

Using some models based on empirical observation of existing reservoirs in Asia, the forecast of sustainable open fish production gives about 11kg/ha/year for FSL.360m (or a production of about 160t/year) and 13kg/ha/year for FSL.320m (or a production of 96t/year). Much higher production may be expected if additional fish culture using floating cages is developed.

### (3) THE DOWNSTREAM AREA

A major impact will be the change of river flow. Turbine operation is anticipated for 16 hours per day, and the flow will be regulated over 24 hours by a re-regulation facility. However, the future situation will be significantly different from the present one: In Muangmai in a mean year, the future flow with the Project at FSL.360m will be about 3 times higher during the dry season and only half of the initial flow during the wet season. This change of flow will have effects on the river use by the population. More regularized flow is beneficial for the development of pumped irrigation and for river transportation. However, a higher level year long will slightly reduce the area of vegetable gardens generally developed by the villagers along the lower banks of the river. An evaluation of the loss and a compensation is recommended.

The change in water quality downstream will reflect the evolution of water quality in the reservoir as previously presented. Fisheries will probably be affected.

### (4) COMPARISON OF ALTERNATIVES

Table 6.3.5 presents, for each project alternative the quantified indicators discussed in this report, in order to facilitate the comparison in the environmental field.

The environmental efficiency of a hydropower project may also be measured by the number of ha of land affected and the number of displaced person for each MW of installed capacity. The position of both alternatives is compared with several other projects in the world and presented in Figure 6.3.1.

#### 6.3.7. ENVIRONMENTAL MANAGEMENT PLAN

The objectives of the Environmental Management and Monitoring Plan (EMP) is i) to provide the framework for undertaking all the Environmental Protection Measures (EPMs) recommended and related to direct impacts of the Project, and ii) to establish a monitoring of these measures throughout the life of the project, but with a special focus during the construction and filling phases. The Plan also provides a possible institutional organization framework for its implementation, defining briefly the roles and responsibilities of each party.

The Environmental Measures proposed as a result of the First EIA study are presented in Table 6.3.6.

Table 6.3.5 Comparison of Alternatives

No.	Components & Indicators	Unit	Alternative	
			FSL,EL.360m	FSL,EL.320m
<b>I. RESERVOIR</b>				
1.	FSL Area	km	148.2	73.8
2.	FSL Volume	Mill.m <sup>3</sup>	6,780	2,280
3.	MOL Level	m	335	284
4.	MOL Area	km	104	32.7
5.	MOL Volume (Dead storage)	Mill.m <sup>3</sup>	3,689	627
6.	Mean Level	m	342	306
7.	Mean Area	km	133	54
8.	Mean Volume	Mill.m <sup>3</sup>	5471	1548
9.	Mean Depth	m	41.4	28.7
10.	Reservoir shoreline at FSL	km	565	350
11.	Draw down (DD) magnitude	m	25	36
12.	DD area (maximum)	ha	4,420	4,110
13.	DD area exposed >120 days	ha	1,200	2,300
14.	Length of river flooded	km	90	70
15.	Average river width in reservoir area	m	80	80
16.	River area flooded	ha	720	560
17.	River area above reservoir	ha	228	388
18.	Length of tributary system dammed	km	372	372
19.	Area of tributary system dammed	ha	2,100	2,100
20.	Average river bank width in reservoir	m	50	50
21.	Area of river bank flooded	ha	450	350
22.	Controlled catchment area	km	3,700	3,700
<b>II. RESERVOIR FORECASTS</b>				
1.	Hydraulic Residence Time (months)	month	13.2	3.6
2.	Areal Hydraulic Loading (m/year)	m/yr	34.5	68.1
3.	Catchment to Reservoir area ratio	-	25.0	49.3
4.	Duration of water quality problems	year	6	2
5.	Filling Period (no riparian release)	month	15	3
6.	Filling Period with RR of 20 m <sup>3</sup> /s	month	16	3
7.	Filling Period with RR of 50 m <sup>3</sup> /s	month	18	4
8.	Mean annual evaporation	Mill.m <sup>3</sup>	204	83
9.	Reservoir shoreline development	-	13.1	11.4
10.	Maximum temperature	°c	29	29.7
11.	Minimum temperature	°c	21	21.4
12.	Phosphorus loading rate (gP/m /y)	-	0.449	0.902
13.	Electrical conductivity in future lake	µS/cm	46	62
14.	Morpho-edaphic index (MEI)	-	0.65	0.93
15.	Reservoir potential fish catch	tons/y	160	96
16.	Reservoir potential fish yields	kg/ha/y	11.3	13.6
<b>III. TERRESTRIAL RESOURCES</b>				
1.	Forest area flooded	ha	9,780	4,930
2.	Timber standing volume (30 m <sup>3</sup> /ha)	m <sup>3</sup>	293,000	148,000
3.	Timber annual production (1.5 m <sup>3</sup> /ha/y)	m <sup>3</sup> /y	16,500	8,000
4.	Open woodland	ha	2,890	1,770
5.	Distance to nearest (NBCA)	km	14	14
6.	Area with important wildlife species	ha	100	100
7.	Flooded biomass rapid decay	'000 t	568	284
8.	Flooded biomass slow decay	tons	2,140	1,071

Table 6.3.5 Comparison of Alternatives

No.	Components & Indicators	Unit	Alternative	
			FSLEL.360m	FSLEL.320m
<b>IV. DOWNSTREAM AREA AND CONSTRUCTION SITES</b>				
1.	Length of river downstream	km	54	54
2.	Area of river downstream	ha	880	880
3.	Area of river banks	ha	400	400
4.	flow change driest month (dam)	initial	355%	333%
5.	flow change wettest month (dam)	initial	34%	49%
6.	Villages along river	nos.	14	14
7.	Households	nos.	1,132	1,132
8.	Population	nos.	6,473	6,473
9.	Grazing land	ha	19,716	19,716
10.	Buffalo	nos.	864	864
11.	Cattle	nos.	986	986
12.	Average flow velocity	m/s	0.2	0.2
13.	Population km 0-10 (from dam site)	nos.	785	785
14.	Population km 10-20 & 20-30	nos.	0	0
15.	Population km 30-40	nos.	3,307	3,307
16.	Population km 40-54	nos.	3,166	3,166
17.	Area for re-regulation pond	ha	240	240
18.	Area for dam construction site & camps	ha	150	150
19.	Area for quarries and borrow areas	ha	150	100?
20.	Length of new access road	km	10	10
21.	Area for new access road	ha	20	20
22.	Length of transmission line	km	110	110
23.	Area for transmission line (ROW)	ha	550	550
24.	Area for TL (land acquisition)	ha	2.0	2.0

Table 6.3.6 Environmental Mitigation Studies and Measures with Related Budget Estimated (Unit : US\$)

No	Environmental Measures	Responsible Organism	Executing Organism	Duration (years)	Total Cost
<b>A Completion of EIA Study to International Standards</b>					
A1	Monitoring of Fisheries	SPC/DOE	Dept. Fishery	2	30,000
A2	Aquatic Ecology Surveys	SPC/DOE	Consultant	2	60,000
A3	Water Quality Monitoring	SPC/DOE	Consultant	2	50,000
A4	Water Quality Forecast Study (Reservoir Modeling)	SPC/DOE	Consultant	1	60,000
A5	Study and Design of Water Re-Aeration Structures	SPC/DOE	Consultant	1	50,000
A6	Study for Optimization of Riparian Release	SPC/DOE	Consultant	1	20,000
A7	Study for D/S Villages Water Supply	SPC/DOE	Consultant	1	50,000
A8	Land Use Study of Village Gardens along River Banks in D/S Area	SPC/DOE	Consultant	1	20,000
A9	Study on Wildlife and Biodiversity with Preparation of Rescue Plan	SPC/DOE	Consultant	1	80,000
A10	Survey of Reservoir Timber and Vegetation Biomass	SPC/DOE	NOFIP, Consultant	2	110,000
A11	Preparation of Logging and Clearing Plan	SPC/DOE	Consultant	1	46,000
A12	Strategic Study for Biodiversity Compensation and Support (possible participation to trust fund)	SPC/DOE	CPAWM, Consultant	1	20,000
A13	Preliminary Watershed Management Plan	SPC/DOE	Consultant	1	10,000
A14	Preparation of Detailed Environmental Management and Monitoring Plan	SPC/DOE	Consultant	-	60,000
A15	Coordination, Reporting, Presentation	SPC/DOE	Consultant	-	60,000
<b>SUB TOTAL A</b>					<b>726,000</b>
<b>B Completion of Resettlement Action Plan(RAP) &amp; Social Action Plan(SAP)</b>					
B1	Preparation of Draft RAP	SPC/DOE	Consultant	2	60,000
B2	Study on Floating Net Aquaculture/Fisheries Intensification	SPC/DOE	Consultant	1	60,000
B3	EIA for Resettlement Sites	SPC/DOE	Consultant	1	70,000
B4	Archeological Review & Field Survey	SPC/DOE	Archeological Department	1/4th	5,000
B5	Detailed (Participatory) Design of Floating Net Aquaculture Livelihood Program	SPC/DOE	Consultant	2	60,000
B6	Agricultural Development Program (design phase)	SPC/DOE	Consultant	2	60,000
B7	Forest Management Program (design phase)	SPC/DOE	Consultant	2	60,000
B8	Livestock Improvement Program (design phase)	SPC/DOE	Consultant	2	60,000
B9	Dairy Development Program (design phase)	SPC/DOE	Consultant	2	60,000
B10	Horticulture Development Program (design phase)	SPC/DOE	Consultant	2	60,000
B11	Technical Training Program (design phase)	SPC/DOE	Consultant	2	60,000
B12	Detailed Census of Inundation Losses	SPC/DOE	Consultant	1	30,000
B13	Preparation of Public Consultation Program	SPC/DOE	Consultant	1	30,000
B14	Capacity Assessment Resettlement Sites	SPC/DOE	Consultant	1	50,000
B15	Backwater & Sedimentation Modeling	SPC/DOE	Consultant	1	100,000
<b>SUB TOTAL B</b>					<b>825,000</b>

Table 6.3.6 Environmental Mitigation Studies and Measures with Related Budget Estimated (Unit : US\$)

C Organization of Environmental Management Unit (EMU) and Committee					
C1	Constitution of EMU	GOL/SPC	STEА/ DOF/EDL	0.5	80,000
C2	Capacity building of EMU and Creation of Committee (1 year Technical Assistance)	STEА/SPC	EMU/ Consultant	1	300,000
C3	Preparation of Detailed Working Program for EMU	GOL/SPC	STEА/ Consultant	0.5	300,000
C4	Appointment of Independent Panel of Experts	GOL/SPC	STEА	-	600,000
C5	Preparation of Detailed Environmental Specification for Contractors	SPC/DOE	Consultant	-	30,000
<b>SUB TOTAL C</b>					<b>500,000</b>
D Measures during Construction Phase (5 years)					
D1	Provide Operating Budget for EMU	GOL/SPC	STEА	5	900,000
D2	Appointment of Independent Panel of Experts	GOL/SPC	EMU	-	300,000
D3	Monitoring of Contractor's Construction Sites and Camps	GOL/SPC	EMU	5	-
D4	Provision for Compensation for Accidental Spill or D/S Pollution	STEА	EMU	When justified	100,000
D5	Provision for Independent Investigation Audit and Arbitration of Impact Event, if required	EMU	Consultant	When justified	20,000
D6	Monitoring of Fisheries in Reservoir & D/S villages	EMU	Fishery Dept.	5	75,000
D7	Construction of Water Supply Facilities for D/S Villages last 1-2 years of Construction	EMU	SPC	1-2	250,000
D8	Water Quality Monitoring (incl. technical assistance)	EMU	Vientiane Laboratory	5	125,000
D9	Study for Detailed Rehabilitation of Quarries, Borrow and Spoil Banks	EMU	Consultant	1	30,000
D10	Preparation of Specifications for Logging and Clearing Tender Documents, Evaluation of Tenders	STEА Forest.Dept.	EMU Consultant	0.5	20,000
D11	Technical Assistance to EMU for Supervision and Monitoring of Logging and Clearing	EMU	Consultant D. Forestry	2	150,000
D12	Clearing of Reservoir	EMU	SPC	2	3,000,000
D13	Preparation of Detailed Watershed Development and Management Plan	STEА CPAWM	Consultant	1	100,000
D14	Study for Creation of Wildlife Reserve	STEА	EMU, Consultant	1	50,000
D15	Budget for Land Acquisition and Compensation along Access Road & Transmission Line	STEА/SPC	EMU	1	110,000
<b>SUB TOTAL D</b>					<b>5,230,000</b>
E Measures during Reservoir Filling Phase					
E1	Provide Operation Budget for EMU	SPC	EMU	1	180,000
E2	Water Quality Monitoring	EMU	Vientiane Laboratory	1	12,000
E3	Specific Monitoring of Released Water Quality	STEА	EMU, Consultant	1	12,000
E4	Monitoring of D/S Fisheries	EMU	Fishery Dept.	1	15,000
E5	Implementation of Animal Rescue Plan and Management of Filling Event (2 years)	EMU	SPC	1st year	130,000
E6	Removal of Floating Trunks and Branches and Release on Ground Landings	EMU	SPC	1	150,000
E7	Implementation of Fisheries Intensification Program in D/S Villages	MOAF	Fish Dept. SPC	-	11,000
<b>SUB TOTAL E</b>					<b>510,000</b>

Table 6.3.6 Environmental Mitigation Studies and Measures with Related Budget Estimated (Unit : US\$)

F Measures during Initial Operation Phase (year 1-5)					
F1	Provide Operation Budget for EMU	GOL/SPC	-	1	180,000
F2	Water Quality Monitoring	EMU	Vientiane Laboratory	5	90,000
F3	Specific Monitoring of Released Water Quality	STEA	EMU Consultant	2	24,000
F4	Management of Filling Event (2 years)	EMU	Consultant SPC	2nd year	40,000
F5	Evaluation/Provision of Compensation for Loss of River Bank Gardens and Existing Irrigation Facilities	STEA	EMU	1	50,000
F6	Monitoring of D/S Fisheries	EMU	Fish. Dept.	5	75,000
F7	Development of Irrigation in D/S Area	MOAF	Irrig. Dept. SPC	-	20,000
F8	Compensate for Lost Biodiversity by Annual Contribution to Environmental Trust Fund	GOL	EDL or SPC	5	50,000
F9	Implementation of Watershed Management Plan (for aspects related to Project)	GOL	EDL or SPC	5	50,000
<b>SUB TOTAL F</b>					<b>579,000</b>
G Measures during Concession Period (year 6-25)					
G1	Water Quality Monitoring	EMU	Vientiane Laboratory	5	60,000
G2	Compensate for Lost Biodiversity by Annual Contribution to possible Environmental Trust Fund	GOL	EDL or SPC	20	120,000
G3	Implementation of Watershed Management Plan	GOL	MOAF	20	120,000
G4	Implementation of Commercial Fisheries Program in Reservoir	GOL/SPC	MOAF	5	60,000
G5	Implementation of Fish Culture in Reservoir	GOL/SPC	MOAF, Private Sect.	5	60,000
<b>SUB TOTAL G</b>					<b>420,000</b>
<b>GRAND TOTAL (A to G)</b>					<b>8,790,000</b>

Note: SPC = Special purpose company,  
 DOE = Department of electricity (MHH),  
 EMU = Environmental Management Unit,  
 GOL = Government of Laos  
 EDL = Electricite du Laos

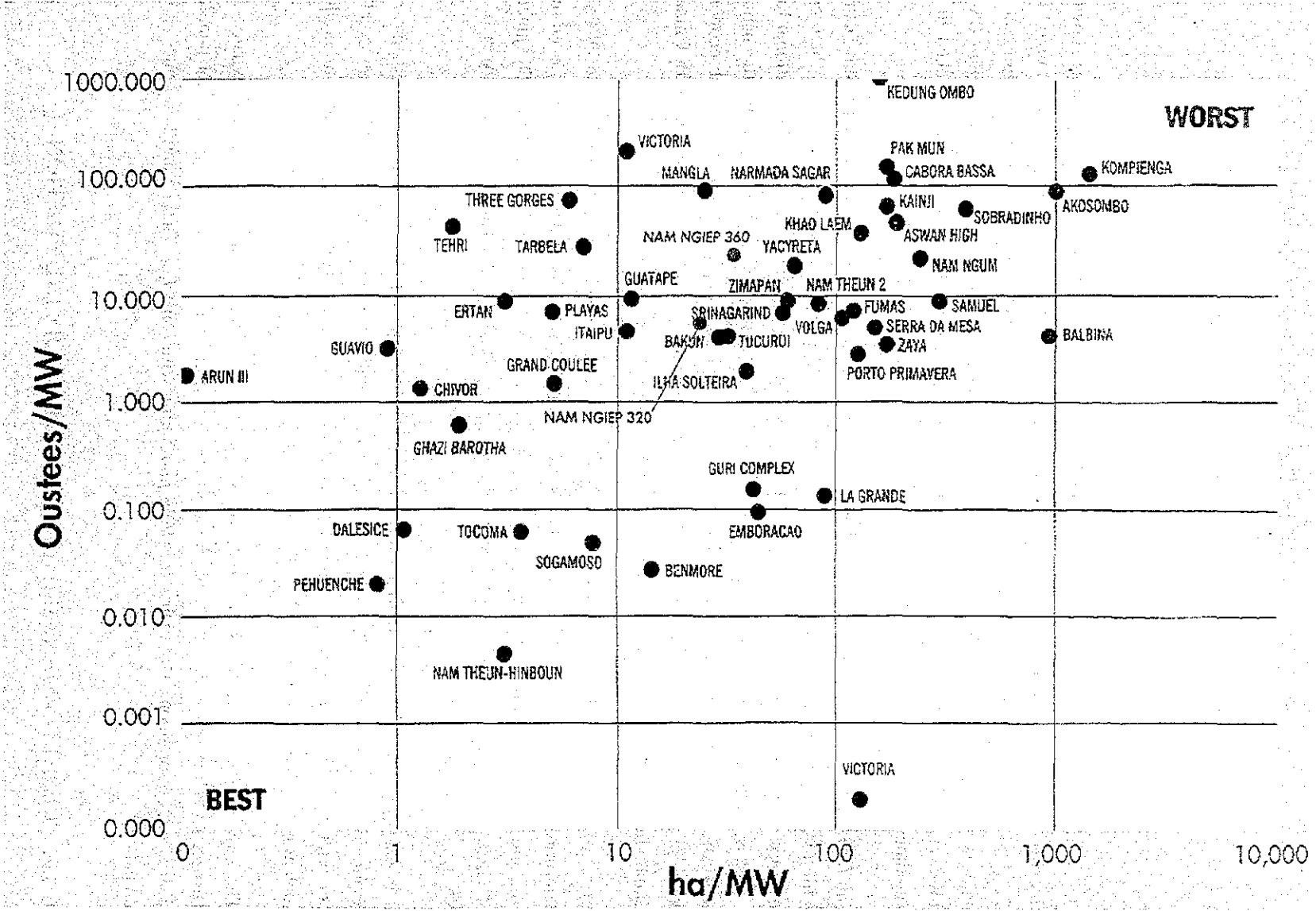


Figure 6.3.1 Position of Both Alternatives compared with Several Other Projects in the World

## 6.4. PRELIMINARY RESETTLEMENT PLAN (PRP)

### 6.4.1. PROPOSED RESERVOIR AREA

The entire NNHP Reservoir Area will be within the *Khetpiset* (Special Zone) Xaysomboon as shown in Figure 6.4.1. Formerly part of Vientiane and Xieng Khouang Provinces, Xaysomboon was set up on July 23, 1994 to give the area special preference for community development. *Lao Soung* represent the majority of the population in the area (45%) followed by *Lao Theung* (35%) and *Lao Loum* (20%). However, in July 2001, Hom and Lonsone Districts out of 5 districts in Xaysomboon backed to the Vientiane Province.

The *Upper Reservoir Area* of the proposed NNHP is within Thathom District, in Thaviang Sub-District. With a population of approximately 7,500 people living in 33 villages, Thathom District has the second lowest population in Xaysomboon. The present National Route 4 (NR4) to be upgraded to National Road 1 passes through the proposed Upper Reservoir Area. The Government plans to extend the national network with a center spine NR1. This road is strategically important for the social economic development of the country and will run from the northern-most point of Lao's border with China to Cambodia in the south, adding another 1,000km to the network.

The Upper Reservoir Area will also benefit from the transmission line route for the ADB-financed Power Transmission and Distribution Project, since the line is along NR4. The district will have an even more strategic location when NR5 is completed, linking Thailand through Vientiane to Vietnam. The junction of NR5 and NR1 will be in the Thaviang Sub-District of Thathom, the Upper Reservoir Area of the NNHP.

It is possible that with better transportation facilities in the Upper Reservoir Area, and with the high population density relative to cultivable land area in China and Vietnam, there could be an excellent potential in *niche* market items grown at high tropical elevations, in addition to more common products such as horticulture, dairy and beef cattle or reservoir fisheries.

The *Lower Reservoir Area* of the proposed NNPP is within Hom District, Vientiane Province. The District's population is approximately 6,600 people living in 31 villages, making it the least populated district in Xaysomboon. Hom District is 90% *Lao Soung* with some *Lao Theung* and *Lao Loum* making up balance.

### 6.4.2. RESETTLEMENT IMPACTS OF RESERVOIR INUNDATION

A reconnaissance field visit August 25-28, 1998 for the IEE found the population within the planned Reservoir Area to be more built up than anticipated. Instead of around an expected 2,000 people, it found



the overall reservoir area population to be more than double this figure, at somewhat less than 5,200 persons. The reconnaissance team also found considerable government-supported irrigation development in the proposed Reservoir Area.

The extent of this was confirmed by a socioeconomic survey carried out December 1998 to January 1999. This survey found about 650ha of irrigated rice paddy, with 150ha more planned by GOL, instead of, as was originally assumed, only dry evergreen tropical forest, temporary or permanent agricultural areas, degraded forest, old re-growth and fallow resulting from shifting cultivation in the proposed Reservoir Area. In addition, the *Upper Reservoir Area* is a national Focal Area for Rural Development (FARD), making it a resettlement receiving area for highland populations; and the *Lower Reservoir Area* has been under a UNDP development project for a couple of decades. At FSL.360m, the proposed reservoir will flood 17 villages consisting of some 903 households, with a population of 5,629. More than 800ha of irrigated paddy land built through GOL or UNDP aid schemes would be inundated. Distribution of all villages in the proposed reservoir area is shown in Figure 6.4.2.

The socioeconomic survey was extended to the downstream area in March 1999, and population was surveyed again in March 2002. According to the socioeconomic survey of the Project Area, overall, including both Upstream and Downstream Areas, nearly 2,300 households and 13,000 persons may be affected to one degree or another by the NNHP. About 660 households and 4,000 persons in 13 villages are in the Upper Reservoir and another 240 households and 1,600 persons in 4 villages the *Lower Reservoir* could potentially be affected by involuntary resettlement. For Downstream Villages as shown in Figure 6.4.3, about 1,400 households and 7,300 people in 15 villages would be affected through changes in the Nam Ngiep River flow and water. The villages affected both upstream and downstream of the proposed Dam are shown in table below: The numbers in table below were reviewed during the 2nd Site Workshop in March 2002.

Table 6.4.1 Numbers of Households and Population in Reservoir Area and Downstream Area

Reservoir Area		Households	Population	EL.(m)
Upper Reservoir:				
1.	B. Phonehom	71	413	368
2.	B. Namlong	21	126	364
3.	B. Xiangkhong	40	240	362
4.	B. Nakang	25	132	355
5.	B. Nahong	75	446	342
6.	B. Viengthong	46	281	339
7.	B. Naxay	25	154	332
8.	B. Naxong	76	461	330
9.	B. Phonyeng	58	332	328
10.	B. Dong	85	535	327
11.	B. Hatsamkhonc	27	174	326
12.	B. Phiangta	48	328	323
13.	B. Pou	67	398	319
<b>Upper Reservoir Sub-Total:</b>		<b>664</b>	<b>4,020</b>	-

<b>Lower Reservoir:</b>		<b>Households</b>	<b>Population</b>	<b>EL.(m)</b>
1.	B. Houaypamon	20	117	275
2.	B. Namyouk	106	715	271
3.	B. Soppouh	35	252	261
4.	B. Sopyouk	78	525	245
<b>Lower Reservoir Sub-Total:</b>		<b>239</b>	<b>1,609</b>	<b>-</b>
<b>Total of Reservoir:</b>		<b>903</b>	<b>5,629</b>	<b>-</b>
<b>Downstream of Dam</b>				
<b>Bolikhan District</b>		<b>Households</b>	<b>Population</b>	<b>EL.(m)</b>
1.	Hat Kham	86	533	-
2.	Tahua	44	252	-
3.	Somseum	197	1,136	-
4.	Nam Pa	75	427	-
5.	Houay Koun	338	1,632	-
<b>Bolikhan District Sub Total :</b>		<b>740</b>	<b>3,980</b>	<b>-</b>
<b>Pakxan District</b>		<b>Households</b>	<b>Population</b>	<b>EL.(m)</b>
1.	Nong - Deng	19	112	-
2.	Thong - Noi	86	585	-
3.	Thong - Gnai	65	368	-
4.	Song Khon	42	239	-
5.	Phonsi	117	637	-
6.	Thakokkhen	-	-	-
7.	Nam Tek	40	295	-
8.	Nam Ngiep	78	309	-
9.	Sen - Oudom	75	397	-
10.	Komsipchet (Military Village)	147	363	-
<b>Pakxan District Sub Total :</b>		<b>669</b>	<b>3,305</b>	<b>-</b>
<b>Total of Dam D/S</b>		<b>1,409</b>	<b>7,285</b>	<b>-</b>

The table also illustrates which villages will be affected at FSL.360m and FSL.320m. While not all villages would be submerged even by FSL.360m alternative, their rice lands are all situated along the Nam Ngiep River and its territories at low levels. So we can assume that virtually all the villages would require resettlement, if FSL.360m dam is chosen for implementation. Generally speaking, mitigation includes minimizing resettlement to the extent possible, carrying out an international standard of resettlement planning and implementation if unavoidable, and fair compensation for the displaced population.

The recommended design mitigation at this time is to consider the lower dam alternative. The initial thinking was that lowering the FSL to EL.320m would reduce the number of affected villages down to 5 villages. There is not enough information at this time, however, to determine the amount of *backwater effect* would be, *i.e.*, how much higher the water at the back of the reservoir will be than at the front end. We would assume about 2m, including a safety margin. Therefore, consideration of the backwater effect indicates that EL.318m might be necessary to protect the majority of irrigated paddy land belonging to the Upper Reservoir villages, nearly 300 ha of the total reservoir paddy land. This FSL.318m dam would more surely reduce the affected population down to 260 households and about 1,600 people.

Besides the backwater effect, *population increase* will also need to be taken into account. Since the *Upper Reservoir Area* is a FARD, located within a river valley and along a national highway, 10 years from now the current population will have grown by natural increase (nationally at 2.6% and in

Xaysomboon at 3%) and by in-migration. Although this Preliminary Resettlement Plan (PRP) will use the above population figures, for planning sake all quantities and financial evaluations will increase by 30% to account for the natural population increase and for in-migration over a 10 year period ending in 2010.

According to the socioeconomic survey, some 53% of households in the Reservoir Area have been there for less than 5 years. For the Upper Reservoir this figure is nearly 60% and for the Lower Reservoir almost 40%. Similarly, some 42% of households reported that they had been 'officially resettled' in the Reservoir Area, 43% in the Upper Reservoir and 41% in the Lower Reservoir. The Reservoir Area households surveyed have come from 23 different districts in the 7 northern Provinces of (i)Xieng Khouang, (ii)Xaysomboon, (iii)Houaphanh, (iv)Bolikhamsay, (v)Vientiane, (vi)Luang Namtha, and (vii)Luang Prahbhangh.

Most village households in the Upper Reservoir surveyed came from Kham District, Xieng Khouang Province. Thathom District itself, which is the district where the Upper Reservoir is located, accounts for the second largest number of households after Kham District. In contrast to the Upper Reservoir, most of the Lower Reservoir households surveyed, virtually all *Lao Soung*, came from Hom District of Vientiane Province, the district in which they now live.

Note; The paragraphs above are quoted from the Phase I Final Report as mentioned in Chapter 6.1 General hereof. In the paragraph above, the FSL.318m, which is 2m below the proposed FSL.320m, was recommended, however, FSL.320m has been applied to the final design by the limited maximum sedimentation height at EL.320m due to the Phase II study results as shown in Chapter 8.3.2 Backwater Effect, hereinafter.

#### 6.4.3. DEVELOPMENT OF DRAFT RAP & FINAL RAP

This document, the Preliminary Resettlement Plan (PRP) is prepared without the final design of the NNHP having been decided. Once the dam height is arrived at, a full Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) will be required by internationally accepted guidelines, as well as preparation of a full Resettlement Action Plan (RAP) and a Social Action Plan (SAP) for mitigating other social impacts. During preparation of a draft RAP, the following studies will take place:

- (i) Socio-Cultural Assessment of Resettlement and Host Communities (Part of SIA)
- (ii) Preparation of a Public Consultation Framework
- (iii) Capacity Assessment of Resettlement Sites
- (iv) Backwater and Sedimentation Modeling
- (v) Archeological Review and Field Survey
- (vi) Technical Resources explored and detailed TOR for development of Livelihood Packages prepared

Upon completion of the draft RAP, the F/S should also come to an end, and Project Preparation, including Detailed Project Engineering Design and a final RAP, should coincide with the process of securing finance and international guarantees for the Project.

During the Project's Detailed Engineering Design Phase, following the F/S, a number of studies and program design activities should be carried out to finalize the RAP. These will include, but not necessarily be limited to:

- (i) Detailed Design of Livelihood Packages
- (ii) Detailed Census of Population and Inundation Loss of Assets and Natural Resources, including detailed Land Tenure Survey
- (iii) New Village Design, including access roads, electricity, water, infrastructure, housing and community layout of resettlers' choice, and other features determined through community consultation
- (iv) Unexploded Ordinance (UXO) Reconnaissance and, as Necessary, Clearance of Resettlement Sites
- (v) Livestock Transport And Health Program Design
- (vi) Pre Resettlement Health Program Design, with focus on maternal and child health, elderly, handicapped and otherwise vulnerable persons
- (vii) AIDS/HIV Awareness And Prevention Program, with focus on construction sites and surrounding areas
- (viii) Estimate of land and population affected by Transmission Line(s) and Access Roads and formulation of compensation plan for affected persons.
- (ix) Environmental Impact Assessment (EIA) of RAP

Other studies and program design activities, with TORs and costs will be determined during preparation of a Social Action Plan (SAP) and Watershed Management *cum* Regional Development Plan.

Some very rough figures for the preparatory RAP studies might be approximately US\$1,100,000 for FSL.360m alternative and about US\$600,000 for FSL.320m alternative, not including costs for studies included under the EIA.

#### 6.4.4. RESETTLEMENT ACTION PLAN (RAP)

##### (1) RESETTLEMENT OBJECTIVES AND PRINCIPLES

The resettlement objectives of the NNHP RAP, as it is developed, will be in accordance with the *Draft National Resettlement Policy for Major Projects in the Lao PDR*, as developed through preparation of the

Nam Theun 2 (NT2) resettlement policy. This policy has been reviewed by the World Bank and found in accordance with international best practice.

Accordingly, the main objectives of the NNHP RAP will ensure that (a) the population to be resettled materially improves its standard of living after resettlement and that (b) those compensated under the policy are compensated adequately.

## (2) IDENTIFICATION OF POTENTIAL RESETTLEMENT SITES

### Phase I Study (in 1999)

The Study Team and the counterparts carried out a preliminary inventory of 16 potential resettlement sites from mid July to mid October 1999 as shown in Figure 6.4.4. Most of the sites were recommended through interviews with officials of Xieng Khouang and Bolikhamsay Provinces, of Borikhan District within Bolikhamsay Province, and of the Xaysomboon Special Zone. An assessment of the sites was also made through use of aerial photos (1:30,000 taken in 1998) for identifying land use at each site. The photo interpretation was backed up with topographic maps at a 1:100,000, 1:50,000 and 1:25,000 scale, depending on availability, to study the topographic conditions.

A prioritizing of resettlement areas was carried out, based on the cultural preference of rural Laotians for rice cultivation. Resettled households are assumed to need 1.0ha of paddy field and 0.5ha for housing, gardens and other facilities. This is about 15% higher for land holding than that currently prevailing in the Reservoir Area, at 0.83ha/household for irrigated and rainfed paddy (0.18ha/household for wet season irrigated paddy alone). The Study Team generally assumed that about 50% of relatively flat land classified as 'unstocked' forest would be suitable for paddy development. On October 2, 1999, a helicopter reconnaissance was also carried out for the proposed resettlement sites to the South of the proposed reservoir.

The preliminary inventory of potential Resettlement Sites for the NNHP has indicated that out of 16 sites proposed by Local Government officials, resettlement might be possible in 14 sites. Three (3) of the sites were judged to be most attractive: Sites D1 and D2 in the Bolikhan District, Bolikhamsay Province and XK3 in Kham District, Xieng Khouang Province. Because they: have greater potential for paddy development; are located close to the administration center and near populated areas that could provide other earning opportunities; are within the FARD of either the concerned District or Province; and have been suggested by local authorities. Although all of the sites will be studied, these 3 sites alone, it is thought, could accommodate 3,250 households.

The Resettlement Site Inventory is a desk study, and its conclusions are preliminary and indicative. The scope of study for future investigations will include, *inter alia*, technical investigation of soil suitability and water availability for agricultural development, particularly of irrigation development; the prevailing socioeconomic, tenure and cultural conditions of the proposed sites; and other feasibility of additional livelihood packages at the sites.

**Phase II Study (in 2002)**

The objective of the resettlement site study is to conduct a detailed survey in the resettlement potential areas. The field survey was conducted by confirming suitability for two (2) resettlement areas and a small possible area just downstream of the proposed dam site. All potential sites are located in Bolikhanh District of Bolikhamsay Province as shown in Figure 6.4.5 and the following table:

Table 6.4.2 Surveyed Resettlement Potential Area

1.	Name of Area	Xiengxian-XiengLeu and Hatkham	Phabuak
2.	Location	a flat terrain along the Nam Lat river stretched from B.Thasi to B.XiengLeu, about 54km from the Bolikhanh district.	a flat terrain located between Talabat and Pousiat mountains along the Nam Sun and Nam Poy rivers around at B.Pakbuak, distance about 37km from the Bolikhanh district.
3.	Surrounding	The North : Nam Mang river The East : Thathom district, Xaisomboun The South : Viengthong district The West : Pou Had and Pou Phathao mountains	The North : Nam Sun river The East : Pou siet mountain The South : Pou Meuy mountain The west : Talabat mountain
4.	altitude	from EL188 to EL.210	-

The objective of the resettlement area survey at Phase II Study was to verify the suitability of the potential areas through a field survey to be undertaken with the participation of the representatives of local communities.

The field survey report includes survey results on (i) land use and forest cover, (ii) land suitability for rice cultivation and other crops, (iii) soil type, (iv) irrigation possibility, (v) land suitability for livestock, (vi) water source availability for domestic consumption, (vii) accessibility, (viii) electrification possibility. And surveyors collected (i) opinion of the local authorities and communities regarding each potential site, and (ii) photography of main physical features of each site.

The survey team briefed the local authority and community on the scope of the survey prior to field visit. The survey team collected their opinions on the relevance of each potential site after the field visit. Soil survey was carried out on the basis of the visual observation and the soil sampling for laboratory analysis (nutrient content, texture and salinity). Types of land use were identified based on existing maps, aerial photo interpretation and field check. GPS was used for assessing the size of the potential site. Irrigation potential was assessed through the visit of streams near each potential site and empirical computation of the water availability.

A Resettlement Site Survey was initiated in July and August, 2002 and was undertaken by STS Consultants, a local consulting firm. This survey focused on sites in Bolikhan District of Bolikhamsay Province, evaluated the topography, present land use, soils, land suitability for rice culture and other crops and considered local water resources, road access, infrastructure and electricity sources. The three (3) sites surveyed included

- (i) Thaksi- Xieng Leu- Xieng Xiane – approximately 2,367 ha containing seven (7) villages with a total population of 2,158 persons located along the future Highway 1D
- (ii) Pakbuak – approximately 3,924 ha containing four villages with a total population of 1,480 persons and located with future access roads gazetted for completion prior to 2005.
- (iii) Hatkham – approximately 385 ha with no resident villages some evidence of use on a seasonal basis and located on the West bank of the Nam Ngiep River in the vicinity of the re-regulation weir with no access at present.

The locations of the sites are given in Figure 6.4.5 and all show good potential for agricultural development when irrigation is developed. The planning for development of the first two (2) sites is being assisted by the Lao-Luxemborg Land Use Planning Project.

No consideration was given to resettlement sites located within Hom District. The full results of the survey are contained in “Detail Report on Resettlement Survey – Nam Ngiep 1 Hydroelectric Power Project” by STS Consultants (August, 2002). The comparison results are shown in Table 6.4.3:

Table 6.4.3 Comparison of Resettlement Sites in Bolikhan District (Based on STS Report)

items	Resettlement Site		
	Thasi-Xiengxiane	Phakbuak	Hatikham
<b>Existing Communities</b>			
1. - Number of Villages	7	4	0
2. - Total Population	478 Families	341 Families	0 Families
3. - Cultural Affinities	30% Lao Lum & 70% Lao Theung	11% Lao Lum & 89% L. Theung	Lao Lum & Lao Soung
4. - No. of Schools & Teachers	7 and 20	4 and 14	1 and 7
5. - No. of Health Posts	0	1	0
<b>Site Investigations</b>			
1. - Total Area - ha	2367	3924	385
2. - Existing Land Use - ha			
Irrigated Land	133	30	0
Rainfed Paddy	449	75	5
Shift Cultivat & Other	132	150	137
3. - Total Area per Family -ha	1.5	0.7	Unknown
4. - Capacity @ 1.5 ha/ Family	1102 Families	2446 Families	165 Families
5. - Slope			
< 8%	74%	83%	100%
>8% and < 16%	26%	17%	-
6. - Irrigation Area/ Potentials			
Built or Programmed	30 ha	0 ha	0 ha
Proposed/ Potential	6 Projects- 3120 ha	Nam Sun-2000 ha	River –63 ha
7. - Suitability-Rice Cultivation			
LSR 1 Class – ha	435	1086	385
LSR 2 Class – ha	1223	670	-
LSR 3 & 4 Class - ha	709	2166	-
8. - Accessibility Potential			
National Roads	Hwy 1D	-	Paved Road
Provincial Roads	Road 01	Road 01	-
District/ Local Roads	Yes	Limited	No

items	Resettlement Site		
	Thasi-Xiengxiane	Phakbuak	Hatikham
9. - Electricity Potential			
Access to Pakxan 22kV	Yes	Yes	Yes
Local Mini-hydro	N.Mang – 4.8 Mw	No	No
Local Project Grid	No	No	Yes
<b>Based on Site Investigations</b>	<b>Score</b>		
1. - Land Availability	10	8	10
2. - Irrigation Potential	25	25	20
3. - Soil Suitable for Rice	20	15	18
4. - Avail of Electricity	10	8	6
5. - Avail of Resources	10	7	10
6. - Availability of Water	5	5	5
7. - Availability of Access	10	9	7
8. - Cap @ 1.5 ha/ Family	10	7	10
Total for Evaluation	100	84	86
Ranking of 3 Options		2nd	1st
Evaluated Points		Favorable from Irrigation and Access Viewpoint	Favorable from Large Capacity and Resources
			Keep for Works Resettlement

### (3) INCOME RESTORATION

Reassembling lost production systems is a complex and difficult task that requires specialists from a diverse set of backgrounds and, in order to work, will require the full participation of the resettlers themselves, not only in implementing the schemes but in planning them as well.

The NNPP will explore a range of livelihood options, each described in more detail in the main text of the PRP. The option of irrigated rice paddy appears to be one that most resettlers from the Reservoir Area are familiar with, given the amount, thanks to Government development programs, of irrigated land that already exists in the affected communities. Forestry management seems to be a concept that is also familiar, at least to those communities in the Lower Reservoir, though more needs to be known about this. Other livelihood options are floating net aquaculture, dairy and/or livestock cattle using grass on some 45km<sup>2</sup> of the reservoir draw-down area, fruit orchards, eco-tourism, and technical skills training. The project will explore using the services of NGOs specializing in rural development to assist in preparing these livelihood packages, through an extensive public consultation program to on the one hand understand villagers' desires and requirements and on the other to inform them about the proposed livelihood packages. This is so that the resettler's desires will be fully incorporated into the RAP at all levels.

### (4) REHABILITATION OF INDIGENOUS AND VULNERABLE PEOPLE

The Project will follow WB and ADB policies on indigenous peoples, which require in the cases of impacted vulnerable minorities, preparation of an Indigenous Peoples Development Plan (IPDP). During the Reservoir Area census carried out as part of the final RAP preparation, identification of other vulnerable groups (elderly, poor, handicapped, etc.) will be made and plans put together accordingly to assist them in making a successful transition to the new Resettlement Sites.



## (5) INSTITUTIONAL ORGANIZATION

In response to the NT2, the largest and most complex development project involving significant resettlement with which GOL has had to deal, GOL has established a comprehensive resettlement organizational structure that may be expected to function as well for the NNHP.

This comprises a Resettlement Committee (RC), a Resettlement Management Unit (RMU), District Resettlement Working Groups (DRWG), and Village Resettlement Committees (VRC). Collectively, these organizations will be given the responsibility for implementing the NNHP's RAP. Other Implementing Organizations will include the Provincial Authorities, the Lao Women's Union (LWU), Village Organizations, the Ownership Company, and Consultants, Contractors and NGOs.

During the resettlement implementation, the RMU and district working groups will play important roles. In order to strengthen their institutional capacity, a training program will be needed for their resettlement staff to have a clear understanding of resettlement policy objectives, the detailed resettlement program, and resettlement entitlements. In addition, workshops and on-the-job training will introduce a wide range of new skills for implementing livelihood and community development programs.

## (6) PARTICIPATION AND CONSULTATION

To obtain WB or other international donor funding requires that high social, environmental and economic standards be met in Project design and implementation. One such requirement is that the Project development process should involve the stakeholders – those people and institutions who have an interest in the Project, who will be directly or indirectly affected by it – and that their involvement should be integrated into the decision-making for the Project.

At the RAP preparation phase, the Study Team has carried out environmental and social studies prior to a decision on the project design, so that these factors are incorporated at the earliest possible stage into the project design itself. As part of the feasibility process for the Project, public consultations in the Project Area will be conducted separately during the Scoping, carrying out of EIA and SIA Studies, and Finalization of the EIA and SIA Reports. The Study Team will engage an NGO or subcontract to a local consultant to design and facilitate the implementation of the Public Consultation Process.

To ensure the basic rights and interests of resettlers are protected, concerns are adequately addressed and entitlements delivered, a Grievance and Appeals Procedure will be designed for the Project during preparation of the RAP. At present, an established procedure has been developed by the NT2 and will be the starting point for the NNPP, as described in detail in the main text of the PRP.

Monitoring will be carried out to ensure that the resettlement implementation is successful and that the villagers materially improve their livelihood after resettlement. Monitoring will be both internal and external. Internal monitoring will focus on the physical progress of resettlement implementation against the schedule in the approved RAP. Independent external monitoring will be on the change of livelihood

and standard of living among the relocated people.

### (7) BUDGET AND INUNDATION COSTS

Actual costs will be determined in the RAP preparation phase, based on a more comprehensive inventory of inundated assets. The current estimate is for FSL.320m dam RAP to cost just over US\$5 million and FSL.360m dam RAP to cost in the vicinity of US\$ 18 million including 15% of contingency. This compares well with international standards for resettlement budgeting, at about \$3,600 per person, or about ten times the per capita GDP of about US\$350. Including 30% added for population growth over ten years, these estimated total RAP figures will be around US\$7 and US\$23 million respectively.

Table 6.4.4 Cost Estimate for Preliminary Resettlement

No.	Items	Unit	Unit Costs	Q'ty	Amount	Source
<b>A Resettlement</b>						
A1.	Houses	House	2,120	260	551,200	HDP
A2.	Infrastructure	HH	1,300	260	338,000	PSPS
A3.	Resettlement Costs (moving)	HH	200	260	52,000	NT2 ALT
A4.	Miscellaneous	HH	130	260	33,800	-
<b>SUB TOTAL A</b>					<b>975,000</b>	
<b>B Livelihood Component</b>						
B1.	Lowland Paddy Irrigation Development	ha	5,000	260	1,300,000	Pan Piao
B2.	Upland Rice Field (0.5ha/HH)	ha	1,000	130	130,000	-
B3.	Garden (0.15ha/HH)	ha	1,000	40	40,000	-
B4.	Forestry Management Program	HH	625	260	162,500	NT2 RAP
B5.	Livestock Improvement Program	HH	625	260	16,250	NT2 RAP
B6.	Reservoir Develop.(Transport/Fishing)	HH	625	260	162,500	NT2 RAP
B7.	Agro Industry and Handicrafts Center	HH	625	260	162,500	NT2 RAP
B8.	Miscellaneous	HH	150	260	39,000	-
<b>SUB TOTAL B</b>					<b>2,159,000</b>	
<b>C Community Development &amp; Management</b>						
C1.	Skills Training	HH	200	260	52,000	NT2 RAP
C2.	Technical Support	HH	200	260	52,000	NT2 RAP
C3.	Community Development	HH	225	260	58,500	NT2 RAP
C4.	Income Support Program	HH	720	260	187,200	NT2 RAP
C5.	Resettlement Manage. Unit for 8 Years	HH	4,065	260	1,056,900	NT2 RAP
C6.	Health Program	HH	477	260	124,020	NT2 RAP
C7.	Miscellaneous	HH	360	260	93,600	-
<b>SUB TOTAL C</b>					<b>1,624,220</b>	

No.	Items	Unit	Unit Costs	Q'ty	Amount	Source
I	<b>TOTAL (A to C)</b>				4,758,220	
II	Possible Population Growth (30% of I)				1,427,466	
<b>GRAND TOTAL (I+II)</b>					<b>6,185,686</b>	

## Summary

A	<b>Grand Total of Environmental Issues</b>				<b>8,790,00</b>	
B	<b>Grand Total of Resettlement Issues</b>				<b>6,185,68</b>	
C	<b>TOTAL (A+B)</b>				<b>14,975,6</b>	
D	<b>Miscellaneous (10% of C)</b>				<b>1,497,56</b>	
<b>GRAND TOTAL (C+D)</b>					<b>16,473,2</b>	

## (8) ENVIRONMENTAL IMPACTS AND RESTORATION

In addition to a Population Carrying Capacity Survey of the identified Resettlement Sites, the Project will carry out EIA studies of the sites. The EIA will identify the beneficial and adverse impacts arising from the Project's resettlement activities, in terms of both the natural and human environment, and will propose mitigative measures to minimize adverse impacts while maximizing the beneficial impacts. An important aspect of the EIA in northern Laos will also be a reconnaissance survey of UXO and defoliants contamination at the Resettlement Sites.

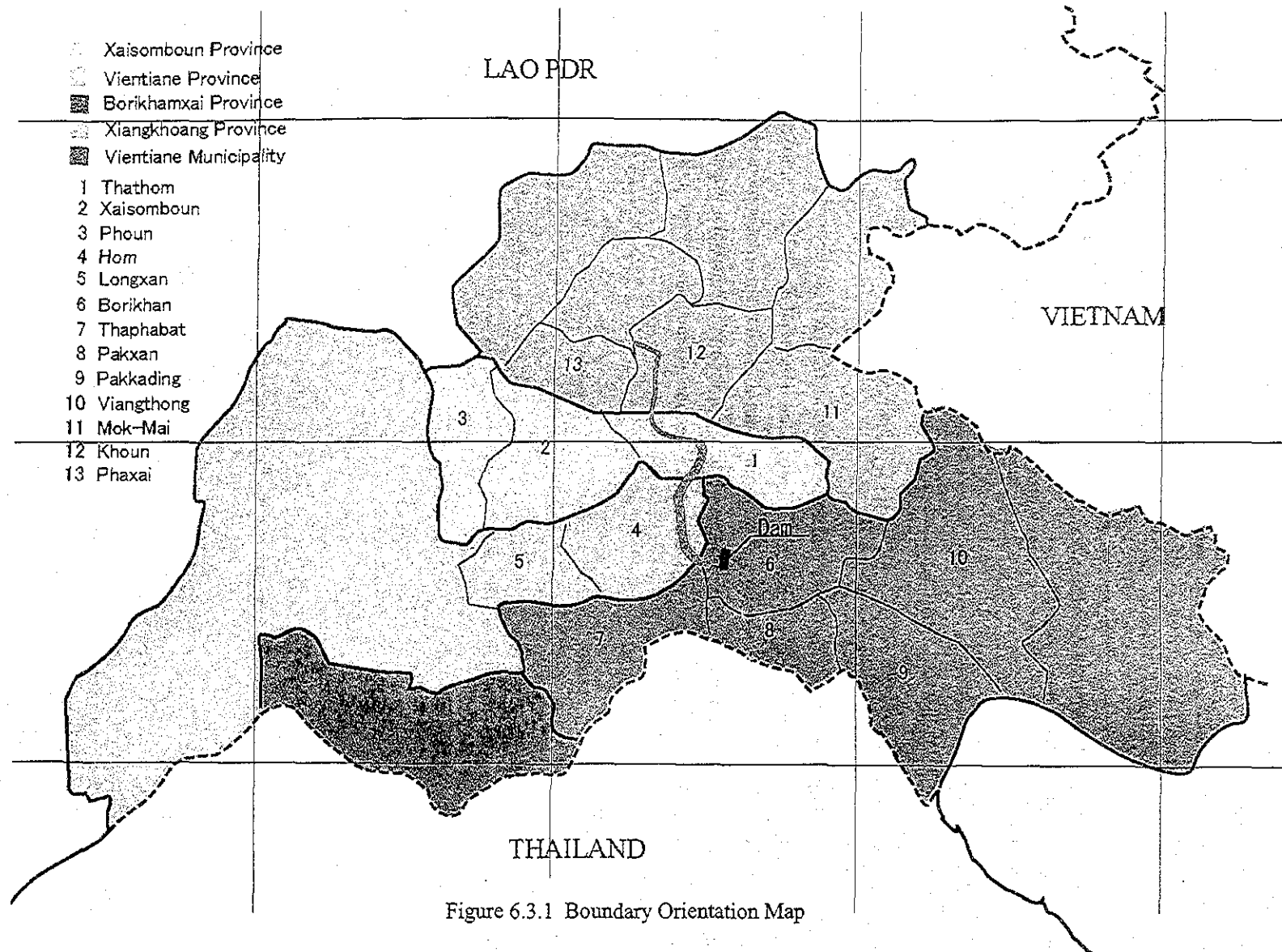


Figure 6.3.1 Boundary Orientation Map

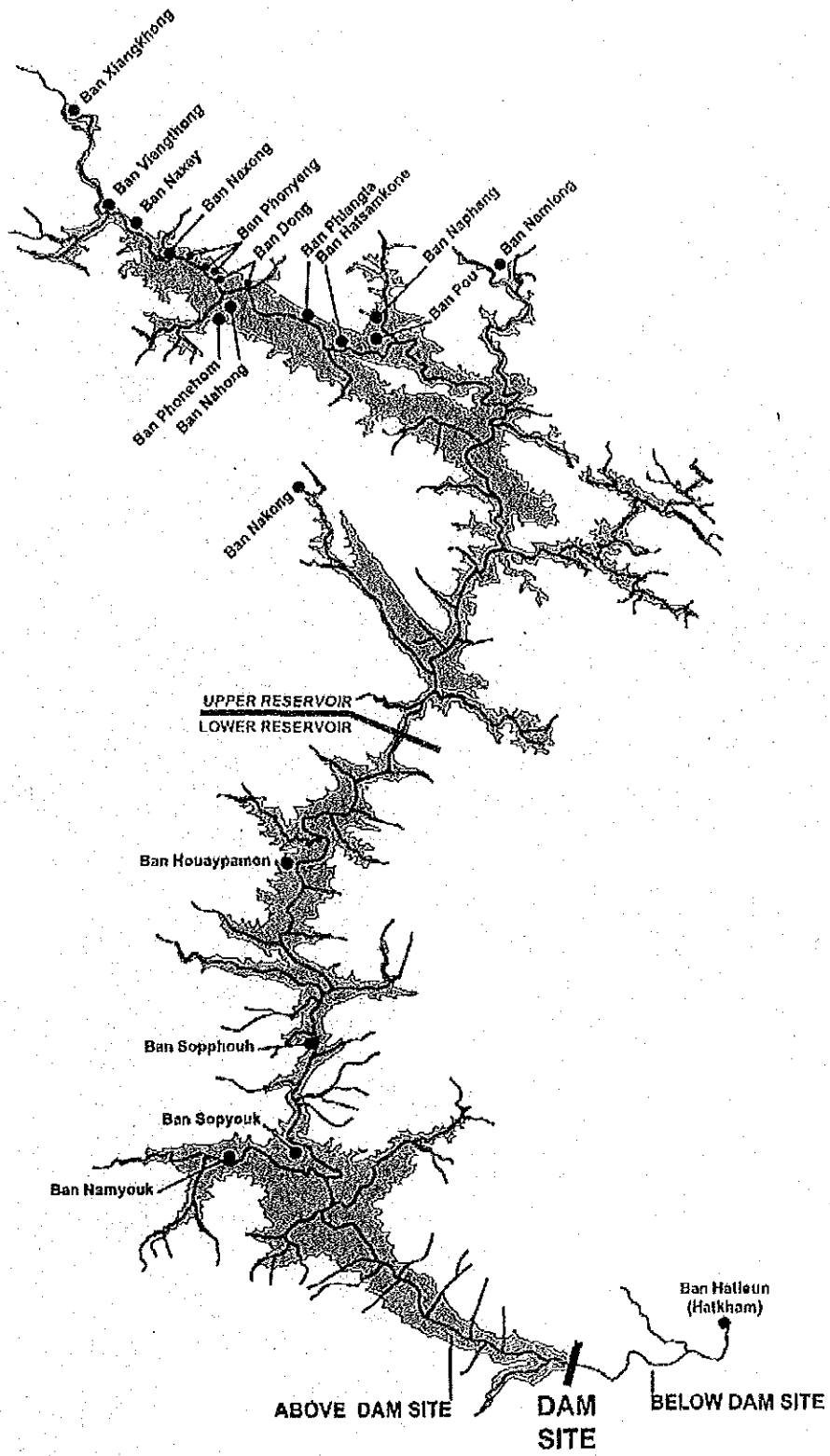


Figure 6.4.2 Reservoir Area Overview Map

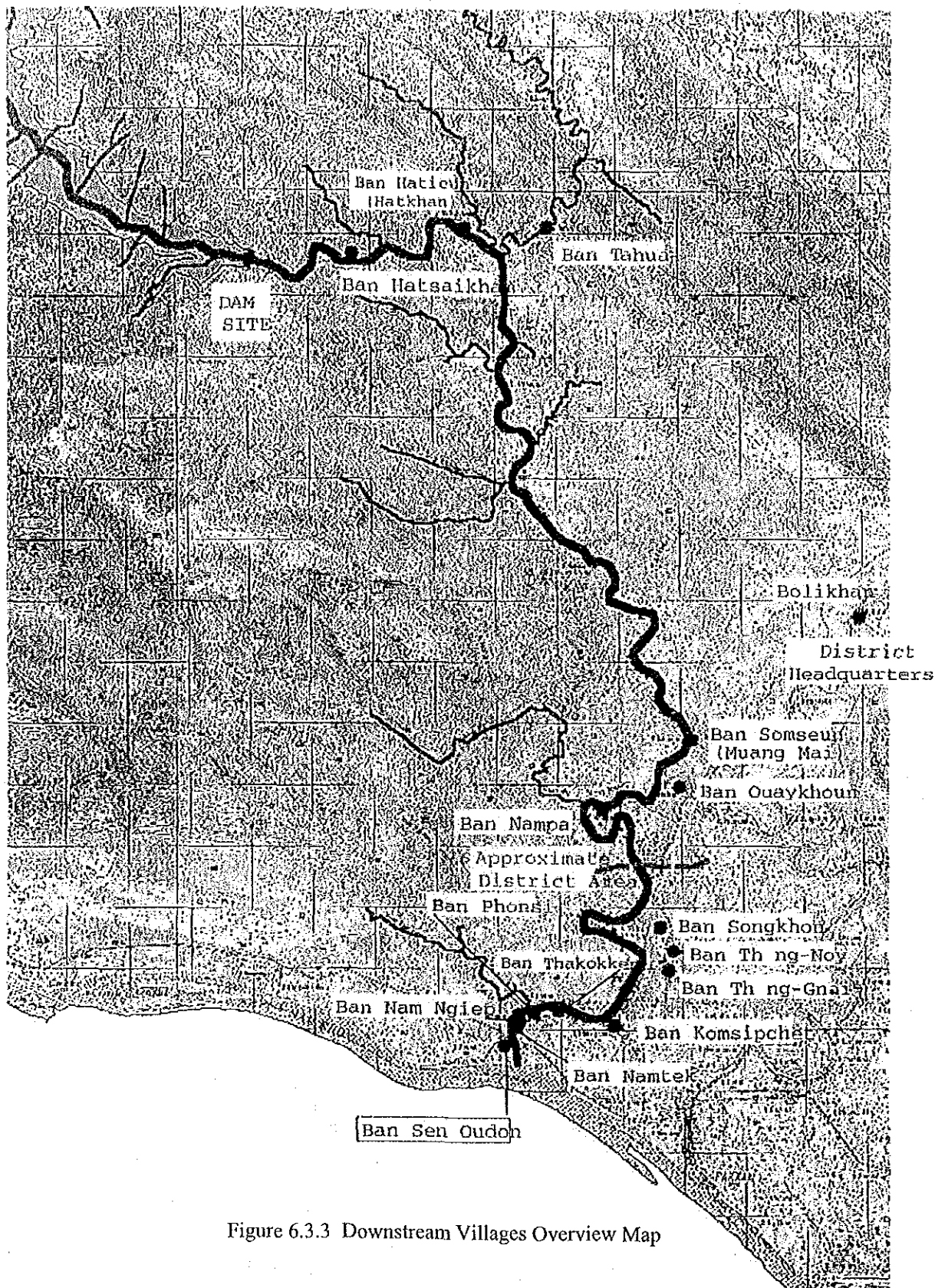


Figure 6.3.3 Downstream Villages Overview Map

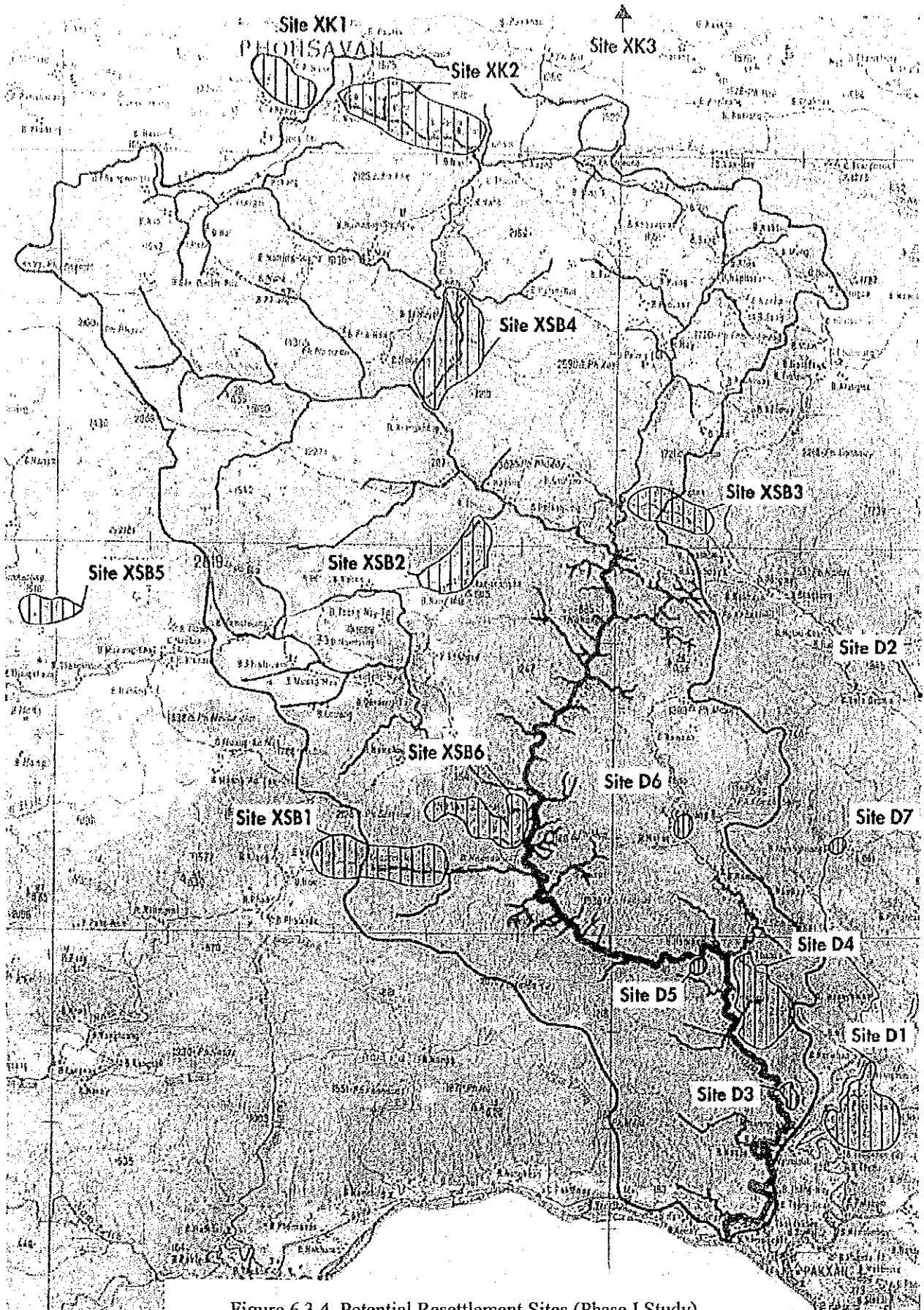


Figure 6.3.4 Potential Resettlement Sites (Phase I Study)

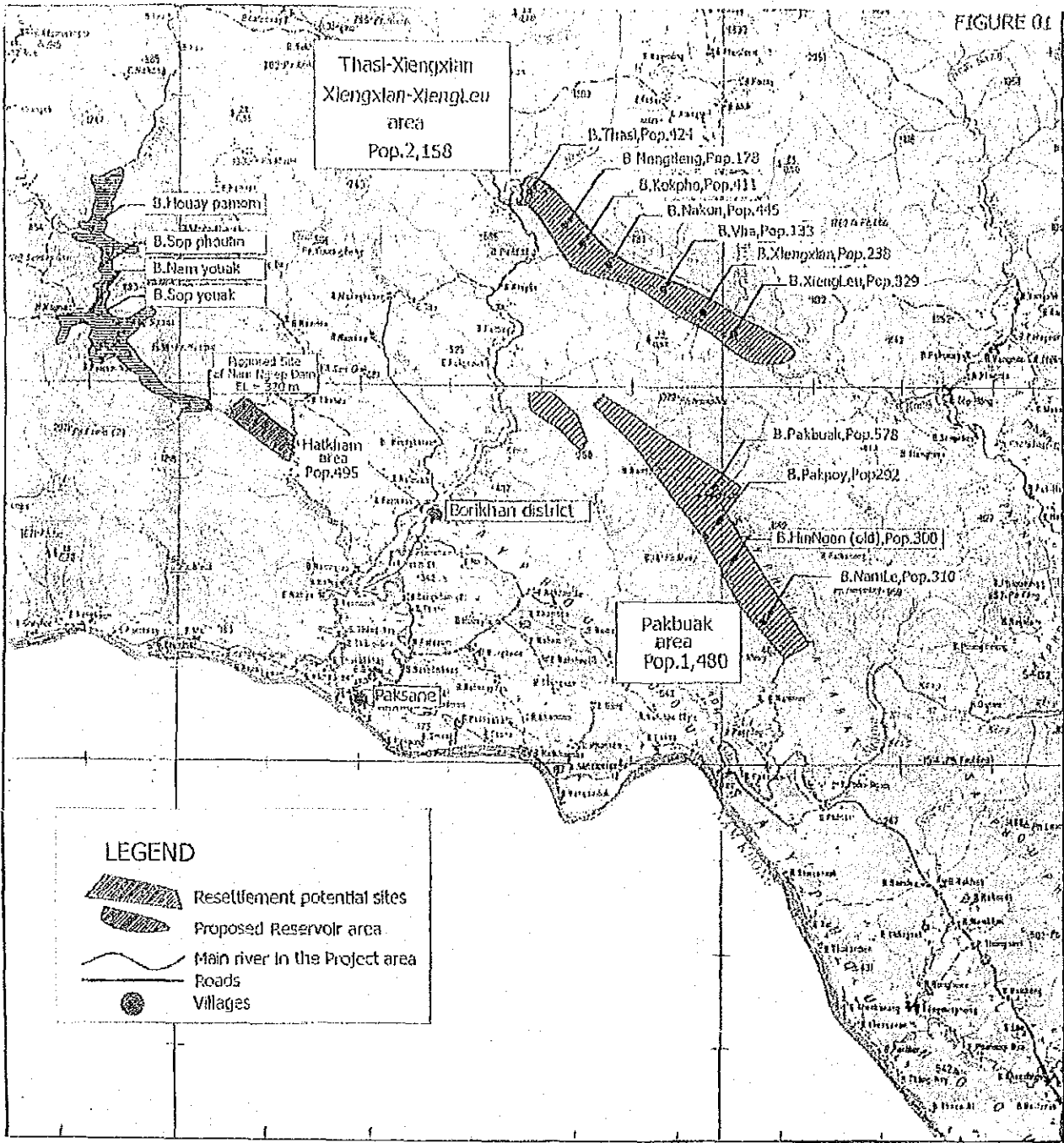


Figure 6.4.5 Potential Resettlement Sites (Phase II Study)



## 7. POWER MARKET RESEARCH

### 7.1 GENERAL

The main purpose of Nam Ngiep-I HEPP is to earn foreign currency by exporting electric power to neighboring countries, especially, Thailand or Vietnam according to the Government of Lao PDR (GOL)'s power sector development policy.

This chapter firstly reviews the GOL's power development policy and discusses GOL's institutional setup and project implementation arrangements for export-oriented hydropower projects. The future power export market potential to Thailand and Vietnam based on the countries' power demand projections and on the corresponding generation plans is also analyzed. Finally, this chapter discusses prospective electricity prices in the future electricity markets as well as impacts of restructuring of the Thai electricity supply industry on Lao's project development.

### 7.2 OVERVIEW OF LAO PDR MACROECONOMY AND ROLE OF POWER SECTOR

Lao PDR is one of the least less-developed countries (LLDC) in Asia with a per-capita GNP of only US\$330 in 2000. A mountainous country with a population of 5.2 million (as of 2000) and a population growth rate of 2.0%, it is landlocked and bordered by Thailand, Cambodia, Vietnam, China (Yunnan) and Myanmar, covering 236,800 km<sup>2</sup>. Agriculture is a major economic sector contributing 52% of GDP and employing over 80% of the labor force.

Since the introduction of reforms under the New Economic Mechanism (NEM) in 1986, the GOL has been transforming the economy from a centrally planned-system to a market-oriented system. The structural reforms and sound macroeconomic policy initiated under the NEM fostered a steady movement towards macroeconomic stability, production growth and emergence of private sector businesses, and increased foreign direct investment and trade flows with neighboring countries (particularly Thailand). It is the GOL's overarching goal to become a middle income country by year 2020 thus existing the LLDC status.

The gross domestic product (GDP) has continued to grow after a slowdown in 1998 due to the 1997 currency crisis. The real GDP growth rate was 7.3% in 1999 and 5.9% in 2000. Growth in the agricultural sector has been healthy at 8.2% in 1999 and 5.1% in 2000, and growth is balanced among

the sectors. Agriculture led the recovery in 1999, and industry and energy production (largely for export) were major contributors to growth in 1999 and especially in 2000. External conditions permitting, the country should be able to grow by 6 to 7% in the next two years.

After the two years of hyper inflation (87% in 1998 and 134% in 1999), prices increased moderately in 2000 and 2001. In 2000, inflation moderated to 27% and would likely to be below 10% in 2001 due to GOL's tight fiscal and monetary policies. The IMF recently approved a poverty reduction and growth facility for the country and this is testament to the GOL's efforts at economic reform.

Exports have grown steadily since 1998 and the balance of payments, although in deficit, is improving. Major exports include wood products, electricity and textiles. External financing has been the major source of funding for the balance of payment deficit, although foreign direct investment (especially in the hydroelectric sector) has played an important role as well. This trend is expected to continue as new hydroelectric investments enter the country.

The power sector in Lao PDR has special importance in the country's development aspirations. Inexpensive electricity is vital for domestic, commercial and industrial consumers within Lao PDR while electricity exports provide much needed foreign exchange. The power sector has played a pivotal role in the economic development of Lao PDR over the last thirty years. Continued economic growth is needed to alleviate poverty and achieve social development goals but the policy options for achieving this are constrained by the small domestic economy and limited trade opportunities. At the current stage of development, Lao PDR has only a few industries in which it enjoys a comparative advantage in the region: the most important of these is the production of electricity. The country has large and untapped energy reserves, principally hydropower and lignite, and a central location in a region characterized by expanding electricity demand.

The Lao power sector is, however, still in a very early stage of development despite huge potential: only 625 MW (3.5%) of an estimated 18,000 MW of exploitable hydropower potential has been harnessed and the existing power grid serves only 30% of the national population. The sector is expected to play a pivotal role in achieving the social and economic development objectives of GOL by expanding the availability of stable and reliable electricity supply within the country and earning foreign exchange by exporting electricity.

The electricity export has been one of few major foreign currency earning industries since 1972 when Nam Ngum 1 HEPP started to export power to Thailand. The export of electricity is a major contributor to steady export growth, which increased from US\$30 million (19.6% of total export value) in 1996 to US\$112 million (28.5% thereof) in 2000. This is reflected in the GOL's GOL power sector policy which aims to promote power generation for export to provide foreign currency revenue to meet GOL development objectives.