

## **Environmental Impact Assessment Report Don Sahong Hydropower Project, Lao PDR**

### **Review Report - Draft**

#### **A Review task description**

1 The MRC Secretariat (MRCS) received letter note on 26 Sep 2007 from WREA Director General Department of Environment, Lao PDR dated 30 Aug 2007 No. 4691, requesting several Lao government agencies and the MRCS to review the EIA Vol. 1 & 2 of the Don Sahong Hydropower Project (DSHEP) at Khone Falls dated: Final Draft 11<sup>th</sup> July 2007(EIA Report).

2 The EIA Report and Feasibility Study (FS) were prepared under MOU with LPDR by PEC Konsult Sdn Bhd (PEC) and Australian Power & Water (APW). They were prepared in accordance with a TOR that is not included in the EIA main report or appendices; however the Letter of Approval of the TOR by the Director General of the Department of Environment, Science Technology and Environment Agency, Prime Minister's Office on 10 October 2006 is contained in Appendix M in both Lao and English languages. Condition 3 of the approval notes that "During the period of reviewing the EIA, should there be some environmental issues that are not covered in the ToR but are deemed necessary to be addressed. In such a case, the project owner will be required to conduct additional study to ensure the completeness, accuracy and adequacy of the EIA Report for it to be acceptable."

3 Thus, this statement provides the basis for review of the EIA Report: completeness, accuracy and adequacy; and the MRCS, in its review, has taken these three elements as guidance for the preparation of its comments. However, without the TOR, it is difficult to know the parameters of the EIA preparation.

4 The MRCS clearly recognizes the necessity of maintaining an impartial position in facilitating the MRC Member States in order to protect the integrity of the MRC and its three organizational bodies in carrying out the mandates of the MA95, which is much more sensitive in responding to an individual member request than a directive from the Joint Committee (JC) on behalf of or with full knowledge of all Member States. The JC at its Preparatory Meeting for the Fourteenth Meeting of the MRC Council has however encouraged the MRC Secretariat to be of assistance to Member States with regard to national governmental requests for provision of advice or technical expertise.

5 It was thus concluded by the MRCS that the EIA Report should only be reviewed and commented upon based upon its stand-alone completeness and adequacy and not accuracy of data and conclusions since much of this data and information is contained in the FS, except where there appears to be scientifically or technically incomplete or contradictory data presented or conclusions reached.

6 However, an initial assessment can be undertaken with respect to information contained in the EIA. This will support the GoL in its internal evaluation on whether to accept the EIA Report, request additional work on the EIA Report, and / or to proceed further with the proposed project.



7 For ease of reference the summary review report follows the chapter outline of the EIA Report. For each chapter of the EIA Report the review:

- (i) Notes areas which adequately address issues at hand;
- (ii) Identifies information gaps, matters not adequately addressed, highlighted inaccurate assumptions and information presented, logical and factual inconsistencies, methodological shortcomings, not considered uncertainties, etc.;
- (iii) Provides additional information in areas relevant to the DSHEP; and
- (iv) Proposes additional research which could facilitate consideration.

8 It was also felt that a simple visual presentation of the DSHEP's features as well as potential impacts could greatly improve the consideration of information contained in the EIA Report or otherwise available. A set of maps and graphs is therefore included.

## **B Review**

9 The following review and the numbering of its headings corresponds to the structure of the EIA Report.

### **Executive Summary**

10 The Executive Summary summarizes information detailed in the main sections of the EIA Report. Comments are therefore provided in under the respective chapter headings below.

#### **1 Introduction**

11 No specific observations.

#### **2 Project Description and Proponent**

12 The EIA Report provides key data and offers brief descriptions of the main temporary and permanent elements of the proposed DSHEP, to the detail of this early planning stage. A separate section introduces Mega First Corporation Berhad, the Project Proponent. Tables summarizing the key features of the DSHEP as well as good quality maps and drawings could greatly improve the readability of this section.

13 The DSHEP will be a run-of-river scheme with no significant storage. An about 25 m high dam with powerhouse will block the Hou Sahong Channel about 150 m upstream of the exit of Hou Sahong between Don Sahong and Don Sadam islands. The dam will back up the water level, creating an impoundment whose water level will vary according to the upstream Mekong water level. Concrete lined embankments will be constructed to prevent the impounded water flooding both sides of the Hou Sahong.

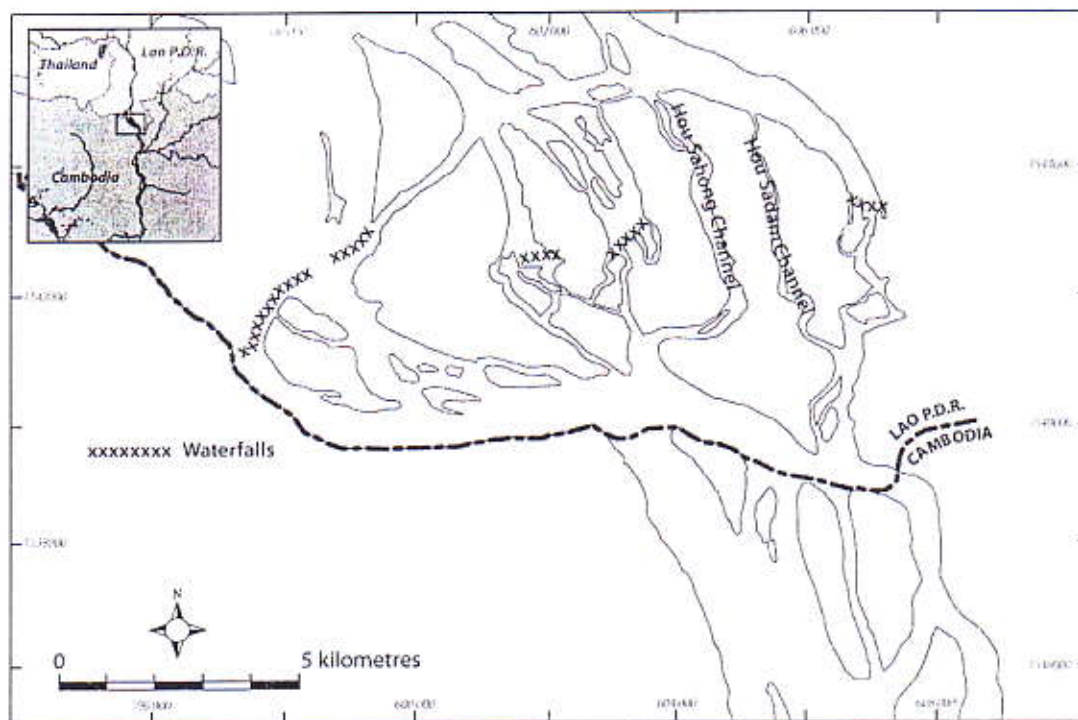


Figure 2-1: At the location of the proposed DSHEP, the Khone Falls fault line, the Mekong is a braided stream of about 10 km width. It comprises several channels, all but two blocked by waterfalls.

14 Rock excavation works in the Hou Sahong will be undertaken to lessen head losses in the channel leading to the powerhouse. The excavations will take place on a 2 km upstream stretch to a depth up to 5 m. Lesser excavations will be made on the downstream side of the powerhouse. Some of the excavation masses will be used to construct embankments and roads, but about 1.3 million m<sup>3</sup> of surplus rock and 0.7 million m<sup>3</sup> of other spoil has to be disposed of. No areas have been reserved for these masses, but it is mentioned that they will be disposed of in low-lying areas, possibly within the embankment area. As for now no borrow and spoils disposal plans exist.

15 The installed capacity of DSHEP is some 300 MW<sup>1</sup>. No figures on the maximum discharge are given in the EIA Report, but from Fig. 2.6 in the report it can be re-calculated that the maximum discharge will be about 2,000 m<sup>3</sup>/s and the turbine rated head some 20 m. The flow will be controlled in such a way that at least an agreed minimum flow<sup>2</sup> (yet to be determined) over the Khone Phapeng falls is always maintained. The control will be based on the observed water level upstream at Thako using a water level gauge installed for this purpose. There are no provisions on how to maintain flows in the adjacent channels and at other water falls (notably the Li Phi Falls).

16 Some channels are proposed to be modified to provide upstream migration routes for fish when the only current year-round fish passage at Hou Sahong is blocked, but no structures appear to have been planned to control the distribution of flow between Khone Phapeng, the DSHEP and the other channels after modification. It is to be noted that the

<sup>1</sup> The EIA mentions in section E.1, page ix that a range of installed capacities from 180 MW to 480 MW were considered and that 360 MW is the currently selected DSHEP capacity. Section 8, page 8-1 mentions that the range of 180 MW to 400 MW was investigated. Fig 2.6, page 2-6 is based on an installed capacity of 300 MW.

<sup>2</sup> Section 2.3, figure 2.6 mentions 1,000 m<sup>3</sup>/s environmental flow, section 4.1.4, page 4-5 states that the environmental flows considered range from 800 to 1,400 m<sup>3</sup>/s and that the economic evaluation of the DSHEP was based on an environmental flow of 1,000 m<sup>3</sup>/s.



modification of channels for fish as proposed as mitigation measures will affect the distribution of flow in the channels. This effect has not been addressed in the EIA Report.

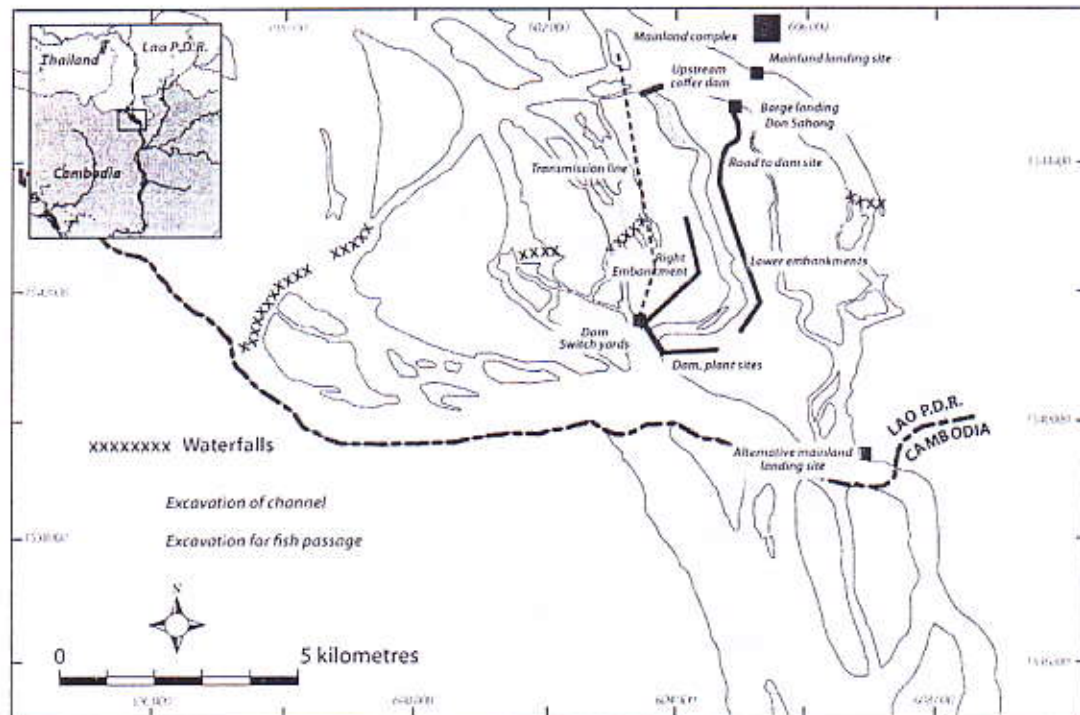


Figure 2-2: Main temporary and permanent elements of the proposed DSHEP.

17 The switchyard will be located on the mainland downstream of the powerhouse. There are no fixed plans for the transmission lines as it has yet to be determined how to connect the DSHEP to existing grids. Delivery points in Stung Treng, Cambodia, in 60 km distance and Ubon, Thailand, in 250 km distance respectively, are considered at this point. The impacts resulting from the development of the transmission line therefore remain unclear. The EIA Report however rightly acknowledges that a detailed inventory of the fauna, flora and land use along the power line's right-of-way is necessary.

18 Up to now only limited attention is given to construction site access and logistics during an estimated four-year construction period. The EIA Report informs that supply of this site by road (route 13) and water (over the Mekong from downstream) is considered. The EIA Report acknowledges that the islands are currently only reachable by small boats and that rock excavation of barge channels will be necessary<sup>3</sup>. Barge transport from the downstream Cambodian Mekong stretch may also require additional measures. Currently, the Cambodian Mekong above Stung Treng to the site is navigable for small boats only<sup>4</sup>. The brief information provided does not yet allow the full understanding of proposed measures and their potential impacts.

19 Main temporary construction facilities will be located at the mainland. Two alternative sites for the so called mainland complex are considered, both adjacent to route 13 in the north and south of the DSHEP area. The complex would hold offices, accommodation, workshops, storage and holding areas. Only limited installations would be established at the islands, mainly rock crushing, concrete batching and basic workshops. Besides the obvious logistic

<sup>3</sup> EIA report, section 2.5.1, page 2-8

<sup>4</sup> The EIA section 2.5.1, page 2-7



advantages for the Project Proponent this arrangement would reduce social and environmental impacts on the more sensitive islands. A more detailed impact assessment of the different logistics options could further decision making on this important point.

### 3 Institutional and Legal Framework

20 In reviewing the legal statements and conclusions contained in the EIA, only those pertaining to the 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (MA95) were considered for review.

21 It was considered not suitable to review the statements applicable to the various laws and policies of the Lao PDR and the application of other international commitments, as various GoL agencies also reviewing the EIA are in a much better position to understand and interpret the application of the national laws and extent of commitments under international agreements. No comments are therefore offered on sections 3.1. – 3.3.

22 Similarly the legal and procedural references to the Ramsar Convention in E.5 and Chapters 3 and 4.7 are not an MRC matter as such and better to be reviewed by experts of GoL who are familiar with the extent of their implementation and interpretations.

#### 3.4. Other Relevant International Institutions

23 The EIA Report provides some detail with regard to international and legal institutional matters. It acknowledges the relevance of both national legislation and the MA95, due to the fact that the DSHEP site is very close to the international border with Cambodia. The EIA Report states that "... during construction and operation ... the project will have very little direct impact on the Cambodian territory *per se*."<sup>5</sup> It also usefully refers to the ongoing formulation and consultation process of the MRC of guidelines for Transboundary Environmental Impact Assessments.<sup>6</sup> The EIA Report further suggests in the Executive Summary that there is uncertainty on the applicability of the MA95 for the DSHEP and in particular the application of Article 5 of the MA95.<sup>7</sup>

24 An assessment of the completeness, adequacy and accuracy of the EAI Report with respect to the MA95 suggests a number of information gaps and inconsistencies. In general, relevant information is scattered throughout the EIA Report and could usefully be consolidated in one section for description of facts (3.4.) and one on assessment of impacts and recommendations (9.3). The same facts and conclusions and recommendations should then be summarized in the Executive Summary to ensure consistency.

25 The EIA Report does make reference to GoL commitments under provisions of the MA95 in Section 3.4.1 to include Articles 3, 7, 5 and 6. However, the interpretation of Article 5 is not entirely correct: there is no "prior notification" as suggested but rather notification, prior consultation and agreement as the options in Article 5. Moreover, the references to the Procedures adopted by the MRC Council are incomplete and not updated in the EIA Report, specifically with regard to the PNPCA. The citation in Chapter 10 on References Section 2 identifies the MRC *Preliminary Procedures for Notification, Prior Consultation and*

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<sup>5</sup> Page 3-4; see also page 4-13 on impacts into Cambodia

<sup>6</sup> Page 3-4 and page 9-2

<sup>7</sup> Page xlvii



*Agreement*, 12 November 2002. The final PNPCA however were adopted by the Council in November 2003 and should thus be referred to by the EIA Report.

26 The conclusion on the application of Article 5 as stated in the Executive Summary E.5 (but not in section 3.4 on this issue) is not based on a full and correct interpretation of Article 5 and the PNPCA. The statement: "One requirement of the Agreement is that all Member States be advised of projects that will affect them and, for some projects, all Member States must approve its development. Literal interpretation of the Agreement indicates that for DSHEP, approval is not necessary but Member States only need to be advised of the project"<sup>8</sup> is also not consistent with other assessments in the EIA Report as to the applicability and process required under the MA95 and the PNPCA, namely those offered in section 9.3., and E.12.2.

27 In section E.12.2 and section 9.3 on Notification of LNMC and MRC, the EIA Report states that the LNMC has been notified of the project; "However, there exists a need to specifically notify the DSHEP to the MRC either directly or indirectly through the LNMC, under Articles 1, 3 and 5 of Chapter III Objectives and Principles of Cooperation of the *"Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin"* (MRC, 1995). This requirement is so that the MRC can raise the DSHEP with the JC, as to its potential effects to other members of the Lower Mekong Basin (LMB) countries; namely Cambodia, Thailand and Vietnam. It should be noted that Article 5 deals specifically with "intra-basin" use of the Mekong River; whether the DSHEP qualifies to this is uncertain at this stage."<sup>9</sup>

28 Section 3.4.1. also suggests that the application of provisions of the MA95 and the PNPCA could cause delays in the project implementation. This is not borne out by the application of the PNPCA for water resources development projects by MRC Member States. The PNPCA, which provide for timely notification as a starting point, have thus far not caused delays in implementation of projects.

29 The EIA Report states correctly that the MRC Guidelines for Transboundary Environmental Impact Assessments (TbEIA) have not been ratified by the MRC JC and Council. It further suggests that the TbEIA will have an impact on the project due to its location near the border to Cambodia.<sup>10</sup> It should be noted, however, that at this point in time with regard to cooperation under the MA95, the MRC TbEIA will only be applicable to the extent that a Member State would wish to use them as a framework or guidance.

30 With regard to legal and institutional matters pertaining to the MA95 the EIA Report is neither complete nor accurate in providing advice to the GoL. In fact, whether the EIA Report should make any conclusion or statements as made in E.5 and Chapter 3.4.1 on how the GoL should respond with regard to the MA95 at all would depend on the TOR for the EIA. If required in the TOR, the EIA could appropriately cite, with proper interpretation and completeness, what national and international commitments may be brought under consideration by GoL if, in fact, the proposed project goes beyond FS and EIA consideration for approval as a hydropower development project.

31 In general terms, the GoL may need to consider wider due diligence matters with regard to the EIA Report against the TOR of the EIA. The EIA Report acknowledges that at this

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<sup>8</sup> Page xiv

<sup>9</sup> Page 9-2 and Page xlvii

<sup>10</sup> Page 9-2



stage that with regard to impacts and mitigation measures "...due to little impact or lack of full information, some descriptions are lacking details."<sup>11</sup> The EIA Report also correctly states that the description of the operational phase impacts and mitigation measures is not complete and will need to be updated, once more information on the engineering design of the DSEHP is finalized.<sup>12</sup> The Project Proponent acknowledges that further work and studies on matters, such as environmental flows, budget and implementation of mitigation measures for fisheries, RAP, SAP and EMP will be required.<sup>13</sup> This does not appear to tally with the statement by the Proponent that "sufficient data and studies are presented in this EIA Report for STEA and DoE-MEM to consider and approve the implementation of the DSEHP."<sup>14</sup>

32 With regard to the legal and institutional aspects of the EIA Report, the following issues are relevant and could be included the EIA Report, if required in the TOR.

33 The MA95 provides a legal and institutional framework agreed to by all four MRC members to promote cooperation in the development of the waters of the Mekong River and related resources of the MRB and protection of its environment in a manner mutually agreeable to all members and to cooperate to avoid or mitigate harmful effects and otherwise to address and resolve any issues, differences and disputes in accordance with the provisions of the MA95. The standards set by the MA95 for cooperation and coordination with each member to optimize the multiple-use and mutual benefits of all riparians and to minimize the harmful effects that might result from natural occurrences and man-made activities are "amicable, timely and good neighbourly manner". Articles 5 and 6 address the issue of utilization of the waters of the Mekong River system.

34 Under the MRC Water Utilization Programme, in order to implement particularly Articles 25, 5 and 6, the MRC has adopted four sets of procedures (with a fifth set approved by the JC and awaiting Council approval) and a number of sets of supporting technical guidelines and instructions to facilitate implementation, particularly at the national agency level. They include: 1. Procedures for Data and Information Exchange and Sharing (PDIES), 2. PNPCA, 3. Procedures for the Maintenance of Flows on the Mainstream (PMFM), and 4. Procedures for Water Use Monitoring (PWUM). The yet to be adopted Procedures for Water Quality (PWQ) raises the issue of integrated water quantity and quality management with the focus on setting some minimum water quality standards for the mainstream.

35 The PNPCA are the most relevant Procedure at this stage for the EIA Report and raise responsibilities of MRC members with proposed projects to use water of the Mekong River system under provision of MA 95 Article 5. The three types of mechanisms to inform MRC members (notification, prior consultation and agreement) vary depending upon location (mainstream or tributary) and time of flow season (wet season and dry season). At this point, it cannot be presumed that GoL will proceed with the DSHEP, but in the event that the project is found feasible and desirable, consideration will have to be made of what mechanism will be used to notify the other Member States via the MRCS and JC. Information contained in the EIA Report suggests that the DSHEP is located on the Mekong mainstream since the source of water for the DSHEP is not from an inflow to the Mekong (hence not a tributary)<sup>15</sup> but

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<sup>11</sup> Page xxiii

<sup>12</sup> Page 5-12

<sup>13</sup> Page 9-3 ; page 7-1 regarding details for the EMP to be prepared prior to tendering contracts and implementation of the DSHEP.

<sup>14</sup> Page xiii

<sup>15</sup> The definition of mainstream and tributary is set out in PNPCA section 1.

**Mainstream of the Mekong River:** The river flowing through six countries, namely China, Myanmar, Lao PDR, Thailand, Cambodia and Viet Nam to the sea via My Thuan and My Tho in Viet Nam.



rather from upstream mainstream passing through an interconnected system of braided channels created by the vast number of islands at the fault line of the Khone Falls. It is also proposed that power generation would take place throughout the year. The mechanism described in the MA95 and PNPCA for such a project is the "prior consultation"<sup>16</sup>. However, it should be noted that it is the prerogative of the GoL, to decide at which point it wishes to start a timely process under the PNPCA, in case it decides to proceed beyond these preliminary steps of project identification and consideration for pursuit.

36 In order to take up the transboundary implications identified in the EIA Report due to the location of the DSHEP immediately above the border of Lao PDR and Cambodia and to provide complete information to the GoL, the EIA Report would need to include not only the environmental impacts of the project in Laos but also the possible transboundary project and cumulative impacts downstream. This could be included for example in section E.8.

37 The GoL has considerable experience in hydropower project planning, construction and EIA preparations including possible transboundary project and cumulative impacts downstream which could be brought to bear in the EIA Report. For example, the October 2004 Cumulative Impact Analysis (CIA) for Nam Theun 2 project prepared by NORPLAN and EcoLao is extensive and contains a Chapter 3 on the Administrative and Legal Framework, and the Lao PDR's international commitments including under the MA95. Similarly, the Hydropower Strategic Impact Assessment (SIA) report contains in Chapter 2, a summary review of the Lao legislation and international commitments including the MA95.

#### 4 Baseline Information on Project Area

##### General physical features

38 The EIA Report sections 4.1.1 to 4.1.3 on topography and setting, geology and soils and climate adequately address pertinent issues. Of particular value are sections on the geology also expanding on dam site geology, geotechnical investigations and climate. Practical applications, in particular on the sourcing of materials and on implications of the distinct monsoonal climate and seasons on the construction process could be further highlighted.

##### Hydrology

39 The EIA Report uses discharge values based on the stream gauge at Pakse, which have been adjusted to reflect actual flows at the DSHEP site<sup>17</sup>. The Pakse discharge values do not take into account the inflows to the mainstream from the Mun-Chi system, a significant tributary system. Some explanations on the methodology of this hydrological adjustment would therefore be useful.

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**Mekong Tributary:** A natural stream of the Mekong River System. For the purposes of the present Procedures, a tributary as decided by the JC is a natural stream of the Mekong River System whose flows have a significant impact on the mainstream.

This definition is subject to be reviewed and agreed upon after some time of implementation if any concern is raised.

<sup>16</sup> The PNPCA were adopted by the Council on 13 November 2003. The PNPCA provide the general objectives and principles of the PNPCA and then separate sections for each (notification, prior consultation and agreement) supported by definitions of each and respective proformas for the first two. Concurrently, the Guidelines on Implementation of the PNPCA adopted by the JC on 31 August 2005 are a complimentary and supplementary document to the PNPCA.

<sup>17</sup> EIA section 2.3, page 2-5



40 The distribution of Mekong flows through the numerous interconnected channels at the DSHEP location is extremely complex and dynamic, both within and between years. The upstream water level at the head of the system at Don Khong island will be the major factor that determines the natural water allocation and therefore the discharge available to the scheme at any given time. The conveyance capacities of these channels will change both seasonally and inter-annually resulting in highly variable flows available to the scheme.

41 The EIA Report acknowledges that a thorough assessment of the hydrological and hydraulic impacts of the DSHEP is required<sup>18</sup>. This would require simulation studies and hydrodynamic modelling. This would demand considerable expertise and quite detailed topographic and channel surveys as well as hydrometric measurement over a substantial period of time. Without this basic information and the insights and understanding developed on the basis of it, the hydrological description and conclusions presented in the EIA Report remain incomplete.

42 The report does not clearly describe how increased flows in the Hou Sadam and/or Hou Xang Peuk will affect the estimated “environmental flow” that would need to be maintained to ensure the visual appearance of Khone Phapeng waterfall and fish migration through the channels. However, it is noted that the distribution during the dry season of the available water among the various channels would pose several technical challenges. It would likely require the construction and operation of several larger and smaller additional regulating structures.

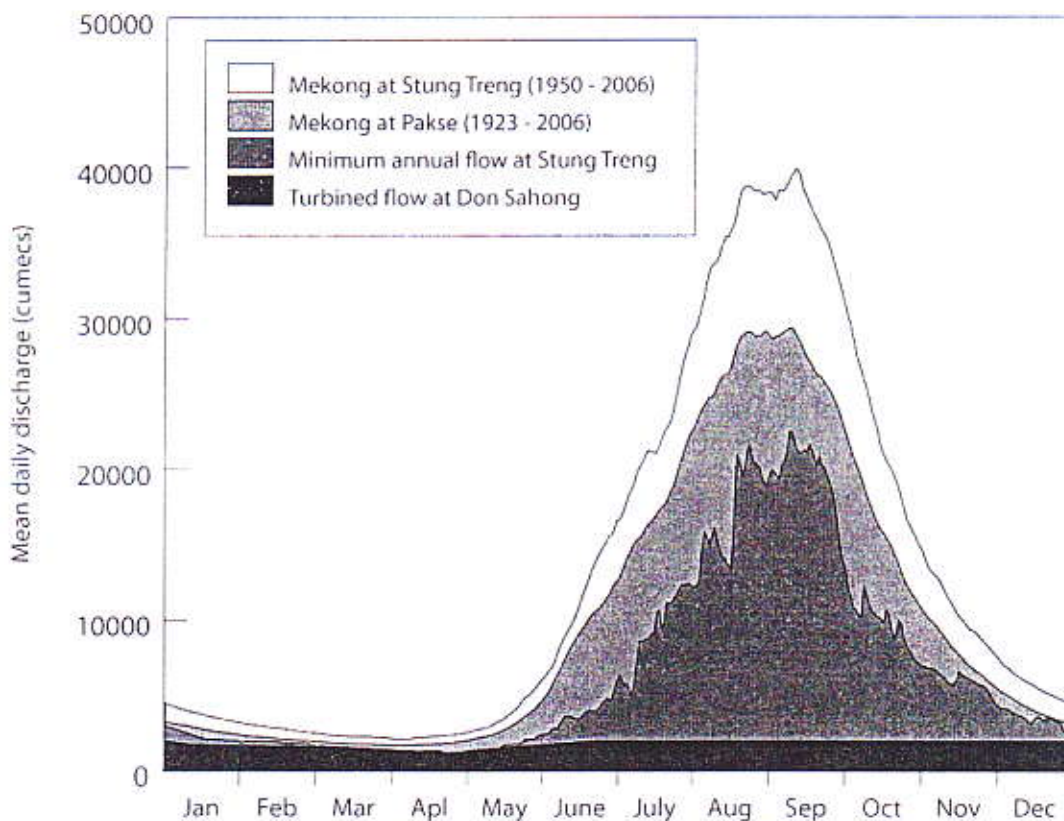


Figure 4-1: Seasonal distribution of Mekong flows upstream (Pakse) and downstream (Stung Treng) of the DSHEP site.

<sup>18</sup> EIA section 9.5, page 9-3



43 The Project Proponent's hydrological considerations are based on adjusted Pakse flows. As the methodology of the adjustments by the Proponent is not set out in the EIA Report, they are here complemented by an analysis using data of Stung Treng downstream the DSHEP. It would however be useful to use both the up- and downstream stations in the adjusted hydrological flow assessment for the site, and verify it with (short-term) observations at site.

44 Based on the 1950 to 2006 time series of flow data at the Mekong in Stung Treng about one third of all Mekong flows are estimated to pass through the turbines during the year. If a 1,000 m<sup>3</sup>/s environmental flow over the falls and other channels is maintained at all times the turbines would operate below their installed capacity of 2,000 m<sup>3</sup>/s for 92 days in average years, and would operate at less than 50% of installed capacity for a period of 116 days in dry years. A lower environmental flow of 800 m<sup>3</sup>/s would increase turbine throughput and generation. The turbines would then operate below their installed capacity for some 78 days in average years, and would operate at less than 50% of installed capacity for a period of 86 days in dry years.

45 The maintenance of this environmental flow would considerably reduce the electricity production in the period January through May, resulting in forgone revenues of some USD 9.7 million in an average year when maintaining a 1,000 m<sup>3</sup>/s environmental flow, or forgone revenues of some USD 6.4 million if only 800 m<sup>3</sup>/s environmental flow is maintained. This illustrates the hydropower operator's challenge to maintain the environmental flows over the falls and in the other channels, in particular in dry years. It would therefore be advisable to consider developing a water allocation plan for a range of hydrological conditions before negotiation of the Project Development Agreement (PDA). During the operation phase, the implementation of such a plan would then need to be monitored with an automatic water level measurement at the Khone Falls.

46 It remains unclear from the EIA Report if and how the scheme will influence flood hydraulics in the area. Possibly the dam and plant will reduce the flood conveyance. This would increase flood water levels in the upstreams and could alter seasonal flooding of low-lying settlements and other areas on the other rather flat islands. Further investigations on this issue may be useful.

#### Aquatic ecology and fisheries

47 This section recognises the role of the Hou Sahong in providing year round passage for fish through the Khone Falls fault line in some detail<sup>19</sup>. In particular Appendix G on fisheries compiles a wealth of useful information. The report recognises that the DSHEP without mitigation measures would adversely affect fisheries in the DSHEP area and down the Mekong into Cambodia<sup>20</sup>. However, the later analysis of fisheries impacts is effectively confined to nearby the Khone Falls, this indicates that the EIA underestimates the geographical extent of the fisheries resources migrating through the fault line. The economic

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<sup>19</sup> Extensive research on fishery at the Khone falls fault line is available. It confirms the Hou Sahong Channel as the major up- and downstream fish migration routes in wet and dry seasons. Two seminal reports on the subject are Roberts, T.R. and I.G. Baird. 1995. Traditional fisheries and fish ecology on the Mekong River at Khone Waterfalls in Southern Laos. *Natural History Bulletin of the Siam Society*. 43: 219-262; and Baran E. (2006) Fish migration triggers in the Lower Mekong Basin and other tropical freshwater systems. MRC Technical Paper No. 14, Mekong River Commission, Vientiane. 56 pp.

<sup>20</sup> The EIA section 4.2.1, page 4-13.



implications are significant<sup>21</sup> – Mekong fisheries experts have estimated the commercial value of fish migrating upstream through the Hou Sahong to be some USD 300 million per year<sup>22</sup>.

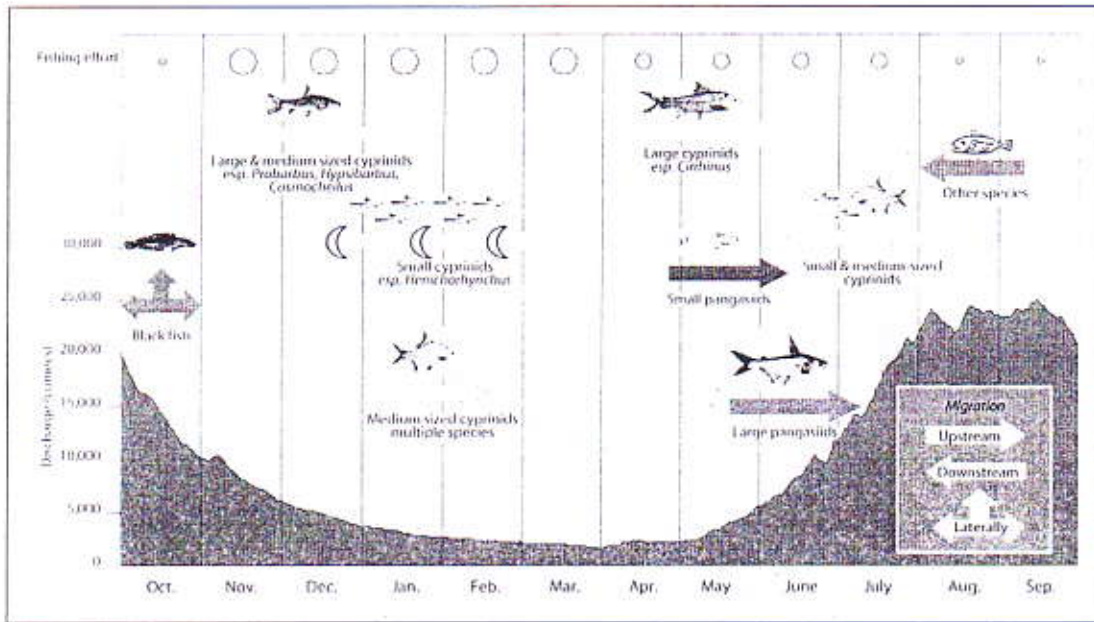


Figure 4-2: Seasonality of fish movement through the Khone Falls fault line (Baran E, 2006)

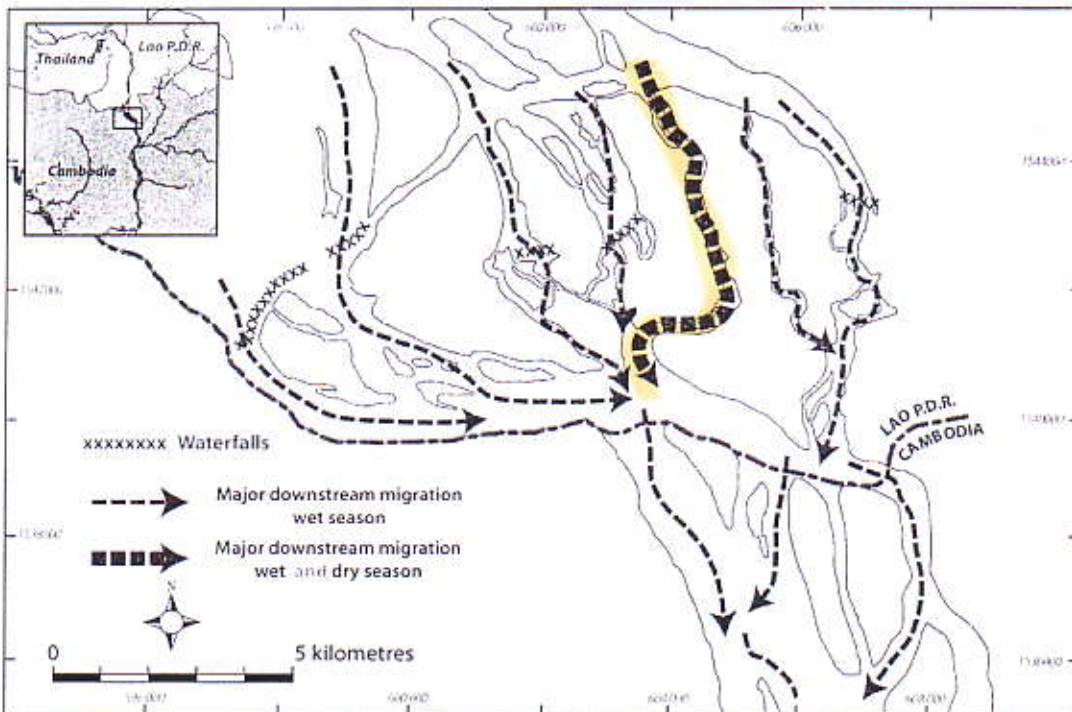


Figure 4-3: Khone Falls area fish passage. Downstream passage is not problematic under natural conditions.

<sup>21</sup> EIA appendix G, page G-3 provides a general estimate on the commercial value of fisheries in the Lower Mekong Basin.

<sup>22</sup> The EIA section 9.2, page 9-1 describes the economic importance of fisheries in the Lower Mekong Basin and that an unmitigated blockage of the Hou Sahong channel would undoubtedly have severe impacts on the fish population and those that depend on fisheries.



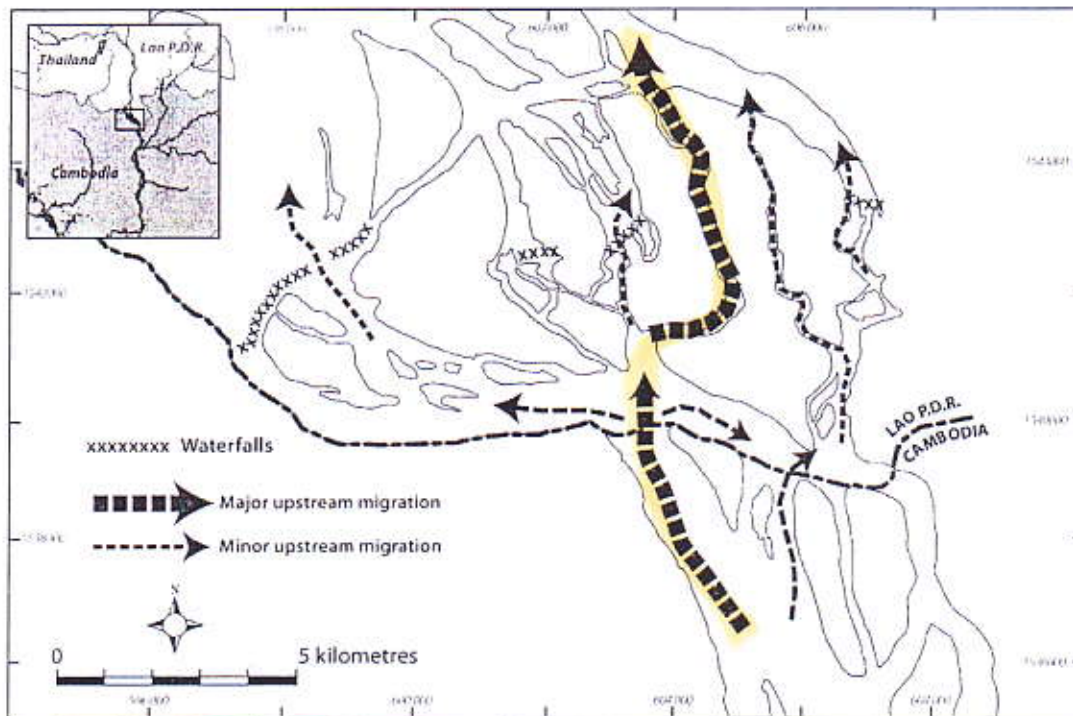


Figure 4-4: Khone Falls area fish passage. Upstream passage is primarily through two channels – the Hou Sahong and the Hou Sadam – which are the only two channels across the entire fault line that do not have waterfalls on them. The Hou Sahong is the major migration route, passable by fish all year round. The Hou Sadam is much smaller and thus less important.

#### Dolphins

48 The EIA discusses potential impacts on the Irrawaddy dolphins population at the Veun Gngang pool. A baseline description of the dolphins natural behaviour, ranging patterns or behavioural ecology is provided in appendix G.8, however, this is not taken up into the main body of the report.

49 This only population of Irrawaddy dolphins found in Lao PDR lives exclusively in the Veun Gngang pool and surrounding habitats on the Lao PDR/Cambodian border as stated in the EIA Report Appendix G.8. It is listed as ‘Critically Endangered’ by the World Conservation Union (IUCN) Red List – the highest level of concern before a population becomes ‘Extinct’.

50 The proposed dam is less than 1 km from the Veun Gngang pool, and the tail race is proposed to extend to the pool. Recorded dolphin sightings have been noted within a few hundred metres of the dam wall<sup>23</sup>.

#### Terrestrial vegetation, wildlife and birdlife

51 With reference to ‘terrestrial’ habitats and species, the EIA Report describes the bird and other wildlife status of the DSHEP area as ‘poor’. Forest condition is stated as disturbed and of low value and the focus of landcover change analysis is loss of economic tree species.

<sup>23</sup> Beasley, I.L. (2006) Biological and social considerations influencing conservation of the Irrawaddy dolphin population inhabiting the Mekong River. Ph.D Thesis. School of Tropical Environment Studies and Geography, James Cook University. 346 pp.



The diversity of seasonal habitats supporting significant bird populations<sup>24</sup>, including aquatic and terrestrial species could be expanded upon.

52 There have been a number of high quality assessments in recent years which could be used to expand on this aspect, for example a European Union funded and Cooperazione e Sviluppo (CESVI) implemented Siphandone Wetland Project, which resulted in a large volume of published studies<sup>25</sup>. Much of the ecological study focussed on the DSHEP area and was based in Ban Hang Khone, around 1.5 km from the proposed dam site.

#### Communities and cultural aspects

53 Overall, the social related sections address relevant social issues, concerns and social responsibilities of the DSHEP. The EIA Report, in particular in its appendices, displays considerable effort in trying to provide sufficient socio-economic information and analysis. Capture fish is the foundation of the socio-economics in Don Sahong and the Khone Falls area. In addition some rice farming is practised on shallow, low fertile soils. However, the socio-economic study area is narrowly defined, focusing exclusively on the 6 communities in the immediate vicinity of the DSHEP. Potentially affected upstream and downstream communities, including on the Cambodian stretch of the Mekong, are not researched.

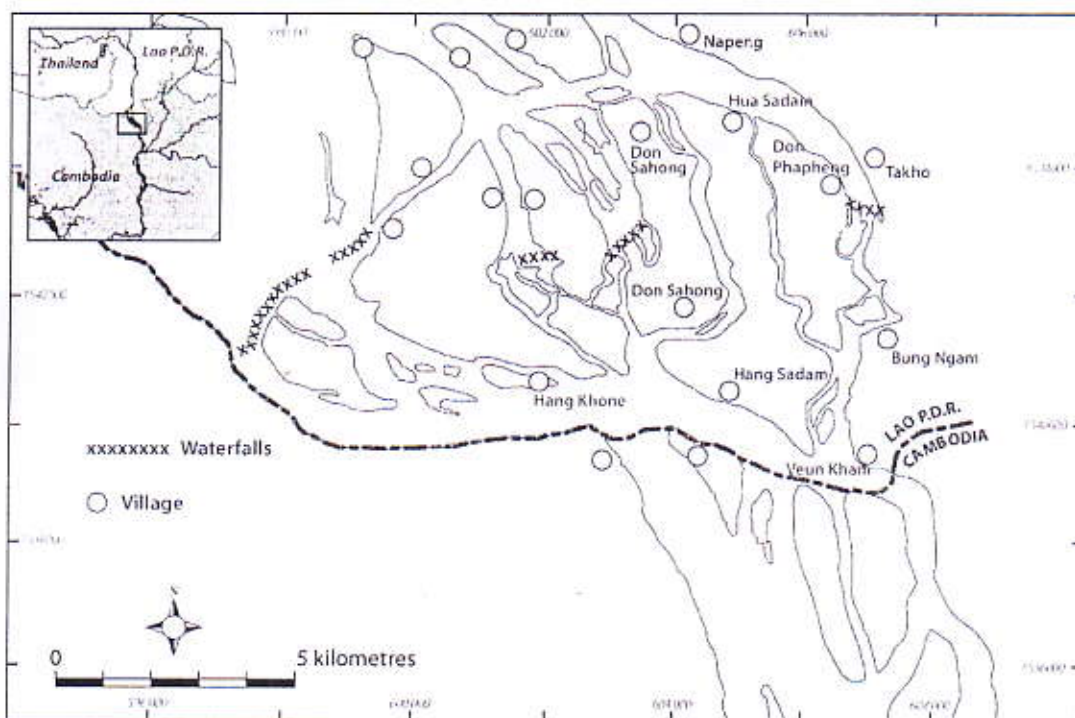


Figure 4-5: Villages in the DSHEP area. MRC maps show some 19 settlements in the DSHEP area. Socio-economic surveys conducted under the EIA Report provide baseline data for Hang Sadam, Houa Sadam, Don Sahong, Thakho, Veunkham and Hang Khon.

#### Public health

54 In this section the EIA Report provides a comprehensive overview of the public health service structure and epidemic situation in the 6 villages adjacent to the DSHEP site. It would be useful to expand this overview to all villages in the DSHEP area, and benchmark against district and provincial data.

<sup>24</sup> 187 species - Daconto, G. (ed) (2001). Siphandone Wetlands. Environmental Protection and Community Development in Siphandone Wetlands, CESVI, Bergamo, Italy, 192 pp.

<sup>25</sup> summarised in Daconto, 2001



## UXO

55 The EIA Report concludes a low risk of unexploded ordinance (UXO) in the DSHEP perimeter. This is supported by independent verification with UNDP. The agency only records three locations in the Khone Falls area with a total of 86 bombs of 500 Lbs, which is considered to be a low contamination. Further information is available at the provincial office of UXO Lao in Pakse. During construction appropriate technical measures for safe infrastructure development and resettlement need to be taken as proposed in appendix F.

## Tourism

56 The EIA Report recognises the importance of tourism in the Siphandone region. Section 4.6 and appendix E provides an overview of conducted surveys and consultations, presents the main tourist attractions, expands on the mix and perceptions of national, regional and international tourists and includes the perspective of the local tourism operators.

57 The Lao PDR Tourism Strategy 2006-2020 specifically states that the Lao National Tourism Administration (LTNA), which has positioned Lao PDR as an eco-tourism destination in its international marketing, will develop and manage Khone Falls areas to become an integrated ecotourism destination. In addition the LNTA's National Eco-tourism Strategy and Action Plan 2005-2010 and the Mekong Tourism Development Project specifically highlight the importance of Siphandone as a key eco-tourism asset. Market research undertaken in 2007 for the Mekong Private Sector Development Fund and SNV Netherlands Development Organisation supports this market positioning: it shows that some 80% of visitors to Lao PDR are either interested or very interested in nature and wildlife.

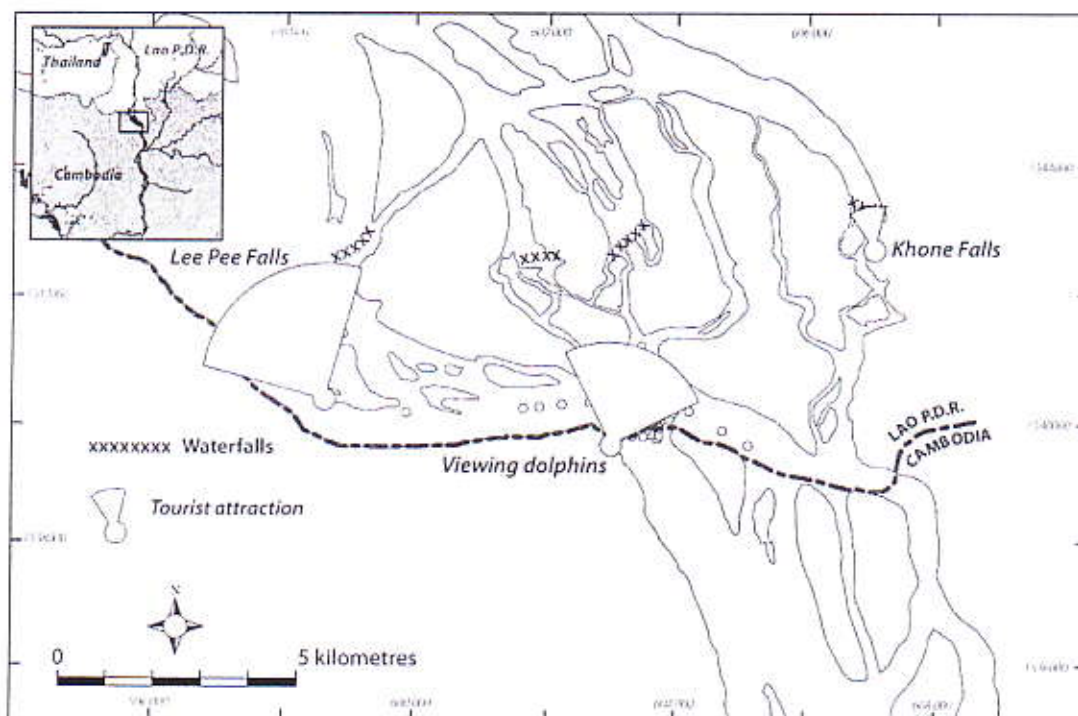


Figure 4-6: Tourist attractions in the Khone Falls area. Major tourist attractions in the close vicinity of the DSHEP are the Khone and Li Phe Falls, and dolphin viewing in the Veum Gngang deep pool. Dolphin sightings at the Veum Gngang pool, 2001 to 2005, as observed by I.L. Beasley (2006).

58 In 2006 tourism was the Lao PDR's number two source of revenues. It is estimated that tourism currently directly employs 300,000 persons. The Siphandone region is one of the



prime tourist attractions (5<sup>th</sup> most popular destination in Lao PDR), a main tourist attraction of Champasak Province, and the most popular location for tourism related investments after Vientiane Municipality and Province.

59 In 2005, more than USD 8 million would have been spent by the 52,539 tourists who visited the Siphandone region, and the ADB's Greater Mekong Sub Region Sustainable Tourism Development Plan estimates that by 2015, this number could double, at 105,000 tourists per year. An even higher number of visitors are reported in the EIA Report, which would indicate further growth.

#### Proposed Siphandone Wetlands Ramsar Site

60 The EIA Report provides relevant detail on the proposed Siphandone Wetlands Ramsar site<sup>26</sup>. It acknowledges the progress of GoL towards accession to the Ramsar Convention<sup>27</sup>. It is important to note the strong local support and pride that Champasak Province has expressed in hosting the first Ramsar site in Lao PDR. Siphandone was selected by a national working group as representing the most important and valuable wetland in Lao PDR and recognised in terms of transboundary aspects by both Lao PDR and Cambodian officials<sup>28</sup>.

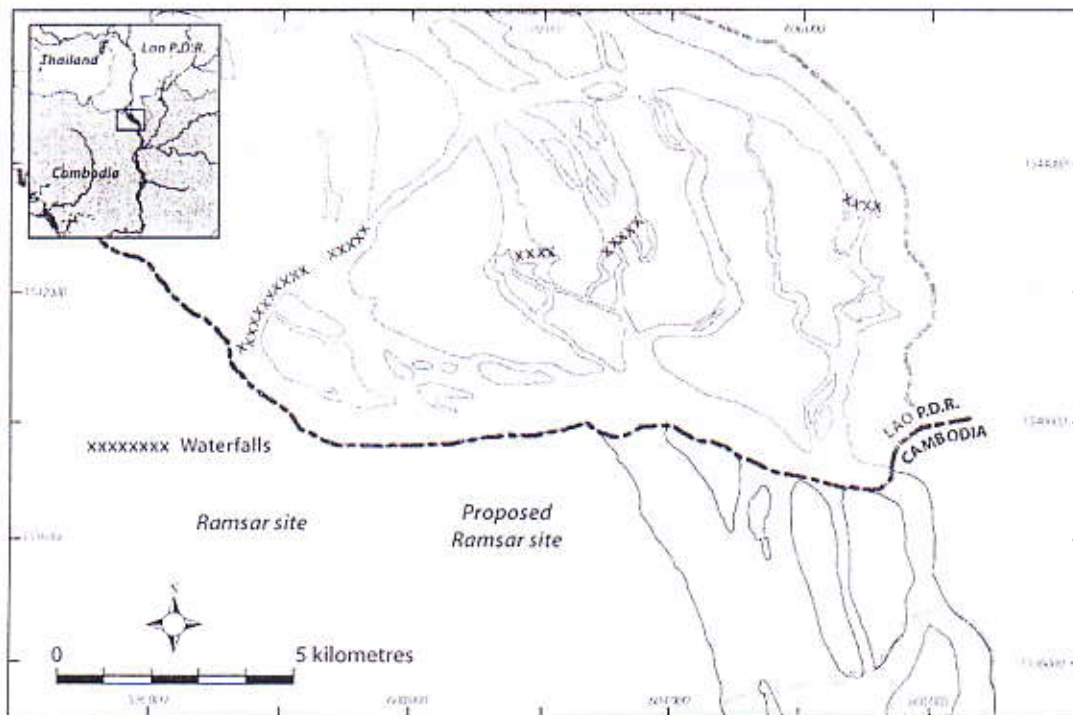


Figure 4-7: Proposed Siphandone Ramsar site in Lao PDR and recognised Stung Treng Ramsar site in Cambodia.

<sup>26</sup> EIA section 4.7.1, page 4-50 recognises that the DSHEP is located in a major zone for conservation and protection of endangered species. EIA page 4-50 and appendix J indicate that GoL regards the Ramsar site declaration as a major step towards fulfilling international conservation policies.

<sup>27</sup> In order to be designated as a Ramsar wetland site of international importance a wetland must be nominated by its government and must fulfill at least one of the nine criteria. Siphandone is nominated as fulfilling all nine criteria characterizing sites containing representative, rare or unique wetland types; sites of international importance for conserving biological diversity, as well as specific criteria on fish and other taxa.

<sup>28</sup> The 'Meeting on transboundary wetland management in Champasak and Stung Treng', held in Pakse, Lao PDR on 24 March 2006 supported the need for co-management of the site in terms of biodiversity, fisheries and tourism. The meeting agreement was signed by the Provincial Vice Governors of Stung Treng, Cambodia and Champasak, Lao PDR and MRC JC members.



## 5 Impact Analysis and Mitigation Measures

### Environmental flows

61 The EIA Report states that an 'environmental flow' will be maintained at all times, but does not provide the methodology for its definition, or describe operational details of a water allocation regime maintaining this environmental flow. Considerations seem to be based on the visual appearance of flows over the Khone Falls and referenced to the Pakse discharge and a gauging station observing the Khone Falls flow. This station was operated by DSHEP during four months of the last dry season. Considerations for the augmentations of the Hou Sadam and Hou Xang Peuk channels are not documented. As acknowledged in the EIA Report further work is required<sup>29</sup>, following a stringent and accepted methodology.

### Excavation and water quality

62 Short term impacts of major concern during the construction phase are the proposed excavation works to be conducted under water or in close proximity to the water body. The EIA Report states that rock excavation will include underwater blasting<sup>30</sup>. According to the report, excavation takes four forms: (i) Sand and gravel mining for concrete aggregate from the Mekong; (ii) Excavation improving the generation capacity of the scheme, namely at the entrance of the Hou Sahong channel and the tail race below the plant; (iii) Excavation works in the Hou Sadam and Hou Xang Peuk channels to open new fish migration routes; and (iv) Excavation of barge channels to provide access to the construction site, and/or potentially additional currently unspecified measures to improve the navigability of the Siphandone to Stung Treng section of the Cambodian Mekong as a supply route to the site.

63 With respect to emissions from excavation and general water quality issues three areas of potential impacts need to be investigated in further detail: (i) Concerns regarding underwater excavation, in particular blasting with respect to emission of debris and sediment load, and the effects on aquatic life, in particular strong sonic disturbance to and possible mortality of dolphins, as well as danger and loss of access for fishing and navigation to human population; (ii) The longer term impacts of these local morphological changes on the overall dynamic river morphology, in particular on longer term bed and bank stability; and (iii) Water quality impacts from emissions of toxic substances in the water body during incidents or resulting from the construction activities at large. These more detailed impact assessments would allow the better design of comprehensive mitigation measures.

### Fisheries

64 The EIA Report notes that effective mitigation of the impacts of the dam on fish migration is central to the DSHEP<sup>31</sup>. The proposed mitigation is to physically alter the channels adjacent to the Hou Sahong, namely the Hou Sadam and the Hou Xang Peuk, so that fish can traverse them throughout the year. In addition, there would be controls on fishing effort introduced in the two channels. Conceptually, the mitigation is a good idea. However, there are two difficulties with the proposed mitigation. Firstly, as correctly pointed out in appendix G channel modifications (which, it appears, have not previously been undertaken on

<sup>29</sup> EIA section 9.5 recommends additional studies to determine more exactly the minimum flow over the Khone Falls (Khone Phapeng) and the flows in channels downstream the entrance of the Hou Sahong. This section, however, suggests that these studies are to be undertaken during detailed design. Given the importance of this issue for comprehensively assessing the financial viability and environmental impacts of DSHEP it may be more useful to clarify this issue as early as possible.

<sup>30</sup> EIA section 5.1.1 (a), page 5-1

<sup>31</sup> EIA sections E.8.4.2, page xxx and 9.1, page 9-1. The latter recognises the DSHEP impact on fisheries migration over the Khone Falls fault line as the most critical issue of the project.



this scale anywhere in the world) need to be thoroughly investigated and shown to be effective prior to the dam being built<sup>32</sup>. Secondly, the same appendix also correctly points out that the outflow from the dam would act as a fish attractant for upstream migration<sup>33</sup>, so minimising the numbers of fish finding passage through other channels. Practical ways of mitigating the fish attracting effect of the outflow from the turbines need to be further developed.

65 The channel modification proposed in the EIA Report only relates to upstream movement of fish. The EIA Report has yet to recognise the importance of downstream movement of fish. There are two issues of concern: firstly, mortality of fish (all life stages) passing through the turbines; and secondly, the proportion of the Mekong's flow which is directed through the turbines.

66 Even considering that the DSHEP will use the more fish-friendly bulb-type low-head turbine design, many published reports indicate that fish mortalities through the turbines will be significant. For fish eggs, larvae and small juveniles, it is likely to be near 100% (due to turbulence and pressures). For sub-adult and adult fish, the mortality will depend on body shape and size.

67 Analyses, based on information presented in the EIA Report and river flow measured at Stung Treng, indicate that on average approximately 30% of the river's annual flow will be directed through the turbines. Obviously, a smaller proportion of the flow will go through the turbines in the wet season than in the dry season. The contribution of different fish species to the downstream drift of fish eggs and larvae will vary through the year, as will the overall volume of egg and larval drift. Data on the composition and annual distribution of the downstream drift are not available, hence determining the mortality rates for species or even for the overall fisheries stock is impossible<sup>34</sup>. No mitigation measures are available to stop fish eggs and larvae from entering the reservoir that would be created on the Hou Sahong, and from there being entrained by the flow through the turbines.

68 The Project Proponent has allocated funds for other mitigation and compensation measures to assist the local communities through the transition period while the DSHEP is being built. These include fishing controls on the Hou Sadam and Hou Xang Peuk channels<sup>35</sup>, temporary fish catch and transfer, reservoir cage culture<sup>36</sup>, compensation schemes and a fisheries study programme<sup>37</sup>. The proposed fisheries research programme is particularly notable. The proposal for this longer term research effort recognises that further work on the

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<sup>32</sup> EIA appendix G, page G-39; and EIA section 5.4.3 (a) which acknowledges that the description of channel improvements to allow fish passage remains basic and would require further engineering and aquatic biology inputs. It also concludes that these investigations should be initiated immediately.

<sup>33</sup> EIA appendix G, page G-34

<sup>34</sup> As an example, if the egg and larval drift was proportional to the river's flow, then 30% mortality of the year class would be expected each year. Since the impact would be experienced every year, the mortality would be effectively cumulative, and consequently would lead to a loss of many fish species within a few years.

<sup>35</sup> EIA section 5.4.3 (b) acknowledges that policy and implementation of fishing controls would need further considerations but suggests that the implemented policy aimed at protecting the dolphins in the Veun Gngang pool could be adapted.

<sup>36</sup> EIA section 5.4.3 (c) proposes research of aquaculture of indigenous Mekong fish species in net cages, estimates associated costs to be USD 1.5 million but does not expand further on details or commitments.

<sup>37</sup> The EIA discusses a set of other fisheries mitigation and compensation measures in section 5.4.3 (b) to (e), pages 5-19 and 5-20.



status and significance of the fish migration routes in the DSHEP area is required to determine the feasibility and practicability of fisheries related mitigation and compensation measures<sup>38</sup>.

69 There are three significant fisheries issues relating to the proposed dam which should be further addressed in the EIA Report. These are: (i) The geographic and economic extent of the DSHEP's impact on fisheries has been underestimated; (ii) The proposed mitigation to allow upstream movement of fish cannot be proven to be effective prior to the DSHEP being built; and moreover the outflow from the turbines will attract fish to the blocked Hou Sahong channel; and (iii) The mortality of fish (all life history stages) that will be entrained through the turbines has been overlooked.

#### Dolphins

70 The possible effects of the construction and operation of the proposed DSHEP on the dolphin population are acknowledged in particular in appendix G.8 but would need to be expanded in the EIA Report. Potential mitigation measures could be developed with the assistance of Irrawaddy dolphin and dolphin acoustic experts as also proposed by the EIA Report<sup>39</sup>.

71 It appears that the possibility for effective mitigation is limited. The disruption to the dolphins' ecology would result from the probable altered flow regimes and increased sedimentation in the dolphins' habitat; intensive underwater noise pollution through blasting, excavation, dredging and turbine operation; increased boat and human activity in the area; and importantly, reduced fish stocks which are the food for the dolphins.

#### Communities and cultural aspects

72 The EIA Report acknowledges the impact on directly affected communities in the DSHEP area. It documents that 77% of the consulted households are involved in fishery and that 65% of the household cash income is generated through fisheries related activities<sup>40</sup>. The EIA Report also mentions that the land plots for agriculture production in the islands are insufficient and that soils are very low in nutrients<sup>41</sup>. Communities wishing to resettle within the islands<sup>42</sup> will therefore find significant difficulties to conduct orchard and other agricultural activities. This further indicates the economic importance of capture fisheries, and the limitations of alternative livelihood packages.

73 When describing the perceptions of the effects of the DSHEP on the local communities, the EIA Report states that those affected were not fully informed, but that they were aware of critical issues such as loss of fishing, flooding and social impacts<sup>43</sup>. However, for the trade-off of electricity and employment, they preferred to see the DSHEP materialise<sup>44</sup>. This indicates that a more thorough process of vulnerability mapping but also wider public consultation is desirable. The process established by the Nam Theun 2 hydropower project could serve as practical example.

<sup>38</sup> Whereas EIA section 5.4.3 (e) remains limited on objectives, scope and implementation arrangements for a fisheries study programme it allocates substantial resources in the order of USD 1.5 million to this activity.

<sup>39</sup> EIA section 5.4.4, page 5-21 confirms DSHEP's willingness to engage with dolphin experts from international conservation groups to define appropriate measures to protect the local dolphin population.

<sup>40</sup> EIA appendix A, page A-14

<sup>41</sup> i.e. page 4-32, 1<sup>st</sup> paragraph

<sup>42</sup> EIA Appendix C, page C-38: The 46 residents of 10 affected households in Hang Sahong village wish to resettle within the Don Sahong island.

<sup>43</sup> EIA section 4.3.3, page 4-34 "At the time of the Household Survey local residents were not fully informed about the DSHEP and its potential effects on their lives."

<sup>44</sup> EIA section 4.3.3, page 4-34 "However there is a general willingness to have the dam constructed."



## Tourism

74 Various wider impacts on tourism may result from the proposed DSHEP and should be researched in further detail. They include: (i) Potential damage to the Lao PDR market positioning as an ecotourism destination; (ii) Potential long-term decline of local tourism if the dolphin tourism stops; and (iii) short-term losses in local tourism if visitors reduce their stay because of construction emissions.

## DSHEP Ramsar compliance and Ramsar site management

75 Several sections of the EIA Report correctly state that accession to the Ramsar convention does not preclude the development of some form of hydropower project<sup>45</sup> but would have implications on the management plan of the Ramsar site. The report notes fisheries management, overall 'ecological integrity' and forestry and wildlife to be important considerations. However, it also states that the compatibility of the DSHEP with the conservation issues of the Ramsar site remains undocumented to date<sup>46</sup>. Further work on the subject could therefore provide the necessary clarification. The EIA Report recommends that the DSHEP cooperates with relevant authorities on engineering and environmental findings of the DSHEP and invites the appointed planning organisation for the Siphandone Wetland to review DSHEP's proposals for monitoring and management of impacted areas<sup>47</sup>. Additionally, the Ramsar Secretariat could provide guidance in the further appraisal of the DSHEP.

## Transboundary and cumulative impacts

76 The EIA Report, whilst recognising that impacts will occur in areas in and adjacent to the immediate area of Khone Falls gives much less consideration to the potential longer-distant impacts; some of these are for example mentioned in appendix G.8 with regard to long distance fish migration. Given the importance of these matters in the decision making on the DSHEP, a stand-alone chapter to transboundary and cumulative impacts could be useful.

## 6 Resettlement and Social Action Plans

77 The EIA Report addresses the management of social impacts through a Resettlement Action Plan (RAP) and a Social Action Plan (SAP) in a dedicated chapter. Respective sections present activities and budget allocations for a two-year resettlement period and a three-year livelihood adjustment period for a total of some USD 2.5 million. Considering the limited size of resettlement required, it will be relatively easy to develop an operational RAP, with proper attention given to its various aspects.

78 It could be useful to present the policy framework for the RAP and SAP in the EIA Report, and analyse specific and concrete requirements for the DSHEP. At this point the presented RAP and SAP remain stand-alone documents, whereas their obvious multiple linkages would call for an integration of both plans under a coherent and comprehensive strategy for the socio-economic development of the DSHEP area, which yet needs to be developed.

79 Given the current level of social development in the area, the proposed three-year transition period of livelihood adjustment may fall too short. The reviews of the efficacy of

<sup>45</sup> EIA section 4.7.2, page 4-52, EIA section 5.2.7 (b), page 5-15, EIA section 9.4, page 9-2, Annex J, page J-4

<sup>46</sup> EIA section 4.7.2, page 4-52.

<sup>47</sup> EIA section 9.4, page 9-2



similar programmes currently implemented in Lao PDR and an assessment of their strengths and weaknesses could further inform a realistic and robust design of the DSHEP's RAP and SAP.

## **7 Environmental Management Plans for Project**

80 As recognised in this section of the EIA Report the material presented cannot yet be considered as an Environmental Management Plan (EMP)<sup>48</sup>. The section describes rather the general process of establishing the EMP than actions for environmental management. Some important elements may not be available at this planning stage of the DSHEP. However, standards measures, environmental obligations (water quality monitoring for example), and obligations that will have to be passed contractually to the construction contractors can already be presented. As a consequence the presented budgets remain limited, and miss important items, for example the cost of operation.

## **8 Alternatives**

81 The DSHEP FS is reported to consider several different options based on different diversion amounts and installed capacity ranging from 180 to 480 MW. However, the effects of these options are not discussed in the EIA Report, except the effect of different environmental flows at Khone Phapeng on flow diverted to the power station. Two other schemes not located in the Hou Sahong, but in alternate channels of the Khone Falls area are briefly discussed.

82 The first one is the Khone Phapeng alternative (or Thako project as it is also called). The EIA Report mentions that this alternative has also been studied by Maunsell/Lahmeyer in a 2004 desk study. The assessment presented in the EIA Report is apparently based on this previous study. The project studied by Maunsell/Lahmeyer was significantly smaller than the DSHEP, only 60 MW, but would have lesser impacts on upstream fish migration as the water would pass the falls in a tunnel and leave all fish passages unaffected.

83 The second alternative discussed the Hou Xang Peuk alternative. The EIA Report mentions that this alternative remains unexplored, but estimates that it would be comparable in size with the DSHEP, but at a much higher cost. It would also have comparable ecological impacts, as it would restrict wet season fish migration which is currently possible. There is currently no dry season migration in this channel.

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<sup>48</sup> EIA introduction to section 7, page 7-1 states: "An Environmental Management Plan (EMP) will have to be devised for the DSHEP according to the MEM-DoE's Environmental Management Standard (EMS) (EM05/00)."



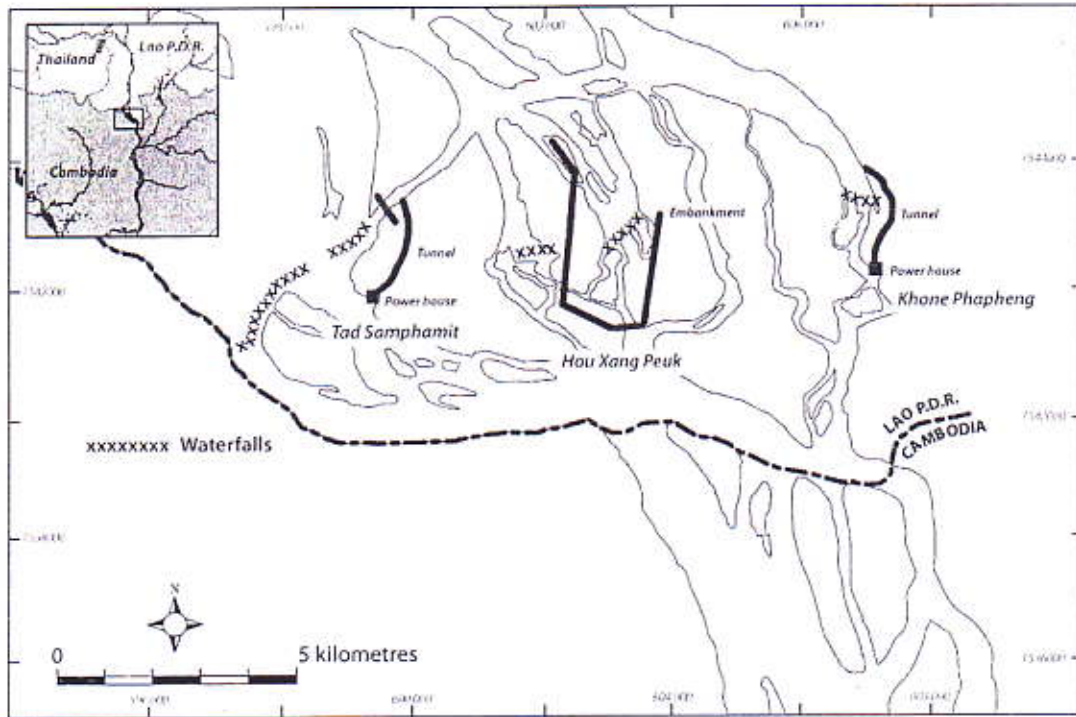


Figure 8-1: Alternative hydropower projects at the Khone Falls fault line. The EIA Report mentions two alternatives, Khone Phapeng and Hou Xang Peuk. The third alternative, the Tad Samphamit project is of similar concept than the Khone Phapeng.

84 The “No project option” is also discussed. The negative impacts listed consist of reduced export earnings for electricity sales, and no improved infrastructure to support economic and tourism development the area.

85 The EIA Report does not consider a third alternative investigated in the Maunsell/Lahmeyer study, namely the Tad Samphamit project. It is of similar size and concept as the Khone Phapeng project, 56 MW, and thus also much smaller than the DSHEP.

86 The EIA Report mentions that the Project Proponent has the mandate to investigate the DSHEP only<sup>49</sup>, but considering the potential impacts by the DSHEP a much more detailed and systematic screening of alternatives may be useful. A matrix type approach for assessment and ranking could be useful, including the different locations and plant concepts and installed capacities, precisely describing impacts and benefits.

<sup>49</sup> EIA section 8, page 8-1