries in their internal EA guidelines may set additional requirements for the contents of IEE reports and the number of copies of reports that are to be submitted.
- If the IEE report concludes that no EIA is needed, an EMP must be developed within the IEE report, which must have the following contents:
  - Measures to prevent and minimize environmental impacts.
  - Programs for environment control and monitoring.
  - Responsibilities, organization, schedule and budget for implementation of the EMP and other issues that the DPRA may deem necessary for the protection of the environment.
- During the IEE process, if it is found that the project needs an EIA, the IEE report must contain Terms of Reference for the scoping of a subsequent EIA.
- The process for reviewing an IEE report and issuing an Environmental Compliance Certificate is the same for both the EA Regulation at the national level and for the Electricity Sector (*see Regulation on Implementing EA for Electricity Projects in Lao PDR No. 447/MIH below*).
- The IEE report and the IEE's EMP must receive approval from the DPRA before STEA (which now WREA) can issue the environmental compliance certificate to the project owner. For projects requiring EIA, the project owner must, during the detailed design phase, prepare the detailed EMP based on the general EMP of the IEE already approved by STEA (which now WREA).
- The project owner is directly responsible for the monitoring and evaluation of the EMP. The DPRAs in central level are responsible for the inspection of the implementation of the monitoring and evaluation for the project environment where projects are approved at the central level.
- In order to ensure the effective implementation, the project must establish an environmental unit. The members of such unit may come from the company itself, hired staff, from an outside organization or be entities working on contractual basis.
- The project owner of the Environmental Unit must establish monthly reports on project environmental monitoring to be sent to the concerned agencies, which include STEA (which now WREA) or Provincial STEO, and the Environmental Management and Monitoring Units (EMMUs) of the concerned line ministries for information and supervision.
- STEA (which now WREA) or provincial STEO and the responsible line agency EMMU retain authority to directly control project activities, in order to ensure that project owners carry out effectively and regularly their environmental protection duties.

**6) Regulation on Implementing EA for Electricity Projects No. 447/MIH, dated 20<sup>th</sup> November 2001**

The following noteworthy information is contained in the Regulation regarding development and review of an IEE for electricity projects:

- The Department of Electricity is required to ensure that environmental assessment is included in its decision to approve, finance or undertake any type of electricity project in Lao PDR.
- Upon receiving a description of an electricity project from the project owner (i.e., EdL or its consultants on behalf of EdL for the Rural Power Distribution Project), the Department of Electricity (DoE), which resides within the Ministry of Energy and Mines (former Ministry of Industry and Handicrafts), has 30 days to complete project screening to determine whether an IEE or more exhaustive EIA is required. STEA (which now WREA) has an additional 15 days to signify its concurrence with this decision, after which DoE has 7 days to provide the screening decision to the project owner. The content of an IEE is determined through the screening process.
- An IEE is prepared by the project owner, and submitted to the DoE for review and decision making. Within 7 days of receiving the IEE, the DoE must circulate the report to other line agencies, local government authorities, and the public that may be affected by the project to comment on the IEE. Government agencies and the concerned public have 30 days to provide their comments.
- Within 40 days of acting on the IEE report (i.e., from the date the report was submitted to the DoE by the project owner), DoE must provide a written decision on the IEE to STEA (which now WREA). DoE may recommend that: a) the IEE and its conclusions are revised; b) the IEE be accepted and the project approved; c) the EMP be revised; or d) terms of reference be developed for an EIA. Within 10 days of receiving the IEE, STEA (which now WREA) must approve the IEE and issue an Environmental Compliance Certificate, agree with DoE that an EIA is required, or indicate in writing to DoE that STEA (which now WREA) disagrees with the DoE decision.

The GOL has also enacted five additional legislative instruments (one policy and four standards) for managing environmental affairs in the power sector of Lao PDR as follow:

- ① The first of these is the Power Sector Environmental Policy (No. 581/MIH.DOE, dated 04 October 2001), which requires the power sector to assist the GOL in meeting its social and economic objectives by managing its activities in an environmentally responsible manner. This includes requiring appropriate environmental assessment and management to be undertaken to international standards.
- ② The environmental management standard addressing Environmental Management Documents for the Department of Electricity (No: 582/MIH.DOE, dated 04 October 2001) establishes the process for developing various environmental management documents, including environmental management standards and guidelines. This documents standard also identifies such things as the requirements for authorizing standards, consultation, and document control.
- ③ The environmental management standard addressing Department of Electricity Environmental Records Management (No: 583/MIH.DOE, dated 04 October 2001), requires that an environmental records management system be established within the Department of Electricity. The standard identifies the types and formats of environmental records that will be kept, requires that a database be created and that records be stored in one central, easily accessible location, such as the

Environmental Management Unit's main office, and that record are available for borrowing during working hours.

- ④ The environmental management standard addressing EMP for Electricity Projects (No: 584/MIH.DOE, dated 04 October 2001), sets out the requirements for preparing EMPs for electricity projects. The standard indicates that:
- An EMP is to be part of a Project Screening Report, IEE report and EIA report, whichever is determined to be required for a project.
  - An EMP must cover all environmental management measures that are to be implemented during the project's pre-construction, construction, operation and decommissioning, and is to address all *significant* environmental issues identified in the Project Screening, IEE or EIA, including a social action plan or resettlement action plan, if required.
  - The EMP must be prepared so as to be able to be used as a stand-alone document for use in implementation.
  - A two-stage public involvement process is to be developed and implemented. The first stage is the process established for Screening, IEE or EIA, when the EMP is under development. The second stage is the process for implementation of the EMP.
- ⑤ The environmental management standard addressing EIA for Electricity Projects (No: 585/MIH.DOE, dated 04 October 2001), sets out the requirements for EIA for electricity projects in Lao PDR. The following noteworthy information is provided in the standard:
- An EIA cannot proceed without an Environmental Screening and an IEE being first carried out. The extent of the EIA and its content depend on the project's Environmental Screening and IEE, with the screening and IEE determining the content and terms of reference of the EIA;
  - The contents and requirements of an EIA for an electricity project, including requirements for public involvement and development of an EMP, are specified. Regarding public involvement, the standard indicates that the process for public involvement for any follow-up EIA that may be required by a decision rendered by STEA (which now WREA) is scoped during the IEE. Otherwise, public involvement for an IEE is limited to the DoE requesting comments on the IEE from project affected persons.
- 7) **MAF Regulation N° 0524/2001**, on Management of National Biodiversity Conservation Areas, Aquatic Animals and Wildlife provides guidelines on NBCA establishment and zoning and also on restricted activities and development fund establishment and the rights and duties of state agencies in NBCA management.
- 8) **Environmental Management Standard for Electricity Project No.0366/ MIH.DOE, (2003)** states that:
- Environmental screening is a preliminary assessment of a project's potential environmental impact. It is normally completed at a projects identification stage. Screening is used to decide whether a project's impacts are of a significant nature to warrant further environmental assessment.
  - The IEE will determine the scope of the EIA. This will include the scope and plan for conducting the study to meet the requirements of an SIA.

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- The IEE shall identify the expected social impacts of the project, and a plan to obtain the necessary information for determining the magnitude of the impact and the potential measures to avoid, minimize, mitigate or compensate for the effects.
  - The IEE shall include the following information related to SIA:
    - Discussion of consistency with governmental regulatory requirement.
    - Brief description of the social conditions in the project area including an estimate of the number of people to be relocated, distribution of population in project area, a brief discussion of the local economy and primary source of income, the presence of significant cultural and infrastructure facilities that will be affected and a list of issues to be discussed in the SIA relative to the social conditions.
    - Preliminary plan for relocating the affected persons (Preliminary Resettlement Plan-PRP). The PRP may provide budget and technical feasibility proposals (availability of relocation sites, etc.) for more than one technical design.
    - A preliminary assessment of land acquisition requirements and a determination of whether the land required for the project fall into forest/tribal or other special areas.
    - Description of indigenous groups in the project area (if any) to include status of the population from the perspective of the GOL, significant unique characteristics of the cultural tradition of the groups, special economic resources of the group.
    - Preliminary plans for protecting and enhancing the integrity of the indigenous groups.
    - Evidence for consulting with governmental agencies, local authorities, NGOs in the project area, and the Project Affected Persons (PAPs) including name of participants, date, location, subjects discussed, discussion results, agreed conclusions, and actions to be taken.
  - The Regulation for implementing environmental assessment for Electricity Projects requires all electricity projects in Lao PDR to be environmentally screened according to the amount of impact they will or will likely have on the environment. A project must meet the following criteria to justify no further environment assessment: *“Because of its nature, size and location, the project can be expected to have immeasurable or insignificant environmental impact on natural resources, ecological resources, public health and public welfare”*.

**ANNEX**

**MAPS SHOW THE LOCATION  
OF THE PROJECT**





Source: <http://oasis.fortunecity.com/bondi/346/laomap.htm>



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## CHAPTER II

### DESCRIPTION OF THE PROJECT

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#### 2.1. Scope of the Project

The scope and extent of the project are, for civil work, to construct a Rollere Compacted Concrete Dam-104.5m high, with 258m long crest, gross reservoir storage of 314 Mm<sup>3</sup> and reservoir surface area of 15 Km<sup>2</sup>, an 8.9 km headrace tunnel, an 2.4 km penstock and power house. The works include the construction of temporary and permanent residential and other amenity complex in order to accommodate personnel as well as construction workforces during and after the construction of the project.

Construction and “upgrading” of the main accesses, during and after the construction, to the dam, intake structure, surge tank and the powerhouse area will be a significant component of the civil construction work of the project.

In addition to civil works, the scope of the project will include the installation of the electrical-mechanical components such as the generators, excitation equipment, switchgear, generator connections, main transformers, High Voltage (HV) substation, auxiliary power supply systems, control and protection equipment, and auxiliary work such as grounding and cabling. The transmission line, the switchyard at the powerhouse and the connection features will also form part of the electrical-mechanical installation work of the project

#### 2.2. Project Study Area

The project study area in this report means that the area covers some villages that are located in the junction or near to the project area that are initially expected to be affected whether directly or indirectly by the project. The project study area situates in the remote northern part of the country, the area straddles over southern Luangprabang and southwestern part of Xiengkhouang province. The main dam is located at Phoukhoun District in Luangprabang province while the powerhouse is approx 10km due south from the dam site, which situate in Phoukout District in Xiengkhouang province. The dam site is only accessible by walking from Ban Chim village along the Nam Soud and Nam Ting River.

The project study area encompasses 280 households (of which 146 households have been interviewed) in 4 Villages (Ban Chim, Nammadao, Phavai and Longmieng) of Phoukhoun District, Luang Prabang Province, and 247 households (of which 63 households have been interviewed) in 3 Villages (Xiangdet, Namchat and Somboun) of Phoukout District, Xiangkhoang Province.

Out of all the seven villages that have been included in the study area, only one village namely Ban Chim has direct impact that is approximately 50 ha of rice fields would be inundated but none of the household needs to be relocated. Ban Xiangdet locates down stream from the dam on the Nam Ting River, however, will be inundated, not from Nam Ngum 5 project but from the influence of the Nam Ngum 3 project, which at the time of the

survey its reservoir area was being cleared out and the main activity was logging of commercial timbers. However, if Nam Ngum 5 project has been constructed and completed before Nam Ngum 3 project, Ban Xiangdet village will be also affected by Nam Ngum 5 project as a downstream impact, and that the mitigation measure will also be developed for such impact.

### 2.3. Project Components

Basic project components are shown in *Annex Figure 2.3* and also listed below. They consist of:

- *The main dam* situates downstream of the confluence of Nam Ting, Nam Sout and Nam Phat , it is of RCC gravity dam with an overall elevation height from the existing river bed of 104.5m high with crest length of 258 m and crest level 1,104.5 masl. The main dam is located at Phoukhoun District in the province of Luang Prabang.
- *The head race tunnel, penstock surge shaft and surge tank* connecting the dam at the intake to the powerhouse making the total length of over 10km due south of the dam site. Discharging the water directly into Nam Ngum 3 reservoir which has full supply level of 720 masl.
- *Powerhouse civil construction and electro-mechanical installation*, with the gross head of 337m and the installed capacity of 120 (2x60) MW output rating with annual energy production of 507 Gwh. The powerhouse situates in Phoukout District in the province of Xiangkhouang.
- *Transmission Lines* of 115 kV capacity, with double circuits of ACSR 240 mm<sup>2</sup> consists of one sections, 2.5km long connecting from switchyard of Nam Ngum 5 to Nam Ngum 5 Substation.
- *Temporary and permanent access roads*, currently and at the time of the survey the access road alignments required to reach the dam site and the powerhouse area were not yet finalized. However, based on the geographical location of the main components of the project – dam site and powerhouse area, it will require two separate accesses, firstly for the “dam access”, from Road No 7, will be approximately 20 km long and secondly will be “powerhouse access” from the Dam site to powerhouse, approximately 14 km.

The general project layout is shown in *Annex Figure 2.3*, and key features of Project components are listed below.

#### **Key Features of the Proposed Nam Ngum 5 Hydropower Project**

##### ①. **RESERVOIR**

Name of River:	Nam Ting
Name of River Basin:	Nam Ting
Catchment Area:	483 Km <sup>2</sup>
Full Supply Level (above sea level):	1,100 m asl
Minimum Operating Level:	1,060 m asl

Reservoir Area at Full Supply Level: 15 km<sup>2</sup>  
 Gross Reservoir Storage: 314 Mm<sup>3</sup>

②. **DAM**

Dam type: RCC gravity dam  
 Dam Height (above present riverbed): 104.5m  
 Crest Length: 258 m  
 Crest Level: 1,104.5 m

③. **POWER FACILITIES**

Power station rated output: 120 MW  
 Installed Capacity: 2 X 60 MW  
 Annual Energy Production: 507 GWh  
 Transmission Lines: 2.5 km of 115 kV, double circuits of ACSR 240 mm<sup>2</sup>  
 (From switchyard of Nam Ngum 5 to Nam Ngum 5 Substation)  
 Gross head: 337 m  
 Headrace tunnel diameter: 4.2m  
 Headrace tunnel length: 8917m  
 Penstock diameter: 3.8m  
 Penstock length: 2443m  
 Surge tank diameter: 6m  
**Type of Surge tank:** Upper chamber type  
 Surge tank level: 1110.5m  
 Turbine: 2 X 60 MW  
 Rated Turbine flow: 21.14m<sup>3</sup>/s

④. **ACCESS ROADS**

New all weather road from Road No 7, approx 20 km (from NR-7) to dam site and approx 14 km from the Dam site to Powerhouse site.

Construction: 34 km

⑤. **RESETTLED PERSONS**



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Resettled Persons: None  
 (But 3 affected households want to move to Phou Khoun District and Luangprabang town)

⑥. **AFFECTED PERSONS (HOUSEHOLDS)**

Affected households (lost of paddy field 50 ha): 49 households

⑦. **BASIC COSTS**

Estimated Basic Project Cost (As-built Cost): US\$170 Million

**2.3.1. Dam Site**

The proposed dam is a rock-filled type with concrete face, located about 8 km east of the centre of Ban Chim village, and some 12.5 km south-west of the centre of Xiangdet village. It will be approximately 104.5 m high, 258 m crest length at 1,104.5 masl dam.

The gorge forms a natural dam site (Between Phou Pha Day and Phou Da Phor mountains) which is only 35 m wide at the bottom of the river bed. Even at 1,100 masl or 90 m above the riverbed, the width is only 170 m considering to be the most favourable dam site. The dam will create a reservoir and regulate the natural flow of the Nam Ting which varies widely from the rainy and dry season, due to the low amount of flow during the dry season; Nam Ting down stream section from the dam would be dry. The water is directed via a tunnel and penstock to the powerhouse and eventually discharged into Nam Ngum 3 reservoir

The gorge at the dam site is 400 m deep and narrow with slopes of 30° to 40° which steepened locally to 50°. The river bed is rocky, appears to have little alluvium and the reach through the gorge is relatively straight. Most slopes have a dense cover of vegetation.

Rock outcrop on the valley slopes is visible at the downstream end of the gorge. The outcrop is of strong rock, possibly quartzite, and the bed is massive (10m to 15 m) and creates a sub-vertical bluff on the left abutment extending from river level to the ridge crest. The unit appears to have wide spaced joints. It is likely that rockfall from the bluff is relatively common although it is not possible to define the extent size and frequency of any future falls. Dam sites upstream of the bluff are preferable given the likelihood of future collapse.

Bedding dip is estimated 40° to 50° downstream and this appears to be consistent along the ridge to the north and south of the site and along adjacent ridges to the east. Bedding strike is parallel to the axis of the ridges which is also parallel to the likely axis of a dam.

If is probable that a number of lithologies will be encountered at the dam site, ranging from the strong sandstone of the bluff to weaker sandstone, siltstone and mudstone. Calcareous beds may also be present although is little evidence of limestone variable. Thin beds typically have more closely spaced joints.

### 2.3.2. Reservoir

The catchment area above the main dam site is 483 km<sup>2</sup> and contains three rivers Nam Phat, Nam Soud and Nam Ting. The reservoir will have an area of some 15 km<sup>2</sup>.

Maximum dam height has been set at about 104.5 m to avoid flooding productive low-lying land in the Muong Chim basin. At that elevation the impoundment also avoids partly inundating the limestone (karst) topography on the north side of the basin. There the limestone may act as a potential leakage path from a high level reservoir although this is unlikely given the considerable distance to the catchments boundary.

Two villages; Ban Chim and Ban Xiangdet have been identified as affected villages which lie within the project area but neither will be affected by the inundation of the reservoir area, except some paddy field at Ban Chim village that will be inundated. Ban Chim is within the catchments area of the reservoir but none of the household is to be relocated; however most of the paddy field (according to our GPS level taken during our survey and the given contour map of the area) would be inundated.

Ban Xiangdet is located about 8 km downstream from the confluence of the Nam Ting and Nam Phat and near the dam site; it situates on the left bank of Nam Ting and is out side the catchments area of the reservoir, hence would not be impacted. However from our survey, BanXiangdet would be inundated by Nam Ngum 3 reservoir which has FSL of 720 m asl. The village consists of 90 households with the total population of approximately 500 people. According to the villagers they have officially been informed and discussion had taken place that they are to relocate to Ban Namkan approximately 20 km south-west of Ban Xiangdet. This relocation will be the responsibility of the developer of Nam Ngum 3 project and the GOL.

### 2.3.3. Powerhouse

The powerhouse site situates in the Phoukout district, Xiangkhouang province, would be on the bank of Nam Ngum 3 reservoir (downstream of Nam Ting/Nam Ngum confluence). The powerhouse would contain 2 Vertical Francis turbines with maximum combine output of 120 MW.

Due to security reasons, visiting or surveying of the site was not possible during that time, hence the account of the environmental, topographical and others etc., information was based on previous information, available forestry map and similar ground conditions as well as villagers' interview.

From available data and information and according to the study by carried out by Maunsell Limited of New Zealand, in association with Lahmeyer International of Germany in 1997, the site located at the toe of ridges and spurs and slopes above the sites are moderately steep. The proposed site is covered with evergreen and mixed deciduous forests (refer to forestry map attached).

Again according to Maunsell and Lahmeyer, for options involving penstock at the surface care will be required to select penstock routes that avoid steep and potentially unstable slopes. Weathering depths are likely to be in the range of 5 m to 10 m on slopes and at power sites, excavation is likely to be one or some combination of alluvium, slope wash



debris (colluvium) and weathered rock. Tailrace excavation is likely to be in alluvium and colluvium.

#### 2.3.4. Water Intake

According to Maunsell and Lahmeyer, and from our survey the water intake is located at a significant distance upstream the dam, where the Nam Ting changes its direction (subject to final design, this arrangement may be altered). With the minimum operation level (MOL) at 1060 m asl, the storage upstream the intake is 30 to 65 Mm<sup>3</sup>, more than enough to accommodate the expected siltation over 50 years of project economic life.

The intake will comprise a bell-mouth entrance and a gate tower, and will be provided with roller gate and trash rack.

The operating maximum discharge will be 42.9m<sup>3</sup>/s.

#### 2.3.5. Headrace Tunnel and Other Underground Work

According to latest design (SINOHYDRO) **the headrace tunnel** alignment has been set by the location of the intake and the surge tank. The tunnel will be 8917 m long with tunnel diameter of 4.2 m.

**The penstock** with the total length of 2443 m and the excavated diameter of 3.8 m, underground type is selected then steep slope and stability of the rock as well as erosion protection should be considered.

Other underground works include the surge tank, the valve chamber etc., would form a significant component of the above works

#### 2.3.6. Transmission Line

In accordance with "Power System Development plan for Lao PDR" , prepared for Lao PDR, Ministry of Industry and Handicrafts, Department of Electricity, and World Bank in August 2004, prepared by Maunsell Limited of New Zealand, in association with Lahmeyer International of Germany.

A 2.5 km of new 115 kV transmission line is from switchyard of Nam Ngum 5 Power Station to new collector 115 kV Substation near Nam Ngum 5 Powerhouse. The total cost for both 115 kV transmission lines and for a new collector 115 kV Substation near Nam Ngum 5 Powerhouse will be born by the Nam Ngum 5 Hydropower Project.

#### 2.3.7. Access Roads

Existing national main roads in the vicinity of the project site are the RN13 and RN7 as shown *Annex Figure 2.3*. Both roads are paved roads and accessible throughout the year. RN13 is the main road from Vientiane Capital City to Luang Prabang, while RN7 is

an arterial road branching from RN13 at Phou Khoun district due east linking Phonsavan District of Xiangkhouang province to the rest of the country.

The construction of the Nam Ngum 5 Hydropower Project will require considerable upgrading of existing access roads and construction of new all weather roads, both for temporary access as well as permanent access. The followings are access routes considered viable and has minimal potential impact on the environment as well as beneficial to local community:

- o **Access road to dam site:** two alternatives routes have been considered and based on the distance and their potential environmental impact :

1. **Access road to dam site (option I):** Upgrading of the existing road, from Ban Longmiang on RN7, (11 km east of RN13/RN7 junction) to Ban Chim, Phoukhoun District, Luang Prabang Province with the total length of 23Km. The road alignment follows Nam Soud on the ridge before it reaches Ban Chim. From Ban Chim to the dam site with the total distance of 12 km, the alignment follows the edge of the future reservoir and crosses Nam Ting and part of the reservoir before it reaches the dam site. Overall the road from RN7 to the dam site will be 35Km long (including two bridges crossing part of the reservoir and Nam Ting).

2. **Access road to dam site (option II):** Taking into consideration the unfavorable locations and shape of the future reservoir with respect to access from Ban Chim Village to the dam site, the most promising route alignment is from the north. The alignment starts some additional 12 km to the east of Phou Soung (or some 24 km to the east of NR 13 north) following the Nam Phat valley to the south on its left side. In total the road would have a length of some 20 km to the dam site.

In summary, and as shown above the most favorable access route to the Dam Site is the option II, this is due its shortest distance hence minimizing adverse impact to the environment – erosion, destruction of habitat etc.; while the access route to the powerhouse has only one option. Other such as existing tract to Ban Xiangdet from RN7 would be flooded by Nam Ngum 3 project.

- **Access road to powerhouse site:** After our investigation it is however believed that additional road would need to be constructed from the dam site itself to the powerhouse site. The distance from the dam site to the powerhouse site is approximately 14 km. During construction, one temporary bridge to cross the Nam Ting river at the downstream of the dam site will needed to be constructed. Later, after construction of the dam is completed, the dam crest will be used as a bridge to cross the Nam Ting river from dam site to powerhouse site.

### 2.3.8. Operator's Village

Currently the final design of the facilities or operator village is yet to be finalized; due to long distance apart between the dam site and the powerhouse area, it is therefore necessary for each site to have its own facility.

However the facilities for each site shall include 12 two-bedroom houses, 3 buildings for junior staff, canteen, offices, and first-aid station. They will be used by the Employer and the Engineers during the construction and after commissioning by the operator and the maintenance staff.

## **2.4. Project Implementation Schedule**

### **2.4.1. Detail Design Stage: (8 months)**

This activity is scheduled to take approximately eight months. The works include appointment of consultants to carry out the detailed design on: (1) Civil structures of the dam, powerhouse and other components such as intake structure, waterways and surge tank; (2) Steel structures and mechanical equipment; (3) Design of electrical equipment, HV substation and transmission line, switchyard at powerhouse and others; (4) Access roads, administration building and other infrastructure requirements.

The basic main component works:

- Consultants selection
- Topographical and geological survey
- Detail designs
- Preparation of tender and contract document

### **2.4.2. Procurement: (3 months)**

This activity is scheduled to take approximately 3 months. The works include bid advertisement, contract processing and evaluation, selection of contractor and awarding of contract. Breakdown details are:

- Bid announcement
- Preparation of bid document by contractors
- Bid opening and evaluation
- Contract negotiation and signed with contractors

### **2.4.3. Civil Works: (4 years)**

The overall construction works are scheduled to take approximately 4 years to complete and these include the construction of the civil work such as dam, powerhouse, tunnels, access roads to dam and powerhouse sites; the construction of electrical work such as HV substation, switchyard, transmission line and electrical equipment erection. All the construction works of the project are scheduled to commence at the same time, hence shortened the construction time considerably. Breakdown details construction activities are:

- Preparation works-Access Roads and Operation villages, UXO survey and clearance (if any)
- Dam Construction
- Spillway Construction

- 
- Power Intake structure
  - Head Race tunnel
  - Surge Tank
  - Penstock and Valve Chamber
  - Powerhouse and associated works
  - Test and commissioning

#### **2.4.4. Electro- Mechanical Work (2.5 years)**

- Detail design and Manufacturing of equipment and transportation
- Turbines Installation
- Generator Installation
- Switch Yards

#### **3.4.5. Transmission Line and Associate works (6 months)**

- Investigation
- Equipment Design and Manufacturing
- Erection of Towers and Conductors
- HV substation
- Test and commissioning

As indicated above the project work schedule is divided into five main parts. They include *detailed design, Procurement of consultant, Civil Construction works, Electro-Mechanical works and Transmission Line.*

The overall time schedule, from project design and preparation to the commissioning of the project is nearly 5 years. For more details is referred to the schedule below.

## **2.5. Quantity and Quality of Raw Material to be used**

In accordance to the proposed type of dam the raw materials required would mainly be rocks and these rocks, as mentioned below, would partly come from the excavation of the underground works and the balance would come from the nearby quarry.

- Approximate of rock requirement for the dam construction is 1.5 Mil m<sup>3</sup>

- =====
- Other raw materials such as sand and aggregates (river gravels) for concrete work would come from the local or nearby sources “to be identified during the detail design stage”
  - Timbers and others materials, mainly for temporary works would be required but of very minimal quantity, hence of no significant impact on the environment.

## 2.6. Quantity of Waste Products generated by the Project

According to SINOHYDRO or from previous similar projects and according to the site survey, the majority of wastes generated from the project would mainly be from:

*Vegetation Clearances* from the dam site, powerhouse area, operation villages surge tank, access roads and along the 115 kV transmission line rights-of-way. However, some of these “wastes” will not be without its usefulness. Apart The local nearby villagers living in the vicinity make use some of these wastes e.g. for firewood, raw materials for charcoal production, fencing component as well as using in constructions of farm buildings and animal sheds. In the case where the forests contain significant quantity of commercial timbers , the trees with more than 30cm diameters will be identified, logged and sold off by the ministry of Agriculture and Forestry (provincial and district forestry staff), prior to the clearing is taking place. As part of the environmental protection procedure, and in order to protect surrounding forests and other natural resources, burning off is not permitted.

*Excess Soil* as a result of excavation and the preparation for construction of all the civil works mainly for dam site, access roads (total distance approx 34Km), powerhouse, operation village etc., and some of these excesses would need to be disposed off so that adverse impact to the surrounding environment is minimized. Because of the rugged terrain the access roads alignment would involve huge quantity of earth works- cut and fill, therefore most of them would be reused in the construction of these access roads.

*Rock Excavation Spoil* resulting from the underground work-Head Race Tunnel excavation etc., with the estimated total amount of 200,000 m<sup>3</sup> and according to SINOHYDRO all of these spoils will be reused in the construction of the dam hence posing no adverse impact to the surrounding environment.

The other waste materials anticipated from the project is excess soil excavated during the construction of tower foundations of the transmission line. It is estimated that there will be approximately 1 m<sup>3</sup> to 1.5 m<sup>3</sup> of soil excavated for each tower. However most of these soils will be used as back fill materials for the foundation; only minor portions will be left behind. The excess soil will be spread around the tower bases to facilitate natural re-vegetation and or use as fill in nearby depressions so as to minimize sedimentation of nearby watercourses. Overall the generated wastes are of minimal quantities, therefore will not have any adverse impact to the environment.

## 2.7. Project Cost

According to the revised cost carried out by SINOHYDRO the Estimated Total Project Cost is an approximately US\$196 Million, this includes:

=====

Civil Works:	US\$99,118,000
Metal Structure Works:	US\$21,943,000
E and M Equipment:	US\$24,152,000
Engineering:	US\$5,809,000
Others:	US\$6,400,000
Contingency:	US\$12,594,000
<b><u>As-Built Cost:</u></b>	<b><u>170,016,000</u></b>
IDC:	US\$17,649,000
Commitment and Management fee of Bank:	US\$1,347,000
Overseas Investment Insurance:	US\$6,896,000
Financing Cost:	US\$25,892,000
<b><u>Total Project Cost:</u></b>	<b><u>US\$195,908,000</u></b>

## 2.8. Executing Agency

Nam Ngum 5 Power Company limited is the Executing Agency for the project.

Project detailed design, including detailed surveys (dam, powerhouse, headrace tunnels, substation, transmission line), preparation and evaluation of tenders, and construction supervision, will be carried out by consultants in accordance with the MEM and EDL' s regulation and guidelines.

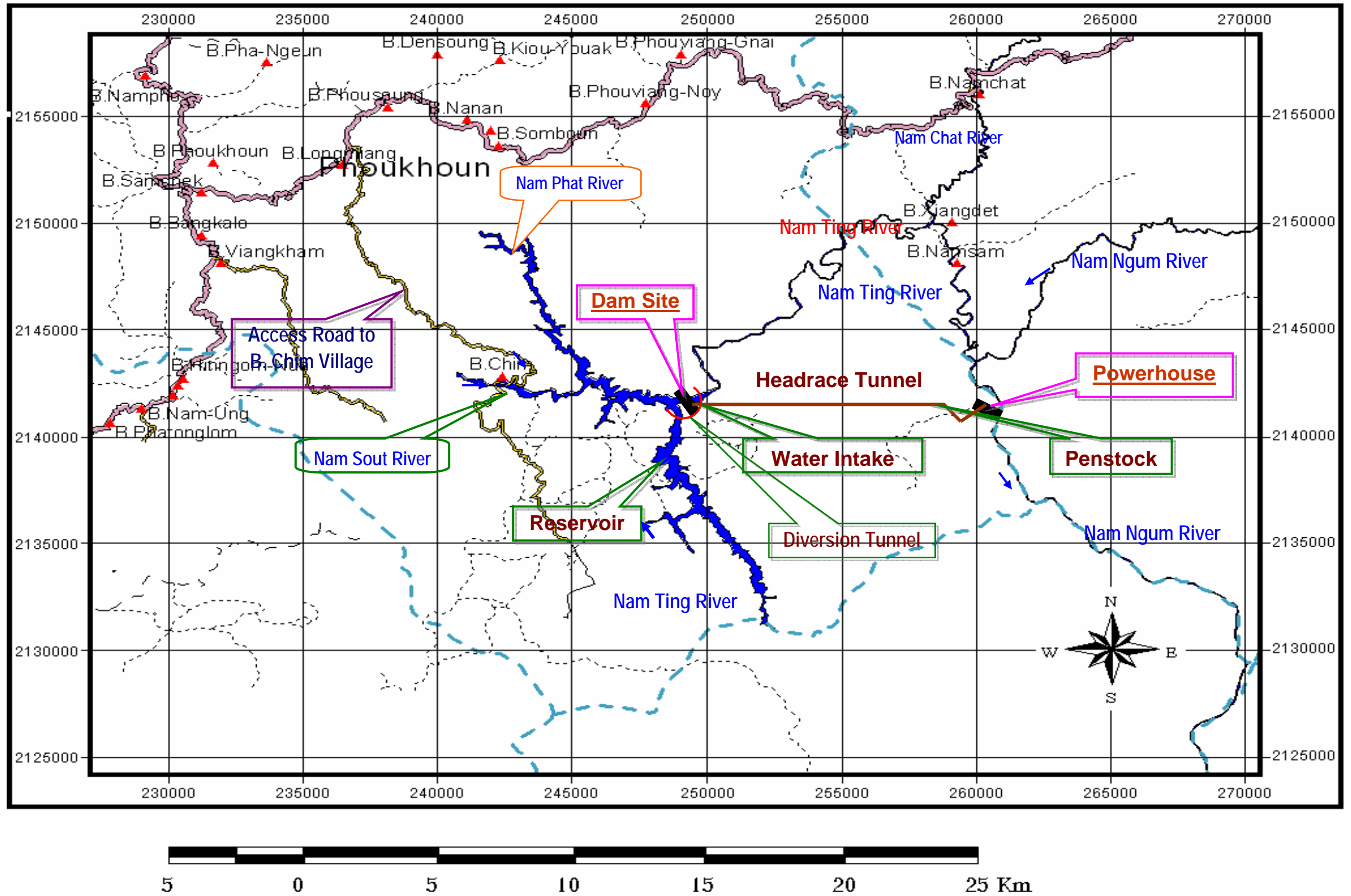
Management of the project will be the responsibility of the general manager of Nam Ngum 5 Power Company Limited, with day-to-day implementation carried out by an project management team, under the direction of the Distribution Manager. Environmental and socio-economic aspects of the project will be the responsibility of Environmental Management and Monitoring Unit (EMMU).

## 2.9. Annexes

**Annex Figure 2.3: Nam Ngum 5 Hydropower Project General Layout**

**Annex Table 2.4: Project Implementation Schedule**

Annex Figure 2.3: Nam Ngum 5 Hydropower Project General Layout







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## CHAPTER III

# ENVIRONMENTAL DESCRIPTION OF THE PROJECT AREA (BASELINE DATA)

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### 3.1. Physical environment

#### 3.1.1. General Physiography

The Northern-Central Laos provinces of Luangprabang and Xiengkhouang are characterized by their young landscapes where ongoing processes continue to shape the land. The topography is predominantly steeply dissected hill country, ranging in elevation from 320 masl in valley bottom areas like Luangprabang and Xiengkhouang to over 2000 masl on mountain ridges. The highest mountain is Phoubia Mountain, 2,820 masl at Xiengkhouang Province. Almost 90% of Luangprabang Province is mountainous. Xiengkhouang is also a rugged mountainous province. The slopes of the lower hill zone tend to be steep where tributaries have downcut in V-shaped valley bottoms. Upper hill slopes tend to be less steep and more rounded. Large flat areas are rare, occurring occasionally in Xiengkhouang Province and along the major rivers where valleys open up to allow river flood plains to develop.

#### 3.1.2. Features of the Project Area

The Nam Ngum 5 Hydropower Project area is located on a left hand tributary of the Nam Ngumsome 150 km north of Vientiane, Lao PDR. Downstream of the confluence of Nam Ting and Nam Phat the topography provides an excellent site for a concrete arch dam to be built on sandstone. The main access to the Project site is along National Road No. 13 North from Vientiane Capital City to the north at Km 257 (Sala Phou Khoune) and to the right with NR No. 7, from Sala Phou Khoune to Xiengkhouang province at Km 15 and continue with small access road on the right hand side of about 20 km to Chim village. The project area covers two provinces; Luangprabang and Xiengkhouang, two districts; Phoukhoun and Phoukout and 5 village related boundaries. However, only one village is directly affected by the project namely, Meuang Chim village, Phoukhoun District, Luangprabang Province.

Ban Chim village is located on the upper part of the Nam Sout river which is a major right bank tributary of the Nam Phat river. It has been recently established as the new district headquarter. The army of Lao PDR was assigned to maintain a permanent camp within this area. Chim village consists of 155 households with total population is 994 people (378 female). An area of some 200-300 ha is used for agricultural production mainly growing rice and crops and animal rising. However, only 49 households of Chim village are directly affected, the village itself is located above 1,100masl. According to the field survey conducted by the Consultant's study team (DSC), the affected households include only those households who use the land for agricultural production such as permanent paddy fields and farmland for growing crops with a total paddy field area of which is under 1,100masl and has high potential flooding is approximately 50 ha.

The project area is bounded by the catchment of three rivers; Nam Tinh, Nam Sout and Nam Phat Rivers. These rivers rise on the elevated sloping mountain and drain to Nam Ngum River, which is currently the main watercourse of the Nam Ngum1 and 2 Hydropower.

The project area mainly is degraded forest and has been cleared for agricultural production including grazing due to most of the area is grassland which is suitable for animal raising. The forest areas that remain are mainly secondary and unstocked forests which are destroyed by slash and burned for shifting cultivation. Apart from the forest areas in upper Phou Da Phor Mountain, wildlife habitats and wildlife population are also destroyed and reduced.

### 3.1.3. Soils

According to OSTE (1993), soils in northern Laos tend to be heavily leached and acidic, with low water retention capacity, and generally low fertility. Combined with the rugged terrain, this limits the opportunities for intensive agriculture.

As a result from the study conducted by FAO-ADB noted that based on observations made of road cuts on steep slopes, it appears that the bedrock has been thoroughly weathered in places to a depth of two or meters such that the original rock structure is not distinguishable. The study further reported that the A and B soil horizons on sloped ground are thick and relatively undifferentiated from one another, suggesting that erosion and soil genesis are in balance. The soils were found to be acidic (pH 4.6-5.6) and of low to medium fertility, with limited available phosphate (FAO-ADB 1998, in WCTPC-IUCN (2000a))

Margules and Pöyry, et al (2000) report that the National Agriculture and Forestry Research Institute (NAFRI) are undertaking a national soil classification for Laos, which was completed at the end of 2000. They provide the most definitive information on soils in Louang Phrabang Province, indicating the following (Margules and Pöyry, et al, 2000).

The soils are mostly derived from siltstones, and sandstones on an ancient uplifted peneplain, which has been heavily dissected by rivers over time. These soils generally highly weathered, moderately deep (0.4 to 1.2 m or more) and well drained. However, the soils are typically acid (sometimes with pH less than 5), with relatively low organic matter, limited available phosphate, and only medium to low fertility. There are also small areas of limestone outcrops, but these areas are generally very steep with shallow soils not widely used for agriculture. The major groups of soils in Luangprabang consist of Acrisols, Alisols, Luvisols and Cambisols, with areas of gleyed soils also found in lowland areas. The soils are generally suitable for shifting cultivation or swidden provided that a fallow period of 7 years or more is maintained, except on steep slopes where severe erosion problems can occur following heavy rains. For more permanent agricultural systems involving annual cropping on less steep slopes (less than 36%), a combination of practices such as soil and water conservation measures, use of nitrogen-fixing legumes, and application of manure, compost or other soil amendments would be required.

### 3.1.4. Regional Geology and Stratum Lithology

In the long geological development and evolution history, in the project area, Devonian System (D) and Permian System (P) of upper Palaeozoic era exist, which are mainly distributed in the large western part and small northern part of this area, accounting for about 50% of the total project area. And Triassic Period (T), Jurassic System (J) and Cretaceous system (K) of Mesozoic era exist, which are mainly distributed in the large eastern part of the project area, accounting for about 50% of the whole project area. The above strata of Upper Palaeozoic era and Mesozoic era are of conformable contact, unconformable contact or fault contact. Sedimentary deposit of Carboniferous System and Devonian System is absent in this area. Moreover, slope wash and colluvium of Quaternary System is widely distributed on the slope surface. The alluvial of the

Quaternary System is distributed in the basins and terrace of Nam Ting River valley and Nan Ngum River valley. See table 3.1.4.

**Table 3.1.4: Strata Summary**

Geological Age				Sym-bold	Thick-ness	Hydrology geological Characteristics
Era	Period	Epoch	Group			
Cenozoic Era	Quaternary	Holocene Series		Q <sub>4</sub>	2~12	Rock blocks, broken stones interlaid with clay and sand and gravel; containing interstitial water
	Quaternary	Pleistocene Series		Q <sub>2,3</sub>	20~30	Red clay, sand and gravel and clay, kaolin clay and black peat
	Late Tertiary	Pliocene Series		N <sub>2</sub> ~Q <sub>1</sub>	70	Sand, gravel and clay, containing interstitial water, partially confined water, water quantity: moderate-rich, good water quality
Mesozoic Era	Cretaceous System	Upper Series	Chamopa	K <sub>2cp</sub>	400	Medium brown banded sandstone and siltstone and siltstone, at the upper part, it is white arkose-quartz sandstone, hard, joints and cracks develop, comparatively crushed.
	Cretaceous System~ Jurassic System		Phou Pha Nang	J-K <sub>pn</sub>	350	Red conglomerate, micaceous sandstone, white or brown siltstone, quartz-sandstone, the rock is hard and complete, but is easy to be weathered with thick strong - weathered layer.
	Triassic Period	Upper Series	Nam Sait	T <sub>3ns</sub>	700~850	Mainly of continental deposit stratum, the lithology is black sandstone, siltstone and mudstone, and at some part it is limestone, conglomerate and claystone.  Sandstone area contain small amount of interstitial water; siltstone and mudstone is comparative water-proof layer, limestone and conglomerate contain rich ground water.
		Middle and Lower Series	Phou Lek Phay	T <sub>1-2pp</sub>	650	Mainly of continental deposit stratum. For the lithology, it is sandstone, claystone interlaid with lenticular granulite at the upper part; it is limestone, shale interlaid with siltstone at the middle part; and it is moderate and thick banded sandstone interlaid with granulite, porphyritic liparite, tuff at the lower part.  Weathered zone of bedrock contains interstitial water, moderate water content.
Palaeozoic	Permian System	Upper Series	Houay La	P <sub>2h1</sub>	400	Liparite, basalt, andesite-basalt, grey arenaceous tuff.  Weathered zone of bedrock contains interstitial water, rich water content.
		Lower	Na Lang	P <sub>1h1</sub>	550	Mainly of marine deposit stratum. The lithology is limestone, siltstone, arkose-quartz sandstone

Geological Age				Sym-bold	Thick-ness	Hydrology geological Characteristics
Era	Period	Epoch	Group			
		Series				interlaid with clay stone, next there are volcanic rock including andesite, liparite and tuff. Weathered zone of bedrock contains interstitial water, rich water content.
	Carbonic System	Middle and Lower Series	Nam Thom	C <sub>1-2n</sub>	>50	Mainly of marine deposit stratum, the lithology is black sandstone, siltstone, shale and limestone. The rock body is hard and complete. Surface crack ratio is 12.48%. Spring output of 0.1~1.0L/S. Groundwater runoff modulus of 1.0~3.0 L/S. KM <sup>2</sup> and mineral content is less than 0.1g/L.
	Devonian System	Middle and Lower Series	Na Sa	D <sub>1-2n</sub>	900	For the lithology, it is sandstone, siltstone and shale interlaid with thin and medium banded limestone at the upper part; at the lower part, it is thin limestone and black siliceous limestone. The rock body is hard and complete. Limestone and sandstone contain rich groundwater; siltstone and shale are comparative water-proof layer. The groundwater is of HCO <sub>3</sub> -Ca.Mg, and mineral content is less than 0.2g/L.

### 3.1.5. Water Resources

The steep terrain of northern Laos is part of an intricate system of streams and rivers that form the Mekong River watershed. Fourth order streams, which have their origins on the upper slopes of mountains, have downcut through the coluvial soils and weathered bedrock to form high gradient V-shaped watercourses. Within the project area, these streams feed the larger third order (tertiary) streams and the main secondary rivers that are the principal tributaries of the Mekong. Most villages are located within 1 km of a permanent stream, the primary source for drinking water in these rural areas.

**Table 3.1.5: Summary of main Rivers and Streams within the area**

Districts	Main Rivers and Streams	Width (m)	Average Deepness (m)	Remarks
Phoukhoun	Nam Phat	4	0.8	Lie within the proposed Nam Ngum5 reservoir
Phoukhoun	Nam Soud	10	1.5	
Phoukhoun	Nam Tinh	20	5-10	
	Nam Madao	10	2.5	
	Nam Sanene	4	1	

### 3.1.6. Run-off

Water vapor of rainfall in the catchment area mainly comes from the southeast wet moisture of South China Sea and southwest wet moisture of Indian Ocean. The yearly runoff distribution fully reflects characteristics of dry and wet seasons in a year. The basis of runoff data from the Num Ngum 1 hydropower project indicated that the total runoff accounted for 73.1% from June to October, only in August runoff occupying a quarter of the whole year. Meanwhile the runoff from November to April only accounted for 15.3% of the total runoff and the driest seasons are three months with lower than 2% of the total throughout the year.

In the good vegetation areas, sufficient water vapor and little effect of human activities, the yearly variation of runoff is stable. Taking inflow of Nam Ngum River (as the record for 1949-1995), the pluvial year runoff (14.2 billion m<sup>3</sup>) is more than 2 times (6.05 billion m<sup>3</sup>). At Kasy District, the hydrology station has recorded 8 years of measure discharge data in Nam Ngum catchment area with the ratio between maximum and minimum runoff is 2.46.

In the proposed Nam Ngum 5 Hydropower Dam Site, due to a lack of basic information, the hydrologic model, regional comprehensive method and cited hydrologic reference station were used to estimate the runoff at the dam site. The Table below is a calculating result of catchment model which was adopted for the runoff series of dam site.

**Table 3.1.6: Mean Annual Runoff at Dam Site of Nam Ngum 5**

Item	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge (m <sup>3</sup> /s)	2.57	4.56	3.95	4.43	8.75	28.6	55.5	69.9	52.1	22.0	11.3	6.9
Distribution (%)	2.0	1.7	1.4	1.6	3.2	10.5	20.3	25.6	19.0	8.1	4.1	2.5
<i>Mean annual discharge: 22.8m<sup>3</sup>/s; Runoff depth: 1,488.7 mm; Runoff: 719 M m<sup>3</sup></i>												

*Source: Feasibility Study Report (Main Report, Vol. II), April 2006 (Sinohydro Corp. Ltd.)*

### 3.1.7. Climate

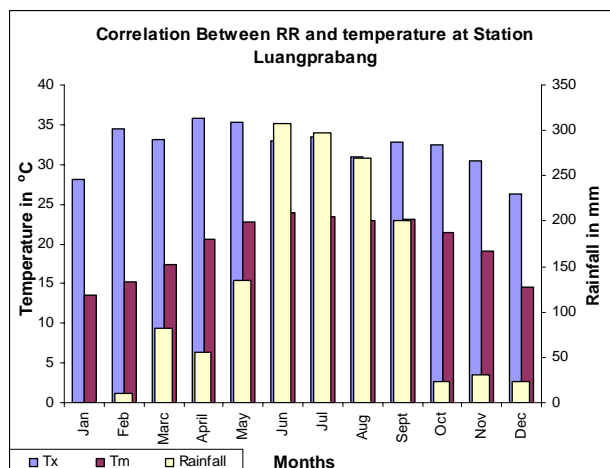
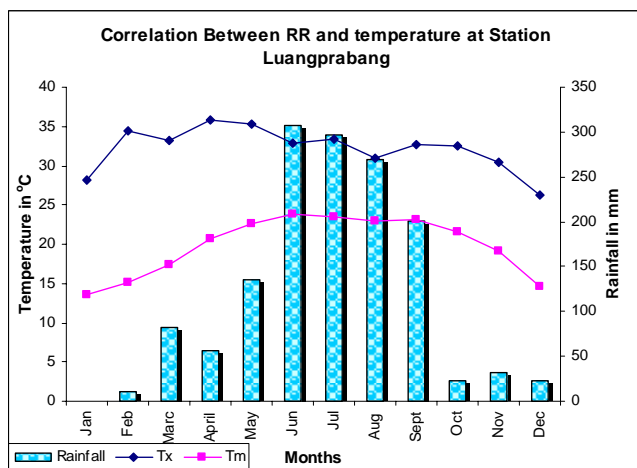
The climate of northern provinces of Lao PDR is subtropical and strongly influenced by the annual southwest monsoon rains that affect the region from April/May to September/October (mean annual rainfall for the year 2004 at Xiengkhouang is 1,372mm, at Xaysomboune is 2,847mm and at Luangprabang is 1,392mm). The period of the dry season between the three Provinces; Luangprabang, Xiengkhouang and Xaysomboune is not much different (from October to April) no rain may fall in some months except for Luangprabang in October. The hottest month is March (29.2°C at Xiengkhouang, 28.1°C at Xaysomboune and 36.3°C at Luangprabang), and the coolest month is December (about 3.5 °C at Xiengkhouang, 6.0°C at Xaysomboune and 12.6°C at Luangprabang).

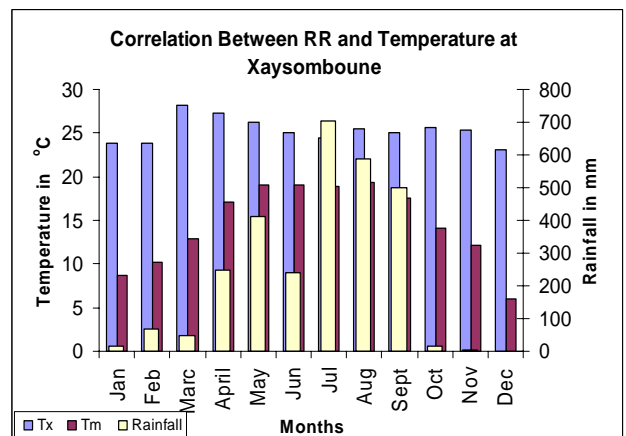
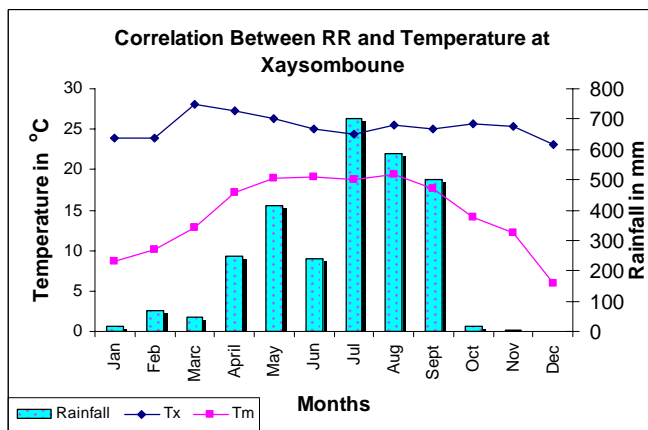
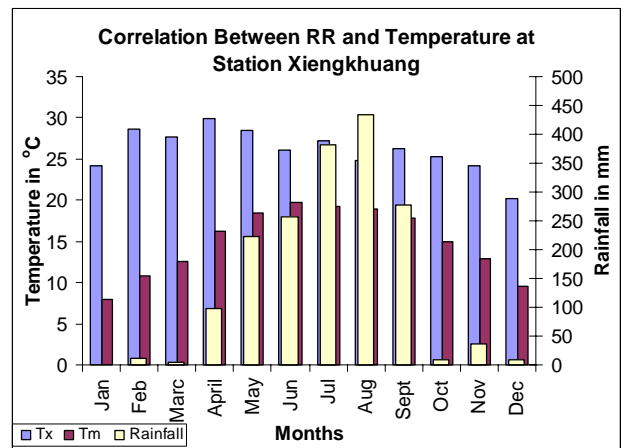
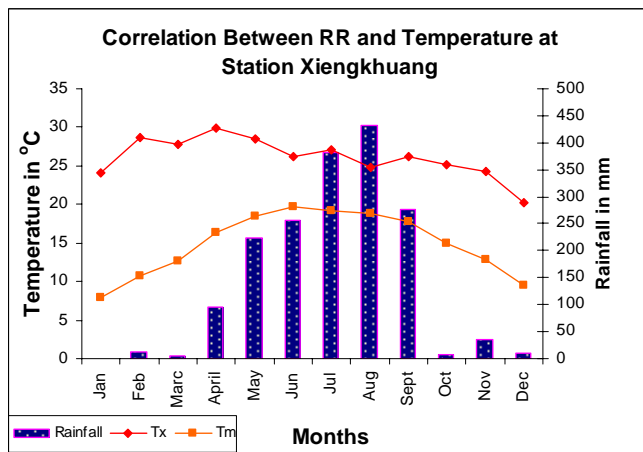
**Table 3.1.7: Climate Data for Luangprabang, Xiengkhouang and Xaysomboune**

Month (2005)	Luangprabang			Xiengkhouang			Xaysomboune		
	Avr.Max Tem.(°C)	Avr.Min Tem.(°C)	Rain (mm)	Avr.Max Tem.(°C)	Avr.Min Tem.(°C)	Rain (mm)	Avr.Max Tem.(°C)	Avr.Min Tem.(°C)	Rain (mm)
January	28.1	13.5	0.0	24.2	8.0	0.0	23.9	8.7	16.8
February	34.5	15.2	10.0	28.7	10.8	11.7	23.9	10.1	67.5
March	33.2	17.4	82.2	27.7	12.6	4.9	28.1	12.9	47.9
April	35.9	20.6	55.8	29.9	16.3	96.9	27.3	17.1	249.0
May	35.4	22.7	134.9	28.5	18.4	222.9	26.3	19.0	413.3
June	32.9	23.9	307.0	26.2	19.8	256.7	25.0	19.1	240.2
July	33.4	23.4	296.8	27.2	19.2	381.0	24.5	18.8	703.6
August	30.9	23.0	269.6	24.8	18.9	433.3	25.6	19.3	587.7
September	32.8	23.1	200.9	26.3	17.7	276.6	25.1	17.6	500.9
October	32.5	21.5	23.1	25.2	15.0	8.1	25.6	14.1	16.1
November	30.4	19.1	31.3	24.2	12.9	35.7	25.3	12.1	4.1
December	26.3	14.6	23.4	20.2	9.5	9.3	23.1	6.0	0.0
<b>Annual (Mean)</b>	<b>32.2</b>	<b>19.8</b>	<b>1,435.0</b>	<b>26.1</b>	<b>14.9</b>	<b>1,736.8</b>	<b>25.3</b>	<b>14.6</b>	<b>2,847.1</b>

Source: Department of Meteorology and Hydrology (2004)

**Figure 3.1.7: Correlation of climate (RR and Temperature) for Luangprabang, Xiengkhouang and Xaysomboune**





### 3.2. Biological Resources

#### 3.2.1. General

Lao PDR is located in the center of Indochina, sharing borders with China to the north, Myanmar to the northwest, Thailand to the west, Vietnam to the east and Cambodia to the south. The total area of Lao PDR is 236,800 square kilometres. Around 70% of its terrain is mountainous, reaching a maximum elevation of 2,820 metres is Phou Bia Mountain in Xieng Khouang province. The landscape of northern Laos and the regions adjacent to Vietnam, in particular, are dominated by rugged peaks and hills. The Mekong River, which flows through nearly 1,900 kilometres of Lao territory, is the main geographical feature in the west, and in fact, forms a natural border with Thailand in some areas. Lao PDR contains parts of four biogeographic units within the Indochinese subdivision of the Indomalayan Realm. Nam Ngum 5 project is covered two provinces; Luangprabang and Xiengkhouang that falls within the Tropical Lowland Plains Sub-Unit (10B), (Corbet and Hill 1992, and Mackinnon and MacKinnon 1986, Lao-IUCN 2000b).

Lao PDR has one of the most pristine forest ecosystems in Southeast Asia. It is estimated that half of its woodlands consist of tropical forest, in particular the primary forest. In addition to the fascinating vegetation, Lao PDR plays host to a very diverse animal kingdom.



According to the Report on the Assessment of Forest Cover and Land Use during 1992-2002, (*Department of Forestry, July 2005*) for the Northern Part of Lao PDR, 28% of the total land area is covered by the Current Forest<sup>1</sup>, while 66.5% is covered by Potential Forest<sup>2</sup>, an approximately 1% is other wooded area, 1.5% is permanent agriculture land and other land use types is covered about 3%. For Luangprabang Province, an approximately 13% of the total land area of the province is covered by the Current Forest, while 81% is covered by Potential Forest, 0.4% is other wooded area, almost 1% is permanent agriculture land and about 4.6% is other land use types. Meanwhile 38.6% of total land area of Xiengkhouang Province is covered by current forest, 49% is covered by potential forest, 0.4% is other wooded area, an approximately 3% is permanent agriculture land and about 9% is other land use types.

### 3.2.2. Forest and Vegetation Cover within the Project Area

Based on a review of the 2002 Land Use and Forest Cover maps for the regions in which the Nam Ngum 5 Hydropower will be constructed, and from the villager's interview as well as observations made during the field reconnaissance survey, the following observations were made regarding the conditions of forest and land use within the project area.

The Land Use Types and Forest Cover maps show that within the project area which will be directly affected by flooding about 2% is mixed deciduous forest and about 24% is other unstocked and scrub forest, while approximately 71% is covered by grassland and only about 2% is paddy field and other agricultural land<sup>3</sup> (see *Annex Figure 3.2.2*). The area along the alignment of the headrace tunnel and penstock pipes, from dam site to powerhouse, which is 50 meters wide and about 12 Kilometers long, would indirectly be affected due to underground construction such as tunneling and surge tank construction. The area is mostly covered by the forest, about 62%, including Dry Evergreen and Mixed Deciduous Forests, while unstocked forest and scrub is covered about 32% and the rest are grassland (5.5%), (see *Table 3.2.2 below*). However, the forest and land use types along the spillway tunnel will be affected during construction only.

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<sup>1</sup> *Current Forest includes natural forests and plantation forests. It is used to refer to land with a tree canopy cover of more than 20% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m. The basis for the distinction between forest and other land use groups is the crow density. In this study the natural forests are classified into forest types which composed of Upper and Lower Dry Evergreen Forests, Upper and Lower Mixed Deciduous Forests, Gallery Forest, Coniferous Forest, Mixed Broadleaved and Coniferous Forest, and Dry Dipterocarp.*

<sup>2</sup> *Previous forest areas where the crown cover has been reduced below 20% for some reason (logging or shifting cultivation) are classified as Potential Forest. The potential forest includes Bamboo, old shifting cultivation areas (young secondary forests) and Temporary Unstocked areas.*

<sup>3</sup> This include permanent and non permanent cultivation areas.

**Table 3.2.2: Land Use Types and Forest Cover within the Project Area**

	Land Use and Forest Types	Area (ha)	%	Remark
Land Use and Forest types within the Reservoir at full supply level of 1,100 masl including Dam site and Powerhouse	Mixed Deciduous Forest (MD)	53	2.30	<b>Directly Affected</b>
	Unstocked Areas (T) and Scrub (SR)	563	24.45	
	Swidden ( <i>Hay</i> ) (RA)	1	0.04	
	Paddy Field (RP) and Other Agricultural Lands (AO)	50	2.17	
	Grassland	1,636	71.04	
	<b>Total</b>	<b>2,303</b>	<b>100</b>	
Land Use and Forest types along headrace tunnel (an approx. 50m wide, 12km long)	Dry Evergreen Forest (DE)	48	44.5	<b>Indirectly affected</b>
	Mixed Deciduous Forest (MD)	19	17.6	
	Unstocked Areas (T) and Scrub (SR)	35	32.4	
	Grassland	6	5.5	
	<b>Total</b>	<b>108</b>	<b>100</b>	

Source: Forest Inventory and Planning, Department of Forestry (FIPD, DOF, 2005)

**BOX 1: Definition of Land Use and Forest Types** (Source: Department of Forestry)

- **Dry Evergreen Forest (DE):** The Dry Evergreen Forest type has a lower proportion of evergreen trees than the Evergreen type, 50% -80%. Except for in disturbed stands there is very little bamboo. Soil is usually deep. The forest consists of a considerable number of species of which 2 to 3 species tend to be predominant.
  - i) **Upper Dry Evergreen Forest (UDE):** This type of Forest is located at an altitude above 200 m. Some characteristic species of this type are Mai Khen (*Hopea* spp), Mai Do (*Pterocarpus pelatus*), Mai Nhang (*Dipterocarpus alatus*) Mai Peua (*Lagerstroemia* spp) and Mai Bak (*Anisoptera* spp). The height of upper and second storey is usually less than in LDE.
  - ii) **Lower Dry Evergreen Forest (LDE):** This type of forest is located at an altitude below 200 m. The second storey is usually dense and the height, varying from 10-30 m, is usually quite even within the stand.
  
- **Mixed Deciduous Forest (MD):** In the Mixed Deciduous Forest type the deciduous tree species represent more than 50% of the stand. The forest storeys are not as dense as those of evergreen types and most of the seedlings and saplings are deciduous trees. Most often bamboo occurs in this type of forest.
  - i) **Upper Mixed Deciduous Forest (UMD):** This type of forest is located at an altitude

above 200 m. In moist areas there might be a lot of climbers, and it could be difficult to distinguish this forest type from the Dry Evergreen type. In dry regions the difference can be clearly seen. The type appears quite open with a considerable amount of bamboo and undergrowth.

ii) *Lower Mixed Deciduous Forest (LMD)*: This type of forest is located at an altitude below 200 m.

- ***Unstocked Forest (T)***: Unstocked Forest Areas are previously forested areas in which the crown density has been reduced to less than 20 % because of logging, shifting cultivation or other heavy disturbance. If the area is left to grow undisturbed it becomes forest again. Abandoned ray and disturbed stands with a crown density less than 20% should be classified as Unstocked Forest Areas. Old ray in which seedlings, sapling and trees cover more than 20% of the area should be classified as some type of Current Forest.
- ***Swidden (Ray) (RA)***: Ray is an area where the forest has been cut and burnt for temporary cultivation of rice and other crops. The area should be classified as Ray from the time of clearcut until one year after it has been abandoned. Areas being prepared for clearcut but not yet clearcut and areas that have been abandoned for more than 1 year should not be classified as Ray.
- ***Other Agricultural Land (OA)***: Agricultural land being used for other agricultural purposes than agricultural crop cultivation, i.e. grazing of cattle, should be classified as Other Agricultural Land, unless the tree cover exceeds 20%. In that case it should be classified as some type of Current Forest depending on the tree species composition.
- ***Rice Paddy (RP)***: Areas permanently being used for rice cultivation. Old paddy that has been abandoned and not been in use for more than one year should not be classified as Rice Paddy.

According to the land use type and forest cover map, the field reconnaissance survey and villagers' interview, a large portion of the project area has been already significantly disturb many years ago by conversion of forest land into other land use types such as slash and burn for agricultural cultivation, burning for hunting and so on especially within and around the proposed reservoir and dam site. The only areas of land covered by evergreen and mixed deciduous forests occur on the upper slope of Phou Pha Day and Phou Da Phor mountain range where the powerhouse is proposed to construct. Within this area there are some commercial tree species which include *Fokinia chinensis* (May Hing), *Castanopsis annamensis* (May Kor), *Cinnamomum iners* (May Xikhay-Ton), *Pterocarpus pedatus* (May Dou Leuang), *Terminalia corticosa* (May Peuay-Dong), *Chukrasia tabularis* (May Nhom-Hin), *Ailanthus fauveliana* (May Nhom-Paa), *Dysoxylum binectariferum* (May Kuang-Deng), *Keteleria tonkinensis* (May Nhane), May Song, May Lang Chik and May Xai. Some of these trees have reached the diameter ranging from 40 to 80 Cm.

### 3.2.3. Wildlife and Aquatic Animals

Wildlife is the undomesticated animals and plants, which are living in nature. They are including many types and species of a very small size up to a very big size of

vertebrates or invertebrates or any type of habitats, such as: mammals, birds, reptile, amphibian, fishes, insects and all type of plant's communities.

Lao PDR, overall is still harboring rich fauna, with many species' populations and their habitats less depleted than many countries of the region. At least 166 species of reptile and amphibian, 700 bird species, and 100 mammal species occur in Lao PDR. However, most of them are found only in the existing NBCAa.

Currently, the richness of Lao PDR's wildlife has less to do with conservation efforts than with the country's low population density and consequently extensive forest cover. Although hunting pressure in the country is still far and wide, the relative abundance of habitat and, in some areas, its long distance from human settlements and the inaccessibility has provided partial protection for the country's wildlife. However, human population and development pressures are on the increase, especially since 1990 and consequently the wildlife population dramatically declines throughout the country.

Threatened species recorded in Lao PDR, based upon November 1998 data from the WCMC, comprised 220 plants and 150 animals.

Within and around the Project Area, wildlife conditions were surveyed and assessed by visual inspection and villagers' interview as well as secondary data and information gathered from available sources in the authorities concerned. Most local villagers within and around the project area including affected and unaffected villages were interviewed regarding their account of wildlife conditions within and around their village areas. According to the survey and villagers' interview, only significant remaining habitats are on the steep inaccessible slopes of Phou Pha Day and Phou Da Phor Mountains and other undisturbed forests outside the project area. All wildlife has been and is still indiscriminately and extensively hunted. The majority of significant wildlife species have either been eliminated from the project area either due to the habitat losses through agricultural clearing mainly slash and burn cultivation or indiscriminately hunting practices which has been for generations a significant part of livelihood of local people. The table below shows the wildlife species found within and around the project area.

**Table 3.2.3a: Wildlife conditions within and around the Project Area**

English Name (Common Name)	Scientific Name	Within Project Area	Outside Project Area	Status
Tiger	<i>Panthera tigris corbetti</i> Mazak	×	✓	Rare
Leopard	<i>Panthera pardus</i> Linnaeus	×	✓	Rare
Asian golden cat	<i>Catopuma temminkii</i> Vigors & Horsfield	×	✓	Rare
Leopard Cat	<i>Prionailurus bengalensis</i> Kerr	×	✓	
Asian wild dog	<i>Cuon alpinus</i> Pallas	×	✓	Rare
Sambar Deer	<i>Cervus unicolor</i>	×	✓	Rare
Barking Deer	<i>Muntiacus muntjak</i>	×	✓	Rare
Gaur	<i>Bos gaurus</i>	×	✓	Rare
Wild boar	<i>Sus scrofa</i> Linnaeus	×	✓	
Southern Serow	<i>Naemorhedus sumatrensis</i>	×	✓	Rare
Monkey	<i>Macaca Spp.</i>	×	✓	
Franci Langur	<i>Presbytis cristatus</i>	×	✓	
Non flying squirrel	<i>Sciuridae</i>	×	✓	
Reticulated Python	<i>Python reticulates</i>	✓	✓	

English Name (Common Name)	Scientific Name	Within Project Area	Outside Project Area	Status
Jellow Tree Monitor	<i>Varanus bengalensis</i>	✓	✓	
Tortoises	<i>Testudo sps</i>	✓	✓	
Pangolin	<i>Manis javanicus</i>	x	✓	
Pheasants	<i>Lophura sps</i>	✓	✓	
Pied Hornbill	<i>Antracoceros albirostris</i>	x	✓	
Red jungle fowl	<i>Gallus gallus</i>	✓	✓	
Mountain Imperial Pigeon	<i>Ducula badia</i>	✓	✓	
Grey peacock-pheasant	<i>Polyplectron bicalearatum</i>	x	✓	
Nak Nam (Smoot-Coated Otter)	<i>Lutrogale perspicillata</i>	✓	✓	

Note: ✓: Indicates “Appearance”. x: Indicates “Disappearance”

Similar to the survey of the fauna the aquatic animal’s survey were carried out, both by observation and villagers’ interview. In all the villages that are within the project area, seven villages were surveyed, interviewed regarding aquatic life conditions and their fishing activities. The results from the survey and interview show that within Nam Ting, Nam Soud and Nam Phat River (these rivers constitute the main storage reservoir) there are more than 20 main common species which belong to different families, some of them are described in the Table 4.2.3b.

However from the interview it was found that there is one type of fish which is only known to this area, its local name is “**Pa Nhoy**” its highest weight caught (in fact hunted – by shooting with military rifle or home made spear) at Ban Chim was about 5-10 kilograms/fish, and according to the villagers, Pa Nhoy lives only in streams or small rivers and confines to the tributaries within and the surrounding area of the project site. Impounding water resulting from the dam construction may limit the aquatic habitat of Pa Nhoy which may lead to reduction in population in the area. However and luckily Pa Nhoy will not be threatened as specie, as Nam Chat and others streams in the surrounding areas where Pa Nhoy is also found, are outside the impounding areas of both Nam Ngum 5 and Nam Ngum 3 project. Table below shows main species of fish found within and in surrounding project area.

From the survey and the interview of villagers from the seven villages within and the surrounding study area, it was found that most households involved in traditional fishing activities; they are using nets (mainly gill nets, others are cast net, scoop net) hooks and other local traditional fishing tools made from bamboo such as traps of various types and so on Other common non traditional but illegal fishing method used are explosives, rifles, poisons and electrical rod etc.. Due to lack of law enforcement and control from the authorities such nontraditional techniques of fishing are widespread and most detrimental to aquatic life in the region.

The majority of the local villagers fish on a part time basis or as a passing time activity or for their own daily consumption especially during the dry season; as such there was no commercial fisherman in the project area. However occasional surplus catches from these part time fishermen or women usually form a major part in general local enterprise within and the surrounding project area. Although fishing is not a main activity among the villages, it is however the main source of protein diet and a supplementary income activity for most villagers in addition to NTFPs collection activity during the dry season when agricultural production is in its lowest time.

**Table 3.2.3b: Main Fish and other Aquatic life Conditions within the Study Areas**

Lao/Local Name	Scientific Name	Nam Ting River	Nam Phat River	Nam Soud River	Status
1. Pa Nhoy	-	✓	✗	✗	Rare
2. Pa Khiengphai	<i>Onychochostoma sp.</i>	✓	✓	✗	Rare
3. Pa Chath	<i>Propopuntius cf. laoensis</i>	✓	✓	✓	Rare
4. Pa Douk	<i>Clarias macrocephalus Gunther</i>	✓	✓	✓	
5. Pa Khor	<i>Channa striata</i>	✓	✓	✗	Rare
6. Pa khea	<i>Bagarius yarrelli</i>	✓	✗	✗	Rare
7. Pa Kot	<i>Hemibagrus wycki</i>	✓	✓	✗	Rare
8. Pa Pak	<i>Hypsibarbus pierrei</i>	✓	✓	✗	Rare
9. Pa Lot	<i>Macrognathus taeniagaster</i>	✓	✓	✓	
10. Pa Lath	<i>Mastacembelus favus Hora</i>	✓	✓	✗	Rare
11. Pa Kang	<i>Channa gachua Hamilton</i>	✓	✓	✓	
12. Pa Khao	<i>cf. Systomus sp.</i>	✓	✓	✓	
13. Pa Sout	<i>Hampala dispar Smith</i>	✓	✓	✗	Rare
14. Pa Phai	<i>Danio cf. aequipinnatus McClelland</i>	✓	✓	✗	Rare
15. Pa Hangdeng	<i>Discherodontus ashmeadi Fowler</i>	✓	✓	✗	
16. Pa Langnam	<i>Mystacoleucus atridorsalis Fowler</i>	✓	✓	✗	
17. Pa Khao-noy	<i>Systomus aurotaeniatus</i>	✓	✓	✓	
18. Pa Khao-mon	<i>Puntius brevis</i>	✓	✓	✗	
19. Pa Soy	<i>Henicorhynchus lineatus</i>	✓	✓	✓	
20. Pa Khikhom	<i>Osteochilus lini Fowler</i>	✓	✓	✗	Rare
21. Two main species of crab		✓	✓	✓	

Note: ✓: Indicates "Appearance". ✗: Indicates "Disappearance"

### 3.2.4. National Biodiversity Conservation Areas (NBCAs) and Protected Areas

The Government of Lao PDR has developed a national protected area system for several years. The program to establish a national biodiversity conservation system<sup>4</sup> has been active since 1989. PM's Decree N<sup>o</sup> 164/1993 firstly established 18 NBCAs covering approximately 10% of the land area of the country, a further two (Dong Phou Vieng and Xe Sap) were added in 1995-1996 plus two corridor areas. The current area totals 3.4 million hectares or 14.3% of the country's area. In addition, provinces and districts have designated their own conservation areas<sup>5</sup> and protection forests<sup>6</sup> bringing the overall national total to 5,3 million hectares or 22.6% of the total land area.

Ministry of Agriculture and Forestry (MAF) has overall responsibility for management of all categories of forest including those NBCAs. Responsibility is delegated to the Department of Forestry (DoF), with the Forest Resource Conservation Division (FRCD) in the role of technical unit. From DOF (FRCD) decentralized responsibilities are with the Provincial Agriculture and Forestry Division (PAFO) and the District Agriculture and Forestry Extension Offices (DAFEO) who manage the conservation forests, aquatic animals and

<sup>4</sup> The Lao term '*Pa Sa-nguan Heng Sat*' means '*national conservation forest*'. To distinguish them from other types of conservation forest, the term 'National Biodiversity Conservation Areas (NBCA)', which more accurately reflects Government intent according to the wording of the Decree, has been adopted for English use (*Berkmüller et al. 1995*).

<sup>5</sup> 57 provincial biodiversity conservation areas (PBCAs) totaling 932,000 ha and 144 district biodiversity conservation areas (DBCAs) totaling 504,000 ha.

<sup>6</sup> 23 provincial protection forests totaling 461,000 ha, and 52 district protection forests totaling 56,000 ha.

wildlife within their jurisdiction. The DAFOs themselves must in turn cooperate with people living inside and on the periphery of the relevant forests.

In addition to the NBCAs, the provinces and districts have also established a number of Provincial and District Protected Areas (PPAs and DPAs) including protection forests<sup>7</sup>. The location of these PPAs and DPAs is quite difficult to confirm especially in the field areas, as the Provincial Agriculture and Forestry Division (PAFOs) have no accurate maps of these areas except for the lists and numbers of PPA and DPA.

However, as the result of conversion of land use and forest types, most of the land and forests within the project area have been disrupted by human activities (logging, slash and burn cultivation and others), and therefore it is unlikely there would be any forest conservation of any kind still existed.

The pre-survey for selecting of the project was conducted and determined by the other survey teams before conducting IEE survey, the specific location of naturally vegetated areas, or areas of secondary species-rich vegetation cover like NBCAs, PPAs, DPAs as well as protection forests was confirmed in advance before the project has been sited and designed so as to avoid such important areas, wherever possible.

Amongst 20 NBCAs throughout the country, only Nam Et-Phouleui NBCA with the total area of about 320,000 ha situates in Luangprabang province; the project area situates well out side and some distances away from it. The project area does not contain any form of protected areas or forests of any kind hence impose no thread to NBCA or protected areas or forests in this region (see Annex Figure 3.2.4).

**Table 3.2.4: Summary of Biodiversity Conservation & Protection Areas (Nationwide)**

<u>Category</u>	<u>No. of areas</u>	<u>Total area (Ha)</u>	<u>% to national land area</u>
NBCAs or NPAs	20	3,313,596	13.99
Provincial Conservation Forests	57	931,969	3.94
Provincial Protection Forests	23	461,410	1.95
District Conservation Forests	144	503,733	2.12
District Protection Forests	52	55,713	0.23
Corridors	2	77,170	0,33
<b>TOTAL</b>	<b>278</b>	<b>5,343,591</b>	<b>22.56</b>

Source: Department of Forestry (2002).

### 3.3. Social , Cul tural and Other Conditions

The demographic, ethnic, socio-economic and cultural conditions within the Project area have been documented using a variety of primary and secondary sources. In order to provide data for load forecasting as well as the social analysis of the Project, the survey and interview were carried out for every affected village and households as mentioned in Section 3.3.1 (49 households from one affected village; Chim village). Before conducting survey and interview, a consultation process with the local authorities concerned such as District Administration Office, DAFEO and village authorities was also carried out.

<sup>7</sup> The Forestry Law also defines 'protection forests' as a distinct forest category (Art. 17) not intended for protection of biodiversity, environment or culture but for watershed protection, erosion control, national security and/or prevention of natural disasters.

Secondary sources of data/information included extensive district annual reports, provincial 2002 census data sets, demographic and other data collected directly from district and village authorities in the Project area; numerous studies, reports and other documents related to the project were also obtained.

### 3.3.1. Population and Demographics

The total population of Lao PDR stands at 5.6 million with 2.8 million is female. At 2.8 million, the proportion of people aged 15-54 years is 48% of the total (*Initial Report on Census at provincial and district levels, NSC, Sept. 2005*). The national average for life expectancy at birth is 54 years (*World Bank, 2000*). This means that the population is very young, with more than 40% aged less than 15 years.

In terms of population distribution, 88% of Lao people lived in rural and remote areas and only 12% lived in urban areas (*NSC, Sept. 2005*). The rural village is the basic social unit of the country. According to the 2005 census, across the country there are nearly 10,600 villages and 140 districts. The average village population is 500, although actual settlements may range from as few as 20-30 households, to larger villages of more than 300 households.

The predominantly rural nature of Lao PDR means population densities are very low. The national average in 2005 is 24 persons/km<sup>2</sup>. The average population density in rural and remote areas is 9 persons/km<sup>2</sup> and in Vientiane Capital City is 177 persons/km<sup>2</sup>. The regional distribution of population densities with central region is 24 persons/km<sup>2</sup>, while northern and southern regions are 18 persons/km<sup>2</sup> and 23 persons/km<sup>2</sup> respectively (*CPC-NSC, 2005*).

As mentioned earlier, the project covers two provinces, two districts and only one village (Chim village) with total household is 155 and total population is 994 people while only 49 households are directly affected by the project. The table below shows number of households being affected by inundation and that are not affected.

**Table 3.3.1: Villages and Households within the Project Study Area**

<b>Project Study Area</b>	<b>Phoukhoun District</b>				<b>Phoukout District</b>		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
	Chim	Long-mieng	Phavai	Namadao	Som-boune	Namchat	Xiengdet
Total No. of households	155	60	21	44	60	91	96
Total population	994	373	140	284	428	491	475
Female	378	192	66	150	218	255	222
Affected households	49	0	0	0	0	0	0

### 3.3.2. Ethnic Composition

Ethnically, Lao PDR is highly diverse, both in terms of number of ethno-linguistic groups and in the breadth of their higher linguistic diversity. More than 230 spoken languages, belonging to four language super stocks, have been identified, making Lao one of the world's most diverse countries. With respect to location, the areas of highest



diversity are often in the remotest upland areas, particularly northern within and around NBCAs. The 2000 Census identified 49 different groups with sub-groups totaling over 200 (ADB, 2000). Ethnic groups within the Lao territory are grouped in four major ethnolinguistic families. These families commonly grouped into three categories that reflect the dominant languages, settlement patterns and agricultural practices.

- Ethnic Lao, Tai Dam, Tai Deng, Lue, Phutai and other members of the Tai-Kadai family are also referred to as Lao Loum or “Lao of the valley”. Together, they constitute about 67% of the population of Lao PDR; the ethnic Lao, about 52%. They tend to live in river valleys and plains up to elevations of 200-400 meters where they practice irrigated paddy rice cultivation. In general, Lao Loum speak the national language and are practicing Buddhists.
- Khmu and other members of the Austro-Asiatic family of ethnic groups have been present in Southeast Asia for over 5,000 years. In Lao PDR, there are at least 35 ethnic groups in this family, comprising about 23% of the population. Also referred to as Lao Theung or “Lao of the mountain slopes”, they tend to inhabit the intermediate slopes, foothills and upper valley areas at elevations of 300-900 meters. They have traditionally practiced upland rice or swidden cultivation, with a community rotating fields from a permanent village. Many of these ethnic groups speak their own languages and most are animists.
- The ethnic groups of the Miao-Yao and Sino-Tibetan families make up about 10% of the population of Laos, having migrated from China and Viet Nam 100-150 years ago. Also known as Lao Soung, or “Lao of the mountain tops”, they generally live in high mountain areas at elevations of 800-1,600 meters. They also practice swidden cultivation, although they tend to be semi-migratory, moving their villages when existing plots decline in productivity. As with Lao Theung, many Lao Soung groups speak their own languages and are animists.

The level of integration of different ethnic groups in Lao PDR depends on a number of factors. In general, ethnic groups are distinguished by social structures and patterns of participation, as well as by how they allocate and use of land and other resources for living and maintaining livelihoods. Ethnic Lao and other lowland groups, as mentioned, generally speak Lao, the national language, and are considered to constitute the “mainstream” of Lao society. Ethnic groups classified as Lao Theung and Lao Soung are considered ethnic minorities due to, among other reasons, the fact that many groups constitute less than 1% of the national population and, cumulatively, they make up about one-third of the population. They also tend to live in more remote areas, do not traditionally practice paddy rice cultivation and frequently most of them are unable to speak Lao.

However, due to the frequent movement of Lao villages, there are varying degrees of integration of different ethnic groups. These movements have occurred due to traditional patterns of swidden cultivation (or shifting cultivation) among Lao Theung and Lao Soung groups; displacements caused by war; and, GOL policies to relocate villages to stop shifting cultivation and/or to combine many small villages into one big village for effective development and administration. There are now many rural villages with 2-4 major ethnic groups, compared with traditional patterns of a single ethnic group in a village. As a consequence, many Khmu and other Lao Theung now practice paddy rice cultivation, instead of or in addition to swidden or shifting cultivation. However, most Lao Soung continue to practice only swidden cultivation because most of them live in the northern upland areas.

As mentioned early, the project area encompasses only two districts in two provinces and one special zone, while only one village (namely Chim) and 55 households are directly affected by the project which consists of 3 small ethnic groups namely *Lao, Hmong and Khmu*. Almost all of them practice paddy rice cultivation, while some of them practice swidden cultivation (or rotational/shifting cultivation), see details in Table below.

**Table 3.3.2: Summary of Ethnic Composition**

Items	Luangprabang	Xiengkhouang
	Phoukhoun District	Phoukout District
<b><u>Overall Districts</u></b>		
Total Village	43	42
Total Household	3,117	3,899
Total population	20,233	24,445
Female	10,003	11,911
Ethnic population	667	1,116
% of Ethnic population	3.3	4.6
<b><u>Within Project Area</u></b>		
Total Affected Village	1	0
Total Household	155	0
Total population	994	0
Female	378	0
Ethnic population	980	0
% of Ethnic population	98.6	0
<b><u>Percent of Ethnic Group within Project Area based on Ethno-linguistic groups</u></b>		
1. Tai-Kadai	14 (1.4%)	0
2. Mon-Khmer	477 (48.0%)	0
3. Hmong-Mien	503 (50.6%)	0
4. Sino-Tibetan	0	0
5. Not State	0	0

*Sources:*

- For overall district, data is based on Initial Report for the National Census 2005 (NSC).
- For the Project Area, data is based on field data collection and interview (May, 2005).
- The Project Area here is focused on the villages locate within the catchment area that will be directly affected.

### 3.3.3. Health and Educational Conditions

The social well-being of a country relates to its ability to meet basic human needs as indicated by health, including, maternal and child health, nutrition and access to safe drinking water, sanitation and, education, including educational achievement and literacy. Overall, the levels of social well-being in Lao PDR tend to be low, in absolute terms and in comparison with other countries. Reflecting overall national trend with respect to level of health and education, the villagers living within and the surrounding area, are low and poor.

**Health and disease conditions within the Project area:**

The Table below summarizes some of the disease conditions during the last three years that occurred within the project area. Some of the diseases are not very dangerous or life threatening, but others need to be closely monitored and paid attention to such diseases are *Malaria, Dengue fever and Tuber Culosis*, which given the right condition can easily break out.

**Table 3.3.3a: Disease Conditions during the last five years within the Project Area**

	Phoukhoun District				Phoukout District		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
<b>Diseases</b>	Chim	Longmieng	Phavai	Namadao	Somboun	Namchat	Xiengdet
Malaria	✓				✓	✓	✓
Grippe ( <i>Khai Watt</i> )			✓	✓	✓		
Tuber Culosis ( <i>Vannalokport</i> )		✓					
Diarrhea ( <i>Thok Thong</i> )	✓	✓	✓	✓	✓	✓	✓
<i>Dengue fever</i>	✓	✓					

Note: This focused only within the Project Study Area.

**Education:**

Table below shows that the educational levels of the villagers within and around the project area are quite different. It was found that for each village and district, a large numbers of illiteracy are still existed, despite some claims of total literacy achievement. As shown in the table below Ban Chim has lowest % illiteracy (less than 10%), while Ban Namadao and Ban Phavai has highest illiteracy rate (over 90%)

**Table 3.3.3b: Educational Level of Villagers within the Study Area**

	Phoukhoun District				Phoukout District		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
<b>Educational Levels</b>	Chim	Longmieng	Phavai	Namadao	Somboun	Namchat	Xiengdet
Uneducated:	40	73	128	259	75	28	48
<i>Female</i>	25	51	66	145	50	5	32
Literacy/Primary School:	328	60	8	20	25	28	62
<i>Female</i>	204	25	0	5	10	7	14
Lower Secondary School:	45	15	4	4	5	16	8
<i>Female</i>	15	4	0	0	0	1	1
Upper Secondary School:	20	0	0	1	2	3	1
<i>Female</i>	5	0	0	0	0	0	0
<b><u>Grand Total:</u></b>	<b><u>433</u></b>	<b><u>148</u></b>	<b><u>140</u></b>	<b><u>284</u></b>	<b><u>107</u></b>	<b><u>75</u></b>	<b><u>119</u></b>
<b><u>Female</u></b>	<b><u>249</u></b>	<b><u>80</u></b>	<b><u>66</u></b>	<b><u>150</u></b>	<b><u>60</u></b>	<b><u>13</u></b>	<b><u>47</u></b>

Note: This focused only within the study area and the children under 6 years old and the old persons more than 55 are not included.

**Labour Force:**

Within the Project area, based on the survey, and as shown in the table below Ban Chim has available over four hundred main labour forces and nearly three hundred secondary labour forces and next in line is Ban Xiengdet. Whose proximity is around powerhouse area therefore the available of labour force would be a great advantage in the construction of the powerhouse and construction activities. The Table below summarizes the number of main and secondary labours which are available for and can be committed to any activities during the Project construction as well as operational phase.

**Table 3.3.3c: Summary of the Number of Labour Force within the Project Area**

	Phoukhoun District				Phoukout District		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
Type of Labour	Chim	Longmieng	Phavai	Namadao	Somboun	Namchat	Xiengdet
<b><u>Main Labour:</u></b>	<b><u>436</u></b>	<b><u>125</u></b>	<b><u>45</u></b>	<b><u>45</u></b>	<b><u>130</u></b>	<b><u>122</u></b>	<b><u>178</u></b>
Male	372	65	23	30	60	52	85
Female	64	60	22	15	70	70	93
<b><u>Secondary Labour:</u></b>	<b><u>279</u></b>	<b><u>18</u></b>	<b><u>18</u></b>	<b><u>30</u></b>	<b><u>50</u></b>	<b><u>56</u></b>	<b><u>44</u></b>
Male	122	8	13	20	22	14	24
Female	157	10	5	10	28	42	20

Note: This focused only within the Project Study Area with the persons who are between 15 and 50 years old were seen as main labour and between 50 and 60 years old were seen as secondary labour.

### 3.3.4. UXO Conditions

UXO contamination is a very serious problem for the Lao PDR. In addition to the human suffering and loss of life, UXO contamination blocks development in large areas of the country. Thus the National UXO Decontamination Program addresses this issue which the government of Lao PDR considers as part of an important factor in implementing its poverty eradication program.



During a ten-year period (1964 to 1973), the Lao PDR experienced intense ground battles and aerial carpet bombings. It is estimated that over 500,000 bombing missions were launched over Lao PDR, and more than 2 million tons of ordnance were dropped during the 1964-1973 in Lao PDR, while about 30% of ordnance failed to explode, leaving large areas of the country littered with unexploded ordnance (UXO). Severe UXO contamination still affects 15 provinces; Luangprebang and Xiengkhouang are among the worst affected areas (NGPES, 2004). The affected areas represent over 50% of all agricultural land (MAF/JICA, 2001).



Three decades after the Indochina War, many people are still being killed or badly crippled from this ordnance. The litter of highly dangerous ordnance denies access to much needed land, deters the planting of crops and grazing of livestock, and hinders collecting fuel and water. It also discourages movement between villages and slows up transport and communication works, and generally undermines social and development activities.

According to the interview of villagers carried out during the survey, paying particular attention to the construction areas such as the dam and powerhouse, there were no severe UXO contaminations. This was due mainly to successive agricultural activities such as clearing and burning, as well as being a non-strategic locality (during the war time) was spare from the enemy's bombardment. However, according to the villagers' interview we see that there are some UXO types still remain within and around the project areas especially within the non-agricultural areas, but in small quantity as indicate in Table below.

From these interviews and from the local information we acquired, it was evident that in general these areas in particular the project areas are clear from UXO.

**Table 3.3.4: Summary of UXO Conditions within the Study Area based on Villagers' Interview**

Project Study Area 	Phoukhoun District				Phoukout District		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
Type of UXO 	Chim	Long-mieng	Phavai	Nam-madao	Som-boun	Namchat	Xiengdet
	N= 55	N= 24	N= 16	N= 22	N= 25	N= 30	N= 32
M 79	✓	✓		✓			✓
DK		✓			✓		
DK 52					✓		
105 mm	✓	✓	✓		✓		✓
60 mm	✓	✓		✓	✓		✓
82 mm	✓	✓	✓	✓	✓		✓
BLU-3	✓	✓	✓	✓	✓	✓	✓
BLU-26-B	✓	✓	✓	✓	✓	✓	✓
BLU-42-B	✓	✓	✓	✓	✓	✓	✓

Project Study Area 	Phoukhoun District				Phoukout District		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
Type of UXO 	Chim	Long-mieng	Phavai	Nam-madao	Som-boun	Namchat	Xiengdet
	N= 55	N= 24	N= 16	N= 22	N= 25	N= 30	N= 32
BLU-61	✓	✓	✓	✓	✓	✓	✓
BLU-63-B	✓	✓	✓	✓	✓	✓	✓
M-26-A-2 and M-67		✓	✓				
MK81/250	✓				✓		✓
MK82/500	✓						
Chemical Bomb		✓					✓
Others		✓			✓	✓	✓

Note: N = Indicates number of respondents. ✓: Indicates "Appearance".

### 3.4. Economic Conditions

#### 3.4.1. General Conditions

According to the National Growth and Poverty Eradication Strategy (NGPES, January, 2004), generally, poverty has indeed decreased dramatically over the last decade, as shown through the Lao Expenditure and Consumption Surveys (LECS). LECS-I in 1992/93 showed that 45% of the population was living below the poverty line. In 1997/98 (LECS-II) this proportion declined to 38.6% of the population – a significant reduction in the incidence of poverty. Preliminary data from LECS-III in 2002/2003 indicates that the poverty level may have fallen further to about 30%. This is very encouraging.

Agricultural households in Lao PDR are primarily subsistence farmers, with 94% of holdings producing mainly for their own consumption<sup>8</sup>. In 1997-1998, 67% of employed persons were involved in subsistence agriculture, including 26% of people working in urban areas and 74% of people working in rural areas. Table 3.4.3a summarizes the percentage of households working in subsistence agriculture and other activities in the affected districts within the Project Area.

Approximately 18% of all agricultural land cultivated in 1998/99 had been cleared the previous year, with the Northern provinces having the highest rates of slash-and-burn cultivation in upland areas. Due to insufficient water during the dry season, farmers generally grow one rice crop (upland rice) per year, during the rainy season. About 25% of land holdings in Lao PDR also grow maize. Vegetables are grown in small gardens along riverbanks, for household consumption and sale. Permanent agriculture production within the Project area is only cash crops and rice. Table below compare the amount of agriculture and livestock production of the two provinces to national statistic.

<sup>8</sup> Agriculture production and livelihood systems are discussed in more detail in Section 3.4.3.

**Table 3.4.1: Summary of Rice and Crops Production and Livestock in 2004/2005**

Item	Whole Country (Ton)	Luangprabang (Ton)	Xiengkhouang (Ton)
<b><i>I. Rice and other Crops</i></b>			
Total of Rice Paddy	2,568,000	98,390	79,450
Seasonal/Lowland Rice	2,082,100	52,000	64,000
Irrigated Rice	271,100	6,790	250
Upland Rice	214,800	39,600	15,200
Maize	372,560	15,050	18,000
Starchy Roots	175,200	13,700	11,570
Mung Beans	2,100	245	90
Soy Beans	4,700	1,025	230
Peanut	12,400	727	445
Sesame	6,200	2,950	NA
Coffee	23,100	25	25
Tea	300	NA	NA
Tobacco	33,000	NA	NA
Cotton	2,200	96	NA
Sugarcane	223,300	2,450	NA
Pineapple	NA	500	240
<b><i>II. Livestock</i></b>	<b><i>(Heads)</i></b>	<b><i>(Heads)</i></b>	<b><i>(Heads)</i></b>
Buffaloes	1,095,800	57,000	44,000
Cattle	1,272,200	39,000	89,000
Goat and Sheep	190,000	36,100	6,700
Pig	1,825,600	151,000	76,000
Poultry	19,801,100	1,345,000	793,000

Source: Agricultural Statistics 2006 (Ministry of Agriculture and Forestry).

Household consumption expenditures for food are used to assess poverty in Lao PDR. Households that allocate 60% or more of their expenditures for the food are considered to be poor. Households that allocate 80% or more are considered to be extremely or "ultra" poor. In 1992-93 in Lao PDR, over 65% of the population lived in conditions of poverty, with 46.1% of the population deemed poor and 21.6%, "ultra" poor (World Bank, 1995).

### 3.4.2. Economic Conditions within the Project Study Area

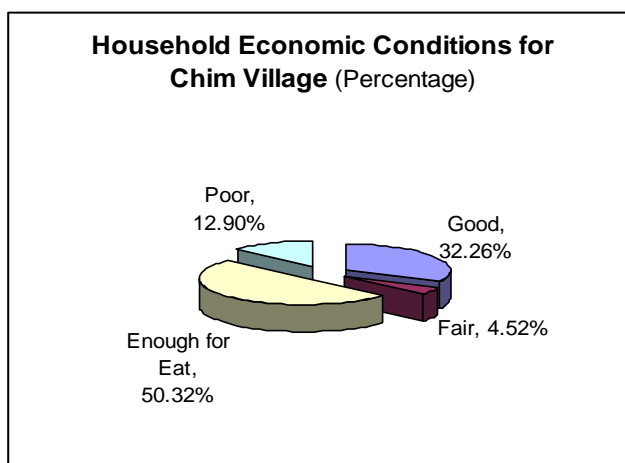
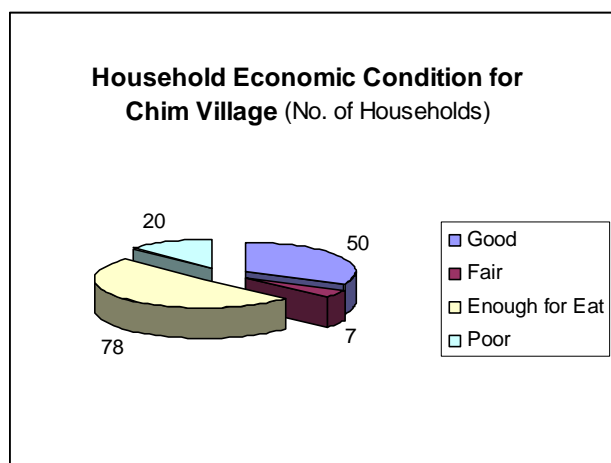
Based on the NGPES (2004) among two districts within the project area, only Phoukhoun district is identified as poor district with total number of 43 villages, while 18 villages were considered as poor, total number of household is 3,117 while 1,964 households or 63% is identified as poor where the total population is 20,233 of which female is 10,003.

Based on the survey and villagers' interview especially within and around the project area most of the villagers are still poor, except for Ban Chim village where most households were considered "above poverty line" this was due to "high incomes" deriving from permanent paddy field rice cultivation.

**Table 3.4.2: Economic conditions among villages within the Project Study Areas**

Economic Conditions	Phoukhoun District				Phoukout District		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
	Chim	Long-mieng	Phavai	Namadao	Som-boune	Namchat	Xiengdet
Good	50	0	0	6	0	0	0
Fair	7	0	0	17	0	2	18
Enough for eat	78	8	3	13	9	63	49
Poor	20	52	18	8	51	26	29

Note: The figures in the Table indicate Number of Households.



### 3.4.3. Agricultural Production and Livelihood Systems

As mentioned early, most of the Lao people especially rural population, involve their livelihood mainly with agricultural productions which include a diversity of cultivation such as paddy rice cultivation, swidden cultivation, upland cultivation, cultivation of vegetable and crash crops, animal rising, fishing and harvesting of NTFPs, and others.

Almost 100% of the study area is mountainous; most of the villagers rely on swidden cultivation and grazing their livestock in the upland area on the mountain slopes. Only very small portion of land along the river flat such as Nam Ting in Ban Chim area that



permanent rice paddy cultivation is feasible, and had been exploited by some households in Ban Chim for few years; however this would be inundated after the construction of the dam.

### **Rice cultivation:**

In Lao PDR there are two main agro-systems such as *rice paddy cultivation* and *swidden cultivation* which included shifting cultivation and rotational cultivation. The most common are rice paddy cultivation method and are widely practiced among the lowlanders, with availability of irrigation system double cropping per year are normally achieved. The swidden methods are most common among the highlanders-mainly ethnic minorities especially in the northern part of the Lao PDR including the project area. However, within the project area especially Chim village, there are 53 households practice rice paddy field who will be affected by the project and some of them do the shifting cultivation.

### **Cash Crops:**

Some households within the Project area practice temporary vegetable gardens near streams and houses where they grow a wide variety of vegetables and crops for household consumption. Swidden households also grow a wide diversity of crops and vegetables during the rainy season, either intercropped with rice during the rainy season or in small plots near to the houses during both rainy and early dry seasons especially vegetables, maize, starchy roots and others.

Subsistence households consume the majority of their crops, for either diet variation or for supplementation during rice shortages or to meet basic needs or some time they use them as animal feed. Surplus vegetables and cash crops are sold in local markets. Due to lower levels of productivity and greater distances to markets and lacking transportation, most of their crop production is for household consuming.

### **Animal rising:**

Generally, nearly 90% of rural households raise one or more kinds of livestock, the sale of which contributes a major source of cash incomes. On average, a household will keep 1 buffalo and 2-3 heads of cattle. Cattle are like household savings, they can be cashed in in time of needs. Buffalo keeping are mainly for use as draught animals in rice paddies, however in today world of technology, they are being replaced by Tok Tok multifunction tractor. Goats have also been becoming very popular livestock among the villagers within the project area as they are hardy animal and in high demand for its meet and for sale. Villagers have also raised pigs and poultry such as chicken and ducks, for their own consumption and for occasional sale.

### **Fishing and NTFPs Collection:**

Fishing is an important secondary activity for many rural households and in general fish are the main source of protein in the household diet as well as being a source of cash income.

Within the project area some households fish in the streams, lakes and seasonal floodplains. Simple gill net, casting nets and other traditional fishing equipment are the only fishing instrument employed. Illegal fishing technique such as using of explosive, using of poison, despite the government crackdown is still widely practiced, in particular within the project area.

NTFPs play a central role in the rural economy, as they provide: 1) animal proteins (from wild meat, fish, frogs, shrimp, soft-shelled turtles, crabs and molluscs), 2) calories, vitamins and dietary fiber (from mushrooms, bamboo shoots, fruits and vegetables, honey), 3) materials for house construction and handicraft production (bamboo, rattan, pandanus,

broom grass, paper mulberry), 4) traditional medicines and 5) cash income (from the sale of NTFP species).

Within and around the project areas, apart from rice and other crops production, livestock and fishing which are seen as sources of income, NTFPs are also seen as important natural sources of most villagers who live traditionally dependent on natural resources for support their livelihoods (see Tables 3.4.3a and 3.4.3b). Main NTFPs are available within and around the project area and have also high potential for generate family income include: rattan, wild mushrooms, bamboo shoot, wild fruits, wild vegetables, Nhot-Nhe (*Calumus sp.*), Nhot-Boun (*Daemonorops schmidtii*) and others. However, the most mentioned NTFPs are available only in the forest areas that locate outside of the project area.

### **Handicrafts and home businesses:**

Traditional handicraft within the project area is only for household consumption. Some of these include weaving and basketry made from bamboo especially among Lao Soung group. From our survey however, villagers that are within the Project area are not involving in weaving or basketry as much as some part of the country. Small home businesses tend to focus only on activities that related to selling drinks and small consumption goods.

### **Income and Sources of income:**

Based on the results from on-site survey and villagers' interview, the results from Table below shows that villagers within and around the project area have many different sources of income. However, the main sources of income of most villagers are agricultural production and livestock and non-timber forest products collection and fishing due to most of the villagers within and around the project area are directly dependent on natural forest to support their livelihood (see Table 3.4.3a). The results indicate that the villagers who live within and around the project area derive their incomes from various sources.

**Table 3.4.3a: Sources of Income within Study Area based on Villagers' interview**

	Phoukhoun District								Phoukout District					
	Affected Village		Villages outside the Project area						Villages outside the Project area					
Name of Village	Chim		Longmieng		Phavai		Namadao		Somboune		Namchat		Xiengdet	
Total No. of HH	155		60		21		44		60		91		96	
Main Sources of Income	No. of HH	%	No. of HH	%	No. of HH	%	No. of HH	%	No. of HH	%	No. of HH	%	No. of HH	%
Agricultural Production and Livestock	92	59	60	100	20	95	44	100	60	100	50	55	85	88
Non-timber Forest Products (NTFPs) and fishing	100	65	58	97	0	0	44	100	0	0	0	0	0	0
Small business and services	28	18	2	3	0	0	5	0	0	0	3	3	0	0
Handcraft and small scale industry	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Government/Private employees or workers	40	26	0	0	0	0	0	0	0	0	0	0	0	0

Others	5	3	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>265</b>		<b>120</b>		<b>20</b>		<b>57</b>		<b>60</b>		<b>53</b>		<b>85</b>	

Note: - This focused only on the villages locate within and outside the proposed catchment area.  
 - HH: Indicates Number of Household within surveyed Villages.

**Table 3.4.3b: Main Cash Income for 2004-05 based on Villagers' Interview**

( 1,000 Kip)

<b>Main Cash Income</b>	<b>Phoukhoun District</b>				<b>Phoukout District</b>		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
	Chim	Longmieng	Phavai	Namadao	Somboune	Namchat	Xiengdet
Agricultural Production and Livestock	199,000	25,000	NA	NA	NA	14,000	46,000
Non-timber Forest Products (NTFPs) and fishing	220,500	35,000	NA	7,000	NA	NA	NA
Small business and services	100,600	2,000	NA	600	NA	130	NA
Handcraft and small scale industry	NA	NA	NA	2,400	NA	NA	NA
Government/Private employees or workers	4,000	NA	NA	NA	NA	NA	NA
Others	12,000	NA	NA	NA	NA	NA	NA
<b>Total</b>	<b>536,100</b>	<b>62,000</b>	<b>-</b>	<b>10,000</b>	<b>-</b>	<b>14,130</b>	<b>46,000</b>

Note: - NA = Not Available  
 - This focused only on the villages locate within and outside the proposed catchment area.

**3.4.4. Commercial and Industrial Activities**

Based on the available information within the study area there are some small shops for selling consumptive uses. Most rural villages have no commercial facilities due to lack of electricity and other facilities. Other villages on well-access road or at road intersections have some small kiosks that sell drinks, fruit, cigarettes and other consumer items. They also have small restaurants that prepare and sell food such as at Phou Khoun junction, and central Phou Kout district. No industrial activity of any kind exists within the project area, this was due mainly to small and scattered population centre hence, providing insufficient demand to warrant the supply

**3.4.5. Infrastructure, Facility and other Development Activity Conditions**

The project area is relatively remote and situates outside of the demographic centre of the region such as Phou Khoun and Phou Koud districts, therefore the availability of the infrastructure and other facilities are very limited. However RN13 and RN7 and major tracks such as Ban Chim track and Ban Xiengdet track, recently upgraded provide

essential accessibility and also play a very important factor in socio-economic development to the project area.

Since the project area is located in the mountainous and remote area, far away from the main centres, none of the villages has electricity, for some of the villages situate along RN7; Ban Chim is the only village in the project area has reticulated water supply, primary school, dispensary, village weekly market and bus. Some villages locate along the National Road No. 13 north and road No. 7 to Xiengkhouang province is far more advantages in comparison to the villages in a remote part of the project area.

#### **3.4.6. Energy Consumption**

Rural households in Lao PDR use a combination of traditional, intermediate and modern energy resources and technologies. In areas where there is no electricity the main source of energy for cooking, heating and other processing activities is firewood. According to FAO, 1999, the consumption of fuel-wood including wood for charcoal in Lao PDR in 1999 is averaged at 0.775m<sup>3</sup> per year per person. However, for the remote and mountainous areas, the consumption of firewood must be higher than in the urban area or in the areas that electricity is available.

Amongst villages locate within and around the project area and all of the villagers that have been interviewed are of no exception, their main energy source, for cooking and heating and to a degree for lighting are from fire wood. Project development such this would not have adverse impact to this communities as the demands are far less than the availability of the wood within the project area; besides the inundation area is quite a distance from the demographic centre of the community, hence collection of fire wood from this area is very un likely.

### **3.5. Annex Figures**

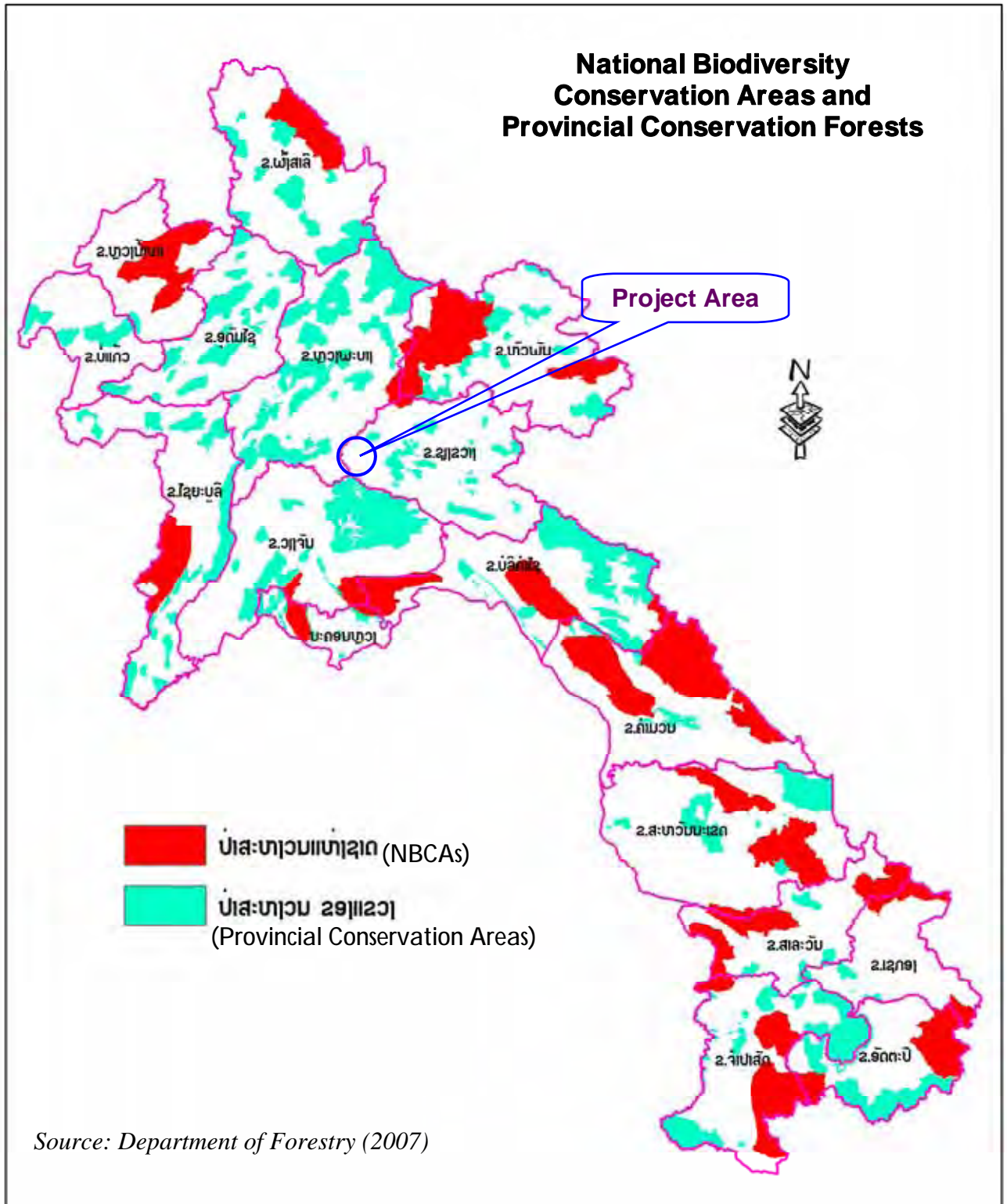
**Annex Figure 3.2.4: Map shows the Location of NBCAs and Provincial Conservation Forests Nationwide**

**Annex Figure 3.3.4: Map shows the Area of UXO Impact**

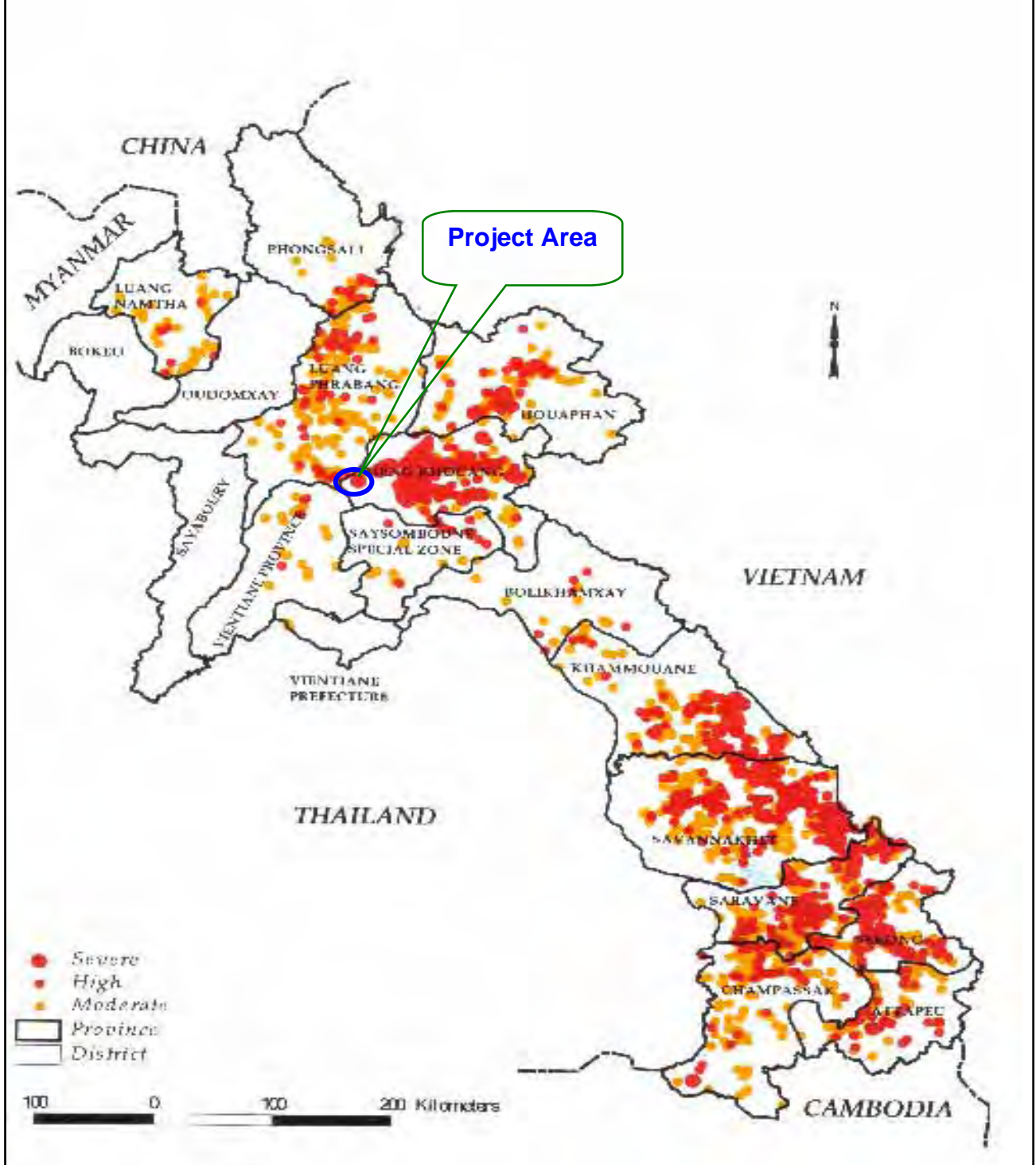
**Annex Figure 3.2.2: Land Use Types and Forest Cover Map of the Project Area**

**Annex Figure 3.2.4: Map shows the Location of NBCAs and Provincial Conservation Forests Nationwide**

*Source: Department of Forestry (2002)*



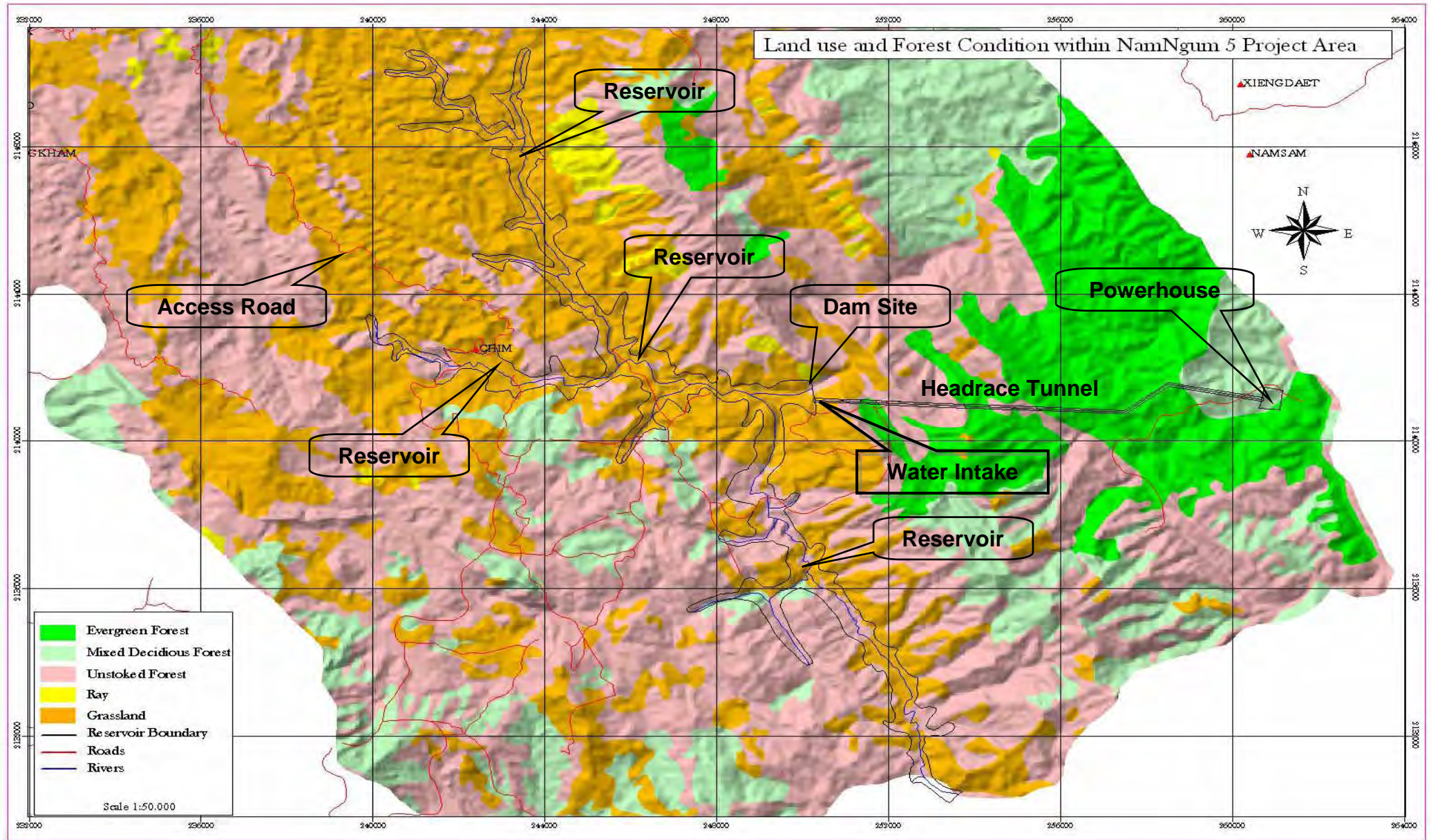
Annex Figure 3.3.4: Map shows the Area of UXO Impact



Source: Lao National UXO Programme (UXO Lao)



Figure 3.2.2: Land Use Types and Forest Cover Map of the Project Area





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## CHAPTER IV

# PROJECT ALTERNATIVES

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### 4.1. Rational

The Government of Lao (GOL) looks to hydropower development as the primary source of income for the country in the future. Concurrently with large and medium-sized hydropower projects, more attention will be given to small-size power plants for supplying electricity to rural areas. Every effort will be made to ensure that 70% of the households have electricity by 2010 (National Poverty Eradication Program, 2003).

The Lao PDR's hydropower potential is very considerable and its development offers extensive benefits for the country. Hydropower is already a major contributor to economic output, government revenues, and export earnings. However, only 623 Megawatts (MW) of an estimated 18,000 MW of hydropower potential has so far been developed. The Lao PDR has one of the lowest levels of electrification in Asia; only 20% of all villages and 34% of households have access to electricity. The development of the country's hydro-electrical potential and rural electrification is thus integral to the national development framework.

The key challenges in accelerating power development that the Government will address include the need for:

- A better and a more transparent integration of social and environmental concerns.
- Curtailing possible over-dependency of the economy on hydropower development.
- Increasing domestic tariffs to cover financial production costs, at least in urban areas, with a transparent subsidy scheme for poor rural areas.
- More effective sub-regional co-operation in producing and distributing electricity.
- Prioritization of proposed hydropower projects and development of suitable financing.
- Improvement of the regulatory framework and encouragement for increased private sector investment.
- Institutional strengthening, especially in financial planning, management, and negotiation capacity with developers.

The Government plans to expand electrification in remote areas through two methods. One is to expand the grid to comparatively easily accessible areas. The other is to provide off-grid supplies to remote areas where it is difficult to expand the present grid due to environment or cost reasons. Only ten per cent of rural areas are provided with grid electricity. From a gender equity perspective, easier access to electricity will facilitate the lives of women and reduce their household chores while contributing to poverty eradication. Since women in rural areas spend a great time in gathering fuel wood, at the expense of other more productive activities, increased accessibility to electricity in rural areas will improve living standards and help reduce poverty.

Energy consumption of the main economic sectors is increasing on average 10% per year. Therefore, the expansion of energy production in tandem with that of the electricity network is a major supporting priority for economic growth, especially in rural and remote areas. To achieve expansion of energy production and the electricity network, the policy and investment priorities include the following:

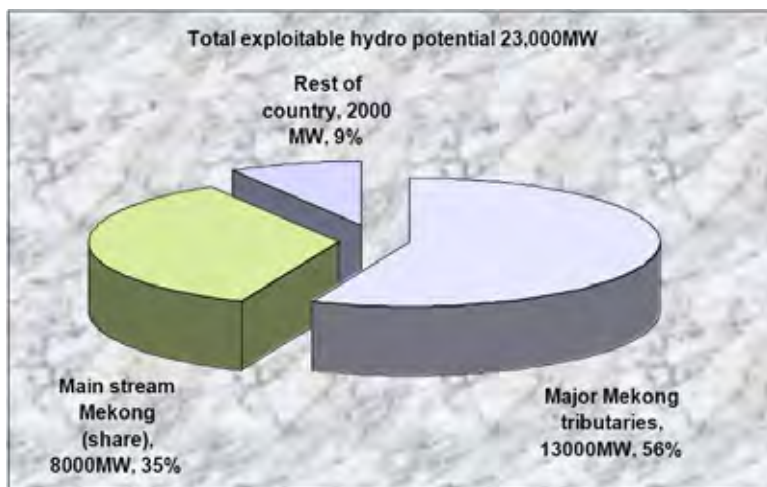
- Expand the electricity network to full coverage, starting with provinces and districts with very limited access to electricity.
- Complete construction of small and medium-scale projects (up to about 60 MW) for domestic utilization using government investment funds.
- Proceed with international investors.
- Construct a 500 KM high voltage electric transmission system.
- Possibly continue mini-developments (micro-hydropower, solar and wind energy projects for off-grid power supply in remote areas.

## 4.2. Hydropower in Lao PDR

### 4.2.1. Potential

A study done by the Mekong Committee in 1970 first identified the country’s huge potential for hydropower generation. UNDP (1993) identified hydropower as one of the country’s most promising development potentials. Forty-nine projects identified by Watco (1984) gave a total installed capacity potential of 19,500 MW.

**Figure 4.2.1: Total Exploitable Hydro Potential 23,000 MW**



source: EdL at UN Symposium on Hydropower and Sustainable development, Peking 2004

According to the report at the UN Symposium on Hydropower and sustainable development in Peking 2004 presented by EdL, theoretically, the hydropower potential of Lao PDR amounted about 26,000 MW (excluding mainstream Mekong) while the exploitable hydropower potential, including share of mainstream Mekong, around 23,000 MW.

Up to date only 671 MW of the estimated 23,000 MW of exploitable hydro potential has been harnessed so far. Compared with the total installed capacity of 685MW, the hydropower share of covers 98% and the rest of 2% is from diesel. From total of hydropower plants, 304MW (45%) are under EdL’s responsibility and another 360MW (54%) are owned by Independent Power Producer-IPP (2 projects) and the rest of 7 MW (1%) under provincial authority.

## 4.2.2. Power Demand

### 4.2.2.1. Domestic Market

The reference point in formulating a development plan for the domestic market is the forecast of demand established by the Government’s target of electrifying 90% of household by 2020 (currently only 41% of households in Lao PDR are electrified). This target will be achieved by:

- 1) Off-grid development – a program of off-grid electrification targets 150,000 household installations by 2020.
- 2) Grid extension program to increase on-grid household electrification to meet the balance of households required to achieve the GoL’s target.

**Table 4.2.2.1: Forecast of Domestic Power Demand of the Lao PDR**

Item	Unit	2002	2005	2010	2015	2020
<b>EdL PDP Demand Forecast:</b>						
Energy Consumption	GWh	968.8	1,839.3	2,775.9	3,716.8	4,834.2
Av. annual Growth Rate	%		24%	9%	6%	5%
Peak Load	MW	204.7	367.7	542.8	727.9	948.8
Av. annual Growth Rate	%		22%	8%	6%	5%
Load Factor	%	55.3%	55.6%	60.0%	60.0%	60.0%

Source: EdL, Ministry of Energy and Mining

According to the ADB report 2006, over 30,000 people, mainly in the rural north, in Lao People’s Democratic Republic will have access to electricity for the first time through a US\$30 million equivalent concessional loan approved today by the Asian Development Bank. Only 16% of Lao households have electricity and the proportion drops to below 2% in the countryside. By increasing the rural population’s access to power, the project will enhance economic growth. It will also complement the earlier and ongoing World Bank assistance for rural electrification in the central and southern parts of the country. The Power Transmission and Distribution Project will extend transmission lines to supply 22,700 new consumers in the provinces of Xieng Khouang and Xayaburi and the special region of Xaysomboun and 8,000 new customers in the Vientiane Plain.

### 4.2.2.2. Export Market

The Greater Mekong Sub-region (GMS), comprising Lao PDR, Thailand, Vietnam, Cambodia, Myanmar and Yunnan Province of the People’s Republic of China, is endowed with substantial energy reserves, but they are unevenly distributed between member countries. Due to its energy surplus and geographical location at the hub of the GMS region, Lao PDR is strategically positioned to play a significant role in promoting regional power trade. The primary markets for Lao PDR are Thailand and Vietnam. These markets are large compared with the potential supply from Lao PDR. Sales of electricity to neighbors remain the main target for a reliable and sustainable revenue stream to give GOL some

measure of financial self-sufficiency and a means to escape the poverty trap. Exports of surplus generation from domestic projects has long been making a valuable contribution and through the early and mid-nineties there was a natural correspondence in Thai and Lao policy to match the abundance of Lao hydropower potential with the high demand for electricity in Thailand. The 1995 capacity in Thailand was 13,000 MW. According to the Electricity Generating Authority of Thailand (EGAT) 1995 plan, power demand will justify the additional of an average of 1,800 MW of installed capacity per year for the next 10 years. In 1996, projections of power demand in Thailand to the year 2005 by the state owned Electricity Generating Authority of Thailand (EGAT) required the addition of 10% of installed capacity per year.

### 4.2.3. International Agreements

In 1993, an MOU was signed with the Thai Government to supply 1,500 MW to Thailand by the year 2000, this being superseded in June 1996 by another to provide 3,000 MW by 2006. In 1995, an MOA was signed with the Vietnamese Government for electricity sales of 1,500 to 2,000 MW by the year 2010. With Cambodia, GOL signed an agreement on power sector cooperation with the Government of the Kingdom of Cambodia for least-cost supply of electricity to areas along the common border. Income to Lao PDR from supplying power to export particularly to Thailand will boost its revenues and help to more rapidly achieve development of the country's social and infrastructure sectors.

## 4.3. Project Alternatives

The dam site of Nam Ngum 5 hydropower station is located on the right bank tributary of Nam Ting River, upstream of Nam Ngum River in Laos, so the project is also known as the Nam Ting hydropower project.

The dam site of hydropower station is located in the mountain area of the north of Laos, is about 300 km north of the capital of Vientiane. The major dam is situated in the adjacent province of Xiengkhouang. To the north and west of the catchment, Road RN7 and RN13 pass through respectively.

Nam Ngum 5 hydropower project will supply the cheap and high quality of electricity for power network of Laos, accelerate the development of the mineral resources in Laos, boost the coordinated development of relevant industries, moreover, it will be favorable to promote the national industrial structural adjustment of Laos so as to transform the resource advantage into the economic advantage to speed up the economical development of Laos.

According to the pre-feasibility study conducted by Lahmeyer International, five alternative approaches to develop the Nam Ngum 5 are proposed.

- 1) Alternative A1
- 2) Alternative C
- 3) Alternative B
- 4) Alternative D
- 5) Alternative A1+A2

In which, two alternatives C and D are recommended. The two alternatives with moderate dam height are analyzed and the main parameters of Alternatives C and D are compared as the following table:

**Table 4.3: The Selected Alternatives**

Item	Unit	Alternative C	Alternative D
Installed capacity	MW	84	120
Annual utilization hours of units	h	4190	4225
Mean annual energy production	GW-h	352	507
<b>Total Project Cost</b>	MUSD	<b>164</b>	<b>196</b>
<b>Unit cost on installation capacity</b>	USD/kw	<b>1962</b>	<b>1633</b>

Based on the hydrological and hydro-energy calculation comparison; the topographical concern; the structure layout investigation; and the economic and financing assessment point of view, the unit cost of installation capacity of alternative D is lower and better than that of alternative C, therefore, the alternative D has finally been chosen for the project development.

#### 4.3.1. Selection of Dam Site

According to the technical report of SINOHYDRO Corporation, the selection of dam site has been primarily chosen based on the geographical and geological conditions. The upstream mountains on both banks within a scope of 1.3 km beginning from the confluence of the Nam Ting river and Nam Phat river to the ending at the dam site are mostly low, and the valley slopes are asymmetric. If the dam site is selected at this location the dam basin is shallow then the catchment area need to be increased this will give more environmental impact to the area selected therefore this location in this area is unsuitable for construction of a high dam.

At the downstream, the mountains in this area are high; thus the dam height must be increased to attain the present water head, this is because of the large river channel gradient at the downstream side. This will make the project technically more difficult and bigger investment. To the environmental point of view, the dam basin at this location is deep and the catchment area required is smaller than that of the upstream one. This obviously gives lesser impact on the environmental conditions. Therefore, the recommended dam site area based on the pre-feasibility study is selected both technically and environmentally.

### 4.3.2. Selection of Water Diversion Route

The two alternatives C and D have the same dam site and same dam type, however the powerhouse of alternative C is located on the right bank of the Nam ting river about 7km downstream from the dam site, this is being a short tunnel option with flow going via a 6.09km long headrace tunnel. Then a 75.1m high surge chamber and finally 1,011.7m long embedded penstock before reaching to the surface powerhouse.

The powerhouse of alternative D is located on the right bank of the reservoir area of Nam Ngum 3 hydropower station; this is being a long tunnel option with flow going via a 8.917 km long headrace tunnel. Then a 93.5m high upper chamber type surge tank, and finally a 2,443m long embedded penstock before reaching to the surface powerhouse.

For the aspect of geological condition for headrace tunnel, alternative D is a litter worse than alternative C, but the difference is not much, and water head of alternative D is bigger than that of alternative C by 83m, installed capacity is increased from 84MW to 100MW.

For the aspect of geological condition for powerhouse, the topographical geological condition is basically similar for both alternative C and D. However, for the alternative D, the project investment is comparatively big, but the installed capacity and mean annual energy output of the hydropower station are also big, under the conditions that water resources to the maximum. After the comparison of comprehensive water energy and economy, alternative D is better, so alternative D (long tunnel alternative) is suggested for this project.

To the environmental point of view it is obviously seen that as long as the tunnel construction gives lesser impact on the environmental conditions than any other constructions in the dam construction process, therefore, technical and economical conditions on the judgment of the alternatives are the best choice.

### 4.3.3. Selection of Dam Type

At pre-feasibility study stage, according to dam site topography and rough geological investigation and exploration, the type of concrete arch dam is recommended by the Design. However, after feasibility study of the topographical and geological conditions has been carried out it is found that the building of the arch dam for this project is technically not satisfied, and this option of dam type is canceled.

Another recommendation of dam type at the feasibility study stage, on the basis of increasing depth of geological investigation and exploration and collecting data, according to the topography conditions, geology conditions, and construction materials, etc. the concrete faced rockfill dam is recommended. But at the full supply level, both concrete faced rockfill dam and RCC gravity dam (Roller Compacted Concrete gravity dam) are feasible; the layout alternatives of the above-mentioned dam types with moderate and high height are compared as follows:

- 1) **Moderate concrete-faced rockfill dam alternative:** The dam body has a maximum height of 73.623m, the dam crest elevation is at EL.1073.623m, dam crest width is 8.3m and the dam crest length is 181m. The wave wall (parapet wall) is adopted as "L" type with a crest elevation of 1074.823m; the toe slab shall have a minimum elevation

of 1000.000m. The upstream and downstream side slopes of the dam body are 1:1.4 and 1:1.672 respectively. *The alternative can make use of local material, save more cement with lower project const, and the disadvantage is filling quantity is large.*

- 2) **Moderate RCC gravity dam:** The gravity dam has a maximum dam height of 73.5m, a dam crest elevation of 1073.50m, dam crest width of 6.0m, where, the overflow dam section has a total length of 23.0m, the non-overflow dam section has a total length of 145.0m, and transverse joints are made for the dam body. According to the requirement of the structure arrangement, the overflow single dam has a section length of 14.0m, and the water retaining single dam has a section length of 15.0m. *The alternative can solve the flood discharge more easily than concrete faced rockfill dam, but the requirement for foundation is relative high with more demand on concrete long distant for transporting material and the project cost is higher than that of concrete faced rockfill dam.*
- 3) **High concrete faced rockfill dam:** The dam body has a maximum height of 103.9m, the dam crest elevation is at EL.1103.900m, dam crest width is 10m and the dam crest length is 249.54m, the to slab shall have a minimum elevation of 1000.000m. The upstream and downstream side slopes of the dam body are same with 1:1.4. *The alternative can make use of local material, save more cement with lower project const, and the disadvantage is filling quantity is large.*
- 4) **High RCC gravity dam:** The gravity dam has a maximum dam height of 104.5m, a dam crest elevation of 1104.5m, excavation elevation of 1000.00m, dam crest width of 8.2m, maximum dam bottom width of 92.685m, dam crest total length of 258m. According to calculation of check flood peak flow, 5 flood discharge gates of 9.0x10.0m are arranged at the middle of the RCC dam, the width of pier is 2.0m, the total length of gated sections is 57.0m with sill elevation of 1090.5m. The check flood level is 1101.65m, design flood level is 1099.15m and full supply level is 1100.00m. The non-overflow dam sections are arranged at two ends, total length of 201.0m. Transverse joints are made for the dam body. According the requirement of the structure arrangement, the single gate section has a length of 22.0m, and the single water retaining section has a length of 15.0m. *The alternative can solve the flood discharge more easily than concrete faced rockfill dam, but the requirement for foundation is relatively high with more demand on concrete long distant for transporting material and the project cost is higher than that of concrete faced rockfill dam.*

According to the feasibility study, the regulating capacity of high dam alternative, which basically meets the requirement of Lao, is higher than that of the moderate dam alternative. Therefore, the high dam alternative is considerably selected for the dam height.

For the high concrete faced rockfill dam the quantity of reinforcing bars used, the excavation, and the filling of earth and rock are much higher than that of the RCC gravity dam. So RCC gravity dam alternative is better than that of concrete faced rockfill dam, if only the work quantity is considered.

Conversely, the quantity of concrete for RCC gravity alternative is higher than that of concrete faced rockfill dam alternative (594.685 thousand m<sup>3</sup> to 78.405 thousand m<sup>3</sup> respectively). As more concrete are used as more cement are needed but poor access to the project will also increase transportation time and cost. Although the concrete faced rockfill dam alternative needs much excavation and filling of earth and rock there are abundant earth and rock materials near the dam site, and the transportation distance is



comparatively short to save the transportation time and cost. So, concrete faced rockfill dam alternative is better than RCC gravity dam considering the construction. It is also recommended that the use of earth and rock filling could be found in the submerged area so that the impact of the environmental condition will be much avoidable after the construction.

Through the whole calculation, the investment of concrete faced rockfill dam is quite lower than RCC gravity dam alternative. So, concrete faced rockfill dam alternative is better than RCC gravity dam considering the construction aspect.

From the above analysis point of view, fully considering water energy, work quantity, construction and cost of project, the high concrete faced rockfill dam is recommended for Nam Ngum 5 hydropower project.

#### **4.4. Environmental Impacts in the Stage of Construction and Mitigation Measures**

##### **4.4.1. Summary of environmental impacts**

During the construction process, the following main environmental impacts will occur:

- Disturbance of the land surface, change of relief and geomorphology at: access road, temporary house, upstream construction site, power way, power house and auxiliary facilities for earth work, drilling, blasting, transportation of construction materials, dumping, tree cutting, site clearance, etc.,
- Increase of environmental hazards such as landslide, creeping, rock fall, other engineering geodynamic processes along road, slope at construction site, quarries and dump site.
- Change of the flow elements of Nam Ting river and Nam Phat river due to the diversion for construction of the dam, the dumping of rock waste and other wastes, spilling of oil and grease, etc.,
- Increase of noise, dust and waste gas due to the earth work, drilling, blasting, transportation of materials, debris, etc.
- Environmental impacts due to the destruction of bombs and mines, clearing reservoir areas, cutting trees, site clearance, etc.

##### **4.4.2. Measure for mitigation of environmental impacts**

- Select the appropriate sites for building roads, temporary houses for the workers with the aim to increase the efficiency of the construction work, minimizing the adverse impact on the environment
- Detect and destroy unexploded bombs and mines throughout the project area with special attention paid to the following locations: the road, the temporary house, reservoir area, dump site, headrace tunnel, power house, auxiliary facilities.
- Extract and utilize the timber from the project area, clear the reservoir area, survey, grout to prevent the water loss through the reservoir bottom
- Accumulate sufficient materials and fuels during the dry season in sufficient amount for the whole year.

- 
- During the construction process, comply with all regulations and procedures on blasting, earth work, and creation of road slope. For the rock waste: appropriately and economically plan the dump site; restore the dump site upon completion to prevent landslide and slope failure.
  - During the diversion of the river for construction: consider and select appropriate alternatives to minimize the impacts on the cultivation land and population area downstream.
  - Comply with all regulations on safety and health of the working people. Impart the environmental awareness to the workers; disseminate the information to the workers about environmental protection during the construction (protection of forest, wild animals, water resources, etc.) and the compliance of the laws of the two countries Laos and China.
  - Implement well the site preparation work and the cleaning up after the completion of each project component.

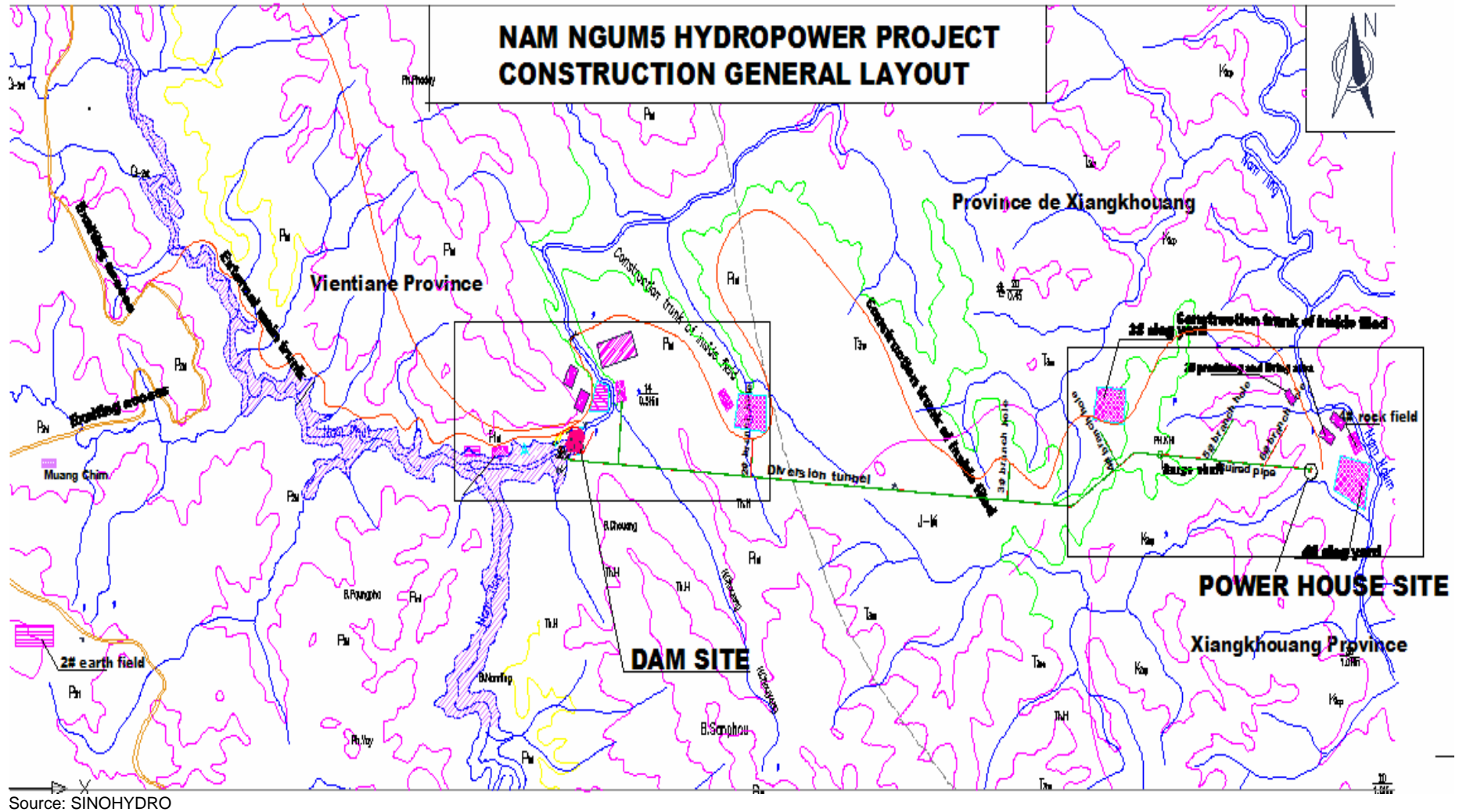
#### **4.4.3. Implementation of the environmental protection work:**

- The project proponents will coordinate with the local environment management agency to plan for the implementation of the environmental protection work throughout the process of project construction and after the project has been put into operation.
- Organize training courses and impart the knowledge about environmental protection and labor safety for all staff and worker engaged in the construction.
- Before the workers come to work on the construction sites, besides the labor contract, it is necessary to sign a commitment of compliance with the laws of the host country, including the commitment on environmental protection.
- Coordinate with the local authorities in establishing the environmental monitoring team to help the project manager to implement well the environmental protection work during the project construction.

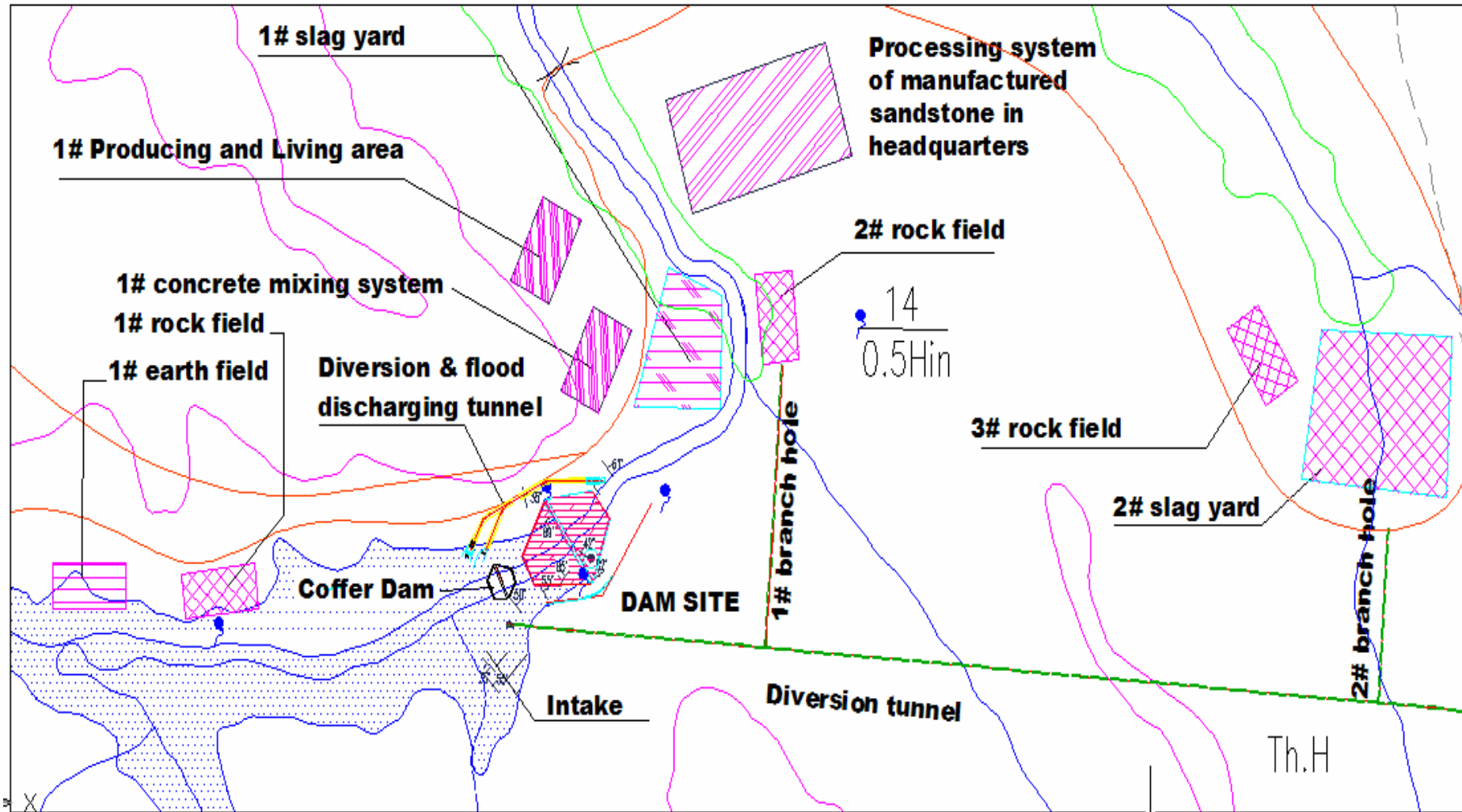
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# ANNEXES

Annex Figure 4.1: General Layout of Nam Ngum 5 Hydropower Construction Project

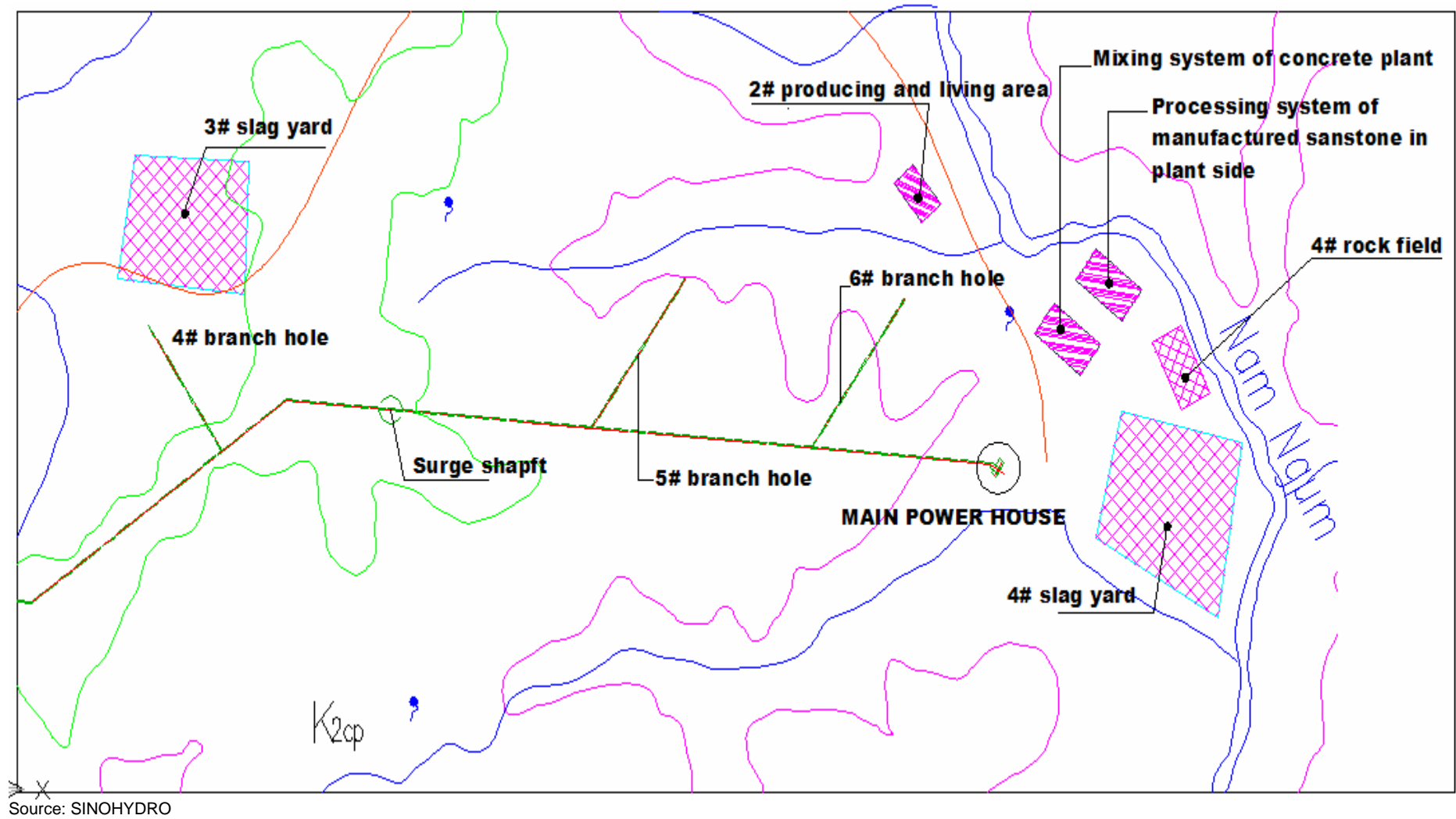


Annex Figure 4.2: Layout of the Dam Construction Site



Source: SINOHYDRO

Annex Figure 4.3: Layout of the Powerhouse Construction Site



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## CHAPTER V

# ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

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### 5.1. General Description

The potential environmental impacts within the project area are assessed with regard to options, location, design types, construction methods, operation and maintenance procedure. Consultation with affected local people and local organizations concerned is a crucial aspect in the impact assessment process. Impacts can be classified as permanent and temporary impacts.

- **Permanent Impacts** are impacts that occur mainly after the project completion phase and during the operation and maintenance period and these impacts are on going and lasting the life time of the project.
- **Temporary Impacts** are impacts that occur mainly during pre-construction and during the construction period. These impacts will cease once the construction is fully completed and the project is entering its operational stage. Temporary impacts and its severity depend on project location, design types and construction method employed.

Impacts can be classified as *positive and negative* (or adverse and beneficial) to the affected areas (socio-economic and environmental) and can also be classified as follow:

- **Direct Impacts** are the impacts that relate to the Project being physically placed within various environments and the impacts that cause directly on the socio-economic and environment within and around the project area by activities for which project has been designed, constructed and operated.
- **Indirect Impacts** are the impacts that arise from implementation of direct impacts mitigation measure and may be manifested in both physical and economic terms.

Impacts are significant when considered from the point of view of magnitude, timing, scale and reversibility<sup>1</sup>. Power generation systems also need to be assessed from the point of view of sustainability and the overall impacts that the project will have on exacerbating global environmental problems. Impacts can also be cumulative whereby the impacts of several projects need to be considered together rather than case by case or as individual project.

#### 5.1.1. Impact Areas

The Project impact boundaries to the physical and biological resources will be usually well defined; however, the diffuse impact boundaries can be expected in association with the socio-economic impacts.

The physical and biological impact boundaries are reasonably defined and include three areas within which the impact will occur.

- *The Project boundaries* within which the hydrological impact are specific to. These are the catchments areas of the main tributaries such as Nam Phat, Nam Sout and Nam Ting rivers.

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<sup>1</sup> Sustainability is very broadly defined as; development that satisfies the needs of the present generation without compromising the ability of future generations to meet their needs.

- *The Project impact area* which includes the watershed area above the dam site, the head pond, the downstream dewater of the Nam Ting River and the release area below the powerhouse (Nam Ngum River).
- *The specific construction impact areas* which have a well defined boundary and includes the areas where they are subject to direct impact generated by construction activities.

The socio-economic impact areas are not well defined which include the people who live within the project boundary and their livelihood system. Some of the forests within the project areas have already been destroyed and converted to other land use types especially the clearing of forest by slash and burn for agricultural cultivation which causes reduction of habitats as well as reduction of wildlife population. While some project areas of less disturbed forest and environment occur within the project area mainly is in between Phou Pha Day and Phou Da Phor Mountains where the Powerhouse will be constructed.

## 5.2. Potential Impacts and Mitigation Measures

### 5.2.1. Impact Matrix

Potential environmental and socioeconomic impacts arising from project option considerations, design, construction, operations and maintenance are summarized below, and presented in details in Table 5.2.1 as the Impact Matrix.

### 5.2.2. Options and Design Consideration

Unlike other types of infrastructural developments (e.g., roads, railways), hydroelectricity power developments (Dam site, head race tunnel and Powerhouse area) are so limited by physical constraints of location and the condition of river networks, catchments and topographical features of the area etc; as such the potential adverse impact to both the community and the environment could be enormous. It is therefore required that the designers to be sensitive in their perspective outlook with regards to social and environmental issues. The benefits derive from technical aspects must be weighted against the adverse impact it causes to the community and the environment including habitat losses and soil degradation.

Following shall form basic principles in design consideration for each project component (*Dam, powerhouse, tunnel access road and transmission line etc.*) in particular the selection of transmission line (TL) and the access road (AR) alignments which are more flexible in comparison with the selection of the dam and the powerhouse site. These basic principles emphasize mainly on minimization of adverse socio and environmental impacts of the project.

- Where possible keep the access road and the transmission line alignment as straight as possible between the start and end points. In the case of TL it will minimize the total number of tower; in both TL and AR it will minimized imported materials, less clearing, less soil erosion as well as minimizing the construction costs.
- Wherever possible locate the TL alignment more or less parallel, and in close proximity of an existing road to facilitate construction access and access for maintenance and repairs during operation;
- Avoid existing settlements, private and community structures, particularly houses and/or built-up areas, to ensure that resettlement would not be required;

- Minimize the need to expropriate valuable land areas, particularly village holy forest, village cemetery, agriculture land, farm land, etc.;
- Avoid areas of mature forest and other environmentally sensitive areas including NBCAs, NPAs, eco-tourism sites;
- Ensure adequate clearance between the TL/AR alignments and significant cultural/historical monuments/sites.
- In addition, wherever possible considerations should be given in minimizing the extent of visual intrusion upon viewscapes considered as unique or valuable as tourist resources. This aspect however limited in so far as the technical consideration of the dam is concern, it is still applicable in determining the visual aspect of the dam, the powerhouse as well as the operation villages.

From the field survey carried out as well as from the information available the most favorable alignments both for TL and AR is recommended and they selections were based on the above principles. However it must be emphasized that subject to further detailed on site survey and investigation, in particular the TL and AR shall be the most economical, socio and environmental friendly options by far.

A pre-feasibility study and survey to identify the project options and location was carried out by ENERGY EQUITY CORPORATION LTD (LAHMEYER INTERNATIONAL) in February 1997. It is anticipated the project would proceed without major alteration.

## 5.2.3 Overview of Impacts

### 5.2.3.1 Vegetation and Wildlife

Generally, the clearance of vegetation within the dam site, powerhouse and reservoir can lead to fragmentation of already diminishing areas of natural forests and wildlife habitats. Overall, the existence value, as well as the ecological research value of the ecosystem will be diminished. Rare and/or threatened vegetation or wildlife species may also be affected by flooding. The permanently maintained access roads to the dam site and powerhouse during and after construction will eliminate the ability of the land on which the roads situate to re-grow to species-rich secondary forest.

Based on the land use and forest map and conducting field survey, as it has been presented in Table 3.2.2, most vegetation type covered within the project area is especially within the proposed reservoir is Unstocked Forest and Scrub (563 ha) which is severely degraded over most of the project area due indiscriminant clearing for various land use types, in particular slash and burn type of clearing endemic not only for the project area but through the country, however, there are some Mixed Deciduous Forest (53 ha) and Dry Evergreen Forests especially within the proposed powerhouse and along the proposed access road from the dam site to powerhouse. In this respect the dam site and reservoir as well as access road particularly the access road from NR-7 to the dam site are sited on the degraded forestlands, hence would not be a significant cumulative adverse impact, in the already degraded vegetations and wildlife in the project area.

### 5.2.3.2. Land Use and Settlements

Resettlement and/or removal of houses and other structural features can lead to disruption of community cohesion and social fabric, change life style and livelihood pattern. In addition it may also give a bad impression of the project as well creating poverty syndrome and a sense of unfairness to villagers if compensation is inappropriate.

Based on a review of land use type and forest map within and around the project area, and from the results of the field survey and villagers' interview, most of land use types within the project area are grassland (1,636 ha) and permanent agricultural lands, mainly rice paddy fields (approximately 50 ha).

The project study area encompasses 280 households (of which 146 households have been interviewed) in 4 Villages (Ban Chim, Nammadao, Phavai and Longmiang) of Phoukhoun District in Luang Prabang Province, and 247 households (of which 63 households have been interviewed) in 3 Villages (Xiangdet, Namchat and Somboun) of Phoukut District of Xiangkhoang Province.

Out of all the seven villages that have been included in the study area, only one village namely Ban Chim has direct impact that is almost the entire paddy fields of rice would be inundated. The 50 ha of seasonal and permanent rice paddy field which belongs to 49 households of Ban Chim village will be directly affected and need to be compensated. However, although no resettlement of any household is needed as all of the houses in Ban Chim situate well above the designated or designed full supply level of 1,100 masl, three of 49 affected households asked for a new paddy field in other areas where suitable for their business and future quality of life of their children. One of the three will move to Luangprabang town and the rest two will move to live with relative in Kasi District. They asked for assistance in transportation for moving their house and rice providing during the first 3 to 5 years.

Ban Xiangdet locates downstream from the dam on the Nam Ting River, however, will be inundated, and the entire village needs to be relocated. The inundation however would not be from Nam Ngum 5 reservoir, but from the Nam Ngum 3 project, which at the time of the survey its reservoir area was being cleared out and the main activity was logging of commercial timbers. The full supply level of Nam Ngum 3 would be 720 masl. However, as mentioned in Section 2.2, Ban Xiangdet will be affected by the Nam Ngum 5 project as downstream impact, if the Nam Ngum 5 is constructed and completed before Nam Ngum 3.

### **5.2.3.3. Cultural and Heritage Sites**

Cultural and heritage sites are important national or world property. Conducting any activity relating to project development, especially the project of the size of Nam Ngum 5 in the proximity of an important cultural heritage can lead to the reduction of the esthetical value of the site, as well as the destruction forever of the cultural heritage.

In principle, any cultural sites such as cemetery, spiritual land found within the constructions areas, especially within the proposed reservoir, dam site and powerhouse as well as access roads need to be removed. Removal and relocation of these cultural properties, unless given due consideration to local ethnic believes and cultures, as well as local participation in all steps and procedures, will be unacceptable to affected community and may result in hostility being directed toward the project and may cause conflict between villagers and the project.

However, according to the field survey conducted and villagers' interview, within the project area there is no cultural property and heritage feature would be affected.

### **5.2.4. Overview of Approach to Compensation**

The following are the key principles and objectives that have been adopted for electricity development projects in Lao PDR:

- Involuntary displacement shall be avoided or minimized wherever possible by exploring all viable alternative project designs and locations.

- Land acquisition and resettlement shall be planned and implemented in such a way as to cause least possible amount of social, cultural and economic disruption.
- Affected people shall be:
  - i). compensated as per the compensation principles below,
  - ii) assisted directly and indirectly in the transfer of residence, if required, and during the transition period at the relocation site,
  - iii) assisted directly and indirectly in their efforts to improve their living standards, in a sustainable manner at the new location.
- Livelihoods shall be restored and be done so without detriment to the environment and the social fabric of the surrounding areas.
- Existing cultural and religious practices shall be respected and, to the maximum extent practical, preserved.
- Special measures shall be implemented to protect socially and economically vulnerable groups such as ethnic groups, women headed families children and aged people without support structures and people living in extreme poverty.
- All people residing cultivating or making a living within the areas acquired for project prior to a formally recognized cut off date shall be considered as affected people and will be entitled to resettlement and rehabilitation assistance sufficient to assist them to improve or at least maintain their pre-project living standards, income earning capacity and production levels. Lack of legal titles to the land a person is cultivating or to the place residence will not be a bar to resettlement entitlements.
- Replacement residential and agricultural land will be as close as possible to the land that was lost, and acceptable to the affected people (AP).
- Temporarily affected land and communal infrastructure will be restored to pre-project conditions.
- The compensation and resettlement activities will be satisfactorily completed and rehabilitation measures in place before starting construction of civil works.
- The previous level of community services and resources shall be improved after resettlement.
- A project affected person (PAP) shall not be dispossessed of his/her property nor displaced from his/her place of residence or employment without payment of full compensation and/or without making arrangements for relocation and rehabilitation.
- The Executing Agency shall see that institutional arrangements are in place to ensure effective and timely design, planning, consultation, and implementation of the Resettlement Plan.
- The entire cost of resettlement program shall be considered as an integral part of the project cost and accordingly shall be budgeted in annual and overall implementation plans of the project.
- The resettlement programs shall be planned and implemented with the consent and agreement of the affected people and host population and shall encourage their active participation. A full participatory public involvement process shall be implemented.
- There shall be effective mechanisms for hearing and resolving grievances during the implementation of resettlement programs.
- Prior to loan appraisal, details of the Resettlement Plan shall be disclosed to the APs in a form and manner that they can understand.

**The principles for compensation are as follows:**

- All affected persons, housing, land, and other assets registered at the time of the population survey and asset inventory, and all who can demonstrate a loss, have the right to adequate compensation for loss and to income restoration in conformity with these principles.
- Compensation for affected houses, other structures, and for land loss shall be at replacement cost and provided prior to relocation.
- The replacement of housing plots, housing and agricultural land shall be of acceptable standard, use and value to the satisfaction of the affected owner.
- Where relocation is required, the transition period shall be as short as possible. The affected person must receive land as compensation prior to relocation, although under special circumstances cash may substitute for land.
- Prior to the approval of the resettlement program, public consultation must be carried out with the affected persons to ascertain their opinions.
- Prior to settling into new resettlement areas, infrastructure and services shall be replaced to a level of service higher than before.
- Material and tools to be used at the new site or for the new occupation, or for rehabilitation, shall be supplied in a timely manner.

If compensation alone is not adequate to improve the livelihood of affected persons, additional rehabilitation measures shall be developed for this purpose.

However, during conducting the field survey for this Study, initial assessments of potential losses to be compensated has been made especially to various land and assets likely to be affected by the project. These assessments are preliminary and are based on the field survey and villagers' interview. However, based on this report, before starting of project construction, construction contractor, under supervision and guidance of environmental management committee, need to coordinate and work in collaboration with local authorities to collect detail data concerning the loss of assets, issue formula which will be applied for cost estimation of construction and negotiation with affected villagers to ensure understanding and agree on compensation cost in order to avoid subsequent impacts. Project Environmental Management Committee (PEMC) needs to be established at province level in order to be responsible on implementation of relevant tasks and activities and convene meeting to discuss on detailed compensation procedures and cost with affected village representatives and affected villagers (See Figure 6.1.4).

The estimation of compensation will be based on the following categories of the losses:

**Permanent Loss:**

For this project, permanent losses especially the land and or paddy field within Ban Chim village need to be compensated as soon as the land is required for construction or before construction is started. The compensation cost for permanent losses must be sufficient to actually replace the lost of land/paddy field and other assets. The permanent losses may include the loss of products or assets on the land and the compensation shall be with land of equal productivity or asset value.

**Temporary Loss:**

Temporary losses of land and/or products on the land are areas that can be returned to the owner, more or less, in their original previous condition after conducting any activity relating to the implementation of the project. The compensation cost for temporary loss of land will be as a rental cost (or subsistence cost) including the cost of lost products (if any) exist on the land based on the local market value in the year of compensation payment. The rental cost of the land will be based on the period of land rental and the real situation of productivity or quality of such land which will be assessed again at the end of rental period. If the land has no adverse impact, then the land can be returned to the owner without any

additional cost concerning land quality loss. However, if the land has been significantly impacted, then the landowner will be compensated properly and satisfactorily.

**Estimation of Compensation Cost:**

The methods used to estimate indicative compensation costs for this project were broadly applied in other similar previous hydropower projects and have been satisfactory for both sides (project owner and affected villagers). However, for this project, the methods and rates will need to be refined closer to actual period of compensation and especially when it is clearly understood what type of compensation package the PAPs want and what is actually available.

The basic principle of compensation for the losses of land is that landowners have their choice between accepting cash payment and compensation by land of equivalent value at other location, meaning that the PAPs will be compensated so that they can restore their land, other assets and their livelihood. The previous experiences from other projects indicated that most PAPs preferred compensation by land. Cash compensation will be normally considered when the affected land and assets are relatively small proportion of the PAPs livelihood and a suitable or equivalent alternative asset is not available.

However, the actual methodology for compensation estimate needs to be agreed upon and finalized in consultation with the concerned local authorities and villagers as well as PAPs and it will be set-up in a final compensation agreement.

According to the other previous similar hydropower projects, the compensation cost especially for the loss of land including seasonal and irrigated rice paddy field, swidden/cultivation areas and other agricultural land was estimated based on the total of average productive value of land in the past ten years and the actual area of the land. The formula below was used for the calculation of permanent loss of land in other similar previous EdL hydropower projects. It was specifically used in the compensation of the rice paddy field and permanent farmland or garden and has been satisfactory for both sides (project owner and affected villagers).

$$\text{Compensation Cost} = \text{Average Annual Productive Value of Land per One Hectare} * \text{Area of lost Land (ha)} * 10 \text{ years}$$

In addition to the above methodology, compensation for crops will be at prevailing current local market price. The value of house garden will vary tremendously depending on what type of crops are grown on the garden. Many small gardens are located around the house and along the riverbank where water is easily accessible; in case of Ban Chim the so-called house garden is well above the water line and not anticipated to be affected.

According to the Technical Guideline for Resettlement and Compensation of the Lao PDR, this states that *“due to a virtual non-existence of rural land markets the compensation should be determined based on the average productive values of land based on the past three to four years of production, and should be equivalent to at least 6-7 years of harvest value”*. This case was applied in the Nam Leuk Hydropower Project.

The Prime Minister Decree No. 192/PM, dated 07 July, 2005 on Compensation for the losses and Resettlement for the development projects in the Lao PDR, Article 6, points 6, 9 and 10 state that the affected persons (APs) who live in the remote areas who own the land and other properties that without legal land title or other certified document for the right of using such land or properties are also to be compensated with equivalent value of such lost land and properties. In addition to compensation they are also to be additionally assisted in order to improve their livelihood. Before provision of compensation, project owners shall

establish a joint committee, with representatives from all stakeholders, to assess the loss to APs. Prior to the commencement of project construction, APs shall be fully compensated and resettled and rehabilitations measures shall be in place, although not necessarily completed yet.

In terms of Assistance during Relocation and Transition Period, Article 7 of the PM Decree No. 192/PM also states that APs displaced and/or affected due to the loss of income and livelihood shall be provided with the following assistance until their income levels and living conditions can be stabilized:

- (a) Transport allowance or assistance in kind to transfer to the resettlement site or their choice of relocation;
- (b) Food allowance, in cash or in kind and cash to compensate for income lost, during the transition period;
- (c) Suitable development assistance after displacement during the transition period until they are able to restore their incomes or improve their living standards.

Most of shifting cultivation areas (including rotational and pioneering shifting cultivation) in Lao PDR especially in the northern part is used for upland rice production. The use of land in upland area of local people is unlikely to have a legal right to the land except for those villages which have been allocated land and forest that conducted by GOL' Land Allocation Program with at least three hectares of land for one household. Therefore, it is an aspect that compensation entitlements need to be carefully considered to ensure that PAPs are compensated so that they can restore their land and other assets as well as their livelihood.

In terms of swidden and cultivation area (rotational cultivation), compensate of one third of total cost of paddy field (with the same area) has been applied for the similar previous projects. However, there is no clear guidance regarding compensation entitlements for areas of fallow upland and/or natural grassland which are likely to be areas of previous shifting cultivation. Whilst impact on these land areas will have an impact on the livelihoods of PAPs, it is considered that the compensation for current shifting cultivation (e.g. assuming permanent or rotational cultivation) especially for the northern part of Lao PDR will target those who are currently using and potential users of such lands.

In terms of planted fruit trees and industrial trees, the following temporary methods have been broadly applied for similar previous projects:

For Planted Industry Trees

$$\text{Compensation Cost} = [\text{Land Clearing Cost} + \text{Cost of Seedling}] + [(\text{Maintenance Cost}) * (\text{Year of Maintenance})]$$

For Planted Fruit Trees

$$\text{Compensation Cost} = [\text{Land Clearing Cost} + \text{Cost of Seedling}] + [(\text{Maintenance Cost}) * (\text{Year of Maintenance})] + [(\text{Average Harvesting Value/year}) * (\text{Years of Harvesting})]$$

Note: Years of Harvesting for Fruit Trees may range from 1 to 7 years depending on Fruit Tree Species.



Forest and non-timber forest products (NTFPs) play an important role in the livelihood of many local people especially the poor. Most rural households, especially the poorest, depend heavily on forests not only for timber for house construction and other purposes but also for food, fodder, fencing materials, medicines and condiments. Villagers also often derive cash income from sale of NTFPs and, in many areas, harvesting of forest resources is one of the few available economic activities. NTFP consumption and sales often equate to more than half of family income. Impact on these resources will have also a significant impact on the livelihoods of PAPs. Although there is no clear guidance regarding compensation entitlement for village forest as well as lost NTFP source within the village forest, however, to ensure that PAPs will be compensated so that they can restore their forest land and assets livelihood, it may be necessary to provide compensation for forest land more broadly than only for village forest land. Where village forest land is lost then new forest will presumably need to be allocated.

**Table 5.2.1: Impact Matrix**

**a). Potential Impacts due to Location**

Item	Potential Impact	Estimated Impact Area/size	Significance	Duration	Mitigation Measure	Responsible Agency
a-1. Dam, Head pond and Powerhouse: Site losses	<u>Biological losses</u>				No commercial value tree species. <i>However, baseline survey need to be conducted to collect commercial big tree species (if any) which to be cut and if tree felling required, will be overseen by Provincial and District Forestry Section (Unit) to ensure no illegal logging and cutting trees outside the approved area. Logging and logs selling must comply with Forestry Law and other laws and regulations concerned.</i>	Provincial and District Forestry Office (PAFO & DAFEO)
	1). Loss of forests:					
	- Mixed Deciduous forest	53 ha	Minor	Project life		
	- Unstocked forest and scrub	563 ha	Minor	Project life		
	2). Loss of wildlife habitat	53ha forest	Insignificant	Project life		
	3). Loss of natural grassland	1,636 ha	Insignificant			
	4). Loss of natural views/ natural amenity of the area		None			
	<u>Social Loss</u>					
	1). Loss of rice paddy field	50 ha	Moderate	Project life		
	2). Loss of swidden area	1 ha	Insignificant	Project life		
3). Loss of houses	None	None				
4). Loss of infrastructure	None	None				
a-2. Head pond: Upstream Impact	Upstream watershed erosion	483 km <sup>2</sup>	Insignificant	Project life	Tree plantation program is needed for forest rehabilitation and soil cover	Project owner

Item	Potential Impact	Estimated Impact Area/size	Significance	Duration	Mitigation Measure	Responsible Agency
a-3. Component Site losses	<u>Biological losses</u>					
	1). Loss of forest;	53 ha			No commercial tree species	
	1-a. Dam site	4 ha forest	Insignificant	Project life	There are some commercial tree species ( <i>see Chapter III, Section 3.2.2</i> ). Detail survey to collect commercial tree species for felling. Logging and logs selling process will be based on the laws and regulations concerned.	Provincial and District Forestry Office
	1-b. Powerhouse	5 ha forest	Minor	Project life		
	1-c. Headpond/reservoir	44 ha forest	Minor	Project life		
	1-c. Intake Tunnel	-	None	-	Avoid excessive clearing, excessive earthwork minimize erosion by utilizing vegetation (indigenous varieties) cover.	Provincial and District Forestry Office
	1-d. Penstock	-	None	-		
	1-e Access road to powerhouse	13 ha forest	Minor	Project life		
	2). Loss of wildlife habitat	18 ha forest	Minor	Project life		
	<u>Social losses</u>		None			
	1). Loss of house	None	None		The project owner must construct about 1 km of new road to Ban Chim	Project Owner under supervision of MCTPC
	2). Loss of infrastructure	None	None			
	3). Loss of existing access road from NR7 to Ban Chim.	1km	Significant	Project Life		
4). Loss of one concrete bridge at Ban Chim	15 meters	Significant	Project Life	The project owner must construct a new concrete bridge at Ban Chim		

**b). Potential Impacts during Construction**

Item	Potential Impact	Estimated Impact Area/size	Significance	Duration	Mitigation Measure	Responsible Agency
b-1. Construction site impacts: Biological	1). Impact on aquatic system	Immediate d/s area	Insignificant	Construction	Nam Ting d/s lower section will be influenced by head pond of Nam Ngum3 reservoir. Provide proper drainage system in harmony with natural drain.	Constructor and Env. Specialist
	2). Impact on wildlife & wildlife habitats	Immediate areas	Insignificant	Project life	Noise limit to reduce disturbance of wildlife, however, daytime working must be from 7.00AM to 6.00PM, avoiding exceeding the noise limit, which is 55 dB daytime, and 45 dB nighttime. Nighttime means 9.00PM-6.00AM.	Constructor/Env spcl
	3). Disposal of spoil	Immediate areas	Beneficial	Project life	Disposed off sump oil properly, avoid washed down of oil into water bodies.	Constructor/Env spcl
	4). Access roads: - From NR7 to Dam site - From Dam site to Powerhouse	30 km 20 km	Insignificant Minor	Construction Construction	Site protection and rehabilitation plan Site protection and rehabilitation plan Site protection and rehabilitation plan	Constructor/Env spcl Constructor/Env spcl
b-2. Construction site impacts: Social	<u>Health and Safety</u>					
	1). Dust	Immediate area	Insignificant	Construction	Dust control plan (watering to control dust)	Constructor/Env spcl
	2). Noise and vibration	Immediate area	Insignificant	Construction	Not required (far away from community)	
	3). Health and Safety (including encroachment into area)	Local people and Workers	Minor	Construction	UXO pathfinder survey and clearance needed before construction to secure workers safety	Constructor and UXO Supervisor/specialist

Item	Potential Impact	Estimated Impact Area/size	Significance	Duration	Mitigation Measure	Responsible Agency
	contaminated by UXO)					
b-3. Construction impacts related to economic	<u>Local Residents</u>					
	1). Employment opportunity	Local people	Beneficial	Construction	Contract specification	Constructor/project owner
	2). Commercial opportunity	Local people	Beneficial	Construction	Community Promotion Plan (CPP)	Project owner
	3). Land value change & population movement	Surrounding areas	Insignificant	Project life	Village land use plan (if necessary)	Project owner
	4). Increase in affluent/poor income gap	Surrounding areas	Insignificant	Project life	Community Promotion Plan (CPP)	Project owner
	<u>Migrant Labours</u>				Community Promotion Plan (CPP)	
	1). Conflict with local residents	Adjacent villages	Insignificant	Construction	Contract specification	Project owner/EMC
	2). Worker health & safety	Workers & villagers	Minor	Construction	Contract specification	Constructor/project owner
	3). Impact due to camping				Contract specification	Constructor/project owner
	- Forest/vegetation	Surrounding area	Minor	Construction	Contract specification	Constructor/project owner
- Wildlife	Surrounding area	Insignificant	Construction	Contract specification	Constructor/project owner	
- Water quality	Immediate area	Minor	Construction	Contract specification	Constructor/project owner	

**c). Potential Impacts during Operation**

Item	Potential Impact	Estimated Impact Area/size	Significance	Duration	Mitigation Measure	Responsible Agency
c-1. Head pond operation	<u>Storage impacts</u>					
	1). Sediment deposition	NA	Minor	Project life	Headpond flushing	
	2). Headpond backwater effects	None	None			
	3). Aquatic habitats	Insignificant	Insignificant	Project life	Environmental Management and Monitoring Plan	
	4). Groundwater	Headpond	Insignificant	Project life	Environmental Management and Monitoring Plan	
	5). Water related diseases	Headpond	Insignificant	Project life	Environmental Management and Monitoring Plan	
C-2. Headrace tunnel operation	1). Effect on wildlife	10,700m long	Insignificant	Project life		
	2). Effect on under ground life	10,700m long	Insignificant	Project life		
	2). Groundwater	10,700m long	Insignificant	Project life		
C-3. Downstream dewatering effect of diversion of Nam Tinh to the Powerhouse	1). Water quality	Along d/s Namting to NamNgum(26km)	Insignificant	Project life	The d/s Namting (from Dam site to Xiengdet village) will be affected by the headwater of NamNgeum 3 reservoir, all of the impact will be similar as NamNgum 3 headpond	EdL's EMU
	2). Aquatic life - Fish species diversity - Fish migration - Fish population (increase)	Along d/s Namting (26km)	Insignificant	Project life	Community Promotion Plan (CPP)	Project owner/EMU
		None				
	3). Wildlife	Along d/s Namting (26km) Along d/s Namting (26km)	Beneficial Insignificant	Project life Project life	Community Promotion Plan (CPP) Community Promotion Plan (CPP)	Project owner/EMU
4). Social impact on local people: - Drinking water supply	Nearby villages Nearby villages		None			

Item	Potential Impact	Estimated Impact Area/size	Significance	Duration	Mitigation Measure	Responsible Agency
	- Fishing/fishery - Water supply for agriculture 5). Loss of natural view/aesthetic	Nearby villages None	None None None			
C-4. Powerhouse release to Nam Ngum River (NNG3)	1). Future Nam Ngum3 headpond/reservoir 2). River channel hydraulic 3). Excess d/s flow variation	NNG3 headpond/reservoir NNG3 headpond/reservoir NNG3 headpond/reservoir	None None None	Project life Project life Project life		
C-5. Local Community benefits	1). Employment opportunity 2). Improve access 3). Improve water supply 4). Improve power supply 5). Fishery/fish rising opportunity 6). Water way access	Affected village Surrounding villages Nearby villages Nearby provinces Nearby villages Nearby villages	Significant Moderate Insignificant Major Major Benefit	Project life Long term Long term Long term Long term Long term		

### 5.3. Environmental Impacts related to Location

Nam Ting River is one of the main tributary of Nam Ngum River and located in the rugged northwestern part of the Nam Ngum catchment. Nam Ting runs along the Valley of Phou Pha Day Mountain through Xiengdet village discharging to Nam Ngum River. Nam Ting River consists of two major tributaries namely Nam Sout and Nam Phat. At full supply level (FSL) which is approximately 1,100 masl these tributaries and Nam Ting itself would form the storage reservoir of Nam Ngum 5 project; the catchments of Nam Ting and the catchments of the tributaries collectively will provide the required flows for power generation.

The highest point in the region is Phou Mieng Mountain (2,455 masl), 20 km south of the dam site and many peaks rise to between 1,500 m and 2,000 m.

The sitting of the dam, headpond, headrace tunnel and powerhouse will have the following impacts.

#### 5.3.1. The Dam and Headpond (Reservoir)

The Dam Site is located at Nam Ting gorge which has been created by Nam Ting River down cutting at right angle across the mountain range of Phou Daphor and Phou Pha Day. The gorge at the dam site is narrow and deep (400m) with steep slopes ranging from 30° to 50°. The river bed is rocky, appears to have little alluvium and the reach through the gorge is relatively straight and are covered by dense vegetation on both sides of the reach.

##### 5.3.1.1. Biological Losses

###### a. Forest/Vegetation

Based on the review of forest cover maps, field reconnaissance and villagers' interview, it indicated that most of the vegetation that will be affected would include some commercial tree species, herbaceous and woody stemmed shrubs, grass and bamboo which belong to different type of forests such as Mixed Deciduous Forest (53 ha), Unstocked Forest and Scrub (563 ha) and Natural Grassland (1,636 ha).

However, some of the big and high value commercial species were destroyed and removed by various causes including bombing during Indochina war, converting activities for other uses such as clearing and burning for shifting cultivation and logging.

It is also confirmed that any areas of old forest such as National Biodiversity Conservation Areas (NBCAs) and protection forests are not present within the project area especially headpond/reservoir and dam site. Other less significant types of forest where the proposed access road and powerhouse will be located such as *Dry Evergreen Forests (DE)* (see Table 3.2.2) were found in significant quantities, and the exact details will be reconfirmed when the detailed construction is underway.

###### b. Wildlife (and wildlife habitats)

Wildlife and wildlife habitat, according to the filed survey and local villagers' interview as well as the data and information gathered from the authorities concerned showed that the only significant habitats remaining occur on the steep upper slope forested areas and/or evergreen forest of Phou Pha Day and Phou Da Phor Mountains. Other more accessible lower and less steep slopes where forests have been destroyed, wildlife and wildlife habitat have also been disturbed, resulting from slash and burn for shifting cultivation, bush fire, and indiscriminant logging as well as bombing during Indochina War.



Most of the project components are located on the lower slopes of Phou Da Phor Mountain which is well below the main wildlife habitats. However, from the results of survey and local villagers' interview indicated that some of the wildlife live mainly on the upper slopes and may move down into the lower area especially around the proposed location of powerhouse at night time and they may return back to the comparative safety of the upper slope areas in the day time. Therefore, through the cause of project design and implementation, it is of prime important that the encroachment and habitat destruction is kept to a minimum and for example temporary access roads to the construction sites should be permanently closed and rehabilitated to its original condition after the completion of the construction work.

Finally and due to most of the forest and forest land within the project area have been destroyed through various causes as stated above it was found that there is no significant wildlife and/or wildlife habitat remained within the project areas except for area surrounding the proposed powerhouse where significant wildlife and wildlife habitat are still in relative abundant; but powerhouse construction's extent represents only a fraction of the surrounding forest, hence generating minimal disturbance to the wildlife and its habitat.

c. Natural amenity, aesthetic areas, outdoor recreation or ecotourism areas

According to the field survey and villagers' interview, the result showed that there is no area, in part or in full that is considered of high significant value with respect to natural amenity, aesthetics, outdoor recreation or ecotourism that is adversely affected by the development of the project. Instead, and being the only main lake in the region, the development could encourage tourism or other commercial activities such as fishing and other recreational activities into the area, hence the betterment of the livelihood of the local community.

### 5.3.1.2. Social Losses

a. Loss of rice paddy field

The results from the field survey as indicated in the Table 3.2.2 shows that approximately 50 ha of rice paddy field at FSL of 1,100masl in Ban Chim village will be inundated. Under power development regulation, the affected household shall be compensated. The estimation of compensation value is shown in Appendix Table.

b. Loss of swidden area

Table 3.2.2 also shows that within the project area especially in the future reservoir there is approximately 1 ha of swidden area will be inundated. This also needs to be compensated. However, under power development regulation, there is no clear guidance regarding compensation entitlements for areas of fallow upland and/or natural grassland which are likely to be areas of previous shifting cultivation. However as stated in section 5.2.4 above "In terms of swidden and cultivation area (rotational cultivation), compensate of one third of total cost of paddy field (with the same area) has been applied for the similar previous projects".

c. Loss of Infrastructure, Houses and Cultural Sites

None of the infrastructure, house and cultural site in the project area is affected, except one concrete bridge and about 1 kilometer of existing access road at Ban Chim that will be flooded

### 5.3.2. Headpond Upstream Impacts

#### a. Upstream Watershed erosion

The upper part of the watershed area has been altered by human activities mainly the clearing of the land for agricultural production in the form of shifting cultivation and as a result the area is covered with swidden areas, unstocked forest, scrub area, grassland and some forestland (shown as mixed deciduous forest). There are some cultivated land within the area as showed in the Land Use and Forest Map. From the above mentioned land use over long period of time and with the combination of high rainfall and steep slopes; overall the area is unstable and subject to severe erosion, the trend would increase as population density increases and remaining forest removal is increased.

However, in some of the catchments the rock is resistant to erosion and has not been unduly deformed and shattered by extreme tectonic activity and relatively stable.

### 5.3.3. Component site losses

#### a. Dam Site and Reservoir

As mentioned above, a total of approximately 616 ha of vegetation including Mixed Deciduous Forest (53 ha) and Unstocked Forest and scrub (563 ha) (excluding grassland) will be inundated at the reservoir and dam site. The main area of mixed deciduous forest remains on the upper slopes of the Nam Ting River especially in the upper reach of Nam Ting and its tributaries.

Due to its relative accessibility most of the trees particularly commercial species in the reservoir area have been logged and removed, what remains are degraded forest and scrublands.

#### b. Powerhouse

At least 5 ha of forestland including dry evergreen and mixed deciduous forests will be directly affected and need to be removed and cleared for powerhouse construction. This included also some commercial tree species. However the area cover by the powerhouse construction represent a fraction of the overall surrounding forest, hence posing insignificant adverse impact to the overall biodiversity of the area.

#### c. Access road from NR 7 to the dam site

According to the results from the Pre-feasibility study (Energy Equity Corporation Ltd, Feb. 1997) regarding option for selection of access road from NR 7 to the dam site where the access road Northern Route II has been selected. The permanent access road from NR 7 to the Dam site with an approximately 20 km long will need to be constructed following the Nam Phat valley to the south on its left side. The construction of this access road will affect 26 ha of grassland and 1.5 ha of unstocked forest where big trees have already been removed.

#### d. Access road from Dam site to Powerhouse

The construction of permanent access road to link between the dam site and powerhouse with an approximately 14 km of length will also be necessary. The construction of this road will occupy 18 ha of forestland is covered mainly by dry evergreen forest (9 ha), mixed deciduous forest (2 ha) and unstocked forest (7 ha).

Generally, the location of all of the construction sites will lead to vegetation losses. The most significant is the need to clear approximately 13 ha of dry evergreen and mixed deciduous forests on the upper slope area along the access road from the dam site to powerhouse and at least 5 ha of dry evergreen forest at the proposed powerhouse. Within these areas there are some main tree species which have high commercial value such as *Cunninghamia sinensis*, *Fokinia chinensis*, *Keteleeria avelyniana*, *Castanopsis annamensis*, *Cinnamomum iners*, *Pterocarpus pedatus*, *Terminalia corticosa*, *Chukrasia tabularis*, *Ailanthus fauveliana*, *Dysoxylum binectariferum*, *Schima wallichii*, *Quercus poilanei*, *Keteleeria tonkinensis*, *May Song*, *May Lang Chik*, *May Xai*. Some of these trees have diameter range from 40 to 80 Cm.

However, this area is not part of the conservation forest or protected area, hence the overall impact of such tree removal is deemed to be minor, as only a few areas are likely to be encountered

In the case that forest need to be removed and individual big trees need to be cut from the project areas, funds will be provided by the project to the Provincial Forestry Section (PFS) and District Forestry Unit (DFU) to conduct a detail survey for collection of commercial tree species that need to be felled. During logging, the monitoring need also to be conducted by EMC which include PSF and/or DFU in order to ensure no illegal logging and cutting trees outside the approved areas. Logging and logs selling must be complied with Forestry Law and other laws and regulations concerned. At the same time, funds will be also provided by the project to assist with a program of compensatory regenerating and/or planting as per Article 15 of the Forestry Law (1996) especially for those areas that temporary access roads need to be constructed. The EMU which include Provincial Agriculture and Forestry Department (PAFO) especially PFS and DFU have responsibility to monitor the implementation of mentioned program. ROW clearing will be carried out by a contractor, whose work will be strictly defined by the contract specifications and special provisions.

A monitoring program will be implemented that involves District Agriculture and Forestry Extension Office (DAFEO), other authorities concerned, village forest association (VFA), and an independent third party, who will audit the environmental performance of the project. Strict rules against wildlife hunting and poaching will be imposed on project staff, workers, and all contractors engaged to the Project, with penalties levied for anyone caught carrying and using fire arms, or using animal snares and traps. Project owner shall be directly responsible for dissemination of all regulations and information concerned to its staff and/or employees as well as for any misconduct made by its staff and workers.

#### **5.3.4. Land Use and Resettlement**

A total of almost 50 ha of rice paddy field which belongs to 49 households of Ban Chim village will be directly affected and need to be properly compensated. The basic principle of compensation for the losses of land is that landowners have their choice between accepting cash payment and compensation by land of equivalent value at other location. The previous experiences from other similar projects indicated that most affected people preferred compensation by land. As it was mentioned in Section 5.1.3.2, although there is no any resettlement required due to there is no any house and construction will be affected, however, among total 49 affected households, three households asked for a new paddy field in other areas where suitable for their future life and business. One of the three will move to Luangprabang town and the rest two will move to live in Kasi District. Additional assistance in transportation for moving their houses/properties and also rice support during the first 3 years need to be provided from the project.

Most of the project will be constructed during the dry season, when there will be fewer crops that could be damaged. If crops are damaged, compensation will be paid properly.

Likewise, compensation will be paid to farmers for lost value of crops if farmers are prevented in advance from cultivating an affected piece of land because construction is planned to proceed during part of the cropping season.

## 5.4. Environmental Impacts during Construction

### 5.4.1. Construction Impacts on Biological Systems

#### a. Impact on Aquatic System

Probably effects on aquatic organism and fishery resources will be caused by water quality deterioration, particularly at the dam site and powerhouse construction areas, due mainly to soil erosion caused by land grading, compaction and excavation and to wastewater and soil wastes generated color, coliform bacteria, soil contents and grease and oils and decrease in dissolved oxygen content are anticipated. The effects are believed to be significant only in the rainy season and will be short term effect. As regards to fishing activities, the adverse impacts are expected to be not significant. However, in order to reduce such impact, some construction activities which may cause significant impact will need to be conducted only in the dry season. During construction, the Nam Ting River will need to be diverted around the dam site, this may extend over two dry seasons during which time the dam embankment will probably be constructed as two separate sections. During the dry season the water around the construction areas will be low and initially the water may be diverted around the dam site by some minor channel alteration, rather than using cofferdam. As the second half of the dam embankment is constructed during the second dry season, Nam Ting would probably be channeled past the site via a lower operating gate, this will also avoid the need for a cofferdam.

#### b. Impact on wildlife/wildlife habitat

As mentioned earlier, some species of wildlife still remains on the upper slope of Phou Da Phor mountain especially where the powerhouse and access road will be constructed and wildlife within the area is under considerable hunting pressure. In addition, about 18 ha of forest and vegetation within this construction areas will be cleared for access road from the dam site to powerhouse and powerhouse site, so the wildlife habitat will also be severely disturbed by the forest clearing activity during construction stage, this will be the supported factor for exacerbation. The boisterous noises from the construction machines will also disturb the natural living of the wildlife. Moreover, the construction workers may hunt wildlife within and around the project area.

In order to additionally reduce such intrusion, strict rules against logging outside the approved construction areas and wildlife hunting and poaching will be imposed on project staff, workers, and all contractors engaged to the Project, with penalties levied for anyone caught carrying and using fire arms, or using animal snares and traps. Project owner shall be directly responsible for dissemination of all regulations and information concerned to its staff and/or employees as well as for any misconduct made by its staff and workers.

#### c. Disposal of spoil

The Nam Ngum5 Project will create spoil disposal areas storing approximately 200,000 m<sup>3</sup> of spoil. The majority of the spoil will come from tunneling operations and will consist of sandstone. Some of this may be used in concrete aggregate, but it is expected that the bulk of this will be placed in the spoil heaps which have been initially sited in depression so as to reduce their visibility. After the operation is finished the heaps will be landscaped and

revegetated as part of the site protection and rehabilitation plan. However, alternatively, the spoil should be placed in heaps so that it can be used at a later date for other development purposes. This should be further considered during detailed design stage.

d. Access roads

Two main permanent access roads need to be constructed; one is the access road from NR 7 to the dam site (approximately 20 km) and another one is access road from the dam site to powerhouse (approximately 14 km). Due to mountainous terrain and steep slope, the roads must have sufficient drainage and where necessary the steep gradient drain shall be lined with rock or concrete in order to ensure the minimization of the soil erosion. In less steep batter or embankment vegetation cover shall be used. The road should have adequate turnoffs for water runoff and they shall be provided along the road to break up the length of slope runoff effect. This should be located and maintained at a vertical and interval of at least 2-3 meters. Excessive earthwork and vegetation clearance shall be kept to a minimum at all times.

## 5.4.2. Construction Impacts on Social

a. Dust

There is no any village located close to the construction area including dam site, access roads, powerhouse and others. There is only Ban Chim village located near to the future Nam Ngum5 reservoir, however, no any construction activity will be conducted within this area. Therefore there is no dust will be affected to the local community except for workers. However, the contractor will need to be prepared mitigation measure to alleviate dust impact on any of the project construction areas which will be affected to workers' health.

b. Noise and Vibration

In terms of noise and vibration, as mentioned above, no any village is located close to the construction area, therefore, there will only be a problem at the construction sites and it is anticipated that noise and vibration will not affect to local community except for site workers and wildlife around the construction area. However, noise suppression systems will need to be fitted to equipment while ear protection tool is needed to provide for site workers.

c. Health and Safety

To protect worker health and safety, the Contractor will be required to prepare and submit a worker health and safety plan for approval, prior to commencement of construction activities. Workers will undergo pre-employment medical screening and be certified as fit for work. Workers will receive health and safety training, including a training component on UXO recognition and management. UXO specialists will carry out surveys of sites that are to be excavated, and will remove and destroy any UXO encountered especially within the areas that the map suggests the remain of UXO. Areas that have been given the "all-clear" for construction will be demarcated. UXO pathfinders will need to be accompanied the ROW clearing teams to sweep for, identify, and dispose of UXO. Local villagers will receive public health education that focuses on prevention of diseases from migrant workers such as hygiene and sexually transmitted diseases.

As for local community, experience in other construction sites elsewhere in remote areas of the Lao PDR showed that the local people are exposed to a greater risk of traffic accidents when traffic volume increase during the construction phase, particularly in the northern mountainous and remote areas where the roads are on high slope and not wide enough, as in this case particularly NR 13 North and NR7. Children are normally most at risk and serious accidents are possible.

The construction work force faces the principal risks to health and safety. The main health and safety risks include:

- Inadequate sanitation facilities in worker camps
- Introduction of vector borne diseases such as dengue fever, malaria or encephalitis
- Other epidemic or sexually transmitted diseases introduced by migrant workers
- Serious injury or death as a result of a fall from any construction
- Serious injury or death resulting from accidental collapse of the spoil from headrace tunneling
- Hand, eye and foot injuries from falling or falling objects
- Road accident due to increasing and overload of transportation
- Serious injury or death from unexploded ordinance (UXO).

### 5.4.3. Construction Impacts related to Economic

#### 5.4.3.1. Local Residents

##### a. Employment Opportunity

It is estimated that the construction period is four years after a decision to conduct the project is made. Many activities will be done during the construction phase such as access roads and hydropower plant. It requires approximately 100-200 workers during this period. Economic benefits will be occurred from employment and linkage activities. The local people may be employed and their income may increase not only from participation in the project activities, but from selling food and other local products as well.

In order to improve the local livelihoods by increasing the income of local people, it should be incumbent on the project to ensure that benefits arising from the labour hiring are prior offered the local residents so that the employment benefits are maximized for the local community. Contractors are required to adopt a socially responsible attitude with regard to ensure that wherever possible the local community is prior given preference in recruitment. So, the contract document should be clearly specified that the local people have priority in employment.

##### b. Commercial Opportunity

Apart from the engaging with project construction activities, the local community will have also opportunity related to their local products production and selling including agricultural and forest products (NTFPs). Payment is made to the large workforce will increase disposable income, some of this will be spent within the local or village markets. This will create a sudden increase in demand for many products including food and non-food products. There will be a corresponding increase in demand for local supply of their products such as meat, fish and vegetable as well as other local handcraft products such as bamboo basket, rice box and others. Local people need to have an informing and awareness raising of these possibilities before the project commence so that they will be able to exploit the opportunities rather than surrender these to outside entrepreneurs.

##### c. Land value change and population movement

The availability of a reliable source of electricity to supply to the energy consumption for these areas, over time, will significantly contribute to the quality of life of local people and contribute to the development of regional industry, agricultural production and commercial activities, in the near future may increase the attraction of people migration to the area especially those who want to improve their living by agricultural production as well as livestock. This may result in a process of induced development along the corridor served by electrification, leading to increased exploitation of remaining forest resources. Other potential negative impacts could include land speculation by investors, and displacement of long time residents. However, due to these areas are mountainous, high slope and have not high potential for agricultural production particularly cropping, therefore, there is no significant impact concerning land value change and population movement.

d. Increase in affluent/poor income gap

Since there is no significant impact concerning land value change and population movement, and no resettlement and relocation is required for this project, therefore, there is no significant impact on this. All of local communities have equal right and opportunity to participate in project development activities as well as in land use within their own villages.

#### 5.4.3.2. Migrant Labours/workers

a. Conflict with local people

Conflict between local community and migrant labour may arise when itinerant labour moves into the area that has different social, cultural, traditional and lifestyle to the resident community. Experience from other similar projects and as a results from the survey and discussion with local villagers we see that there is no any specific reason may cause any conflict between them except for tradition and/or custom local community are not respected by outsiders. Therefore, worker behavior needs to be controlled in order to follow and comply with the local community rule and tradition particularly Lao minor ethnic groups.

b. Impact due to camping

▪ Forest/vegetation and wildlife

Some forests still remain within the project areas particularly in the powerhouse site. Camping within this area should not cause any impact on forest. Worker camps should not be established within the proximity of any rich forest like evergreen and/or mixed deciduous forest and attention must be paid with siting of the worker camps so that the workers do not interfere with any wildlife. Hunting and removal of forest products including timber and NTFPs from this area is not allowed except for some kind of NTFPs such as wild-vegetable, wild-fruits, bamboo shoot, mushroom, rattan shoot and some wild starchy roots and this will need to be strictly controlled so as to avoid any further depredation of these resources.

According to the laws and regulations concerned, logging outside the approved construction areas and wildlife hunting and poaching within the area will be strictly enforced on project staff, workers, and all contractors engaged to the Project, with penalties levied for anyone caught carrying and using fire arms, or using animal snares and traps. Project staff and workers will not be allowed and have no right to hunt wildlife and cut any tree except for dead fuel-wood. However, the best way, the Contactor should provide bottled gas or kerosene to workers for cooking as an alternative to fuel-wood. Burning to clear vegetation and wastes within the construction sites will not be permitted. Project owner shall be directly responsible for dissemination of all regulations and information concerned to its staff and/or

employees as well as for any misconduct made by its staff and workers. These requirements will be stipulated in the contract document. These issues need to be also stated in the Environmental Management Statement prepared by the Contractor.

- Water Quality

Since there is no any village located within the project construction areas, so the project staff and worker camps will be located far away from community center. It is anticipated that there is a minor impact on water quality concerning worker camping within the construction areas. However, the camps need to be provided with portable drinking water and that adequate waste water and sanitation facilities will be also installed. In order to avoid water pollution cause by rubbish/waste, regular waste collection will be part of the camp requirements that needs to be done and this must be taken to a managed waste disposal facility. The location of the temporary and permanent camps will be determined during detail design under discussion amongst contractor and stakeholders.

## 5.5. Environmental Impacts during Operation

The Nam Ngum5 Project will collect the flow from the upstream area of three main rivers such as Nam Ting, Nam Sout and Nam Phat. After turbining the flows will be released to the Nam Ngum River which will be Nam Ngum3 head pond in the near future and will be stored and re-used by the Nam Ngum3 Hydropower Project. The major impact that Nam Neum 5 will have, is on the reduction of the flow of the downstream from the dam site to Xiengdet village, however, after the Nam Ngum3 project is completed, with FSL of Nam Ngum3 reservoir is assuming at 720 masl, where Xiengdet village will be inundated, therefore, it is anticipated that there is no significant impact for the downstream of Nam Ngum5 project.

### 5.5.1. Head Pond Operation

#### 5.5.1.1. Headpond storage

##### a. Sediment Deposition and Reservoir Filling

The indicated reservoir is for an approximately 100 m high dam is narrow and sinuous, extending along Nam Ting valley to the south and along Nam Sout and Nam Phat, tributary of Nam Ting, to the North. No significant slope stability issues were apparent, however, reservoir slope stability will require careful consideration, particularly immediately upstream of the dam site where gorge slopes are steep and inundation depths will be greatest.

Since the catchment area of NNg5 with its 483 km<sup>2</sup> and the run-off from this catchment is only small compare to the other Nam Ngum Hydropower Projects, its impact will be relatively small. The water stored in the dead storage of NNg5 is equivalent to some 2% of the annual run-off at NNg3, some 1% at NNg2 and some 0.7% at NNg1 (Pre-feasibility Study, Feb. 1997).

Since the water have to be stored in the dead storage only one - in the year of reservoir filling – it will result in a loss energy generation only one. After filling of the reservoir has taken place the reservoir operation will start with the release of a regular monthly run-off some 44 mill. m<sup>3</sup> per month. The maximum possible total energy losses for the Nam Ngum cascade will be in the order of 66 Gwh.



In fact the energy losses will be smaller because the reservoir filling will take place during rainy season. If the stored water is water which would have otherwise been spilled at the downstream dams from the reservoirs, it will not cause any energy generation losses.

b. Regulation Benefits

The benefits which will be created by NNg5 reservoir through its regulation impact on the downstream schemes were estimated based on very simple assumptions as is given in the Table 5.5.1 below. The estimates is based on a similar study carried out for NNg3 and NNg2 to identify the impact of that projects on the downstream projects. The impact decreases from upstream to downstream. The same degree of additional regulation as calculated for NNg3 has been assumed under consideration of the substantially smaller catchment area of NNg5. Thus the additional benefits are limited to a very low percentage. The benefits have been estimated to be 1.7% of additional energy generation at NNg3 and even less for the downstream projects (Pre-feasibility Study, Feb. 1997).

**Table 5.5.1.1: Energy Generation Benefits due to Additional Upstream Regulation**

Scenario	Generation without Regulation of NNg5 (GWh/a)	Generation with Regulation of NNg5 (GWh/a)	Difference (GWh/a)
Nam Ngum 5	-	507	-
Nam Ngum 3	2,087	2,122	35
Nam Ngum 2	1,784	1,793	9
Nam Ngum 1	854	855	1
<b>Total</b>			<b>45</b>

Since the NNg5 is smallest project of the one mentioned above within the Nam Ngum basin, the need to establish a “Nam Ngum Water Management Association” could coordinate the use of water resources within the Nam Ngum basin and also a need for establishment of “Water Management Plan” will be more developed and related to the larger hydropower schemes. However, the additional flow regulation provided by the NNg5 project will create additional benefits, which increase the economic performance of the scheme (Recommendation made by Pre-feasibility Study, Energy Equity Corporation Ltd., Feb.1997).

c. Aquatic Habitats

There is no any significant impact on aquatic habitats due to the headpond and/or reservoir is small and lie along the Nam Ting, Nam Sout and Nam Phat rivers and it will be flushed each year. For the existing fish species in the project area, it is surmised that those species which can not live in a lentic environment will migrate to suitable habitats upstream of those three main rivers. Whereas, those species that prefer standing water will increase in their abundance. This increase will be most dramatic in the first few years of impoundment.

d. Ground Water

There will be an increase of in the ground water level beside and around the head pond due to the water level in the head pond will be raised. However, there is no any village or community center adjacent to the head pond will be benefited from this.

e. Water related Diseases

According to the result of survey and villagers interview, it was found that there is no any water related diseases were occurred within the project area. However, fecal coliform

bacteria were found in all of the natural watercourses particularly in tropical forests. Poor quality of drinking water is the main cause of disease and debilitation to the local community particularly in the remote areas. Therefore, clean water supply will have an overall beneficial effect in improving project workers and local community health.

### **5.5.2. Headrace Tunnel Operation**

There is no any significant impact on vegetation, wildlife, underground life and ground water due to headrace tunnel operation.

### **5.5.3. Dewatering Effect of Downstream Diversion**

The Dam is located in a relatively remote area which is sparsely populated. According to the field reconnaissance survey conducted by DSC Team to collect the data and information for preparation of this report indicate that no requirement on water for agricultural production, neither for irrigation, fishery nor any other uses along Nam Ting river downstream from the Dam site to Nam Ngum River and Powerhouse site.

Along the Nam Ting river, some 600 m downstream of the Dam site on the right side there is a small stream joins as a tributary stream of Nam Ting river and at about 2 km further downstream a large tributary stream enters Nam Ting river. The sum of these two inflows is expected to refill and maintain a sufficient minimum flow for domestic and conservation purposes in the reach between the dam site and power house. Furthermore, the headwater of the future Nam Ngum 3 reservoir will reach the areas and villages assuming a FSL of 720 masl and might inundate some areas and part of Xiengdet village.

### **5.5.4. Powerhouse Release**

The NNg5 powerhouse is located immediately on the right bank the Nam Ngum River where will be the Nam Ngum 3 head pond in the near future and that the NNg5 powerhouse will be discharged directly to the NNg3 head pond. Thus there will be no effect on flow variation or channel hydraulic.

### **5.5.5. Local Community Benefits**

This project is basically similar to others development projects, this project will have some socio-economic benefits for local community and local region not only during the construction phase, but also during the project life. Apart from the provision of additional work opportunities within the project area, most of the benefits will be related to improving services and basic facilities. It is anticipated that the project will create some following benefits;

- Creation of additional employment opportunities (during construction)
- Improvement of access (project life)
- Improvement of water supplies for agricultural production and livestock (project life)
- Improvement of water supply for drinking (project life)
- Increase potential for village fishpond and headpond fishing opportunities (project life)
- Improvement of commercial and service opportunities (project life)
- Improvement of power supply (project life).

## 5.6. Transmission Line

According to report of the Pre-feasibility Study, Feb. 1997, conducted by Energy Equity Corporation Ltd., indicated that the selection of transmission line has been considered and the option 3 was chosen for comparison. This option requires connection to new collector 500 kv sub-station near Vangvieng District or Nam Leuk and some 80 km of new 115 kv transmission line following mainly the alignment of the southern access route (see *Picture*).

The GOL is considering the construction of a 500 kv collector substation. Possible locations are in the west at Houaypamom village near Vangvieng District or in the east near Nam Leuk Powerhouse. A common substation collecting the energy from various projects would save costs and reduce environmental damage to all. Possible candidates are the hydropower plants of NNg2 (360 MW) and NNg3 (460 MW). They would link their 230 kv lines into the proposed substation as Nam Ngum 5 could also feed into the net at that station. However, the Nam Ngum 5 project will be responsible only for the 2.5 km transmission line connection from the switchyard to the Nam Ngum 5 sub-station and a decision whether to build a joint station or not has not been taken. The study for the other joint stations and transmission lines will be separately conducted.

### 5.6.1. Transmission Line Considerations

Unlike other types of linear corridor developments (e.g., roads, railways), where the transmission lines are severely limited by physical constraints of gradient, length of river crossing, etc., transmission lines afford considerably more flexibility, thereby enabling the designers to avoid areas of sensitivity.

As principally said, the alignments will be sited so as to avoid cross villages and other areas of settlement. Instead, the transmission lines will be routed behind, around or between villages. In case the construction of transmission line could not avoid crossing villages, houses and/or other constructions, such houses and other constructions e.g. temple and rice huts, within 25m along the line need to be removed, resettlement and compensation must be considered based on the laws and regulations concerned. While the compensation cost for the losses will be paid suitably by the project owners or EdL to villagers according to the existing conditions of such houses and/or constructions and under both sides negotiation. On the other hand, in case the construction of transmission line could not avoid crossing villages, houses and/or other constructions, in order to reduce such impacts, construct with higher towers or locate towers on the highest points is more recommended.

The consideration and selection of transmission line was based on the following engineering principles:

- Construction of the towers, however, to keep the alignment as straight as reasonably possible between the start and end points (at least between first PI or angle tower and next angle towers) so as to minimize the costs of construction and imported materials;
- Wherever possible locate the alignment more or less parallel, and in close proximity of an existing road to facilitate construction access and access for maintenance and repairs during operation;

According to the existing conditions of the project area, the following environmental and social principles of route consideration and selection will be used in addition to the engineering principles listed above:

- Avoid existing settlements, private and community structures, particularly houses and/or built-up areas, to ensure that resettlement would not be required;
- Minimize the need to expropriate valuable land areas, particularly village holy forest, village cemetery, agriculture land, farm land, etc.;
- Avoid areas of mature forest and other environmentally sensitive areas including NBCAs, NPAs, eco-tourism sites;
- Ensure adequate clearance between the alignment and significant cultural/historical monuments/sites.
- In addition, wherever possible considerations were given to minimizing the extent of visual intrusion upon viewscapes considered as unique or valuable as tourist resources.

In addition to the above engineering principles, the following factors need to be paid attention in transmission line consideration;

#### **5.6.1.1. Land Use and Vegetation**

Generally, the clearance of vegetation along the presence of the alignment can lead to fragmentation of already diminishing areas of natural forests and wildlife habitats. Overall, the existence value, as well as the ecological research value of the ecosystem will be diminished. Rare and/or threatened vegetation or wildlife species may also be affected by the alignment. The permanent maintenance of the ROW during and after construction will eliminate the ability of the land on which the ROW is situated to re-grow to species-rich secondary forest.

However, for this project, as the habitats are severely degraded over most of the project area due to from time to time exploitation of forest and land resources and the alignment will more or less run parallel with the NR 13 North and/or RN7 for most of the line length, the construction of access roads to the ROW is not much required, it is, therefore, anticipated that forests/vegetations and wildlife habitats will not be significantly affected.

However, although forests and wildlife habitats will not be affected significantly by the Project, in the cases of holy forests and cemeteries are affected by the project, where it is necessary to remove vegetation, only a narrow right-of-way will be cleared, and then proper compensation cost will be paid to the villages in order to conduct traditional religion ceremony.

The alignment will more or less parallel, and be in relatively close proximity to (i.e., no more than 1 ½ to 2 km) from existing road, thereby minimizing the disruption that would be caused by having to construct lengthy access ways. No new roads will be constructed, only small access tracks to facilitate movement by light tractors or pickup trucks to tower sites. In inaccessible areas or in the areas that TL locates far away from the main road, the potential of moving materials to construct towers onto the sites may be small tractors by using old village tracks or feeder roads/trails.

To ensure that the alignment and new access tracks are sited to avoid areas of environmental sensitivity, a member of EdL's EMU will be involved in the detail design and reviewing the detailed alignment survey and conducted monitoring since early stage of construction.

#### **5.6.1.2. Settlements**

Resettlement and/or removal of houses and other construction can lead to disruption of community cohesion and social structure, change life style and livelihood pattern of

villagers, may also create a bad impression and poverty to villagers if compensation is improper. Since the alignment is not exactly identified in the field, however, during detail design and construction, some houses or single residences may lie in the path of the proposed transmission line, requiring that a portion or all of the villagers be resettled. In order to reduce the cost for compensation and to reduce social impacts as mentioned above, transmission line route should be located behind and away from houses and villages. During the detailed alignment survey and identification in the field, villagers along the route should be consulted again regarding their attitudes and opinions as well as value of their properties and resources.

### **5.6.1.3. Cultural and Heritage Sites**

Cultural and heritage sites are national property. Running a high voltage transmission line within close proximity of an important cultural or heritage feature can reduce the esthetics of the site, as well as reduce its existence value, i.e., the value that it exists without being affected by external influences. Relocation of monuments may be culturally unacceptable and result in hostility being directed toward a project.

Although some village temples and/or ruins are not seen as cultural and heritage sites, they are respected as valuable cultural properties of villagers. As mentioned above, the removal of such properties will be unacceptable and unsatisfactory by villagers and may result in and create conflict between villagers and project. However, during field survey, consultations with local villagers should be conducted. In order to reduce such social impact, is to locate the line away from such properties. The proposed alignment will be altered if, as a result of the detailed design and alignment survey, any property removals are unacceptable and unsatisfactory by villagers who are seen as the owners of the properties and heretofore-unknown cultural/heritage monuments are discovered or identified by villagers.

### **5.6.1.4. Drainage System**

Since the project area is mountainous, high slope, towers should be sited to take advantage of high points of land. This minimizes the number of towers that are needed, and provides large clearance distances between overhead conductors and vegetation growing in the valleys. The watercourses within the valleys are left undisturbed, with the vegetation intact. In order to reduce potential additional sites from which soil could be eroded into rivers or streams, the amount of side slope disturbance that would be required to build access tracks and sites for placing towers in depressions should be minimized. Towers should also be kept out of streams or watercourses as well as the areas of possible flooding, mass wasting and wetland areas.

### **5.6.1.5. Other Utilities and Traffic**

International safety standards for minimum clearance distances have been adopted by EdL for high, medium and low voltage conductors. Minimum clearances are prescribed between conductors and the ground, navigable and un-navigable waterways, road crossings, buildings, antennae, telecommunications lines and other types of utilities.

Table below provides a summary of the clearance distances used by EdL for the 115kv line. The proposed alignment will avoid existing utilities wherever possible. Otherwise, the minimum safety clearances need to be used.

**Table 5.6.1.5: Safety Clearances to Live Conductors**

<b>Conductor to Specified Target</b>	<b>Minimum Clearance Distance (m) for 115kv</b>
Ground Surface (Accessible to pedestrians only)	7.5
Navigable River	5.0 Above mast height
Un-navigable River	7.0
Road Crossing	8.5
Buildings	Not Permitted
Antennae	N/A
Telecommunications Lines	4.0
Other (Mekong Crossings)	16.5 above high water level, or 5.0 above mast height, which- ever is greater

Source: EdL, MIH

## 5.6.2. Potential Impact from the Transmission Line Construction

### 6.6.2.1. Main Construction Activities

Generally, construction of the 115 KV transmission lines will typically involve the following tasks:

- Clearing of vegetation from at least 25m ROW by felling and lopping of trees, shrubs and bamboo including disposal of waste from site clearing to provide adequate clearance between vegetation and the conductor wires.
- To gain access to the alignment, access tracks will be cut from various points along the main roads to which the TL runs more or less parallel. Where soil conditions dictate, the tracks will be surfaced with suitable road topping material.
- The sites for lattice steel towers will be cleared and grubbed, and holes dug to permit construction of each of the four tower footings. At locations where rock or densely compacted soil is encountered, rock drills will be used to create holes for the tower anchor bolts. In such cases, compressors will be required on site to provide compressed air for the pneumatic drills.
- Cement and aggregates will be carried to the each tower site to make concrete that will be poured into the holes to serve as the tower footings.
- The steel components and bolts for the lattice steel towers will be carried to each tower site, where the tower will be assembled and erected manually.
- When once the towers are in place, the insulators will be installed and pulling wheels will be hung from each insulator string. Nylon ropes will be run along the centerline of the alignment from tower to tower. Drums of conductor wire will be transported to strategic locations on the alignment, connected to the nylon ropes, which will then be connected to (gasoline) powered winch that is secured further along the alignment. Conductor wire will be secured to the nylon rope, which will be winched in one at a time to string the

conductors from tower to tower, through the wheels suspended from the insulators. The conductor wires will be secured to the insulators with the appropriate tension and sag.

- Grounding rods and/or continuous buried “counterpoise” (grounding) wires will be installed as required.
- Temporary equipment stockyards, work camps and field mobile offices will be constructed. The main stockyards will be located near existing towns where advantage can be taken of transportation systems, existing vacant level land and, wherever possible, fenced off secure areas. Work camps along the transmission line will generally consist of temporary tent camps that will be moved as the construction proceeds along the alignment. Camps will house small work crews and will, therefore, not require any significant infrastructure.
- When once construction has been completed, sites that are no longer required (e.g., access tracks, storage and camp sites) will be reinstated. This will include removing debris or other contaminants, and returning the site to the same (or better) condition in which it was found. Where it was necessary to gain access to the alignment across agricultural lands, these areas will be reinstated to ensure future productivity.

### 5.6.2.2. Potential Impacts

Since the detail design of transmission line for this project and the decision whether to build a joint station or not has not been taken yet and that the information concerning transmission line ROW is not available yet, therefore, an environmental impact assessment for the transmission line could not also conduct particularly in the field level. Preliminary route selection of the transmission lines for this project was based on a topography map recommended in the report of Pre-feasibility Study conducted in 1997.

However, for this project, the detailed alignment survey which involved cutting survey lines through vegetation to enable the cadastral survey team to take unimpeded shots along sight-lines with their survey instruments will be conducted as well as the tower locations will be marked on the ground along with the centerline of the alignment.

#### a. Vegetation and Wildlife/wildlife habitat

Based on the field observation and review of land use and forest cover map in the northern Lao PDR, it is anticipated that most of the vegetation that will be affected is unstocked forest and scrub which include herbaceous, woody stemmed shrubs and bamboo. This is the characteristic early serial stage vegetation community that becomes established following logging and shifting cultivation. It is not anticipated that any areas of old forest will be encountered along the proposed rights-of-way. Nor does it appear that the alignment will pass through any species-rich areas of second growth forest and any NBCA or protected area. However, this will be confirmed when the detailed alignment survey is undertaken. In the event that trees may need to be cut through second growth stands, the overall impact of such tree removal is deemed to be minor, as only a few if any such areas are likely to be encountered. Also, the rapid rate of growth, estimated at 0.5 m<sup>3</sup>/ha/year, for tree species in most of Laos means that those areas currently classified as woody scrubland, have the potential to become secondary forest land, if properly stocked and managed except for some area particularly in the Phou Khoune District where most of the land is covered by grass and herbaceous that have no potential to become secondary forest. There is no any area appeared as wildlife habitat due to most of forestlands have been converted from time to time by heavy logging and slash and burn for shifting cultivation.

b. Land Use and Settlements

As noted earlier, the alignments will be sited so as to avoid crossing villages and other areas of settlement. Instead, the transmission lines will be routed behind, around or between villages. At this time, it is anticipated that there will be no need for resettlement, or relocation or replacement of structures. This will be confirmed during the detailed alignment survey. In the unlikely event that resettlement is required, then the provisions of the Land Law (1997), the Electricity Law (1997) and other laws and regulations of the Lao PDR concerning resettlement and compensation will be strictly followed.

Based on the field observation and review of land use and forest cover map particularly in the northern part Laos, it is indicated that there is very little agricultural land within the proposed alignment. The main concentration of agriculture land is along NR 13 of Vientiane Province. Since the valleys in which the transmission lines will be located run parallel to the direction of the alignments, the transmission line will be situated along the edges of the agriculture areas on the lower slopes of the hills/mountains that confine the valleys. Therefore, no permanent acquisition of farmland is expected. This will be confirmed during the detailed alignment surveys.

Where it is necessary to construct transmission lines across agricultural land, the land on which the tower is to be situated will be permanently acquired by project owner/EdL. For standard lattice towers 36 m<sup>2</sup> of land is required per tower. Angle towers require 72 m<sup>2</sup> of land per tower.

In terms of other land used types such as tree plantation, fruit trees garden and other crops if any higher than 3m will be removed and compensation will be based on the loss of such properties not based on the land value because there is no land acquisition. Likewise, the land compensation for construction of towers is also based on the loss of existing properties on the land that the towers will be situated.

c. Erosion and Silt control

During the construction, the project will involve only minimal excavation that could contribute to soil erosion and the potential for sedimentation of watercourses. Excavation will be limited to the following:

- Digging four holes for each of the lattice tower concrete support bases,
- Clearing, excavating and leveling tracks to access the transmission line alignment or tower base construction sites.

The towers should be located so that to avoid high slope areas. In case that can not avoid such areas, excavations for tower bases must be limited to the immediate area of the tower legs. It is recommended that on sloped land, the legs of the tower be designed so that the downhill legs are longer than the uphill legs (i.e., staggered legs). This will enable the towers to be sited without having to excavate a level cut into the slope, which could create future problems with slope stability and erosion. Most construction will proceed during the dry season. This will avoid difficulties that would otherwise be encountered during the rainy season.

The number of access tracks used will be limited to approximately one every three transmission towers (approximately one every kilometer). Access tracks will be selected at a closest point and should be an average not more than 1 km in length. The tracks will be no wider than 2.5 meters and will be covered with suitable road topping material in areas where moist soil conditions or the potential for water borne soil erosion could lead to problems. However, using of existing or dry season farm roads/tracks to gain access to the alignments is more recommended.



In case of access tracks that are not required for permanent use<sup>2</sup> will be decommissioned by rehabilitation, re-contouring the slope and seeding the surface to encourage rapid re-vegetation. Internationally accepted best environmental management practices will be used to assess the risk of slope failure and erosion, and prevent and control potential problems. It is anticipated that existing sources of aggregate will be available for use by the project. Therefore, no major borrow sites, and no quarries will be developed for the purposes of the project.

The re-vegetation after construction within the transmission line towers is not necessary due to the footprint for a 115 kv tower is quite small (about 36 m<sup>2</sup> - 49 m<sup>2</sup> for suspension towers and about 52 m<sup>2</sup> – 72 m<sup>2</sup> for angle towers), therefore, the area that would be exposed to the forces of erosion is quite limited; and natural plants regeneration occurs quite quickly during the early part of the rainy season, thereby the possibility that soil erosion within the transmission line towers will become minor problem.

d. Interference with Other Infrastructure

As transmission line construction, particularly tower erection and conductor stringing, moves from location to location as the work progresses, traffic disruption along the roads where erection crews are unloading materials from heavy trucks will be minor. Project owner should adhere to its established practices of posting warning signs and managing traffic to protect the traveling public and its workers. In the event that stringing conductors presents a possible risk to traffic on roads or rivers, bamboo scaffolds will be constructed across the roads and rivers to protect pedestrians, vehicles, boats (and the conductor itself) from potential injury/damage during conductor stringing. In case of over weight of construction materials that will be transported to the construction and/or substation sites, it may be necessary to temporarily reinforce some of the weaker roads or bridges.

e. Transmission Line Maintenance

EdL carries out corridor maintenance using manual means of trimming the vegetation. In the current practice, EdL is conducted inspection of transmission line at least twice per year with aiming to check the condition of towers, conductors, insulators as well as clearing or trimming vegetation and cut any tree with higher than 3 meters in order to avoid electrical arching or service interruption. Using of herbicides or chemical poison along the ROW which can contribute to contamination of watercourses and threaten people, beneficial insects, birds and other wildlife will not be allowed. Burning to control vegetation along the ROW is also prohibited. Any crop cultivation of local people under transmission line is allowed. Rather, local people living along routes will be participated under contract to manually clear and cut vegetation/trees along ROW under supervision of EdL technical staff. However, villagers' participation in maintenance of Transmission Line is more recommended.

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<sup>2</sup> If necessary, only those tracks that provide access to 'corner' towers will be constructed for permanent use

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## CHAPTER VI

### ENVIRONMENTAL MANAGEMENT PLAN (EMP)



#### **6.1. Protective Measures for Socio-economic and Environmental Impacts**

The details measures for mitigation of impact on socio-economic and environmental have been presented in the Impact Matrix, Section 5.2, Chapter V.

#### **6.2. Project Implementation Schedule**

Project construction is scheduled to start in September 2007 (if approved) and to last no more than 48 months, with the commissioning of the units in June 2011 and finishing works completed in September 2011. This organization takes into consideration the constraint of the rainy Season (mid-June to mid-October) during which only limited outdoor works can be performed. Underground works (tunnels, surge shaft) can be performed all year long. Details are presented in Annex Table 2.4, Section 2.9, Chapter II.

#### **6.3. Main Contents of the Plan**

##### **6.3.1. Proposed Measure**

The measures proposed in the EMP are basically related to mitigation and monitoring activities, which constitute the core strategy of this plan.

Mitigation measures are proposed during both construction and operation phases. They include diversified activities as additional studies, technical sub-projects, and financial compensation. These measures are detailed in section 6.3.2.

Monitoring measures are basically related to 2 types of activities: regular acquisition of additional data for the quantification of Project impacts and the follow-up of the appropriate implementation of the mitigation measures and Contractor's obligations. These measures are detailed in section 4.3.

The EMP components are listed in the Table 6.3.1 which provides the potential impacts, the measures proposed and where individual executing responsibilities lie.

**Table 6.3.1: Summary of Mitigation Plan**

Phase	component Concerned	Potential Impacts	Mitigating Measure	Responsibility
<b>DESIGN AND CONSTRUCTION PHASES</b>	<b>AIR QUALITY</b>			
	Vehicle and engine emission	Increase of air emission	<ul style="list-style-type: none"> <li>- Reduce vehicle travel distance between camp and work sites</li> <li>- Maintain of engine</li> </ul>	Engineer
	Dust emission	Increase airborne dust along the roads during dry season	<ul style="list-style-type: none"> <li>- Control with water spraying in concerned villages and work sites</li> </ul>	Contractor
		Dust from crushing plants	<ul style="list-style-type: none"> <li>- Respiratory protection devices for workers at crushing site</li> </ul>	Contractor
	<b>SOILS</b>			
	Land use	Lost of farm land and forest	<ul style="list-style-type: none"> <li>- Preserve top soil, rehabilitate and revegetate after use</li> <li>- Village land use plan (if necessary)</li> </ul>	Contractor/EdL
	Road construction	Alter drainage, cutting of slope, loss of vegetation cover, risk of erosion	<ul style="list-style-type: none"> <li>- Road design to satisfy national or international standards</li> </ul>	EdL/Engineer
			<ul style="list-style-type: none"> <li>- Construction methods to follow present best practice</li> </ul>	Contractor
			<ul style="list-style-type: none"> <li>- Slope protection measures with revegetation</li> </ul>	Contractor
	Spoil dams	Creation of sterile fill areas, loss of vegetation cover	<ul style="list-style-type: none"> <li>- Select site within reservoir area</li> </ul>	EdL/Engineer
			<ul style="list-style-type: none"> <li>- Use spoil as backfill of borrow areas</li> </ul>	Contractor
	Quarry and borrow areas	Alter drainage, cutting of slope, loss of vegetation cover and farmland	<ul style="list-style-type: none"> <li>- Submit detail plan for quarry operation and rehabilitation prior to excavation</li> </ul>	Contractor
			<ul style="list-style-type: none"> <li>- Fill borrow area with excavation spoil from tunnel</li> </ul>	Contractor
			<ul style="list-style-type: none"> <li>- Compensate farmers for loss of agriculture land</li> </ul>	EdL/NN5 EMC
	Temporary camps and permanent facilities	Alter land-use, loss of land and vegetation cover	<ul style="list-style-type: none"> <li>- Submit detail plan for approval before implementation</li> </ul>	Contractor
			<ul style="list-style-type: none"> <li>- Compensate farmers for temporary or permanent loss of agriculture land</li> </ul>	EdL/NN5 EMC
			<ul style="list-style-type: none"> <li>- Implement when possible temporary facilities within future reservoir limits</li> </ul>	Contractor
	<b>WILDLIFE</b>			
	Wildlife	Loss of habitats and local disturbance of breeding sites	<ul style="list-style-type: none"> <li>- Organize animal rescue during clearing operation</li> </ul>	District forestry office
	<b>AQUATIC</b>			
	Water quality	Increased sediment load in river	<ul style="list-style-type: none"> <li>- Trap sediments on construction sites</li> </ul>	Contractor
		Water pollution during construction	<ul style="list-style-type: none"> <li>- No direct runoff to river from vehicles/engines maintenance areas</li> </ul>	Contractor
			<ul style="list-style-type: none"> <li>- No direct runoff to river from toilet and waste disposal sites</li> </ul>	Contractor
	<b>SOCIO-ECONOMY</b>			

Phase	component Concerned	Potential Impacts	Mitigating Measure	Responsibility
	Workforce and population movement	Concentration of workers with associated risk	- Provide adequate housing facilities	Contractor
			- Provide fair opportunities of work for local population especially women	Contractor/EdL/NN5-EMC
			- Recruitment and training of local residents as staff for project operation	EdL
			- Discourage antisocial behavior(gambling, fighting, alcohol, drugs)	Contractor/EdL/NN5-PEMC
		Uncontrolled settlements	- Strict control of settlement development next to workers camps	Contractor
			- Awareness campaign for temporary settlement of workers	NN5-PEMC
	Public Health and safety	Introduction and spreading of diseases	- Carry out workers pre-employment screening	Contractor/ district health office
			- Malaria control for workers	Contractor/ district health office
			- Malaria control for near-by population	NN5-PEMC/MOH
			- Support health service both facilities and human resources in Ban Chim	MOH/District health office
			- Non-formal education campaign for hygiene and prevention of sexually transmitted diseases (STD)	MOH/LWU
			- Carry out malaco-ecological survey	MOH
		Road accident cause by traffic congestion	- Proper road system design - Control the driver behavior, - Signboard where dangerous areas	Contractor
		Worker injury during construction	- Elaboration and enforcement of safety regulation - Implementation of an emergency evacuation procedure	Contractor/project owner
		Encroach into area contaminated by UXO	- UXO pathfinder survey and clearance before construction	Constructor and UXO Supervisor/specialist
		Land tenure	Temporary or permanent acquisition of farmland	- Creation and financial support of the NN5-PEMC
	- Land titling in Ban Chim			District land office
	- Land acquisition and compensation			EdL/NN5-PEMC
	Education and Culture	Increase in students during construction	- Assist improving existing facilities to required standard and capacity to accommodate student population from workers families	Contractor/project owner
	<b>OPERATION PHASE</b>	<b>AQUATIC</b>		
Hydrology		Dam will alter downstream discharges mainly in wet season	- Monitoring exiting gauging stations	EdL
		Sudden changes in Nam Ting (Minor impact)	- Awareness information among local fishermen	EdL/NN5-PEMC
Water Quality		Alteration of water quality after impoundment by flooded	- Total logging and clearing of the reservoir	EdL/provincial & district forestry office

Phase	component Concerned	Potential Impacts	Mitigating Measure	Responsibility	
		vegetation (Minor impact)			
	Fisheries	Disruption of upstream fish movement (minor impact) and possible reduction of some fish species	– Preparation of a reservoir fisheries management plan	EdL/DiF	
	<b>FOREST</b>				
	Forest cover	Flooding or clearing of forest (minor impact)	– Reforestation of degraded areas		
	<b>WILDLIFE</b>				
	Operation of facilities	Easier access to area leading to increase hunting and poaching pressure	– Destruction of temporary access and reforestation	Contractor	
			– Provide long-term financial resources for Phou Da Phor and Phou Pha Day conservation management operation	Project proponent	
			– Implementation of long-term Phou Da Phor and Phou Pha Day management plan	District conservation office	
	<b>SOCIO-ECONOMY</b>				
	Population movement	Uncontrolled settlements	– Strict control of settlement development	EdL/NN5-PEMC	
			– Monitor and control population movement in other areas	EdL/NN5-PEMC	
	Rural electrification	-	– Provide electrical connection to Ban Chim	Project proponent/EdL	
	Education	Children drop out school	– Develop a new secondary school – Promote and support local teacher to study and come back to teach in their hometown.	Project proponent/MOE	

### 6.3.2. The Mitigation Plan

#### 6.3.2.1. Construction Phase

Mitigation measures during construction phase will be carried out by range of agencies depending on the nature of the measures. There are 3 principal categories of the mitigation measures:

##### a) **Construction Contracts**

*Construction contracts contain obligations for environmental mitigation measures, including both preventive measures, working methods and social measures specific to certain conditions prevailing in the project area. These obligations are detailed in Section 6.6, which set out the principles for the Contractor will be expected to observe as far as applicable.*

*The main Contractor will be required to prepare, for the approval of the Environmental Manager and the Project Manager, a Health and Safety Plan, and an Environmental Management Plan detailing general construction measures applicable to preserve land use, soils, water quality, biodiversity and local socio-economy.*

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*The borrow areas in charge by the Contractor will be requested to prepare a detailed Management Rehabilitation Plan of the area, in accordance with the obligation detailed in Section 6.6.*

*All works by the Contractor with potential impacts on the environment and land-cover will be subjected to prior approval by the Environmental Manager (EM) and the Project Manager.*

**b) Specific Measures**

*These measures are under the responsibility of EdL or of any sub-contracted executing Agencies from GOL. These measures are mainly related:*

- *The creation of financial supports of the Nam Ngum 5 Environmental Management Committee (NN5-PEMC), which includes representative from local population and authorities and from the Project Manager (see section 5.1.4). This Committee will provide the main information and coordination link between the Project and population concerned.*
- *The organization of reforestation in order to preserve water quality in the future reservoir.*
- *The preparation of a reservoir fisheries management plan.*
- *The wildlife conservation of the Phou Da Phor and Phou Pha Day Mountains.*
- *The organization of awareness campaigns for temporary settlers and workers concerning the status of their temporary presence in the project area.*
- *The implementation of Non Formal Education Campaign for local population regarding hygiene and prevention of sexual transmitted disease (STD).*
- *The implementation of malaria control program for the local population not directly involved in the Project activities.*
- *The implementation of UXO pathfinder survey and clearance before construction.*
- *The organization of a malaco-ecological survey in the project area, in order to assess the risk level regarding potential development of Schistosomiasis.*

**c) Improvement Measures**

*The improvement measures take the opportunity of the Development Project that need to be concerned by the project proponent to restoration/ rehabilitation of the effected people and village based on the Degree on the Compensation and Resettlement of the Development Project. The main measures proposed in the mitigation plan concern:*

- *The financial support provided by the Project to appoint an Integrated Development advisor for a 2 years period to prepare a long-term management plan, train the local staff and assist the Project in the monitoring activities during and after construction, especially in the field of forestry, wildlife, conservation and extension.*
- *The construction of secondary school in Ban Chim, support facilities and human resources for health centre.*



- *Provide electrical connection to Ban Chim, which is the priority issue concerned by village community.*

### **6.3.2.2. Operation Phase**

After impoundment of the reservoir and the beginning of operation, several mitigation measures will be implemented under the responsibility of EdL or sub-contracted agencies. The major measures will be as follows:

- The project will try to recruit as much as possible manpower for local residents as permanent staff for the operation of the project.
- The operation budget of the NN5-PEMC will be supported by the project proponent for the first two years of operation. This period of time is considered as necessary for the completion of the compensation procedure of Ban Chim in case of grievance regarding the rehabilitation of paddy fields and others.
- Provide long-term financial resources for Phou Da Phor and Phou Pha Day conservation management operation and reforestation of degraded areas around the project.
- Strict control of settlement development by outsiders.
- Awareness raising program will be implemented among the fishermen in order to inform them about possible changes of the Nam Ting current when the power plant starts operation. An alert procedure will be set up as part of the safety operation guidelines of the project.

### **6.3.3. Grievance Procedure and Resolution**

The "Project Environmental Management Unit" will provide "Ban Chim Village Mitigation Committee" with standard Complaints Forms to be issued to all households. Household, or groups of households wishing to complain about the effects of construction works on their property, production systems, economic well-being, spiritual life, quality of water or air, health, safety, welfare or any other facet of their lives shall make their complaint using these Complaints Forms.

The Process of Grievance Investigation and Resolution will follow these steps:

- 1) *Complaint Forms will be sent by households or groups of households to the "Ban Chim Village Mitigation Committee".*
- 2) *Within 30 days the "Ban Chim Village Mitigation Committee" will investigate the complaint. If it is judged by them to be valid the Complaint Form will be forwarded to the "Project Environmental Management Unit".*
- 3) *Within 30 days the "Project Environmental Management Unit" "Ban Chim Village Mitigation Committee" and the complainant will decide how to resolve the matter.*
- 4) *The "Project Environmental Management Unit" shall take such measures as are agreed in step 3 above to resolve the complaint within 30 days, or some other period acceptable to the parties referred to in step 3.*
- 5) *When the complaint has been resolved the Complaint Form, signed and annotated at each stage of the process, will be filed by the "Project Environmental Management Unit", with copies to be sent to WREA.*

6) The "Project Environmental Management Unit" will keep vouchered accounts of any expenditures made in resolving complaints,

### 6.3.4. The Monitoring Plan

#### 6.3.4.1. Construction Phase

During the construction phase, the monitoring activities will mainly focus on the regular follow-up of EMP measures for compensation with performance standards. These activities will be based on a day-to-day follow-up and various levels of technical reviews.

Some minor monitoring activities will be related to specific monitoring, for the acquisition of additional technical data which were not obtained during the EIA and which are deemed necessary for eventual quantification of impacts or mitigation measures.

##### 6.3.4.1.1. Proposed Plan for Regular Monitoring

###### a). Day-to-Day monitoring

Monitoring on a day-to-day basis will be implemented by the Environmental Manager (EM) and his assistant and by the personnel of some concerned Agencies, mainly the agriculture, forestry and extension office and Land office. The main tasks for the EM and assistant will include:

- General follow-up all task of EMP.
- Review and approval of Environmental Plans submitted by the Contractor.
- Maintenance of appropriate records of the monitoring results.

These monitoring activities will be partly complemented by the monitoring obligation of the Contractors.

The agriculture and forestry extension office and land office will mainly monitor the progress and implementation of the land acquisition and compensation process in Ban Chim, monitor the logging and enforcement of hunting ban.

###### b). Quarterly or 6 Monthly Reviews

When carrying out the monitoring, the EM will be assisted by the Resident Engineer and the Consultant Engineer specialists on an informal basis. However, formal missions of the Consultant Engineer Specialists will provide the expertise for a critical review of results obtained during the last period and a re-adjustment, when required, of the monitoring and mitigation strategies, methodologies and work plan.

It is anticipated one specialist(s) mission every 4 months (3 times per year) during the first 2 years of construction and one mission every 6 months (2 times per year) the remaining year of construction and the first year of operation.

Each review will include basically:

- The review of published data, reports, guidelines and plans available at the time of the review.
- The setting-up of monitoring criteria and the selection of quantitative and qualitative indicators.

- Field inspection including direct observations and data collection, interviews with selected local and project groups, individuals.
- Evaluation and comment on Project performance, with recommendations and remedial actions.
- Definition of the scope of work for the period before the next review
- Recommendations for additional tasks or changes to the present EMP.

c). Annual Review

The annual review will involve, in addition to the representatives from the project, Provincial STEO, DOE/MIH and EdL, representative from lenders (if any).

The annual review will be combined with one of the 4 monthly or 6 monthly reviews every year. The scope of work will be basically identical to the one describe above.

d). Auditing

Government of Lao PDR through Division of Environmental (DOE)/Department of Electricity/Ministry of Industry and Handicraft (MIH), EdL, NN5-PEMC and WREA or lender organization (if any) may visit the project site at any time and when deemed necessary during the construction period.

e). Personnel Involved

The consultant Engineer will provide one qualified Environmental Specialist who will assist informally the EM and will participate to the 4 monthly, 6 monthly and annual reviews.

This specialist will be assisted where necessary by other specialists having expertise in forestry, agriculture, extension, wildlife, social science, civil engineering (construction practices, slope stability, drainage, run-off and silt control), fishery and watershed management.

f). Reporting

Day-to-day monitoring activities will be recorded in daily, weekly and monthly reports by the EM.

Reviews will involve the production of Review Reports which will be supplied to NN5-PEMC, EdL, DOE/MIH, WREA and lender (if any).

The basic format for the report will include:

- Overview of the review
- Specialist personnel involved
- Status of work progress
- Overall conclusion
- Specific points requiring attention
- Performance indicators for the monitoring
- Specialist reports, if any

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g). Compliance

Compliance will be evaluated through the adherence to the mitigation measures, to other criteria also presented in the EMP and to the Contractor environmental obligations as detailed in Section 5.3.

h). Notification Process

In case of non-compliance with environmental protection measures as required in the EMP and in the construction Contractors, the Project Manager can serve the following types of notices depending on the severity of the environmental damages (Table 6.3.4.1.1):

**Table 6.3.4.1.1: Proposed Types of Notice**

No.	Type of Notice	Issued By:
1	Verbal notification for minor infraction	EM
2	Written Instruction	EM signed by PM
3	Notice to comply	PM
4	Application of fine	PM through WREA
5	Order to stop work	PM through WREA

6.3.4.1.2. Specific Monitoring Activities

These tasks are related to the acquisition of additional technical data. The mainly concern:

- o Agriculture Product Monitoring

The survey will provide the technical basis to set up with NN5-PEMC the compensation level for permanent lost of paddy field. It will also provide the performance criteria for land rehabilitation and livelihood restoration.

- o Hydrological Monitoring

EdL will monitor the existing and future gauging stations implemented on the Nam Ting River. Data will be recorded, interpreted and kept available whenever required by specialists or Agencies.

- o Water Quality Monitoring

EdL (EM) will monitor water quality in Nam Ting River and various places in order to confirm the efficiency of water quality protection measures set up by the Contractors.

- Fish Monitoring

Survey on fish population, especially Pa Nhoy and other rare species mentioned in EIA will be carried out by Department of Livestock and Fishery. These data will provide the criteria to quantify the impact of the project on future fishes and allow the elaboration of mitigation measures if necessary.

#### **6.3.4.2. Operation Phase**

During the first few years of operation, monitoring activities will be carried out and will concern:

##### **a). Monitoring of Water Quality**

This monitoring will focus on the reservoir in order to follow up the progressive improvement of water quality after the impoundment. It will provide the basis to identify the occurrence of stratification with deoxygenated bottom layers and to adjust the reservoir management to the observed quality constraints, if any. The EdL will be responsible for the monitoring which will be performed at least 5 stations on a monthly basis.

##### **b). Monitoring of Livelihood Restoration**

Monitoring of livelihood restoration will be carried out for at least 2 years on the rehabilitated paddy fields and livestock of Ban Chim. The monitoring will be performed by the NN5-PEMC, especially the District agriculture, livestock and irrigation offices. The cost will be supported by the project proponent.

##### **c). Monitoring of Fish**

Fish monitoring will continue in the villages of the lower Nam Ting in order to identify any decrease in Pa Nhoy and other species which could result for NN5 HDP implemented. In case a significant decrease is confirmed, mitigation measures will be considered and supported by the project owner. The monitoring will be performed by Department of Fishery.

#### **6.3.5. Cost Estimation**

The total budget required for the implementation of the Environmental Management Plan is estimated at US\$ 1,471,845. The estimated budget for each major component of the plan and per year of disbursement is detailed in the following Table 6.3.5.

**Table 6.3.5: Estimated Budget for EPM (Unit = US\$)**

Item/Year	Pre-	Construction				Operation					Total (USD)
	1	2	3	4	5	6	7	8	9	10	
Compensation for paddy field	180,541	-	-	-	-	-	-	-	-	-	180,541
Affected restoration	2000	10,750	10,750	10,750	10,750	24,500	24,500	24,500	24,500	24,500	167,500
Village Restoration	-	70,000	12,500	12,500	12,000	12,500	12,500	12,000	12,500	12,500	170,000
"Seed funding" for "self-help"	-	5,000	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	25,000
Fisheries	-	10,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	50,000
Water Quality	-	10,000	4,000	4,000	2,000	2,000	2,000	2,000	2,000	2,000	30,000
Reforestation for watershed Management	15,120	17,920	18,320	19,920	20,520	20,920	21,320	21,720	22,120	22,120	200,00
Wildlife		15,000		15,000		15,000		10,000		10,000	65,000
Erosion and Spoils		10,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	50,000
Public Health	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20,000
School Education	-	30,000	-	-	-	-	-	-	-	-	30,000
Extension	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	200,000
Development of village operation ecotourism	-	-	-	-	-	-	30,000	30,000	20,000	20,000	100,000
EMP Management and Monitoring	30,000	30,000	30,000	30,000	30,000	30,000	20,000	20,000	20,000	10,000	250,000
<b>Contingency 10%</b>											<b>133,804</b>
<b>TOTAL</b>											<b>1,471,845</b>

Note: Road/bridge and rural electrification need to be discussed and negotiated with EdL and province

## **6.4. Public Involvement**

### **6.4.1. Objective of the Consultation and Public Participation**

In order to be able to increase an understanding concerning the project development especially the construction and operation of the project, it is necessary to disseminate all related information to stakeholders and local people. Additionally, conducting consultation with all stakeholders and authorities concerned including affected persons (APs) will also be able to reduce conflicts that may occur during construction and operation of the project. At the same time it can minimize the risk of Project delays as well as will enable the Project to design resettlement and rehabilitation as a comprehensive development program to suit the needs and priorities of the APs, thereby will maximize economic and social benefits of the investment. Specific objectives of public consultation are as follows:

- To establish a clear, easily accessible and effective complaints and grievance procedure.
- To share fully the information as well as opinions on the proposed Project, its components and its activities, with the APs.
- To obtain information about the needs and priorities of the APs, as well as information about their reactions to proposed mitigation approaches, compensation and activities.
- To inform about various options for relocation (if any), compensation and rehabilitation measures available to the APs.
- To obtain the cooperation and participation of the APs and communities in activities required to be undertaken for planning and implementation.
- To ensure transparency in all activities related to land acquisition, resettlement, compensation and rehabilitation.

### **6.4.2. Consultation during the EIA Study**

#### **6.4.2.1. Process and Methodology of Consultation**

During the field survey which carried out initially in May-June 2005 and additional ESIA study has been conducted in May 2006, the interviews and consultations with affected villagers and village authorities have been conducted by the Dongsays Company (DSC) study teams for all affected villages within and around the proposed project area. Since an official contacts and appointments with all villages around the project areas have been done before the field survey and data collection was conducted, therefore it was not difficult to invite all villagers at one village to a joint consultation meeting at once. The study teams directly visited each village respectively, and held consultations and interviews with village representatives, and also invited affected villagers to attend the consultation meetings.

During the consultation and discussion, particular effort was made so the villagers were aware that the project, as proposed, was not imposed to the villagers and that they had every right in determining the outcome of the project.

Before conducting consultations, list of families/households especially for those people who were expected to be affected by the project were collected from the head of villages. Similarly some relevant secondary data such as total number of population, houses, households, the amount of land and name of the owners were also collected. Consultation has been conducted in form of discussion and interview.

The primary data collection was obtained through the questionnaire survey of residents including chief of villages and villagers who own land and other assets within potential

project affected areas. All head of the villages and almost all of the head of the families or households who have affected land were consulted especially the rice paddy field at Chim village. The discussion focused on the attitude of local villagers, regarding the proposed project and its potential impact on current status of land and forest usage, income generation activities, land acquisition, wildlife conditions, resettlement and compensation as well as potential impacts on social, economic and environment.

**6.4.2.2. Duration and Places for Consultation**

The consultation with local organizations concerned as well as affected villagers has been carried out at every surveyed village around the project areas with an average one day for consultation meeting at one village and another one day for field visit to see the real situation of the land use and agricultural production. (See Table 6.4.2).

The consultations have usually been carried out at the houses of the villages' chiefs. However, in some villages these were not possible due to some of the families were busy with rainy agricultural production as well as stayed in the farms at day time, therefore, some consultations were carried out at individual's families at night or at their farms (if they are located not far away from the village).

**6.4.2.3. Key Participants and Main Issues for Discussion**

Key participants to the consultations were mostly included chiefs of village, representatives from village mass organizations including Lao women Union in each village, village elderly, village Youth and affected villagers. The number of participants and other details are shown in the Table 6.4.2.

Outline of the Project as well as topography map and land use map were shown and explained to the villagers and village authorities concerned. The expected project area as well as project study areas which expected to be affected both direct and indirect by the project especially land use types that expected to be inundated have been discussed. Brochures on briefing of the project were distribute and explained.

Since the impacts and affected land by the Project will be minimal, all of participants basically agreed the implementation of the Project with few comments. They expressed their willingness to participate in the construction work of the Project as labors to get income from the Project. Only in some villages, participants mentioned that proper compensation for affected land should be ensured. In some villages, they have desired access to electricity especially direct affected village as Ban Chim Village.

**Table 6.4.2: Detail of Consultation with Local Village Authorities and APs**

No	Date	Time	Village/ District	No. of Participants	Chair Person	Remarks
1	16/5/2005	9:00	PHOUKHOUN	4	Chief of District Cabinet	Only district officials
2	17/5/2005	10:30	Ban Chim	3	Chief of Ban Chim Village	Only officials
3	18/5/2005	8:30	Ban Chim	All villagers	Chief of Ban Chim Village	All villagers including APs
4	19/5/2005	8:30	Ban Chim	55	Chief of Ban Chim Village	Only APs
5	20/5/2005	8:00	Ban Chim	55	Chief of Ban Chim Village	Checking paddy field
6	21/5/2005	7:00	Ban Chim	10	Villagers including Army (Soldiers) visited Dam Site	
7	23/5/2005	8:00	Longmieng	All villagers	Chief of Village	Including village authorities
8	24/5/2005	7:00	Longmieng	8	Chief of Village	Field survey for land use



No	Date	Time	Village/ District	No. of Participants	Chair Person	Remarks
9	26/5/2005	9:00	Phavay	All villagers	Chief of Village	Including village authorities
10	27/5/2005	9:00	Phavay	10	Chief of Village	Field survey for land use
11	29/5/2005	9:00	Nammadao	All villagers	Chief of Village	Including village authorities
12	30/5/2005	9:00	Nammadao	11	Chief of Village	Field survey for land use
13	<u>1/6/2005</u>	<u>13:00</u>	<u>PHOUKOUT</u>	<u>5</u>	<u>Chief of District Cabinet</u>	<u>Only district officials</u>
14	2/6/2005	11:00	Xiengdet	7	Chief of Village	Only officials
15	3/6/2005	8:00	Xiengdet	All villagers	Chief of Village	Including village authorities
16	4/6/2005	8:00	Xiengdet	25 (Field)	Chief of Village, village authorities and army (visited around powerhouse site)	
17	6/6/2005	8:00	Namchat	12	Chief of Village, Including village authorities	
18	7/6/2005	7:00	Namchat	10	Field visit, Chief of Village, Including village authorities	
19	8/6/2005	10:00	Somboun	8	Chief of Village, Including village authorities	
20	9/6/2005	9:00	Somboun	11	Field visit, Chief of Village, Including village authorities	
<b><u>Additional ESIA Study for preparation of ESIA Report</u></b>						
<u>1</u>	<u>4/5/2006</u>	<u>13:00</u>	<u>PHOUKHOUN</u>	<u>5</u>	<u>District Governor</u>	<u>Courtesy Call</u>
2	5/5/2006	11:00	Ban Chim	6	Chief of Village	Including village authorities
3	6/5/2006	8:30	Ban Chim	57	Chief of Village	All APs, Including village authorities
4	7/5/2006	8:00	Ban Chim	25	Chief of Village	Checking paddy field
5	8/5/2006	8:00	Ban Chim	22	Chief of Village	Checking paddy field
6	9/5/2006	8:00	Ban Chim	17	Chief of Village	Checking paddy field
7	10/5/2006	8:00	Ban Chim	15	Chief of Village	Checking paddy field
8	11/5/2006	9:00	Ban Chim	55	Chief of Village, Including village authorities	All APs (to agree on compensation measures)

**Note:** The above record is only for field consultation and participation of local authorities concerned and villagers during the field surveys and field studies.

#### 6.4.2.4. Field Check by Provincial Authorities Concerned

According to the Environment Protection Law and Regulations concerned and with reference to the official letter of the Science, Technology and Environmental Authority (STE) no. 758/DOEIA.STEA, dated 30<sup>th</sup> Mar, 2007, the field check has been conducted from 22<sup>nd</sup> to 24<sup>th</sup> June, 2007 by the provincial, district and village authorities concerned with participation of total 21 officers who were representatives from the different authorities concerned such as representatives from provincial Science, Technology and Environment Offices, provincial Department of Agriculture and Forestry, provincial Department of Energy and Mines of Luangprabang and Xiengkhouang provinces, Phoukhoun district Cabinet officer, district Planning and Investment Offices, district Agriculture and Forestry Offices of Phoukhoun and Phoukout districts, representative from Village Cluster of Ban Chim and Bam Chim authorities and mass organizations concerned including the affected villagers at Ban Chim village.

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The main objective of the field check is to: 1) observe the real situations of the project areas especially within the proposed reservoir that will cause impacts to the environment and socio-economic as well as the properties of local people, 2) consult and discuss with local authorities concerned as well as affected persons concerning their perceptions, attitudes and opinions with regards to the construction of the project whether they agree with the project purpose or not as well as impacts mitigation and compensation measures. However, from the discussion and consultation during the field check we see that most of local people strongly agreed with the project, since they expected that the project will benefit to them and contribute to improve their livelihood both direct and indirect.

#### **6.4.2.5. Provincial/District Level Consultation Meeting**

According to the official notification of Water Resource and Environment Authority (WREA, former STEA), no. 422/DOEIA, dated 26 August 2007, the provincial/district consultation meeting has been held in Phoukhoun district on 24 July 2007 with aiming to present, discuss, agree and recommend on the ESIA report, EMP and SAP. The meeting was chaired by Phoukhoun District Governor with total participants of over 30 persons who were representatives from the different government authorities concerned including representatives from affected villages and affected persons.

From the detail discussion and consultation, basically the ESIA report as well as EMP and SAP have been agreed by all participants, however, there were some minor comments concerning the period of compensation and assistance that will be given by the project to the villages and local people in order to improve some infrastructures and improve villagers' livelihoods especially affected village and affected persons. Since most of the project areas are covered by classland, so the other comments were related to tree plantation and rehabilitation of the remaining forested areas within the catchment areas for a long time in order to protect soil erosion and water courses.

#### **6.4.3. Further Consultation and Participation**

However, apart from the consultations as mentioned above, the other field check by the GOL authorities concerned from the central level will be conducted in order to reconfirm and listen to the feedback from APs. After that the important national consultation meeting will also be held at Vientiane Capital which will be chaired by the Minister of WREA with participation of all representatives of GOL authorities concerned at central level including provincial, district and village representatives.

Further consultation with and participation of APs will be considered as follows:

- Disclosure of EMP and SAP to APs:

Once these ESIA, EMP and SAP are approved, it will be translated into Lao language and then disclosed to APs and opened in public for further public consultation.

- Information to APs about Compensation Payment:

The Nam Ngum 5 Project Environmental Management Committee (NN5-PEMC), which will be established at central and provincial level same as the other HEP projects in Lao PDR, through the districts and villages authorities shall notify and consulted each AP with the time and procedures for compensation payment.

- Information to APs regarding Site Clearance and Construction:

APs will be informed and consulted about the schedule for the Project construction and operation.

Information to the General Public about Schedule of Physical Works:

The local authorities will notify the general public along with APs about the schedule of physical works. Public announcements will be made in village meetings.

Feedback from APs related to the Project should be accepted anytime on the course of the procedures and NN5-PEMC or project owner should reply to them.

## 6.5. Institutional Arrangement

### 6.5.1. Roles and Responsibilities

Several parties will be concerned by the EMP. However, EdL and its EMU will keep the primary responsibility for the appropriate implementation of all mitigation and monitoring measures during and after construction phases (operation phase), on behalf of the Government of Lao PDR (GOL). As such, EdL activities will include management, organization, coordination, monitoring and reporting.

Other parties involved including government Agencies, NGOs, contractors and Nam Ngum 5 Environmental Management Committee (NN5-PEMC) through its members.

#### 6.5.1.1. Electricité du Laos (EdL)

Electricité du Laos (EdL) must ensure that the Project conforms to the environmental criteria set out in the EIA and in this Plan. To achieve successfully this objective, EdL will appoint an Environmental Manager (EM) on a full time basis, for a minimum period of 6 years (4 years of construction and first two years of operation).

The EM will report directly to the EdL and Project Manager. His ultimate objective is to ensure that the mitigation and monitoring measures are effectively and adequately implemented, in accordance with performance standards and anticipated schedule.

The EM will act on behalf of the EdL in dealing with Government Agencies or other parties concerned. He will represent EdL in the Nam Ngum 5 Environmental Management Committee (NN5-PEMC) and will be responsible for maintaining good relations and communication with the local communities.

The EM will have to carry out basic activities namely: Coordination, supervision, monitoring and reporting. These activities cover the following aspects:

- Providing the liaison between the Project Manager with the Consultants, the Government Agencies, the contractors and the NGOs concerned.
- Supervising and monitoring filed activities of sub-contracting parties, more especially of those under direct responsibility of EdL.
- Discussing contract obligations with sub-contracting parties and ensuring respect of contractual time schedules.
- Carrying out specific technical tasks (hydrology monitoring, water quality monitoring).

- Reporting (see detail in section 5.2)

To implement these task, the Environmental Manager (EM) will be assisted by a full time assistant and international/or national experts to be provided on a part time basis. This technical assistance will include the services of an environmental planner mainly at the beginning of the implementation of the EMP, and by specialists who will provide professional guidance at critical steps of the program (or on ad hoc basis according to problems encountered).

#### 6.5.1.2. Government Agencies and NGOs

Several Government Agencies will be sub-contracted within the framework of the EMP to carry out specific technical investigations:

- **Ministry of agriculture and forestry (MAF)** cooperate with DAFO will be in charge of land allocation program for Ban Chim and monitor the livelihood restoration of Ban Chim, evaluate clearly the present production of the affected paddy field and monitor production after rehabilitation.
- **Department of Land (DOL)** working with District Land Office will elaborate a land titling program for Ban Chim.
- **Division of Fisheries (DiF)**, assisted by a consultant will be in charge, to monitor fish in the villages of downstream and prepare a preliminary management plan of fisheries in the reservoir area.
- **Ministry of Health (MOH)** will have the responsibility to monitor the efficient implementation of the public health components of the Environment management Plan, particularly the worker's pre-employment of screening and implementation of a health centre in Ban Chim.
- **The Institute of Malaria, Parasitology and Entomology** will carry out the implementation of all activities related to malaria control. It will carry out the additional malacological surveys.
- **Water Resource and Environment Agency (WREA)** will participate in the plan as an observer from the central Government, to ensure that Lao PDR environmental policies are satisfied within the context of the NN5 HDP.
- **The Lao Women's Union (LWU)** will be the main organization for grassroots activities with the affected people. Its involvement, in close relation with the NN5-PEMC, will cover all aspects regarding compensation for permanent losses of paddy land fields, monitoring of compensation process, public information to residents and women's involvement in hygiene and child care.

#### 6.5.1.3. Contractors

The construction Manager appointed by the Contractor(s) will be directly responsible for implementation of the environmental protection guidelines as attached to the contracts and for the compliance with the safeguards and standards required.

The Construction Manager will nominate a representative as Environmental Officer (EO), with appropriate experience in environmental field. The EO will speak and write fluently in English.

The EO will execute monitoring tasks and report to the Construction Manager. He will coordinate with sub-contractor engineers.

General and specific guidelines and obligations, to be attached to each contract, are given in Section 6.6. These are related to:

- The General Environmental Protection Guidelines to be observed by the Contractor during its construction activities.
- The Health and Safety Plan, to be prepared by the Contractor and submitted to be approval of EdL and MOH.
- Quarry Management Plan, to be prepared by the Contractor and submitted to be approved of EdL and NN5 Environmental Management Committee.

The EO will be required to submit to the EM a monthly report detailing status and progress of mitigation measure including recorded monitoring data.

#### **6.5.1.4. Nam Ngum 5 Project Environmental Management Committee (NN5-PEMC)**

The NN5-PEMC needs to be established for the Nam Ngum 5 Hydropower Development Project (experience from many Hydropower Projects), in order to provide a formal link between the Project and residents.

The NN5-PEMC will be implemented at least 1 month before the start of the Project and will operate for 6 years, 4 years to cover the construction stage and 2 years to monitor post impoundment impacts and take action where necessary.

The provisional list of the Committee members will include:

- District Vice Governor/Cabinet Officer
- Environmental Manager (EdL)
- District Industry & Handicraft Officer.
- District Forestry Officer
- District Land Officer
- Lao Woman's Union representative
- District Education Officer
- District Health Officer
- Village chief from Ban Chim

The operational costs of the NN5-PEMC will be supported by the project proponent

The main function of the Committee is to represent the interest of the concerned population in dealing with project impacts and mitigation measures. Main issues to be addressed by the NN5-PEMC will be to:

- Compensate for permanent loss of paddy field in Ban Chim
- Promote the involvement of the local population in the project activities either as unskilled, semi-skilled workers or as food suppliers (vegetables, chicken, eggs...etc.) for the workers canteens.
- Preserve the social integrity of the village during the construction stage in assisting the people to protect themselves against antisocial behavior which

may develop through contact with large number of foreign workers: gambling, alcohol or drug abuse, fighting, crime and prostitution.

- Provide health and sanitation through the promotion of a malaria control program and non-formal education on hygiene, sanitation and child care.

The NN5-PEMC will debate and advise on these issues, in order to reach a consensus in decision making. Implementation of action will be mainly executed by the Lao Woman's Union, in relation with other executive bodies concerned: MAF, MOH, MOE, specialized NGOs.

### 6.5.2. Reporting

The reporting program must satisfy 3 objectives:

- To provide a regular distribution of information through the several parties involved in the project.
- To set up a formal framework for performance achievement evaluation
- To assist a fast decision making procedure in order to implement within the shortest time any decision taken by concerned parties

The system is based on 7 types of reports:

- a) **Day to day report:** filled by the EM in order to take formal notes of daily events, decisions, actions. These reports are only registered for further consultation when necessary.
- b) **Weekly report:** prepared by the EM and submitted to the PM.
- c) **Monthly report:** prepared by the EM for submission to PM, the reports will summarize:
  - Activities carried out during the month, task completed, personnel involvement, schedule of activities,
  - Problems encountered, decisions taken,
  - Major issues under debate, proposed solutions,
  - Proposed activities for the coming months,
  - Budget situation: expenses, invoices, fund reallocation...etc.
  - List of major meeting held during the month,
- d) **Meeting reports:** minute of monthly (or ad-hoc) coordination meetings held with NN5-PEMC and others). To be prepared by Secretary of the NN5-PEMC, signed by the Chairman and counter signed by the EM. For submission to EdL, Project Manager and NN5-PEMC members.
- e) **Review reports:** to be submitted to EdL and lender (if any), every four months the first 2 years and every 6 months after (see proposed review program in section 4). These report will summarize major issues addressed, major achievements, major pending problems, budget situation, recommended strategy and work plan until the next review. They will be prepared by the review team.
- f) **Annual review report:** to be submitted by EdL to DoE (MIH), WREA and lender (if any), summarizing the progress of environmental mitigation and monitoring

activities during the last 12 months of activity and presenting strategy and work program for coming 12 months.

- g) Technical report:** prepared by sub-contracted Agencies or consultants. Submitted to EM according to schedule.

**Table 6.5.2: Summary of Reporting Program**

<b>Report Types</b>	<b>By:</b>	<b>To:</b>	<b>Purpose</b>
Daily Report	EM	Project files	Registration of daily events. For consultation only
Weekly Report	EM	PM	Follow-up of social and environmental activities
Meeting Reports (monthly and ad-hoc)	NN5 EMC	EM	Signed by concerned parties & summarized in monthly report
Technical Reports	GOL Agencies, consultants	EM, Cons. Engineer	According to technical
Monthly Report (Project)	EM	PM, EdL, DoE/MIH, WREA	Monitoring of EMP implementation
Monthly Report (Contractor)	EO	PM, EdL, DoE/MIH, WREA	Follow-up of contract obligations
Interim Review Reports (4 to 6 monthly)	Review mission member	EdL, DoE/MIH, WREA, Lenders (if any)	Progress in EMP implementation, issues & achievement
Annual Review Report	Review mission member	EdL, DoE/MIH, WREA, Lenders (if any)	Annual status of EMP achievement

## 6.6. Mitigation and Monitoring Plan for Contractor

This Section describes the detailed environmental obligations of the Contractors and Sub-contractors who will be appointed to carry out the construction of the NNg5 Hydropower Project.

The mitigation and monitoring Plan for the Contractors consists of 3 parts as follows:

- a) *General Environmental Protection Obligations*
- b) *Health and Safety Plan*
- c) *Quarry Area Management Plan*

### 6.6.1. General Environmental Protection Obligations

#### 6.6.1.1. Organization and Responsibilities

The Construction Manager will be directly responsible for the respect of the environmental protection guidelines and the compliance with safeguards and standards required.

The main Contractor in charge of construction and civil engineering will nominate a representative (Environmental Officer, EO) with appropriate experience in the environmental field and fluent in English.

The Environmental Officer (EO) will do the following main tasks:

- monitor environmental activities of the Contractor
- assist in resolution of non-conformance
- identify the need for and recommend corrective actions
- liaise with the Environmental Manager from EdL
- prepare a monthly report.

The EO will report to the Contractor Construction Manager.

The EO will prepare a monthly report, including (when required) photographic record of implemented environmental protection measures. The report will be submitted to the Construction Manager with a copy (in English) to the EM.

The monthly report will summarize any relevant special sites investigations and monitoring activities.

#### 6.6.1.2. Sequence of Construction Activities

General sequence of activities will include:

- The preparation of plans in accordance with obligations detailed hereafter and their submission to the Project Manager for discussions and approval.
- The construction of sediment and pollution control measures prior to major earthworks.
- Site clearing and commencement of earthworks and construction of structure.
- Site rehabilitation where required.



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The first step in the sequence of operations is to plan the environmental management activities as well as the construction activities. In general, the planning requires the Contractor to:

- Prepare erosion and sediment control plans.
- Schedule earthwork to retain as much protection from ground cover vegetation as possible.
- Plan the stabilization and vegetation work to follow as quickly as possible after the completion of the earthwork.
- Minimize noise generated by construction.
- Prepare chemical incident management procedures.

In practice, this leads to the following during construction:

- Construction work is phased so the land disturbance is confined to areas of manageable size.
- Stripping and stockpiling of topsoil is the first step in the construction process.
- Stockpiles to be protected from erosion.
- Drainage works, sediment traps, diversions, culverts and related structures are installed prior to major earthwork taking place and prior to storage of harmful chemicals.
- Stabilization measures are installed progressively as each area is developed. For example, as works achieve their final land form, they shall, where appropriate, be progressively revegetated.
- Area which will remain disturbed for some time such as topsoil dumps shall have a temporary vegetative cover established.
- All sediment and erosion control structure are inspected regularly and maintained or cleaned out to ensure their effectiveness.
- Use of water carts for dust suppression in appropriate area (villages, work sites).
- Appropriate maintenance of engines (generators, trucks, heavy machinery)

### **6.6.1.3. Water Quality, Erosion and Sedimentation Control**

#### **6.6.1.3.1. Guidelines and Plan Preparation**

Soil and water management plans will be developed to meet acceptable and appropriate standards. Under these plans, drainage works, sediment traps, diversions, culverts and related structures will be specified and designed to treat water to an acceptable quality and will be installed prior to the commencement of earthworks in any area and inspected regularly to ensure effectiveness.

Soil erosion and sedimentation controls would be the first measures installed at any new work and stabilization measures will be progressively installed as area are developed. Drainage systems for the construction area will be designed and located to restrict alteration of water regimes in adjacent areas to a practical minimum.

#### **6.6.1.3.2. Erosion and Sedimentation Control Measures**

Specific erosion and sediment control measures applicable to the construction sites outlined below:

**a) Drains and Banks**

Catch drains, diversion drains, table drains, windrows and associated drop-down drains shall be used to ensure runoff from the works is directed into existing water courses. Periodic inspections are conducted to repair damage caused by scour, sediment deposition, channel obstruction, excessive traffic can loss of vegetative cover.

Temporary banking shall be used when required to divide slope lengths into non-erodible segments through the interception of runoff and its diversion to stable outlets at non-erosive velocities. Temporary banking shall be utilized from the time of initial clearing to the time of the final landform is attained.

Stable outlets for such temporary banking shall be located at natural drainage lines such as the point where cut and fill sections meet at natural ground level. Temporary banking shall be constructed with adequate capacity to cater for runoff from high intensity storm flows and to ensure channel grades are not excessive.

**b) Sediment Controls**

Silt entering drains shall be controlled where appropriate by either of two devices depending on the size of the catchment, intended duration of the structure, and other local physical and environmental constraints.

- **Silt trap fences**

Silt trap fences may be placed across minor drainage lines to control sheet flows. They require regular maintenance to ensure that the toe of the filter fence remains buried and anchored.

- **Sedimentation basins**

Sedimentation basins are constructed off-stream and are used to remove the sediment load generated on construction sites. They shall be installed prior to development activity and remain in place until such activity is completed.

Silt shall be removed from the basins on a regular basis such that the capacity of the pond remains adequate to control the runoff generated within each catchment area. This is generally when the capacity of the basin has been reduced by 30%.

Regular maintenance shall be carried out to the basins themselves such that the integrity of the structure is maintained at all times.

Silt trap fences may be located at the lip of the spillway of each basin should the capacity of the basin be surcharged during storm events.

**c) Clearing and stripping topsoil**

Clearing and stripping shall be limited only to those areas where the commencement of work in that area is imminent having due respect for the progress on site and the construction program in general.

**d) Stockpile construction and maintenance**

Topsoil shall be stripped, separated and stockpiled for respreading on all exposed areas when final shaping has been completed.

Stockpiles shall be constructed to be smooth and free draining and better slopes shall not exceed 1.5: 1. The height of the topsoil stockpiles shall be limited to three meters and compacting of the stockpile shall be only by equipment necessary for the hauling, placing and spreading of the topsoil material (excessive compacting alters quality and fertility of topsoil).

All topsoil stockpiles shall be deep ripped to ensure the retention of moisture and the promotion of regrowth.

Erosion and sediment control shall be implemented around stockpiles. Stockpiles shall be located in areas of convenient access for recovery and away from drainage lines.

**e) Construction site and storage depot protection**

All earthworks shall be conducted in such a manner so as to mitigate the possibility of erosion.

To prevent the possibility of the discharge of storm and construction water into areas outside the limit of the works, the areas of excavation and fill shall be shaped in a concave manner, where possible, such that the water is contained within the works areas.

**f) Road Construction**

The locations of roadways shall be slightly off contour for drainage control and to aid in reducing erosion.

Apart from the erosion and control measures already mentioned, cleared areas shall remain in a rough condition to absorb water and minimize runoff.

Road development along the escarpment, between the water intake and the power plant, will require particular attention regarding slope stability. Construction techniques will require the approval from the Consulting Engineer prior to implementation. Cut materials will not be indiscriminately tipped along the downhill side of the road, as it can induce major instability on steep slopes. Wherever possible, cut material will be used as filling material for the road and for the eventual rehabilitation of the area.

**6.6.1.3.3. Rehabilitation and Revegetation**

Staged restoration will proceed as soon as possible following completion of construction.

The surfaces will be lightly tined to remove undesirable objects, stones, rocks to prevent ponding. These areas will then be top-soiled and revegetated.

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The stabilization of the disturbed areas shall be commenced as soon as possible. Drains may be stabilized with vegetation, stone pitching, rip-rap or concrete lining depending on the circumstances.

All disturbed areas shall be seeded and fertilized if necessary progressively as structures are completed and as the final landform is achieved.

#### 6.6.1.3.4. Water quality protection

##### a) Storage of engine oil, fuel and other chemicals.

All storage areas for fuels and other hazardous liquids will be bundled to an adequate capacity to mitigate potential spillage problems and pollution of surface water. A sump will be provided to allow pump out of any contained liquid.

To minimize the risks of pollution, refueling of heavy construction machinery will generally be undertaken using a service vehicle.

Workshop facilities will be kept at least 50 m away from watercourses, and will have grease and oil traps which are properly maintained to ensure clean runoff from the sites even during rain events. Field maintenance will be done as far as practicable from the watercourses.

##### b) Rubbish and sewerage disposal

All rubbish and sewerage will be kept away from any water course to avoid contamination through seepage or direct runoff. See also sections 1.3.6, 2.5 and 2.6 of the present guidelines.

#### 6.6.1.3.5. Traffic Management

The safety of site access roads and intersections with the classified road network is paramount. Safe sight distances and appropriate signals will be maintained. Suitable vehicle parking and storage areas will be provided on site, and appropriate maintenance of cars and trucks will be provided, with regular inspection of lighting system, brakes and tires.

The road surface and shoulders of site access roads will be maintained at their designed standard.

#### 6.6.1.3.6. Waste Management

Bins and dumping facilities are to be provided at each site to avoid the proliferation of litter and construction waste and the potential for the escape of material off site. Waste is to be burned or buried.

Toilet and wash basin facilities will be provided on sites and at camps with appropriate treatment prior to effluent discharge. Toilet facilities will not be located where there is potential for drinking water contamination in the event of a spillage.

#### **6.6.1.4. Biodiversity Conservation**

The project site is located in the vicinity of Phou Da Phor and Phou Pha Day mountains which seen as forested areas locate in Khoun District. Although these areas are not seen as protected areas or conservation forests, but the forest and habitat conditions in these areas are still in good condition. As a consequence, hunting and poaching are not allowed within these areas. The strict respect of this ban will be required from all workers appointed by the Contractors or Sub-contractors for the construction of the Project.

The Construction Manager will be responsible for the strict application of the rule and may be fined in case of non-compliance. The monitoring of the hunting ban enforcement will be carried out by the District ranger staff.

The Construction Manager is also requested to ban firearms within the premises of the workers camps and of all the working sites including the reservoir area. Some firearms may be required to ensure the security of the workers particularly when working in densely forested areas. In such case, those in charge of security will be clearly registered and the use of their arms strictly controlled.

Workers will be prohibited from fishing activities which may harm the river fisheries, e.g. using explosives or poison.

#### **6.6.1.5. Air Quality**

The air quality in the area is good. Two main factors from the Project construction may locally alter it: dust and exhaust fumes. Dust is potentially the most significant component, at least during the dry season, from October to May. During this period it may be generated by wind action on cleared and bare soils, and by traffic on tracks and roads. To limit as much as possible this impact near populated areas (villages, camps, work sites), the following measures will be implemented:

- Minimization of bare areas at anyone time by appropriate work organization and progressive revegetation of sites.
- Provision for improved surfacing of roads in populated areas to reduce the production of dust.
- Appropriate maintenance of engines in order to generate as clean exhaust fumes as possible.
- Appropriate location of facilities (generators, crushers, waste disposal site for burning) under prevailing wind conditions.

#### **6.6.2. Health and Safety Plan**

The main public health consideration during Project construction would relate to controlling introduction of new diseases in the area and out- breaks of malaria and other mosquito-related diseases. For that reason, the Contractor will be responsible for preparing and implementing a Health and Safety Plan, subject to the approval of EdL and MOH.

The Health and Safety Plan will address the following components:

### 6.6.2.1. Pre-employment Medical Screening

The Contractor will be required to carry out a pre-employment medical screening for all workers, national or foreign, employed on the Project sites. Health records will be filled for each worker, providing the health status resulting from the screening.

The following aspects will be covered by the screening:

- General physical examination: To determine fitness, gross defects and past health problems.
- Radiological examination: Strongly recommended for all workers as pulmonary tuberculosis is rather common in the region.
- Examination for detection of STD, if any suspected.
- Test for occupational hazards: Concerns workers anticipated to be assigned to hazardous/precision works. Additional tests should include hearing, visual acuity, heart condition, dexterity, blood and urine examination.
- Malarial parasite examination: Concerns all workers, and will use thin film method.
- Stool examination or blood examination for Schistosomiasis and skin tests for all workers coming from infested regions (southern Provinces of Lao PDR for instance).

### 6.6.2.2. Worker Safety

The following measures will be implemented:

- Elaboration and enforcement of safety regulations and measures in workers camps, construction sites and on roads.
- Implementation of medical facilities on each of the major working sites, (because of transportation difficulties in the area): 1 mobile medical unit with medical staff and equipment for first aid and emergency assistance will be placed at the operator's village.
- Facilities for first aid will be provided at the: dam site, water intake site, and river diversion site.
- Implementation of an emergency evacuation procedure in case of serious health/accident problems which cannot be managed on site: helicopter for transfer to surgical/I.C. units in Vientiane or in Thailand, and international assistance for repatriation of foreign workers.
- Follow-up medical examination: General physical examination including routine malarial, urine and stool tests will be performed as follow:
  - i. every 2 years for workers less than 45,
  - ii. every year for workers older than 45 or all workers attached to hazardous works.
- Follow-up of curative treatment for any worker subject to identified health problems. This may concern especially malaria, respiratory diseases, digestive track diseases, intestinal parasites and STD.

### 6.6.2.3. Malaria Control Program

A procedure will be implemented to control risks of malaria break-out. It will cover.

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- a) Malarial parasite examination (routine procedure within the Pre- employment medical screening).
  - b) The use of Chloroquine, Fansidar or Quinine according to the parasite detected.
  - c) Chemoprophylaxis based on 2 Chloroquine tablets ( 150 mg/tab ) to be taken weekly. This is essential to limit risk of outbreak and loss of working days.
  - d) Promotion of individual protection and reduction of mosquito development through:
    - A minimum health education program regarding malaria prevention (every 6 months, under the supervision of the Institute of Malaria, Parasitology and Entomology, Vientiane),
    - The supply of mosquito nets (with Permethrin) to workers,
    - Regular spraying of working buildings and workers camps (dormitories) with Sumithion.

#### **6.6.2.4. Water Supply**

Workers camps and working sites will be provided with clean and potable water, satisfying recommended guidelines of World Health Organization for drinking water (1994 Standards).

If necessary the water source will be protected from any pollution risk from animal or human origin. The Contractor will carry out regular control of water quality.

In the workers camps, washing facilities including taps, wash basins and showers will be provided to the workers in compliance with the international standards generally applied.

#### **6.6.2.5. Sanitation**

In order to preserve the contamination of surface water by human waste and the transmission of water-related diseases, sanitation facilities will be provided in the workers camps and on the major working sites by the Contractor Facilities will be in conformity with WHO recommended technologies (at least VIP latrine type), and with a ratio of one toilet for no more than 20 workers. The designed capacity of the facilities will have to accommodate the expected load over the full construction period. A maintenance program of the facilities will be presented in the Contractor's Plan, to approval by EdL and MOH.

#### **6.6.2.6. Domestic Wastes**

Solid waste from domestic origin will be collected on a regular basis from work sites and workers camps, in order to avoid the development of unhealthy condition and the proliferation of insects nearby.

An appropriate area will be identified and developed by the contractor for the safe disposal and burning of the wastes. The plan will be submitted to the EM for approval. The area will be developed in such a way to avoid:

- the pollution of surface water by run-off,
- the pollution of any underground source of drinking water by the leachate,

- the production of smokes' affecting directly working sites, workers camps or villages.

### **6.6.3. Quarry Areas and Management Plan**

#### **6.6.3.1. Justification**

During the field survey and study for preparation of this report, the location of suitable source of gravel and sand for the construction of the Nam Ngum 5 HEP has not been identified yet. However, the suitable source to provide gravel and sand for the construction will be identified and finalized by the project owner (SinoHydro Corporation Ltd.) soon, and then additional and separate study will be carried out by project owner or contractor. In order to do so, the project owner or Contractor is requested to prepare a detailed management plan for this area prior to start borrowing activities. The management plan will be submitted to the EM and Consulting Engineer for approval.

#### **6.6.3.2. Content of the Plan**

This plan will provide a technical study of the area, a detailed program of operation and supporting maps. It will be prepared in accordance with the following obligations:

- If technically possible, borrowing will preferably starts on areas which are not cultivated.
- Borrowing operations in cultivated areas will be organized into small I blocks in such a way that areas under excavation at the same time will be minimized. Borrowing and rehabilitation of successive blocks will be carried out simultaneously.
- Borrow areas previously under cultivation (paddy terraces) will be fully rehabilitated after use. The will be achieve through:
  - i. stock piling of top soil,
  - ii. using the excavated volumes for the disposal of spoils from road, tunnel, power plant and tailrace channel,
  - iii. filling and compacting of spoils in order to maintain levels of the original topography,
  - iv. spreading and grading of stockpiled topsoil to an even surface, and reconstitution of irrigated terraces.



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## CHAPTER VII

### CONCLUSION AND RECOMMENDATION

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#### 7.1. National and Local Benefits

The development of Nam Ngum 5 (NNG5) hydropower project will be able to supply the cheap and high quality of electricity for power network of the Lao PDR, accelerate the development of the mineral resources in Lao PDR, boost the coordinated development of relevant industries, moreover, it will be favorable to promote the national industrial structural adjustment of the Lao PDR so as to transform the resource advantage into the economic benefits to speed up the economic growth and poverty eradication of the Lao PDR.

The Nam Ngum 5 hydropower project will have an installed capacity of 2x60MW with a firm output of 44.8MW with the annual power generation of 507 GWh and annual utilized hour of 4,225h.

The Nam Ngum 5 will be developed at Nam Ting River which is the main tributary of Nam Ngum River and located in the rugged northwestern part of the Nam Ngum catchment. Nam Ting runs along the valley of Phou Pha Day Mountain through Xiengdet village discharging to Nam Ngum River and it consists of two major tributaries namely Nam Sout and Nam Phat. The NNG5 project is comparative small and it is seen as a run-of-river project, this will minimize impact because no large reservoir is required. Overall, the project will generate a few significant environmental impacts and all of such impacts can be minimized. Additionally, no any resettlement will be required for this project.

In terms of socio-economic benefits, this project, is basically similar to others development projects, will have some socio-economic benefits for local community and local region not only during the construction phase, but also during the project life. Apart from the provision of additional work opportunities within the project area, most of the benefits will be related to improving services and basic facilities. It is anticipated that the project will create some following benefits;

- Creation of additional employment opportunities (during construction).
- Improvement of access (project life).
- Improvement of water supplies for agricultural production and livestock (project life).
- Improvement of water supply for drinking (project life).
- Increase potential for village fishpond and headpond fishing opportunities (project life).
- Improvement of commercial and service opportunities (during construction and project life).
- Creation of opportunity for development of eco-tourism (project life).
- Improvement of reliability of electricity supplies (project life).

## 7.2. Overall Conclusion of the EIA

Overall, the Nam Ngum 5 Hydropower Project will generate only minor environmental impacts, which will be offset considerably by the positive benefits that will accrue from the project. This evaluation is supported by the following:

- Within the project areas there are some forest area which classified as current forest including Dry Evergreen Forests and Mixed Deciduous Forests. However, some high commercial value species, big trees and wildlife habitat were already removed except for powerhouse site that only small portion of forest and wildlife habitat will be affected.
- The project sites have been designed and selected on the basis that they will reduce and avoid environmentally sensitive areas and important view-scapes and that there is no any sensitive areas such as National Park, National Biodiversity Conservation Area (NBCA), Protected Area, outdoor recreation area, waterfall, Protection Forest, wildlife habitat, research area, religious and cultural/heritage site including village holy forest and cemetery, and high valued wetland will be affected.
- The biophysical resources in the areas have been extensively exploited over the recent past by human activities such as logging, fuel wood collection, and shifting (slash and burn) cultivation, leaving degraded land that is only just recovering in some areas.
- There is no any resettlement required for this project except for an approximately 50 ha of rice paddy field at Chim Village will be affected and that properly compensation will be discussed and paid. However, economic and villager livelihood system, social cohesion, community structure, will not be adversely affected as a result of losing such paddy field.
- There is no any village located along the downstream of the proposed NNg5 Dam that will be affected, except for Ban Xiengdet village which will be directly affected by Nam Ngum 3 Hydropower Project.
- There is no significant impact concerning aquatic life within the proposed headpond area.
- Legislative and regulatory mechanisms are in place, which ensure the project will be subjected to a thorough environmental review, including review of the EMP as well as Social Action Plan (SAP) which is separately presented.
- Legislative and regulatory mechanisms are also in place and that the project affected people will be compensated for the losses, damage to land, or loss of land that results from the project. Temporally losses of land, fruit trees, crops and other properties during construction phase (if any) will be compensated by construction contractor.
- Mitigation measures have been proposed that will, if implemented effectively, ensure that any adverse impacts that may accrue as a result of the project, will be satisfactorily addressed. A monitoring plan will be developed, which will be executed by a third party to ensure that environmental mitigation is undertaken to address negative impacts.

## 7.3. Specific Conclusion of the EIA

### 7.3.1. Conclusion Resulting from the Location of the Project

- The location of the project especially in the proposed dam site, headpond and powerhouse will cause the loss of about 616 ha of forest land of which 53 ha is Mixed Deciduous Forest while the rest (563 ha) is Unstocked Forest.
- Any area of old forest such as National Biodiversity Conservation Areas (NBCAs) and protection forests are not existent within the project area especially headpond/reservoir and dam site.
- Other less significant types of forest where the proposed access roads will be located such as *Dry Evergreen and Mixed Deciduous Forests* (13ha) were found in significant quantities, and the exact details will be reconfirmed when the detailed construction is underway.
- There is no significant wildlife and/or wildlife habitat remained within the project areas except for areas along the proposed access road from the dam site to powerhouse (13ha) and surrounding the proposed powerhouse (5 ha of forest) where significant wildlife and wildlife habitat are still in relative abundant; but powerhouse construction's extent represents only a fraction of the surrounding forest, hence generating minimal disturbance to the wildlife and its habitat.
- Compensation with total amount of approximately 1,733,200,000 kip (or US\$173,320) will need to be paid in kind of as buffalo for the loss of almost 50ha paddy field which belong to 49 households at Chim village.
- No any resettlement is required except for, however, 3 of 49 affected households asked for a new paddy field in other areas where suitable for their business and future quality of life and asked for assisting in terms of transport for moving their house and providing some rice during the first 3 years. However, the total cost for this case will not exceed 50,000,000 Kip (or US\$5,000).
- There is no area, in part or in full that is considered of high significant value with respect to natural amenity, aesthetics, outdoor recreation or ecotourism that is adversely affected by the development of the project.

### 7.3.2. Conclusion Resulting from the Construction and Operation of the Project

- Reservoir slope stability will require careful consideration, particularly immediately upstream of the dam site where gorge slopes are steep and inundation depths will be greatest.
- The major impact on Nam Neum 5 is of the flow of the downstream from the dam site to Xiengdet village which will be inundated. As anticipated, there is no significant impact for the downstream of Nam Ngum5 project.
- The need to establish a "Nam Ngum Water Management Association" could coordinate the use of water resources within the Nam Ngum basin and also a need for establishment of "Water Management Plan" will be more developed and related to the larger hydropower schemes. However, the additional flow regulation provided by the NNg5 project will create additional benefits.

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- There is no any significant impact on aquatic habitats. For those species that can not live in a lentic environment will migrate to suitable habitats upstream of those three main rivers. Whereas, those species that prefer standing water will increase in their abundance.
- There will be an increase of the ground water level beside and around the head pond due to the raise of the water level but no adjacent villages or communities will benefit from this.
- Quality of the water nearby the construction site may get infected from the work operation; therefore, water for consumption should be taken into account.
- There is no any significant impact on vegetation, wildlife, underground life and ground water due to headrace tunnel operation.
- No requirement on water for agricultural production, neither for irrigation, fishery nor any other uses along Nam Ting River downstream from the Dam site to Nam Ngum River and Powerhouse site.
- There will be no effect on flow variation or channel hydraulic from the powerhouse release.
- There will be some socio-economic benefits for local community and local region not only during the construction phase, but also during the project life such as employment, improvement of access, and improvement of water supplies.

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## 7.4. Recommendations

The following details need to be incorporated in relevant contracts and sub-contracts.

- During the construction labour force from numbers of nearby village is available, and hiring of villagers labour from nearby villages is highly recommended in order to have participation and promote them to have additional income.
- Construction contractors are required to comply with environmental guidelines with regard to dust, noise and vibration as well as site clearing, storing of topsoils, site protection and site rehabilitation.
- Contractors will be responsible for provision of suitable accommodation, water supply, soil waste disposal, waste water treatment facility, health and safety issues for workers.
- Contractors will be responsible for provision of gas and kerosene for cooking in order to avoid poaching to the forest for fuel-wood.
- Contractors will be responsible for provision of adequate food ration for workers in order to avoid wildlife hunting.
- Contractors will be responsible for controlling workers in order to not exacerbate hunting of wildlife and forest destruction.
- Worker camps will not be allowed to construct in the forest areas that may cause any impact on forest and wildlife.
- Conducting of construction in the dry season and/or at the time that the farm productions (paddy rice and other crops) are already harvested is highly recommended.

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# EXECUTIVE SUMMARY

## (NAM NGUM 5 HYDROPOWER)



### I. Introduction

#### 1.1. Background

Nam Ngum 5 (NNG5) Hydroelectricity project is one of several hydroelectricity schemes in Lao PDR and it is one of the six (*there is Nam Ngum 4A and 4B*) and the last of the hydroelectricity projects in the Nam Ngum river networks. NNG 5 just immediately upstream from Nam Ngum 3 which is currently under investigation for construction and its full supply level is 720 meters above sea level (masl) in comparison with 1,070 masl of NNG 5. The development of these projects, once completed the Lao People Democratic Republic (Lao PDR) will be relatively self-sufficient in energy consumption, in particular in the Northern region of the country where current electricity shortfall is supplemented by importing from Vietnam at nearly 20% higher rate than the export tariff (to Thailand).

The NNG 5 Hydropower Development Project is identified among others-Nam Mang (completed 2004) and Xeset 2 (started June 2005) and Nam Ngum 3 etc., in “*POWER SYSTEMS DEVELOPMENT PLAN FOR LAO PDR*”, as one such potential that can be realized. The feasibility of NNG 5 was prepared for the Ministry of Industry and Handicrafts, Department of Electricity, and World Bank, by Maunsell Limited of New Zealand, in association with Lahmeyer International of Germany in 1997.

#### 1.2. Project Location

The NNG 5 Hydropower Project is located on the Nam Ting, into which Nam Phat and Nam Soud flow. Nam Ting is one of the main tributary of Nam Ngum where the confluent is approximately 15 Km down stream from the proposed dam site, 150 km north of Vientiane Capital City in Lao PDR.

At the survey time, the proposed dam site was only accessible by foot or by boat (during the wet months) from Ban Chim which situates on the upper middle reach of Nam Ting of some 35 Km from Phou Khoune.

Powerhouse area locates approximately 12km due east of the dam site on the right bank of Nam Ngum into which the water from the powerhouse is discharged. The powerhouse area is currently accessible (on foot) only via Ban Xiengdeth from the main road to Xieng Khouang. Ban Xiengdeth situates on the left bank of Nam Ting approximately 10km down stream from the proposed dam site.

### II. Description of the project

#### 2.1. Scope of the Project

The main scope and extent of the project are, for civil work, to construct a Concrete face Rock-filled Dam-74m high, with 168m long crest, gross reservoir storage of 97 Mm<sup>3</sup> and reservoir surface area of 3.5 Km<sup>2</sup>, an 8.6km headrace tunnel, an 1.5 km penstock and power house. Construction and “upgrading” of the main accesses, during and after the

construction, to the dam, intake structure, surge tank and the powerhouse area will be a significant component of the civil construction work of the project.

## 2.2. The Project Study Area

The project study area situates in the straddles over southern Luangprabang and southwestern part of Xiengkhouang province and part of former Xaysomboun Special zone where encompasses 280 households (of which 146 households have been interviewed) in 4 Villages (Ban Chim, Nammadao, Phavai and Longmieng) of Phoukhoun District in Luang Prabang Province, and 247 households (of which 63 households have been interviewed) in 3 Villages (Xiangdet, Namchat and Somboun) of Phoukut District, Xiengkhouang Province. Among these studied villages, only Ban Chim village has direct impact that is approximately 50 ha of rice fields would be inundated but none of the household needs to be relocated. Ban Xiengdet locates down stream from the dam on the Nam Ting River, however, will be inundated, not from Nam Ngum 5 project but from the influence of the Nam Ngum 3 project, which at the time of the survey its reservoir area was being cleared out and the main activity was logging of commercial timbers.

## 2.3. Key Features and General Layout of the Project

### ①. RESERVOIR

Name of River:	Nam Ting
Name of River Basin:	Nam Ting
Catchment Area:	483 Km <sup>2</sup>
Full Supply Level (above sea level):	1070 m asl
Minimum Operating Level:	1035 m asl
Reservoir Area at Full Supply Level:	3.5 km <sup>2</sup>
Reservoir Length:	14 km
Gross Reservoir Storage:	97 Mm <sup>3</sup>

### ②. DAM

Dam type:	Concrete face rock fill dam
Dam Height (above present riverbed):	74m
Crest Length:	168 m
Crest Level:	1074 m

### ③. POWER FACILITIES

Power station rated output:	100 MW
Installed Capacity:	2 X 50 MW
Annual Energy Production:	421 GWh
Transmission Lines:	26 km of 115 kV, double circuits of ACSR 240 mm <sup>2</sup> (From Nam Ngum 5 to Phoukhoun) 72 km of 115 kV, double circuits of ACSR 240 mm <sup>2</sup> (From Banging to Phoukhoun)
Gross head:	333 m
Headrace tunnel diameter:	4.2m
Headrace tunnel length:	8627m

Penstock diameter:	3.5m
Penstock length:	1493m
Surge shaft diameter:	3.5m
Surge shaft length:	388m
Surge tank diameter:	6m
Surge tank length:	70m
Surge tank level:	997m
Turbine:	2 X 50 MW
Maximum Turbine flow:	19.95 m <sup>3</sup> /s

④. **ACCESS ROADS**

New all weather road from Road No 7, 30 km (from Ban Chim junction) to dam site and approximately 14km from Dam site to Powerhouse.

Construction:	44 km
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⑤. **RESETTLED PERSONS**

Resettled Persons:	None
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(But 3 affected households want to move to Phou Khoun District and Luangprabang town)

⑥. **AFFECTED PERSONS (HOUSEHOLDS)**

Affected households (lost of paddy field 50 ha):	49 households
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⑦. **BASIC COSTS**

Estimated Basic Project Cost (As-built Cost):	US\$170 Million
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### III. Environmental Description of the project Area

#### 3.1. Physical Environment

##### 3.1.1. Features of the Project Area

The main access to the Project site is along National Road No. 13 North from Vientiane Capital City to the north at Km 257 (Sala Phou Khoune) and to the right with NR No. 7, from Sala Phou Khoune to Xiengkhouang province at Km 15 and continue with small access road on the right hand side of about 20 km to Chim village.

Ban Chim village is located on the upper part of the Nam Sout river which is a major right bank tributary of the Nam Phat river. It consists of 155 households with total population is 994 people (378 female). An area of some 200-300 ha is used for agricultural production mainly growing rice and crops and animal rising. However, only 49 households of Chim village are directly affected, the village itself is located above 1,100masl. The affected households include only those households who have paddy fields and farmland for growing crops under 1,100masl with a total area of approximately 50 ha that will be inundated.

### 3.1.2. Soils

The soils are mostly derived from siltstones, and sandstones on an ancient uplifted peneplain, which has been heavily dissected by rivers over time. These soils generally highly weathered, moderately deep (0.4 to 1.2 m or more) and well drained. However, the soils are typically acid (sometimes with pH less than 5), with relatively low organic matter, limited available phosphate, and only medium to low fertility. There are also small areas of limestone outcrops, but these areas are generally very steep with shallow soils not widely used for agriculture.

### 3.1.3. Water Resources

The project area is bounded by the catchment of three rivers; Nam Tinh, Nam Sout and Nam Phat Rivers. These rivers rise on the elevated sloping mountain and drain to Nam Ngum River, which is currently the main watercourse of the Nam Ngum 1 and 2 Hydropower. Within the project area, these streams feed the larger third order (tertiary) streams and the main secondary rivers that are the principal tributaries of the Mekong. Most villages are located within 1 km of a permanent stream, the primary source for drinking water in these rural areas.

### 3.1.4. Run-off

The Table below is a calculating result of catchment model which was adopted for the runoff series of dam site.

**Table 3.1.5: Mean Annual Runoff at Dam Site of Nam Ngum 5**

Item	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge (m <sup>3</sup> /s)	2.57	4.56	3.95	4.43	8.75	28.6	55.5	69.9	52.1	22.0	11.3	6.9
Distribution (%)	2.0	1.7	1.4	1.6	3.2	10.5	20.3	25.6	19.0	8.1	4.1	2.5
<i>Mean annual discharge: 22.8m<sup>3</sup>/s; Runoff depth: 1,488.7 mm; Runoff: 719 M m<sup>3</sup></i>												

*Source: Feasibility Study Report (Main Report, Vol. II), April 2006 (Sinohydro Corp. Ltd.)*

### 3.1.5. Climate

The climate of northern provinces of Lao PDR is subtropical and strongly influenced by the annual southwest monsoon rains that affect the region from April/May to September/October (mean annual rainfall for the year 2005 at Xiengkhouang is 1,372mm, at Xaysomboune is 2,847mm and at Luangprabang is 1,392mm). The period of the dry season between the three Provinces; Luangprabang, Xiengkhouang and Xaysomboune is not much different (from October to April) no rain may fall in some months except for Luangprabang in October. The hottest month is March (29.2°C at Xiengkhouang, 28.1°C at Xaysomboune and 36.3°C at Luangprabang), and the coolest month is December (about 3.5 °C at Xiengkhouang, 6.0°C at Xaysomboune and 12.6°C at Luangprabang).

## 3.2. Biological Resources

According to the Report on the Assessment of Forest Cover and Land Use during 1992-2002, (*Department of Forestry, July 2005*) we see that for Luangprabang Province, an approximately 13% of the total land area is covered by the Current Forest, while 81% is covered by Potential Forest, 0.4% is other wooded area, almost 1% is permanent agriculture land and about 4.6% is other land use types. Meanwhile 38.6% of total land area of Xiengkhouang Province is covered by current forest, 49% is covered by potential forest, 0.4% is other wooded area, an approximately 3% is permanent agriculture land and about 9% is other land use types.

### 3.2.1. Forest and Vegetation Cover within the Project Area

The Land Use Types and Forest Cover maps show that within the project area which will be directly affected by flooding about 2% is mixed deciduous forest and about 24% is other unstocked and scrub forest, while approximately 71% is covered by grassland and only about 2% is paddy field and other agricultural land<sup>1</sup>. The area along the alignment of the headrace tunnel and penstock pipes, from dam site to powerhouse, which is 50 meters wide and about 12 Kilometers long, would indirectly be affected due to underground construction such as tunneling and surge tank construction. The area is mostly covered by the forest, about 62%, including Dry Evergreen and Mixed Deciduous Forests, while unstocked forest and scrub is covered about 32% and the rest are grassland (5.5%). However, the forest and land use types along the spillway tunnel will be affected during construction only.

The only areas of land covered by evergreen and mixed deciduous forests where the powerhouse is proposed to construct there are some commercial tree species which include *Fokinia chinensis* (May Hing), *Castanopsis annamensis* (May Kor), *Cinnamomum iners* (May Xikhay-Ton), *Pterocarpus pedatus* (May Dou Leuang), *Terminalia corticosa* (May Peuay-Dong), *Chukrasia tabularis* (May Nhom-Hin), *Ailanthus fauveliana* (May Nhom-Paa), *Dysoxylum binectariferum* (May Kuang-Deng), *Keteleria tonkinensis* (May Nhane), May Song, May Lang Chik and May Xai. Some of these trees have reached the diameter ranging from 40 to 80 Cm.

**Table 3.2.1: Land Use Types and Forest Cover within the Project Area**

	Land Use and Forest Types	Area (ha)	%	Remark
Land Use and Forest types within the Reservoir at full supply level of 1,070 masl including Dam site and Powerhouse	Mixed Deciduous Forest (MD)	53	2.30	<b>Directly Affected</b>
	Unstocked Areas (T) and Scrub (SR)	563	24.45	
	Swidden ( <i>Hay</i> ) (RA)	1	0.04	
	Paddy Field (RP) and Other Agricultural Lands (AO)	50	2.17	
	Grassland	1,636	71.04	
	<b>Total</b>	<b>2,303</b>	<b>100</b>	

Source: *Forest Inventory and Planning, Department of Forestry (FIPD, DOF, 2005)*

<sup>1</sup> This include permanent and non permanent cultivation areas.

### 3.2.2. Wildlife and Aquatic Animals

Significant habitats are remaining only on the steep inaccessible slopes of Phou Pha Day and Phou Da Phor Mountains and other undisturbed forests outside the project area. All wildlife has been and is still indiscriminately and extensively hunted. The majority of significant wildlife species have either been eliminated from the project area either due to the habitat losses through agricultural clearing mainly slash and burn cultivation or indiscriminately hunting practices which has been for generations a significant part of livelihood of local people.

In terms of aquatic animals, the results from the survey show that within Nam Ting, Nam Soud and Nam Phat River (these rivers constitute the main storage reservoir) there are more than 20 main common species which belong to different families. The main species are included Pa Khiengfay (*Onychostoma sp.*), Pa Chat (*Propopuntius cf. laoensis*), Pa Douk (*Clarias macrocephalus Gunther*), Pa Khor (*Channa striata*), Pa Kot (*Hemibagrus wycki*), Pa Pak (*Hypsibarbus pierrei*), Pa Lot (*Macrogathus taeniagaster*), Pa Lat (*Mastacembelus favus Hora*), Pa Kang (*Channa gachua Hamilton*), Pa Khao (*cf. Systomus sp.*), Pa Sout (*Hampala dispar Smith*), Pa Fay (*Danio cf. aequipinnatus McClelland*), Pa Hangdeng (*Discherodontus ashmeadi Fowler*), Pa Langnam (*Mystacoleucus atridorsalis Fowler*), Pa Khaonoy (*Systomus aurotaeniatus*), Pa Khaomon (*Puntius brevis*), Pa Soy (*Henicorhynchus lineatus*), Pa Khikhom (*Osteochilus lini Fowler*). It was also found that there is one type of fish which is only known to this area, its local name is "**Pa Nhoy**" its highest weight caught (in fact hunted – by shooting with military rifle or home made spear) at Ban Chim was about 5-10 kilograms/fish, and according to the villagers, Pa Nhoy lives only in streams or small rivers and confines to the tributaries within and the surrounding area of the project site.

### 3.2.3. National Biodiversity Conservation Areas (NBCAs) and Protected Areas

Amongst 20 NBCAs throughout the country, only Nam Et-Phouleui NBCA with the total area of about 320,000 ha situates in Luangprabang province; the project area situates well out side and some distances away from it. The project area does not contain any form of protected areas or forests of any kind hence impose no thread to NBCA or protected areas or forests in this region.

## 3.3. Social, Cultural and Other Conditions

### 3.3.1. Population and Demographics

As mentioned earlier, the project covers two provinces, two districts and only one village (Chim village) with total household is 155 and total population is 994 people while only 49 households are directly affected by the project. The table below shows number of households being affected by inundation and that are not affected.

**Table 3.3.1: Villages and Households within and Around the Project Study Area**

<b>Project Study Area</b>	<b>Phoukhoun District</b>				<b>Phoukout District</b>		
	Affected Village	Villages outside the Project area			Villages outside the Project area		
	Chim	Long-mieng	Phavai	Namadao	Som-boune	Namchat	Xiengdet
Total No. of households	155	60	21	44	60	91	96
Total population	994	373	140	284	428	491	475
Female	378	192	66	150	218	255	222
Affected households	49	0	0	0	0	0	0

### 3.3.2. Ethnic Composition

As mentioned early, there is only one village (namely Chim) with 49 households are directly affected by the project which consists of 3 small ethnic groups namely *Lao, Hmong and Khmu* which belongs to three main ethno-linguistic groups such as Tai-kadai (1.4%), Mon-kmer (48%) and Hmong-mien (50.6%). Almost all of them practice paddy rice cultivation, while some of them practice swidden cultivation (or rotational/shifting cultivation).

### 3.3.3. Health, Educational and Labour Conditions

According to the survey, during the last three years, it was found that there were some diseases occurred within and around the project area, although they are not very dangerous or life threatening, but they need to be closely monitored and paid attention to such diseases are Malaria, *Dengue fever and Tuber Culosis*, which given the right condition can easily break out.

In terms of education condition, it was found that for each village and district, a large numbers of illiteracy are still existed, despite some claims of total literacy achievement. Ban Chim has lowest % illiteracy (less than 10%), while Ban Namadao and Ban Phavai has highest illiteracy rate (over 90%).

In terms of labour force, it was indicated that Ban Chim has available over four hundred main labour forces and nearly three hundred secondary labour forces and next in line is Ban Xiengdet. Whose proximity is around powerhouse area therefore the available of labour force would be a great advantage in the construction of the powerhouse and construction activities.

### 3.3.4. UXO Conditions

According to the UXO map, UXO scarcely still remain on some areas within the project area. Paying particular attention to the construction areas such as the dam and powerhouse, there were no severe UXO contaminations. This was due mainly to successive agricultural activities such as clearing and burning, as well as being a non-strategic locality (during the war time) was spare from the enemy's bombardment. From these interviews and from the local information we acquired, it was evident that in general these areas in particular the project areas there are some type of UXO still remain.

### **3.4. Economic Conditions**

Based on the NGPES (2004) among two districts within the project area, only Phoukhoun district is identified as poor with total number of 43 villages, while 18 villages were considered as poor, total number of household is 3,117 while 1,964 households or 63% is identified as poor where the total population is 20,233 of which female is 10,003.

Based on the survey within and around the project area most of the villagers are still poor, except for Ban Chim village where most households were considered “above poverty line” this was due to “high incomes” deriving from permanent paddy field rice cultivation. Among 155 households at Chim village, only 12.9% is considered as poor and not enough to eat, while 50.3% is considered as enough for eat and 36.7% is fair and good.

#### **3.4.1. Agricultural Production and Livelihood Systems**

Almost 100% of the study area is mountainous; most of the villagers rely on swidden cultivation and grazing their livestock in the upland area on the mountain slopes. Only very small portion of land along the river flat such as Nam Sout in Ban Chim area that permanent rice paddy cultivation is feasible, and had been exploited by some households in Ban Chim for few years; however this would be inundated after the construction of the dam.

Apart from rice and other crops production, livestock and fishing, NTFPs are also seen as important natural sources of most villagers who live traditionally dependent on natural resources for support their livelihoods. Main NTFPs are available around the project area include: rattan, wild mushrooms, bamboo shoot, wild fruits, wild vegetables, Nhot-Nhe (*Calumus sp.*), Nhot-Boun (*Daemonorops schmidtii*) and others. However, the most mentioned NTFPs are available only in the forest areas that locate outside of the project area.

Traditional handicraft within the project area is only for household consumption. Some of these include weaving and basketry made from bamboo especially among Lao Soung group. However, most villagers are not involving in weaving or basketry as much as some part of the country.

#### **3.4.2. Commercial and Industrial Activities**

There is no any commercial activity due to lack of electricity and other facilities. Other villages on well-access road or at road intersections have some small kiosks that sell drinks, fruit, cigarettes and other consumer items such as at Phou Khoun junction, and central Phou Kout district. However, small home businesses tend to focus only on activities that related to selling drinks and small consumption goods. No industrial activity of any kind exists within the project area; this was due mainly to small and scattered population centre hence, providing insufficient demand to warrant the supply.

#### **3.4.3. Infrastructure, Facility and other Development Activity Conditions**

The project area is relatively remote and situates outside of the demographic centre of the region such as Phou Khoun and Phou Koud districts, therefore the availability of the infrastructure and other facilities including electricity are very limited. However RN13 and RN7 and major tracks such as Ban Chim track, recently upgraded provide essential accessibility and also play a very important factor in socio-economic development to the project area.

#### **3.4.4. Energy Consumption**

Since electricity is not available within the project area, therefore the main energy source for cooking, heating and lighting are from fire wood. Project development such this



would not have adverse impact to this communities as the demands are far less than the availability of the wood within the project area; besides the inundation area is quite a distance from the demographic centre of the community, hence collection of fire wood from this area is very unlikely.

#### IV. Project Alternatives

Nam Ngum 5 hydropower project will supply the cheap and high quality of electricity for power network of the Lao PDR, accelerate the development of the mineral resources in Laos, boost the coordinated development of relevant industries, moreover, it will be favorable to promote the national industrial structural adjustment of Laos so as to transform the resource advantage into the economic advantage to speed up the economical development of Laos.

According to the pre-feasibility study conducted by Lahmeyer International, five alternative approaches to develop the Nam Ngum 5 are proposed such as Alternatives A1, C, B, D and Alternative A1+A2. In which, however, two alternatives C and D are recommended. The two alternatives with moderate dam height are analyzed and the main parameters of Alternatives C and D are compared as the following table:

Item	Unit	Alternative C	Alternative D
Installed capacity	MW	84	100
Annual utilization hours of units	h	4190	4860
Mean annual energy production	GW-h	352	486
<b>Total Project Cost</b>	MUSD	<b>164</b>	<b>196</b>
<b>Unit cost on installation capacity</b>	USD/kw	<b>1962</b>	<b>1959</b>

Based on the hydrological and hydro-energy calculation comparison; the topographical concern; the structure layout investigation; and the economic and financing assessment point of view, the unit cost of installation capacity of alternative D is lower and better than that of alternative C, therefore, the alternative D has finally been chosen for the project development.

#### V. Environmental Impacts and Mitigation Measures

##### 5.1. Environmental Impacts Related to Location

##### 5.1.1. The Dam and Headpond

##### a). Biological Losses

##### Forest/Vegetation

Most of the vegetation that will be affected would include some commercial tree species, herbaceous and woody stemmed shrubs, grass and bamboo which belong to different type of forests such as Mixed Deciduous Forest (53 ha), Unstocked Forest and Scrub (563 ha) and Natural Grassland (1,636 ha).

However, some of the big and high value commercial species were destroyed and removed by various causes including bombing during Indochina war, converting activities for other uses such as clearing and burning for shifting cultivation and logging.

It is also confirmed that any areas of old forest such as National Biodiversity Conservation Areas (NBCAs) and protection forests are not present within the project area especially headpond/reservoir and dam site.

#### Wildlife (and wildlife habitats)

There are only significant habitats remaining occur on the steep upper slope forested areas and/or evergreen forest of Phou Pha Day and Phou Da Phor Mountains. Other more accessible lower and less steep slopes where forests have been destroyed, wildlife and wildlife habitat have also been disturbed, resulting from slash and burn for shifting cultivation, bush fire, and indiscriminant logging as well as bombing during Indochina War.

Most of the project components are located on the lower slopes of Phou Da Phor Mountain which is well below the main wildlife habitats. Finally and due to most of the forest and forest land within the project area have been destroyed through various causes as stated above it was found that there is no significant wildlife and/or wildlife habitat remained within the project areas except for area surrounding the proposed powerhouse where significant wildlife and wildlife habitat are still in relative abundant; but powerhouse construction's extent represents only a fraction of the surrounding forest, hence generating minimal disturbance to the wildlife and its habitat.

#### Natural amenity, aesthetic areas, outdoor recreation or ecotourism areas

According to the field survey and villagers' interview, the result showed that there is no area, in part or in full that is considered of high significant value with respect to natural amenity, aesthetics, outdoor recreation or ecotourism that is adversely affected by the development of the project. Instead, and being the only main lake in the region, the development could encourage tourism or other commercial activities such as fishing and other recreational activities into the area, hence the betterment of the livelihood of the local community.

### **b). Social Losses**

#### Loss of rice paddy field

An approximately 50 ha of rice paddy field at FSL of 1,070masl in Ban Chim village will be inundated. Under power development regulation, the affected household shall be compensated. The estimation of compensation value is shown in Appendix Table.

#### Loss of swidden area

Within the project area especially in the future reservoir there is approximately 1 ha of swidden area will be inundated. This also needs to be compensated for. However, under power development regulation, there is no clear guidance regarding compensation entitlements for areas of fallow upland and/or natural grassland which are likely to be areas of previous shifting cultivation. However, in terms of swidden and cultivation area (rotational cultivation), compensate of one third of total cost of paddy field (with the same area) has been applied for the similar previous projects".

#### Loss of Infrastructure, Houses and Cultural Sites

None of the infrastructure, house and cultural site in the project area is affected, except existing access road of about 1 kilometer and concrete bridge at Ban Chim village that will be flooded.

### **5.1.2. Headpond Upstream Impacts**

#### **a. Upstream Watershed erosion**

The upper part of the watershed area has been altered by human activities mainly the clearing of the land for agricultural production in the form of shifting cultivation and as a result the area is covered with swidden areas, unstocked forest, scrub area, grassland and some forestland (shown as mixed deciduous forest). There are some cultivated land within the area as shown in the Land Use and Forest Map. From the above mentioned land use over long period of time and with the combination of high rainfall and steep slopes; overall the area is unstable and subject to severe erosion, the trend would increase as population density increases and remaining forest removal is increased.

However, in some of the catchments the rock is resistant to erosion and has not been unduly deformed and shattered by extreme tectonic activity and relatively stable.

### **5.1.3. Component site losses**

#### **a. Dam Site and Reservoir**

As mentioned above, a total of approximately 616 ha of vegetation including Mixed Deciduous Forest (53 ha) and Unstocked Forest and scrub (563 ha) (excluding grassland) will be inundated at the reservoir and dam site. The main area of mixed deciduous forest remains on the upper slopes of the Nam Ting River especially in the upper reach of Nam Ting and its tributaries.

Due to its relative accessibility most of the trees particularly commercial species in the reservoir area have been logged and removed, what remains are degraded forest and scrublands.

#### **b. Powerhouse**

At least 5 ha of forestland including dry evergreen and mixed deciduous forests will be directly affected and need to be removed and cleared for powerhouse construction. This included also some commercial tree species. However the area cover by the powerhouse construction represent a fraction of the overall surrounding forest, hence posing insignificant adverse impact to the overall biodiversity of the area.

#### **c. Access road from NR 7 to the dam site**

According to the results from the Pre-feasibility study (Energy Equity Corporation Ltd, Feb. 1997) regarding option for selection of access road from NR 7 to the dam site where the access road Northern Route II has been selected. The permanent access road from NR 7 to the Dam site with an approximately 20 km long will need to be constructed following the Nam Phat valley to the south on its left side. The construction of this access road will affect 26 ha of grassland and 1.5 ha of unstocked forest where big trees have already been removed.

#### **d. Access road from Dam site to Powerhouse**

The construction of powerhouse and permanent access road to link between the dam site and powerhouse with an approximately 14 km of length will be necessary and will occupy 18 ha of forestland which is covered mainly by dry evergreen forest (9 ha), mixed deciduous forest (2 ha) and unstocked forest (7 ha).

The most significant is the need to clear approximately 13 ha of dry evergreen and mixed deciduous forests on the upper slope area along the access road from the dam site to powerhouse and at least 5 ha of dry evergreen forest at the proposed powerhouse. Within these areas there are some main tree species which have high commercial value such as *Cunninghamia sinensis*, *Fokienia chinensis*, *Keteleeria avelyniana*, *Castanopsis*

*annamonsis*, *Cinnamomum iners*, *Pterocarpus pedatus*, *Terminalia corticosa*, *Chukrasia tabularis*, *Ailanthus fauveliana*, *Dysoxylum binectariferum*, *Schima wallichii*, *Quercus poilanei*, *Keteleria tonkinensis*, *May Song*, *May Lang Chik*, *May Xai*. Some of these trees have diameter range from 40 to 80 Cm.

However, this area is not part of the conservation forest or protected area, hence the overall impact of such tree removal is deemed to be minor, as only a few areas are likely to be encountered.

Funds will be provided by the project to the Forestry Department, Provincial Forestry Section (PFS) and District Forestry Unit (DFU) to conduct a detail survey for collection of commercial tree species that need to be felled. During logging, the monitoring need also to be conducted by EMC which include PFS and/or DFU in order to ensure no illegal logging and cutting trees outside the approved areas. Logging and logs selling must be complied with Forestry Law and other laws and regulations concerned. At the same time, funds will be also provided by the project to assist with a program of compensatory regenerating and/or planting as per Article 15 of the Forestry Law (1996) especially for those areas that temporary access roads need to be constructed. The EMU which include Provincial Agriculture and Forestry Department (PAFO) especially PFS and DFU have responsibility to monitor the implementation of mentioned program. ROW clearing will be carried out by a contractor, whose work will be strictly defined by the contract specifications and special provisions.

A monitoring program will be implemented that involves District Agriculture and Forestry Extension Office (DAFEO), other authorities concerned, Village Forest Organization (VFO), and an independent third party, who will audit the environmental performance of the project. Strict rules against wildlife hunting and poaching will be imposed on project staff, workers, and all contractors engaged to the Project, with penalties levied for anyone caught carrying and using fire arms, or using animal snares and traps. Project owner shall be directly responsible for dissemination of all regulations and information concerned to its staff and/or employees as well as for any misconduct made by its staff and workers.

#### **5.1.4. Land Use and Resettlement**

A total of almost 50 ha of rice paddy field which belongs to 49 households of Ban Chim village will be directly affected and need to be properly compensated. The basic principle of compensation for the losses of land is that landowners have their choice between accepting cash payment and compensation by land of equivalent value at other location. The previous experiences from other similar projects indicated that most affected people preferred compensation by land. Although there is no any resettlement required due to there is no any house and construction will be affected, however, among total 49 affected households, three of them asked for a new paddy field in other locations. One of the three asked to move to Luangprabang town and the rest two asked to move to Kasi District. Additional assistance in transportation for moving their houses/properties and also rice support during the first 3 years need to be provided from the project.

Most of the project will be constructed during the dry season, when there will be fewer crops that could be damaged. If crops are damaged, compensation will be paid properly. Likewise, compensation will be paid to farmers for lost value of crops if farmers are prevented in advance from cultivating an affected piece of land because construction is planned to proceed during part of the cropping season.

## **5.2. Environmental Impacts during Construction**

### **5.2.1. Construction Impacts on Biological Systems**

a. Impact on Aquatic System

Probably effects on aquatic organism and fishery resources will be caused by water quality deterioration during construction, due mainly to soil erosion caused by land grading, compaction and excavation. The effects are expected to be significant only in the rainy season and will be short term effect. As regards to fishing activities, the adverse impacts are expected to be not significant. However, in order to reduce such impact, some construction activities which may cause significant impact will need to be conducted only in the dry season.

b. Impact on wildlife/wildlife habitat

As mentioned earlier, some species of wildlife still remains on the upper slope of Phou Da Phor Mountain where only the powerhouse and access road will be constructed. About 18 ha of forest and vegetation within this construction areas will be cleared, so the wildlife habitat will also be severely disturbed by the forest clearing activity during construction stage, this will be the supported factor for exacerbation. The boisterous noises from the construction machines will also disturb the natural living of the wildlife. Moreover, the construction workers may hunt wildlife within and around the project area.

In order to reduce such intrusion, strict rules against clearing and logging outside the approved areas and wildlife hunting and poaching will be imposed on project staff, workers, and all contractors engaged to the Project. Project owner shall be directly responsible for dissemination of all regulations and information concerned to its staff and/or employees as well as for any misconduct made by its staff and workers.

c. Disposal of spoil

An approximately 200,000 m<sup>3</sup> of spoil will be created during construction. The majority of the spoil will come from tunneling operations and will consist of sandstone. Some of this may be used in concrete aggregate, but it is expected that the bulk of this will be placed in the spoil heaps which have been initially sited in depression so as to reduce their visibility. After the operation is finished the heaps will be landscaped and revegetated as part of the site protection and rehabilitation plan.

d. Access roads

Two main permanent access roads need to be constructed; one is from NR 7 to the dam site (approximately 20 km) and another one is from the dam site to powerhouse (approximately 14 km). Due to mountainous terrain and steep slope, the roads must have sufficient drainage in order to ensure the minimization of soil erosion. In less steep batter or embankment vegetation cover shall be used.

## **5.2.2. Construction Impacts on Social**

a. Dust

There is no any village located close to the construction area including dam site, access roads, powerhouse and others. There is only Ban Chim village located near to the future NNg5 reservoir, however, no any construction activity will be conducted within this area. Therefore there is no dust will be affected to the local community except for workers. However, the contractor will need to be prepared mitigation measure to alleviate dust impact on any of the project construction areas which will be affected to workers' health.

b. Noise and Vibration

In terms of noise and vibration, as mentioned above, no any village is located close to the construction area, therefore, there will only be a problem at the construction sites

and it is anticipated that noise and vibration will not affect to local community except for site workers and wildlife around the construction area. However, noise suppression systems will need to be fitted to equipment while ear protection tool is needed to provide for site workers.

c. Health and Safety

To protect worker health and safety, the Contractor will be required to prepare a worker health and safety plan. Workers will receive health and safety training, including a training component on UXO recognition and management. UXO specialists will carry out surveys of sites that are to be excavated, and will remove and destroy any UXO encountered.

As for local community, experience in other construction sites showed that they are exposed to a greater risk of traffic accidents when traffic volume increase during the construction phase, particularly in the mountainous and remote areas where the roads are on high slope and not wide enough, as in this case particularly NR 13 North and NR 7. Children are normally most at risk and serious accidents are possible.

The construction work force faces the principal risks to health and safety. The main health and safety risks include:

- Inadequate sanitation facilities in worker camps.
- Introduction of vector borne diseases such as dengue fever, malaria or encephalitis.
- Other epidemic or sexually transmitted diseases introduced by migrant workers.
- Serious injury or death as a result of a fall from any construction.
- Serious injury of death resulting from accidental collapse of the spoil from headrace tunneling.
- Hand, eye and foot injuries from falling or falling objects.
- Road accident due to increasing and overload of transportation.
- Serious injury or death from unexploded ordinance (UXO).

### **5.2.3. Construction Impacts related to Economic**

#### **5.2.3.1. Local Residents**

a. Employment Opportunity

It is estimated that the construction period is four years. Many activities will be done and it requires approximately 100-200 workers. Economic benefits will be occurred from employment and linkage activities. The local people may be employed and their income may increase not only from participation in the project activities, but from selling food and other local products as well. Contractors are required to adopt a socially responsible attitude with regard to ensure that wherever possible the local community is prior given preference in recruitment. So, the contract document should be clearly specified that the local people have priority in employment.

b. Commercial Opportunity

Apart form the engaging with project construction activities, the local community will have also opportunity related to their local products production and selling including agricultural and forest products (NTFPs). There will be a corresponding increase in demand for local supply of their products such as meat, fish and vegetable as well as other local handcraft products such as bamboo basket, rice box and others. Local people

need to have an informing and awareness raising of these possibilities before the project commence so that they will be able to exploit the opportunities rather than surrender these to outside entrepreneurs.

c. Land value change and population movement

The potential negative impacts could include land speculation by investors, and displacement of long time residents. However, due to these areas are mountainous, high slope and have not high potential for agricultural production particularly cropping, therefore, there is no significant impact concerning land value change and population movement.

d. Increase in affluent/poor income gap

Since there is no significant impact concerning land value change and population movement, and no resettlement and relocation is required for this project, therefore, there is no significant impact on this. All of local communities have equal right and opportunity to participate in project development activities as well as in land use within their own villages.

### **5.2.3.2. Migrant Labours/workers**

a. Conflict with local people

Conflict between local community and migrant labour may arise when itinerant labour moves into the area that has different social, cultural, traditional and lifestyle to the resident community. However, Experience from other similar projects and as a results from the survey we see that there is no any specific reason may cause any conflict between them except for tradition and/or custom local community are not respected by outsiders. Therefore, worker behavior needs to be controlled in order to follow and comply with the local community rule and tradition particularly Lao minor ethnic groups.

b. Impact due to camping

▪ Forest/vegetation and wildlife

Some forests still remain within the project areas particularly in the powerhouse site. Worker camps should not be established outside approved areas especially within the proximity of any rich forest. Hunting and removal of forest products including timber and NTFPs from this area is not allowed except for some kind of NTFPs for daily food and dead wood for fuel-wood. Burning to clear vegetation and wastes within the construction sites will not be permitted. All these requirements will be stipulated in the contract document.

▪ Water Quality

It is anticipated that there is a minor impact on water quality concerning worker camping within the construction areas. However, the camps need to be provided adequate sanitation facilities. In order to avoid water pollution cause by rubbish/waste, regular waste collection will be part of the camp requirements that needs to be done and this must be taken to a managed waste disposal facility. The location of the temporary and permanent camps will be determined during detail design.

## **VI. Conclusion and Recommendations**

### **6.1. National and Local Benefits**

The NNg5 hydropower project will have an installed capacity of 2x50 MW with a firm output of 44.8MW with the annual power generation of 486 million kWh and annual utilized hour of 4,860h.

The development of NNg5 hydropower project will be able to supply the cheap and high quality of electricity for power network of the Lao PDR, accelerate and boost the coordinated development of relevant industries and also will be favorable to promote the national industrial structural adjustment of the Lao PDR so as to transform the resource advantage into the economic benefits to speed up the economic growth and poverty eradication of the Lao PDR.

It is anticipated that the project will create some following benefits:

- Creation of additional employment opportunities (during construction).
- Improvement of access (project life).
- Improvement of water supplies for agricultural production and livestock as well as for drinking (project life).
- Increase potential for village fishpond and headpond fishing opportunities (project life).
- Improvement of commercial and service opportunities (during construction and project life).
- Creation of opportunity for development of eco-tourism (project life).
- Improvement of reliability of electricity supplies (project life).

### **6.2. Conclusion**

The NNg5 project, generally, is comparative small and it is seen as a run-of-river project, this will minimize impact because no large reservoir is required. Overall, the project will generate a few significant environmental impacts and all of such impacts can be minimized. Additionally, no any resettlement will be required for this project except for some rice paddy field at Chim village.

#### **6.2.1. Conclusion Resulting from the Location**

- The location of the project will cause the loss of about 616 ha of forest land of which 53 ha is Mixed Deciduous Forest and 563 ha is Unstocked Forest.
- Any area of old forest such as National Biodiversity Conservation Areas (NBCAs) and protection forests are not existent within the project area.
- Other less significant types of forest where the proposed access roads will be located such as *Dry Evergreen and Mixed Deciduous Forests* (13ha) were found in significant quantities, and the exact details will be reconfirmed when the detailed construction is underway.
- There is no significant wildlife and/or wildlife habitat remained within the project areas except for areas along the proposed access road from the dam site to powerhouse and surrounding the proposed powerhouse where significant wildlife habitat are still in relative abundant; but powerhouse construction's



extent represents only a fraction of the surrounding forest, hence generating minimal disturbance to the wildlife and its habitat.

- Compensation with total amount of approximately 1,733,200,000 kip (or US\$180,000) will need to be paid in kind of as buffalo for the loss of almost 50ha paddy field which belong to 49 households at Chim village.
- No any resettlement is required except for, however, 3 of 49 affected households asked for a new paddy field in other areas where suitable for their business and future quality of life and asked for assisting in terms of transport for moving their house and providing some rice during the first 3 years. However, the total cost for this case will not exceed 50,000,000 Kip (or US\$5,000).
- There is no area, in part or in full that is considered of high significant value with respect to natural amenity, aesthetics, outdoor recreation or ecotourism that is adversely affected by the development of the project.

### **6.2.2. Conclusion Resulting from the Construction and Operation**

- Reservoir slope stability will require careful consideration, particularly immediately upstream of the dam site where gorge slopes are steep and inundation depths will be greatest.
- The major impact on NNg5 is of the flow of the downstream from the dam site to Xiengdet village which will be inundated. As anticipated, there is no significant impact for the downstream of NNg5 project.
- The need to establish a “Nam Ngum Water Management Association” could coordinate the use of water resources within the Nam Ngum basin and also a need for establishment of “Water Management Plan” will be more developed and related to the larger hydropower schemes. However, the additional flow regulation provided by the NNg5 project will create additional benefits.
- There is no any significant impact on aquatic habitats. For those species that can not live in a lentic environment will migrate to suitable habitats upstream of those three main rivers. Whereas, those species that prefer standing water will increase in their abundance.
- There will be an increase of the ground water level beside and around the head pond due to the raise of the water level but no adjacent villages or communities will benefit from this.
- There is no any significant impact on vegetation, wildlife, underground life and ground water due to headrace tunnel operation.
- No requirement on water for agricultural production, neither for irrigation, fishery nor any other uses along Nam Ting River downstream from the Dam site to Nam Ngum River and Powerhouse site.
- There will be no effect on flow variation or channel hydraulic from the powerhouse release.
- There will be some socio-economic benefits for local community and local region not only during the construction phase, but also during the project life such as employment, improvement of access, and improvement of water supplies.

### **6.3. Recommendations**

The following details need to be incorporated in relevant contracts and sub-contracts.

- During the construction labour force from nearby villages is available, and hiring of villagers labour from nearby villages is highly recommended in order to have participation and promote them to have additional income.
- Quality of the water nearby the construction site may get infected from the work operation; therefore, water for consumption should be taken into account.
- Construction contractors are required to comply with environmental guidelines with regard to dust, noise and vibration as well as site clearing, storing of topsoil, site protection and site rehabilitation.
- Contractors will be responsible for provision of suitable accommodation, water supply, soil waste disposal, waste water treatment facility, health and safety issues for workers.
- Contractors will be responsible for controlling the use of fire for cooking and other purposes by workers in order to protect fire forest.
- Contractors will be responsible for provision of adequate food ration for workers in order to avoid wildlife hunting.
- Contractors will be responsible for controlling workers in order to not exacerbate hunting of wildlife and forest destruction.
- Worker camps will not be allowed to construct in the forest areas that may cause any impact on forest and wildlife.
- Conducting of construction in the dry season and/or at the time that the farm productions (paddy rice and other crops) are already harvested is highly recommended.

# ບົດສະຫຼຸບຫຍໍ້

## ການສຶກສາ ປະເມີນຜົນກະທົບຕໍ່ສັງຄົມ ແລະ ສິ່ງແວດລ້ອມ

### ໂຄງການກໍ່ສ້າງເຂື່ອນໄຟຟ້າ ນ້ຳຖິ້ມ 5

#### I. ພາກສະເໜີ

##### 1.1. ຄວາມເປັນມາ

ລັດຖະບານ ແຫ່ງ ສປປລາວ ເວລາໃດກໍເປັນຫວ່າງເປັນໃຍ ແລະ ໄດ້ກຳນົດນະໂຍບາຍຢ່າງຈະແຈ້ງ ໃນການພັດທະນາ ຂະແໜງການ ພະລັງງານ ໃນໄລຍະ ແຕ່ ນີ້ ຮອດປີ 2020, ຊຶ່ງບັນຫາດັ່ງກ່າວນີ້ ໄດ້ກຳນົດແຈ້ງໃນກອງປະຊຸມ ອາຊຽນ ຄັ້ງທີ 10 ທີ່ນະຄອນ ຫຼວງວຽງຈັນ, ກໍຄື ໃນມະຕິກອງປະຊຸມໃຫຍ່ ຄັ້ງທີ VIII, ໂດຍເລັ່ງໃສ່ ການພັດທະນາ ແລະ ສະໜອງ ພະລັງງານໄຟຟ້ານໍ້າຕົກ ໃນຂົງເຂດພາກພື້ນ ຊຶ່ງຖືວ່າເປັນຂະແໜງການທີ່ສໍາຄັນ ແນໃສ່ ສ້າງ ສປປລາວ ໃຫ້ກາຍເປັນ “ໝໍໄຟ ແຫ່ງອາຊຽນ” ທີ່ນີ້ ກໍເພື່ອແນໃສ່ ໃຫ້ບັນລຸເປົ້າໝາຍ 90% ໃນຂອບເຂດທີ່ວ່າປະເທດ ໃນປີ 2020 ແລະ ເພື່ອປະກອບສ່ວນ ເຂົ້າໃນການຈັດຕັ້ງປະຕິບັດ ຍຸດທະສາດແຫ່ງການຂະຫຍາຍຕົວ ແລະ ລິບລ້າງຄວາມທຸກຍາກແຫ່ງຊາດ (NGPES), ນໍາເອົາ ປະເທດຊາດ ໃຫ້ຫຼຸດພື້ນ ອອກຈາກຄວາມທຸກຍາກ ແລະ ດອ້ຍພັດທະນາໃນປີ 2020.

ໂຄງການກໍ່ສ້າງເຂື່ອນໄຟຟ້າ ນ້ຳຖິ້ມ 5 ແມ່ນໜຶ່ງໃນໂຄງການພັດທະນາ ເຂື່ອນໄຟຟ້ານໍ້າຕົກ ຂອງ ລັດຖະບານ ແລະ ເປັນໂຄງການໜຶ່ງ ແລະ ໂຄງການສຸດທ້າຍ ໃນຈຳນວນ 6 ໂຄງການເຂື່ອນໄຟຟ້ານໍ້າຖິ້ມ (ນໍ້າຖິ້ມ 1, 2, 3, 4A, 4B ແລະ ນໍ້າຖິ້ມ 5). ນໍ້າຖິ້ມ 5 ຕັ້ງຢູ່ທາງຕອນເທິງ ຖັດຈາກ ນໍ້າຖິ້ມ 3 ຊຶ່ງກຳລັງຢູ່ໃນຂັ້ນຕອນການສຶກສາ ໂດຍມີລະດັບການສະໜອງນໍ້າສູງສຸດ ແມ່ນ 1.070 ແມັດ ເໜືອໜ້ານໍ້າ ທະເລ. ພາຍຫຼັງທີ່ໂຄງການດັ່ງກ່າວນີ້ສໍາເລັດ ຈະສາມາດສະໜອງກຳລັງຜະລິດກະແສໄຟຟ້າໄດ້ ຂອັນຂ້າງ ພຽງພໍ ໂດຍສະເພາະ ໃນເຂດພາກເໜືອ ຊຶ່ງປະຈຸບັນການນໍາໃຊ້ກະແສໄຟຟ້າ ແມ່ນບໍ່ພຽງພໍ ຊຶ່ງຕ້ອງໄດ້ ນໍາເຂົ້າຈາກ ສ.ສ.ຫວຽດນາມ ປະມານ 20% ຊຶ່ງສູງກວ່າອັດຕາ ການສົ່ງອອກກະແສໄຟຟ້າ ໃຫ້ແກ່ ປະເທດໄທ. ໂຄງການເຂື່ອນໄຟຟ້າ ນໍ້າຖິ້ມ 5 ໄດ້ກຳນົດຍຸດທະສາດ ໃນການພັດທະນາ ຄືກັນກັບ ເຂື່ອນໄຟຟ້າອື່ນໆ ເຊັ່ນ: ຊຶ່ງນອນໃນແຜນພັດທະນາລະບົບ ພະລັງງານ ໄຟຟ້າ ຂອງ ສປປລາວ. ການສຶກສາຄວາມເປັນໄປໄດ້ ຂອງໂຄງການນໍ້າຖິ້ມ 5 ແມ່ນ ຢູ່ພາຍໃຕ້ຄວາມຮັບຜິດຊອບ ຂອງ ກະຊວງ ອຸດສາຫະກຳ ແລະ ຫັດຖະກຳ (ຊຶ່ງປະຈຸບັນໄດ້ປ່ຽນມາເປັນ ກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່), ກົມໄຟຟ້າ ໂດຍການ ຮວ່ມມືກັບທະນາຄານໂລກ, ຊຶ່ງການສຶກສາຕົວຈິງ ແມ່ນດຳເນີນ ໃນປີ 1997 ໂດຍ ບໍລິສັດ ທີ່ບຶກສາ Maunsell Limited ຈາກປະເທດ ນິວຊີແລນ ຮວ່ມກັບ ບໍລິສັດ Lahmeyer International ຈາກປະເທດ ເຢຍຣະມັນ.

## 1.2. ສະຖານທີ່ ແລະ ທີ່ຕັ້ງຂອງໂຄງການ

ໂຄງການເຂື່ອນໄຟຟ້ານ້ຳຖ້ຳ 5 ຕັ້ງຢູ່ໃນເຂດເມືອງພູຄູນ ຫ່າງຈາກນະຄອນຫຼວງວຽງຈັນໄປທາງເໜືອຕາມເສັ້ນທາງ 13 ເໜືອ ປະມານ 150 ກິໂລແມັດ (ກມ) ຊຶ່ງຕັ້ງຢູ່ເທິງນ້ຳຕົງ ທີ່ມີສາຂາ ຄື ນ້ຳຂຸດ ແລະ ນ້ຳພັດ ໄຫຼລົງໃສ່. ນ້ຳຕົງ ແມ່ນສາຂາທີ່ສຳຄັນ ທີ່ໄຫຼລົງສູ່ນ້ຳຖ້ຳ ຊຶ່ງນັບຈາກບ່ອນທີ່ຈະຕັ້ງເຂື່ອນ (Dam Site) ລົງໄປ ຕາມເຂດຕອນລຸ່ມນ້ຳ ຂອງເຂື່ອນ ມີລວງຍາວ ປະມານ 15 ກິໂລແມັດ. ໃນໄລຍະເວລາທີ່ດຳເນີນ ການສຳຫຼວດ (ໂດຍສະເພາະລະດູຝົນ) ແມ່ນ ສາມາດ ເຂົ້າໄປຫາເຂດທີ່ຈະກໍ່ສ້າງເຂື່ອນໄດ້ ໂດຍທາງຢ່າງ ຫຼື ທາງເຮືອເທົ່ານັ້ນ. ທາງລົດ ສາມາດເຂົ້າ ໄດ້ແຕ່ຮອດ ບ້ານຈິມ ຊຶ່ງຫ່າງຈາກພູຄູນ (ສາມແຍກ ສາລາພູຄູນ) ປະມານ 35 ກມ, (ເບິ່ງຮູບ 1.2).

ສະຖານທີ່ຈະຕັ້ງເຮືອນຈັກ (Powerhouse) ແມ່ນຫ່າງຈາກ ສະຖານທີ່ຕັ້ງເຂື່ອນ ໄປທາງທິດຕາເວັນອອກ ປະມານ 12 ກມ ຊຶ່ງຕັ້ງຢູ່ແຄມຝັ່ງເບື້ອງຂວາ ຂອງນ້ຳຖ້ຳ ບ່ອນທີ່ນ້ຳຈາກອຸໂມງ ຈະຖືກລະບາຍ ຜ່ານເຮືອນຈັກ ລົງສູ່ນ້ຳຖ້ຳ. ໃນເວລາດຳເນີນການສຳຫຼວດ ເສັ້ນທາງເຂົ້າໄປຫາ ບ່ອນທີ່ຈະຕັ້ງເຮືອນຈັກ ແມ່ນມີແຕ່ເສັ້ນທາງດຽວ ຄືທາງຢ່າງ ໂດຍຜ່ານບ້ານຊຽງແດດ ເທົ່ານັ້ນ. ບ້ານຊຽງແດດ ຕັ້ງຢູ່ທາງຝັ່ງຊ້າຍຂອງນ້ຳຕົງ ຊຶ່ງຫ່າງຈາກ ສະຖານທີ່ຈະສ້າງເຂື່ອນ ປະມານ 10 ກມ (ຄິດໄລ່ຕາມສາຍນ້ຳ).

## II. ລາຍລະອຽດ ຂອງໂຄງການ

### 2.1. ກອບລວມຂອງໂຄງການ

ກອບ ແລະ ຂະໜາດຂອງໂຄງການ ປະກອບດ້ວຍ ການກໍ່ສ້າງເຂື່ອນເບຕົງ ທີ່ມີຄວາມສູງ 104,5 ແມັດ, ຄວາມຍາວຂອງສັນເຂື່ອນ 258 ແມັດ ຊຶ່ງສາມາດເກັບກັກນ້ຳໄດ້ປະມານ 314 ລ້ານ ແມັດກວນ, ເນື້ອທີ່ຂອງອ່າງ ປະມານ 15 ກິໂລຕາແມັດ. ຄວາມຍາວຂອງອຸໂມງຈາກເຂື່ອນ ໄປຫາເຮືອນຈັກ ແມ່ນ 8,9 ກມ ຊຶ່ງມີໄລຍະຫ່າງຈາກອ່າງລະບາຍນ້ຳຂອງອຸໂມງ ຫາເຮືອນຈັກ ປະມານ 2,4 ກມ. ນອກຈາກນັ້ນ ຍັງມີການກໍ່ສ້າງ ທາງເຂົ້າຫາເຂື່ອນ, ປາກອຸໂມງ ແລະ ຫາເຮືອນຈັກ.

### 2.2. ກອບລວມໃນການສຶກສາໂຄງການ

ການສຶກສາ ປະເມີນຜົນກະທົບຕໍ່ສັງຄົມ ແລະ ສິ່ງແວດລ້ອມ ໄດ້ດຳເນີນໃນຂອບເຂດ 7 ບ້ານ, ໃນນັ້ນ ມີ 4 ບ້ານ ທີ່ຂຶ້ນກັບເມືອງພູຄູນ, ແຂວງຫຼວງພະບາງ ຄື: ບ້ານຈິມ, ນ້ຳມ້າດາວ, ຜາຫວາຍ ແລະ ລ່ອງໝັ່ງ ຊຶ່ງມີທັງໝົດ 280 ຄອບຄົວ, ໃນນີ້ ມີ 146 ຄອບຄົວທີ່ໄດ້ສຳພາດ ແລະ 3 ບ້ານ ທີ່ຂຶ້ນກັບເມືອງພູຄູນ, ແຂວງຊຽງຂວາງ ຄື ບ້ານ ຊຽງແດດ, ນ້ຳຈັດ ແລະ ບ້ານສົມບູນ ຊຶ່ງມີທັງໝົດ 247 ຄອບຄົວ, ໃນນີ້ 63 ຄອບຄົວ ໄດ້ຖືກສຳພາດ. ໃນຈຳນວນ 7 ບ້ານ ທີ່ດຳເນີນການສຶກສາ ແມ່ນມີພຽງແຕ່ ບ້ານຈິມ ບ້ານດຽວ ທີ່ຖືວ່າໄດ້ຮັບຜົນກະທົບ ຈາກໂຄງການ ຊຶ່ງໃນນັ້ນ ແມ່ນທັງນາ ປະມານ 50 ເຮັກຕາ ທີ່ຂຶ້ນກັບ 49 ຄອບຄົວ ທີ່ໄດ້ຮັບຜົນກະທົບຈາກນ້ຳຖ້ຳ. ຈາກຜົນການສຶກສາ ແມ່ນບໍ່ປະກົດມີເຮືອນຊານ ຫຼື ສິ່ງປຸກສ້າງໃດໆ ທີ່ຈະໄດ້ຮັບຜົນກະທົບ ຫຼື ວ່າ ຈະໄດ້ຍົກຍ້າຍຈັດສັນໃໝ່. ເຖິງຢ່າງໃດກໍຕາມ ບ້ານຊຽງແດດ ຊຶ່ງຕັ້ງຢູ່ໃນເຂດຕອນລຸ່ມ ຂອງໂຄງການນ້ຳຖ້ຳ 5 ຈະໄດ້ຮັບຜົນກະທົບຈາກນ້ຳຖ້ຳ ແຕ່ ບໍ່ແມ່ນຍອນໂຄງການເຂື່ອນໄຟຟ້ານ້ຳຖ້ຳ 5 ແຕ່ແມ່ນຜົນກະທົບ ຈາກເຂື່ອນໄຟຟ້ານ້ຳຖ້ຳ 3.

## 2.3. ລັກສະນະ ແລະ ພາບລວມ ຂອງໂຄງການ

### ① ອ່າງເກັບນ້ຳ

- ຊີ້ແມ່ນ້ຳ: ນ້ຳຕົງ
- ຊີ້ຂອງອ່າງເກັບນ້ຳ: ນ້ຳຕົງ
- ຂອບເຂດອ່າງໂຕ່ງ: 483 ກິໂລຕາແມັດ
- ລະດັບເກັບກັນນ້ຳ ແລະ ສະໜອງນ້ຳສູງສຸດ: 1.100 ແມັດ ເໜືອໜ້ານ້ຳທະເລ
- ລະດັບການສະໜອງນ້ຳຕໍ່າສຸດ: 1.060 ແມັດ ເໜືອໜ້ານ້ຳທະເລ
- ເນື້ອທີ່ຂອງອ່າງ ໃນລະດັບນ້ຳສູງສຸດ: 15 ກິໂລຕາແມັດ
- ຄວາມຍາວຂອງອ່າງ: 14 ກິໂລແມັດ
- ຄວາມອາດສາມາດເກັບກັນນ້ຳ: 314 ລ້ານແມັດກວກັ້ນ.

### ② ເຂື່ອນ

- ປະເພດຂອງເຂື່ອນ: ເບຕົງ (Concrete face rock fill dam)
- ຄວາມສູງຂອງເຂື່ອນ (ຈາກລະດັບນ້ຳໃນປະຈຸບັນ): 104,5 ແມັດ
- ຄວາມຍາວ ຂອງສັນເຂື່ອນ: 258 ແມັດ
- ຄວາມສູງຂອງຍອດສັນເຂື່ອນ: 1.104,5 ແມັດ

### ③ ອົງປະກອບ ແລະ ສິ່ງອຳນວຍຄວາມສະດວກອື່ນໆ

- ສະຖານີຈ່າຍໄຟຟ້າ: 120 ເມກາວັດ
- ກຳລັງ ໃນການຕິດຕັ້ງ: 2 x 60 ເມກາວັດ
- ຄວາມອາດສາມາດຜະລິດພະລັງງານຕໍ່ປີ: 507 GWh
- ແລວສາຍສົ່ງ: (115 ກິໂລໂວນ, Double circuits of ACSR 240 mm<sup>2</sup>) ຈາກເຮືອນຈັກຫາ ສະຖານີຍອ່ຍນ້ຳຖິ້ມ 5; ຍາວ 2,5 ກມ.
- ໜ້າຕັດຂອງອຸໂມງ: 4,2 ແມັດ
- ຄວາມຍາວຂອງອຸໂມງ: 8.917 ແມັດ
- ໜ້າຕັດຂອງທໍ່ລະບາຍນ້ຳໄປຍັງຈັກ: 3,8 ແມັດ
- ຄວາມຍາວຂອງ ທໍ່ລະບາຍນ້ຳໄປຍັງຈັກ: 2.443 ແມັດ
- ຕວກບິນ (Turbine): 2 x 60 MW
- ລະດັບນ້ຳໄຫຼເຂົ້າຕວກບິນ ສູງສຸດ: 21,14 ແມັດກວກັ້ນ/ນາທີ

### III. ລັກສະນະລວມ ທາງດ້ານສະພາບແວດລ້ອມ ຂອງໂຄງການ

#### 3.1. ລັກສະນະທາງດ້ານວັດຖຸ

##### 3.1.1. ລັກສະນະທີ່ສຳຄັນ ຂອງໂຄງການ

ເສັ້ນທາງຫຼັກ ເຂົ້າສູ່ເຂດໂຄງການ ແມ່ນເສັ້ນທາງ 13 ເໜືອ, ຈາກນະຄອນຫຼວງວຽງຈັນ ໄປທາງທິດເໜືອ ປະມານ 257 ກິໂລແມັດ (ຮອດສາມແຍກສາລາພູຄູນ) ຫຼັງຈາກນັ້ນ ແມ່ນແຍກໄປທາງ ທິດຕາເວັນອອກ ຕາມເສັ້ນທາງ ເລກ 7 ໄປຊຽງຂວາງ ຊຶ່ງຫ່າງຈາກສາມແຍກສາລາພູຄູນ ໄປປະມານ 15 ກິໂລແມັດ ຈະມີທາງແຍກ ທາງກຳຂວາມີ ເຂົ້າຫາບ້ານຈິມ ປະມານ 20 ກິໂລແມັດ.

ບ້ານຈິມ ຕັ້ງຢູ່ສ່ວນເທິງ ທາງຝັ່ງເບື້ອງຂວາຂອງນ້ຳຊູດ ຊຶ່ງແມ່ນສາຂາທີ່ສຳຄັນ ໄຫຼລົງສູ່ນ້ຳພັດ ຊຶ່ງນ້ຳພັດ ໄຫຼລົງສູ່ນ້ຳຕົ້ງ. ບ້ານຈິມ ປະກອບມີ 155 ຄອບຄົວ, ມີປະຊາກອນທັງໝົດ 994 ຄົນ (ຍິງ 378 ຄົນ). ເນື້ອທີ່ສ່ວນໃຫຍ່ຂອງບ້ານ ຄືປະມານ 200-300 ເຮັກຕາ ແມ່ນທີ່ດິນນຳໃຊ້ ເພື່ອການຜະລິດກະສິກຳ ຊຶ່ງລວມທັງການປູກເຂົ້າ, ປູກພືດ ແລະ ລ້ຽງສັດ. ໃນຈຳນວນທີ່ດິນກະສິກຳນັ້ນ ມີເນື້ອທີ່ນຳປູກເຂົ້າ ແລະ ສວນປູກພືດ ປະມານ 50 ເຮັກຕາ ທີ່ຂຶ້ນກັບ 49 ຄອບຄົວ ທີ່ຈະໄດ້ຮັບຜົນກະທົບ, ຊຶ່ງເນື້ອທີ່ດັ່ງກ່າວ ແມ່ນນອນຢູ່ໃນເຂດອ່າງ ທີ່ນ້ຳຈະຖວ້ມ ຊຶ່ງມີລະດັບຄວາມສູງຈາກໜ້ານ້ຳທະເລ ຕໍ່າກວ່າ 1.100 ແມັດ. ເຖິງຢ່າງໃດກໍຕາມ ສຳລັບບ້ານຈິມເອງ ລວມທັງສິ່ງປູກສ້າງ ແລະ ເຮືອນຊານຂອງປະຊາຊົນ ແມ່ນຈະບໍ່ໄດ້ຮັບຜົນກະທົບແຕ່ໃດໆ ເພາະວ່າ ບ້ານຈິມແມ່ນຕັ້ງຢູ່ໃນລະດັບຄວາມສູງ ເໜືອໜ້ານ້ຳທະເລ ສູງກວ່າ 1.100 ແມັດ ຊຶ່ງຖືວ່າເປັນລະດັບຄວາມສູງທີ່ປອດໄພ.

##### 3.1.2. ລັກສະນະຂອງດິນ

ໂດຍລວມແລ້ວ ລັກສະນະຂອງດິນໃນເຂດດັ່ງກ່າວ ແມ່ນເປັນດິນປະສົມແຮ່ ຊຶ່ງຜ່ານການກັດເຊາະມາຫຼາຍປີ ຈາກຜົນຂອງປ່າໄມ້ທີ່ຖືກທຳລາຍ ຊຶ່ງສ່ວນໃຫຍ່ ແມ່ນເປັນດິນທີ່ບໍ່ຄອ່ຍ ອຸດົມສົມບູນປານໃດ ແລະ ເປັນ ຊັ້ນດິນຕົ້ນ ຊຶ່ງມີຄວາມເລິກແຕ່ 0,4 ຫາ 1,2 ແມັດ. ລັກສະນະຂອງດິນ ແມ່ນເປັນດິນສົ້ມເປັນກົດ, ບາງບ່ອນ ທີ່ບໍ່ມີປ່າໄມ້ປົກຄຸມ ແມ່ນມີຄ່າ pH ຕໍ່າກວ່າ 5 ແລະ ມີທາດອິນຊີ ແລະ ອາລູມິນູມ ຕໍ່າ ບໍ່ເໝາະສົມ ແກ່ການຜະລິດກະສິກຳປານໃດ.

##### 3.1.3. ນ້ຳ ແລະ ຊັບພະຍາກອນນ້ຳ

ເຂດໂຄງການ ແມ່ນກວມເອົາ ພື້ນທີ່ອ່າງໂຕ່ງ ຂອງ ແມ່ນ້ຳ ສາມສາຍ ຄື: ນ້ຳຕົ້ງ, ນ້ຳຊູດ ແລະ ນ້ຳພັດ. ແມ່ນ້ຳທັງສາມສາຍນີ້ ເກີດຈາກສາຍພູແຕ່ລະສາຍທີ່ແຕກຕ່າງກັນ ຊຶ່ງໄຫຼໂຮມເຂົ້າກັນ ແລ້ວໄຫຼລົງສູ່ນ້ຳຈຶ່ງມີ ຊຶ່ງຖືວ່າເປັນແຫຼ່ງນ້ຳທີ່ສຳຄັນຕົ້ນຕໍ ຂອງເຂື່ອນໄຟຟ້ານ້ຳຈຶ່ງມີ 1, 2 ແລະ ນ້ຳຈຶ່ງມີ 3 ທີ່ມີແຜນຈະກໍ່ສ້າງໃນມຸ່ງນີ້. ແມ່ນ້ຳທັງໝົດເຫຼົ່ານີ້ ແມ່ນຖືເປັນສາຂາຍອ່ຍ ອັນດັບ 3 ແລະ ອັນດັບ 2 ທີ່ສຳຄັນຂອງ ແມ່ນ້ຳຂອງ. ປະຊາຊົນ ໃນບ້ານທີ່ຕັ້ງໃນຂອບເຂດ 1 ກມ ຫ່າງຈາກ ແມ່ນ້ຳເຫຼົ່ານີ້ ສ່ວນໃຫຍ່ແມ່ນນຳໃຊ້ແມ່ນ້ຳເຫຼົ່ານີ້ ເພື່ອບໍລິໂພກ ແລະ ອຸປະໂພກ.

3.1.4. ລະດັບການໄຫຼຂອງນ້ຳ (Runoff)

ຕາຕະລາງລຸ່ມນີ້ ສະແດງເຖິງຜົນຂອງການຄິດໄລ່ ສຳລັບຮູບແບບຂອງອ່າງໂຕ່ງ ທີ່ໄດ້ຮັບການ ຍອມຮັບ ສຳລັບລະດັບການໄຫຼ ຂອງນ້ຳ ໃນເຂື່ອນ.

ຕາຕະລາງ 3.1.5: ຄ່າສະເລັ່ງລະດັບການໄຫຼ ປະຈຳປີ ໃນເຂດທີ່ຈະສ້າງເຂື່ອນ (ນ້ຳຖ້ຳ 5)

Item	ເດືອນ											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ກະແສນ້ຳ (m <sup>3</sup> /s)	2.57	4.56	3.95	4.43	8.75	28.6	55.5	69.9	52.1	22.0	11.3	6.9
ການກະຈາຍ Distribution (%)	2.0	1.7	1.4	1.6	3.2	10.5	20.3	25.6	19.0	8.1	4.1	2.5
ຄ່າສະເລັ່ງປະຈຳປີຂອງກະແສນ້ຳໄຫຼ: 22.8m <sup>3</sup> /s; Runoff depth: 1,488.7 mm; Runoff: 719 M.m <sup>3</sup>												

Source: Feasibility Study Report (Main Report, Vol. II), April 2006 (Sinohydro Corp. Ltd.)

3.1.5. ສະພາບອາກາດ

ອາກາດໃນເຂດພາກເໜືອຂອງລາວ ແມ່ນນອນຢູ່ໃນອາກາດເຄິ່ງເຂດຮອ້ນ ແລະ ໄດ້ຮັບອິດທິພົນ ຈາກລົມມໍລະສຸມຕາວັນຕົກສ່ຽງໃຕ້ ໃນຊ່ວງລະດູຝົນ ແຕ່ເດືອນ ເມສາ/ພຶດສະພາ ຫາ ເດືອນກັນຍາ/ຕຸລາ. ປະລິມານນ້ຳຝົນສະເລັ່ງປະຈຳປີ ຢູ່ຊຽງຂວາງ ໃນປີ 2005 ປະມານ 1.372ມມ, ຢູ່ໄຊສົມບູນ ປະມານ 2.847ມມ ແລະ ຢູ່ແຂວງຫຼວງພະບາງ ປະມານ 1.392ມມ. ອຸນຫະພູມສະເລັ່ງ ໃນເດືອນທີ່ຮອ້ນສຸດ ຄື ເດືອນມິນາ; ຢູ່ຊຽງຂວາງ 29,2°C, ຢູ່ໄຊສົມບູນ 28,1°C ແລະ ຢູ່ຫຼວງພະບາງ 36,3°C ແລະ ອຸນຫະພູມ ສະເລັ່ງ ໃນເດືອນທີ່ໜ້າວສຸດ ຄື ເດືອນທັນວາ; ຢູ່ຊຽງຂວາງ 3,5°C, ຢູ່ໄຊສົມບູນ 6,0°C ແລະ ຢູ່ຫຼວງພະບາງ 12,6°C. ລະດູແລ້ງລະຫວ່າງ ສາມແຂວງ; ບໍລິຄຳໄຊ, ຄຳມ່ວນ ແລະ ສະຫວັນນະເຂດ ບໍ່ ແຕກຕ່າງກັນ ຄືແຕ່ເດືອນ ຕຸລາ ຫາເດືອນ ເມສາ.

3.2. ລັກສະນະທາງດ້ານຊີວະວິທະຍາ

3.2.1. ຄວາມປົກຫຸ້ມຂອງປ່າໄມ້ ແລະ ພຶດພັນ ໃນເຂດໂຄງການ

ອີງຕາມບົດລາຍງານ ຜົນການສຳຫຼວດ ຄວາມປົກຫຸ້ມຂອງປ່າໄມ້ ໃນປີ 2002 (ກົມປ່າໄມ້, ກຳລະກິດ, 2005) ຊື້ໃຫ້ເຫັນວ່າ ແຂວງຫຼວງພະບາງ ມີປ່າໄມ້ທີ່ຂອ້ນຂ້າງອຸດົມສົມບູນປົກຫຸ້ມ ປະມານ 13% ຂອງເນື້ອທີ່ທັງໝົດ, ປະມານ 81% ແມ່ນເຂດປ່າເຫຼົ້າ, ປ່າຊຸດໂຊມ ແລະ ປະມານ 1% ແມ່ນທີ່ດິນກະສິກຳ ຖາວອນ. ສຳລັບແຂວງຊຽງຂວາງ ໃນເນື້ອທີ່ທັງໝົດ ມີປະມານ 38,6% ແມ່ນປົກຄຸມດ້ວຍປ່າໄມ້ ທີ່ຂອ້ນ ຂ້າງອຸດົມສົມບູນ, 49% ແມ່ນເຂດປ່າເຫຼົ້າ, ປ່າຊຸດໂຊມ ແລະ ປະມານ 3% ແມ່ນທີ່ດິນກະສິກຳຖາວອນ.

ສຳລັບໃນຂອບເຂດຂອງໂຄງການ ທີ່ຈະໄດ້ຮັບຜົນກະທົບ ໂດຍສະເພາະ ໃນເຂດທີ່ນ້ຳຈະຖວ້ມ ທີ່ຈະກາຍເປັນອ່າງ, ເຂດທີ່ຈະກໍ່ສ້າງເຂື່ອນ ແລະ ເຂດທີ່ຈະຕັ້ງເຮືອນຈັກ; ປະມານ 2% (53 ຮຕ)

ແມ່ນເປັນປ່າປະສົມ, ປະມານ 24% (563 ຮຕ) ແມ່ນເປັນປ່າເຫຼົ້າ, ປ່າຊຸດໂຊມ, ປະມານ 2% (51 ຮຕ) ແມ່ນທົ່ງນາ, ໄຮ່ ແລະ ດິນກະສິກຳອື່ນໆ ແລະ ປະມານ 71% (1.636 ຮຕ) ແມ່ນທົ່ງຫຍ້າ (*ເບິ່ງແຜນທີ່*).

**ຕາຕະລາງ 3.2.1: ປະເພດການນຳໃຊ້ດິນ ແລະ ຄວາມປົກຫຸ້ມຂອງປ່າໄມ້ ໃນເຂດໂຄງການ**

	ປະເພດການນຳໃຊ້ທີ່ດິນ ແລະ ປ່າໄມ້	ເນື້ອທີ່ (ha)	ເປີເຊັນ %	Remark
ປະເພດການນຳໃຊ້ດິນ ແລະ ປ່າໄມ້ ໃນເຂດໂຄງການ ລວມທັງ ເຂດອ່າງ, ເຂື່ອນ ແລະ ເຮືອນຈັກ (ສະເພາະ ອ່າງນ້ຳ ແມ່ນຄິດໄລ່ ໃນ ລະດັບ ຄວາມສູງ 1.070 ແມັດ ເໜືອໜ້ານ້ຳທະເລ)	ປ່າປະສົມ (Mixed Deciduous)	53	2.30	<i>ໄດ້ຮັບຜົນກະທົບໂດຍກົງ</i>
	ປ່າເຫຼົ້າ (Unstock) ແລະ ປ່າພຸ່ມ (SR)	563	24.45	
	ໄຮ່ (Hay) (RA)	1	0.04	
	ທົ່ງນາ (RP) ແລະ ດິນກະສິກຳອື່ນໆ (AO)	50	2.17	
	ທົ່ງຫຍ້າ (Grassland)	1,636	71.04	
<b>Total</b>		<b>2,303</b>	<b>100</b>	

*ແຫຼ່ງຂໍ້ມູນ: ສູນສຳຫຼວດ ແລະ ວາງແຜນປ່າໄມ້, ກົມປ່າໄມ້ (2005).*

### 3.2.2. ສະພາບສັດປ່າ ແລະ ສັດນ້ຳ

ເນື່ອງຈາກວ່າ ປ່າໄມ້ສ່ວນໃຫຍ່ ໃນເຂດໂຄງການ ທີ່ເຄີຍເປັນທີ່ພັກອາໄສຂອງສັດປ່າຖືກບຸກລຸກ ແລະ ທຳລາຍ ຈາກການຖາງປ່າ ເຮັດໄຮ່ ແລະ ຖືກທຳລາຍ ໃນປາງສົງຄາມ ແລະ ຍອັນການລ່າຂອງ ປະຊາຊົນດັ່ງນັ້ນ ຈຶ່ງເຮັດໃຫ້ຈຳນວນປະຊາກອນ ແລະ ຊະນິດພັນຂອງສັດປ່າຫຼຸດລົງ, ເຮັດໃຫ້ສະພາບຄວາມ ອຸດົມສົມບູນຂອງສັດປ່າໃນປະຈຸບັນ ຫຼຸດນ້ອຍ ຖອຍລົງ ຫຼື ອາດສາມາດເວົ້າໄດ້ວ່າ ໃນເຂດຂອງໂຄງການ ແມ່ນບໍ່ມີສັດປ່າເລີຍ. ອີງຕາມຂໍ້ມູນຂອງກົມປ່າໄມ້, ອີງການອະນຸລັກສັດປ່າ ແລະ ຈາກການສຳພາດ ປະຊາຊົນ ໃນບ້ານທີ່ນອນຢູ່ໃນເຂດໂຄງການ ຊຶ່ງໃຫ້ເຫັນວ່າ ໃນຂອບເຂດໂຄງການ ແມ່ນບໍ່ປະກົດເຫັນສັດ ປ່າເລີຍ ຍົກເວັ້ນແຕ່ນົກນ້ອຍບາງຊະນິດເທົ່ານັ້ນ, ສັດປ່າສ່ວນໃຫຍ່ໄດ້ອົບພະຍົບໜີໄປຢູ່ໃນເຂດປ່າດົງ ຕິບໜາ ໂດຍສະເພາະ ຢູ່ເທິງເຂດພູ ຜາໃດ, ພູດ່າພໍ່ ແລະ ເຂດປ່າອື່ນໆທີ່ຫ່າງໄກ ຈາກການລົບກວນ ແລະ ທຳລາຍ ຊຶ່ງເຂດດັ່ງກ່າວ ແມ່ນຢູ່ນອກເຂດ ຂອງໂຄງການ.

ສຳລັບສັດນ້ຳ ໂດຍສະເພາະ ແມ່ນຈຳພວກປາ ອີງຕາມການສຳຫຼວດຕົວຈິງ ສົມທົບກັບການ ສຳພາດປະຊາຊົນ ໃນເຂດໃກ້ຄຽງ ໃຫ້ຮູ້ວ່າ ໃນແມ່ນ້ຳ ທັງສາມສາຍຕົ້ນຕໍ ຄື: ນ້ຳຊູດ, ນ້ຳພັດ ແລະ ນ້ຳຕົ່ງ ແມ່ນຍັງປະກົດມີປາທຳມະຊາດ ຢູ່ປະມານເກືອບ 20 ຊະນິດ ຄື: ປາຄຽງໄຟ, ປາຈາດ, ປາດູກ, ປາຄໍ່, ປາກິດ, ປາປາກ, ປາຫຼົດ, ປາຫຼາດ, ປາກັ້ງ, ປາຂາວ, ປາສູດ, ປາໄຟ, ປາຫາງແດງ, ປາຫຼັງໜາມ, ປາຂາວ, ປາສອ້ຍ, ປາຂີ້ຂົມ ແລະ ຊະນິດປານອື່ນໆ, ແຕ່ສ່ວນໃຫຍ່ ຊະນິດປາເຫຼົ່ານີ້ ແມ່ນມີໜ້ອຍ ແລະ ຫາຍາກ ເນື່ອງຈາກການຫາ ແບບບໍ່ຖືກວິທີ ຫຼື ແບບດັບສູນ ຂອງປະຊາຊົນໃນເຂດດັ່ງກ່າວ.



ນອກຈາກນີ້ ໃນເຂດດັ່ງກ່າວ ແມ່ນປະກົດມີປາຊະນິດໜຶ່ງ ຊຶ່ງປະຊາຊົນໃນເຂດນັ້ນເອີ້ນວ່າ “ປາຍອຍ” ຊຶ່ງເປັນຊະນິດປາ ທອ້ງຖິ່ນ ທີ່ຫາຍາກ ມີຂະໜາດໃຫຍ່ສຸດ ປະມານ 10 ກິໂລ (ອີງຕາມການສຳພາດ ປະຊາຊົນ), ມັກອາໄສຢູ່ໃນແມ່ນ້ຳ ທີ່ບໍ່ເລິກພໍປານໃດ.

### 3.2.3. ປ່າສະຫງວນ

ລັດຖະບານໄດ້ມີຂໍ້ກຳນົດ ໃນການສ້າງຕັ້ງປ່າສະຫງວນແຫ່ງຊາດ ທັງໝົດ 20 ແຫ່ງ ໃນທົ່ວປະເທດ. ໃນນັ້ນ ຢູ່ແຂວງຫຼວງພະບາງ ມີພຽງແຕ່ປ່າສະຫງວນແຫ່ງຊາດ ໜຶ່ງແຫ່ງ ຄື ປ່າສະຫງວນແຫ່ງຊາດ ນ້ຳແອດ-ພູເລີຍ ຊຶ່ງມີເນື້ອທີ່ 320.000 ເຮັກຕາ ຊຶ່ງຢູ່ຫ່າງໄກ ຈາກທີ່ຕັ້ງ ຂອງໂຄງການ, ດັ່ງນັ້ນ ໂຄງການພັດທະນາເຂື່ອນໄຟຟ້ານ້ຳຈື່ມ 5 ຈຶ່ງບໍ່ມີຜົນກະທົບໃດໆ ຕໍ່ກັບປ່າສະຫງວນ ກໍຄືປ່າປອ້ງກັນ.

## 3.3. ສະພາບທາງດ້ານສັງຄົມ ແລະ ວັດທະນະທຳ

### 3.3.1. ສະພາບທາງດ້ານປະຊາກອນ

ຄືດັ່ງທີ່ໄດ້ກ່າວມາແລ້ວນັ້ນ, ເຂດໂຄງການກວມເອົາ 2 ແຂວງ, 2 ເມືອງ, ແຕ່ໃນນັ້ນ ມີພຽງແຕ່ ບ້ານດຽວ ຄືບ້ານຈິມ ທີ່ໄດ້ຮັບຜົນກະທົບໂດຍກົງ. ບ້ານຈິມ ມີຈຳນວນຄອບຄົວທັງໝົດ 155 ຄອບຄົວ, ມີປະຊາກອນທັງໝົດ 994 ຄົນ, ໃນນີ້ ມີພຽງແຕ່ 49 ຄອບຄົວ ທີ່ມີນາ ຢູ່ແຄມນ້ຳຂຸດ ທີ່ໄດ້ຮັບຜົນກະທົບ. ຕາຕະລາງລຸ່ມນີ້ ສະແດງເຖິງ ການກະຈາຍຂອງບ້ານ ໃນເຂດໃກ້ຄຽງໂຄງການ.

ຕາຕະລາງ 3.3.1: ຈຳນວນບ້ານ ແລະ ຄອບຄົວ ໃນເຂດໃກ້ຄຽງໂຄງການ

ຂອບເຂດໃນການສຶກສາ ໂຄງການ	ເມືອງພູຄູນ				ເມືອງພູກູດ		
	ບ້ານທີ່ໄດ້ຮັບ ຜົນກະທົບ	ບ້ານໃນເຂດໃກ້ຄຽງໂຄງການ (ແຕ່ຢູ່ນອກຂອບເຂດໂຄງການ)			ບ້ານໃນເຂດໃກ້ຄຽງໂຄງການ (ແຕ່ຢູ່ນອກຂອບເຂດໂຄງການ)		
		ບ້ານຈິມ	ລອງໝັງ	ຜາຫວາຍ	ນ້ຳມ້າດາວ	ສົມບູນ	ນ້ຳຈັດ
ຈຳນວນຄອບຄົວທັງໝົດ	155	60	21	44	60	91	96
ຈຳນວນປະຊາກອນທັງໝົດ	994	373	140	284	428	491	475
ເພດຍິງ	378	192	66	150	218	255	222
ຄອບຄົວທີ່ໄດ້ຮັບ ຜົນກະທົບ	49	0	0	0	0	0	0

### 3.3.2. ສະພາບຊົນຊາດ-ຊົນເຜົ່າ (ເຜົ່າຊົນ)

ບ້ານຈິມ ຊຶ່ງມີຈຳນວນຄອບຄົວທັງໝົດ 155 ຄອບຄົວ ແລະ ມີປະຊາກອນທັງໝົດ 994 ຄົນ ປະກອບມີ 3 ຊົນເຜົ່າຕົ້ນຕໍ ຄື: ຊົນເຜົ່າລາວ (ກວມ 1,4%), ເຜົ່າມົ້ງ (ກວມ 50,6%) ແລະ ຊົນເຜົ່າຂະມຸ (ກວມ 48%) ທີ່ຂຶ້ນກັບກຸ່ມພາສາປາກເວົ້າ 3 ກຸ່ມຊົນໃຫຍ່ ທີ່ແຕກຕ່າງກັນ ຄື: ໄທ-ກະດາຍ, ມອນຂະແມ ແລະ ເຮີມິງ-ມຽນ. ການດຳລົງຊີວິດຂອງແຕ່ລະເຜົ່າຊົນນັ້ນ ບໍ່ແຕກຕ່າງກັນຫຼາຍ ສ່ວນໃຫຍ່ ການດຳລົງຊີວິດ ຂອງເຂົາເຈົ້າ ຈະໄດ້ຮັບອິດທິພົນຕໍ່ກັນແລະກັນ ໂດຍການຍຶດຖືອາຊີບການຜະລິດກະສິກຳເປັນຫຼັກ (ເຮັດນາ,

ເຮັດໄຮ່, ເຮັດສວນ, ລ້ຽງສັດ ແລະ ອື່ນໆ), ສ່ວນອາຊີບອື່ນໆ ແມ່ນຖືວ່າສຳຮອງ. ຮູບແບບໃນການດຳລົງຊີວິດຂອງເຂົາເຈົ້າ ຈະເປັນຮູບແບບທີ່ປະສົມປະສານກັນ ໂດຍຢູ່ຮວມກັນໃນບ້ານໜຶ່ງ ຊຶ່ງໃຊ້ຊີວິດຢູ່ຮ່ວມກັນ ຢ່າງກົມກືນ ໂດຍມີຄະນິບທຳນຽມທີ່ແຕກຕ່າງກັນ ຂຶ້ນກັບການເຊື່ອຖືສາສະໜາຂອງໃຜມັນ ເຊິ່ງປະກອບມີ 2 ສາສະໜາຕົ້ນຕໍ ຄື: ສາສະໜາພຸດ ແລະ ນິບຖືຜີ.

### 3.3.3. ສະພາບ ທາງດ້ານສຸຂະພາບ, ການສຶກສາ ແລະ ແຮງງານ

ສຳລັບສະພາບທາງດ້ານສຸຂະພາບ ແລະ ໂລກລະບາດຕ່າງໆ ໃນຂອບເຂດໂຄງການ, ອີງຕາມການສຳພາດ, ໂດຍລວມ ປະຊາຊົນຈະມີສຸຂະພາບທີ່ຂອ້ນຂ້າງດີສົມຄວນ. ເຖິງຢ່າງໃດກໍຕາມ, ໃນຊ່ວງໄລຍະ 3 ປີຜ່ານມາ ຍັງມີພະຍາດທີ່ມັກເກີດພາຍໃນພື້ນທີ່ດັ່ງກ່າວຢູ່ ສ່ວນໃຫຍ່ຈະເປັນພະຍາດປະຈຳລະດູ ເຊັ່ນ: ໄຂ້ມະລາເລັງ, ໄຂ້ເລືອດອອກ ແລະ ວັນນະໂລກ, ແຕ່ກໍເກີດໃນວົງແຄບ ແລະ ບໍ່ໄດ້ແຜ່ລະບາດໃນວົງກວ້າງ ເຊິ່ງບໍ່ສົ່ງຜົນກະທົບຮ້າຍແຮງປານໃດ ໃຫ້ແກ່ການດຳເນີນການຜະລິດຂອງປະຊາຊົນ, ແຕ່ກໍມີຄວາມຈຳເປັນທີ່ຈະຕ້ອງໄດ້ເອົາໃຈໃສ່ ໃນໄລຍະການດຳເນີນໂຄງການ.

ສຳລັບການສຶກສາ ປະຊາຊົນສ່ວນຫຼາຍ ຍັງກຶກໜັງສື ແລະ ມີລະດັບການສຶກສາພຽງແຕ່ຈົບຊັ້ນປະຖົມ ຫຼື ລະບົບບຳລຸງ (ປະຊາສຶກສາ ຫຼື ລົບລ້າງກຶກໜັງສື). ໃນບັນດາບ້ານ ທີ່ໄດ້ດຳເນີນການສຳຫຼວດ, ບ້ານຈິມ ມີປະຊາກອນທີ່ກຶກໜັງສື ຢູ່ໃນອັດຕາຕໍ່ກວ່າໜູ່ ຄືຕໍ່ກວ່າ 10% ຂອງຈຳນວນ ປະຊາກອນທັງໝົດ, ແຕ່ສຳລັບບ້ານຜາຫວາຍ ແລະ ນ້ຳມ້າດາວ ມີອັດຕາການກຶກໜັງສືສູງສຸດ (ສູງກວ່າ 90%).

ສຳລັບສະພາບທາງດ້ານແຮງງານ ເຫັນວ່າ ທັງໝົດ ບ້ານໃນເຂດໄກ້ຄຽງ ໂດຍສະເພາະແມ່ນບ້ານຈິມ ແມ່ນມີຄວາມເປັນໄປໄດ້ສູງ ທາງດ້ານແຮງງານ ຊຶ່ງມີແຮງງານຕົ້ນຕໍຫຼາຍກວ່າ 400 ຄົນ ແລະ ແຮງງານສຳຮອງ ແມ່ນມີເກືອບ 300 ຄົນ. ນອກຈາກນັ້ນ ບ້ານອື່ນໆ ເຊັ່ນ: ບ້ານຊຽງແດດ ກໍມີຄວາມເປັນໄປໄດ້ ທາງດ້ານແຮງງານເຊັ່ນດຽວກັນ. ບັນຫາດັ່ງກ່າວນີ້ ເປັນທ່າແຮງອັນໜຶ່ງ ໃນການກໍ່ສ້າງໂຄງການທັງຍັງເປັນການສ້າງອາຊີບ ແລະ ສ້າງລາຍຮັບ ໃຫ້ແກ່ປະຊາຊົນທ້ອງຖິ່ນ ຜູ້ທີ່ດອ້ຍໂອກາດອີກດ້ວຍ.

### 3.3.2. ສະພາບຂອງລູກລະເບີດທີ່ບໍ່ທັນແຕກ (UXO)

ຄືດັ່ງທີ່ຮູ້ກັນແລ້ວວ່າ ນັບເປັນເວລາດົນນານພິສິມຄວນທີ່ປະເທດລາວ ໄດ້ຖືກຮຸກຮານໂດຍຈັກກະພັດຝຣັ່ງ ແລະ ອາເມລິກາ. ພາຍຫຼັງທີ່ຈັກກະພັດຝຣັ່ງ ໄດ້ປະລາໄຊໃນສົງຄາມອິນດູຈີນ, ຈັກກະພັດອາເມລິກາ ໄດ້ສືບຕໍ່ຮຸກຮານລາວ. ໃນຊ່ວງປີ 1964 ຫາ 1973 ພວກຈັກກະພັດອາເມລິກາໄດ້ຖິ້ມລະເບີດລົງໃສ່ສາມປະເທດອິນດູຈີນ ເວົ້າລວມ, ເວົ້າສະເພາະ ສປປລາວ ຢ່າງໜັກໜ່ວງ. ຜົນຂອງການຖິ້ມລະເບີດຢ່າງໜັກໜ່ວງຂອງຈັກກະພັດອາເມລິກາຄືດັ່ງກ່າວ ຈຶ່ງສົ່ງຜົນກະທົບໃຫ້ແກ່ການດຳລົງຊີວິດຂອງປະຊາຊົນລາວ ມາຮອດປະຈຸບັນ. ຈາກຂໍ້ມູນຂອງອົງການ UXO ຊຶ່ງໃຫ້ເຫັນວ່າ ສປປລາວ ແມ່ນມີບັນຫາເລື່ອງລູກລະເບີດທີ່ຕົກຄ້າງ ແລະ ບໍ່ທັນແຕກ ຢ່າງໜັກໜ່ວງ. ເຊິ່ງໃນຊ່ວງໄລຍະ 10 ປີ (1964-1973) ມີລູກລະເບີດຖິ້ມລົງໃນດິນແດນຂອງລາວ ປະມານຫຼາຍກວ່າ 500.000 ຄັ້ງ ຊຶ່ງຫຼາຍກວ່າ 2 ໂຕນ, ໃນນັ້ນ ປະມານ 30% ຂອງຈຳນວນລູກລະເບີດທັງໝົດ (ທັງຂະໜາດນ້ອຍ, ກາງ ແລະ ໃຫຍ່) ແມ່ນບໍ່ທັນແຕກ ແລະ ກະແຈກ ກະຈາຍໄປໃນທິວທຸກທິນແຫ່ງ ໃນຈຳນວນ 15 ແຂວງ, ໂດຍສະເພາະ ແມ່ນບັນດາແຂວງພາກເໜືອ ແລະ ພາກໃຕ້ຂອງລາວ. ແຂວງຫຼວງພະບາງ ແລະ ຊຽງຂວາງ ແມ່ນຖືວ່າເປັນແຂວງທີ່ໄດ້ຮັບຜົນກະທົບຫຼາຍທີ່ສຸດ (ຂໍ້ມູນຈາກ NGPES, 2004). ຕາມຂໍ້ມູນຂອງອົງການເກັບກູ້ລະເບີດ (UXO) ສະ

ແດງໃຫ້ເຫັນວ່າ ໃນເຂດຂອງໂຄງການ ຍັງປະກົດມີລະເບີດຕົກຄ້າງ ຈຳນວນໜຶ່ງ. ໃນນັ້ນ ຫຼາຍກວ່າ 50% ຂອງພື້ນທີ່ທັງໝົດ ທີ່ຖືກຜົນກະທົບ ແມ່ນດິນກະສິກຳ (ຂໍ້ມູນຈາກ ກະຊວງກະສິກຳ ແລະ ປ່າໄມ້/ອົງການ ໃຈກາ, 2001).

ເຖິງຢ່າງໃດກໍຕາມ ຈາກຜົນການລົງສຳຫຼວດ ເກັບກຳຂໍ້ມູນຢູ່ພາກສະໜາມ ໂດຍການສຳພາດ ປະຊາຊົນ ໃນບັນດາບ້ານ ທີ່ນອນໃນເຂດໂຄງການ ແມ່ນປະກົດວ່າ ໃນເຂດໂຄງການ ແມ່ນບໍ່ມີຜົນກະທົບ ຈາກລູກລະເບີດໃນປາງສົງຄາມ ເນື່ອງຈາກວ່າ ເຊິ່ງພື້ນທີ່ດິນສ່ວນໃຫຍ່ ໃນເຂດໂຄງການ ແມ່ນໄດ້ຮັບການ ສັບສ່ວນ, ບຸກເບີກ ເພື່ອການຜະລິດກະສິກຳ. ເຖິງຢ່າງໃດກໍຕາມ ເພື່ອຮັບປະກັນໃຫ້ແກ່ ການກໍ່ສ້າງ ໂຄງການ, ຮັບປະກັນ ທັງຊີວິດ ແລະ ຊັບສິນ ຂອງປະຊາຊົນ ແລະ ກຳມະກອນ ກ່ອນຈະ ລົງມື ດຳເນີນໂຄງການ ຄວນຈະວ່າຈ້າງ ຜູ້ຊ່ຽວຊານ ຈາກອົງການສຳຫຼວດ ແລະ ເກັບກຳ ລະເບີດ (ອົງການ UXO Lao) ມາສຶກສາ ແລະ ສຳຫຼວດລະອຽດກ່ອນ ໃນເຂດທີ່ມີຄວາມສົງໄສ.

### 3.4. ສະພາບທາງດ້ານເສດຖະກິດ

ອີງຕາມຂໍ້ມູນ ຂອງຍຸດທະສາດ ແຫ່ງການຂະຫຍາຍໂຕ ແລະ ລິບລ້າງຄວາມທຸກຍາກແຫ່ງຊາດ (NGPES, 2004) ໃຫ້ຮູ້ວ່າ ໃນ ສອງເມືອງ ໃນຂອບເຂດຂອງໂຄງການ, ມີແຕ່ເມືອງພູຄູນເທົ່ານັ້ນ ທີ່ຖືກຈັດ ໃຫ້ເປັນເມືອງທຸກຍາກ ຊຶ່ງປະກອບມີ ທັງໝົດ 43 ບ້ານ, ມີ 3.117 ຄອບຄົວ, ໃນນີ້ມີ 18 ບ້ານ ແລະ ມີ 1.964 ຄອບຄົວ (ຊຶ່ງເທົ່າກັບ 63%) ແມ່ນທຸກຍາກ. ຈາກຜົນການສຳຫຼວດ ຊຶ່ງໃຫ້ເຫັນວ່າ ຈຳນວນຄອບຄົວ ສ່ວນໃຫຍ່ ແມ່ນຍັງທຸກຍາກ ຍົກເວັ້ນ ບ້ານຈິມ ທີ່ຖືວ່າ ຈຳນວນຄອບຄົວສ່ວນໃຫຍ່ ແມ່ນພໍຢູ່ພໍກິນ ທັງນີ້ ອາດເນື່ອງມາຈາກ ເຂົາເຈົ້າເຫຼົ່ານັ້ນ ມີນາ ທີ່ສາມາດຜະລິດເຂົ້າໄດ້ພໍກຸ້ມກິນ. ໃນຈຳນວນ 155 ຄອບຄົວທັງໝົດ ໃນບ້ານຈິມ ມີພຽງແຕ່ 12,9% ທີ່ຖືວ່າທຸກຍາກ, 50,3% ແມ່ນຖືວ່າພໍຢູ່ພໍກິນ ແລະ ປະມານ 36,7% ແມ່ນຖືວ່າມີຖານະປານກາງ ແລະ ຂອບເຂດອື່ນໆ.

#### 3.4.1. ສະພາບການຜະລິດກະສິກຳ ແລະ ວິຖີຊີວິດ ຂອງປະຊາຊົນ

ເນື່ອງຈາກວ່າ ພື້ນທີ່ສ່ວນໃຫຍ່ ໃນເຂດໂຄງການ ແມ່ນເປັນພູ, ດັ່ງນັ້ນ ປະຊາຊົນສ່ວນໃຫຍ່ ຈຶ່ງອາໄສການເຮັດໄຮ່, ເຮັດສວນ ແລະ ລ້ຽງສັດໃຫຍ່. ມີພຽງແຕ່ພື້ນທີ່ບາງສ່ວນເທົ່ານັ້ນ ທີ່ຂອບເຂດ ຮາບພຽງ ໂດຍສະເພາະ ແມ່ນຢູ່ລຽບຕາມແຄມແມ່ນ້ຳຊູດ ໃນເຂດບ້ານຈິມ ທີ່ປະຊາຊົນຈຳນວນໜຶ່ງ ສາມາດເຮັດນາໄດ້, ຊຶ່ງພາຍຫຼັງການກໍ່ສ້າງໂຄງການສຳເລັດ ເນື້ອທີ່ນາດັ່ງກ່າວ ກໍຈະຖືກນ້ຳຖ້ວມ. ການເກັບກຳເຄື່ອງປ່າຂອງດົງ ກໍແມ່ນວິຖີຊີວິດໜຶ່ງ ຂອງປະຊາຊົນໃນເຂດດັ່ງກ່າວ ໂດຍສະເພາະ ແມ່ນ ຈຳພວກ ຫວາຍ: ເຫັດ, ໜໍ່ໄມ້, ຜັກປ່າ, ໝາກໄມ້ປ່າ, ຍອດແຍ້, ຍອດບຸ່ນ, ຍອດສານ ແລະ ອື່ນໆ. ເຖິງຢ່າງໃດກໍຕາມ ເຄື່ອງປ່າຂອງດົງເຫຼົ່ານີ້ ສ່ວນໃຫຍ່ແມ່ນມີຢູ່ໃນເຂດປ່າດົງ ຊຶ່ງຢູ່ນອກເຂດໂຄງການ ແລະ ການເກັບກຳແມ່ນເພື່ອເປັນອາຫານ ແລະ ສຳລັບໃຊ້ສອຍພາຍໃນຄອບຄົວເທົ່ານັ້ນ. ນອກຈາກນີ້ ປະຊາຊົນຈຳນວນໜຶ່ງ ຍັງເຮັດຫັດຖະກຳຈັກສານ ແຕ່ບໍ່ຖືວ່າເປັນອາຊີບ, ສ່ວນໃຫຍ່ແມ່ນຈັກສານກະຕ່າ, ກະເຊົ້າເປ້, ຕິບເຊົ້າ ແລະ ເຄື່ອງໃຊ້ສອຍອື່ນໆທີ່ຈຳເປັນ ສຳລັບຄອບຄົວເທົ່ານັ້ນ.

**3.4.2. ສະພາບທາງດ້ານການຄ້າ ແລະ ກິດຈະການອຸດສາຫະກຳ**

ບັນດາກິດຈະກຳທາງດ້ານການຄ້າ ມີພຽງບາງບ້ານທີ່ຕັ້ງຢູ່ໃກ້ທົນທາງ ແລະ ຕົວເມືອງເທົ່ານັ້ນ ທີ່ມີ ຕະຫຼາດຂາຍ ແລະ ແລກປ່ຽນສິນຄ້າ, ນອກຈາກໃນເຂດຕົວເມືອງໃຫຍ່ແລ້ວ ລຽບຕາມເສັ້ນທາງໃຫຍ່ ຢູ່ໃນ ເຂດຊຸມຊົນ ເຊັ່ນ: ຢູ່ສາມແຍກພູຄູນ ແລະ ພູກູດ ກໍມີຮ້ານຂາຍເຄື່ອງຍ່ອຍ ແລະ ຮ້ານອາຫານ ຂະໜາດ ນ້ອຍຂອງປະຊາຊົນ. ສ່ວນໃຫຍ່ແລ້ວ ບັນດາກິດຈະກຳທາງການຄ້າ ແມ່ນມີສະເພາະແຕ່ຢູ່ໃນເຂດທີ່ມີ ທົນທາງເຂົ້າເຖິງໄດ້ທັງສອງລະດູ. ສຳລັບການດຳເນີນກິດຈະການ ທາງດ້ານອຸດສາຫະກຳ ແມ່ນບໍ່ມີເລີຍ ເນື່ອງຈາກວ່າບ້ານສ່ວນໃຫຍ່ ໃນເຂດໂຄງການ ແມ່ນບໍ່ມີໄຟຟ້າ.

**3.4.3. ສະພາບພື້ນຖານໂຄງລ່າງ, ສິ່ງປຸກສ້າງ ແລະ ສິ່ງອຳນວຍຄວາມສະດວກຕ່າງໆ**

ເນື່ອງຈາກວ່າ ໂຄງການ ແມ່ນຕັ້ງຢູ່ໃນເຂດພູດອຍ, ຫ່າງໄກສອກຫຼີກ, ສະນັ້ນ ຈິ່ງມີຂໍ້ຈຳກັດຫຼາຍ ທາງດ້ານ ພື້ນຖານໂຄງລ່າງ ແລະ ສິ່ງອຳນວຍຄວາມສະດວກຕ່າງໆ ເປັນຕົ້ນແມ່ນ ເສັ້ນທາງ, ໄຟຟ້າ ແລະ ອື່ນໆ. ເສັ້ນທາງ 13 ເໜືອ, ເສັ້ນທາງເລກ 7 ແລະ ເສັ້ນທາງຊອຍເຂົ້າໄປຫາບ້ານຈິມ ຖືວ່າເປັນພື້ນຖານ ໂຄງລ່າງ ທີ່ສຳຄັນ ໃນການເຂົ້າໄປເຖິງພື້ນທີ່ສ່ວນໜຶ່ງ ຂອງໂຄງການ.

**3.4.4. ການຊົມໃຊ້ພະລັງງານ**

ເນື່ອງຈາກວ່າ ໃນເຂດໂຄງການ ບໍ່ມີໄຟຟ້າ, ດັ່ງນັ້ນ ປະຊາຊົນໃນເຂດດັ່ງກ່າວ ຈິ່ງນຳໃຊ້ໄມ້ຟິນ ເປັນຕົ້ນຕໍ ເພື່ອເປັນພະລັງງານ ໃນການທຸງຕົ້ມ, ໃຫ້ແສງສະຫວ່າງ ແລະ ໃຫ້ຄວາມອົບອຸ່ນ. ການພັດທະນາ ໂຄງການໄຟຟ້າ ດັ່ງກ່າວ ຈະບໍ່ສົ່ງຜົນກະທົບອັນໃຫຍ່ຫຼວງ ໃຫ້ແກ່ປະຊາຊົນ ໂດຍສະເພາະ ທາງດ້ານການ ນຳໃຊ້ພະລັງງານໄມ້ຟິນ ເນື່ອງຈາກວ່າ ຖ້າສົມທຽບຄວາມຕ້ອງການໄມ້ຟິນ ໃສ່ກັບຄວາມອາດສາມາດ ສະ ໜອງ ຕົວຈິງແລ້ວ ເຫັນວ່າ ຄວາມອາດສາມາດສະໜອງ ແມ່ນມີສູງກວ່າ ແລະ ອີກປະການໜຶ່ງ ເຂດອ່າງທີ່ນຳ້ຈະຖ້ວມ ສ່ວນໃຫຍ່ແລ້ວ ແມ່ນຢູ່ຫ່າງໄກຈາກເຂດຊຸມຊົນ ແລະ ເປັນເຂດທີ່ບໍ່ມີປ່າໄມ້.

**IV. ທາງເລືອກ ຂອງໂຄງການ**

ອີງຕາມຜົນການສຶກສາຄວາມເປັນໄປໄດ້ ທີ່ດຳເນີນໂດຍ ບໍລິສັດ Lahmeyer International ໄດ້ ສະເໜີທາງເລືອກຂອງໂຄງການ 5 ທາງເລືອກ A1, C, B, D ແລະ A1+A2, ຜ່ານການ ພິຈາລະນາ ບໍ່ວ່າທາງດ້ານເຕັກນິກ, ເສດຖະກິດ ແລະ ສິ່ແວດລ້ອມ ເຫັນວ່າ ມີພຽງ 2 ທາງເລືອກ ທີ່ພໍຈະສາມາດ ນຳມາພິຈາລະນາໄດ້ ຄື: ທາງເລືອກ C ແລະ D. ທັງສອງທາງເລືອກ ໄດ້ຮັບການວິເຄາະ-ວິໃຈ ແລະ ສົມທຽບ ຕາມແຕ່ລະປັດໃຈ ຄືດັ່ງຕາຕະລາງລຸ່ມນີ້:

ລາຍການ (Item)	ຫົວໜ່ວຍ (Unit)	ທາງເລືອກ C (Alternative C)	ທາງເລືອກ D (Alternative D)
ກຳລັງຕິດຕັ້ງ Installed capacity	MW	84	100
ຫົວໜ່ວຍການນຳໃຊ້ປະຈຳປີ ເປັນຊົ່ວໂມງ Annual utilization hours of units	h	4190	4860
ຄ່າສະເລ່ຍປະຈຳປີ ໃນການຜະລິດກະແສໄຟຟ້າ Mean annual energy production	GW-h	352	486

<b>ມູນຄ່າລວມ ຂອງໂຄງການ</b> <b>Total Project Cost</b>	MUSD	<b>164</b>	<b>196</b>
<b>ລາຄາຫົວໜ່ວຍສຳລັບກຳລັງຕິດຕັ້ງ</b> <b>Unit cost on installation capacity</b>	USD/kw	<b>1962</b>	<b>1959</b>

*ໝາຍເຫດ: MW: ເມກາວັດ, h: ຊົ່ວໂມງ, GW-h: ກິກາວັດໂມງ, MUSD: ລ້ານໂດລາສະຫະລັດ, USD/kw: ຫົວໜ່ວຍເປັນໂດລາ ຕໍ່ຊົ່ວໂມງ.*

ອີງຕາມຜົນການຄິດໄລ່ລົມທຽບ ທາງດ້ານເຕັກນິກວິຊາການ, ພະລັງງານເຂື່ອນ, ກຳລັງນ້ຳ ລວມທັງສະພາບພື້ນທີ່ ພູມິປະເທດ, ການສຳຫຼວດ ອອກແບບໂຄງສ້າງ ແລະ ການປະເມີນທາງດ້ານເສດຖະກິດ ແລະ ສິ່ງແວດລ້ອມ ເຫັນວ່າ ຫົວໜ່ວຍກຳລັງການຕິດຕັ້ງ ສຳລັບທາງເລືອກ D ຕໍ່ກວ່າ ແລະ ດີກວ່າ ທາງເລືອກ C, ດັ່ງນັ້ນ ທາງເລືອກ D ຈຶ່ງໄດ້ຮັບການພິຈາລະນາຄັດເລືອກ ເປັນຄັ້ງສຸດທ້າຍ ສຳລັບ ການພັດທະນາໂຄງການເຂື່ອນໄຟຟ້ານ້ຳຈື່ມ 5.

## V. ຜົນກະທົບທາງດ້ານສັງຄົມ-ສິ່ງແວດລ້ອມທີ່ອາດເກີດຂຶ້ນ ແລະ ມາດຕະການຫຼຸດຜ່ອນ

### 5.1. ຜົນກະທົບ ທີ່ກ່ຽວພັນກັບທີ່ຕັ້ງຂອງໂຄງການ

#### 5.1.1. ສຳລັບເຂດກໍ່ສ້າງເຂື່ອນ ແລະ ໜ້າເຂື່ອນ

##### ກ). ຜົນກະທົບ ຕໍ່ກັບລະບົບຊີວະວິທະຍາ

##### ປ່າໄມ້ ແລະ ພືດພັນ

ເນື່ອງຈາກວ່າ ສະພາບປ່າໄມ້ ໃນເຂດດັ່ງກ່າວ ໄດ້ຖືກທຳລາຍມາກ່ອນແລ້ວ ຍອ້ນການຖາງປ່າ ເຮັດໄຮ່, ການຂຸດຄົ້ນໄມ້, ການບຸກເບີກ ເພື່ອເປົ້າໝາຍອື່ນໆ ແລະ ຍອ້ນລົງຄາມທຳລາຍ, ດັ່ງນັ້ນ ປ່າໄມ້ທີ່ຍັງເຫຼືອ ໃນເຂດດັ່ງກ່າວ ທີ່ຈະໄດ້ຮັບຜົນກະທົບ ຈາກໂຄງການ ສວ່ນໃຫຍ່ ແມ່ນປ່າເຫຼົ່າ, ປ່າພຸ່ມ ທີ່ເປັນປ່າຊຸດໂຊມ (Unstocked Forest and Scrub) ຊຶ່ງມີປະມານ 563 ເຮັກຕາ, ຈຳນວນໜຶ່ງ ແມ່ນປ່າປະສົມ (Mixed Deciduous Forest) ກວມປະມານ 53 ເຮັກຕາ ຊຶ່ງຍັງປະກົດມີ ຊະນິດພັນໄມ້ ທີ່ເປັນເສດຖະກິດ ຈຳນວນໜຶ່ງ ແຕ່ເປັນໄມ້ເນື້ອອ່ອນ ທີ່ມີລາຄາຕໍ່າ ທີ່ຕະຫຼາດບໍ່ຕ້ອງການ ແລະ ເປັນຕົ້ນໄມ້ທີ່ມີໜ້າຕ້ອງນອ້ຍ ເຊັ່ນ: ໄມ້ສົງ, ໄມ້ລາງຈິກ, ໄມ້ຫວ້າດົງ, ໄມ້ສີໂຄດິນ, ໄມ້ຫົວໂລ້ນ, ໄມ້ກໍ່ຂີ້ໝູ, ໄມ້ຂາວ, ໄມ້ຫາດ, ສວ່ນທີ່ເຫຼືອ ຊຶ່ງກວມເນື້ອທີ່ສວ່ນໃຫຍ່ ແມ່ນເປັນທົ່ງຫຍ້າ ຊຶ່ງລວມມີ ທັງກໍເລົາ, ກໍແຂມ ແລະ ຫຍ້າຄາ ກວມປະມານ 1.636 ເຮັກຕາ. ອີກປະການໜຶ່ງ ໃນເຂດໂຄງການ ກໍບໍ່ປະກົດມີປ່າສະຫງວນ ຫຼື ປ່າປອ້ອກັນໃດໆ, ດັ່ງນັ້ນ ຈຶ່ງສາມາດເວົ້າໄດ້ວ່າ ໂຄງການ ຈະບໍ່ສົ່ງຜົນກະທົບອັນຮ້າຍແຮງ ໃຫ້ແກ່ປ່າໄມ້.

##### ສະພາບສັດປ່າ ແລະ ຖິ່ນອາໄສຂອງສັດປ່າ

ຄືດັ່ງທີ່ໄດ້ກ່າວຂ້າງເທິງນັ້ນ ສະພາບປ່າໄມ້ ໃນເຂດດັ່ງກ່າວ ສວ່ນໃຫຍ່ ແມ່ນຖືກທຳລາຍ ແລະ ພອ້ມດຽວກັນ ຖິ່ນອາໄສ ຂອງສັດປ່າ ກໍຖືກທຳລາຍເຊັ່ນດຽວກັນ. ເຖິງຢ່າງໃດກໍຕາມ ການສຳຫຼວດ ເກັບກຳຂໍ້ມູນ ແລະ ການສຳພາດປະຊາຊົນ ໃຫ້ຮູ້ວ່າ ຢູ່ເທິງພູຜາໃດ ແລະ ພູດ່າພໍ່ ຍັງປະກົດມີສັດປ່າ ຈຳນວນໜຶ່ງ ແຕ່ເຂດດັ່ງກ່າວ ແມ່ນຢູ່ນອກໂຄງການ. ດັ່ງນັ້ນ ຈຶ່ງຄາດວ່າ ໂຄງການ ຈະບໍ່ສົ່ງຜົນກະທົບໃດໆ ຕໍ່ກັບສັດປ່າ ກໍຄື ຖິ່ນອາໄສ ຂອງສັດປ່າ.

**ຊັບສິນທີ່ມີຄ່າທາງທຳມະຊາດ, ວັດຖຸບູຮານ, ແຫຼ່ງວັດທະນະທຳ ແລະ ສະຖານທີ່ທ່ອງທ່ຽວ**

ຈາກຜົນການສຳຫຼວດ ໃຫ້ຮູ້ວ່າ ເຂດພັດທະນາໂຄງການ ບໍ່ໄດ້ກວມເອົາ ແຫຼ່ງຊັບສິນທີ່ມີຄ່າ, ແຫຼ່ງວັດທະນະທຳ, ວັດຖຸບູຮານ ແລະ ສະຖານທີ່ທ່ອງທ່ຽວໃດໆ, ແຕ່ກົງກັນຂ້າມ ພາຍຫຼັງ ການກໍ່ສ້າງ ເຂື່ອນສຳເລັດ ເຂດອ່າງນ້ຳ ອາດສາມາດກາຍເປັນແຫຼ່ງທ່ອງທ່ຽວ ທາງທຳມະຊາດ, ຫຼື ບໍ່ກໍກາຍເປັນທ່າແຮງ ໃຫ້ແກ່ປະຊາຊົນ ໃນການດຳເນີນກິດຈະການຕ່າງໆ ເພື່ອພັດທະນາເສດຖະກິດ ຂອງທ້ອງຖິ່ນ ກໍອາດ ເປັນໄດ້.

**ຂ). ຜົນກະທົບ ທາງດ້ານສັງຄົມ**

**ການສູນເສັຍນາເຂົ້າ ແລະ ໄຮ່**

ຢູ່ໃນລະດັບນ້ຳ ໃນໜ້າເຂື່ອນສູງສຸດ 1.100 ແມັດ ເໜືອໜ້ານ້ຳທະເລ, ມີທົ່ງນາເຂົ້າ ທັງໝົດ 50 ເຮັກຕາ ຂອງປະຊາຊົນ ຢູ່ບ້ານຈິມ ຈະຖືກນ້ຳຖວ້ມ ຊຶ່ງເຮັດໃຫ້ປະຊາຊົນ ຈຳນວນ 49 ຄົນ ຈະສູນເສັຍ ທີ່ດິນນາດັ່ງກ່າວ. ເຖິງຢ່າງໃດກໍຕາມ ການປະເມີນມູນຄ່າເວນຄືນ ຕໍ່ກັບການສູນເສັຍດັ່ງກ່າວ ແມ່ນ ໄດ້ກຳນົດແຈ້ງ ຢູ່ໃນຕາຕະລາງ ຕິດຄັດ ທີ 1.

ໃນຂອບເຂດຂອງອ່າງ ມີໄຮ່ ຢູ່ປະມານ 1 ເຮັກຕາເທົ່ານັ້ນ ທີ່ຈະຖືກນ້ຳຖວ້ມ ທັງນີ້ ກໍຍອ້ນວ່າ ໄຮ່ຂອງປະຊາຊົນ ສ່ວນໃຫຍ່ ຈະຕັ້ງຢູ່ໃນເຂດເນີນສູງ ຍັງຍາຍຢູ່ຕາມເປັນພູ ຊຶ່ງມີລະດັບຄວາມສູງ ເໜືອ ກວ່າ ລະດັບສູງສຸດ ທີ່ນ້ຳຈະຖວ້ມ. ສະນັ້ນ ຈຶ່ງເຮັດໃຫ້ຜົນກະທົບຕໍ່ປະເພດການນຳໃຊ້ທີ່ດິນດັ່ງກ່າວ ມີໜ້ອຍ ຫຼື ອາດເວົ້າໄດ້ວ່າ ບໍ່ມີເລີຍ.

**ການສູນເສັຍ ທີ່ພັກພາອາໄສ ແລະ ສິ່ງປຸກສ້າງອື່ນໆ**

ຈາກຜົນການສຳຫຼວດ ຊື່ໃຫ້ເຫັນວ່າ ບໍ່ມີເຮືອນຊານ, ທີ່ພັກພາອາໄສ ແລະ ສິ່ງປຸກສ້າງໃດໆ ທີ່ຈະ ໄດ້ຮັບຜົນກະທົບ ຈາກໂຄງການ, ເນື່ອງຈາກວ່າ ບ້ານຂອງປະຊາຊົນສ່ວນຫຼາຍ ແມ່ນຕັ້ງຢູ່ຫ່າງໄກ ຈາກເຂດ ໂຄງການ ມີພຽງແຕ່ບ້ານຈິມ ບ້ານດຽວເທົ່ານັ້ນ ທີ່ຕັ້ງຢູ່ແຄມນ້ຳຊູດ ແຕ່ກໍຕັ້ງຢູ່ໃນລະດັບຄວາມສູງທີ່ປອດໄພ. ດັ່ງນັ້ນ ຈຶ່ງບໍ່ມີການຍົກຍ້າຍ ຈັດສັນໃດໆ ສຳລັບໂຄງການນີ້, ຍົກເວັ້ນ ແຕ່ ປະຊາຊົນ ຈຳນວນ 03 ຄອບຄົວ ທີ່ນາຂອງເຂົາເຈົ້າ ຈະຖືກນ້ຳຖວ້ມ ຈະຂໍຍົກຍ້າຍໄປຕັ້ງຖິ່ນຖານໃໝ່, ສອງຄອບຄົວ ຂໍຍ້າຍໄປຢູ່ ເມືອງພູຄູນ ແລະ ໜຶ່ງຄອບຄົວ ຂໍຍ້າຍໄປຢູ່ຫຼວງພະບາງ ຊຶ່ງຂໍໃຫ້ທາງໂຄງການຊ່ວຍເຫຼືອ ໃນການຍົກຍ້າຍ, ແຕ່ສະຖານທີ່ ບ່ອນໃໝ່ ແມ່ນເຂົາເຈົ້າຈະເປັນຜູ້ຈັດສັນເອົາເອງ (ລາຍລະອຽດ ເບິ່ງໃນເອກະສານ ຕາຕະລາງຕິດຄັດ).

**5.1.2. ສຳລັບເຂດອ່າງເກັບນ້ຳຕອນເທິງ ຂອງເຂື່ອນ**

**ກ). ການເຊາະເຈື່ອນ ໃນເຂດອ່າງໂຕ່ງ**

ເນື່ອງຈາກວ່າ ປ່າໄມ້ ໃນເຂດອ່າງໂຕ່ງ ສ່ວນໃຫຍ່ ຖືກທຳລາຍ ດັ່ງນັ້ນ ຈຶ່ງເຮັດໃຫ້ ສ່ວນເທິງ ຂອງເຂດອ່າງໂຕ່ງ ມີການປ່ຽນແປງ ຈາກສະພາບ ທີ່ເຄີຍເປັນປ່າໄມ້ທີ່ອຸດົມສົມບູນ ໄດ້ກາຍມາເປັນປ່າເຫຼົ້າ, ປ່າຊຸດໂຊມ ແລະ ທົ່ງຫຍ້າ ອັນເນື່ອງມາຈາກຫຼາຍສາເຫດ ຄືດັ່ງໄດ້ເວົ້າມາຂ້າງເທິງນັ້ນ, ຈະຍັງເຫຼືອຢູ່ ກໍເປັນພຽງແຕ່ປ່າປະສົມ ທີ່ພື້ນພູຄືນ ໃນບາງບ່ອນ ໂດຍສະເພາະ ໃນເຂດທີ່ມີຄວາມຄອ້ຍຊັນສູງ ຊຶ່ງຍາກ ແກ່ການບຸກເບີກເທົ່ານັ້ນ. ສະນັ້ນ ໃນເຂດດັ່ງກ່າວ ຈຶ່ງຂອ້ນຂ້າງ່າຍ ທີ່ຈະເກີດມີການເຊາະເຈື່ອນດິນ ໃນລະດູຝົນ ໂດຍສະເພາະ ໃນເຂດທີ່ມີຄວາມຄອ້ຍຊັນສູງ. ແຕ່ເຖິງຢ່າງໃດກໍຕາມ ອີງຕາມຂໍ້ມູນປະລິມານ

ນ້ຳຝົນ ໃນເຂດດັ່ງກ່າວແລ້ວ ເຫັນວ່າ ໃນຊ່ວງເດືອນ 6 ຫາ ເດືອນ 8, ປະລິມານນ້ຳຝົນ ຢູ່ໃນ ສອງແຂວງ; ຫຼວງພະບາງ ແລະ ຫຼວງຂວາງ ແມ່ນຢູ່ໃນລະດັບສະເລ່ຍແຕ່ 200 ມມ ຫາ 400 ມມ ຊຶ່ງເຫັນວ່າຢູ່ໃນລະດັບ ປານກາງ, ແລະ ອີກປະການໜຶ່ງ ເຖິງວ່າເຂດອ່າງໂຕ່ງສ່ວນໃຫຍ່ ຈະເປັນທົ່ງຫຍ້າ ແຕ່ກໍຍັງມີຈຳພວກ ໄມ້ພຸ່ມ ແລະ ປ່າຕໍ່າປະປົນຢູ່, ຈຶ່ງຄາດວ່າ ການເຊາະເຈື່ອນ ຈະບໍ່ຮຸນແຮງປານໃດ, ຍົກເວັ້ນ ໃນກໍລະນີ ຖ້າຫາກວ່າ ປະຊາກອນ ໃນເຂດດັ່ງກ່າວ ຫາກເພີ່ມຂຶ້ນ ໂດຍການຍ້າຍຖິ່ນຖານເຂົ້າມາ, ຊຶ່ງການບຸກລຸກ ປ່າໄມ້ ເພື່ອທຳການຜະລິດ ຫາກເພີ່ມຂຶ້ນ ກໍອາດຈະເຮັດໃຫ້ອັດຕາການເຊາະເຈື່ອນດິນ ແລະ ການຕົກ ຕະກອນ ໃນເຂດດັ່ງກ່າວ ເພີ່ມຂຶ້ນ.

### 5.1.3. ການສູນເສັຍ ແລະ ຜົນກະທົບ ເນື່ອງຈາກທີ່ຕັ້ງ ແລະ ໂຄງປະກອບສ້າງຕ່າງໆ ຂອງໂຄງການ

#### ກ). ເຂດສ້າງເຂື່ອນ ແລະ ເຂດອ່າງເກັບນ້ຳ

ຄືດັ່ງທີ່ໄດ້ເວົ້າມາຂ້າງເທິງນັ້ນ, ມີເນື້ອທີ່ປ່າໄມ້ທັງໝົດ ໃນເຂດເຂື່ອນ ແລະ ເຂດອ່າງເກັບນ້ຳ ປະມານ 616 ເຮັກຕາ ທີ່ຈະຖືກນຳຖວ້ມ, ໃນນັ້ນ ມີປ່າປະສົມ ປະມານ 53 ເຮັກຕາ ແລະ ປ່າເຫຼົ້າ ແລະ ປ່າພຸ່ມ ທີ່ເປັນປ່າຊຸດໂຊມ ປະມານ 563 ເຮັກຕາ. ໃນເຂດທີ່ຍັງມີປ່າ ໂດຍສະເພາະ ໃນເຂດປ່າປະສົມ ຊະນິດໄມ້ສ່ວນໃຫຍ່ ທີ່ມີຄຸນຄ່າທາງ ດ້ານການຄ້າ ແມ່ນໄດ້ຖືກຊຸດຄົ້ນແລ້ວ ຍັງເຫຼືອແຕ່ໄມ້ບາງຊະນິດ ທີ່ເປັນໄມ້ນ້ອຍ ປະເພດໄມ້ເນື້ອອ່ອນ ຄືດັ່ງໄດ້ຍົກຂຶ້ນ ໃນຂໍ້ ກ ຂອງ 5.1.1.

#### ຂ). ເຂດກໍ່ສ້າງເຮືອນຈັກ (Powerhouse)

ອີງຕາມຜົນການສຳຫຼວດ ໃນເຂດດັ່ງກ່າວນີ້, ຄາດວ່າ ມີປ່າໄມ້ ທີ່ເປັນປ່າດົງດິບ (Evergreen Forest) ແລະ ປ່າປະສົມ (Mixed Deciduous Forest) ປະມານ 5 ເຮັກຕາ ຈະໄດ້ຮັບຜົນກະທົບ ຈາກການບຸກເບີກ. ໃນເຂດປ່າດັ່ງກ່າວ ຍັງມີຊະນິດພັນໄມ້ ທີ່ມີຄຸນຄ່າທາງດ້ານການຄ້າ ເຊັ່ນ: ໄມ້ໂລ່ງ ເລ່ງ, ໄມ້ຮື້ງ, ໄມ້ກໍ່ຂີ້ໝູ, ໄມ້ສີໄຄຕົ້ນ, ໄມ້ດູ່ຜ້າຍ, ໄມ້ເປືອຍດົງ, ໄມ້ຍົມຫິນ/ຍົມຜາ, ໄມ້ກວາງແດງ, ໄມ້ຍານ, ໄມ້ສົງ, ໄມ້ລາງຈິກ, ໄມ້ຊາຍ. ໄມ້ຈຳນວນດັ່ງກ່າວນີ້ ແມ່ນມີໜ້າຕ້າງ ສະເລ່ຍ ແຕ່ 40 ຫາ 80 ຊັງຕີແມັດ. ເຖິງຢ່າງໃດກໍຕາມ ປ່າໄມ້ໃນເຂດດັ່ງກ່າວ ບໍ່ໄດ້ຖືກຈັດ ຫຼື ນອນໃນເປັນປ່າສະຫງວນ, ປ່າປອ້ງກັນ ແລະ ປ່າຜະລິດ.

#### ຄ). ເສັ້ນທາງຈາກທາງເລກ 7 ເຂົ້າສູ່ຕົວເຂື່ອນ (Dam Dite)

ການກໍ່ສ້າງເສັ້ນທາງ ຈາກ ເສັ້ນທາງເລກ 7 ເຂົ້າສູ່ຕົວເຂື່ອນ (ອີງຕາມ ຜົນການສຶກ ສາຄວາມເປັນ ໄປໄດ້ ຂອງບໍລິສັດ Energy Equity Corporation Ltd. ໃນເດືອນ 2, 1997) ແມ່ນຖືກຄັດເລືອກ ແລະ ກຳນົດລຽບໄປຕາມນ້ຳພັດ ລົງມາທາງທິດໃຕ້ ຊຶ່ງມີລວງຍາວປະມານ 20 ກິໂລແມັດ. ການກໍ່ສ້າງເສັ້ນທາງ ດັ່ງກ່າວ ຈະເປັນເສັ້ນທາງຖາວອນ ຊຶ່ງຈະກວມເອົາ ທີ່ດິນແຕ່ລະປະເພດ ຄື: ທົ່ງຫຍ້າ ປະມານ 26 ເຮັກຕາ ແລະ ເປັນປ່າເຫຼົ້າ ປະມານ 1,5 ເຮັກຕາ (ເບິ່ງຮູບພາບ ທີ່ຕິດຄັດ).

#### ງ). ເສັ້ນທາງຈາກຕົວເຂື່ອນ ເຂົ້າສູ່ເຮືອນຈັກ (Powerhouse)

ເນື່ອງຈາກວ່າປ່າໄມ້ ໃນເຂດແຕ່ ເຂື່ອນ ໄປຫາ ເຂດກໍ່ສ້າງເຮືອນຈັກ ຍັງຂອ້ນຂ້າງອຸດົມສົມບູນ ດັ່ງນັ້ນ ການກໍ່ສ້າງເສັ້ນທາງ ແຕ່ ແຕ່ຕົວເຂື່ອນ ໄປຫາ ເຂດກໍ່ສ້າງເຮືອນຈັກ ຊຶ່ງເປັນເສັ້ນທາງຖາວອນ

ທີ່ມີລວງຍາວປະມານ 14 ກິໂລແມັດ ຈະກວມເອົາ ແລະ ສິ່ງຜົນກະທົບເລັກນ້ອຍ ຕໍ່ປ່າໄມ້ ທັງໝົດ ປະມານ 18 ເຮັກຕາ ໃນນັ້ນ ມີ: ປ່າດົງດິບ ປະມານ 9 ເຮັກຕາ, ປ່າປະສົມ ປະມານ 2 ເຮັກຕາ ແລະ ປ່າເຫຼົ່າ/ປ່າພຸ່ມຊຸດໂຊມ ປະມານ 7 ເຮັກຕາ. ບັນດາຊະນິດພັນໄມ້ ສ່ວນໃຫຍ່ ໃນເຂດດັ່ງກ່າວ ຈະເປັນໄມ້ເນື້ອອ່ອນ ຊຶ່ງມີບາງຊະນິດທີ່ມີຄຸນຄ່າທາງດ້ານການຄ້າ ດັ່ງທີ່ໄດ້ຍົກໃຫ້ເຫັນ ໃນຂໍ້ 2, 5.1.3 ເທິງນີ້.

ເຖິງຢ່າງໃດກໍຕາມ ກ່ອນທີ່ຈະດຳເນີນໂຄງການ ຈະຕ້ອງໄດ້ດຳເນີນການສຳຫຼວດລະອຽດ ເພື່ອກຳ ນົດຂອບເຂດ ແລະ ເກັບກຳຂໍ້ມູນຊະນິດພັນໄມ້ ແລະ ປະເມີນບໍລິມາດໄມ້ຢືນຕົ້ນ ໂດຍສະເພາະ ໃນເຂດ ທີ່ຈະກໍ່ສ້າງເຮືອນຈັກ ຊຶ່ງວຽກງານ ດັ່ງກ່າວ ແມ່ນຢູ່ພາຍໃຕ້ຄວາມຮັບຜິດຊອບ ຂອງກົມປ່າໄມ້ ຮ່ວມກັບ ຂະແໜງປ່າໄມ້ແຂວງ ແລະ ປ່າໄມ້ເມືອງ ທີ່ໂຄງການຕັ້ງຢູ່. ພາຍຫຼັງໄດ້ຮັບອະນຸຍາດຈາກລັດຖະບານ ໂດຍການນຳສະເໜີ ຂອງ ຂະແໜງການ ທີ່ກ່ຽວຂ້ອງແລ້ວ ຈຶ່ງຈະສາມາດ ດຳເນີນການຂຸດຄົ້ນໄດ້. ການຂຸດຄົ້ນ ຈະຕ້ອງປະຕິບັດ ຕາມລະບຽບ ການທີ່ກ່ຽວຂ້ອງ ຢ່າງເຂັ້ມງວດ. ເຈົ້າຂອງໂຄງການ ຫຼື ບໍລິສັດກໍ່ສ້າງ ທີ່ໄດ້ຮັບອະນຸຍາດຈາກເຈົ້າຂອງໂຄງການ ຈະຕ້ອງໄດ້ຈ່າຍຄ່າສິ້ນເປືອງຕ່າງໆ ທັງໝົດ ໃນການດຳເນີນການສຳຫຼວດ. ການຂາຍໄມ້ ທີ່ຂຸດຄົ້ນອອກ ຈາກເຂດກໍ່ສ້າງເຂື່ອນ ຈະຕ້ອງເປັນໄປຕາມ ລະບຽບ ຫຼັກການ ທີ່ກ່ຽວຂ້ອງ. ໃນເຂດທີ່ມີການບຸກເບີກ ແລະ ກໍ່ສ້າງຊົ່ວຄາວ ເຊັ່ນ: ທາງຊອຍ, ທີ່ພັກ ກຳມະກອນ, ສະຖານທີ່ເກັບມ້ຽນວັດຖຸອຸປະກອນຕ່າງໆ ຈະຕ້ອງ ໄດ້ຮັບການຟື້ນຟູຄືນ ພາຍຫຼັງທີ່ການ ກໍ່ສ້າງ ສຳເລັດ ໂດຍແມ່ນເຈົ້າຂອງໂຄງການ ຈະເປັນຜູ້ຮັບຜິດຊອບ ທັງໝົດ.

ກ່ອນດຳເນີນການກໍ່ສ້າງ, ຈຳເປັນຈະຕ້ອງ ໄດ້ຂຸດຄົ້ນໄມ້ ໃນເຂດດັ່ງກ່າວ ທັງໝົດ ອອກ, ໃນໄລຍະ ດຳເນີນການຂຸດຄົ້ນໄມ້, ວຽກງານການຄຸ້ມຄອງ ກວດກາ ແລະ ຕິດຕາມ ການຂຸດຄົ້ນ ແລະ ລາກແກ່ໄມ້ ແມ່ນຄວາມຮັບຜິດຊອບ ຂອງຂະແໜງປ່າໄມ້ແຂວງ ແລະ ປ່າໄມ້ເມືອງ. ສຳລັບການຄຸ້ມຄອງ ຕິດຕາມ ແລະ ກວດກາ ການດຳເນີນກິດຈະການອື່ນໆ ທີ່ຕິດພັນກັບວຽກງານ ສິ່ງແວດລ້ອມ ແລະ ສັງຄົມ ໃນເຂດໂຄງການ ແມ່ນນອນຢູ່ໃນຄວາມຮັບຜິດຊອບ ຂອງ ຄະນະກຳມະການ ແລະ ການກວດກາ ຂອງອົງການເອກະລາດ. ການປະຕິບັດ ລະບຽບກົດໝາຍ ກ່ຽວກັບຂໍ້ຫ້າມ ໃນການບຸກລຸກ ທຳລາຍປ່າໄມ້, ຊັບພະຍາກອນປ່າໄມ້, ສັດປ່າ ແລະ ສັດນ້ຳ ລວມທັງສິ່ງແວດລ້ອມ ຈະຕ້ອງຖືກບັງຄັບໃຊ້ຢ່າງເຂັ້ມງວດ. ເຈົ້າຂອງໂຄງການ ຈະເປັນຜູ້ຮັບຜິດຊອບ ໃນການເຜີຍແຜ່ ກົດໝາຍ ແລະ ລະບຽບການຕ່າງໆ ທັງໝົດ ທີ່ກ່ຽວຂ້ອງ ໃນໄລຍະການກໍ່ສ້າງໂຄງການ ຊຶ່ງບາງມາດຕະການທີ່ສຳຄັນ ຈະຕ້ອງໄດ້ລະບຸໄວ້ຢ່າງຈະແຈ້ງ ໃນສັນຍາ ລະຫວ່າງເຈົ້າຂອງໂຄງການ ແລະ ຜູ້ຮັບເໝົາກໍ່ສ້າງ.

**5.1.4. ການນຳໃຊ້ທີ່ດິນ ແລະ ການຍົກຍ້າຍ ຈັດສັນ**

ຈຳນວນທີ່ດິນ ທີ່ເປັນນາຂອງປະຊາຊົນ ທັງໝົດ ທີ່ຈະໄດ້ຮັບຜົນກະທົບ ແມ່ນປະມານ 50 ເຮັກຕາ ຊຶ່ງຂຶ້ນກັບປະຊາຊົນ ຈຳນວນ 49 ຄອບຄົວ ໃນບ້ານຈິມ, ຊຶ່ງຕໍ່ກັບຜົນເສັຽຫາຍດັ່ງກ່າວ ແມ່ນຈະໄດ້ຮັບການ ຊົດເຊີຍ ຢ່າງສົມບາດ ສົມຜົນ. ຫຼັກການຟື້ນຖານ ໃນການເວນຄືນ ຕໍ່ກັບຜົນເສັຽຫາຍດັ່ງກ່າວ ແມ່ນ ເຈົ້າຂອງ ຜູ້ໄດ້ຮັບຜົນກະທົບ ຈະສະເໜີທາງເລືອກເອງ ຊຶ່ງອາດຈະເປັນ ເງິນສົດ ຕາມມູນຄ່າທຽບເທົ່າ, ເປັນທີ່ດິນ, ໂດຍການຈັດສັນທີ່ດິນ ຢູ່ເຂດອື່ນໆທົດແທນ ຫຼື ເປັນວັດຖຸສິ່ງຂອງ ຕາມມູນຄ່າເທົ່າທຽມກັນ. ບົດຮຽນ ຈາກຫຼາຍໆໂຄງການ ໃນໄລຍະຜ່ານມາ ແມ່ນ ປະຊາຊົນຜູ້ໄດ້ຮັບຜົນກະທົບສ່ວນໃຫຍ່ ແມ່ນ ສະເໜີຂໍທົດແທນ ເປັນທີ່ດິນ ໂດຍການຈັດສັນທີ່ດິນທຳກິນ ຢູ່ເຂດອື່ນໆ ທີ່ເໝາະສົມໃຫ້ໃໝ່. ໃນກໍລະນີ



ຂອງໂຄງການນີ້ຈຶ່ງມີ 5, ປະຊາຊົນສ່ວນໃຫຍ່ ໃນຈຳນວນ 49 ຄອບຄົວ ທີ່ໄດ້ຮັບຜົນກະທົບ ສະເໜີ ຂໍການທົດແທນເປັນ ຄວາຍ ຫຼື ງົວ ຕາມມູນຄ່າເທົ່າທຽມ. ມີພຽງແຕ່ 3 ຄອບຄົວ ທີ່ມີຈຸດປະສົງ ຢາກ ຍົກຍ້າຍ ໄປດຳລົງຊີວິດ ຢູ່ເຂດອື່ນ ໂດຍສະເໜີໃຫ້ໂຄງການຊ່ວຍເຫຼືອ ໃນການຍົກຍ້າຍ ແລະ ສະໜອງ ເຂົ້າກິນໃຫ້ພຽງພໍ ໃນ 03 ປີທຳອິດ. ໃນຈຳນວນ 3 ຄອບຄົວນັ້ນ, 2 ຄອບຄົວ ສະເໜີຂໍຍົກຍ້າຍ ໄປຢູ່ ເມືອງພູຄູນ ແລະ ໜຶ່ງຄອບຄົວ ສະເໜີຍົກຍ້າຍໄປ ເມືອງຫຼວງພະບາງ. ໃນເຂດໂຄງການ ແມ່ນບໍ່ມີເຮືອນ ຊານ ແລະ ສິ່ງປຸກສ້າງໃດໆ ທີ່ຈະໄດ້ຮັບ ຜົນກະທົບ, ສະນັ້ນ ຈຶ່ງບໍ່ມີການຍົກຍ້າຍຈັດສັນ ນອກຈາກ 3 ຄອບຄົວ ຄືດັ່ງທີ່ກ່າວມານັ້ນ.

## 5.2. ຜົນກະທົບ ໃນໄລຍະການກໍ່ສ້າງໂຄງການ

### 5.2.1. ຜົນກະທົບຕໍ່ກັບ ລະບົບຊີວະວິທະຍາ

#### ກ). ຜົນກະທົບ ຕໍ່ກັບຊັບພະຍາກອນນ້ຳ ແລະ ສັດນ້ຳ

ໃນໄລຍະການກໍ່ສ້າງໂຄງການ ຖືເປັນໄລຍະທີ່ສຳຄັນທີ່ສຸດ ຊຶ່ງອາດກໍ່ໃຫ້ເກີດຜົນກະທົບ ຕໍ່ກັບ ຊັບພະຍາກອນນ້ຳ ລວມທັງ ສັດນ້ຳ ແລະ ສິ່ງທີ່ມີຊີວິດໃນນ້ຳ ເນື່ອງຈາກການປ່ຽນແປງ ຂອງຄຸນນະພາບ ຂອງນ້ຳ ຍ້ອນການເຊາະເຈື່ອນດິນ ສາເຫດມາຈາກການບຸກເບີກ ແລະ ດັດປັບພື້ນທີ່, ການຂຸດເຈາະ ແລະ ການຖິ້ມດິນ ອື່ນໆ. ບັນຫາດັ່ງກ່າວນີ້ ອາດວ່າຈະມີຜົນກະທົບທີ່ຮ້າຍແຮງ ພຽງແຕ່ໃນໄລຍະສັ້ນ ໂດຍສະ ເພາະ ໃນລະດູຝົນເທົ່ານັ້ນ, ສຳລັບລະດູແລ້ງ ອາດຈະບໍ່ສົ່ງຜົນກະທົບທີ່ຮ້າຍແຮງພໍປານໃດ. ເຖິງຢ່າງໃດ ກໍຕາມ ເພື່ອຫຼຸດຜ່ອນຜົນກະທົບທີ່ອາດເກີດຂຶ້ນ ຕໍ່ກັບຊັບພະຍາກອນນ້ຳ ແລະ ສັດນ້ຳ, ການດຳເນີນ ກິດຈະການກໍ່ສ້າງຕ່າງໆ ທີ່ສຳຄັນ ທີ່ອາດຈະສົ່ງຜົນກະທົບຮ້າຍແຮງ ຈະຕ້ອງໄດ້ດຳເນີນສະເພາະ ແຕ່ໃນ ລະດູແລ້ງເທົ່ານັ້ນ. ຄຽງຄູ່ກັນນັ້ນ ການຄວບຄຸມ ການຮົ່ວໄຫຼ ຂອງນ້ຳມັນ, ທາດເຄມີ (ຖ້ຳມີ) ແລະ ສິ່ງເສດເຫຼືອອື່ນໆ ຈະຕ້ອງເປັນໄປຕາມລະບຽບຫຼັກການຢ່າງເຂັ້ມງວດ.

#### ຂ). ຜົນກະທົບ ຕໍ່ກັບສັດປ່າ ແລະ ທີ່ຢູ່ອາໄສ ຂອງສັດປ່າ

ເນື່ອງຈາກວ່າ ປ່າໄມ້ ທີ່ເປັນປ່າດົງດິບ ແລະ ເປັນທີ່ຢູ່ອາໄສຂອງສັດປ່າຈຳນວນໜຶ່ງ (ເຊັ່ນ: ໝູ່ປ່າ, ງູເຫຼືອມ, ແລນ, ເຕົ້າ, ນົກຂວາ, ໄກ່ປ່າ ແລະ ນົກບາງຊະນິດ) ປະມານ 18 ເຮັກຕາ ໃນເຂດກໍ່ສ້າງ ເຮືອນຈັກ ແລະ ເສັ້ນທາງຈາກເຂື່ອນ ເຂົ້າໄປຫາເຮືອນຈັກ ຈະຖືກບຸກເບີກ ດັ່ງນັ້ນ ຈຶ່ງອາດຈະສົ່ງຜົນກະທົບ ເລັກນ້ອຍ ຕໍ່ກັບເຂດທີ່ຢູ່ອາໄສຂອງສັດປ່າ, ເຖິງວ່າເຂດດັ່ງກ່າວ ຈະບໍ່ປະກົດມີ ສັດປ່າທີ່ມີຄຸນຄ່າສູງກໍຕາມ, ແຕ່ເຂດດັ່ງກ່າວ ກໍເປັນທາງທຽວຂອງສັດປ່າ ລະຫວ່າງ ເຂດພູສູງ ລົງສູ່ ແມ່ນ້ຳຈຶ່ງມ, ດັ່ງນັ້ນ ສັດປ່າ ໃນເຂດໃກ້ຄຽງ ກໍຈະໄດ້ຮັບຜົນກະທົບ ຈາກສຽງຂອງເຄື່ອງຈັກ ໃນເວລາ ດຳເນີນການ ກໍ່ສ້າງ ເຊັ່ນດຽວກັນ. ເພື່ອຫຼຸດຜ່ອນຜົນກະທົບດັ່ງກ່າວ, ການປະຕິບັດ ລະບຽບກົດໝາຍ ກ່ຽວກັບ ຂໍ້ຫ້າມ ໃນການບຸກລຸກ ທຳລາຍປ່າໄມ້ ທີ່ເປັນທີ່ຢູ່ອາໄສຂອງ ສັດປ່າ ຢູ່ນອກເຂດໂຄງການ ທີ່ບໍ່ໄດ້ຮັບ ອະນຸຍາດ ຈະຕ້ອງ ຖືກບັງຄັບໃຊ້ ຢ່າງເຂັ້ມງວດ. ເຈົ້າຂອງໂຄງການ ສົມທົບກັບຜູ້ຮັບເໝົາກໍ່ສ້າງ ຈະເປັນຜູ້ ຮັບຜິດຊອບ ໃນການເຜີຍແຜ່ ກົດໝາຍ ແລະ ລະບຽບການຕ່າງໆ ທີ່ກ່ຽວຂ້ອງ ທັງໝົດ, ບາງມາດຕະການທີ່ສຳຄັນ ຈະຕ້ອງໄດ້ລະບຸໄວ້ຢ່າງຈະແຈ້ງ ໃນສັນຍາ ລະຫວ່າງ ເຈົ້າຂອງໂຄງການ ແລະ ຜູ້ຮັບເໝົາກໍ່ສ້າງ ເຊັ່ນ: ການກຳນົດເວລາ ໃນການກໍ່ສ້າງ ຊຶ່ງຈະຕ້ອງປະຕິບັດ ສະເພາະ ໃນເວລາ ກາງເວັນ ເທົ່ານັ້ນ.

**ຄ). ສິ່ງເສດເຫຼືອ ຈາກການກໍ່ສ້າງໂຄງການ ແລະ ການກຳຈັດ ສິ່ງເສດເຫຼືອ ດັ່ງກ່າວ**

ການກໍ່ສ້າງໂຄງການ ຄາດວ່າ ຈະກໍ່ໃຫ້ເກີດ ຫຼື ມີການຂຸດເຈາະດິນ ປະມານ 200.000 ແມັດກວ້າງ, ຊຶ່ງຕົ້ນຕໍ ແມ່ນມາຈາກ ການຂຸດເຈາະອຸໂມງໃຕ້ດິນ (Headrace Tunnel) ຊຶ່ງຈະມີທັງດິນ, ຫີນ ແລະ ຊາຍປະປົນກັນຢູ່. ສິ່ງເສດເຫຼືອ ດັ່ງກ່າວນີ້ ຈະກາຍເປັນກອງດິນອັນໃຫຍ່, ແຕ່ເຖິງຢ່າງໃດກໍຕາມ ຈຳນວນ ໜຶ່ງ ອາດສາມາດນຳໃຊ້ເຂົ້າໃນການປັບປຸງ ຫຼື ປັບລະດັບພື້ນທີ່, ຫຼື ໃຊ້ໃນການກໍ່ສ້າງອື່ນໆໃນເຂດໂຄງການ ໂດຍສະເພາະ ສ່ວນທີ່ເປັນຫີນ ແລະ ຊາຍ. ເພື່ອຫຼຸດຜ່ອນຜົນກະທົບ ຈາກບັນຫາດັ່ງກ່າວນີ້ ການກຳນົດ ສະຖານທີ່ຈະເກັບມ້ຽນ ກອງດິນດັ່ງກ່າວໃຫ້ເໝາະສົມ ຈະຕ້ອງໄດ້ຄຳນຶງເຖິງ ບັນຫາສິ່ງແວດລ້ອມ ເຊັ່ນ: ຈະຕ້ອງ ຫຼີ້ລ້ຽງການກອງຕົ້ນທາງນ້ຳ, ກອງໃຫ້ທ່າງໂກແຄມແມ່ນ້ຳ, ກອງໃນເຂດທີ່ບໍ່ມີປ່າໄມ້ (ບໍ່ອະນຸຍາດ ໃຫ້ນຳໃຊ້ ຫຼື ບຸກເບີກ ສະຖານທີ່ຍັງມີປ່າໄມ້ປົກຄຸມ ເພື່ອເປັນສະຖານທີ່ເກັບມ້ຽນ ສິ່ງເສດເຫຼືອ ດັ່ງກ່າວ ທັງໝົດ). ພາຍຫຼັງໂຄງການສຳເລັດ ກອງດິນດັ່ງກ່າວ ຈະຕ້ອງໄດ້ປັບປຸງ ຫຼື ດັດປັບ ໃຫ້ຄືນສູ່ສະພາບເດີມ ຕາມແຜນການຄວບຄຸມ ສິ່ງແວດລ້ອມ (EMP).

**ງ). ເສັ້ນທາງເຂົ້າສູ່ເຂດກໍ່ສ້າງໂຄງການ (Access Roads)**

ໃນການດຳເນີນໂຄງການ ມີຄວາມຈຳເປັນ ຈະຕ້ອງໄດ້ສ້າງເສັ້ນທາງເຂົ້າສູ່ແຕ່ລະເຂດກໍ່ສ້າງ, ໃນນີ້ ມີສອງເສັ້ນທາງ ທີ່ເປັນເສັ້ນທາງທີ່ຈະຖືກນຳໃຊ້ຖາວອນ ຄື: ເສັ້ນທາງ ຈາກ ຖະໜົນເລກ 7 (ສາລາພູຄູນ-- ຊຽງຂວາງ) ເຂົ້າຫາເຂດກໍ່ສ້າງເຂື່ອນ (ປະມານ 20 ກມ) ແລະ ເສັ້ນທາງ ຈາກເຂດກໍ່ສ້າງເຂື່ອນ ເຂົ້າຫາ ເຂດກໍ່ສ້າງເຮືອນຈັກ (ປະມານ 14 ກມ). ເນື່ອງຈາກເຂດດັ່ງກ່າວ ເປັນເຂດພູດອຍ, ມີຄວາມຄອ້ຍຊັນສູງ, ດັ່ງນັ້ນ ການກໍ່ສ້າງເສັ້ນທາງ ຈະເປັນໄປຕາມເສັ້ນລະດັບ (Contour) ແລະ ຈະຕ້ອງມີລະບົບລະບາຍນ້ຳ ຢ່າງພຽງພໍ ທັງນີ້ກໍເພື່ອຫຼຸດຜ່ອນການເຂາະເຈື່ອນດິນ. ເຖິງຢ່າງໃດກໍຕາມ ການກໍ່ສ້າງເສັ້ນທາງ ຈະບໍ່ສົ່ງ ຜົນກະທົບ ໃຫ້ແກ່ຊັບພະຍາກອນປ່າໄມ້ ແລະ ການນຳໃຊ້ທີ່ດິນຫຼາຍປານໃດ ເນື່ອງຈາກວ່າ ເຂດດັ່ງກ່າວ ເປັນປ່າເຫຼົ້າ.

**5.2.2. ຜົນກະທົບ ທາງດ້ານສັງຄົມ**

**ກ). ຜົນກະທົບ ຈາກຂີ້ຝຸ່ນ**

ເນື່ອງຈາກວ່າ ບໍ່ມີບ້ານໃດທີ່ຕັ້ງໃກ້ກັບເຂດກໍ່ສ້າງໂຄງການ ລວມທັງ ເຂດກໍ່ສ້າງເຂື່ອນ, ເຂດກໍ່ສ້າງ ເຮືອນຈັກ, ເຂດກໍ່ສ້າງເສັ້ນທາງ ແລະ ເຂດກໍ່ສ້າງອື່ນໆ, ດັ່ງນັ້ນ ບັນຫາມົນລະພິດ ຫຼື ຜົນກະທົບ ຈາກຂີ້ຝຸ່ນ ຈຶ່ງຖືວ່າ ມີໜ້ອຍ ຫຼື ບໍ່ມີເລີຍ ຕໍ່ປະຊາຊົນ ຢູ່ໃນເຂດໃກ້ຄຽງ ຍົກເວັ້ນ ຜົນກະທົບທີ່ອາດເກີດຂຶ້ນ ຕໍ່ກັບ ກຳມະກອນກໍ່ສ້າງເທົ່ານັ້ນ. ສຳລັບມາດຕະການຫຼຸດຜ່ອນຜົນກະທົບດັ່ງກ່າວ ຕໍ່ກັບກຳມະກອນ ແມ່ນຈະຕ້ອງ ໄດ້ຮັບການ ເອົາໃຈໃສ່ ແລະ ຜູ້ຮັບເໝົາກໍ່ສ້າງໂຄງການ ຈະຕ້ອງມີມາດຕະການທີ່ເໝາະສົມ ເຊັ່ນ: ຈະຕ້ອງ ມີເຄື່ອງປອ້ງກັນ ສຳລັບກຳມະກອນ ຢ່າງພຽງພໍ ແລະ ຕ້ອງໄດ້ໃຊ້ນ້ຳທົດ (ຫີນທາງຂົນສົ່ງ ຫຼື ເຂດກໍ່ສ້າງ ທີ່ຫຼໍ່ແຫຼມ) ເພື່ອຫຼຸດຜ່ອນຂີ້ຝຸ່ນ.

**ຂ). ຜົນກະທົບ ຈາກສຽງ ແລະ ການສັ່ນສະເທືອນ**

ຄືດັ່ງທີ່ກ່າວຂ້າງເທິງນີ້ ໃນເຂດກໍ່ສ້າງໂຄງການ ບໍ່ມີບ້ານໃດທີ່ຕັ້ງໃກ້ກັບເຂດກໍ່ສ້າງໂຄງການ, ດັ່ງນັ້ນ ບັນຫາຜົນກະທົບ ຈາກສຽງ ຫຼື ການສັ່ນສະເທືອນ ຈຶ່ງຖືວ່າ ມີໜ້ອຍ ຫຼື ບໍ່ມີເລີຍ ຕໍ່ປະຊາຊົນ ຢູ່ໃນເຂດ

ໃກ້ຄຽງ ຍົກເວັ້ນ ຜົນກະທົບທີ່ອາດເກີດຂຶ້ນ ຕໍ່ກັບ ກຳມະກອນກໍ່ສ້າງເທົ່ານັ້ນ. ສຳລັບມາດຕະການ ຫຼຸດຜ່ອນ ຜົນກະທົບດັ່ງກ່າວ, ຜູ້ຮັບເໝົາກໍ່ສ້າງໂຄງການ ຈະຕ້ອງມີມາດຕະການທີ່ເໝາະສົມ ເຊັ່ນ: ຈະຕ້ອງມີເຄື່ອງ ປ້ອງກັນສຽງ (ເຄື່ອງອັດຫູ) ສຳລັບກຳມະກອນ ຢ່າງພຽງພໍ. ເຖິງຢ່າງໃດກໍຕາມ ບັນຫາເລື່ອງສຽງ ແລະ ການສັ່ນສະເທືອນ ຈະຕ້ອງໄດ້ຮັບການຄວບຄຸມ ບໍ່ໃຫ້ມີສຽງດັງ ເກີນອັດຕາທີ່ກຳນົດ ຄື: 55 ເດຊິເບວ ສຳລັບກາງເວັນ ແລະ 45 ເດຊິເບວ ສຳລັບກາງຄືນ (ຕາມມາດຖານຂອງທະນາຄານໂລກ) ແລະ ການ ກໍ່ສ້າງ ຈະຕ້ອງດຳເນີນແຕ່ໃນເວລາກາງເວັນເທົ່ານັ້ນ (ແຕ່ 7 ໂມງເຊົ້າ ຫາ 6 ໂມງແລງ).

**ຄ). ບັນຫາທາງດ້ານສຸຂະພາບ ແລະ ຄວາມປອດໄພ**

ເພື່ອຮັກສາສຸຂະພາບ ແລະ ຄວາມປອດໄພຂອງກຳມະກອນ, ຜູ້ຮັບເໝົາກໍ່ສ້າງ ຈະຕ້ອງໄດ້ກະກຽມ ແຜນປ້ອງກັນສຸຂະພາບ ແລະ ຄວາມປອດໄພຂອງກຳມະກອນ ໃນນັ້ນ ອາດກວມເອົາ ການຝຶກອົບຮົມ ປ້ອງກັນພະຍາດຕິດແປດ ແລະ ບັນຫາກ່ຽວກັບລູກລະເບີດທີ່ບໍ່ທັນແຕກ (UXO). ຜູ້ຮັບເໝົາກໍ່ສ້າງ ຈະຕ້ອງໄດ້ວ່າຈ້າງ ຊ່ຽວຊານທາງດ້ານການສຳຫຼວດ ແລະ ເກັບກູ້ ລູກລະເບີດ ເພື່ອດຳເນີນການສຳຫຼວດ ແລະ ເກັບກູ້ (ຖ້າພົບເຫັນ), ທັງນີ້ ກໍ່ເພື່ອຮັບປະກັນຄວາມປອດໄພ ໃຫ້ແກ່ ຊີວິດ ແລະ ຊັບສິນ ຂອງທຸກພາກສ່ວນ ລວມທັງ ເຈົ້າຂອງໂຄງການ, ຜູ້ຮັບເໝົາກໍ່ສ້າງ ແລະ ປະຊາຊົນ.

ສຳລັບປະຊາຊົນໃນເຂດທ້ອງຖິ່ນໃກ້ຄຽງ ບັນຫາທີ່ມີຄວາມສ່ຽງ ສວນໃຫຍ່ ທີ່ຈະຕ້ອງໄດ້ເອົາໃຈໃສ່ ແມ່ນ ອຸປະຕິເຫດ ຈາກການຂົນສົ່ງ ວັດຖຸອຸປະກອນ ໃນໄລຍະການກໍ່ສ້າງ ໂດຍສະເພາະ ໃນເຂດພູດອຍ ຊຶ່ງມີຫົນທາງທີ່ແຄບ ແລະ ຄິດລ້ຽວ ບໍ່ວ່າ ໃນຫົນທາງເສັ້ນສຳຄັນ ຄື ທາງ 13 ເໜືອ ແລະ ທາງເລກ 7 ກໍ່ຄື ເສັ້ນທາງຊອຍ ເຂົ້າຫາເຂດກໍ່ສ້າງໂຄງການ ຊຶ່ງຜູ້ທີ່ມີຄວາມສ່ຽງສູງກວ່າໝູ່ ແມ່ນເດັກນ້ອຍ. ບັນຫາ ຜົນກະທົບ, ຄວາມສ່ຽງ ແລະ ອຸປະຕິເຫດ ສ່ວນໃຫຍ່ ທີ່ຜູ້ຮັບເໝົາກໍ່ສ້າງ ຈະຕ້ອງໄດ້ເອົາໃຈໃສ່ ແມ່ນ ມີສາເຫດ ເກີດມາຈາກ:

- ການສະໜອງລະບົບສຸຂະອະນາໄມ ໃນເຂດທີ່ພັກ ຂອງກຳມະກອນ ບໍ່ພຽງພໍ ຊຶ່ງພາໃຫ້ເກີດພະຍາດ ຕິດແປດ.
- ກຳມະກອນ ເຄີຍເປັນພະຍາດຕິດແປດ ໂດຍບໍ່ໄດ້ຮັບການກວດເຊັກ ຢ່າງລະອຽດ ລວມທັງ ບັນຫາ ໄພສັງຄົມ ແລະ ພະຍາດຕິດຕໍ່ທາງເພດ.
- ກຳມະກອນບໍ່ມີເຄື່ອງປ້ອງກັນໄພແຮງງານ ຢ່າງພຽງພໍ ເຊັ່ນ: ໝວກ, ເກັບ, ຖົງມື, ເຄື່ອງປ້ອງກັນແສງ, ສຽງ ແລະ ຂີ້ຝຸ່ນ ແລະ ອື່ນໆ ທີ່ຈຳເປັນ.
- ກຳມະກອນບໍ່ໄດ້ຮັບການຝຶກອົບຮົມ ໃນການປ້ອງກັນອຸປະຕິເຫດ ຢ່າງພຽງພໍ ຫຼື ບໍ່ປະຕິບັດ ຕາມຫຼັກ ວິຊາການ.
- ເຄື່ອງຈັກ ແລະ ເຄື່ອງມື ທີ່ນຳໃຊ້ໃນການກໍ່ສ້າງ ລວມທັງພະຫານະຂົນສົ່ງ ວັດຖຸກໍ່ສ້າງ ບໍ່ຮັບປະກັນ ຄຸນນະພາບ.
- ການບັນທຸກນ້ຳໜັກເກີນ ຂອງລົດຂົນສົ່ງວັດຖຸກໍ່ສ້າງ ແລະ ແລ່ນເກີນຄວາມໄວທີ່ກຳນົດ.
- ລົດຂົນສົ່ງວັດຖຸກໍ່ສ້າງ ໂດຍສະເພາະ ວັດຖຸທີ່ມີຄວາມຍາວ, ມີຄວາມກວ້າງ ເກີນກວ່າປົກກະຕິ ແຕ່ບໍ່ມີ ເຄື່ອງໝາຍ.
- ການລ່ວງລະເມີດ ຮີດຄອງປະເພນີ, ສິ່ງສັກສິດ ທີ່ເປັນທີ່ເຊື່ອຖື ຂອງປະຊາຊົນບັນດາເຜົ່າ.

- ການກວດກາ ລູກລະເບີດຕົກຄ້າງບໍ່ລະອຽດ ແລະ ເກັບກູ້ບໍ່ໝົດ.

**5.2.3. ຜົນກະທົບ ທາງດ້ານເສດຖະກິດ**

**5.2.3.1. ຜົນກະທົບ ທາງດ້ານເສດຖະກິດ ຕໍ່ກັບປະຊາຊົນທ້ອງຖິ່ນ**

ກ). ໂອກາດໃນການສ້າງວຽກເຮັດງານທຳ ແລະ ການຄ້າຂາຍ

ເຖິງວ່າປະຊາຊົນຈຳນວນໜຶ່ງ ຈະໄດ້ຮັບຜົນກະທົບທາງດ້ານລົບ ຈາກໂຄງການ ເຊັ່ນ: ການສູນເສັຍ ໄຮ່ນາ ທີ່ເປັນທີ່ດິນ ທຳກິນ ແຕ່ເມື່ອສົມທຽບໃສ່ ຜົນກະທົບທາງດ້ານບວກ ຈາກໂຄງການແລ້ວ ເຫັນວ່າ ຜົນກະທົບທາງດ້ານລົບ ຕໍ່ເສດຖະກິດ ແມ່ນໜ້ອຍກວ່າ. ໃນໄລຍະການກໍ່ສ້າງໂຄງການ ຊຶ່ງຈະໃຊ້ເວລາ 4 ປີ ມີການຄາດກະວ່າ ຈະໃຊ້ແຮງງານກຳມະການ ປະມານ 100-200 ຄົນ ເພື່ອດຳເນີນກິດຈະກຳຕ່າງໆ ທີ່ແຕກຕ່າງກັນ, ຊຶ່ງນີ້ ຖືເປັນໂອກາດທີ່ດີ ໃນການສ້າງວຽກເຮັດງານທຳ ໃຫ້ແກ່ປະຊາຊົນລາວ ເວົ້າລວມ, ເວົ້າສະເພາະ ປະຊາຊົນ ໃນເຂດໂຄງການ. ໃນນີ້ ບໍ່ສະເພາະ ແຕ່ເປັນກຳມະກອນ ໃນໂຄງການ ແຕ່ຍັງ ສາມາດ ເພີ່ມໂອກາດ ໃນການສ້າງລາຍຮັບ ຈາກການຂາຍ ຜົນຜະລິດກະສິກຳ, ເຄື່ອງປ່າຂອງດົງ ແລະ ຫັດຖະກຳຈັກສານ ອື່ນໆອີກ. ເຖິງຢ່າງໃດກໍຕາມ ເພື່ອເປັນການປະກອບສ່ວນ ສ້າງລາຍຮັບ ໃຫ້ແກ່ປະຊາຊົນທ້ອງຖິ່ນ ເພື່ອແກ້ໄຂຄວາມທຸກຍາກ ໃນລະດັບໃດໜຶ່ງ, ເຈົ້າຂອງໂຄງການ ແລະ ຜູ້ຮັບເໝົາກໍ່ສ້າງ ຄວນພິຈາລະນາ ແລະ ໃຫ້ບຸລິມະສິດ ແກ່ແຮງງານທ້ອງຖິ່ນ ຊຶ່ງບັນຫາດັ່ງກ່າວນີ້ ຄວນໄດ້ກຳນົດແຈ້ງ ຢູ່ໃນ ສັນຍາພັດທະນາ ໂຄງການ.

ຂ). ການເຂົ້າມາຕັ້ງຖິ່ນຖານ, ການປ່ຽນແປງ ແລະ ຄວາມຂັດແຍ່ງ ໃນການນຳໃຊ້ທີ່ດິນ

ບັນຫາການລ່ຽງໄຫຼ ຫຼື ການເຄື່ອນຍ້າຍ ເຂົ້າມາຕັ້ງຖິ່ນຖານໃໝ່ ແລະ ການເຂົ້າມາຈັບຈອງທີ່ດິນ ຂອງປະຊາຊົນຈາກເຂດອື່ນ ເຂົ້າມາໃນເຂດໂຄງການ ຊຶ່ງອາດຈະເຮັດໃຫ້ ມີການປ່ຽນແປງ ການນຳໃຊ້ ທີ່ດິນ, ເກີດຄວາມຂັດແຍ່ງ ໃນການນຳໃຊ້ທີ່ດິນ ແລະ ການບຸກລຸກທຳລາຍປ່າໄມ້ນັ້ນ, ສຳລັບໂຄງການ ນຳຖິ້ມ 5 ເຫັນວ່າ ຈະບໍ່ສົ່ງຜົນກະທົບ ທີ່ຮ້າຍແຮງ ຫຼື ອາດເວົ້າໄດ້ວ່າບໍ່ມີຜົນກະທົບເລີຍ, ເນື່ອງຈາກວ່າ ເຂດໂຄງການ ແມ່ນເປັນເຂດພູດອຍ ຫ່າງໄກ ສອກຫຼີກ ແລະ ເສັ້ນທາງເຂົ້າສູ່ ເຂດດັ່ງກ່າວ ແມ່ນ ຫຍຸ້ງຍາກ, ອີກປະການໜຶ່ງ ທີ່ດິນໃນເຂດດັ່ງກ່າວ ແມ່ນບໍ່ຄ່ອຍເໝາະສົມ ແກ່ການຜະລິດກະສິກຳ ປ່ານໃດ, ດັ່ງນັ້ນ ຈຶ່ງສາມາດເວົ້າໄດ້ວ່າ ບັນຫາດັ່ງກ່າວ ຈະບໍ່ມີຜົນກະທົບເລີຍ.

**5.2.3.2. ຜົນກະທົບ ຈາກແຮງງານ/ກຳມະກອນ ຈາກພາຍນອກ**

ກ). ຄວາມຂັດແຍ່ງ ທາງດ້ານແຮງງານ

ຄວາມຂັດແຍ່ງ ລະຫວ່າງ ກຳມະກອນຈາກພາຍນອກ ແລະ ປະຊາຊົນທ້ອງຖິ່ນ ອາດຈະເກີດຂຶ້ນ ຖ້າຫາກວ່າ ການນຳໃຊ້ແຮງງານ ລະຫວ່າງ ແຮງງານຈາກພາຍນອກ ແລະ ແຮງງານ ທ້ອງຖິ່ນ ບໍ່ມີຄວາມສົມດູນ, ອີກປະການໜຶ່ງ ເນື່ອງຈາກວ່າ ມີຄວາມແຕກຕ່າງກັນ ທາງດ້ານວັດທະນະທຳ, ຂະນົບ ທຳນຽມ, ຮີດຄອງປະເພນີ ແລະ ຄວາມເຊື່ອຖື. ເຖິງຢ່າງໃດກໍຕາມ ອີງໃສ່ປະສົບການ ແລະ ບົດຮຽນ ຈາກຫຼາຍໆໂຄງການພັດທະນາເຂື່ອນໄຟຟ້າ ໃນໄລຍະຜ່ານມາ ແລະ ຈາກຜົນການສຶກສາ ເກັບກຳຂໍ້ມູນ ຕົວຈິງ ໃນເຂດໂຄງການ ເຫັນວ່າ ບໍ່ມີເຫດຜົນໃດໆ ທີ່ຈະສ້າງໃຫ້ມີຄວາມຂັດແຍ່ງ ທາງດ້ານນີ້ ເກີດຂຶ້ນ ຍົກເວັ້ນ ກໍລະນີ ທີ່ຂະນົບທຳນຽມ, ຮີດຄອງປະເພນີ ແລະ ຄວາມເຊື່ອຖືຂອງປະຊາຊົນບັນດາເຜົ່າ ໃນເຂດທ້ອງຖິ່ນ ຫາກບໍ່ໄດ້ຮັບການເຄົາລົບ ນັບຖື ຈາກຄົນພາຍນອກ. ເພື່ອຫຼີກລ້ຽງບັນຫາດັ່ງກ່າວ,

ຜູ້ຮັບເໝົາໂຄງການ ຕ້ອງໄດ້ຄວບຄຸມຄວາມປະພຶດ ຂອງກຳມະກອນ ຂອງຕົນຢ່າງເຂັ້ມງວດ ໂດຍສະເພາະ ຜູ້ທີ່ມາຈາກເຂດອື່ນໆ ແລະ ຕ້ອງໃຫ້ຄວາມເຄົາລົບ ແລະ ນັບຖື ຂະນົບ ທຳນຽມ ແລະ ຮີດຄອງປະເພນີ ຂອງປະຊາຊົນທ້ອງຖິ່ນ ຢ່າງເຂັ້ມງວດ ໂດຍສະເພາະ ຊົນເຜົ່າສ່ວນນ້ອຍ ໃນເຂດໃກ້ຄຽງໂຄງການ.

ຂ). ຜົນກະທົບອື່ນໆ ທີ່ອາດເກີດຂຶ້ນ

ຜົນກະທົບ ຈາກການຕັ້ງແຄ້ມ (ທີ່ພັກ) ກຳມະກອນ: ການຕັ້ງແຄ້ມ ກຳມະກອນ ໂດຍສະເພາະ ໃນເຂດກໍ່ສ້າງ ອຸໂມງ, ເຮືອນຈັກ ແລະ ເສັ້ນທາງເຂົ້າສູ່ເຮືອນຈັກ ຊຶ່ງເຂດດັ່ງກ່າວ ຍັງມີປ່າໄມ້ ທີ່ຂັ້ນຂ້າງ ອຸດົມສົມບູນ (ປ່າດົງດິບ ແລະ ປ່າປະສົມ) ຈະຕ້ອງໄດ້ພິຈາລະນາກຳນົດເອົາເຂດທີ່ບໍ່ມີປ່າໄມ້, ຈະຕ້ອງຕັ້ງ ຢູ່ຫ່າງໄກຈາກປ່າໄມ້, ເຂດທີ່ມີຄວາມຄອ້ຍຊັນສູງ ແລະ ເຂດທີ່ເປັນຍອດຫວ້ຍ, ຮອງ ແລະ ສາຍນ້ຳນ້ອຍ ຕ່າງໆ ຊຶ່ງອາດຈະສ້າງຜົນກະທົບ ທາງດ້ານສິ່ງແວດລ້ອມ ຕໍ່ຊັບພະຍາກອນປ່າໄມ້ ແລະ ນ້ຳ. ກຳມະກອນ ຈະບໍ່ໄດ້ຮັບອະນຸຍາດໃຫ້ລ່າສັດ, ຕັດໄມ້ ແລະ ເກັບກູ້ເຄື່ອງປ່າຂອງດົງ ບໍ່ວ່າຈະເປັນດ້ວຍວິທີການໃດກໍຕາມ ຍົກເວັ້ນ ເຄື່ອງປ່າຂອງດົງບາງຊະນິດ ເພື່ອເປັນອາຫານປະຈຳວັນ ແລະ ໄມ້ຕາຍ ໃນເຂດທີ່ອະນຸຍາດ ເພື່ອເຮັດພື້ນ ເທົ່ານັ້ນ. ບັນຫາຂໍ້ເກືອດຫ້າມຕ່າງທັງໝົດ ແມ່ນຈະຕ້ອງໄດ້ກຳນົດແຈ້ງ ໃນສັນຍາ ພັດທະນາ ໂຄງການ. ນອກຈາກນັ້ນ ໃນເຂດທີ່ຕັ້ງແຄ້ມ ຫຼື ເຂດທີ່ພັກ ຂອງກຳມະກອນ ຈະຕ້ອງມີລະບົບ ການ ກຳຈັດຂີ້ເຫຍື້ອ/ສິ່ງເສດເຫຼືອ, ລະບົບສຸຂາອະນາໄມ ແລະ ລະບົບລະບາຍນ້ຳເສ້ຍ ທີ່ຖືກຕ້ອງ ແລະ ໝາະສົມ ທັງນີ້ ກໍເພື່ອຫຼີກລ້ຽງ ການຖິ້ມຂີ້ເຫຍື້ອ/ສິ່ງເສດເຫຼືອ ເຂົ້າປ່າ, ການລະບາຍນ້ຳເສ້ຍ ຫຼື ຂອງເສ້ຍ ຕ່າງໆ ລົງນ້ຳ ຊຶ່ງອາດກໍ່ໃຫ້ເກີດ ຜົນກະທົບ ຫຼື ມົນລະພິດ ຕໍ່ສິ່ງແວດລ້ອມ.

VI. ພາກສະຫຼຸບ ແລະ ຂໍ້ສະເໜີແນະ

6.1. ຜົນປະໂຫຍດ ຈາກການກໍ່ສ້າງໂຄງການ

ໂຄງການເຂື່ອນໄຟຟ້າ ນ້ຳຖ້ືມ 5 ພາຍຫຼັງທີ່ກໍ່ສ້າງສຳເລັດ ຈະມີກຳລັງຕິດຕັ້ງ 2 x 60 ເມກາວັດ, ມີກຳລັງຜະລິດກະແສ ໄຟຟ້າ 120 ເມກາວັດ, ຊຶ່ງສາມາດຜະລິດກະແສໄຟຟ້າ ສະເລ່ຍ ຕໍ່ປີ ປະມານ 507 ກິກາວັດໂມງ ແລະ ມີອັດຕາການນຳໃຊ້ສະເລ່ຍຕໍ່ປີ (Annual Utilized Hour) ແມ່ນ 4.860 ຊົ່ວໂມງ.

ການກໍ່ສ້າງ ເຂື່ອນໄຟຟ້າ ນ້ຳຖ້ືມ 5 ຈະສາມາດ ສະໜອງພະລັງງານ ກະແສໄຟຟ້າ ໃນລາຄາ ທີ່ຖືກລົງ ແລະ ສາມາດສ້າງ ລະບົບເຄື່ອນຂ່າຍ ຕາໜ່າງຜະລິດ ກະແສໄຟຟ້າ ທີ່ມີຄຸນນະພາບສູງຂຶ້ນ ເພື່ອສະໜອງໃຫ້ແກ່ ການພັດທະນາອຸດສາຫະກຳດ້ານອື່ນໆ ຊຶ່ງຖືເປັນການສ້າງ, ຂະຫຍາຍ ແລະ ນຳໃຊ້ທ່າແຮງ ທາງດ້ານຊັບພະຍາກອນທຳມະຊາດ ເຂົ້າໃນການພັດທະນາເສດຖະກິດ-ສັງຄົມຂອງຊາດ, ສ້າງລາຍຮັບແຫ່ງຊາດ ແລະ ໃຫ້ແກ່ທ້ອງຖິ່ນ, ປະກອບສ່ວນ ເຂົ້າໃນການຈັດຕັ້ງປະຕິບັດ ຍຸດທະສາດ ແຫ່ງການເຕີບໂຕ ແລະ ລຶບລ້າງຄວາມທຸກຍາກແຫ່ງຊາດ (National Growth and Poverty Eradication Strategy/NGPES), ໂດຍສະເພາະ ຕົວເລກຄາດ ໝາຍສູງຊົນ ດັ່ງທີ່ໄດ້ກຳນົດໄວ້ ໃນມະຕິຂອງ ກອງປະຊຸມ ໃຫຍ່ ຄັ້ງທີ VIII ກໍຄື ແຜນພັດທະນາເສດຖະກິດ-ສັງຄົມ ແຫ່ງຊາດຄັ້ງທີ VI.

ຕາມການປະເມີນ ໃຫ້ຮູ້ວ່າ ພາຍຫຼັງ ການກໍ່ສ້າງໂຄງການສຳເລັດ ຈະສາມາດ ສ້າງຜົນປະໂຫຍດ ທາງດ້ານ ໃຫ້ແກ່ປະເທດຊາດ ກໍຄືປະຊາຊົນທອ້ງຖິ່ນ ຄືດັ່ງລຸ່ມນີ້:

- ສ້າງໂອກາດ ທາງດ້ານວຽກເຮັດງານທຳ ໃຫ້ແກ່ປະຊາຊົນ.
- ສ້າງສິ່ງອຳນວຍຄວາມສະດວກ ໃນການເຂົ້າເຖິງເຂດທີ່ພັດທະນາແລ້ວ ສຳລັບປະຊາຊົນ ທີ່ເຄີຍຢູ່ໃນ ເຂດພູດອຍ ຫ່າງໄກ ສອກຫຼີກ.
- ປັບປຸງພື້ນຖານ ໃນການສະໜອງນໍ້າກິນ ແລະ ນໍ້າໃຊ້ ເພື່ອການຜະລິດ ກະສິກຳ, ປູກຝັງ, ລ້ຽງສັດ ຂອງປະຊາຊົນ ບັນດາເຜົ່າ ທີ່ດຳລົງຊີວິດ ໃນເຂດໃກ້ຄຽງດັ່ງກ່າວ.
- ສ້າງໂອກາດ ແລະ ເພີ່ມທ່າແຮງ ໃນການລ້ຽງປາ ໃນເຂດດັ່ງກ່າວ.
- ສ້າງໂອກາດ ແລະ ທ່າແຮງ ໃນການເຂົ້າເຖິງ ການດຳເນີນກິດຈະການທາງດ້ານ ການຄ້າ ແລະ ການຕະຫຼາດ ໂດຍສະເພາະ ແມ່ນການແລກປ່ຽນສິນຄ້າພື້ນເມືອງ ທີ່ເປັນຜົນຜະລິດກະສິກຳ-ປ່າໄມ້, ຫັດຖະກຳ-ຈັກສານ ແລະ ອື່ນໆ.
- ສ້າງໂອກາດ ແລະ ເພີ່ມ ທ່າແຮງ ທາງດ້ານ ການທ່ອງທ່ຽວ ແລະ ການບໍລິການ ດ້ານການ ທ່ອງທ່ຽວ ທຳມະຊາດ.
- ເພີ່ມກຳລັງການຜະລິດກະແສໄຟຟ້າ ແລະ ຕາໜ່າງໄຟຟ້າ ໃນຂອບເຂດທົ່ວປະເທດ ໂດຍສະເພາະ ບັນດາແຂວງພາກເໜືອ, ສ້າງລາຍຮັບ ໃຫ້ແກ່ ປະເທດຊາດ ແລະ ທອ້ງຖິ່ນ ຈາກການສົ່ງອອກ ກະແສໄຟຟ້າ ແລະ ຫຼຸດຜ່ອນ ການນຳເຂົ້າ ກະແສໄຟຟ້າ ຈາກປະເທດເພື່ອບ້ານໃກ້ຄຽງ.

## 6.2. ສະຫຼຸບລວມ

ສະຫຼຸບລວມແລ້ວ ໂຄງການເຂື່ອນໄຟຟ້ານ້ຳຖິ້ມ 5 ເປັນໂຄງການທີ່ບໍ່ໄຫຍ່ ແລະ ບໍ່ສ້າງຜົນກະທົບ ຫຼາຍຕໍ່ສັງຄົມ ແລະ ສິ່ງແວດລ້ອມ ເນື່ອງຈາກວ່າ ເຂດອ່າງເກັບນ້ຳຂອງເຂື່ອນ ແມ່ນຈະບໍ່ເປັນອ່າງກວ້າງ, ອ່າງຈະຖືກສ້າງຂຶ້ນ ແລະ ເປັນໄປຕາມຮ່ອມພູ ຕາມຮູບແບບຂອງສາຍນ້ຳ ຊຶ່ງມີ ສາຍນ້ຳ ສາມສາຍຫຼັກ ຄື: ນ້ຳພັດ, ນ້ຳຊູດ ແລະ ນ້ຳຕິ່ງ. ອີກປະການໜຶ່ງ ຊັບພະຍາກອນປ່າໄມ້ ໃນເຂດດັ່ງກ່າວ ສ່ວນໃຫຍ່ ແມ່ນໄດ້ຖືກບຸກເບີກ, ຖາກຖາງ ແລະ ຖືກທຳລາຍມາກ່ອນແລ້ວ ແລະ ໂຄງການດັ່ງກ່າວ ກໍບໍ່ໄດ້ກວມເອົາ ເຂດຫວງຫ້າມຕ່າງໆ ເຊັ່ນ: ປ່າສະຫງວນ, ປ່າປອ້ງກັນ, ເຂດຮ່ອຍຮອຍທາງດ້ານປະຫວັດສາດ, ຮ່ອງຮອຍ ວັດທະນະທຳ ແລະ ວັດຖຸບູຮານທີ່ເກົ່າແກ່ຕ່າງໆ ທັງຍັງບໍ່ມີການ ຍົກຍ້າຍ ຈັດສັນປະຊາຊົນ ແຕ່ປະການໃດ ຍົກເວັ້ນ ທີ່ດິນ ທີ່ເປັນນາຈຳນວນໜຶ່ງ ໃນເຂດບ້ານຈິມ ແຕ່ເມື່ອສິມທຽບ ລະຫວ່າງ ຜົນກະທົບ ທາງດ້ານບວກ ແລະ ລົບ ໃສ່ກັນແລ້ວ ເຫັນວ່າ ຜົນກະທົບທາງດ້ານລົບ ບໍ່ວ່າຕໍ່ສັງຄົມ ແລະ ສິ່ງແວດລ້ອມ ແມ່ນມີໜ້ອຍທີ່ສຸດ.

### 6.2.1. ສະຫຼຸບລວມ ຜົນກະທົບ ທີ່ກ່ຽວພັນກັບທີ່ຕັ້ງ ຂອງໂຄງການ

- ເຂດໂຄງການ ໂດຍສະເພາະ ເຂດທີ່ນ້ຳຈະຖວ້ມ (ເຂດອ່າງເກັບນ້ຳ) ຈະກວມເອົາທີ່ດິນທີ່ມີ ປ່າໄມ້ປົກຄຸມ ປະມານ 616 ເຮັກຕາ, ໃນນີ້ ສ່ວນໃຫຍ່ ແມ່ນເປັນປ່າເຫຼົ້າ ຈຳນວນ 563 ເຮັກຕາ ແລະ ປ່າປະສົມ ປະມານ 53 ເຮັກຕາ.
- ໂຄງການບໍ່ໄດ້ກວມເອົາ ປ່າໄມ້ທີ່ເປັນປະເພດປ່າຫວງຫ້າມ ເຊັ່ນ: ປ່າສະຫງວນ, ປ່າປອ້ງກັນ.

- ສຳລັບທີ່ຕັ້ງ ຂອງເສັ້ນທາງ ໂດຍສະເພາະ ເສັ້ນທາງ ຈາກ ເຂດກໍ່ສ້າງເຂື່ອນ ໄປຫາ ເຂດກໍ່ສ້າງ ເຮືອນຈັກ ແມ່ນ ຈະກວມເອົາປ່າໄມ້ ທີ່ເປັນປ່າດົງດິບ ແລະ ປ່າປະສົມ ປະມານ 13 ເຮັກຕາ.
- ສຳລັບທີ່ຕັ້ງ ຂອງເຮືອນຈັກ ແມ່ນຈະກວມເອົາປ່າໄມ້ ທີ່ເປັນປ່າດົງດິບ ປະມານ 5 ເຮັກຕາ ແລະ ປ່າປະສົມ ຈຳນວນໜຶ່ງ.
- ໃນເຂດໂຄງການ ບໍ່ປະກົດມີເຂດໃດ ທີ່ສະແດງໃຫ້ເຫັນວ່າ ເປັນທີ່ຢູ່ອາໄສທີ່ສຳຄັນ ຂອງສັດປ່າ ຍົກເວັ້ນ ເຂດໃກ້ຄຽງ ແຕ່ຢູ່ນອກເຂດໂຄງການ ເຊັ່ນ: ເຂດພູຜາໃດ ແລະ ພູດ່າພໍ່. ເຖິງຢ່າງ ໃດກໍຕາມ ອົງຕາມຂໍ້ມູນທີ່ມີ ລວມທັງຜົນການສຳຫຼວດ ເຂດທີ່ຈະກໍ່ສ້າງເຮືອນຈັກ ເຄີຍເປັນເຂດ ທາງຜ່ານ ຂອງສັດປ່າຈຳນວນໜຶ່ງ ຈາກພູສູງ ລົງສູ່ແມ່ນ້ຳຖ້ຳ ໂດຍສະເພາະ ໃນລະດູແລ້ງ, ແຕ່ພາຍຫຼັງຖືກລົບກວນ ຈາກຫຼາຍໂຄງການ ໂດຍສະເພາະ ການກະກຽມກໍ່ສ້າງ ເຂື່ອນນ້ຳຖ້ຳ 3 ແລະ ການລ່າ ຂອງປະຊາຊົນ ຈຶ່ງບໍ່ປະກົດເຫັນສັດປ່າເຫຼົ່ານັ້ນໃນເຂດດັ່ງກ່າວອີກ.
- ມູນຄ່າເວນຄືນ ທັງໝົດຂອງໂຄງການ ທີ່ຈະຕ້ອງຈ່າຍໃຫ້ແກ່ການ ຊົດເຊີຍທີ່ດິນນາ ຈຳນວນ 49 ເຮັກຕາ ຂອງປະຊາຊົນ ຈຳນວນ 49 ຄອບຄົວ ແມ່ນປະມານ 1.733.200.000 ກີບ (ຫຼືເທົ່າກັບປະມານ 180.000 ໂດລາສະຫະລັດ). ຊຶ່ງການຊົດເຊີຍ ຈະຈ່າຍເປັນງົວ ຫຼື ຄວາຍ ໃນມູນຄ່າເທົ່າທຽມກັນ ຍົກເວັ້ນ 3 ຄອບຄົວ ທີ່ສະເໜີຂໍ້ຍ້າຍໄປຢູ່ບ່ອນອື່ນ.
- ບໍ່ມີສິ່ງປຸກສ້າງ ຫຼື ເຮືອນຊານປະຊາຊົນໃດໆ ທີ່ຈະໄດ້ຮັບຜົນກະທົບ ຈາກໂຄງການ, ດັ່ງນັ້ນ ຈຶ່ງບໍ່ມີການຍົກຍ້າຍຈັດສັນແຕ່ຢ່າງໃດ ຍົກເວັ້ນ 3 ຄອບຄົວ ທີ່ສະເໜີຍົກຍ້າຍ ໄປຢູ່ບ່ອນອື່ນ ແລະ ສະເໜີຂໍການຊ່ວຍເຫຼືອ ຈາກໂຄງການ ໃນການຍົກຍ້າຍວັດຖຸສິ່ງຂອງ ແລະ ສະໜອງ ເຂົ້າກິນໃນໄລຍະ 3 ປີ ທຳອິດ ເພື່ອໃຫ້ເຂົາເຈົ້າ ສາມາດຕັ້ງໂຕໄດ້. ເຖິງຢ່າງໃດກໍຕາມ ໃນກໍລະນີນີ້ ຄະນະກຳມະການ ຈະເປັນຜູ້ພິຈາລະນາ ຊຶ່ງນອກຈາກມູນຄ່າຊົດເຊີຍທີ່ດິນ ທີ່ເຈົ້າ ຂອງໂຄງການ ຈະຕ້ອງຈ່າຍໃຫ້ເຂົາເຈົ້າແລ້ວ, ສຳລັບມູນຄ່າ ຍົກຍ້າຍ ທີ່ 3 ຄອບຄົວສະເໜີ ຂໍການຊ່ວຍເຫຼືອ ແມ່ນຈະບໍ່ເກີນ 50.000.000 ກີບ.
- ໂຄງການບໍ່ໄດ້ກວມເອົາເຂດ ທີ່ສຳຄັນທາງດ້ານວັດທະນະທຳ, ຮ່ອງຮອຍປະຫວັດສາດທີ່ເກົ່າແກ່ ແລະ ເຂດທ່ອງທ່ຽວທຳມະຊາດໃດໆ.

**6.2.2. ສະຫຼຸບລວມ ຜົນກະທົບ ທີ່ກ່ຽວພັນກັບການກໍ່ສ້າງ ແລະ ການດຳເນີນໂຄງການ**

- ເນື່ອງຈາກວ່າ ອ່າງເກັບນ້ຳ ໂດຍສະເພາະ ໃນຕອນເທິງ ໃກ້ໜ້າເຂື່ອນ ເປັນຮ່ອມພູ ທີ່ມີລັກ ສະນະແຄບ ແລະ ມີຄວາມຄອ້ຍຊັນສູງ ຊຶ່ງຈະເຮັດໃຫ້ລະດັບນ້ຳ ໃນອ່າງມີຄວາມເລິກ ກວ່າເຂດອື່ນໆ ດັ່ງນັ້ນການອອກແບບ ແລະ ກໍ່ສ້າງ ຈຶ່ງຕ້ອງໄດ້ ພິຈາລະນາເປັນພິເສດ ເຮັດແນວໃດ ເພື່ອຮັບປະກັນ ບໍ່ໃຫ້ມີການເຊາະເຈື່ອນ.
- ບັນຫາສຳຄັນ ຂອງການກໍ່ສ້າງເຂື່ອນໄຟຟ້າ ສ່ວນໃຫຍ່ ແມ່ນ ຜົນກະທົບຕໍ່ກັບລະດັບນ້ຳ ໃນເຂດຕອນລຸ່ມ ຂອງເຂື່ອນ ຈະບົກແຫ້ງລົງກວ່າເກົ່າ ພາຍຫຼັງທີ່ມີການຕັ້ງເຂື່ອນ, ແຕ່ສຳລັບ ໂຄງການເຂື່ອນໄຟຟ້າ ນ້ຳຖ້ຳ 5 ເນື່ອງຈາກວ່າ ເຂດຕອນລຸ່ມຂອງເຂື່ອນ ໂດຍສະເພາະ ແຕ່ ເຂື່ອນ ລົງໄປຫາ ເຂດບ້ານຊຽງແດດ ຈະຖືກນ້ຳຖ້ວມ ແລະ ກາຍເປັນອ່າງເກັບນ້ຳ ຂອງເຂື່ອນ

ໄຟຟ້ານຳຮື້ມ 3 (ລະດັບ ຄວາມສູງ 720 ແມັດເໜືອໜ້ານຳທະເລ). ດັ່ງນັ້ນ ຜົນກະທົບ ຕໍ່ກັບລະດັບນ້ຳ ໃນເຂດຕອນລຸ່ມ ຂອງເຂື່ອນໄຟຟ້ານຳຮື້ມ 5 ແມ່ນບໍ່ມີ.

- ເພື່ອຮັບປະກັນໃຫ້ແກ່ການຄຸ້ມຄອງເຂດອ່າງໂຕ່ງນຳຮື້ມ ໃຫ້ມີປະສິດຕິຜົນ ຮັບປະກັນການສະໜອງນ້ຳ ໃຫ້ເປັນປົກກະຕິ ແລະ ພຽງພໍ ໃຫ້ແກ່ທັງໝົດ ແຕ່ລະເຂື່ອນ ໃນເຂດນຳຮື້ມ, ມີຄວາມຈຳເປັນ ຕ້ອງໄດ້ສ້າງຕັ້ງສະມາຄົມ ຫຼື ຄະນະກຳມະການສະເພາະ ເພື່ອຮັບຜິດຊອບ ໃນການຄຸ້ມຄອງນຳຮື້ມ ໂດຍການສ້າງ ແລະ ພັດທະນາເປັນແຜນການຄຸ້ມຄອງນຳຮື້ມ ຢ່າງລະອຽດຈະແຈ້ງ. ເຖິງຢ່າງໃດກໍຕາມ ການກຳນົດລະບຽບການ ສະເພາະ ການຄວບຄຸມການໄຫຼຂອງນ້ຳ ສຳລັບເຂື່ອນໄຟຟ້ານຳຮື້ມ 5 ຈະສາມາດສ້າງຜົນປະໂຫຍດເພີ່ມ.
- ໂຄງການຈະບໍ່ສ້າງຜົນກະທົບໃດໆຕໍ່ກັບ ຊະນິດພັນສັດນ້ຳ ແລະ ທີ່ຢູ່ອາໄສຂອງມັນ. ສຳລັບ ຊະນິດພັນສັດນ້ຳ ທີ່ຄຸ້ນເຄີຍອາໄສ ຢູ່ໃນເຂດນ້ຳໄຫຼ ຈະເຄື່ອນຍ້າຍ ຂຶ້ນໄປເຂດຕອນເທິງ ຂອງແມ່ນ້ຳ ທັງສາມສາຍທີ່ສຳຄັນ (ນ້ຳພັດ, ນ້ຳຂູດ ແລະ ນ້ຳຕິ່ງ). ສຳລັບຊະນິດພັນທີ່ຄຸ້ນເຄີຍ ແລະ ອາໄສຢູ່ໃນນ້ຳທີ່ບໍ່ໄຫຼ ຍິ່ງຈະເພີ່ມຈຳນວນ ແລະ ຄວາມອຸດົມສົມບູນຂຶ້ນ.
- ພາຍຫຼັງທີ່ໂຄງການສຳເລັດ, ເວລາທີ່ລະດັບນ້ຳ ໃນອ່າງເກັບນ້ຳເພີ່ມຂຶ້ນ ຈະເຮັດໃຫ້ ລະດັບນ້ຳ ໃຕ້ດິນ ໃນເຂດໃກ້ຄຽງອ່າງ ເພີ່ມຂຶ້ນ, ປະຊາຊົນທີ່ຢູ່ໃກ້ຄຽງເຂດດັ່ງກ່າວ ຈະໄດ້ຮັບຜົນປະໂຫຍດ ຈາກສິ່ງດັ່ງກ່າວ.
- ເນື່ອງຈາກວ່າໂຄງການດັ່ງກ່າວ ຈະນຳໃຊ້ອຸໂມງໃຕ້ດິນ ເພື່ອລະບາຍນ້ຳ ຈາກຕົວເຂື່ອນ ເຂົ້າຫາ ເຮືອນຈັກ, ດັ່ງນັ້ນ ຈິ່ງຄາດວ່າ ຈະບໍ່ມີຜົນກະທົບທີ່ຮ້າຍແຮງໃດໆ ຕໍ່ກັບປ່າໄມ້, ສັດປ່າ, ລະບົບນ້ຳໃຕ້ດິນ.
- ເນື່ອງຈາກວ່າ ໃນເຂດຕອນລຸ່ມຂອງນ້ຳຕິ່ງ ໂດຍສະເພາະ ແຕ່ຕົວເຂື່ອນ ຫາ ນ້ຳຮື້ມ ແລະ ທີ່ຕັ້ງເຮືອນຈັກ ບໍ່ມີບ້ານປະຊາຊົນຕັ້ງຢູ່, ດັ່ງນັ້ນ ຈິ່ງບໍ່ມີ ຄວາມຕ້ອງການນຳໃຊ້ນ້ຳ ໃນຕອນລຸ່ມ ຂອງນ້ຳຕິ່ງ ເພື່ອການຜະລິດກະສິກຳ, ຊົນລະປະທານ ແລະ ການປະມົງ.
- ເນື່ອງຈາກວ່າ ເຂດອ່າງເກັບນ້ຳ ປະກອບດ້ວຍ ແມ່ນ້ຳສາມສາຍ ທີ່ສຳຄັນ, ດັ່ງນັ້ນ ຈິ່ງຄາດວ່າ ຈະບໍ່ມີຜົນກະທົບໃດໆ ຕໍ່ກັບການປ່ຽນແປງ ລະດັບການໄຫຼຂອງນ້ຳ ໂດຍສະເພາະ ລະດັບ ການໄຫຼຂອງນ້ຳ ໃນອຸໂມງ.
- ໂຄງການດັ່ງກ່າວ ບໍ່ພຽງແຕ່ ຈະສາມາດສ້າງຜົນປະໂຫຍດ ໃນການສະໜອງກະແສໄຟຟ້າ ເທົ່ານັ້ນ ຍັງສາມາດ ສ້າງຜົນປະໂຫຍດທາງດ້ານສັງຄົມ ແລະ ເສດຖະກິດອື່ນໆອີກດ້ວຍ ຄືດັ່ງໄດ້ຍົກໃຫ້ເຫັນ ໃນຂໍ້ 6.1 ເທິງນີ້.

### 6.3. ຂໍ້ສະເໜີແນະ

ບັນດາຂໍ້ສະເໜີແນະຕ່າງໆລຸ່ມນີ້ ຄວນໄດ້ຮັບການພິຈາລະນາ ໃນເວລາ ເຮັດສັນຍາພັດທະນາ ໂຄງການ ລະຫວ່າງເຈົ້າຂອງໂຄງການ ແລະ ຄູ່ສັນຍາ ຫຼື ຜູ້ຮັບເໝົາກໍ່ສ້າງ ກໍຄື ໃນເວລາ ດຳເນີນ ການກໍ່ສ້າງໂຄງການ:

- ເພື່ອເປັນການສ້າງໂອກາດ ແລະ ສ້າງວຽກເຮັດງານທຳ ໃຫ້ແກ່ປະຊາຊົນທ້ອງຖິ່ນ, ປະກອບສ່ວນ ສ້າງລາຍຮັບ ເພື່ອແກ້ໄຂຄວາມທຸກຍາກ ໃຫ້ແກ່ເຂົາເຈົ້າ ຕາມທິດທາງຂອງລັດຖະບານ, ໃນເວລາກໍ່ສ້າງ ໂຄງການ, ແຮງງານທ້ອງຖິ່ນ ຄວນໄດ້ຮັບການພິຈາລະນາ ເປັນກໍລະນີພິເສດ.



- ກ່ອນທີ່ຈະລົງມືດຳເນີນການກໍ່ສ້າງ, ບັນຫາການຊົດເຊີຍ, ຍົກຍ້າຍ ຈັດສັນ ທັງໝົດ ຕາມທີ່ໄດ້ກຳນົດໄວ້ ໃນແຜນຍົກຍ້າຍ ຈັດສັນ ຫຼື ແຜນດຳເນີນງານ ທາງດ້ານສັງຄົມ (Social Action Plan) ຈະຕ້ອງໄດ້ຮັບການຈັດຕັ້ງ ປະຕິບັດ ໃຫ້ສຳເລັດ.
- ມາດຕະການໃນການຫຼຸດຜ່ອນຜົນກະທົບ ທີ່ໄດ້ຖືກສະເໜີໃນບົດລາຍງານ ການປະເມີນຜົນກະທົບ ທາງດ້ານສັງຄົມ ແລະ ສິ່ງແວດລ້ອມ ຈະຕ້ອງໄດ້ຮັບການຈັດຕັ້ງປະຕິບັດໃຫ້ເກີດປະສິດຕິຜົນສູງສຸດ ຕາມແຜນດຳເນີນງານການກວດກາ ແລະ ປະເມີນຜົນ ທີ່ໄດ້ສະເໜີເປັນແຕ່ລະໄລຍະ. ຄຽງຄູ່ໄປກັບ ການຈັດຕັ້ງປະຕິບັດການກວດກາ ແລະ ປະເມີນຜົນເປັນແຕ່ລະໄລຍະ, ແຜນການກວດກາ-ປະເມີນ ຜົນ ຈະໄດ້ຮັບການປັບປຸງເປັນແຕ່ລະໄລຍະເຊັ່ນດຽວກັນ (ຖ້າເຫັນວ່າຈຳເປັນ) ເຊິ່ງຂຶ້ນກັບຜົນຂອງການ ກວດກາ ແລະ ປະເມີນຜົນໃນແຕ່ລະຄັ້ງ.
- ໃນເວລາດຳເນີນການກໍ່ສ້າງ ອາດຈະສົ່ງຜົນກະທົບ ຕໍ່ກັບຄຸນນະພາບນ້ຳ ໃນແມ່ນ້ຳຕ່າງໆ ຊຶ່ງສ່ວນໜຶ່ງ ແມ່ນເປັນແຫຼ່ງນ້ຳກິນ ແລະ ນ້ຳໃຊ້ຂອງປະຊາຊົນ ແລະ ກຳມະກອນ, ສະນັ້ນ ບັນຫາການແກ້ໄຂ ຫຼື ສະໜອງນ້ຳລືມ ຫຼື ນ້ຳບາດານ ເພື່ອເປັນນ້ຳກິນ ແລະ ນ້ຳໃຊ້ ໃຫ້ແກ່ປະຊາຊົນ ໃນເຂດໃກ້ຄຽງ ຄວນໄດ້ຮັບການພິຈາລະນາ.
- ຜູ້ຮັບເໝົາກໍ່ສ້າງ ຕ້ອງໄດ້ປະຕິບັດ ຕາມກົດໝາຍ ແລະ ລະບຽບການ ກ່ຽວກັບການປ້ອງກັນ ສິ່ງແວດ ລ້ອມ ແລະ ລະບຽບການທີ່ກ່ຽວຂ້ອງອື່ນໆ ຢ່າງເຂັ້ມງວດ ໂດຍສະເພາະ ແມ່ນລະບຽບການ ກ່ຽວກັບ ການຄຸ້ມຄອງ ແລະ ປ້ອງກັນປ່າໄມ້, ສັດປ່າ ແລະ ສັດນ້ຳ.
- ຜູ້ຮັບເໝົາກໍ່ສ້າງ ຈະຕ້ອງຮັບຜິດຊອບທັງໝົດ ໃນການຈັດສັນສະຖານທີ່ຕັ້ງແຄ້ມທີ່ພັກ ຂອງກຳມະກອນ ໃຫ້ເປັນໄປຕາມທີ່ກຳນົດ, ສະໜອງສິ່ງອຳນວຍຄວາມສະດວກຕ່າງໆ ໃນທີ່ພັກເຊົາ ໃຫ້ພຽງພໍ ເຊັ່ນ: ນ້ຳສະອາດ, ລະບົບສຸຂາອະນາໄມ, ລະບົບລະບາຍນ້ຳເສ້ຍ, ລະບົບກຳຈັດຂີ້ເຫຍື້ອ ແລະ ສິ່ງເສດເຫຼືອ ຕ່າງໆ ແລະ ປັດໃຈຮອງຮັບທາງດ້ານສຸຂະພາບ ແລະ ຄວາມປອດໄພອື່ນໆ ທັງນີ້ກໍເພື່ອ ຫຼຸດຜ່ອນ ຜົນກະທົບຕ່າງໆ ທີ່ອາດເກີດຂຶ້ນ.
- ການນຳໃຊ້ໄຟໃນເຂດທີ່ມີປ່າໄມ້ ຈະຕ້ອງໄດ້ຮັບການຄວບຄຸມ ໂດຍສະເພາະ ໃນລະດູແລ້ງ ທັງນີ້ກໍເພື່ອ ຫຼີກລ້ຽງ ໄຟໃໝ້ລາມປ່າ ທີ່ອາດເກີດຂຶ້ນ.
- ຈັດການຝຶກອົບຮົມ ໃຫ້ແກ່ກຳມະກອນ ກ່ຽວກັບຄວາມຮັບຮູ້ ໃນການປ້ອງກັນອຸປະຕິເຫດ, ການປ້ອງກັນ ພະຍາດຕິດແປດ, ຄວາມຮັບຮູ້ກ່ຽວກັບການນຳໃຊ້ເຄື່ອງມືອຸປະກອນຕ່າງໆ, ຄວາມຮັບຮູ້ ກ່ຽວກັບ ການ ປ້ອງກັນອະປະຕິເຫດ ກ່ຽວກັບລູກລະເບີດທີ່ບໍ່ທັຍແຕກ ຕະຫຼອດຮອດ ຄວາມຮັບຮູ້ກ່ຽວກັບ ຮີດຄອງ ປະເພນີ ຂອງປະຊາຊົນທ້ອງຖິ່ນ ໃນເຂດໃກ້ຄຽງໂຄງການ.
- ການດຳເນີນກິດຈະການຕ່າງໆ ໃນການກໍ່ສ້າງ ທີ່ອາດຈະກໍ່ໃຫ້ເກີດຜົນກະທົບທີ່ຮ້າຍແຮງ ຄວນປະຕິບັດ ສະເພາະໃນລະດູແລ້ງ ຫຼື ໃນລະດູ ທີ່ປະຊາຊົນ ໄດ້ເກັບກ່ຽວຜົນຜະລິດຂອງເຂົ້າເຈົ້າແລ້ວເທົ່ານັ້ນ ແລະ ຄວນປະຕິບັດ ສະເພາະ ໃນເວລາກາງເວັນ.

## **PUBLIC CONSULTATION**

Public participation can be defined as the process through which the views and opinions of all interested parties or stakeholders are integrated into project planning, implementation and monitoring. Consultation is a type of communication that specifically establishes an ongoing "feedback loop", integrating stakeholder views and opinions into various project activities. Communication also consists of information dissemination, including discussions with non-stakeholders and media presentation of the project.

Public consultation had been conducted on two levels. Firstly, information dissemination and consultative were held with relevant staff at both provincial and district level. Second, further public consultation began with the implementation of the initial social and environmental impact assessment. During the assessment, villagers were informed of the project and their comments were solicited. The first public consultation campaign was held during field study from May-June 2005. The results were compiled and developed an Initial Environmental Examination (IEE).

The Second phase of consultation was conducted in ... 2006, after the draft IEE report had been completed. The aim of this round consultation was to discuss the range of proposed recommendations and mitigation strategies to ensure that all issues had been adequately addressed.

Based on comments of the second consultation, additional survey for upgrading an IEE into EIA was undertaken in May 2006. The main concerned is to identify the options for compensation of the affected people, especially those who lost their paddy fields (49 families) which the total of 49.52 ha and assess the potential for restoration of the affected people and village.

Consultation was held at the district level with Government representatives to keep them informed of the project developments and to gain any insights they had in terms of project impacts on the district and options for compensation of the paddy field. Issues were raised during this meeting:

- Development of the Nam Ngum 5 Hydropower project has been supported by District which is one of the priorities of the government as well as local authority in order to reduce poverty alleviation.
- Regarding the options for paddy field compensation of the 49 families which the total of 49.52 ha, there are no other paddy field in Phou Khoun District to compensate affected people. However, livestock is the strength of Ban Chim area and cash crop plantation can be the second options for improving the livelihood of the local people.
- Round year access to the village is the good potential for selling agricultural product. It would not be a problem for the local people; provincial authority as well as district authority can manage and resettle this issue.

- Paying for Compensation should not be in cash (experience from other projects), type of payment should be based on EdL formula then change into property asset like buffalo, cow or wire fence.
- Project proponent should ensure that paddy fields of Ban Chim will be fully compensated and restoration of the affected people, village needs to be concerned in order to improve the livelihood of the local community.

Meetings were also held at the village level. Participants included the chief and deputy chief of Ban Chim village, elder union, woman union representative, Youth Organization, head of army and security and 49 affected households.

The main issues were raised by local residents during the consultation meeting:

- Regarding the permanent loss of paddy field, the residents expressed a general preference for compensation by cow/buffalo and wire fence which equivalent to the amount of paddy field. However, 3 of them preferred a new paddy field in other areas where suitable for their business and future quality of life of their children rather than financial compensation. One of them will move to Luangprabang town and the rest two will move to live with relative in Kasi District. However, they asked for help in terms of transport for moving their house and rice providing during the first 3 years.
- The residents requested that project proponent should provide with the following assistance until their income levels and living conditions can be stabilized:
  - (a) During the transition period (the first 3 years), rice need to support for the APs , especially those who lost all paddy fields
  - (b) Support the technical assistant to the APs related to agriculture and livestock activities.
  - (c) Support high yield production species for cash crop and rice variety to improve the production of the APs as well local community.
  - (d) One important aspect that raised by the APs is market promoting need the involvement of the government authority in order to control the market price avoiding middle man buyers.
  - (e) Since the village is almost mountainous areas which are the limitation to Expanse. Residents therefore asked for help by the project to expanse more land for future housing construction
  - (f) Village revolving fund helping local people to improve their livelihood in the form of extension works.
- The project was positively received by the villagers, especially in regard to the provision of electricity, improvement in social service and infrastructure that concerned by the village community

Comments were compiled and reviewed, with the reports adapted wherever appropriate to reflect the outcomes of discussions or new information brought forward through the consultation process.



ສະພາບການນຳໃຊ້ທີ່ດິນ  
ໃນເຂດໂຄງການ  
Land Use Conditions  
within the Project Areas



ສະພາບທີ່ງານຢູ່ບ້ານຈິມ  
ທີ່ຈະຖືກນ້ຳຖ້ວມ  
Rice Paddy Field  
Condition at B. Chim  
Village which will be  
inundated  
(The elevation of lowest point of  
paddy field is at 1,095 masl and  
highest point is at 1,112 masl)



ທີມງານສຳຫຼວດພາກສະ  
ໜາມໂດຍການເຂົ້າຮ່ວມ  
ຂອງປະຊາຊົນ (ບ້ານຈິມ)  
Survey Team during  
conducting field survey  
at B. Chim Village



ສະພາບຖຽງງານຂອງປະຊາ  
ຊົນ ຢູ່ບ້ານຈິມ ທີ່ຈະຖືກ  
ນ້ຳຖ້ວມ  
Temporary (Paddy  
Field) Hut Condition in  
B. Chim Village which  
will be affected





ສະພາບນ້ຳ ໃນແມ່ນ້ຳຊູດ  
 ໃນເວລາສຳຫຼວດ  
 (ເດືອນ 5/2005)  
 Nam Sout River  
 Condition (as in May,  
 05) within the Project  
 Areas



ຂົວຂ້າມນ້ຳຊູດ ຢູ່ບ້ານຈິມ  
 (ລະດັບຫຼັງຂົວແມ່ນ 1.104  
 ແມັດ ເໜືອໜ້ານ້ຳທະເລ)  
 Bridge crosses Nam Sout  
 River at Chim Village  
 (The elevation of bridge  
 crest is at 1,104 masl)



ສະພາບປ່າ-ຖຽງນາ  
 ຢູ່ຕອນເທິງ ຂອງຂົວນ້ຳຊູດ  
 (ລະດັບຄວາມສູງເໜືອໜ້ານ້ຳ  
 ທະເລແມ່ນ 1.103 ແມັດ)  
 Up-stream of Nam Sout River (at  
 upper Nam Sout Bridge), at  
 Chim Village (The elevation of  
 the hut is at 1,103 masl)



ໜອງປາ ແລະ ສວນກວ້ຍຂອງ  
 ທະຫານຢູ່ບ້ານຈິມ (ລະດັບ  
 ຄວາມສູງ ເໜືອໜ້ານ້ຳທະເລ  
 ແຕ່ 1.104 ຫາ 1.108 ແມັດ)  
 Military Fishpond on the bank of  
 Nam Sout River at Chim Village  
 (The elevation of the highest  
 point of the fishpond is 1,108  
 masl and lowest is 1,104 masl)





ສວນສາລີ ຂອງປະຊາຊົນ ຢູ່  
ແຄມນ້ຳຊູດ, ບ້ານຈິມ (ລະດັບ  
ຄວາມສູງ ເໝືອໜ້ານ້ຳທະເລ  
ແຕ່ 1.104 ຫາ 1.108 ແມັດ)  
Wheat Plantation in the fishpond  
area on the bank of Nam Sout  
River at Chim Village  
(The elevation of the highest  
point is 1,108 masl and lowest  
point is 1,104 masl)



ສະພາບນ້ຳຕົງ ຢູ່ບ້ານຊຽງແດດ  
ເຂດຕອນລຸ່ມຂອງນ້ຳຈຶ່ງມ 5  
ຊຶ່ງຈະຖືກຖວ້ມກາຍເປັນອ່າງ  
ຈາກໂຄງການໄຟຟ້ານ້ຳຈຶ່ງມ 3  
Nam Ting River conditions at  
downstream (Xieng Det Village)  
where will be inundated as  
reservoir of Nam Ngum 3 Project



ສະພາບທີ່ດິນ ແລະ ປ່າໄມ້  
ໃນເຂດກໍ່ສ້າງ ເຮືອນຈັກ  
Forest Conditions around  
the Powerhouse



ສະພາບທີ່ດິນ ແລະ ປ່າໄມ້  
ໃນເຂດກໍ່ສ້າງເຂື່ອນ  
Forest Conditions around  
the Dam Site





ສະພາບປ່າ ແລະ ນ້ຳ (ນ້ຳຕົງ)  
 ໃນເຂດທີ່ຈະສ້າງເຂື່ອນ  
 Forest Conditions along  
 the two sides of Nam Ting  
 where the Dam will be  
 located and constructed



ສະພາບທີ່ດິນ ແລະ ປ່າໄມ້  
 ໃນເຂດ ທີ່ຈະສ້າງທາງ ຈາກ  
 ທາງເລກ 7 ເຂົ້າຫາ ເຂື່ອນ  
 Forest Conditions along  
 the proposed access road  
 from NR 7 to the Dam Site



ສະພາບທີ່ດິນ ແລະ ປ່າໄມ້  
 ໃນເຂດ ທີ່ຈະສ້າງເສັ້ນທາງ  
 ຈາກເຂື່ອນ ໄປຫາເຮືອນຈັກ  
 Forest Conditions where  
 the access road from the  
 Dam Site to Powerhouse  
 will cross



ການປະຊຸມປຶກສາຫາລື ຮ່ວມ  
 ກັບປະຊາຊົນ ໃນເວລາລົງ  
 ສຳຫຼວດ ເກັບກຳຂໍ້ມູນ  
 ຢູ່ພາກສະໜາມ  
 Consultation with Villagers  
 and Village Authority during  
 Field Survey and Data  
 Collection





ການປຶກສາຫາລືຮ່ວມກັບປະ  
 ຊາຊົນ ແລະ ການສຳພາດ  
 ປະຊາຊົນ ໃນເວລາ ລົງເກັບ  
 ກຳ ຂໍ້ມູນຢູ່ພາກສະໜາມ  
 Consultation with and  
 Interview of Villagers  
 during Field Survey and  
 Data collection



ການລົງສຳຫຼວດ ເກັບກຳ  
 ຂໍ້ມູນ ຢູ່ພາກສະໜາມ  
 ໂດຍການມີສ່ວນຮ່ວມ  
 ຂອງອ້າຍນ້ອງປ້ອງກັນຊາດ  
 Participatory Field Survey  
 and Data collection



ການລົງສຳຫຼວດ ເກັບກຳ  
 ຂໍ້ມູນ ຢູ່ພາກສະໜາມ  
 ໂດຍການມີສ່ວນຮ່ວມ  
 ຂອງອ້າຍນ້ອງປ້ອງກັນຊາດ  
 Participatory Field Survey  
 and Data collection