II

MRC SEA FOR HYDROPOWER ON THE MEKONG MAINSTREAM

INCEPTION REPORT

VOL II

MAINSTREAM PROJECT PROFILE SUMMARIES

23 OCTOBER 2009

The MRC SEA of Hydropower on the Mekong mainstream comprises 4 main phases: (i) scoping, (ii) baseline assessment, (iii) opportunities & risks assessment, and (iv) avoidance, enhancement and mitigation assessment.

This Inception report formally concludes the scoping phase of the SEA and reports on the outcomes of the scoping consultations as well as the methodology and design of the SEA for the subsequent phases.

The Inception report is comprises five volumes including supporting materials and reports:

VOLUME I: Inception Report
VOLUME II: *Mainstream project profile summaries*
VOLUME III: *National scoping consultation summaries*
VOLUME IV: *SEA Theme papers and additional studies proposals*
VOLUME V: *The SEA Communications, Consultations and Capacity Building Plan*

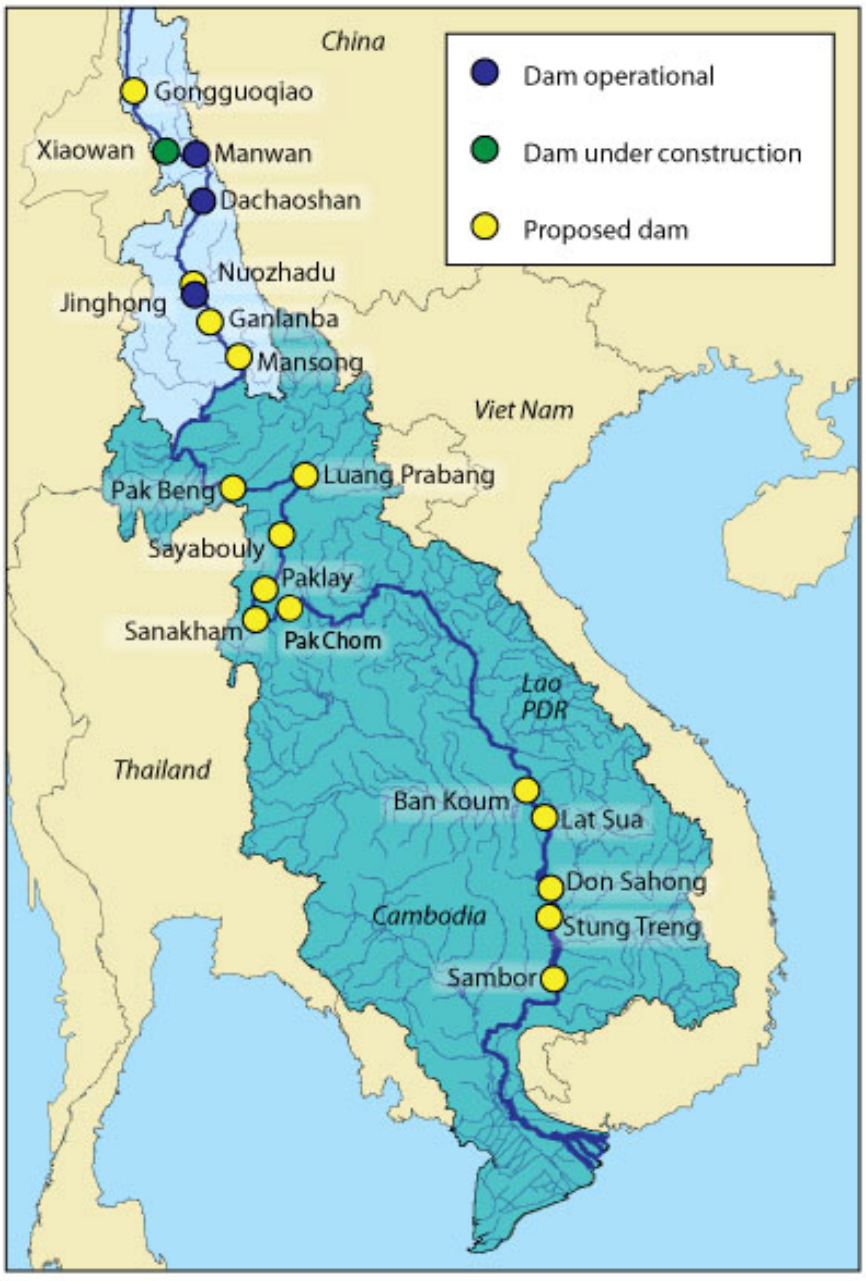
This volume summarizes the results of field missions and developer consultations to define the design and characteristics of the 11 mainstream projects

ICEM – International Centre for Environmental Management

CONTENTS

1 ORIENTATION

The Lower Mekong mainstream dams described below can be found in the map below[1]:



[1] The SEA team is preparing a comprehensive set of maps in which spelling for all proposed hydropower projects is consistent as follows: Pak Beng, Luang Prabang, Xayaburi, Pak Lay, Sanakham, Pak Chom, Ban Koum, Lat Sua, Don Sahong, Thakho diversion, Stung Treng, Sambor. For the purposes of the inception report Map 1 taken from the MRC website uses alternative spelling for Xayaburi.

2 SOURCES OF INFORMATION

The design and characteristics of the 11 mainstream hydropower projects are continually evolving. The information presented in this volume reflects the updated and new information that the SEA team has been able to collect on the projects through a program of developer consultation activities, including:

(i) Field missions
(ii) Consultations with developers
(iii) Developer presentations
(iv) Environmental and Feasibility assessments
(v) Government reports

A detailed listing of information sources is given in Table 1.

Table 1 Mainstream projects covered in the SEA

No.	MAINSTREAM PROJECT	DEVELOPER	SOURCE OF INFORMATION FOR THE SEA
1	Pak Beng	Datang International Power Generation (China)	▪ MRC hydropower data base ▪ IEE prepared by NorConsult, ▪ Optimization Study
2	Luang Prabang	PETROVIETNAM Power Corporation (Vietnam)	▪ MRC hydropower data base ▪ Consultation & field visit with PetroVietnam, ▪ Optimization Study
3	Xayabouri	SEAN & Ch. Karnchang Public Co Ltd (Thailand)	▪ MRC hydropower data base ▪ EIA and discussion with TEAM Engineering consultants, ▪ Optimization Study
4	Pak Lay	CEIEC & Sino-Hydro (China)	▪ MRC hydropower data base ▪ IEE for Pak Lay by Norconsult, ▪ Optimization Study
5	Xanakham	Datang International Power Generation (China)	▪ MRC hydropower data base ▪ Optimization Study
6	Pak Chom	Joint feasibility study by Panya consultants commissioned by Ministry of Energy in Thailand and Ministry of Mines and Energy in Lao PDR	▪ MRC hydropower data base ▪ Presentation made by Panya consultants – March 2008
7	Lat Sua	Italian Thai Asia Corp. Holdings (Thailand)	▪ MRC hydropower data base ▪ Feasibility study prepared by Team Engineering consultants
8	Ban Koum	Charoen Energy & Waters Asia Co. Ltd	▪ MRC Hydropower database ▪ Presentation made by Macro consultants, March 2008
9	Don Sahong	Mega First	▪ MRC hydropower data base ▪ EIA 2007
10	Thakho	Compagnie Nationale du Rhone and EDL	▪ IEE prepared for CNR and WWF
11	Stung Treng	Open Joint Stock Co. Bureyagessttroy	▪ MRC Hydropower database
12	Sambor	China Southern Power Grid	▪ MRC hydropower data base ▪ Consultations with China Southern Grid rep in PP ▪ Review of the feasibility study

3 DESIGN AND CHARACTERISTICS OVERVIEW

MAINSTREAM DAM		MANAGEMENT STATUS				DESIGN SPECIFICATIONS									DIMENSIONS		
	LOCATION	DEVELOPER	EARLIEST POTENTIAL COMMISSION DATE	DESIGN STATUS	ENVIRONMENTAL ASSESSMENT STATUS	Rated Head (m)	Plant Design Discharge (m3/s)	Installed Capacity (MW)	Peaking Capability (MW)	Mean Annual Energy (GWh)	Firm Annual Energy (GWh)	Full Supply Level (mamsl)	Low Supply Level (Mamsl)	Live Storage (mcm)	RESERVOIR AREA (km2)	Length of dam (m)	Height (m)
Pak Beng	Lao PDR	Datang International Power Generation	2016	MoU, feasibility	IEE submitted	31	7,250	1,230	1,230	5,517	4,073	340	334	442	87	943	76
Louang Prabang	Lao PDR	Petrovietnam Power Corporation	2016	MoU, feasibility	Feasibility study,	40	3,812	1,410	1,412	5,437	4,205	310	308	734	90	1,106	68
Xayaburi	Lao PDR	SEAN & Ch. Karnchang Public Co Ltd	2016	MoU, feasibility	Feasibility and full ESIA submitted	24	6,018	1,260	1,260	6,035	5,139	275	270	225	49	810	32
Pak Lay	Lao PDR	CEIEC and Sino-Hydro	2016	MoU, feasibility	IEE submitted	26	4,500	1,320	1,320	6,460	4,252	240	237	384	108	630	35
Sanakham	Lao PDR	Datang International Power Generation	2016	MoU, feasibility	Not yet	25	5,918	700	1,200	5,015	3,978	220	215	106	81	1,144	38
Pakchom	Lao PDR	N/a	2017	MasterPlan	Not yet	22	5,720	1,079	1,079	5,318	5,052	192	190	12	74	1,200	55
Ban Koum	Lao PDR	Italian Thai Asia Corp. Holdings	2017	MoU, feasibility	Not yet	19	11,700	1,872	1,872	8,434	8,012	115	115	0	133	780	53
Latsua	Lao PDR	Charoen Energy and Water Asia Co Ltd	2018	MoU, pre-feasibility	Pre-feasibility study submitted	10.6	10,000	686	686	2,668	1,524	97.5	95.5	0	13	1,300	27
Don Sahong	Lao PDR	Mega First	2016	PDA, detailed planning	Full EIA submitted, Additional studies	17	2,400	240	240	2,375	1,989	75	72	115	290 (ha)	1820-720-2730	10.6-8.2-8.3
Thakho diversion	Lao PDR	CNR & EDL	2016	MoU, pre-feasibility	IEE submitted	16	380	50	50	360		71.7	68.7	n/a	n/a	Channel - 1,800m	n/a
Stung Treng	Cambodia	Open Joint Stock Co. Bureyagessttroy	N/a	MoU, pre-feasibility	Not yet	15	18,493	980	591	4,870	2,937	55	50	70	211	10,884	22
Sambor	Cambodia	China Southern Power Grid	2020	MoU, pre-feasibility	Pre-feasibility submitted	33	17,668	2,600	2,030	11,740	9,150	40	39	465	620	18,002	56

4 DETAILED PROJECT PROFILES

During consultations with developers, the SEA team prepared a project questionnaire which was filled out with the developers or formally sent for completion, and based upon the information collected as shown in Table 1.

(i) Pak Beng
(ii) Luang Prabang
(iii) Xayabouri
(iv) Pak Lay
(v) Sanakham
(vi) Pak Chom
(vii) Ban Koum
(viii) Lat Sua
(ix) Don Sahong
(x) Thakho diversion
(xi) Stung Treng
(xii) Sambor

It should be pointed out that the designs are changing regularly as greater detail on feasibility and constraints are investigated and upon the requirements of the different governments. All information is relevant as of October 2009. The details and specific characteristics are evolving through their design cycle and the SEA team will be updating information as needed.

4.1 PAK BENG

Source: Pak Beng IEE, Norconsult
MRC database figures shown in red where different.

4.1.1 OVERVIEW OF PROJECT

1. Name of Dam — **Pak Beng HPP**

2. Location of preferred site option — 2,188 km upstream of delta
   - Latitude — 19°50'37.64"N
   - Longitude — 101° 1'7.22"E

   MRC database gave a location downstream of Pak Beng town. This was incorrect the location is about 15 km upstream of Pak Beng Town

2. Dam statistics —
   - Height, — 85 m — 76 (MRC)
   - Length, — 943 m
   - Type of dam construction — Concrete gravity

3. Please provide dam lay out if available — N/A

4. Rated head (metres) — 30.5 (IEE) 35 (Dept of Electricity) — 31 (MRC)

5. Plant discharge (cu.m/sec) — 7,250

6. Number of Units — 10 x 123 MW

7. Installed capacity (MW) 1,230 MW

8. Firm and secondary energy generated annually (gigawatt hours) Mean - 5,517 GWh/yr
   Firm – 4,073

9. Mode of operation –
   - continuous generation or peak load
   - if peak load, hours of operation per day

10. Environmental flow discharges, Q (cu.m/sec) Mean annual Q – 3,160 (312.05 masl)
    Min observed flow – 635 (306.10 masl)
    Max observed flow – 23,500 (333.7 masl)

11. Spillway design –
    - open flow
    - gated spillway, 15 gates - Elevation 322 masl
    - dimensions 15 m wide x 23 m high

12. Max spillway design discharge and return period used 27,300 (P=0.2%)

13. Estimated sediment load per year (million cu.m/year)

14. Mechanisms proposed for clearing sediment, how often might these be used?
    Sand flushing gates

15. Dimensions of bottom outlets,

16. Design discharge for bottom outlet (cu.m/sec)

17. Sediment flushing outlets - dimensions and design discharge
    3 x (3 m wide x 5 m high) elevation 306 m asl

4.1.2 PURPOSE

18. Proposed market for electricity,
    3.1 national (%) 10%
    4.1 export (%) to which country? 90% Thailand

19. Multipurpose uses considered (if any) Navigation

20. Details of irrigation, if being considered (Cu.m/s or area irrigated)

4.1.3 RESERVOIR

Headpond type capable of being lowered to pass floods and bedload

21. Full Supply level of reservoir (masl) 345 **changed to 340 masl (Dept of Electricity**)

22. Low Supply level of reservoir (masl) 339

23. Area inundated at FSL (sq. km) 86.51

24. Active volume of the reservoir (million.cu.m) 442

25. Dead storage volume of reservoir (million.cu.m)

26. Draw down (m)

27. Expected daily fluctuations in level of reservoir (m)

28. Length of reservoir (km) 130 – 144.5

4.1.4 CONSTRUCTION

Area of construction site **214 ha for living areas, construction sites, internal roads, 2 quarries on left and right banks, port area**

29. Duration of construction
    64 months
    First generation starts after 48 months

30. Access roads required – length (km)
    1.74 km to connect the road from Ban Pak Beng
    Internal access roads 7.4 km concrete roads
    6.5 km of gravel roads
    Upstream bridge across Mekong to connect both sides of site
    2.6 ha of mixed deciduous and unstocked forest

31. Transmission line required – length (km) To Thailand – route not determined yet

32. Expected size of construction workforce, 2 – 3000 workers
    - skill types required
    - policy for local employment

33. Dimensions of navigation locks (if any)
    1 lock capacity 500 tonnes
    73 m long x 12 m wide x 3.2 m deep
    Lift 37.48 m

34. Type and dimensions of fish passes (if any) included but no details

4.1.5 IMPACTS

Total area of reservoir	**87 sq km**	
Mekong river and tributaries	**70 sq km**	**80%**
Cultivated land	**13 sq km**	**15%**
Mixed bamboo and secondary forest	**4 sq km**	**5%**

35. Total area of agricultural land inundated (ha) 1,325 ha
    - irrigated area inundated (ha) 332 ha
    - rainfed agriculture (ha)
    - “slash and burn” (ha)

- Main crop types

36. Total Area of forest (ha)
    - types of forest cover inundated — mixed bamboo and secondary forest

37. Number of communities, households and people to be resettled
    - Communities — 28 villages
    - households — 774 households
    - people — 6,700 persons

38. Infrastructure inundated in reservoir –
    - Paved roads (km)
    - Government buildings,
    - Hospitals,
    - Schools,
    - Temples etc.

39. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites
    - Cultural sites

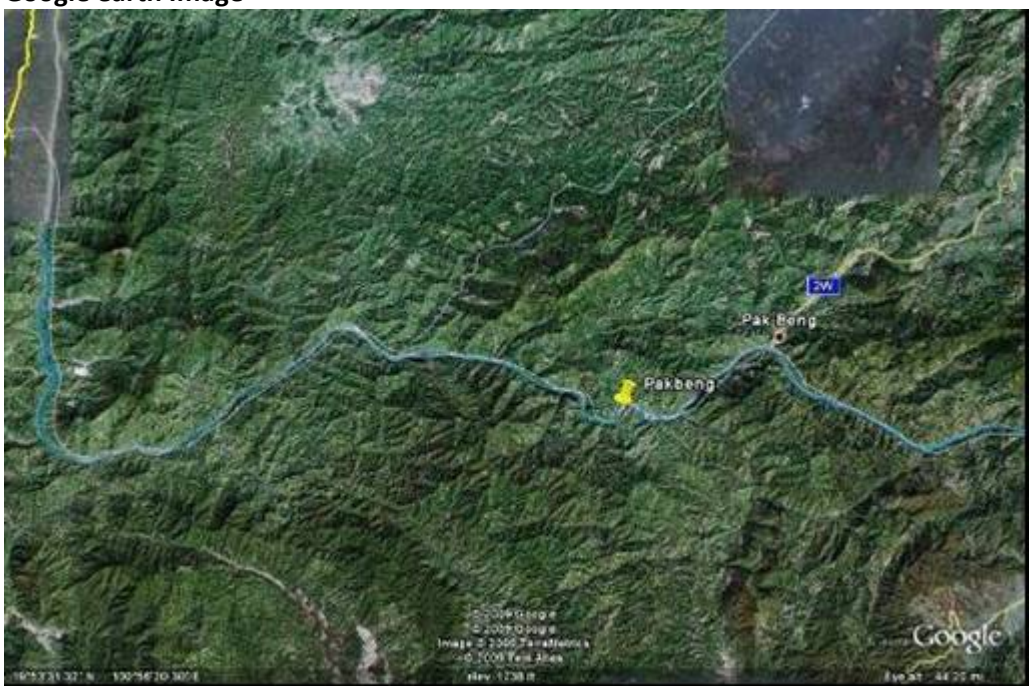
4.1.6 COSTS

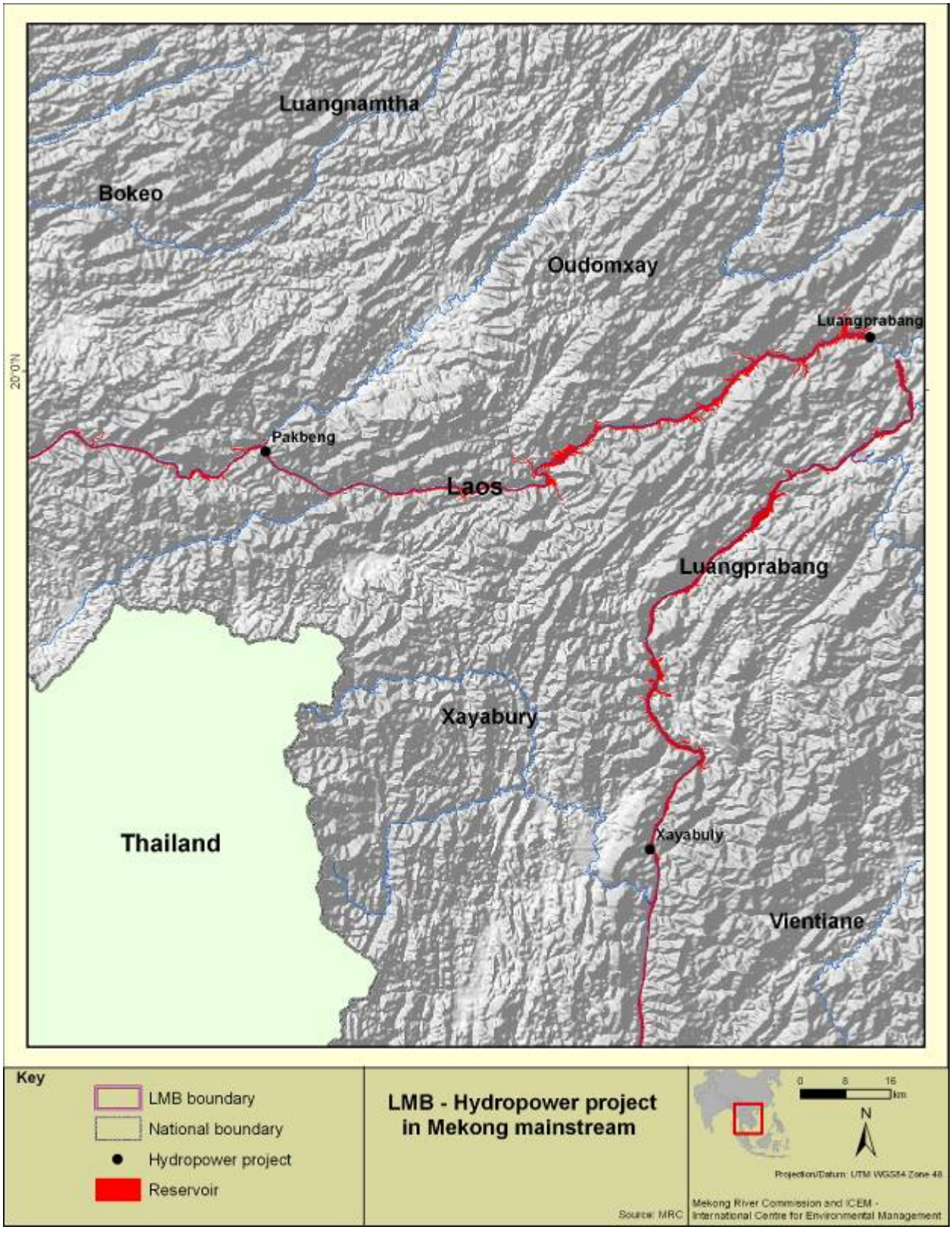
40. Estimated cost of the dam (Million $)

41. Estimated environmental and social costs (million $)

4.1.7 MAPS AND IMAGES

Google earth Image




Luangnamtha
Bokeo
Oudomxay
Luangprabang
Pakbeng
Laos
Luangprabang
Xayabury
Thailand
Xayabuly
Vientiane
20°0'N
Key
LMB boundary
National boundary
Hydropower project
Reservoir
LMB - Hydropower project in Mekong mainstream
Source: MRC
0 8 16
km
N
Projection/Datum: UTM WGS84 Zone 48
Mekong River Commission and ICEM - International Centre for Environmental Management

Pak Beng HPP Dam site – drilling boreholes

Surveyors camp

4.2 LUANG PRABANG

Source: Feasibility study prepared by PECC1 for Louangprabang
MRC database figures shown in red where different.

4.2.1 OVERVIEW OF PROJECT

3. Name of Dam – Louangprabang

4. Location of preferred site option –
   - Latitude 20 03' 58.8" 2036 km from sea. 3.5 km upstream from Nam Ou confluence
   - Longitude 102 11' 30.7"

42. Dam statistics –
   - Height, 57.5 m
   - Length, 318 m
   - Type of dam construction Gravity, concrete

43. Please provide dam lay out if available

44. Rated head (metres) 33.6 m (NB Optimisation study suggests 32 m)

45. Plant discharge (cu.m/sec) 5,091 cu.m/sec

46. Number of Units 10 Kaplan units

47. Installed capacity (MW) 1500 MW

48. Firm and secondary energy generated annually (gigawatt hours) Isolated 7,102.7 x 10^6 KWh
    Cascade 8,258.0 x 10^6 KWh

49. Mode of operation –
   - continuous generation or peak load 12 – 15 hrs per day
   - if peak load, hours of operation per day isolated 4,735 hrs/yr
     cascade 5,505 hrs/yr

50. Environmental flow discharges (cu.m/sec) N/A - but Average flow = 3,061 cu.m/sec
    PMF 45,900 cu.m/sec

51. Spillway design –
   - open flow
   - gated spillway, 10 radial gates
   - dimensions 18 x 22 m

52. Max spillway design discharge and return period used 44,838 cu.m/sec - 1:10,000 yrs

53. Estimated sediment load per year (million cu.m/year) 59.1 m tonne per yr
    Inflow to dam site 46.7 m tonne/yr

6.95% captured by dam site

54. Mechanisms proposed for clearing sediment, how often might these be used? NA

55. Dimensions of bottom outlets, NA

56. Design discharge for bottom outlet (cu.m/sec) NA

57. Sediment flushing outlets - dimensions and design discharge NA

4.2.2 PURPOSE

58. Proposed market for electricity,
    5.1 national (%) 10%
    6.1 export (%) to which country? 90% to Vietnam

59. Multipurpose uses considered (if any) navigation

60. Details of irrigation, if being considered (Cu.m/s or area irrigated) None

4.2.3 RESERVOIR

61. Full Supply level of reservoir (masl) 320 masl

62. Low Supply level of reservoir (masl) 318 masl

63. Area inundated at FSL (sq. km) 72.39 sq km

64. Active volume of the reservoir (million.cu.m) 136.1 mcu.m

65. Dead storage volume of reservoir (million.cu.m) 1,453.7 m cu.m (total storage 1,589.5 m cu.m)

66. Draw down (m) 2 m

67. Expected daily fluctuations in level of reservoir (m) up to 2 m

68. Length of reservoir (km) 170 at FSL, 140 at MSL

4.2.4 CONSTRUCTION

69. Duration of construction 2 yrs prep, 8 yrs construction

70. Access roads required – length (km) 1 bridge across Nam Ou,
temporary bridge across mainstream
4 km access road along left bank
11 km from Pak Ou to Route 13

71. Transmission line required – length (km) 400 km of 500 kva line to sub-station

72. Expected size of construction workforce,	6000
o skill types required	skilled workers from Vietnam, but Laos
skilled	
	workers can apply
o policy for local employment	
73. Dimensions of navigation locks (if any)	Multiple step, 1,210,000 ton of shipping /yr 2 locks at 12 x 120 x 3 m depth
74. Type and dimensions of fish passes (if any)	Provided for on right bank but no details yet

4.2.5 IMPACTS

Total reservoir area	7,239 ha
Existing water surface	2,864 ha
75. Total area of agricultural land inundated (ha)	194 ha
o irrigated area inundated (ha)	
o rainfed agriculture (ha)	
o "slash and burn" (ha)	
o Main crop types	Industrial trees (teak)
76. Total Area of forest (ha)	4,181.0 ha various
o types of forest cover inundated	
77. Number of communities, households and people to be resettled	9ha of settlement
o Communities	36
o households	2,516
o people	12,966
78. Infrastructure inundated in reservoir –	
o Paved roads (km)	None
o Government buildings,	
o Hospitals,	
o Schools,	small
o Temples etc.	small
79. Tourism and cultural sites lying in the inundation zone	
o Caves, waterfalls, historic sites	Pak Ou caves are 3 km downstream of dam site
o Cultural sites	

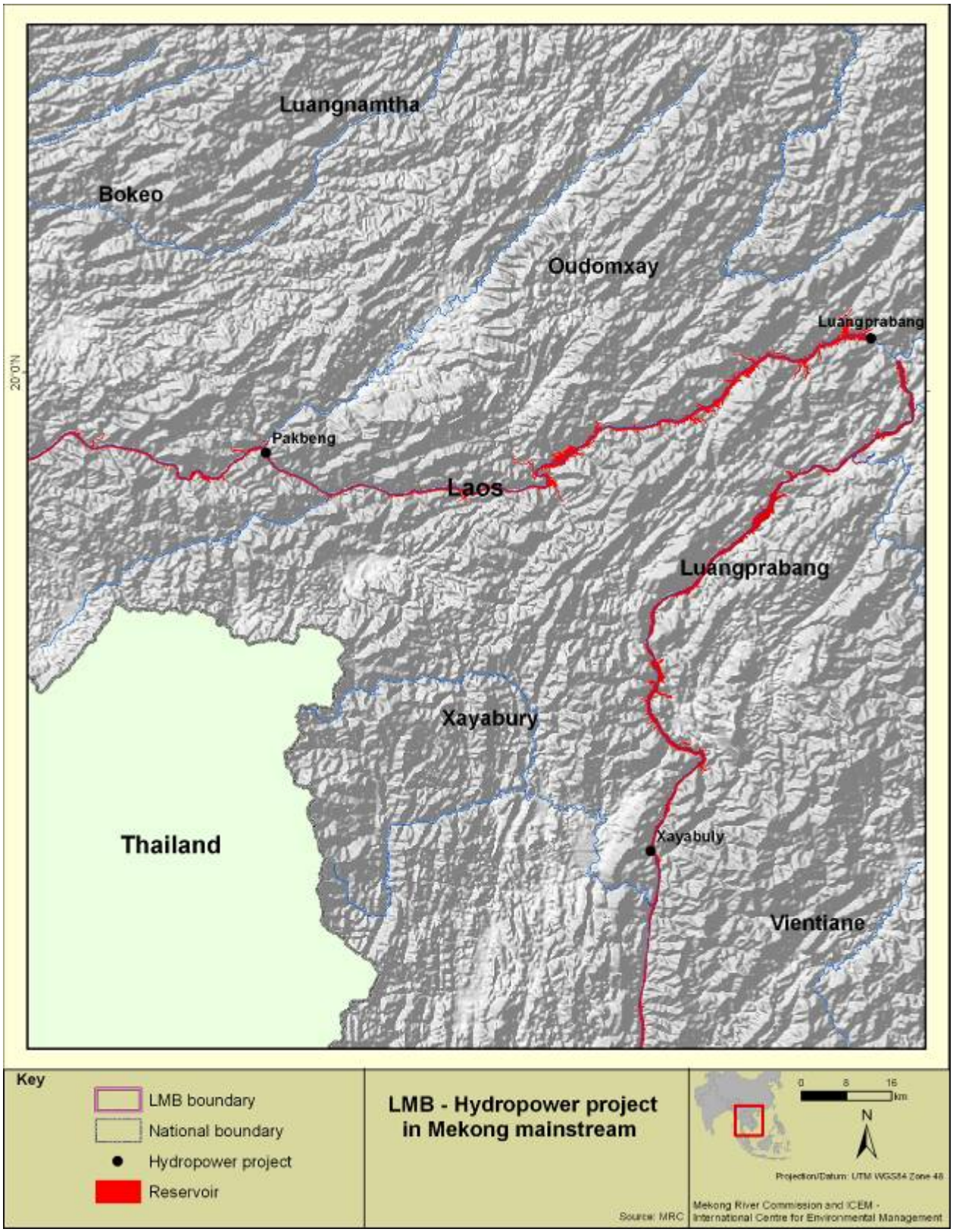
4.2.6 COSTS

80. Estimated cost of the dam (Million $)	3.685 Billion USD
81. Estimated environmental and social costs (million $)	9.88 million USD over 10 yrs construction period 7 million USD over 30 yr operation

4.2.7 MAPS AND IMAGES

Google earth pictures of Louangprabang HPP site

Reservoir area of Louangprabang extends to Pak Beng



View from Pak Ou upstream to dam site

Nam Ou confluence with Mekong

Dam site – left bank

Dam site – right bank – see village just downstream of dam site

4.3 XAYABURI

Source: Team Consult, consulting engineers and EIA consultants for Xayaburi HPP

4.3.1 OVERVIEW

1. **Name of Dam**

   Xayaburi Hydroelectric Power Project

2. **Location of preferred site of option**

   Longitude E 796, 300
   Latitude N 2,130, 300

3. **Dam statistics**

   - **Height** 38 m.
   - **Length** 810 m.
   - **Type of dam construction** Composite of Powerhouse, Spillway, Fish passing facilities and Navigation locks with no dam body.

4. **Rated head :** 29.5 m.

5. **Plant discharge:** 5,000 m^3 / sec

6. **Number of Units:** 8 Kaplan units

7. **Installed capacity:** 8 x 160 MW = 1,280 MW

8. **Firm and secondary energy generated annually.**

Primary energy	4,180.9 GWh / year
Secondary energy	871.0 GWh / year
Excess energy	2,264.7 GWh / year
Total energy	7,316.6 GWh / year

9. **Mode of operation**

   - Operating criteria, Daily discharge = Daily in flow.
   - Water loss form fish passing facilities 10 m^3 / sec.
   - Water loss from sand flushing 500 m^3 / sec. for 6 hrs. / day during dry season.

10. **Environmental flow discharges:** 2,000 m^3 / sec.

11. **Spillway design**

    - **Open flow** 47,500 m. / sec.
    - **Gated spillway** 12 units.
    - **Dimensions** 18 x 20 m^3

12. **Max spillway design discharge and return period used**

    47,500 m^3 / sec. for 10,000 years flood.

13. **Estimated sediment load per year**

    Under investigation

14. **Mechanisms proposed for electing sediment, how often might these be used?**

    Twin steel lined conduits located between every two units and controlled by bonneted gates. In order to allow the operation of the sand flushing outlets without stopping the operation of the near by generators. Flushing about 6 hrs. per day when water in Mekong less than 5,000 m^3 / sec.

15. **Dimension of bottom outlets:** No bottom outlets

16. **Design discharge for bottom outlet:** No.

17. **Sediment flushing outlet-dimensions and design discharge**.

    Twin 3x3 m conduits that can discharge 140 m^3 / sec each.

18. **Proposed market for electricity**

    - national 10%
    - export 90% to Thailand

19. **Multipurpose use considered:** Navigation

20. **Details of irrigation:** No.

4.3.2 RESERVOIR

21. **Full supply level :** +275. msl

22. **Low supply level:** +268 msl.

23. **Area inundated at FSL:** 49 sq km.

24. **Active volume of reservoir:** 211.97 mcm.

25. **Dead storage volume of reservoir:** 514.05 mcm.

26. **Draw down:** 7.0 m.

27. **Expected daily fluctuations in level of reservoir:** No.

28. **Length of reservoir** 90 km.

4.3.3 CONSTRUCTION

29. **Duration of construction:** 7.5 years

30. **Access road required:** 25 km.

31. **Transmission line required:** 220 km.

32. **Expected size of construction work force,**

- **Skill types required**

- Engineer	100 - 200	persons
- Technician and skilled labor	500 - 600	persons
- Unskilled labor	2,000 - 2,200	persons

- **Policy for local employment** Priority to local people

33. **Dimensions of navigation locks:** Two step of navigation locks 12 m. x 195 m. x 5m. each

34. **Type and dimensions of fish passes**

2 sets of Fish ladder with opening of 3x10 m^2, between spillway and power house and left abutment near power house.

4.3.4 IMPACTS

35. **Total area of agricultural land inundated**

- **Irrigation area inundated** No
- **Rain fed agriculture** 18 ha
- **Slash and burn** No
- **Main crop types** Maize, Job's teas, and sesame

36. **Total area of forest**

-**Type of forest cover inundated** Teak plant 162 ha

37. **Number of communities, households and people to be resettled**

- **Communities:** 10 villages
- **Households:** 391 HH.
- **People:** About 2,130 people

38. **Infrastructure inundated in reservoir:**

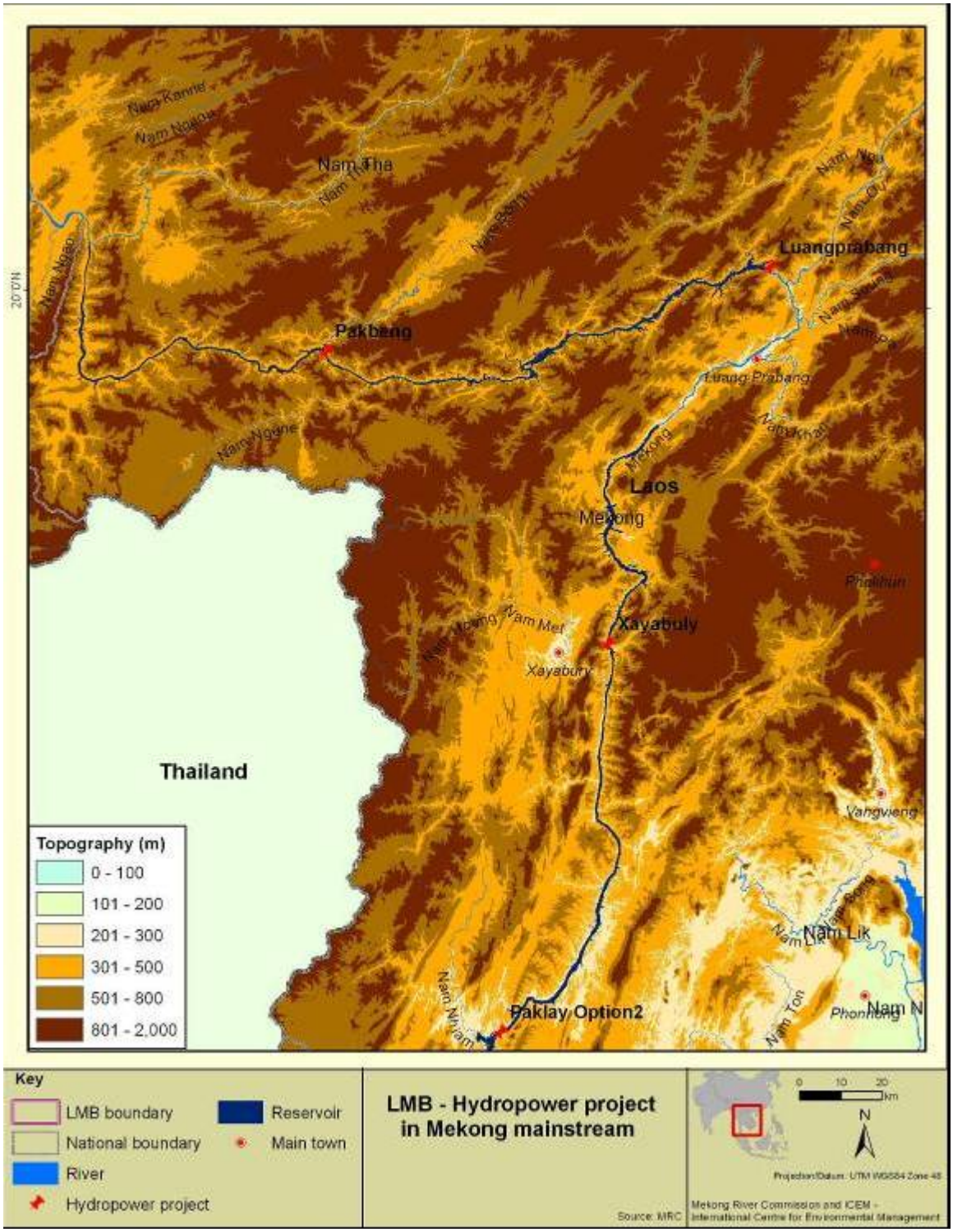
- **Paved roads:** No
- **Government building:** One small building not in use
- **Hospital:** No
- **Schools:** 7
- **Temple:** 4
- **Cemetery:** 1

39. **Tourism and Cultural sites lying in the inundated zone**

- **Cave, water fall, historic site:** No
- **Cultural sites** No

4.3.5 MAPS AND FIGURES

Google Earth images of the Xayaburi Dam site


Nam Tha
Luangprabang
Pakbeng
Laos
Mekong
Thailand
Xayaburi
Phonhong
Vangvieng
Nam Lik
Nam N
Paklay Option2
Topography (m)
0 - 100
101 - 200
201 - 300
301 - 500
501 - 800
801 - 2,000
Key
LMB boundary
National boundary
River
Hydropower project
Reservoir
Main town
LMB - Hydropower project in Mekong mainstream
Source: MRC
Mekong River Commission and ICEM - International Centre for Environmental Management

Xayaburi Dam site - looking upstream

Xayaburi Dam site – looking to right bank, with village to be moved temporarily during construction works

Xayaburi Dam site – looking downstream

About 20 km upstream of dam site, showing current navigation, settlements and shifting cultivation

4.4 PAK LAY

Source: Pak Lay IEE, Norconsult.

MRC database figures shown in red where different.

Note: Following optimization study, Pak Lay has been subject both to reduced reservoir FSL levels and choice of site Option 2. The design details quoted here refer to the original specification, and so these will change.

4.4.1 OVERVIEW OF PROJECT

1.	Name of Dam	**Pak Lay (Lao PDR)**	
2.	Location of preferred site	**Option 1**	**Option 2**
	o Latitude	18 ^{o} 19.5'N	18°24'5.34"N
	o Longitude	101^{o} 31.6'E	101°35'1.01"E

There is a second option for the site, Option 2, which is located 10 km upstream, which will flood a smaller area and require only 1/3 rd of people to be resettled.

1. Dam statistics –
   - o Height, 35 m (54.5 m or 45.5m)
   - o Length, 630 m (738.1m or 1,165m)
   - o Type of dam construction: Set of 5 x Earth fill Rock closure dykes Across two channels
2. Please provide dam lay out if available
3. Rated head (metres): max head – 38.5 m at 211.5 masl; min. 35 m (25.7m)
4. Plant discharge (cu.m/sec): 4,500 cu.m/sec (5,782 cu.m/sec)
5. Number of Units: 2 x 5 = 10 Kaplan units
6. Installed capacity (MW): 1,320 MW
7. Firm and secondary energy generated annually (gigawatt hours)
   - Mean 6,460 GWh (5,782)
   - Firm (4,636)
8. Mode of operation –
   - o continuous generation or peak load: peak load
   - o if peak load, hours of operation per day: 8 – 10 hrs per day
9. Environmental flow discharges (cu.m/sec): 5 – 8% of mean annual flow = 308 cu.m/s; Mean Annual Flow – 3,850 cu.m/sec (4,030)
10. Spillway design –
    - o open flow
    - o gated spillway, 12 radial gates
    - o dimensions: 294 m in length, 67 m wide (230 masl at 18 m)
11. Max spillway design discharge and return period used: 38,400 cu.m/sec (32,526 Cu.m/sec) 1 in 10,000 year flood (33,600 cu.m/sec = 1 in 1,000 yr flood)

12. Estimated sediment load per year (million cu.m/year) N/a
13. Mechanisms proposed for clearing sediment, how often might these be used?
14. Dimensions of bottom outlets,
15. Design discharge for bottom outlet (cu.m/sec) (4,500 cu.m/sec)
16. Sediment flushing outlets - dimensions and design discharge

4.4.2 PURPOSE

17. Proposed market for electricity,
    national (%)
    export (%) to which country? 100% Thailand
18. Multipurpose uses considered (if any) Hydropower only
19. Details of irrigation, if being considered (Cu.m/s or area irrigated) None

4.4.3 RESERVOIR

20. Full Supply level of reservoir (masl) 250 masl (248 masl)

    Changed to 240 masl (Dept of Electricity)

21. Low Supply level of reservoir (masl) 247 masl (245 masl)

    Changed to 237 masl (Dept of Electricity)

22. Area inundated at FSL (sq. km) Option 1 – 108 sq.km

    Option 2 - 70 sq.km

23. Active volume of the reservoir (million.cu.m) (316.5 m.cu.m)
    - Volume of water discharged through turbines 144 m.cu.m
    - Time taken to refill after 8 hours generation at dry season flow 20 hours
24. Dead storage volume of reservoir (million.cu.m)
25. Draw down (m) 3 m
26. Expected daily fluctuations in level of reservoir (m) 1 – 2 m

27. Length of reservoir (km) Option 1 – 120 km

    Option 2 – 110 km

4.4.4 CONSTRUCTION

28. Duration of construction 4-5 years
29. Access roads required – length (km) 3 options – 1) Upgrade existing road from Vientiane to site;

    2) construction new road into site;

    3) using Mekong river transport

30. Transmission line required – length (km) — 4 circuit 210 volt from 2 x 500kV Switchyards to Thailand

31. Expected size of construction workforce, — several 1,000s
    - skill types required
    - policy for local employment

32. Dimensions of navigation locks (if any) — 1000 tonne, One single line double-lift lock chamber

33. Type and dimensions of fish passes (if any) — Planned but no dimensions yet

4.4.5 IMPACTS

34. Flooded area — River – 33% existing river channel

    Forest – 48%

    Agricultural land – 24%

    River bank and island – 8%

35. Total area of agricultural land inundated (ha) — Option 1 – 1,300 ha, Option 2 – 665 ha
    - irrigated area inundated (ha) — rice paddy 1) 700 ha 2) 165 ha
    - rainfed agriculture (ha) — production land 1) 600 ha, 2) 500 ha
    - "slash and burn" (ha)
    - Main crop types

36. Total Area of forest (ha)
    - types of forest cover inundated — Production forest 1) 3,600 ha 2) 2000

      Conservation forest 1)350 ha 2) 180 ha

      Protection forest 1) 250 ha 2) 0

	Option 1	Option 2
Unstocked forest	38%	25%
Upper mixed deciduous forest	11%	10%
Other land (bamboo, rice paddies, shifting)	18%	16%
River and tributaries	33%	

37. Number of communities, households and people to be resettled
    - Communities — Option 1 – 27, Option 2 – 16
    - households

- people — Option 1 – 19,046, Option 2 – 6,129 (MRC data base 1,780)

NB: With Option 2 and lower FSL at 240 masl, Dept of Electricity considers that NO resettlement necessary

38. Infrastructure inundated in reservoir –
    - Paved roads (km)
    - Government buildings,
    - Hospitals,
    - Schools,
    - Temples etc.
39. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites
    - Cultural sites

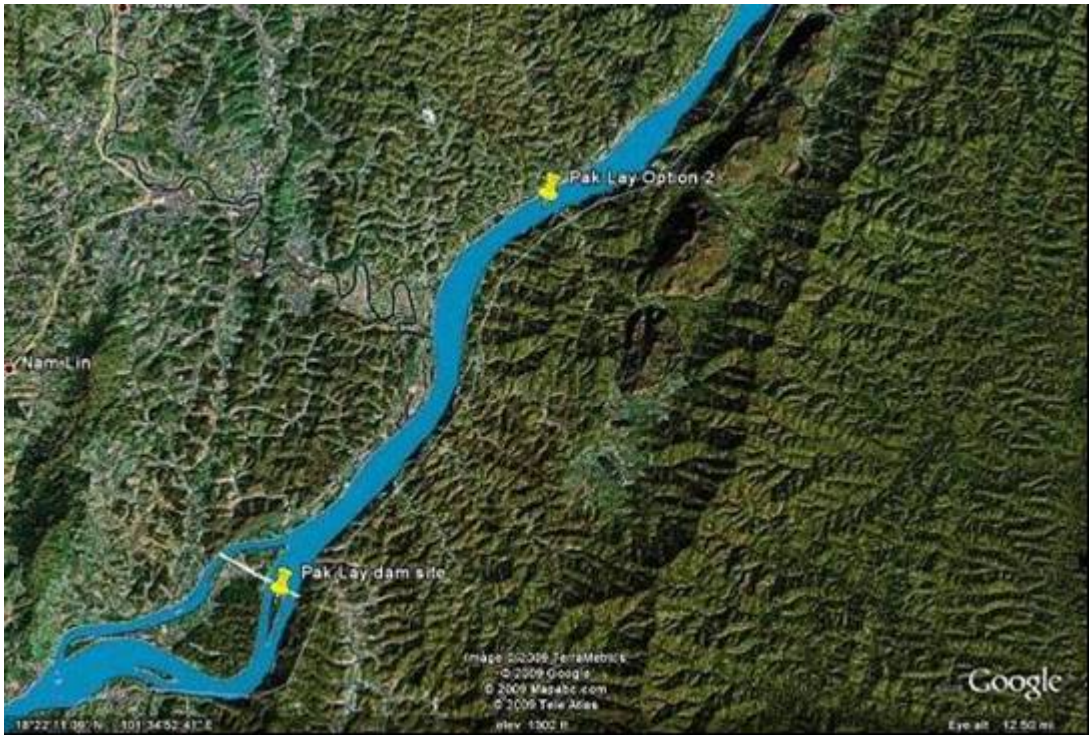
4.4.6 COSTS

40. Estimated cost of the dam (Million $) — estimated 1,000 M$ +/-

41. Estimated environmental and social costs (million $)

4.4.7 MAPS AND IMAGES

Google earth Image



Pak Lay Dam Site Option 1 – looking upstream

Dam site Option 1 - looking towards right bank

4.5 SANAKHAM

Source: TOR for ESIA, Datang, MRC database
MRC database figures shown in red where different.
Note that following the optimization study, the FSL of the reservoir has been reduced to 220 masl and the dam location has been moved 35 km downstream.

4.5.1 OVERVIEW OF PROJECT

1. Name of Dam — **Sanakham HPP**

2. Location of preferred site option — 1,737 km upstream of delta
   - Latitude — 17°50'N
   - Longitude — 101° 33'E

   Note that this new location is about 1 km upstream of the Thai/Lao border

   Originally located at — 1772 km upstream of delta
   - Latitude — 17°57.3'N
   - Longitude — 101° 25'E

3. Dam statistics –
   - Height, — 38 m (MRC)
   - Length, — 1,143.6 m
   - Type of dam construction — Concrete gravity

4. Please provide dam lay out if available — N/A

5. Rated head (metres) — 25 (MRC)

6. Plant discharge (cu.m/sec) — 5,918

7. Number of Units — 10 x 70 MW

8. Installed capacity (MW) — 700 MW (1,268 MW MRC)

9. Firm and secondary energy generated annually (gigawatt hours) — Mean - 3,210 GWh/yr (5,516 MW MRC)
   Firm – 4,438 GWh/yr

10. Mode of operation –
    - continuous generation or peak load
    - if peak load, hours of operation per day — Not known yet

11. Environmental flow discharges, Q (cu.m/sec) — Mean annual Q – 4,160
    Min observed flow –
    Max observed flow – 33,900

12. Spillway design –
    - open flow
    - gated spillway,

- dimensions

13. Max spillway design discharge and return period used

14. Estimated sediment load per year (million cu.m/year)

15. Mechanisms proposed for clearing sediment, how often might these be used?
    Sand flushing gates

16. Dimensions of bottom outlets,

17. Design discharge for bottom outlet (cu.m/sec)

18. Sediment flushing outlets - dimensions and design discharge

4.5.2 PURPOSE

19. Proposed market for electricity,
    national (%) 10%
    export (%) to which country? 90% Thailand

20. Multipurpose uses considered (if any) Navigation

21. Details of irrigation, if being considered (Cu.m/s or area irrigated)

4.5.3 RESERVOIR

Headpond type capable of being lowered to pass floods and bedload

22. Full Supply level of reservoir (masl) 220 **(Dept of Electricity**)

23. Low Supply level of reservoir (masl) 215

24. Area inundated at FSL (sq. km) 94
    (but this will increase with move 35 km downstream)

25. Active volume of the reservoir (million.cu.m) 186.7
    (but this will increase with move 35 km downstream)

26. Dead storage volume of reservoir (million.cu.m)

27. Draw down (m) 5 m

28. Expected daily fluctuations in level of reservoir (m) not known

29. Length of reservoir (km) 80 km

4.5.4 CONSTRUCTION

Area of construction site	**?**
30. Duration of construction	? months
	Access roads required – length (km)
31. Transmission line required – length (km)	To Thailand – route not determined yet
32. Expected size of construction workforce, o skill types required o policy for local employment	2 – 3000 workers
33. Dimensions of navigation locks (if any)	2 step ship lock capacity 1,000 tonnes
34. Type and dimensions of fish passes (if any)	included but no details

4.5.5 IMPACTS

Total area of reservoir	**80 sq km**	
Mekong river and tributaries	**20 sq km**	**25%**
Cultivated land	**60 sq km**	**75%**
Mixed bamboo and secondary forest	**? sq km**	**%**

(but this will increase with move 35 km downstream)

35. Total area of agricultural land inundated (ha)
    - o irrigated area inundated (ha)
    - o rainfed agriculture (ha)
    - o "slash and burn" (ha)
    - o Main crop types

36. Total Area of forest (ha)
    - o types of forest cover inundated — mixed bamboo and secondary forest

37. Number of communities, households and people to be resettled
    - o Communities — 10 Villages
    - o households — 800
    - o people — 4,000 persons

38. Infrastructure inundated in reservoir –
    - o Paved roads (km)
    - o Government buildings,
    - o Hospitals,
    - o Schools,
    - o Temples etc.

39. Tourism and cultural sites lying in the inundation zone
    - o Caves, waterfalls, historic sites
    - o Cultural sites

4.5.6 COSTS

40. Estimated cost of the dam (Million $)

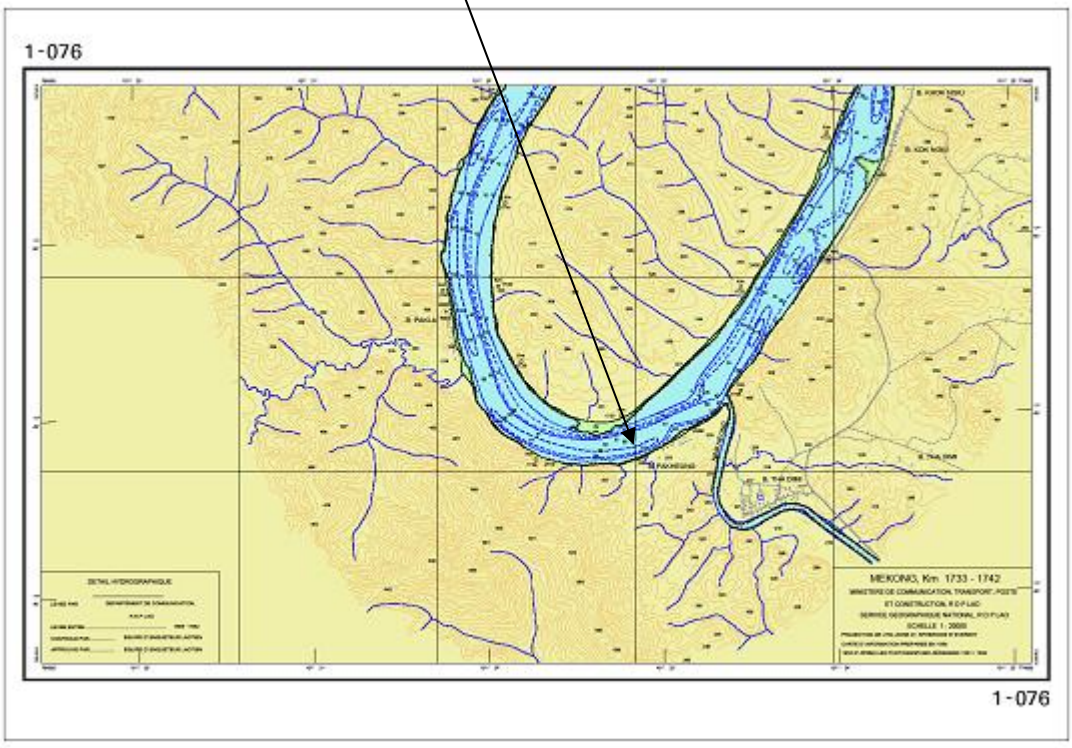
41. Estimated environmental and social costs (million $)

4.5.7 MAPS AND IMAGES

Google earth Image (new revised site)
(Yellow line marks the Thai/Lao border)

Google earth image showing new site 35 km downstream of original site and 80 km downstream of PakLay dam site

Location of proposed Sanakham dam site



Mekong river upstream of Sanakham dam site and looking south (downstream)

Mekong river near proposed Sanakham dam site

Mekong river 10 km downstream of Sanakham dam site, after border with Thailand (on left) and Laos

4.6 PAK CHOM

Source: presentation on Pak Chom made by Panya Consultants on behalf of Ministry of Energy March 2008. MRC Database.

4.6.1 OVERVIEW OF PROJECT

1. Name of Dam — **Pak Chom HPP**

2. Location of preferred site option — 1,651 km upstream of delta
   - Latitude — 18°12'12.00"N
   - Longitude — 102° 3'0.00"E

   Located at KM 1651 from the mouth of the Mekong River and adjacent to Ban Huai Khop, Loei Province, Thailand and to Ban Huai Hang, Sangthong District, Vientiane Capital, Lao PDR

3. Dam statistics –
   - Height, — 55 m
   - Length, — 1,200 m
   - Type of dam construction — Concrete gravity

4. Please provide dam lay out if available — N/A

5. Rated head (metres) — 22 m

6. Plant discharge (cu.m/sec) — 5,720

7. Number of Units — 13 x 83 MW

8. Installed capacity (MW) — 1,079 MW

9. Firm and secondary energy generated annually (gigawatt hours) — Mean - 5,318 GWh/yr; Firm – 5,052

10. Mode of operation –
    - continuous generation or peak load — Continuous
    - if peak load, hours of operation per day

11. Environmental flow discharges, Q (cu.m/sec) — Mean annual Q – 4,385; Max observed flow – 33,526 (100 yr)

12. Spillway design –
    - open flow
    - gated spillway, — 14 gates
    - dimensions — 20 m wide x 25 m high

13. Max spillway design discharge and return period used — 33,526 (100 yr)

14. Estimated sediment load per year (million cu.m/year)

15. Mechanisms proposed for clearing sediment, how often might these be used?
    Sand flushing gates

16. Dimensions of bottom outlets,

17. Design discharge for bottom outlet (cu.m/sec)

18. Sediment flushing outlets - dimensions and design discharge

4.6.2 PURPOSE

19. Proposed market for electricity,
    national (%) 10% Lao
    export (%) 90% Thailand

20. Multipurpose uses considered (if any) Navigation,
    6 x Flood mitigation projects, with protecting dykes, regulating gates and pumping stations

21. Details of irrigation, if being considered (Cu.m/s or area irrigated)
    11 pumped irrigation projects with total are of 2,944 ha and irrigated area of 2,706 ha.
    (1 project in Lao PDR (217 ha irrigated, 10 projects in Thailand)

4.6.3 RESERVOIR

22. Full Supply level of reservoir (masl) 192 masl
23. Low Supply level of reservoir (masl) 190 masl

24. Area inundated at FSL (sq. km) 73.54 sq km

25. Active volume of the reservoir (million.cu.m) 807.7 MCM

26. Dead storage volume of reservoir (million.cu.m)

27. Draw down (m) 2 m

28. Expected daily fluctuations in level of reservoir (m) up to 2 m

29. Length of reservoir (km) >80 km

4.6.4 CONSTRUCTION

Area of construction site

30. Duration of construction

31. Access roads required – length (km)

32. Transmission line required – length (km) To Thailand – 185 km to Udon substation

33. Expected size of construction workforce,
    - skill types required
    - policy for local employment

34. Dimensions of navigation locks (if any) 2 lock capacity 500 tonnes
    200 m long x 20 m wide x 3.2 m deep
35. Type and dimensions of fish passes (if any) included but no details – see diagram

4.6.5 IMPACTS

Total area of reservoir		**73.54 sq km**	
Mekong river and tributaries		**67.5 sq km**	**92%**
River bank area		**6.04 sq km**	**8%**
	in Thailand	**2.78 sq km**	**46%**
	in Lao PDR	**3.26 sq km**	**54%**

36. Total area of agricultural land inundated (ha)
    - irrigated area inundated (ha) Thailand 128 ha
      Lao PDR 88.5 ha
    - rainfed agriculture (ha)
    - "slash and burn" (ha)
    - Main crop types

37. Total Area of forest (ha)
    - types of forest cover inundated

38. Number of communities, households and people to be resettled
    - Communities 2 villages (1 Lao, 1 Thai)
    - households 107 households
    - people c 535 persons

39. Infrastructure inundated in reservoir –
    - Paved roads (km) 1.1 km road and 4 bridges in Thailand
    - 1.6 km road and 1 bridge in Lao PDR
    - Government buildings,
    - Hospitals,
    - Schools, 1 school
    - Temples etc. 1 Temple

40. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites
    - Cultural sites

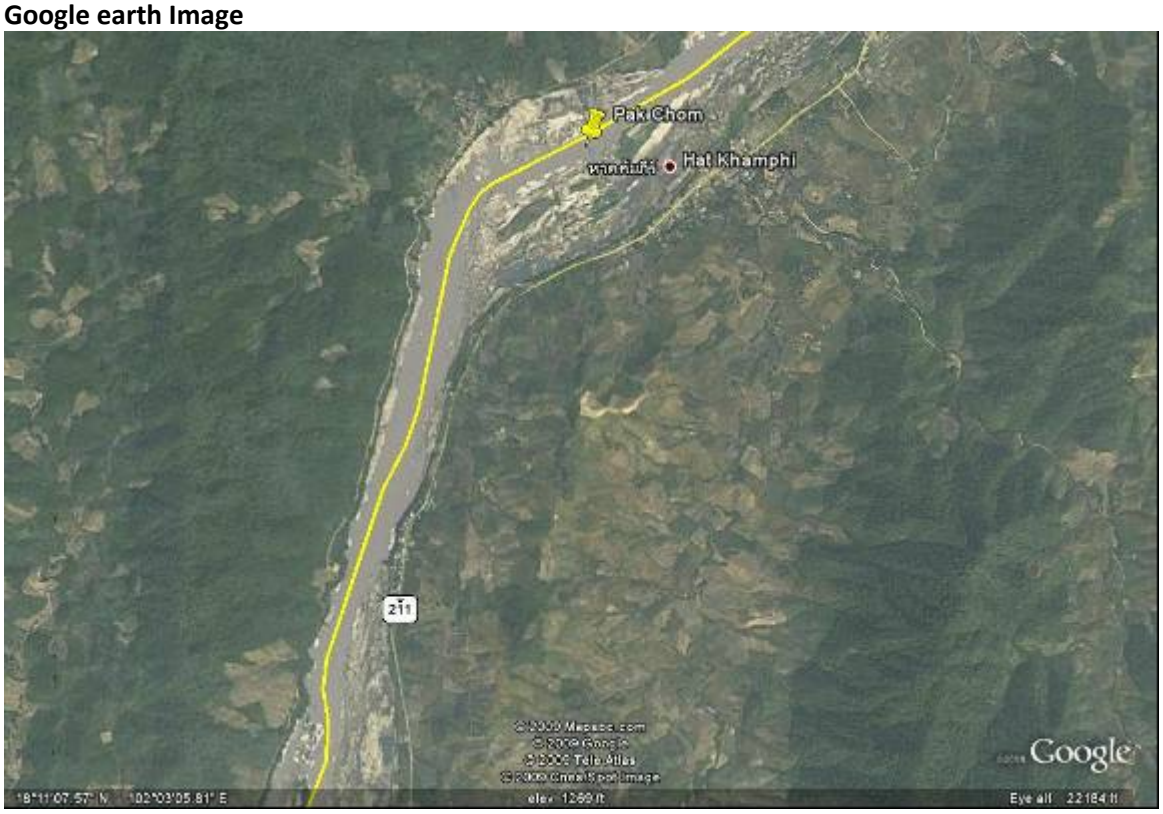
4.6.6 COSTS

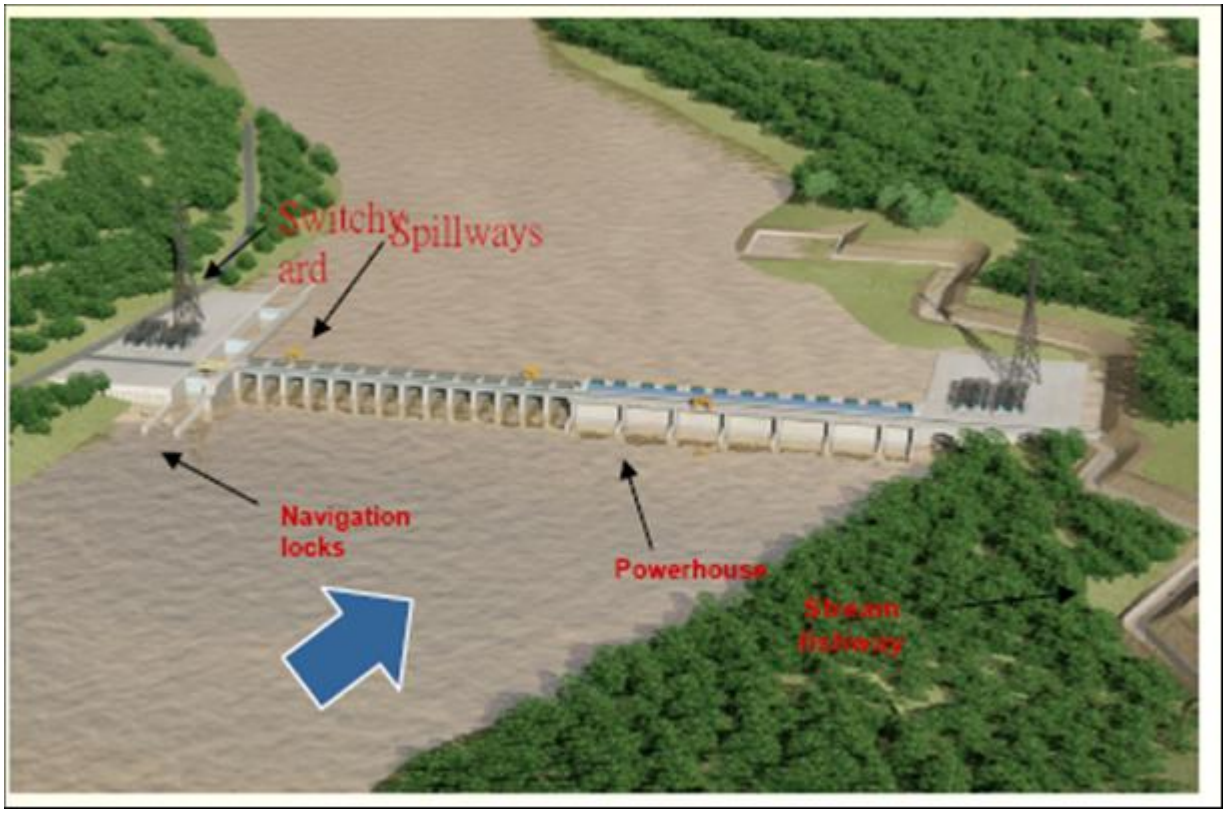
41. Estimated cost of the dam (Million $) 1,764 Million $

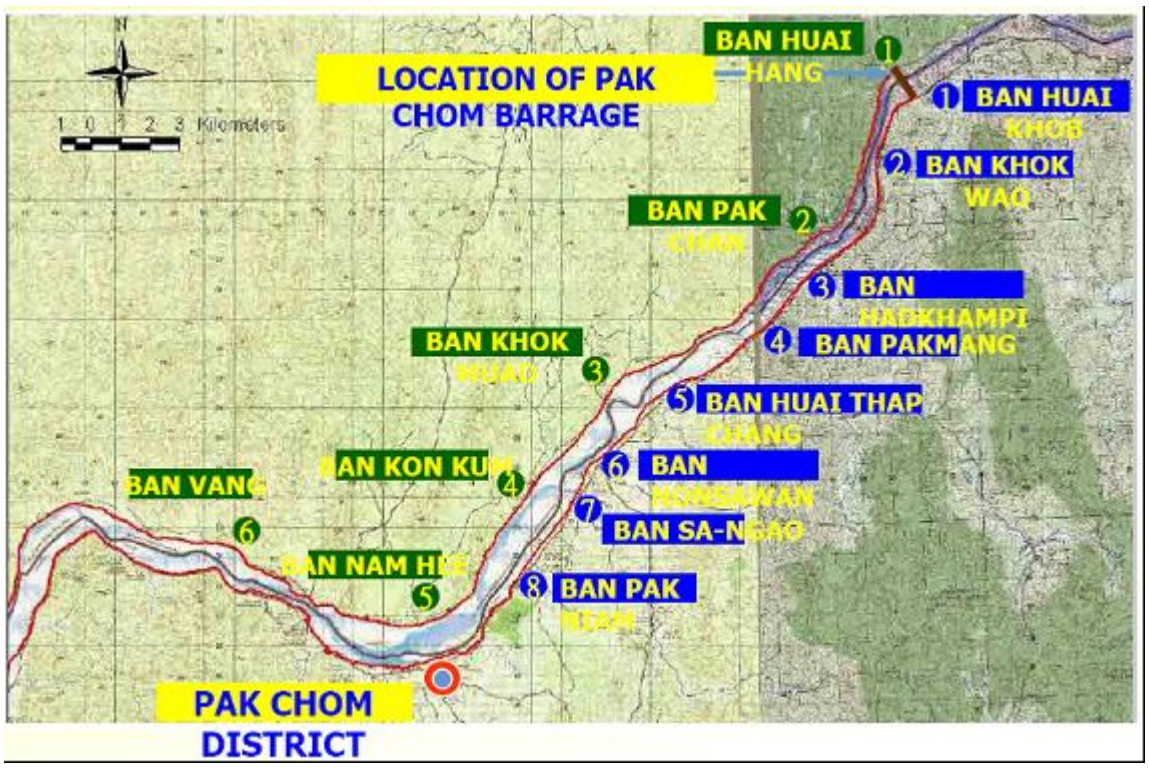
42. Estimated environmental and social costs (million $) 20 million $

4.6.7 MAPS AND IMAGES

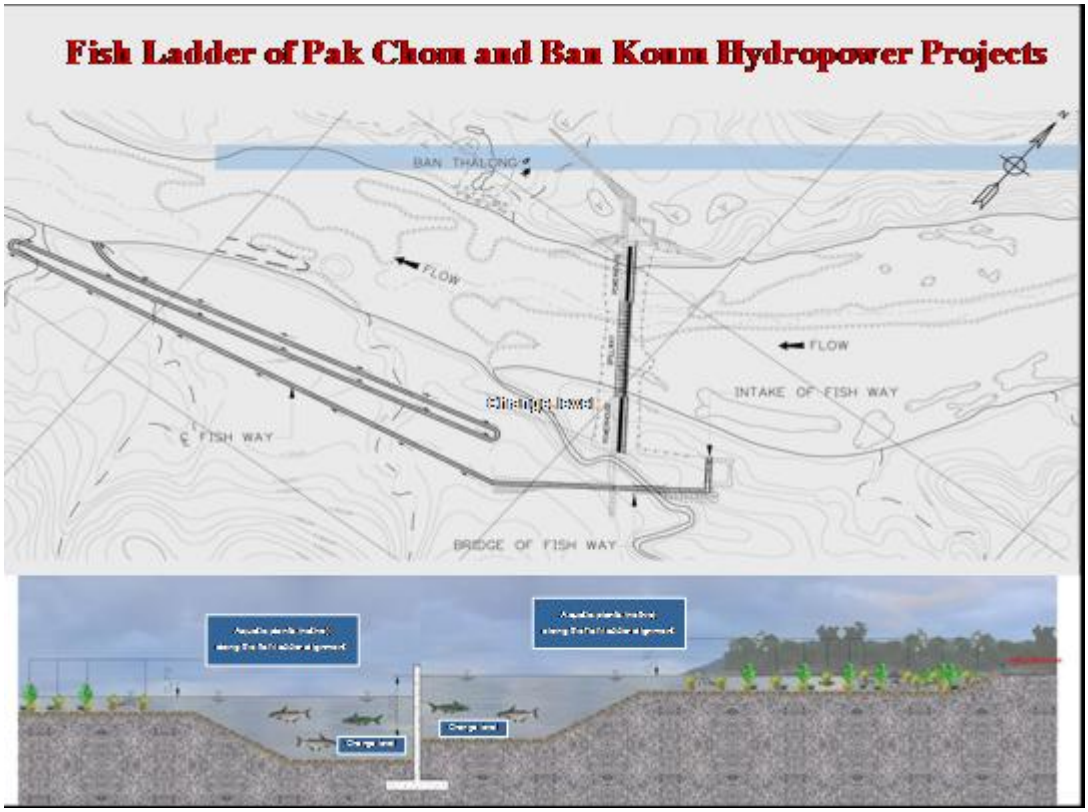
Google earth Image




Switchyard
Spillways
Navigation locks
Powerhouse
Stream flow


LOCATION OF PAK CHOM BARRAGE
BAN HUAI HANG
1 BAN HUAI KHOB
2 BAN KHOK WAO
BAN PAK CHAN
3 BAN HADKHAMPI
4 BAN PAKMANG
BAN KHOK HUAD
5 BAN HUAI THAP CHANG
BAN KON KUM
6 BAN KUNSAWAN
7 BAN SA-NGAO
BAN VANG
BAN NAM HEE
8 BAN PAK NEAM
PAK CHOM DISTRICT


start
302 m
BAN HUAI HANG
MEKONG RIVER
RELOCATED AREA
(FOR 37 HH)
image from www.PointAsia.com


Fish Ladder of Pak Chom and Ban Koum Hydropower Projects
BAN THALONG
FLOW
FLOW
INTAKE OF FISH WAY
FISH WAY
BRIDGE OF FISH WAY

Landscapes in the proposed Pak Chom reservoir area

4.7 BAN KOUM

Source: presentation on Ban Koum made by Macro Consultants on behalf of Ministry of Energy March 2008
MRC database figures shown in red where different.

4.7.1 OVERVIEW OF PROJECT

1.	Name of Dam	**Ban Koum HPP**
2.	Location of preferred site option –	928.5 km upstream of delta
	o Latitude	15°25'6.00"N
	o Longitude	105°35'12.00"E
3.	Dam statistics –	
	o Height,	53 m
	o Length,	780 m
	o Type of dam construction	Concrete gravity
4.	Please provide dam lay out if available	see below
5.	Rated head (metres)	18.6 m
6.	Plant discharge (cu.m/sec)	11,700
7.	Number of Units	26 x 72 MW
8.	Installed capacity (MW)	1,872 MW
9.	Firm and secondary energy generated annually (gigawatt hours)	Mean - 8,434 GWh/yr Firm – 8,012 GWh/yr
10.	Mode of operation –	
	o continuous generation or peak load	Continuous
	o if peak load, hours of operation per day	
11.	Environmental flow discharges, Q (cu.m/sec)	Mean annual Q – 9,149 Max observed flow – 60,972
12.	Spillway design –	
	o open flow	
	o gated spillway,	20 gates @ 90 masl
	o dimensions	20 m wide x 25.5 m high
13.	Max spillway design discharge and return period used	60,972 (100 yrs)
14.	Estimated sediment load per year (million cu.m/year)	n/a
15.	Mechanisms proposed for clearing sediment, how often might these be used?	Sand flushing gates

16. Dimensions of bottom outlets,

17. Design discharge for bottom outlet (cu.m/sec)

18. Sediment flushing outlets - dimensions and design discharge

4.7.2 PURPOSE

19. Proposed market for electricity,
    national (%) 10% Laos,
    export (%) 90% Thailand

20. Multipurpose uses considered (if any) Navigation
    Irrigation

21. Details of irrigation, if being considered (Cu.m/s or area irrigated)
    - 22 pumped irrigation projects 8 in Lao PDR, 14 in Thailand
    - Total area = 11,006 ha of which 7,870 ha will be irrigated

4.7.3 RESERVOIR

22. Full Supply level of reservoir (masl) 115 masl
23. Low Supply level of reservoir (masl) 115 masl

24. Area inundated at FSL (sq. km) 158.09 sq km (132.50 sq km)

25. Active volume of the reservoir (million.cu.m) 2,110 MCM

26. Dead storage volume of reservoir (million.cu.m)

27. Draw down (m) 0 m

28. Expected daily fluctuations in level of reservoir (m) ?

29. Length of reservoir (km)

4.7.4 CONSTRUCTION

Area of construction site

30. Duration of construction

31. Access roads required – length (km)

32. Transmission line required – length (km) 434 km to Chaiyaphum substation in Thailand

33. Expected size of construction workforce,

- skill types required
- policy for local employment

34. Dimensions of navigation locks (if any) — 2 lock capacity 500 tonnes
200 m long x 20 m wide x 3.2 m deep

35. Type and dimensions of fish passes (if any) — see design below

4.7.5 IMPACTS

Total area of reservoir — **158.09 sq km**

- In channel 135.92 sq km
- Above banks 221.72 sq km of which 87.84 in Thailand, and 133.88 in Laos

36. Total area of agricultural land inundated (ha) — 144 ha in Thailand, 198.6 ha in Laos
    - irrigated area inundated (ha)
    - rainfed agriculture (ha)
    - "slash and burn" (ha)
    - Main crop types

37. Total Area of forest (ha)
    - types of forest cover inundated

38. Number of communities, households and people to be resettled
    - Communities — 1 villages in Thailand, 3 villages in Laos
    - households — 29 in Thailand, 158 in Laos
    - people — c. 935 persons

39. Infrastructure inundated in reservoir –
    - Paved roads (km)
    - Government buildings,
    - Hospitals,
    - Schools,
    - Temples etc.

40. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites
    - Cultural sites

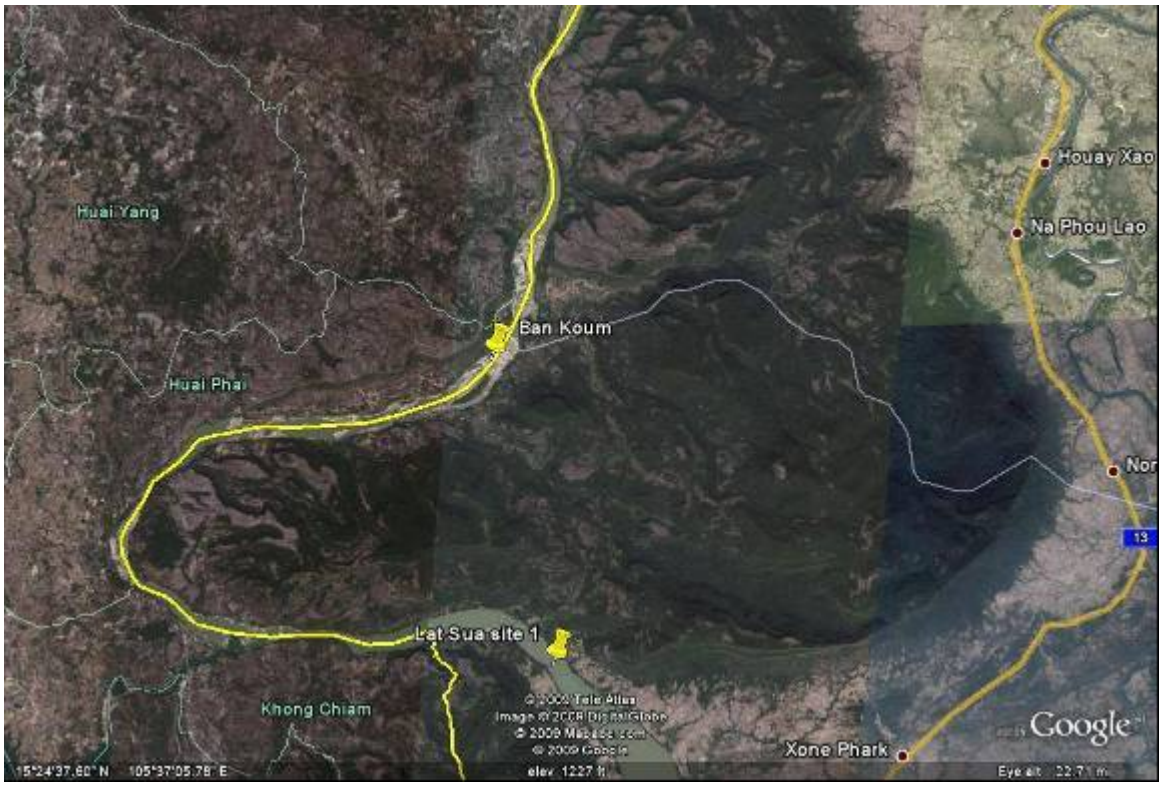
4.7.6 COSTS

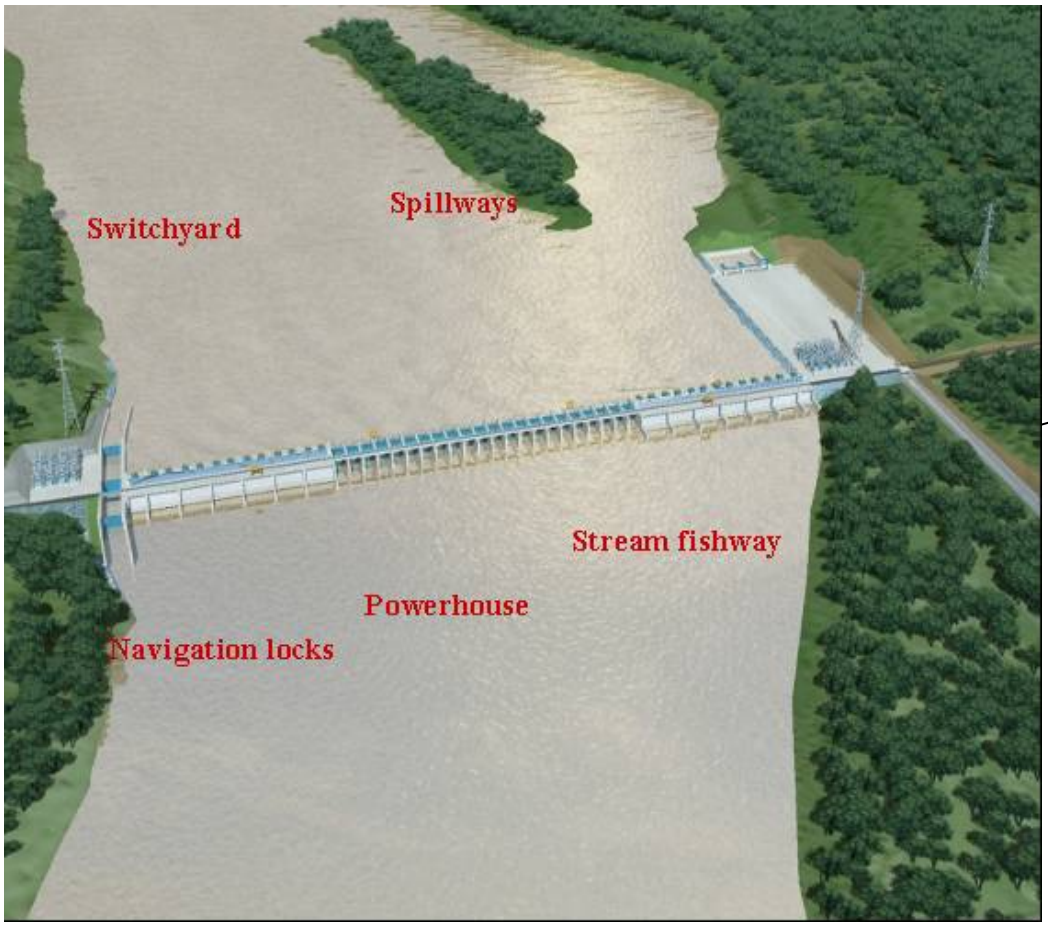
41. Estimated cost of the dam (Million $) — 3,000 million $

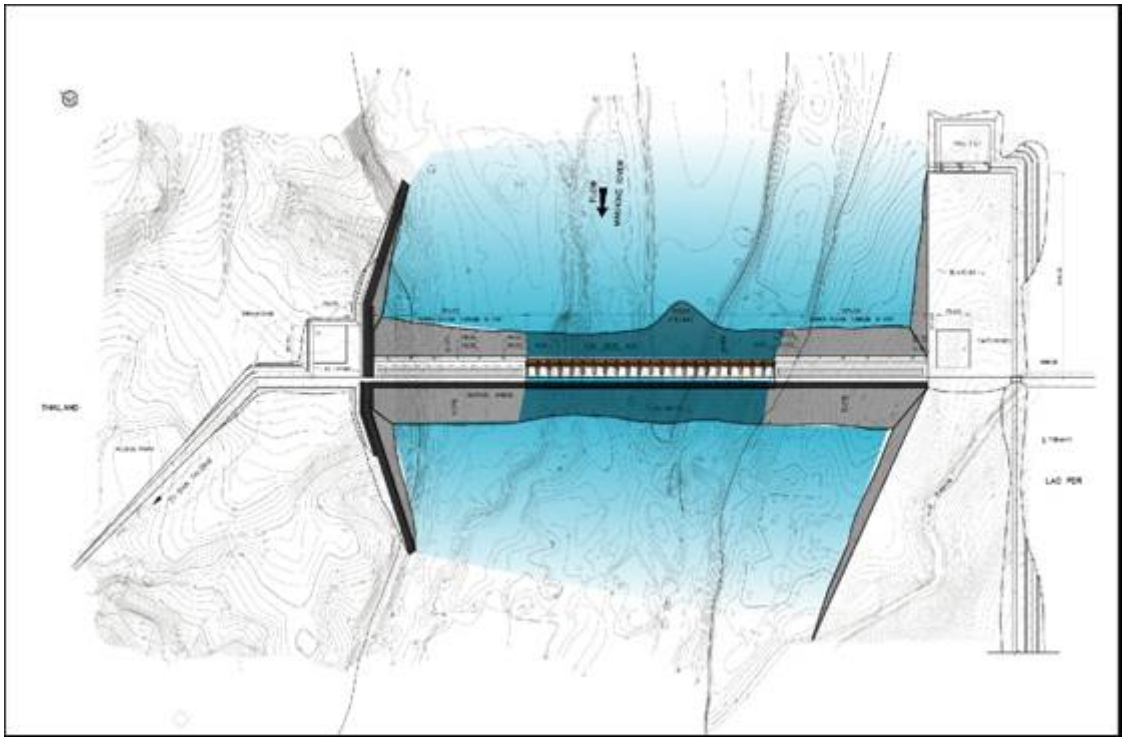
42. Estimated environmental and social costs (million $) — 35 million USD

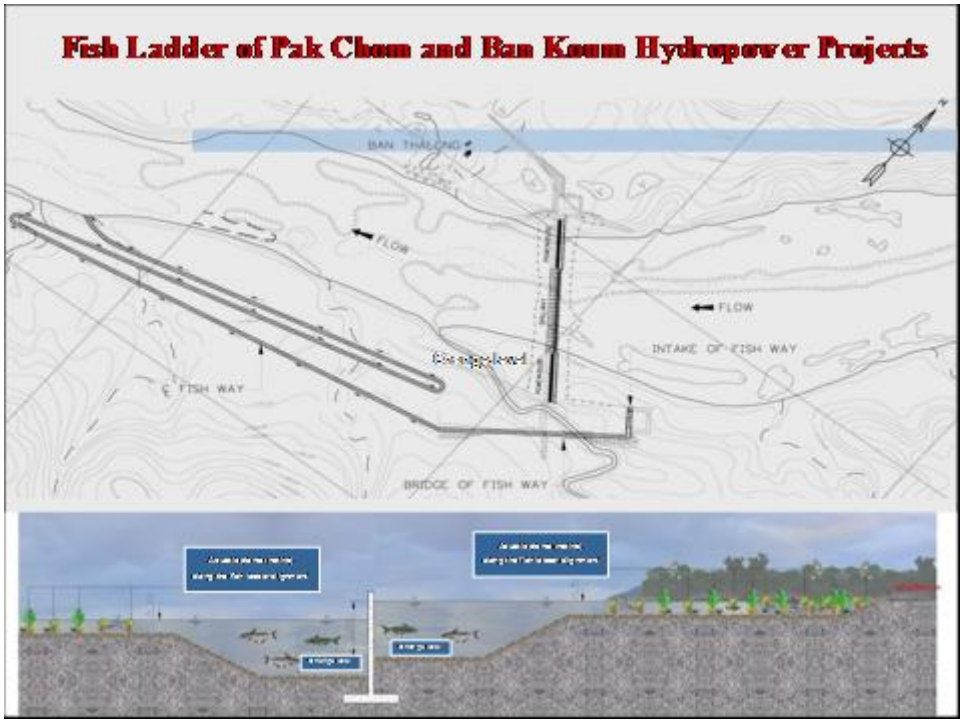
4.7.7 MAPS AND IMAGES

Google earth Image

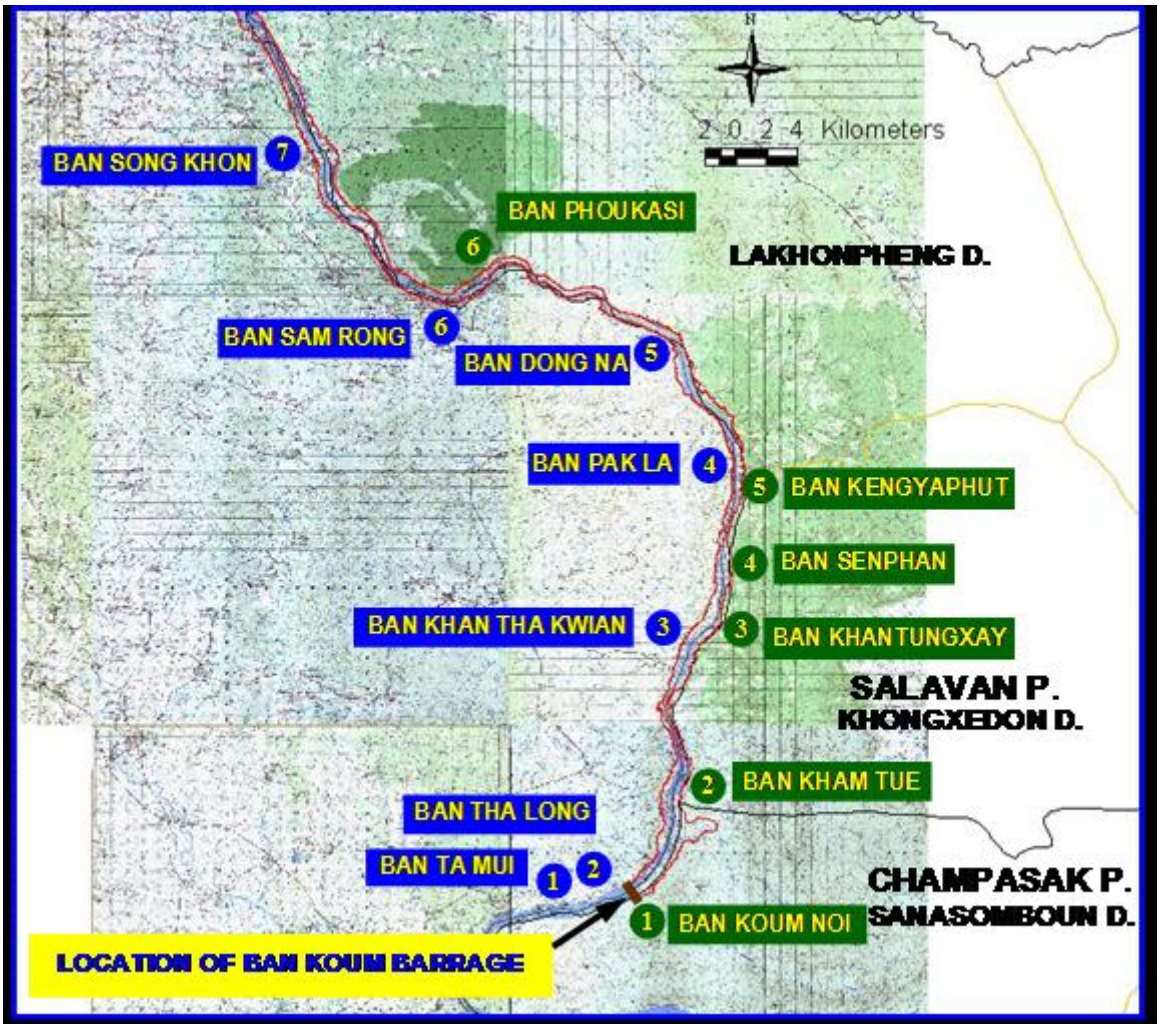



Switchyard
Spillways
Stream fishway
Powerhouse
Navigation locks




Fish Ladder of Pak Chom and Ban Koum Hydropower Projects
BAN THALONG
FLOW
FLOW
INTAKE OF FISH WAY
FISH WAY
BRIDGE OF FISH WAY

Villages alongside Ban Koum reservoir



4.8 LAT SUA

Source: Lat Sua Feasibility study, TEAM Consulting for Charoen Energy and Water Asia Co.Ltd
MRC database figures shown in red where different.

4.8.1 OVERVIEW OF PROJECT

1. Name of Dam — **Lat Sua HPP**

2. Location of preferred site option – — 898.5 km — 854.6 km upstream of delta
   - Latitude — 15°19.2'N — 15° 1'31.38"N
   - Longitude — 105° 37'E — 105°52'6.23"E

   Feasibility study recommends Site 2 at 854.6 km

3. Dam statistics –
   a. Height, — 27 m
   b. Length, — 1,300 m
   c. Type of dam construction — Concrete gravity

4. Please provide dam lay out if available — N/A

5. Rated head (metres) — 10.6 m (max) 3.0 m (min)

6. Plant discharge (cu.m/sec) — 20 x 500 = Max flow 10,000 cu.m/sec

7. Number of Units — 20 x 34.3 MW

8. Installed capacity (MW) — 686 MW

9. Firm and secondary energy generated annually (gigawatt hrs) Primary – 1,524 GWh/yr
   Secondary – 318 GWh/yr
   Excess energy – 826 GWh/yr

10. Mode of operation –
    - continuous generation or peak load
    - if peak load, hours of operation per day
      - Primary energy over 16 hrs per day,
      - secondary energy for 2hrs per day on 6 days and 8 hrs on Sundays,
      - excess energy on 6hrs per day on 6 days

11. Environmental flow discharges, Q (cu.m/sec) — Mean annual Q – 5,559 (97.5 masl)
    Max observed flow – 89,590 (104 masl)

12. Spillway design –
    - open flow
    - gated spillway, — 24 gates - Elevation 70 masl
    - dimensions — 20 m wide x 25 m high

13. Max spillway design discharge and return period used — 89,590 cu.m/sec (Tr=10,000 yrs)

14. Estimated sediment load per year (million cu.m/year)

15. Mechanisms proposed for clearing sediment, how often might these be used?
    Sand flushing gates

16. Dimensions of bottom outlets,

17. Design discharge for bottom outlet (cu.m/sec)

18. Sediment flushing outlets - dimensions and design discharge

4.8.2 PURPOSE

19. Proposed market for electricity,
    national (%) 10% Laos
    export (%) to which country? 90% Thailand

20. Multipurpose uses considered (if any) Navigation
    Irrigation

21. Details of irrigation, if being considered (Cu.m/s or area irrigated)
    Area proposed for irrigation on right bank = 730,000 ha
    3 crops per year
    Feasibility study underway

4.8.3 RESERVOIR

Headpond type capable of being lowered to pass floods and bedload

22. Full Supply level of reservoir (masl) 97.5 masl

23. Low Supply level of reservoir (masl)

24. Minimum Downstream water level 86.16 masl

25. Area inundated at FSL (sq. km)

26. Active volume of the reservoir (million.cu.m)

27. Dead storage volume of reservoir (million.cu.m)

28. Draw down (m) 2m

29. Expected daily fluctuations in level of reservoir (m) 2m

30. Length of reservoir (km)

4.8.4 CONSTRUCTION

Area of construction site

31. Duration of construction	8yrs First generation by 2015, assuming construction starts in 2011
32. Access roads required – length (km)	
33. Transmission line required – length (km)	To Thailand – route not determined yet
34. Expected size of construction workforce, o skill types required o policy for local employment	
35. Dimensions of navigation locks (if any)	1 lock capacity 500 tonnes 195 m long x 12 m wide x 3.2 m deep
36. Type and dimensions of fish passes (if any)	800 m long x 10 m wide x 3 m deep at slope of 5%. 4 fish entrances 10 m wide requires 1 – 5% of competing flow

4.8.5 IMPACTS

Total area of reservoir	**87 sq km**	
Mekong river and tributaries	**70 sq km**	**80%**
Cultivated land	**13 sq km**	**15%**
Mixed bamboo and secondary forest	**4 sq km**	**5%**

37. Total area of agricultural land inundated (ha)	1,325 ha
o irrigated area inundated (ha)	332 ha
o rainfed agriculture (ha)	
o "slash and burn" (ha)	
o Main crop types	
38. Total Area of forest (ha)	
o types of forest cover inundated	mixed bamboo and secondary forest

39. Number of communities, households and people to be resettled
    - o Communities
    - o households
    - o people

    note for site 1 with 100 masl FSL – 9 villages in Thailand, 2 villages in Lao were considered affected because they lay at or above 100 masl level and were likely to experience flooding.
    For site 2 with 97.5 masl FSL – no villages are implicated, although flood protection measures will be taken for villages near Pakse at 98.5 masl (which is equivalent to flood magnitude of 15,000 cu.m/sec

40. Infrastructure inundated in reservoir –
    - o Paved roads (km)
    - o Government buildings,

- Hospitals,
- Schools,
- Temples etc.

41. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites
    - Cultural sites

4.8.6 COSTS

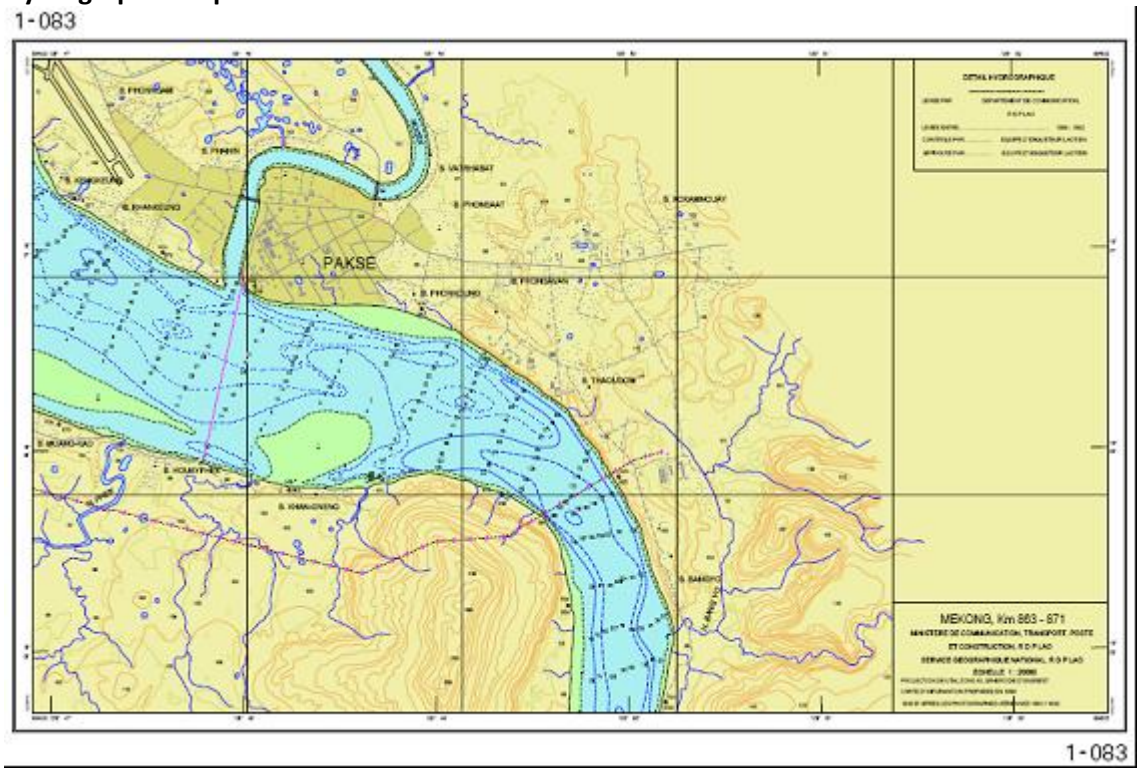
42. Estimated cost of the dam (Million $)

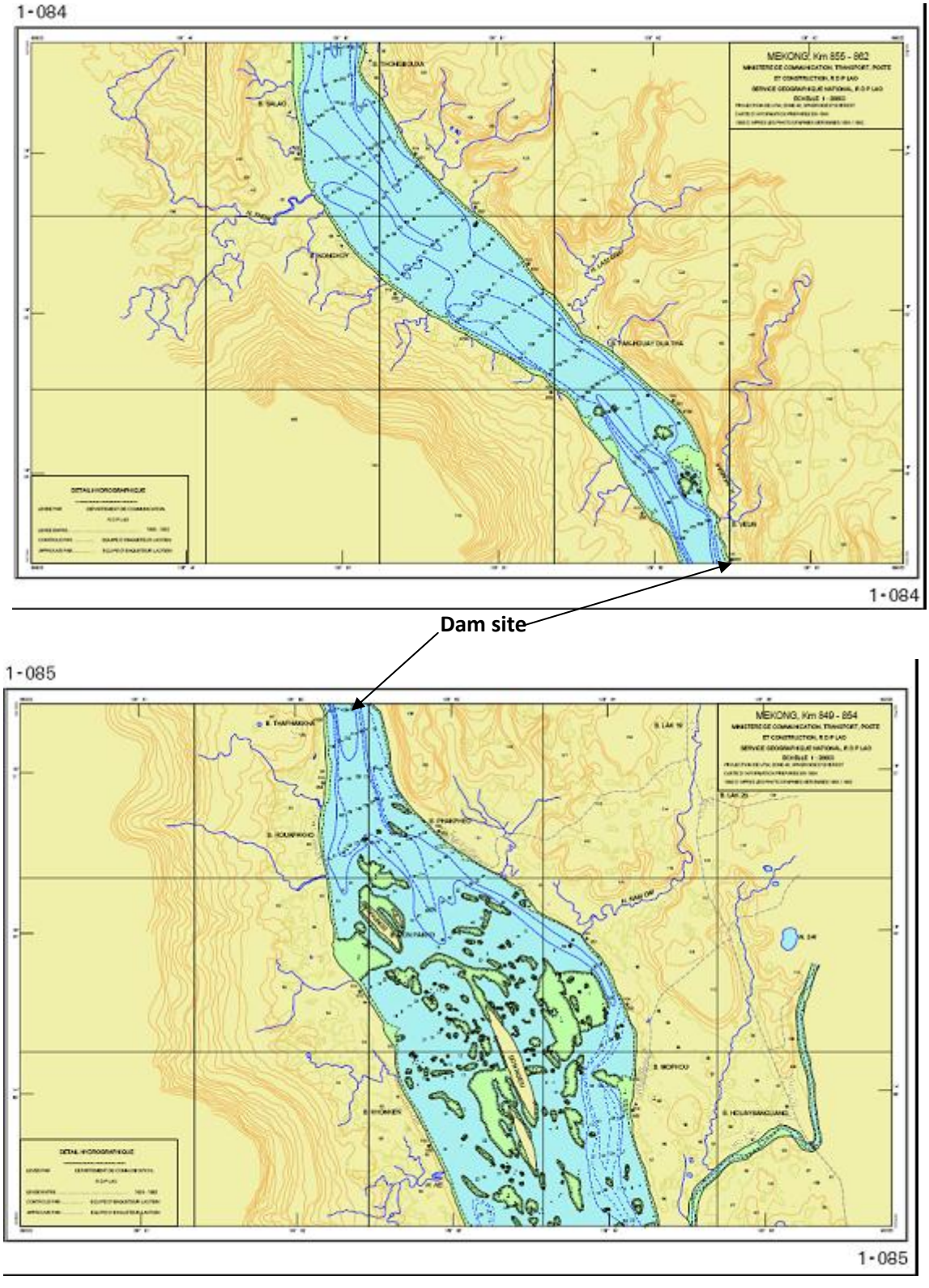
43. Estimated environmental and social costs (million $)

4.8.7 MAPS AND IMAGES

Google earth Image

Hydrographic maps from Pakse to below dam site at 854.6 km




1-084
MEKONG, Km 855 - 862
1-084
Dam site
1-085
MEKONG, Km 849 - 854
1-085

4.9 DON SAHONG

Source: Don Sahong EIA (2007), Mega First Corporation, MRC Database

4.9.1 OVERVIEW OF PROJECT

3.	Name of Dam	**Don Sahong HPP**	
4.	Location of preferred site option –	722 km upstream of delta	
		Original	revised
	o Latitude	13°57.4'N	13°56'37.88"N
	o Longitude	105° 57.8'E	105°57'22.59"E
	Note that according to Ministry of Mines and Energy, location has been moved to bottom end of Don Sahong channel		
44.	Dam statistics –		
	o Height,	10.6 m with two walls of 8.2/8.3 m extending into main channel at top end of Hou Sahong	
	o Length,	720 m with walls along Hou Sahong 1,820 m and 2,730 m	
	o Type of dam construction	Rolled Concrete dam and walls	
45.	Please provide dam lay out if available		
46.	Rated head (metres)	17 m	
47.	Plant discharge (cu.m/sec)	2,400 cu.m/sec	
48.	Number of Units	4 x 60 MW	
49.	Installed capacity (MW)	240 MW	
50.	Firm and secondary energy generated annually (gigawatt hours)	Mean - 2,375 GWh/yr Firm – 1,988 GWh/yr	
51.	Mode of operation –		
	o continuous generation or peak load	Continuous	
	o if peak load, hours of operation per day		
52.	Environmental flow discharges, Q (cu.m/sec) for whole Mekong at Khone Phapheng Falls	Mean annual Q – 10,310 Min observed flow – 1,068 Max observed flow – 42,447	
53.	Spillway design –	No spillway	
	o open flow		
	o gated spillway,		
	o dimensions		
54.	Max spillway design discharge and return period used		
55.	Estimated sediment load per year (million cu.m/year)		

56. Mechanisms proposed for clearing sediment, how often might these be used?
    Sand flushing gates

57. Dimensions of bottom outlets,

58. Design discharge for bottom outlet (cu.m/sec)

59. Sediment flushing outlets - dimensions and design discharge

4.9.2 PURPOSE

60. Proposed market for electricity,
    national (%) 10%
    export (%) to which country? 90% Thailand

61. Multipurpose uses considered (if any) None

62. Details of irrigation, if being considered (Cu.m/s or area irrigated) None

4.9.3 RESERVOIR

Headpond type capable of being lowered to pass floods and bedload

63. Full Supply level of reservoir (masl) 74.5

64. Low Supply level of reservoir (masl) 72.0

65. Area inundated at FSL 290 ha

66. Active volume of the reservoir (million.cu.m) 115 MCM

67. Dead storage volume of reservoir (million.cu.m)

68. Draw down (m) 2.5 m

69. Expected daily fluctuations in level of reservoir (m)

70. Length of reservoir (km) 5 km

4.9.4 CONSTRUCTION

Area of construction site **12.8 ha**
Embankments **4.5 ha**

71. Duration of construction

72. Access roads required – length (km) 5.7 km on Don Sahong
    Barge depots

73. Transmission line required – length (km) — 20.68 km for 230 kva line to Ban Hat substation

74. Expected size of construction workforce,
    - skill types required
    - policy for local employment

75. Dimensions of navigation locks (if any) — No navigation facility

76. Type and dimensions of fish passes (if any) — Modifications to side channels and small fish pass to be constructed and trialed during construction

4.9.5 IMPACTS

Total area affected	**290.7 ha**
Total area of reservoir	**265.2 ha**
Mekong river and tributaries	**92.6 ha**
Island area flooded at 75 masl	**94.8 ha (right bank) + 77.8 ha (left bank)**

77. Total area of agricultural land inundated (ha) — 30.4 ha
    - irrigated area inundated (ha)
    - rainfed agriculture (ha)
    - "slash and burn" (ha)
    - Main crop types

78. Total Area of forest (ha) — 172.7
    - types of forest cover inundated

79. Number of communities, households and people to be resettled
    - Communities — 3 villages on 2 islands, 1 village on mainland
    - households — 14
    - people — 66

80. Infrastructure inundated in reservoir –
    - Paved roads (km)
    - Government buildings,
    - Hospitals,
    - Schools,
    - Temples etc.

81. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites — Near Khone Phapheng Falls – possible impact upon flow of water over main falls
    - Cultural sites

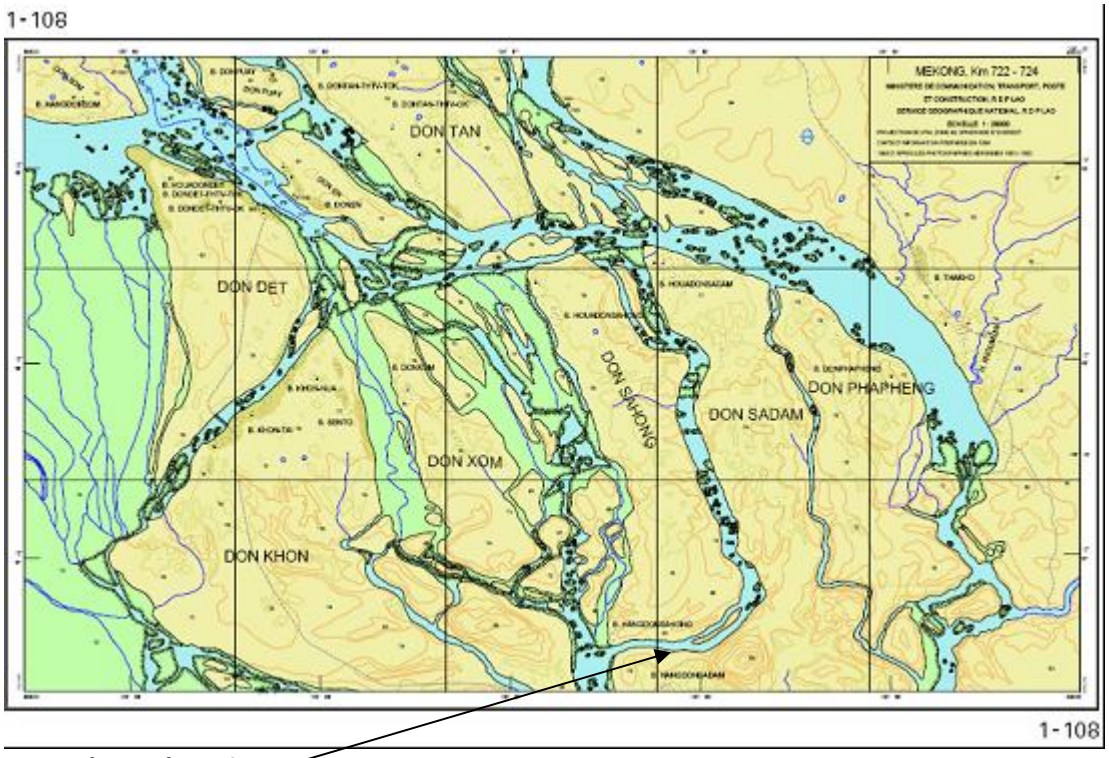
4.9.6 COSTS

82. Estimated cost of the dam (Million $)

83. Estimated environmental and social costs (million $)

4.9.7 MAPS AND IMAGES

Google earth Image



Don Sahong dam site

Dam site looking downstream

Hou Sahong looking upstream from dam site

Hou Sahong – drilling rig for dam survey

Top end of Hou Sahong

Hou Xang Peuk – channel to be modified for improving fish passage

4.10 THAKHO HPP

Source: Thakho IEE, prepared for CNR August 2009

4.10.1 OVERVIEW OF PROJECT

1.	Name of Dam	**Thakho Diversion HPP**	
2.	Location of preferred site option –	722 km upstream of delta	
		Intake	Power house
	o Latitude	13°57'50.9"N	13°57'6.6"N
	o Longitude	105° 59'15.3"E	105° 59'20.2"E
3.	Dam statistics –	No dam	
	o Height,		
	o Length,		
	o Type of dam construction		
4.	Please provide dam lay out if available	Intake structure located 300 m upstream of Khone Phapheng Falls – 12 sluices 7.5 m wide – total width 100m Headrace channel – 1,700 m x 70 m width Power house located 500 m below Khone Phapheng Falls	
5.	Rated head (metres)	15.5 m	
6.	Plant discharge (cu.m/sec)	380 cu.m/sec	
7.	Number of Units	2 x 25 MW	
8.	Installed capacity (MW)	50 MW	
9.	Firm and secondary energy generated annually (gigawatt hours)	Mean - 360 GWh/yr	
10.	Mode of operation –		
	o continuous generation or peak load	Continuous	
	o if peak load, hours of operation per day		
11.	Environmental flow discharges, Q (cu.m/sec) for whole Mekong at Khone Phapheng Falls	Mean annual Q – 10,310 Min observed flow – 1,068 Max observed flow – 42,447	
12.	Spillway design –	No spillway	
	o open flow		
	o gated spillway,		

- dimensions

13. Max spillway design discharge and return period used
14. Estimated sediment load per year (million cu.m/year) Not applicable
15. Mechanisms proposed for clearing sediment, how often might these be used?
16. Dimensions of bottom outlets, No bottom outlets
17. Design discharge for bottom outlet (cu.m/sec)
18. Sediment flushing outlets - dimensions and design discharge

4.10.2 PURPOSE

19. Proposed market for electricity,
    national (%) 100%
    export (%) to which country? 0%
20. Multipurpose uses considered (if any) possible irrigation and water supply from channel under consideration
21. Details of irrigation, if being considered (Cu.m/s or area irrigated)

4.10.3 RESERVOIR

22. Full Supply level of reservoir (masl) No Reservoir envisaged
    71.7 masl (normal Mekong level at intake)
23. Low Supply level of reservoir (masl) 68.7 masl (min.operating level of Mekong
24. Area inundated at FSL (sq. km) 30 ha of land affected by intake, headrace channel, and power house out of 1,500 ha in the immediate locality
25. Active volume of the reservoir (million.cu.m) n/a
26. Dead storage volume of reservoir (million.cu.m) n/a
27. Draw down (m) n/a
28. Expected daily fluctuations in level of reservoir (m) n/a
29. Length of reservoir (km) n/a

4.10.4 CONSTRUCTION

Area of construction site

30. Duration of construction

31. Access roads required – length (km)	2km Access road from Route 13
32. Transmission line required – length (km)	155 kva - 2 km to road then along road 20 km to Ban Hat sub-station

33. Expected size of construction workforce,
    - skill types required
    - policy for local employment

34. Dimensions of navigation locks (if any)	No Navigation
35. Type and dimensions of fish passes (if any)	Not required

4.10.5 IMPACTS

Total area of reservoir	**No reservoir**
Total land area affected	**30.3 ha**
Cultivated land	**13.5 ha**
Secondary forest	**16.4 ha**

36. Total area of agricultural land inundated (ha)	13.5 ha
o irrigated area inundated (ha)	
o rainfed agriculture (ha)	
o "slash and burn" (ha)	
o Main crop types	
37. Total Area of forest (ha)	16.4 ha
o types of forest cover inundated	secondary forest, dry dipterocarp and mixed deciduous

38. Number of communities, households and people to be resettled

o Communities	0
o households	0
o people	0

39. Infrastructure inundated in reservoir –
    - Paved roads (km)
    - Government buildings,
    - Hospitals,
    - Schools,
    - Temples etc.

40. Tourism and cultural sites lying in the inundation zone	
o Caves, waterfalls, historic sites	Water is diverted around Khone

Phapheng Falls. Minimum dry season (c. 800 cu.m/sec) flows ensured over falls under operational rules

- Cultural sites

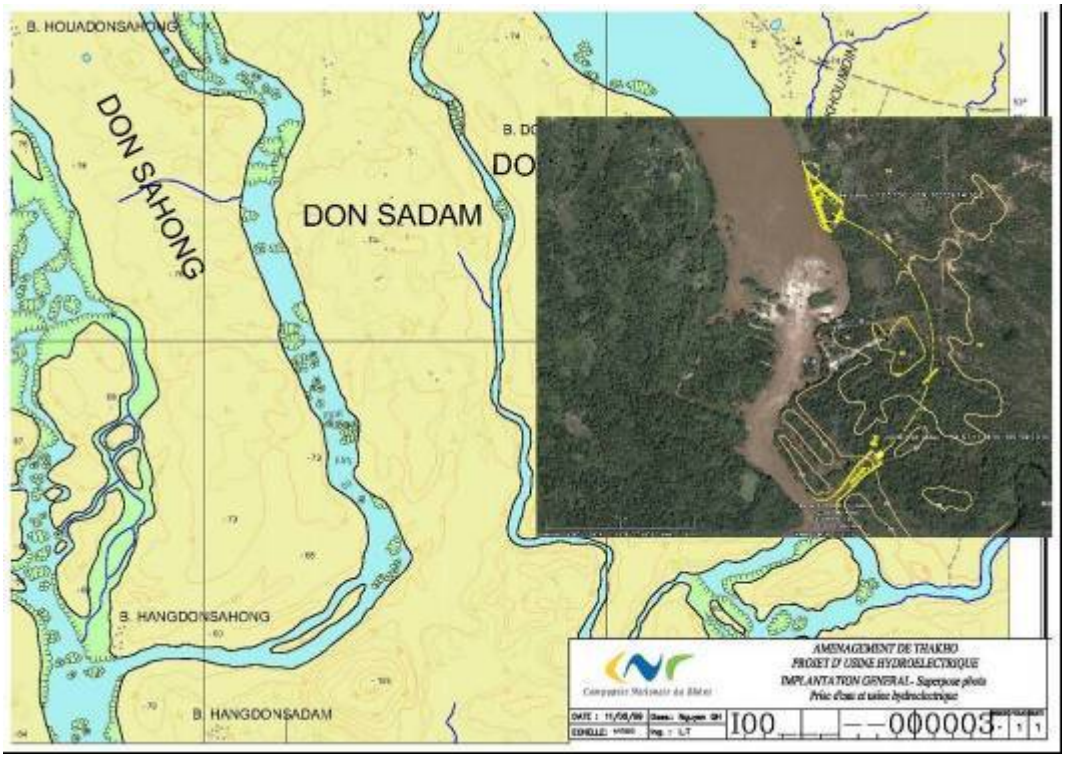
4.10.6 COSTS

41. Estimated cost of the dam (Million $) $ 109 Million

42. Estimated environmental and social costs (million $) c. 2% of total investment costs

4.10.7 MAPS AND IMAGES

Google earth Image with layout



View of Intake site looking downstream towards Khone Phapheng Falls

Khone Phapheng Falls

Location of Tailrace looking out to main channel of Mekong

4.11 STUNG TRENG

Source: MRC database
Note: very little detailed information is available on the Stung Treng HPP because there has been no feedback from Russian developers on the feasibility study

4.11.1 OVERVIEW OF PROJECT

3.	Name of Dam	**Stung Treng HPP**
4.	Location of preferred site option –	about 8 km upstream of Stung Treng
	o Latitude	13°34'31.13"N
	o Longitude	105°59'0.41"E
	(NB: location given in MRC database is incorrect)	
43.	Dam statistics –	
	o Height,	22 m
	o Length,	10,844 m
	o Type of dam construction	Gravity, earth fill
44.	Please provide dam lay out if available	N/A
45.	Rated head (metres)	15.2 m
46.	Plant discharge (cu.m/sec)	18,493
47.	Number of Units	10 x 98 MW
48.	Installed capacity (MW)	978 MW Peaking capability 591 MW
49.	Firm and secondary energy generated annually (gigawatt hours)	Mean - 4,870 GWh/yr Firm – 2,937 GWh/yr
50.	Mode of operation –	
	o continuous generation or peak load	Continuous
	o if peak load, hours of operation per day	
51.	Environmental flow discharges, Q (cu.m/sec)	Nominal flow – 8,000 Mean annual Q – 13,714 Max flood – 79,100
52.	Spillway design –	N/a
	o open flow	
	o gated spillway,	
	o dimensions	
53.	Max spillway design discharge and return period used	73,500 cu.m/sec

54. Estimated sediment load per year (million cu.m/year) N/a

55. Mechanisms proposed for clearing sediment, how often might these be used?

56. Dimensions of bottom outlets, N/a

57. Design discharge for bottom outlet (cu.m/sec)

58. Sediment flushing outlets - dimensions and design discharge

4.11.2 PURPOSE

59. Proposed market for electricity,
    national (%) 10%
    export (%) to which country? 90% Vietnam

60. Multipurpose uses considered (if any) Navigation
    Irrigation
    Flood control

61. Details of irrigation, if being considered (Cu.m/s or area irrigated) N/a

4.11.3 RESERVOIR

62. Full Supply level of reservoir (masl) 55 masl

63. Low Supply level of reservoir (masl) 50 masl

64. Area inundated at FSL (sq. km) 211 sq km

65. Active volume of the reservoir (million.cu.m) 70 MCM

66. Dead storage volume of reservoir (million.cu.m)

67. Draw down (m) 5 m

68. Expected daily fluctuations in level of reservoir (m) 2 m

69. Length of reservoir (km) 50 km

4.11.4 CONSTRUCTION

Area of construction site

70. Duration of construction

71. Access roads required – length (km)

72. Transmission line required – length (km) To Vietnam – route not determined yet

73. Expected size of construction workforce,
    - o skill types required
    - o policy for local employment

74. Dimensions of navigation locks (if any) N/a

75. Type and dimensions of fish passes (if any) N/a

4.11.5 IMPACTS

Total area of reservoir **211 sq km**

76. Total area of agricultural land inundated (ha) N/a
    - o irrigated area inundated (ha)
    - o rainfed agriculture (ha)
    - o "slash and burn" (ha)
    - o Main crop types

77. Total Area of forest (ha)
    - o types of forest cover inundated riverine forest

78. Number of communities, households and people to be resettled
    - o Communities 21 villages
    - o households 2,059 households
    - o people 10,617 persons

Note these figures are taken from estimates of people living in the Stung Treng Ramsar site

79. Infrastructure inundated in reservoir –
    - o Paved roads (km)
    - o Government buildings,
    - o Hospitals,
    - o Schools,
    - o Temples etc.

80. Tourism and cultural sites lying in the inundation zone
    - o Caves, waterfalls, historic sites The whole reservoir area lies within the Stung Treng Ramsar site
      It has high biodiversity and high tourism potential
    - o Cultural sites

4.11.6 COSTS

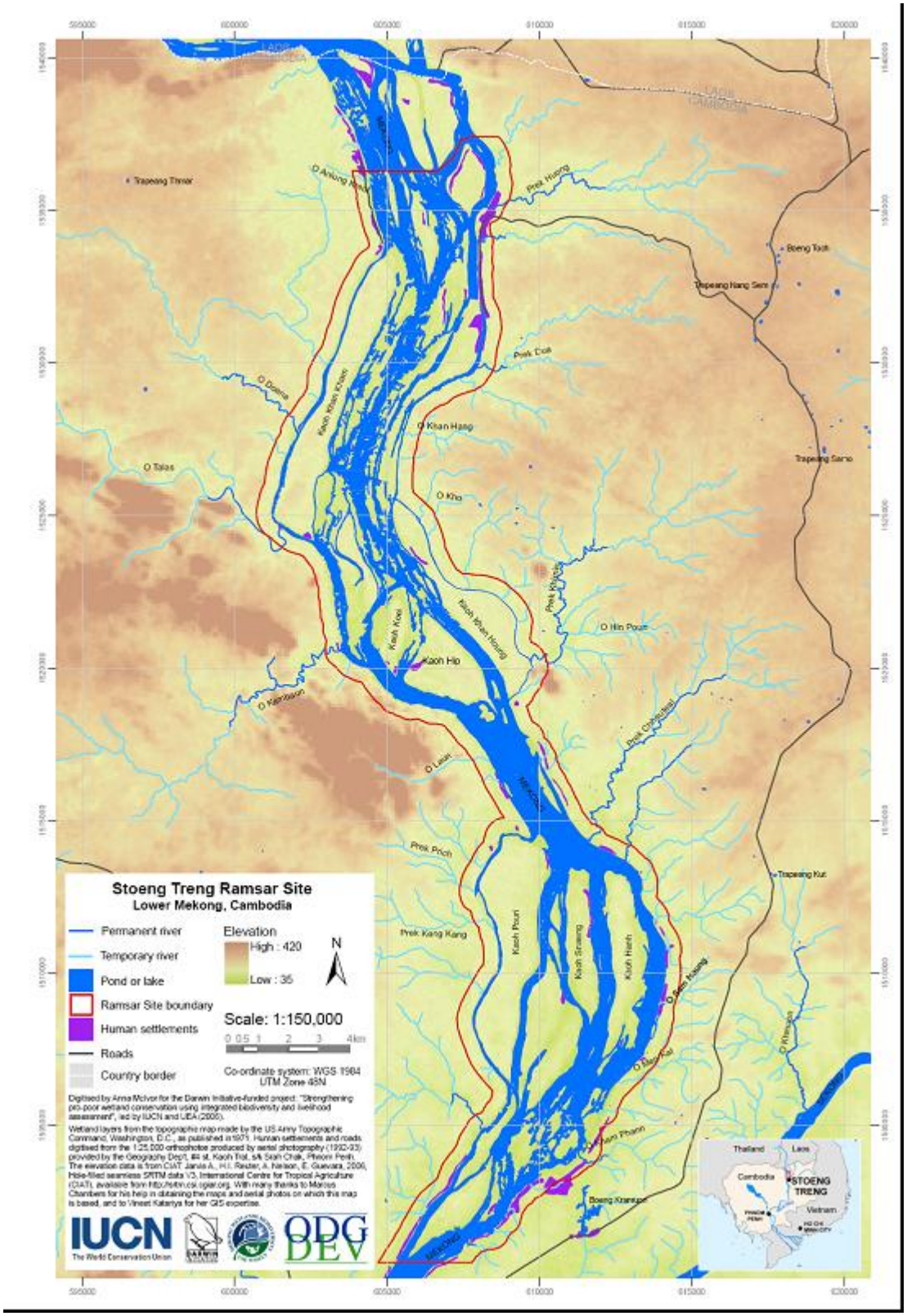
81. Estimated cost of the dam (Million $) N/a

82. Estimated environmental and social costs (million $)

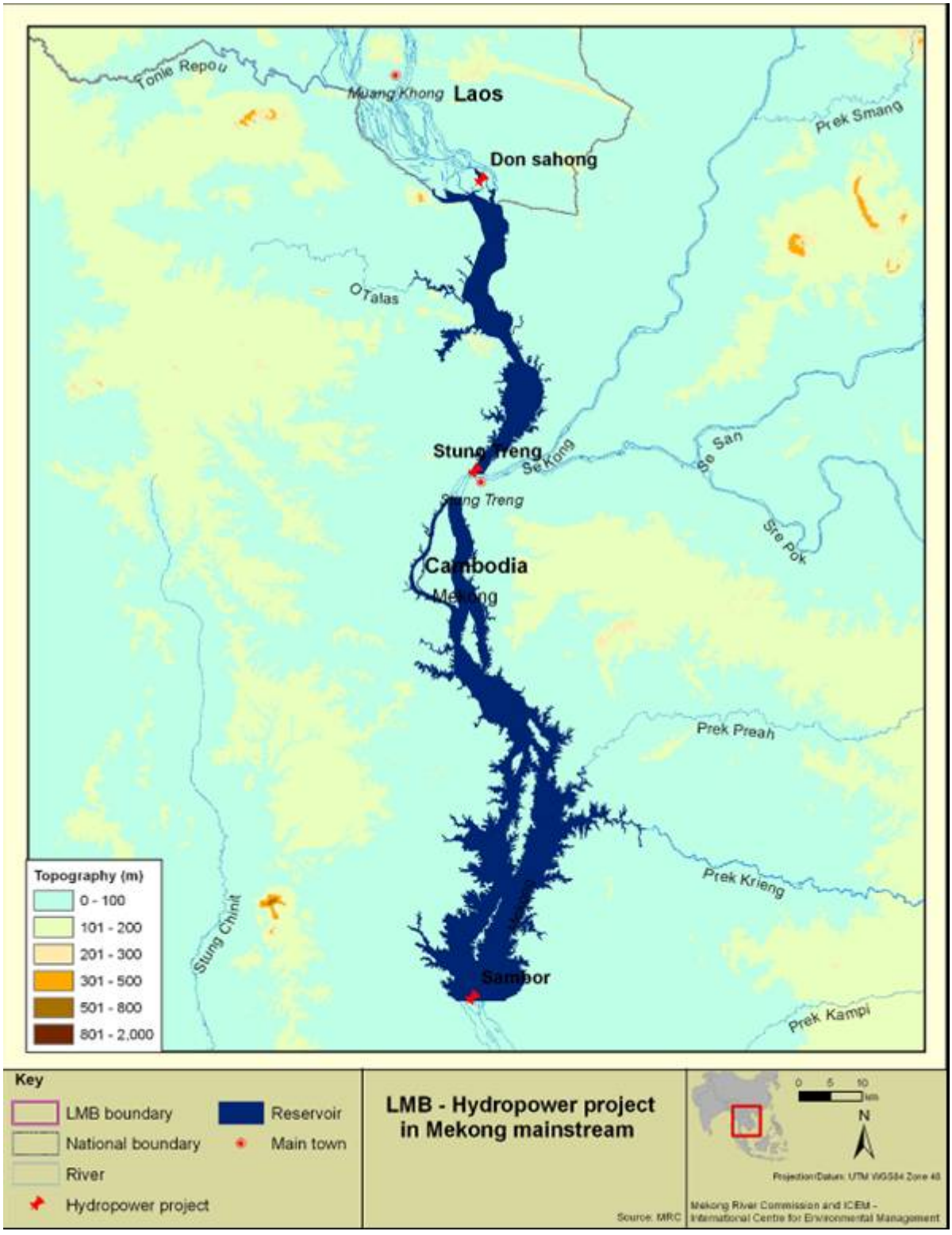
4.11.7 MAPS AND IMAGES

Google earth Image

Map of the Stung Treng Ramsar Site



Reservoir areas of Sambor and Stung Treng HPPs



4.12 SAMBOR

Source: Sambor Prefeasibility study by China Southern Grid Co Ltd. Cambodia
MRC database figures shown in red where different.

4.12.1 OVERVIEW OF PROJECT

5. Name of Dam **SAMBOR, Cambodia**

6. Location of preferred site option –
   - Latitude Dam site II – 12° 47' N (12 36.5'N)
   - Longitude 105 ° 57' E (106 1.0'E)

(Taken from Google earth picture of location from Chinese developers)

83. Dam statistics –
   - Height, 56 m (35m)
   - Length, 18,002 m (30,664 m)
   - Type of dam construction Concrete gravity dam and earth rock fill dam

84. Please provide dam lay out if available

85. Rated head (metres) 16.5 (22.9 – 9.5 m max and min) (32.9)

86. Plant discharge (cu.m/sec) 441.7 x 40 = 17,668 (19,163)

87. Number of Units 40

88. Installed capacity (MW) 65MW x 40 = 2,600 (3,300)

89. Firm and secondary energy generated annually (gigawatt hours)
   - Average annual energy 11,740 Gw.h (14,870)

90. Mode of operation –
   - continuous generation or peak load Continuous?
   - if peak load, hours of operation per day hrs.day Annual average 4515 hours = 12.37

91. Environmental flow discharges (cu.m/sec) Continuous

92. Spillway design –
   - open flow
   - gated spillway,

93. Max spillway design discharge and return period used (149,300 cu.m/sec)
   - Peak inflow (161,000 cu.m/sec)

94. Estimated sediment load per year (million cu.m/year)

95. Mechanisms proposed for clearing sediment, how often might these be used?

96. Dimensions of bottom outlets,

97. Design discharge for bottom outlet (cu.m/sec)

- Sediment flushing outlets – 37 release sluices
- dimensions and design discharge 15m x 20 m elevation, 159 cu.m/sec = 5,883 cu.m/sec

4.12.2 PURPOSE

98. Proposed market for electricity,
    7.1 national (%) 30%
    8.1 export (%) to which country? 70% to Vietnam

99. Multipurpose uses considered (if any) Power, flood control and Navigation

100. Details of irrigation, if being considered (Cu.m/s or area irrigated)

4.12.3 RESERVOIR

101. Full Supply level of reservoir (masl)	40	(40)
102. Low Supply level of reservoir (masl)	39	(38)
103. Area inundated at FSL (sq. km)	620	
104. Active volume of the reservoir (million.cu.m)	465	(2,000)
105. Storage Coefficient	0.108%	
106. Dead storage volume of reservoir (million.cu.m)	3,794	
107. Draw down (m)	1 m	
108. Expected daily fluctuations in level of reservoir (m) the time,	small daily regulation, generating all	
109. Length of reservoir (km)		

4.12.4 CONSTRUCTION

110. Duration of construction 87 months

111. Access roads required – length (km)

112. Transmission line required – length (km) 3 x 260 km, 500 kv to HCMC

113. Expected size of construction workforce, Av 2700, max 3000
- skill types required
- policy for local employment

114. Dimensions of navigation locks (if any) — 100 tonnes – 481 m long, 8m wide from 40masl – 16 masl

115. Type and dimensions of fish passes (if any) — 3,397.8 m

- Dolphin breeding farm included

4.12.5 IMPACTS

116. Total area of agricultural land inundated (ha) — 3,369 ha
    - irrigated area inundated (ha)
    - rainfed agriculture (ha)
    - "slash and burn" (ha)
    - Main crop types

117. Total Area of forest (ha)
    - types of forest cover inundated — 13,143 ha

118. Number of communities, households and people to be resettled
    - communities
    - households
    - people — 19,034 (5,120)

119. Infrastructure inundated in reservoir –
    - House area — 24,351 sq m
    - Paved roads (km)
    - Government buildings,
    - Hospitals,
    - Schools,
    - Temples etc.

120. Tourism and cultural sites lying in the inundation zone
    - Caves, waterfalls, historic sites
    - Cultural sites

4.12.6 COSTS

121. Estimated cost of the dam (Million $) — 4,947 M$
    - Transmission line — 312.9 M$

122. Estimated environmental and social costs (million $)

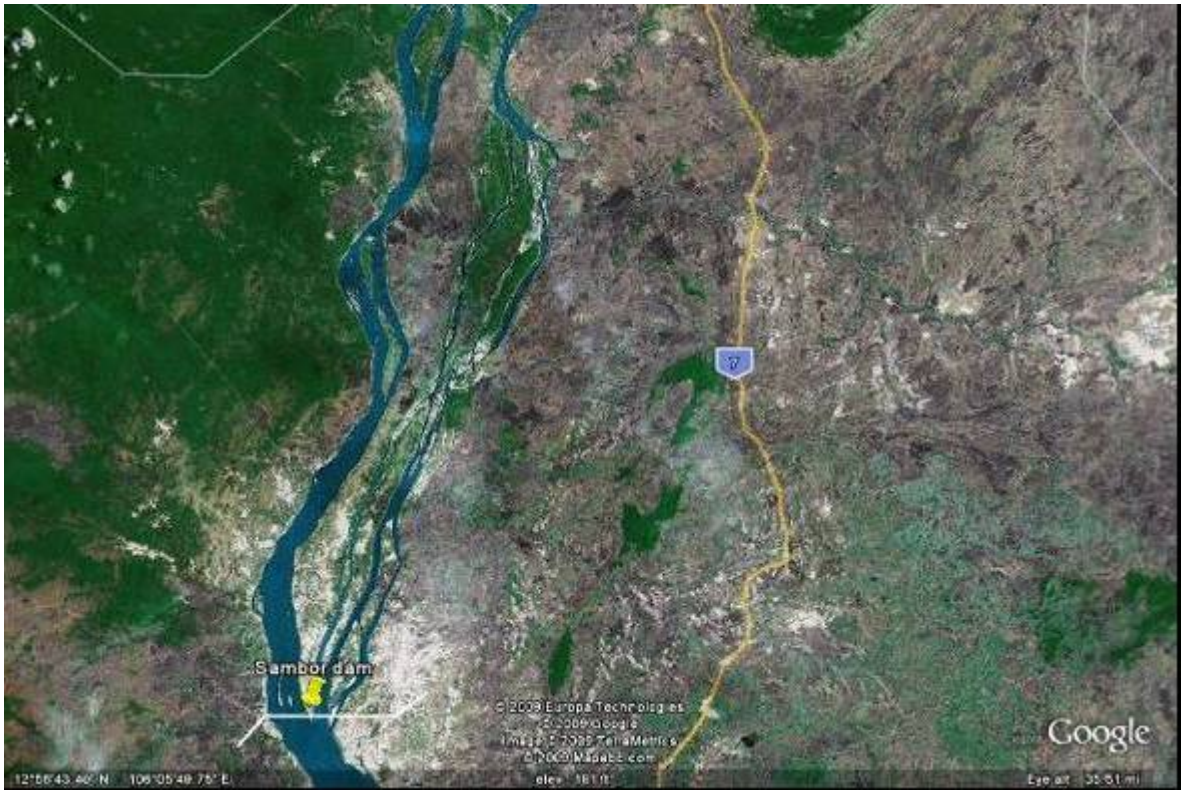
    - Social including resettlement — 80.33 M$ but note that this was based on 10,000 people for resettlement, so will probably be double this
    - Environmental — 21.24 M$

    - Cost/KW — 1,685 $/KW
    - Cost/kwh — 0.373 – 0.398 $/KWh

- Online tariff 7.23 – 7.97 cents/kwh
- IRR 13.0%
- Loan agreement 25 years

4.12.7 MAPS AND FIGURES

Dam location on Google Earth



Reservoir areas of Sambor and Stung Treng HPPs