Mekong River Commission

Procedures for Notification, Prior Consultation and Agreement (PNPCA) Prior Consultation

TECHNICAL REVIEW REPORT

on

Prior Consultation for the Proposed Don Sahong Hydropower Project

Prepared by:

The Mekong River Commission Secretariat

06 February 2015

For:

The Mekong River Commission Joint Committee

Disclaimer

This Technical Review Report reflects a consensus opinion of the internationally recognised experts appointed by the MRC Secretariat. However, the opinions expressed in the report do not necessarily reflect the views and opinions of all the Member Countries. Views, responses and comments from Member Countries have been provided separately.

PREFACE

This Technical Review Report has been prepared by the Mekong River Commission (MRC) Secretariat for the MRC Joint Committee (JC). It has been prepared under guidance from the Joint Committee Working Group (JCWG) for Prior Consultation on the Don Sahong Hydropower Project, and includes guidance provided by the JCWG from its final meeting on 9 January 2015. It is intended to provide the JC with information that *may be* needed to support their discussions leading to an agreement with conditions (PNPCA – Article 5.4.3), or the extension of the Prior Consultation process (PNPCA – Article 5.5.2).

The Report includes assessments of the possible impacts of the DSHPP, the likely extent of those impacts, the level of confidence in these assessments and the likely efficacy of mitigation measures proposed by the developer. The report aims to provide a level playing field for discussions through a robust and scientifically sound evaluation of all ***available*** information and data, in so far as the initial timeframe for prior consultation has allowed. The JC, in pursuance of considering all relevant factors when considering whether the DSHPP reflects a reasonable and equitable use of the Mekong River System ('95 Mekong Agreement Article 5), may wish to consider other matters not covered in this Report.

The Report draws on the following documents and information;

- The Expert Groups' evaluations of the documents submitted by the Lao National Mekong Committee;
- The Report on the Public Consultation Process in support of Prior Consultation on the DSHPP, and the documents submitted as part of that process;
- The agreed IWRM-based Basin Development Strategy and its Scenarios;
- The MRC Preliminary Design Guidance for Proposed Mainstream Dams (PDG); and
- Indigenous knowledge and information gained during site visits.

The following Annexes support this Technical Review Report, and form part of the Report;

- Annex A1: Prior Consultation Road Map
- Annex A2: List of International, Regional and MRCS Expert contributors.
- Annex B: Alignment with the MRC PDG
- Annex C: Fisheries Report
- Annex D: Dolphin Report
- Annex E: Hydrology and Hydraulics Report
- Annex F: Water quality and Ecosystems Report
- Annex G: Sediment Report
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7. CONCLUSIONS, RECOMMENDATIONS AND CONDITIONS

1. Background

1.1 The 1995 Mekong Agreement

1.1.1 Objectives and Principles

On 5 April 1995 the Governments of Cambodia, Lao PDR, Thailand, and Viet Nam signed the Agreement on Cooperation for the Sustainable Development of the Mekong River Basin (the 1995 Mekong Agreement or 'Agreement'[1]). This re-affirmed the Member Countries' desire to develop, *inter alia*, hydro-power in the Mekong River Basin in a sustainable and cooperative manner. The Agreement recognises that further utilisation of the waters of the Mekong River system for socio-economic development would occur, and promotes joint development that results in sustainable benefits for all the Member Countries. However, recognising that unfettered development could result in adverse impacts, Chapter III of the Agreement establishes a framework of principles and objectives to guide development. In Chapter III the Member Countries (the Parties) agree to, *inter alia*);

- Protect the ecological balance of the Mekong River Basin;
- The reasonable and equitable use of the waters of the Mekong River System, pursuant to all relevant factors and circumstances, and the Rules of Water Utilisation and Inter-basin Diversion;
- Discuss and aim to agree (in the Joint Committee) on *significant*[2] water uses on the mainstream in the dry season (Prior Consultation);
- Maintain flows in the Mekong mainstream;
- *Make every effort* to avoid, minimise and mitigate harmful effects on the river system;
- Take responsibility where harmful effects result in *substantial*[2] damage to the other Member Countries;
- Maintain the freedom of navigation on the mainstream, and;
- Warn other Member Countries of water quality and quantity emergencies.

Achievement of these objectives and principles are underpinned by the unique spirit of cooperation and mutual assistance that has inspired cooperation between the Countries since 1957.

[1] The 1995 Mekong Agreement is available at:

http://www.mrcmekong.org/assets/Publications/agreements/95-agreement.pdf

[2] The terms 'significant' and 'substantial', as used in the main body of the Technical Review Report, have the following meanings; 'significant impact' means non-trivial impacts that may be measured through objective evidence, and should result in consultations; 'substantial' means damage to the wellbeing of the people and / or economy of the Member Countries, and may invoke the provisions of Article 8 of the Agreement. (Derived from an analysis of the 1995 Mekong Agreement, the International Law Commission's commentaries on the 1997 UN Watercourses Convention, and the Revised SADC Protocol on Shared Watercourses).

1.1.2 Institutional arrangements and powers and functions

The Parties established the Mekong River Commission and its standing bodies through the 1995 Mekong Agreement. These are the Council, the Joint Committee (JC), and the Secretariat, the Parties conferred certain powers and functions to/on these bodies through the Agreement. Council is empowered to establish policy and the 'Rules for Water Utilization and Inter-basin Diversions' under Article 26 (now the 5 Procedures). The Procedures for Notification, Prior Consultation and Agreement (PNPCA) were agreed through this delegated power, by the Council on 30 November 2003. The Council is also empowered to address and resolve any *differences and disputes*[3] referred to it.

The JC is empowered to undertake the Prior Consultation process, which should aim at arriving at an agreement with agreed upon conditions. The JC agreed Technical Guidelines to support the implementation of the PNPCA on 31 August 2005. The JC must make every effort to resolve *differences* referred to it.

The Secretariat is the technical and administrative support arm of the MRC, and has prepared this Technical Review Report under guidance from the Joint Committee Working Group (JCWG) for the Don Sahong Hydropower Project (DSHPP).

The Parties may engage in Country to Country discussions outside of the provisions of the 1995 at any point.

1.2 The PNPCA and Prior Consultation Process

The PNPCA derive from Article 5 of the 1995 Mekong Agreement in which the Parties agree to the reasonable and equitable use of the Mekong River System. The PNPCA specify three distinct forms inter-State communication; i) notification, ii) prior consultation and iii) specific agreement. Notification is applicable to water use on the tributaries of the Mekong mainstream and for 'wet season' use on the mainstream. Prior consultation is required for water use on the mainstream in the 'dry season', and for inter-basin diversions in the 'wet season'. Specific agreement is required for inter-basin diversions in the dry season. These increasing levels of interaction reflect the increasing likelihood of adverse transboundary impacts and hence an increasing requirement for engagement with the affected Parties (based on the perceptions at the time of signing the Agreement).

Prior consultation is aimed at evaluating whether the proposed development reflects a reasonable and equitable use of the waters of the Mekong River system, its consistency with the principles and objectives of cooperation agreed in Chapter III of the Agreement, and its alignment with the Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin. This Technical Review Report supports this process specifically with respect to prior consultation on the DSHPP.

[3] In reference to the powers conferred by the Parties to the Council and the Joint Committee; a '*difference*' may be interpreted as a diverging interpretations of a technical nature, a dispute may be interpreted as a different interpretation of policy or the Agreement.

Prior consultation is defined in the 1995 Mekong Agreement as;

> *"Timely notification plus additional data and information to the Joint Committee, as provided in the Rules for Water Utilisation and Inter-Basin Diversion under Article 26, that would allow the other member riparians to discuss and evaluate the impact of the proposed use on their uses of water and any other affects, which is the basis of arriving at an agreement. Prior consultation is neither a right to veto the use nor a unilateral right to use water by any riparian without taking into consideration other riparians' rights."*

1.3 Principles Governing the Prior Consultation Process

As prior consultation is neither a unilateral right to proceed, nor a veto right, its success relies heavily on good faith cooperation, recognising the rights of all the Parties. The PNPCA's Article 3 specifies that they shall be governed by the following principles;

a. Sovereign equality and territorial integrity;
b. Equitable and reasonable utilisation;
c. Respect for rights and legitimate interests; and
d. Good faith and transparency.

Article 5.4.3 of the PNPCA indicates that the JC shall aim to arrive at an agreement on the proposed use that contains agreed upon conditions, which become part of the record of the proposed use. These 'conditions' are added to the record of the proposed use to ensure that the concerns of the notified Parties are accommodated, and their inclusion in the Procedures for Water Use Monitoring (PWUM) can confirm that implementation of the conditions is monitored and reported to the MRC. Article 5.5.1 of the PNPCA provides for a six month timeframe for prior consultation, which may be extended by a decision by the JC (Article 5.2.2).

The primary purpose of this Technical Review Report is to support discussion and consultation in the JC. It aims to provide the information that would be required for the JC to reach a decision under Articles 5.4.3 or 5.5.2 of the PNPCA. The report aims to support a balanced basis for good faith consultations and cooperation, as well as providing some indication of the extent of any possible impacts, and the level of confidence in the findings.

Should the JC not be able to come to agreement on the proposed use or conditions to attach to that use, they may (after making every effort to resolve issue under Article 24 F of the Agreement), raise the matter to the Council to resolve under Article 18 C. In the event that the Commission is unable to resolve the difference or dispute in a timely manner, the issue shall be referred to the Governments to resolve by negotiation through the diplomatic channels as provided for in Article 35 of the Agreement.

2. The Don Sahong Prior Consultation Process

2.1 Background

On 30 September 2013, Lao PDR submitted the Don Sahong Hydropower Project (DSHPP), located in Champasak Province, Lao PDR, for "Notification" under the MRC Procedures for Notification, Prior Consultation and Agreement (PNPCA). In pursuance of the provisions of the MRC's PNPCA and its Technical Guidelines, the MRC Secretariat forwarded this submission, along with a number of supporting documents submitted by the Lao PDR, to the other three Member Countries: Cambodia, Thailand and Viet Nam on 3 October 2013.

At this time the other Member Countries expressed the opinion that the DSHPP should be submitted for Prior Consultation. Between October and December 2013 the Secretariat was requested to conduct a preliminary review of the documentation submitted by the Lao National Mekong Committee (LNMC). This was submitted to the Joint Committee (JC) in January 2014 at its Special Session to discuss the proposed Project. This Special Session agreed to refer the matter to the MRC Council. The preliminary review noted that further information on particular aspects of the DSHPP, its possible impacts, and potential mitigation options was necessary in order to fully support any possible discussions between the Member Countries.

On 7th March 2014 the LNMC hosted a technical consultation with the MRC Member Countries and other stakeholders, including Development Partners, to further discuss the potential impacts and mitigation options for the DSHPP. The developer, through the LNMC, provided the MRCS with a written response to the questions raised in the preliminary review. Two site visits were arranged by Lao PDR, the first on 11th - 12th November 2013, and another on 11th March 2014 to allow interested parties to directly engage the project developers and their proposed impact mitigation approaches. Further site visits from Expert Teams appointed to investigate potential impacts in depth have been conducted to gather additional information.

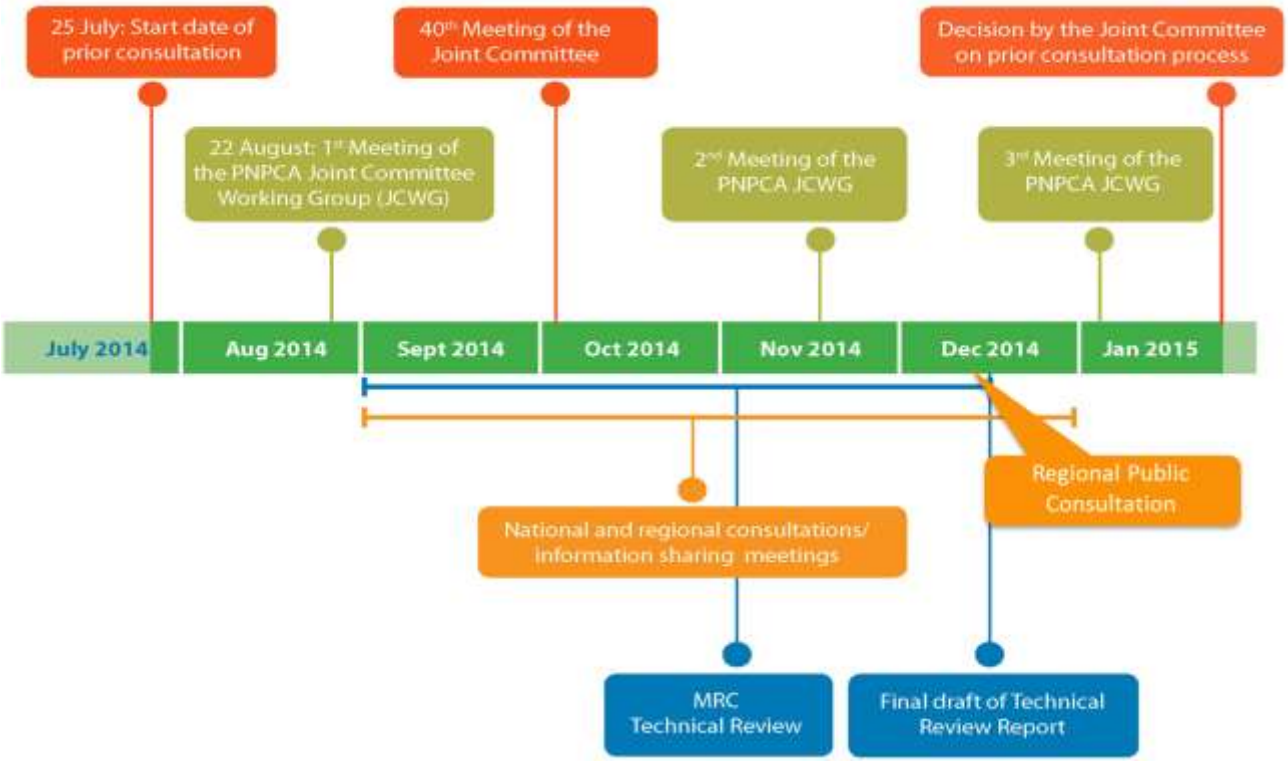
At the 20th Council Meeting on 26 June 2014, Lao PDR stated that the DSHPP would be re-submitted for the Prior Consultation process under the PNPCA. A letter to this effect was received by the Secretariat from the LNMC on 30 June 2014, along with confirmation of the list of relevant documents originally submitted in September 2013. The Secretariat submitted the letter and list to the JC members from the other three Member Countries on 3 July 2014. The MRCS subsequently requested that the LNMC makes any additional documents available through the appropriate channels as and when they are completed. The LNMC indicated that the Developer's website should be used to source any additional reports[4]. It was subsequently decided by the JC at its 40th Meeting on 1st October 2014, in Phnom Penh, Cambodia, that the formal start date for Prior Consultation would be 25 July 2014. The six month Prior Consultation period provided for in Article 5.5.1 of the PNPCA consequently ends on 24 January 2015.

The three notified Countries are reviewing the documents submitted for prior consultation and will submit their replies to the JC via the Secretariat. In order to support the preparation of these replies, the JC has

[4] The MRCS notes that CNMC and TNMC requested that the use of any documents for the prior consultation process should be formally endorsed by the LNMC.

under Article 5.3.3 [c] of the PNPCA established the PNPCA Joint Committee Working Group (JCWG). Under guidance from the JCWG the MRC Secretariat has appointed several expert groups to provide independent specialist evaluations of the potential impacts associated with the DSHPP and, based on their reviews plus other relevant information, has prepared this consolidated Technical Review Report. Participation by regional and international experts in these Expert Groups is outlined in Annex A2.

The following diagramme outlines the Prior Consultation process on the DSHPP, while Annex A1 outlines the roadmap and activities in more detail.



2.2 Preparing the Technical Review Report

This Technical Review Report has undergone a number of iterations to ensure that it fully and accurately reflects the views of the Expert Groups, and comment from the JCWG. These iterations are summarised in the table overleaf.

Report	Ver.	Date	Comment
Initial Assessment of the notified DSHPP		Jan 2014	Submitted to the MRC Joint Committee's Special Meeting on the Don Sahong Project on 16 January 2014 which discussed a suitable discussion process for the project.
Scoping Assessment Report		Aug 2014	Submitted to the 1st meeting of the JCWG to define the scope of the assessments that would be undertaken.

Report	Ver.	Date	Comment
Background Document		Sept 2014	Document to report progress to JCWG.
Interim Progress Report		Nov 2014	Submitted to the 2nd meeting of the JCWG
Drafts of the Technical Review Report	V 1.0	21 Dec 14	MRCS internal draft submitted to the CEO
	V 2.0	27 Dec 14	Includes comments from the CEO – submitted to Expert Groups for comments.
	V 2.2	29 Dec 14	Submitted to CEO for final signoff, and re-submission to Expert Groups for verification.
	V2.3	30 Dec 14	Includes final comments from the Expert Groups and CEO.
Final Draft of the Technical Review Report	V 3.0	14 Jan 15	Submitted to the CEO and Expert Groups
	V 3.1	16 Jan 15	Submitted to the JCWG
Final Technical Review Report	**V 3.2**	**1 March 15**	**Submitted to the JC Special Session on Prior Consultation on the DSHPP, and uploaded with Member Countries' comments to the MRC website;** http://www.mrcmekong.org/news-and-events/consultations/don-sahong-hydropower-project/

2.3 Key documents used for the Review[5]

The Technical Review Report is based on data and statements provided by the DSHPP developers and submitted to the MRC via the LNMC as outlined below.

- Documentation received from the project developers via the LNMC as follows[6]:
  - Final Environmental Impact Assessment, 2013.
  - Final Cumulative Impact Assessment, 2013.
  - Final Environmental Management and Monitoring Plan.
  - Hydrology, Hydraulics and Sedimentation design studies, 2011.
  - Engineering status reports Volumes 1 and 2, 2011.
  - Transboundary hydraulics effects study, 2013.

- Data and assessments contained in various MRC documents, including:
  - Procedures for Water Quality.
  - Procedures for Maintenance of Flows on the Mainstream.
  - Procedures for Notification, Prior Consultation and Agreement.
  - Diagnostic study of water quality in the Lower Mekong Basin, MRC Technical Paper no 15, 2007.
  - Impacts of Climate change and developments on Mekong Flow regimes – First assessment 2009, MRC Technical paper no. 29, 2010.

[5] All available from: http://www.mrcmekong.org/news-and-events/consultations/don-sahong-hydropower-project/

[6] This does not include documents not formally provided by the LNMC.

- The Mekong River Report Card on Water Quality Volume 2, 2010 – Assessment of potential human impacts on Mekong river water quality.
- 2011 Water Quality Assessment Report, MRC Technical Paper No 40, 2013.
- MRC Water quality report card, Volume 3, 2013.
- Biomonitoring of the Lower Mekong River and selected Tributaries 2004 – 2007, MRC Technical Paper No. 20, 2008.
- Report on the 2011 biomonitoring survey of the Lower Mekong River and selected tributaries, MRC Technical paper No 43, 2014.
- MRC Aquatic ecological health report card 2011, Volume 3, 2013
- MRC Aquatic ecological health report card 2013, Volume 4, 2014.
- Preliminary Design Guidance for the proposed mainstream dams in the Lower Mekong basin, 2009.
- BDP Scenario Assessment Report.
- MRC Basin Development Strategy.

2.4 Scope of the Technical Review Report

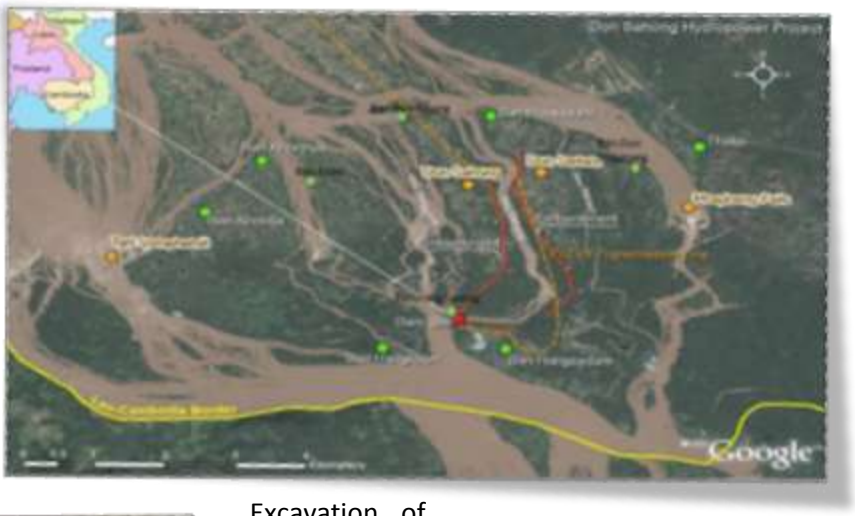
The primary purpose of this Technical Review Report is to support discussion and consultation in the JC. It aims to provide key information that would be required for the JC to reach a decision under Articles 5.4.3 or 5.5.2 of the PNPCA. The report aims to support a balanced basis for good faith consultations and cooperation, as well as providing some indication of the extent of any possible impacts, and the level of confidence in the findings.

The Technical Review Report also makes recommendations with respect to opportunities to increase the level of confidence in the assessments of the possible impacts. Recommendations are made with respect to options to increase transboundary cooperation and mutual benefits should the DSHPP proceed to construction. The Technical Review Report makes no comment on the acceptability or otherwise of the DSHPP, that being in the purview of the JC.

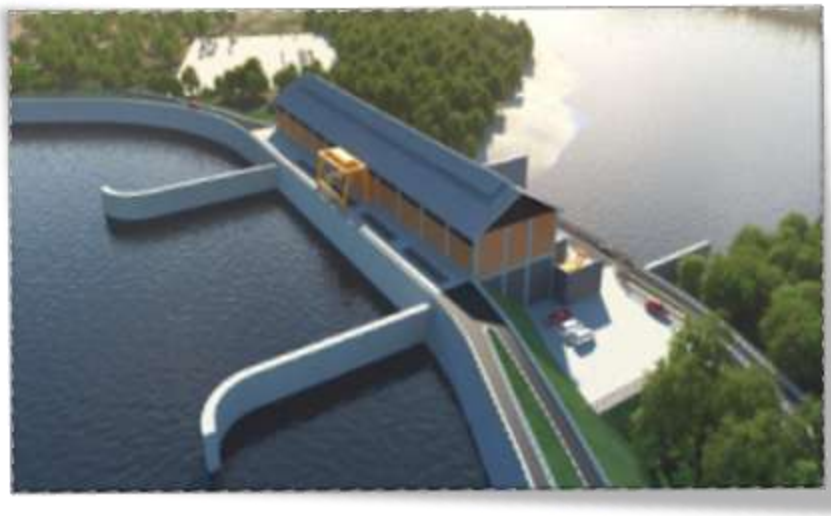
3. The Proposed Don Sahong Hydropower Project

3.1 Project description

The DSHPP is designed as a run of river plant on the Hou Sahong channel of the Mekong mainstream in southern Lao PDR. It consists of 4 x 65MW bulb turbines totalling 260 MW. The economic viability of the scheme depends on excavating the Hou Sahong inlet to divert a design flow of 1,600 m^3/s through the turbines. This will be supplemented by an embankment and excavation of the Hou Sahong to create a headpond. Excavation will occur at the downstream end of the DSHPP to create a tailwater.



Water will be retained in the headpond by embankments, and a spill way will be constructed to divert excess flows into the Hou Xang Pheuak channel.



Excavation of the Hou Sahong inlet will also be done to divert more of the natural flow into the headpond to maintain the desired flows through the turbines. At the height of the dry season, some 50% of the total flow in the Mekong will be diverted through the DSHPP turbines.

This diversion of flows is mostly at the expense of flows over the Khone Phapheng in the dry season, which will see reductions in maximum monthly dry season flows of about 400-700 m^3/s, depending on the total flow in the mainstream. At the height of the wet season, on average, about 7% of the flow in the Mekong is expected to be diverted through the DSHPP, while flows in the other channels would not be significantly altered. There will be no peaking operations for the hydropower scheme, and hence rapid changes in flow over the daily cycle would not occur. Overall the DSHPP will be operated as a run-of-river scheme, with minimal 2-3 hours retention of water in the headpond. Ultimately, the Project is expected to use some 15% of the flow in the Mekong mainstream to generate power.

Further details on the proposed DSHPP are available from the Project Developer (the Don Sahong Power Company) at http://dshpp.com/.

3.2 The Developer's agreement to mitigate impacts

The Developer's website indicates that "*the ultimate goal is not only to build an economically viable project, but one that will provide the infrastructure, opportunity, and assistance for local development. Accordingly, a strong focus has been placed on understanding the social and environmental impacts of the project.*"

The Developer has noted, in this regard, that the DSHPP could potentially have *"major negative impacts"* (DSHPP - EMMP), and has proposed several options to mitigate these. In addition, there is a commitment to monitor potential impacts, and apply adaptive management through improving the operations of the scheme. These monitoring actions are noted to continue for a *minimum* of 10 years, however, the Developer has indicated[7] that monitoring could continue longer if needed.

The Developer's mitigation proposals have been outlined in a number of reports available on their website, but are briefly outlined here for completeness (see www.dshpp.com/reports/). These proposals have been evaluated in some depth by the expert groups[8] and their opinions are summarised in Section 4 of this document.

The developer has committed *inter alia* to;

- Modify the Hou Xang Pheuak and Hou Sadam channels to act as alternative fish passage routes to mimic the morphological and flow conditions of the current major migratory routes.
- Initiate a monitoring programme to identify the current pre-DSHPP migration patterns.
- Implement an adaptive management fish monitoring and action plan (FishMAP), which would monitor the impacts on fish on an ongoing basis, and allow for adaptive measures to be put in place.
- Not to use underwater blasting to limit impacts on the local dolphin population.
- To contribute to dolphin conservation efforts.
- Maintain flows over the Khone Phapheng at a minimum of 800 m^3/s using automatic recording and automatic reduction of flows through the powerhouse.
- Develop alternative livelihoods for the fisherfolk displaced by the construction work, and the removal of the lee traps.
- Supply safe potable water to villages directly affected by the construction work.

The developer has not expanded these efforts to potentially affected communities neither upstream in Thailand, nor downstream in Cambodia, and has not as yet fully explained how these commitments will be met or resourced.

3.3 The DSHPP in the basin-wide context

3.3.1 Basin Wide Development and cumulative impacts

The developer's reports forwarded via the LNMC refer to basin-wide studies, such as the SEA of

[7] At the Regional Public Consultation meeting in Pakse on 12 December 2014.
[8] These are summarised in section 5 below, and are presented in full, un-redacted, form in Annexes B-H.

Hydropower on the Mekong Mainstream proposed mainstream dams and the MRCS's Basin Development Planning programme (BDP) cumulative impact assessment of basin-wide development scenarios. This section summarises the main issues relevant to the evaluation of the DSHPP by the JC.

The scenario assessment includes information on cumulative impacts (positive and negative) on a range of economic, social and environmental indicators.

The BDP studies led to the adoption, in January 2011, of the first-ever Basin Development Strategy by the Council. The Strategy provides the shared understanding of the development opportunities and risks of water resources development in the Mekong basin, as well as the agreed strategic priorities and actions to guide future decisions on basin development and management. With respect to capture fisheries, the BDP assessment and the MRCS-commissioned SEA study arrived at similar findings for the potential impacts of existing, under-construction and planned water resources development, as follows:

- **The Definite Future Scenario (2015)** with the water resources development as per 2015 (hydropower, irrigation, flood protection, WASH) may lower the fish yield in the LMB by about 7% compared with the 2000 baseline. This scenario does not include any mainstream dams, and many of the proposed developments may not be subject to prior consultation. This scenario is now a reality.
- **The Foreseeable Future Scenario (2030) without the LMB mainstream dams** but with 71 tributary dams, some 5 million hectares of irrigated agriculture, flood protection and WASH, may *further* reduce the fish yield in the basin by about 4% compared to the Definite Future Scenario. Again many of these developments may not be subject to prior consultation;
- **The Foreseeable Future Scenario (2030) with all 11 LMB mainstream dams** and irrigation, flood protection, WASH, may reduce fish yield in the basin by about 18% compared to the Definite Future Scenario.

The reduction of capture fisheries in the LMB caused by the 11 LMB mainstream dams, and hence subject to prior consultation, is estimated by the BDP at about 14%. However, the larger part of these losses is caused by hydropower dams further down in the mainstream. The BDP estimates that the three middle mainstream dams (Latsua, Ban Koum and Don Sahong) would cause a reduction in LMB fish yield of about 4%. By implication, potential impact of Don Sahong may be less than 4%, without any mitigation measures in place. The FEG estimates this at between 3 and 6%, for the Lao PDR, which would potentially translate into similar losses to the fisheries in Cambodia and Vietnam if fish passage and this recruitment dynamics to the fisheries is compromised. More detailed studies on this potential loss are required once a full understanding of fisheries recruitment dynamics is available from DSHPP studies.

Having considered the assessments provided, the Council (by approving the BDS) agreed that "*There is an opportunity to consider some mainstream hydropower, provided that the major uncertainties and risks associated with mainstream dams are fully addressed, and the opportunity is provided for Member Countries to consider and address jointly the trans-boundary impacts of any proposed project (through the PNPCA)*".

As noted elsewhere in this Technical Review Report, the uncertainties around the transboundary impacts of

the DSHPP on fish and fish passage are high.

3.3.2 Considering cumulative impacts

While mainstream hydropower contributes only a proportion of the total cumulative impacts, and the DSHPP a smaller portion of that impact, the impacts of the DSHPP are likely to be significant, and may rise to the level of substantial damage (see Footnote 2 on page 1) .

The JC may consider the following in this regard;

- Consideration of whether the DSHPP reflects an equitable use of the waters of the Mekong River system may consider its potential impacts relative to the other mainstream hydropower projects, and other developments not subject to prior consultation.
- Consideration of both existing and potential uses in determining reasonable and equitable use is included in the 1997 UN Watercourses Convention, and in many other international watercourse agreements. The JC may wish to consider that fisheries be regarded as an existing use, future hydropower would be regarded as a potential uses;
- All dams on the mainstream should be subject to Prior Consultation as and when they are proposed, and these PC processes ***may*** result in a decision not to proceed, or to significantly alter the nature of the proposed use to minimise their impacts;
- The BDP 3 process ***may*** identify alternative options for development of the basin, ***may*** prioritise the 'lower impact, higher return developments', or ***may*** identify joint projects with mutual benefits and lower impacts;
- The DSHPP, because of its characteristics, and after the mitigation options outlined in this report, ***may*** contribute a small amount to the total cumulative impact of all the planned hydropower on the mainstream;
- The potential negative impacts of the DSHPP can be partially reduced if the recommendations outlined in this report are followed.

Nonetheless;

- The DSHPP is very close to the Cambodian border, and is situated in an area of high fish production;
- There is uncertainty around the potential impacts of the DSHPP on fish passage and fisheries; and
- This uncertainty will be greater when considering the impacts of future hydropower dams.

3.4 The MRC Preliminary Design Guidance

The up-front note in the MRC's Preliminary Design Guidance for the proposed mainstream dams in the Lower Mekong basin (PDG) indicates that;

> *"The design guidance recommended in this document is preliminary and advisory in nature. The intention is to provide developers of proposed dams on the Lower Mekong mainstream with an overview of the issues that the MRC will be considering during the process of prior consultation*

under the 1995 Mekong Agreement. Responsibility for ensuring compliance with national standards and provisions of the 1995 Mekong Agreement remains with the project developers. MRC may commission an international expert group to assist in the interpretation of such requirements."

This section of the Technical Review Report therefore assesses the extent to which the developer has considered the PDG, while Annex B provides a detailed table in this regard.

The DSHPP in its current form is only consistent with the PDG advice to a limited extent. The following are relevant;

- The Guidance with respect to Fish Passage includes 29 criteria, the current design fully considers 4 of these, while 13 have not been adequately considered, and a further 12 require more information before an evaluation can be made.
- The Guidance with respect to environmental flows shows that the current design considers 2 criteria, 5 are not considered, and 2 are not applicable to the DSHPP.
- The extent to which the current design of the DSHPP considers the Guidance with respect to sediment is complicated by the fact that the developer contends that the headpond would reach a sediment equilibrium within a short time (3-4 years), and hence sediment management is not required. In this regard, the developer has undertaken detailed sediment modelling (as suggested in PDG Article 127), the results of this suggest that PDG Articles 128-140 are not relevant. The Section 5.7 addresses this in more detail.
- The PDG with respect to the safety of dams are primarily relevant to the detailed design, which has not yet been delivered, and are hence not considered here.
- The PDG with respect to navigation are not considered relevant to the DSHPP.

4. Changes in flows in the Siphandone Area

4.1 Introduction

The Mekong mainstream divides into a number of distributary channels in the Siphandone[9] (4000 islands) Area, at the site of the proposed DSHPP. The DSHPP will be built in one of these channels - the Hou Sahong. The proportion of the flow carried by the Hou Sahong before and after the DSHPP becomes operational, and the importance of the Hou Sahong for fish passage are central to assessing the total impacts of the hydropower plant on the Mekong mainstream, and are therefore summarised here.

4.2 The division of flows among the channels

Hou Sahong channel (before development of the DSHPP) carries, on average, some 4% of the total flows in the Mekong mainstream over the annual cycle. This will increase to, on average, some 15% after construction in order to maintain sufficient flows through the turbines to maintain the economic viability of the scheme. However, the proportions in the various channels vary according to the total flows in the mainstream. At low flows a greater percentage of the total Mekong mainstream flow would need to be diverted, while at higher flows a smaller percentage of the flows will be diverted. The wide variation between the wet and dry season flows is therefore directly relevant to the proportion of the flows that will be diverted through the DSHPP. The higher dry season flows in the Mekong mainstream as a result of hydropower development further upstream are also directly relevant to the distribution of flows among the channels, and for this reason the 'definite future scenario' in the MRC's Basin Development Plan is used as a basis for this analysis. The further development of hydropower on the upstream tributaries, and the consequent increase in dry season flows is therefore also relevant to the future impacts of the DSHPP.

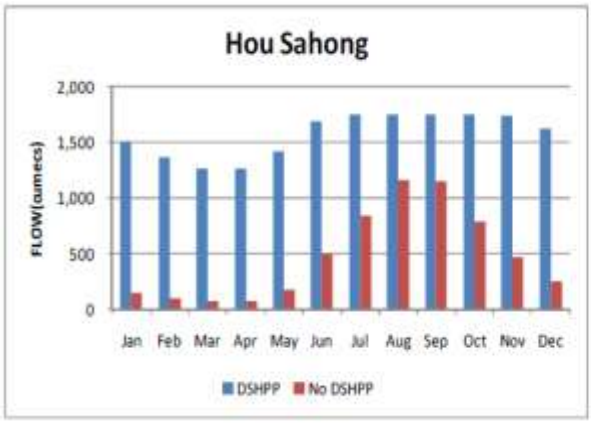
Hydrological modelling and flow measurements taken across all the channels in the area shows that in the dry season most of the water flows in the eastern most channels (Hou Phapheng - 90%, and Hou Sadam / Hou Sahong – 6%). In the wet season the western most channels (Tad Somphamit) carry the greater proportion of the flow possibly due to hydraulic constriction at the Khone Phapheng. In the wet season, therefore, some 55% of the flow occurs in the Tad Somphamit, and 15% in the Hou Xang Pheuak. The higher dry season flows noted recently as a result of upstream hydropower operations means that the Hou Xang Pheuak, Hou Sahong, Hou Sadam and Hou Phapheng now carry higher flows in the dry season. The developer contends that this now allows for year round fish migration in more channels, but has not yet provided empirical evidence to this effect.

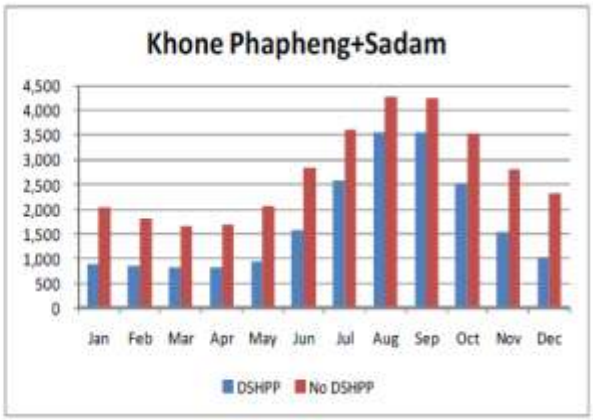
4.3 Modifications to the distribution of flows

One of the key interventions required to ensure the viability of the DSHPP is to deepen the inlet to the Hou Sahong by an average of 3 meters (ranging from1.5m at the lower end to 5m at the deepest point). This is expected to divert flows away from the Hou Phapheng and Hou Sadam. Flows into the Hou Sahong will

[9] This is variously referred to by commenters on the DSHPP as, the Khone Falls or Great Fault Area.

therefore be higher throughout the year, while those in the Hou Phapheng will be lower throughout the year, and up to 50% lower in the dry season. As shown in the figure below, the *average* monthly flows into the Hou Sahong are expected to be lower than the design flow of 1,600 m^3/s for some 6-7 months of the year, as a result of the need to maintain minimum flows of 800 m^3/s over the Phapheng Falls. This makes the economic viability of the DSHPP vulnerable to reduced dry season flows. The increase in dry season flows due to the operation of upstream hydropower is relevant in this regard. The Engineering Report modelled dry and wet years and assumes that the power station is often operating below its optimum. However, the impacts of diverting a greater proportion of the flow into the Hou Xang Pheuak to improve fish passage have not yet been investigated. .

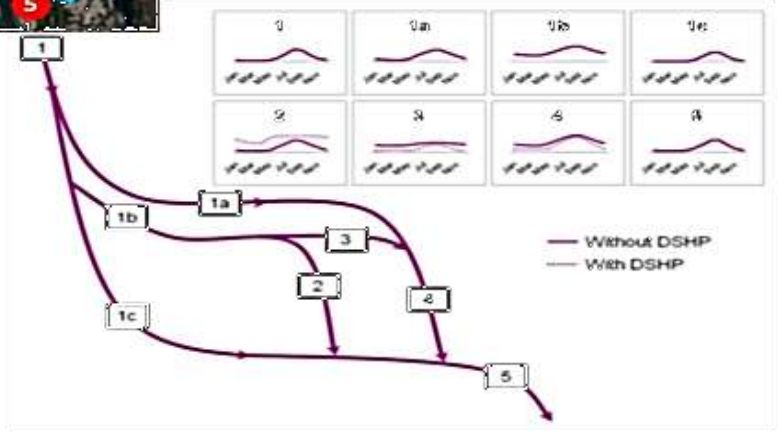




Blue lines = no expected changes,

Pink lines expected changes in flows.

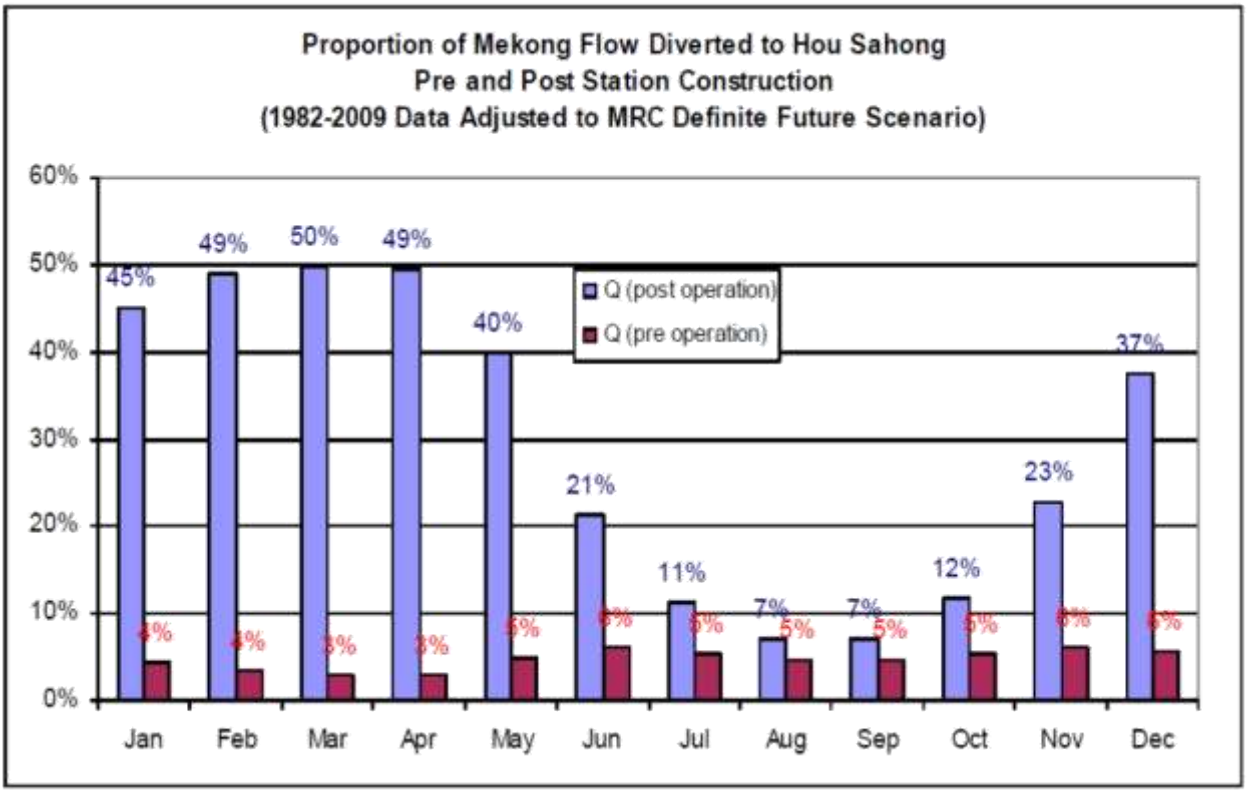
Indicative changes in flows are outlined below



If the system is operated as designed, an average of 50% of the flow in the Mekong mainstream will be diverted through the Hou Sahong at the height of the dry season (March), while some 7-21% of the flow in

the wet season (June to October) will be diverted through the powerplant (see Figure below).

Minor changes in flows (10-20%) of channels to the west of Hou Xang Pheuak would probably occur in the dry season (EIA data) but these have not been modelled in detail and hence the impacts on fish habitats have not been assessed for these channels.



4.4 The impacts of climate change on flows at Pakse

Stakeholders at the Regional Public Consultation in Pakse on 12 December 2014 noted that the Mekong ARCC report indicates that climate change is expected to have a significant impact on the region, and that this should be considered in the Technical Review Report.

The MRC has invested considerable resources in assessing the potential impacts of climate change on flows in the system. Taking a broad brush approach, the MRCS has investigated the outputs of 62 General Circulation Models (also known as Global Climate Models or GCMs), and the full range of the International Panel on Climate Change (IPCC) emission scenarios. The results of the initial analysis were used to identify 3 GCMs which provided the most reliable outputs for the Mekong Basin. These 3 GCMs forecast a possible range of changes in temperature, rainfall, humidity, and solar radiation for the near (2030), medium-(2060) and long term (2090) future. These outputs were used as a basis for input into the Soil and Water Assessment Tool (SWAT) model and Integrated Water Quantity and Quality Model (IQQM) in the MRC Decision Support Framework (DSF), to determine the impacts of climate change on flow.

These analyses show that while most GCMs predict increased temperatures, the projected rainfall varies widely between the models suggesting different future climate change scenarios as follows;

- The wet season gets more rainfall, while the dry season gets less;
- Both the wet and dry season get more rainfall; and
- Both the wet and dry season get less rainfall

The initial simulated results under the Medium emission scenarios and the 3 selected GCMs indicate that flows at Pakse in the wet season (Jun-Nov) in 2030 could change from reductions of 16% to increases of 3% from the baseline (1985-2008), while, flows in the dry season (Dec-May) could change from reductions of 12% to increases of 9%. The position of the MRCS is therefore that all of these scenarios are equally plausible, and no definitive statement can be made with regards to impact of climate change on mainstream flows at Don Sahong, its potential impacts on the impacts of the DSHPP, or the viability of the mitigation options proposed.

5. Technical Review

5.1 Introduction

Under direction from the JCWG, the Secretariat established 6 Technical Expert Groups;

- Fisheries and Fish Passage group (FEG);
- Dolphin group DEG);
- Hydrology group (HEG);
- Water Quality and Ecosystems group (WQ&EG);
- Sediment group (SEG); and
- Socio-economic group (ECONG)

These Expert Groups are comprised of internationally recognised experts working together with the experts from the relevant Programmes in the MRCS, and the Member Countries. Members of these Expert Groups are listed in Annex A2. In the interests of transparency, the reports prepared by these groups are appended in original form in Annex C-H, and should be considered as part of the Technical Review process for the purposes of supporting the Joint Committee's deliberations.

The following summary draws out those elements of their reports and conclusions that are considered directly relevant to consultation in the Joint Committee.

5.2 Fisheries and Fish Passage Expert Group

5.2.1 Background

The Siphandone area represents a keystone location in the Lower Mekong Basin as it acts as a natural *partial* obstruction to migratory fishes moving between spawning and nursery areas and feeding and refuge areas. While the area has a series of channels that facilitate fish migration, these are not all necessarily functional for fish passage at all times of the year.

The impacts that may be caused by the DSHPP are primarily related to the loss of fish passage in the Hou Sahong channel, which has been reported to be the main year round channel suitable for fish migration and passage, and importantly the passage of larger fish. The knock on effects of the reduced fish passage on upstream and downstream fisheries – including those in Cambodia and Viet Nam, and the subsequent possible socio-economic impacts are central to the extent to which the DSHPP is consistent with the principles and objectives of the 1995 Mekong Agreement.

5.2.2 Fish ecology

One of the major problems highlighted by the FEG's review of DSHPP is the lack of empirical data on how important the area and the various channels are to fish migration in terms of biomass and species diversity. This partly arises from difficulties in studying fish populations in large rivers, but also the lack of attention to primary studies in the region prior to submission of the documentation. There is consequently still considerable uncertainty surrounding the impacts of the DSHPP. The EIA submitted by the developer does little to reduce this uncertainty.

It is recommended that efforts are undertaken to close fundamental gaps in knowledge about the ecology of the fish, status of the fisheries, livelihoods analyses in relation to operational design of the dam and upstream and downstream fish passage. This would include evidence to justify the assumptions made in the design of the fish bypass channels. The fish monitoring currently being undertaken by the developer (see Section 6.3) may go some way to reducing this uncertainty, but the work needs to be carried on and needs to be more focused on detecting and responding to any impact detected.

It is consequently important that the current fish monitoring programme is independently evaluated to assess whether it is fit-for-purpose, and that it continues before, during and after the construction phase. This should be used to adapt the design criteria for the alternative fish passage channels to ensure ecological needs of the fish, fisheries and other aquatic biodiversity are addressed. The collection and evaluation of these data beyond the construction phase of the dam is needed to determine whether the modified channels are being used by fish.

A full appraisal of the fisheries, species assemblage life cycles, migratory behavior and biomass should be undertaken to provide the evidence base to underpin decisions made on mitigation measures proposed. This should include a meta-analysis of the composition and ecology of the fauna in areas adjacent to and upstream and downstream of the dam site – such as is typical of developments like the DSHPP. In addition, further information on baseline conditions and migration behaviors is needed to assess future changes.

5.2.3 Fish Passage Design

Background

The developer's proposal for mitigating the impacts of the lost fish passage in the Hou Sahong channel is to modify the Hou Xang Pheuak and Hou Sadam channels. The design and feasibility assessment of the fishways (both upstream and downstream) submitted by the developer in this regard are limited in both detail and scope. It is important that the likelihood of these modifications replacing at least a significant portion of the lost fish passage is assessed in more detail. In particular, the current designs made available to the FEG lack details of the hydraulic and morphological conditions that are likely or required in the modified channels, and whether the target species and all sizes of fish will be able to make use of the alternative routes.

Downstream passage of adults, eggs and larvae

The limited information provided on the downstream passage of fish, eggs and larvae makes it difficult to interpret whether the alternative passages would function as intended. This is particularly important given that all life stages (including eggs and larvae) and the range of fish sizes that need to be accommodated. One of the greatest aspects of maintaining fish stocks, is facilitating downstream movement.

It is noted that, over the year, some 15% of the flow in the Mekong mainstream will be diverted through the turbines, but this may range from 7% at the height of the wet season, to 50% at the height of the dry season. The timing of downstream migration and larval drift is therefore important to assessing the overall impacts on downstream migration. There appears to be continuous spawning in the river over the year, with peaks in February-March when the DSHPP is using 50% of flow, followed by a peak at the onset of the flood season (June-July), when the DSHPP is using 21% - 11%, of the flow, and when the water is receding (November), when the hydropower plant is using 23% of the flow. These spawning periods are associated

with continuous capture of larval and juvenile life stages in drift samples, although the highest volumes of larvae are found at the onset of the flood season.

It is difficult to assess what proportion of the fish and larvae would enter the Hou Sahong and the headpond after the completion of the DSHPP, or whether the larvae and adults would survive passage through the turbines. The developer contends that 'fish-friendly' turbines will be used but no evidence is provided to support this, especially with regard to Mekong fish species. The proportion of adults and larvae entering the Hou Sahong, and surviving the turbines may also differ between species. To complicate matters, studies in Australia have shown that long lived species (those living longer than 3 years) 'remember' migration patterns. It is likely that long lived Mekong species may behave in the same way and repeatedly choose to use the Hou Sahong channel. The impacts of the DSHPP on the *downstream* passage of fish may range from relatively small impacts, to larger impacts, especially if target species spawn in the dry season. More information on larval drift is therefore required to fully assess the possible impacts on downstream fish passage.

There is an assumption in the developer's documentation that modern bulb turbine design is fish-friendly and therefore fish and larval survival is unlikely to be an issue. Specifications of fish-friendly turbines, including performance standards, need to be specifically included in the design to justify this assumption, and the impact thereof on the fisheries recruitment determined. Fish passing through bulb turbines still experience rapid depressurization which impacts the swim bladder which often causes injuries and mortality; significantly, carp species (Cyprinids) appear sensitive to these pressure changes. High mortalities are also expected for large fish passing through proposed fish-friendly turbines, therefore, options for fish screening and downstream fish passage may need to be considered.

Upstream passage of adults and juveniles

The main option proposed by the developer to facilitate upstream migration is to re-engineer the Hou Xang Pheuak and Hou Sadam channels to improve the hydraulics and increase their fish passage capacity, so they serve as replacement migration routes. Deepening of the inlets of the Hou Xang Pheuak and Hou Sadam channels is proposed to mitigate the loss of flow due to lowering of the river caused by the increase in flow through Hou Sahong. The EIA claims the new channels will be able to accommodate all sizes of fish. However, no evidence is provided to support this claim.

The EIA claims that the conditions in Hou Sahong will be replicated in Hou Sadam and Hou Xang Pheuak. However, the current morphology of these channels is very different to that in the Hou Sahong. Hou Sahong is a single channel, whereas Xang Pheuak has several channels and hence the flow is divided between these channels. The Hou Sadam is narrow and carries considerably less flow. The EIA also states that the two channels are similar in width but the site visits and remote sensing imagery suggest that the Hou Sahong provides a much wider passage for fish migration, especially in the dry season. This suggests that the Hou Sahong currently has characteristics that allow it to carry a significant proportion of the upstream migration.

The design of the fish passage entrances and exits to the various channels lack detail, particularly with respect to the hydraulic conditions, making it difficult to evaluate fully whether the fish would be able to find the entrance and whether they would be diverted by the higher flows from the turbines. Fish passage entrances are a critical part of fish passage design and physical modelling is recommended to optimise

entrances for migrating fish. These entrances need to cover a variety of depths and locations to enable passage of surface, mid-water, benthic and thalweg-oriented fishes.

Effective upstream fish passage relies on the following criteria;

i. ***Attraction*** (i.e. the fish passage entrance), which includes the following components;
   - *Proportion of flow.* The higher the proportion of flow from the fish passage the greater the attraction for fish.
   - *Upstream limit of migration.* Migrating fish swim upstream, usually attracted by the flow, to the limit of migration; this is where a fish passage entrance needs to be located.
   - *Discrete flow for fish to locate.* The flow from a fish passage needs to be readily distinguishable to migrating fish and not masked by turbulence or competing flows.

ii. Passage

   - Fish of all species and sizes should be able to negotiate water velocity and turbulence, and swim (and rest) throughout the passage channel.

These criteria are interdependent: if fish are not *attracted* to the fish passage or cannot locate it, they cannot use it; equally, if they can locate the fish passage but passage conditions are poor (shallow water or high water velocities beyond swimming capacity) fish cannot use it. The FEG notes that changing the position of the dam and power plant, shifting it further up the Hou Sahong, may improve the attraction flows in the Hou Xang Pheuak. The Hou Sahong forms an ideal fish passage, which is exploited by the local fisherfolk who have established a great many lee traps and other fishing methods in this channel.

These fish passage criteria also apply to the natural passage conditions, and the behavior of fish under the pre-DSHPP condition with respect to finding and using the Hou Sahong channel or alternative channels, particularly in the dry season which is relevant to whether they would find and use the alternative channels. Indigenous knowledge, evidenced by the placing of fish traps, indicates that fish move far up many of the channels during the wet season and lee traps are found even close to the top of the Khone Phapheng, and Lippi Falls. The developers noted, at the regional Public Consultation, that fish monitoring has been done in the Hou Sahong, Hou Sadam and Hou Xang Pheuak channels throughout 2014. These data may provide some indication of the proportion and species of fish using the Hou Sahong channel versus other channels. However, these data have not yet been analysed.

While the developer has proposed a rock wall at the downstream end of the Hou Xang Pheuak to improve attraction flows, there is insufficient information to fully evaluate whether this and the other alternative channels will both attract and allow for fish passage of all sizes and species of fish. Critical to this would be whether sufficient flow can be maintained in the alternative channels to allow for both attraction and passage, and the ability of the operators to manage this only through controlling the flow through the turbines.

Recommendations with respect to improved fish passage

The recommendations relate to downstream and upstream fish passage, and flow management. For downstream fish passage, the impact of the turbines, blade strike mortality and particularly pressure and

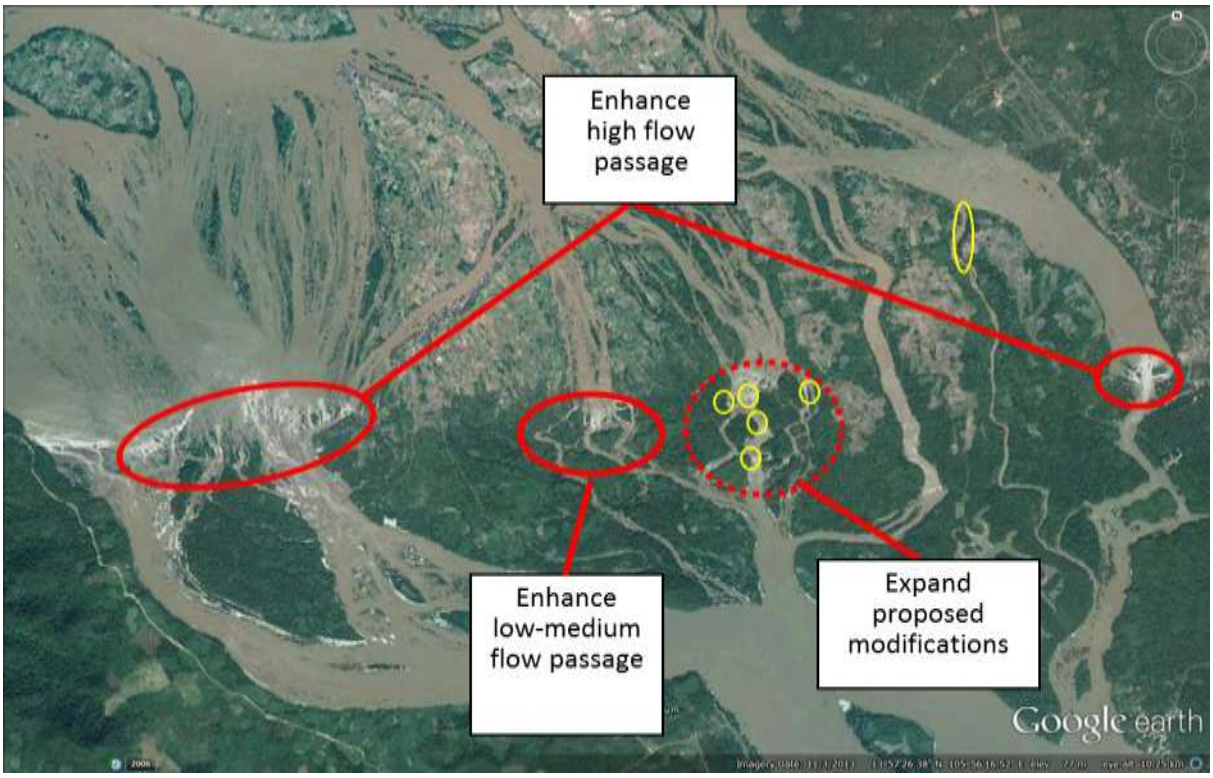
barotrauma[10], on Mekong fish species (adults and larvae) is uncertain and should be further investigated to ascertain the assumptions/expectations by the developer. The turbine design or operation (e.g. slower speeds and sub-optimal operation) may need to be modified to reduce mortality of Mekong fish to acceptable levels.

In order to divert downstream-migrating fish from the turbines fish screens would need to be installed at the inlet of Hou Sahong. To be effective this would require a full evaluation of downstream fish passage facilities appropriate to all migratory species, life history stages and sizes, including surface, mid-water and benthic species.

For upstream passage it may be difficult to replace the migration up the Hou Sahong entirely. The developer's proposal to improve the fish passage in other channels by modifying the structure and hydraulics has potential. However, the success of these measures are entirely dependent on: i) more detailed hydraulic modelling combined with an assessment of the channel morphology to ensure fish passage within the channels, and ii) integrating the dam location and flows from the dam, with flows from Hou Xang Pheuak, to ensure fish are attracted into the main alternative pathways provided. For the latter recommendation, physical modelling in a hydraulics laboratory is the most common and suitable method to optimize these conditions. With respect to the recommendation on physical modeling it is noted that the dam location is important as this impact cannot be mitigated after the dam is built (i.e. the dam cannot be moved) and the dam location and foundations are likely to be early on the critical path of the project.

To mitigate the loss of passage in Hou Sahong it is recommended that the scope of upstream passage be expanded to more sites and channels to provide for high flow and low flow passage (see below). The technical scope also needs to be expanded and it is recommended that fish passage experts are engaged to guide the final design of fish passage for upstream and downstream.

[10] Barotrauma = Physical damage to body tissue as a result of the difference in pressure between the gas inside the body, and the fluid outside.



Options for expanding fish passage at Khone Falls to compensate for lost dry season and wet season fish passage in Hou Sahong. Yellow is existing and proposed by developer, red is recommended for investigation by FEG.

Flow management is an integral part of mitigating impacts on fish passage. Increasing the volume of water diverted into the alternative fish passage channels is likely to increase their capacity to allow for fish passage; hence, the operation of the DSHPP to increase the flows down these channels should be considered. However, it is noted that ensuring sufficient flow through the turbines over the annual cycle is central to the economic viability of the DSHPP. The more water that is required to ensure effective upstream fish passage, the less is available for hydropower production. Investigation into an appropriate balance would provide a useful surrogate measure for evaluating whether all reasonable efforts have been taken to *avoid, minimize and mitigate impacts on the environment* (1995 Mekong Agreement – Article 7). Other useful surrogate measures include describing the hydraulics (depth, velocity etc.) of channels where fish passage presently occurs and using these parameters to measure whether "all reasonable efforts" have been taken in the modified channels. Ultimately, measuring the proportion of fish that actually approach, pass through and exit the modified channels provides a direct measure of the effectiveness and whether impacts on the environment have been mitigated.

5.2.4 Socio-economic impacts associated with fisheries

Limited information on the socio-economic dimensions of the DSHPP has been provided, particularly with respect to the importance of the fishery to food security and rural livelihoods, the number of people affected and loss of ecosystem services to rural communities. The DSHPP EIA report provides limited baseline and impact information on socio-economic conditions of people living in the area that may be

affected by the DSHPP, including those further upstream in Lao PDR, and downstream into Cambodia. Moreover, the FEG notes that the effects of lost fish passage and the efficacy of the alternate fish passage routes could take several years to materialize. A comprehensive and long term monitoring programme involving both fish passage and fisheries is therefore needed after commissioning of the DSHPP, if it proceeds, in order to assess the effectiveness of the mitigation measures. The FEG report (Annex C) provides some suggestions in this regard, but an independent detailed review of the experimental design and methodology is needed for the FishMAP programme to ensure it addresses the important questions of key stakeholders.

The socio-economic impacts of the DSHPP on fisheries are largely related to the efficacy of the alternative fish passages, the social and economic dependency of the affected population on fisheries, and the extent to which alternative livelihoods can replace these lost services. These impacts can therefore only be evaluated after a detailed baseline study on the socio-economic impacts on both the local, upstream and downstream communities.

Tables 3 and 4 of the FEG Report (pgs C-32 and C-33 of Annex C) suggest that there are considerable risks associated with the design of the DSHPP, but well-designed mitigation measures could reduce some of the risks associated with lost fish passage in the Hou Sahong. An effective evaluation of the socio-economic impacts of this on fisheries and the potential for alternative livelihoods is necessary before an assessment can be made on the extent to which the DSHPP is consistent with and contributes to the vision of *"An economically prosperous, socially just and environmentally sound Mekong River Basin."*

5.2.5 Considerations for the Joint Committee

Overall the impacts on the fish ecology and fisheries, hence the impacts on fisheries dependent people both upstream and downstream of the DSHPP are described, for the purposes of discussion in the JC as, ***significant, and potentially substantial***.

- Even with the modifications of Hou Xang Pheuak and Hou Sadam channels, it is unlikely that the lost fish passage in the Hou Sahong can be completely compensated. Nonetheless, the other channels in the area are known to provide for some fish passage during high flows, and after the modifications (if done to international best practice) of the Hou Xang Pheuak and Hou Sadam channels, some upstream dry season migration of small and medium-bodied fish is likely. However, the extent to which this may replace the migration that is lost in the Hou Sahong is unknown.
- The EIA and other documents available to the FEG (at the time their work was completed) did not substantially reduce the uncertainties around fish migration across the area and the consequent socio-economic impacts. While some data and information exist, and are still being collected, they have not been analysed with respect to the time of the year that target species migrate and spawn, the channels they use, and whether the alternative channels could replace a meaningful proportion of the total fish passage in both directions, including meeting the 95% of target fish species advised by the PDG. The extent of lost fish passage through the Hou Sahong therefore remains unknown. Design for upstream fish passage is incomplete (hydraulics) and for downstream passage missing.

In addition to the recommendations outlined above, the FEG noted that;

- Improved fish passage design would reduce the risks posed by the loss of fish passage in the Hou Sahong.
- The risks associated with passage of larvae and small fish through the turbines in the dry season; and upstream passage of large, long-lived species and high biomass of fish remain high.

Consultations in the JC may wish to explore the impacts on fish passage and fisheries in the context of the impacts of existing fishing pressures, and the enforcement of existing legislation in the Member Countries with respect to ensuring sustainable fisheries both upstream and downstream of the area.

5.3 Transboundary Socio-Economic Impacts

5.3.1 Background

The MRC recognises both the inter-linked nature of the Mekong River System, and that developments in the basin, and particularly along the mainstream, may have transboundary impacts. The importance of the river and the ecological goods and services it offers to many poor communities is known and widely acknowledged. The dependence of many communities on aquatic resources as a source of protein security and income has been well documented. The MRC's SIMVA study provides some substance to the number of people that may be affected in this regard.

The SIMVA study notes the following with respect to the proportion of people who have ready access to the Mekong mainstream;

- *Population living within reach[11] of Mekong River mainstream resources:*
  - About 29.7 million people; Viet Nam 13.9 million (16% of its national population) Cambodia with 9.9 million (70% of its national population), Lao PDR with 3.4 million (53% of its national population), and Thailand with 2.5 million (4% of its national population)
  - About 25 million people are living in rural areas.
- *Occupation and livelihood dependence on Mekong mainstream resources:*
  - 73% of households rank farming and 8% rank fishing as their most important occupation,
  - 27% of households rank fishing and 8% farming as their 2nd most important occupation[12].
  - 15% of households fish on an occasional basis.
  - For Cambodia 26% and 28% indicated fishing as 1st and 2nd important occupations respectively.
  - For Laos 57% of households regard fishing as the 2nd important occupation;
- *Food self-sufficiency*
  - The dependence on purchased versus natural food items vary, with 90% of food eaten in Vietnamese households purchased, followed by 77% in Cambodia (some people are highly dependent on fish sales to purchase food) and Thailand (self-sufficiency through mixed farming), Lao households purchase only about 3% of food items hence a high level of dependence on farming and natural resources.
- *Income and expenditure:*
  - 50% of rural households report the sale of rice as the major source of income. Other important income sources are remittances from family members (31%), local irregular/seasonal employment (30%), full-time employment (25%), sale of livestock (25%), and/or sale of own fish catch (25%).
  - 25% of the households across the study sites earn some income from the sale of fish. In Cambodia and Lao PDR, fish sales are a source of income for close to 40% of households.

[11] This was taken as a 15km wide band on either side of the river.

[12] "The proportion stating fishing to be their occupation is lower than in other surveys where the focus has been on fishing Communities, as reported in the Strategic Environmental Assessment (SEA), mainly because the objective of SIMVA has been to capture the broader dependence of the corridor population, not only that of fishing communities in 'sensitive' areas."

These figures reflect a significant proportion of households across the basin are reliant on fisheries to a greater or lesser extent, and the potential reduction in fisheries is an important aspect of the overall socio-economic impacts of the DSHPP. However, a large proportion of the households living within reach of the Mekong mainstream derive much of their income and food security from rice farming and protein security from the purchase of fish or other aquatic species.

5.3.2 Social safeguard and related reports

The documents provided by the developer would have to be improved to allow a comprehensive review of potential impacts and proposed mitigation measures on the whole population of the Lower Mekong Basin. Similarly, a Gender Action Plan and an Indigenous People Plan have not been made available. This information is usually required for a project of this size, and would enable a better assessment of the transboundary socio-economic impacts of the DSHPP.

Furthermore, a Project Communication Plan backed by adequate funding for implementation, during pre-construction, construction and operation phases, would build a better social trust and establish a better *social licence to operate*. This should go far beyond the current proposals for the immediately affected population and the mechanisms for resettlement and grievance procedures, but should also to cover wider national and international complaints and Public Relations. Closer engagement between the developer, MRC and Member Countries in this regard would also increase the 'faith' in the prior consultation process to yield a better project.

Importantly, the potential transboundary socio-economic impacts (both positive and negative) have not been elaborated for either the construction or operational phases. Thus, only a preliminary assessment and related mitigation steps are described in the developer's reports. This may, however, be related to the ability and mandate of the developer to operate outside of Lao PDR.

5.3.3 Increasing regional-transboundary cooperation

Increasing regional cooperation rates highly on the regional ASEAN and MRC Agenda (Articles 1 and 2 of the 1995 Mekong Agreement). However, the current focus of the DSHPP and the documentation produced is on local implementation and impacts. The accuracy of developer's contention that the Project would not have a significant transboundary impacts in terms of changes in fisheries appears to be somewhat premature and *some* transboundary socio-economic impacts are likely. Engagement with communities throughout the LMB as part of the EIA is consequently important to the commitment to cooperate.

The Project could reflect other advantages if a greater regional-transboundary perspective is adopted. This would enhance the extent to which the DSHPP aligns with the principles and objectives of the 1995 Mekong Agreement. The Socio-economic Expert Group has offered the considerations in the following section in this regard.

5.3.4 Considerations for the Joint Committee

The extent to which the project supports the preference for basin-wide or joint projects (Article 2 of the 1995 Mekong Agreement) would be enhanced but not limited by (to the extent that the Internal Rate of Return is not unacceptably compromised);

- Recruiting staff from ***all*** the Member Countries for the construction and operational phases.
- The establishment of an independent 'Social and Environmental Office' to undertake the monitoring as outlined in this Technical Review Report, and staffed by specialists from the riparian countries. Such an office would be part-financed by the concession holder, but could seek additional support from other sources to execute is responsibilities effectively.
- Increasing the proportion of the dry season flows diverted into the Hou Xang Pheuak to improve fish passage.

The prior consultation process has initiated a starting point for a transboundary communication process proven to be necessary. The continuation of this by the developer, through the appropriate national channels in each country, could form part of the Corporate Social Responsibility (CSR) of the developer.

The commitment of the developer to an adaptive approach to monitoring and evaluation and operations management is welcome. The transboundary reach of these programmes would be enhanced by including the recommendations made elsewhere in this Technical Review Report as well as in the Reports from the various Expert Groups. This should ideally be linked to other fisheries and dolphin management programmes in the Lao-Cambodian Mekong border area.

The project is delivering significant infrastructure in the area, including improved WASH for the communities displaced or immediately affected by the development. The extension of this into the immediate cross border area may help build cross border cooperation, and share some of the benefits of the DSHPP with directly affected communities in Cambodia and Viet Nam.

5.4 Dolphin Expert Group

5.4.1 Background

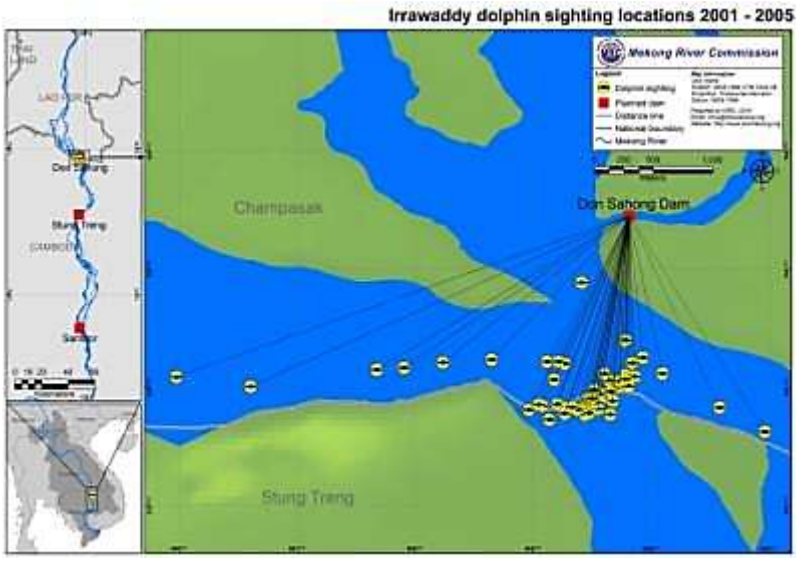
The Irrawaddy dolphin (*Orcaella brevirostris*) sub-population in the Mekong River is classified as critically endangered by the IUCN. This indicates that without adequate protection the sub-population is at high risk of local (in the Mekong Basin) extinction. The species is iconic to the Mekong and important to the local population and tourism. The dolphin historically ranged throughout much of the Lower Mekong Basin south of Siphandone area (including Tonle Sap Great Lake and major tributaries such as the Sekong sub-basin). However, the population is now restricted to a 190-km river stretch, between Kratie (Cambodia) north to just below Khone Falls on the Laos/Cambodia border.

The total population size was estimated as 200 individuals in 1997, but has declined to 85 individuals as of 2011. Accidental entanglement in gillnets, low calf survival and daily harassment by dolphin-watching tour vessels at two locations are noted as the primary causes of population decline. The small population inhabiting the area close to the proposed DSHPP (see the sightings map) is the only dolphin population in Laos. This group has declined from 20-30 individuals in 1991, to 6 individuals as of 2013. The viability of such a small population is unknown, but it is possible that this small group could form the nucleus of a growing population. There is also genetic exchange between this group, and the groups further downstream in the Mekong, suggesting that in the wet season there is movement between the populations. The proximity of this local (transboundary) population to the proposed DSHPP, and the small number of individuals, makes this group particularly vulnerable.

5.4.2 Potential impacts associated with the construction and operation of the DSHPP

The potential threats to this population due to the construction and operation of the DSHPP are;

- excavation and construction impacts primarily due to noise;
- noise related to the operations of the turbines;
- altered local water flow regimes and potential changes in sedimentation;
- increased boat traffic as a result of increased human presence in the area; and
- reduced prey abundance and diversity through degradation and blocking of fish migration pathways.



The threats posed by the proposed project to the whole Mekong dolphin population primarily arise from reduced prey abundance and diversity due to the reduced fish migration in the Hou Sahong. The issue of reduced prey abundance is being dealt with

by the fisheries and fish passage team, and this summary focuses primarily on impacts on the local population of six animals due to construction noise and increased boat traffic. The potential loss of this local population would reduce the Mekong dolphin population by 7%.

Given the proximity of the dolphin pool to the proposed hydropower plant, and the fact that dolphins have been sighted within or close to the area that will be excavated for the tailwater, and may forage into the Hou Sahong channel; it is likely that the local transboundary population will be affected in some way during construction and excavation. The proximity of the dolphin pool to the site means that construction sound (even on dry land) may be heard well into the dolphin pool in Cambodia. Similarly, during operations, noise from the turbines may be sufficiently alien to the normal noise of the cascade of water, to affect the dolphin. While little is known about, or reported in the EIA, on the methods of the eventual decommissioning of the hydropower plant, the potential noise associated with this process is also relevant.

It is known that dolphins have extremely sensitive hearing and a complex sonar system used for foraging, navigating and communicating. The impact of human-made sounds may therefore result in physical and/or behavioural changes for these animals. The nature and degree of any impacts vary with the animal's distance from the source, the propagation qualities of the material between the source and the dolphin, and the levels and characteristics of the sound. The impacts are therefore very site specific and difficult to predict without site-specific tests. The impacts may range from death and physical damage at close range to intense sounds, through to; permanent hearing loss; temporary hearing loss; avoidance of the sound; masking of biologically relevant sounds; and interruption of feeding, breeding, and nursing behaviour.

Few studies have been conducted on the effects of marine mammals and turbines, although one source noted that the impact zone for a 2 MW turbine was small (60-200m). No studies have been found on the noise levels emitted from a 260MW dam and the potential impact of marine mammals, or how that sound may differ from the background noise from the flow in the area. However, it is likely that some sound impacts will occur. Sound from dry land blasting will propagate through the bedrock and into the water, potentially deep into the transboundary deep pool just inside Cambodia. Similarly noise and increased activities in the area during construction is likely to have some impact on the dolphin population, while noise from the turbines during operations may have some effect. While, the developers' commitment to avoid underwater blasting is welcomed, and will reduce the potential impacts, this may not eliminate them entirely.

The dolphin expert group has offered the following recommendations;

- The implementation of internationally accepted guidelines for future seismic surveys to be conducted as part of the design phase of the DSHPP would reduce the impacts on the dolphin population.
- A monitoring plan would be required prior to seismic surveys being undertaken, to outline precaution zones and precautions taken to mitigate impacts to the transboundary dolphin subpopulation.
- Assessments on the frequency, duration, sound pressure levels and propagation of sound from various construction activities need to be made in order to determine the potential impacts to dolphins, and develop appropriate exclusion/precaution zones. Activities would stop if any dolphin were sighted in these zones.

- The EMMP should ideally include provisions for monitoring impacts on the local dolphin population. Preferably, the monitoring strategy should be developed or peer reviewed by qualified experts.
- The contributions to dolphin conservation efforts are welcomed, but need to be adequately budgeted and aligned with the existing efforts, and planned in consultation with these experts in order to maximise the potential benefits offered.

Moreover, they have recommended that standard procedures used internationally for seismic and other sound-based construction activities (such as piling) are adopted. These include precautionary zones, where construction work will not commence if a marine mammal is sighted within the zone. (As an example, for seismic surveys in Australia, standard precaution zones are: Observation zones, 3+km radius from the sound source; Low power zone, 2km radius from the sound source; Shut-down zone, 500m radius from the sound source.) Other international guidelines that may be considered are to use trained marine mammal observers on-watch, soft-starts, and exclusion zones.

5.4.3 Considerations for the Joint Committee

The Mekong dolphin population is already under threat from a variety of activities, and it seems likely that the DSHPP would add to these impacts. However, the extent of the impacts due to the DSHPP is unknown and may range from the dolphin moving out of the area during construction, to their permanent relocation downstream, to the extinction of the local population. It does not seem viable that greater certainty in the extent of these impacts could be derived through studies that could be conducted within a reasonable timeframe, and before construction starts.

While the dolphin expert group has proposed that site specific sound propagation studies are undertaken to prepare precaution zones for construction, it does not seem viable to undertake these studies without testing dry land blasting behind the coffer dam, hence impacting on the dolphin. However, some sound monitoring should be done as construction starts in order to adapt existing international guidelines around dolphin watches and precaution zones. Dolphin watching platforms and equipment developed to monitor in these precaution zones may be converted for tourism use post construction.

The extent to which impacts on the dolphin population are considered a key element in any decision on whether to proceed with the Project must be set against the effort applied to current dolphin conservation efforts. Cambodia and Lao PDR have already recognised their commitments under Articles 3 and 7 of the 1995 Mekong Agreement in this regard, and in 2006 the vice-governors of Champassak and Stung Treng provinces agreed to cooperate in the management and protection of the Dolphin population. It is important that these efforts continue and are adequately supported. In this respect, the proposal for an independent social and environment office made above (partly supported by the Project), could be charged with this work.

5.5 Hydrology Expert Group

5.5.1 Background

The hydrology at the site was derived from the long term records at Pakse some 100km upstream, as well as several years of on-site measurements. This enabled the calculation of "synthetic" daily discharge time-series at the scheme. These estimates were used to prepare daily flow duration curves at ten sites within the various distributary channels associated with the Project. The selection of Pakse, is sound, since the incremental catchment is less than 2% greater. The hydrology baseline for the Project is 1982 to 2009. This is comparable to the long term record (1923 – 2013).

Computational hydraulic modeling was undertaken to;

1. Understand the natural water levels and flows in the various distributary channels;
2. Determine the effects of channel excavation and hydropower operations on water levels, velocities and flow rates.

The evaluation was based on 15 discrete points on the flow duration curves that were estimated for each of the channels. Several models were used for modelling the head- and tailwaters. The latest model available from the developer is a 3 dimensional Telemac model for the headpond as well as an extended upstream 2 dimensional Telemac model. The 2 dimensional Mike 21 was used for the headwater and tailrace model, using a 5m x 5m grid. The immediate transboundary flows were modelled using the 1 dimensional HECRAS model. While the 2D headwater model is considered adequate, further modelling studies are recommended to confirm extent of headwater excavation needed. The results from the HECRAS model should therefore be regarded as tentative.

5.5.2 Hydrology

The Hydrology Expert Group notes that all of the pertinent hydrological variables relevant to the evaluation of the scheme, its design and operation have been considered. The "at site" estimation of hydrology from the upstream Pakse MRC PMFM site is described in detail. Similarly, the on-site measurements of flows are more comprehensive than is typical for hydropower schemes. The 28-year baseline series adopted for the hydrological analysis is considered to be of sufficient length to represent the natural variability in Mekong flows, although additional verification may lend further weight to the assessment.

The long term mean flows at Pakse are compared to those obtained for the baseline, however, the inter-annual and seasonal variance of the hydrological data should be evaluated using an appropriate statistical measure such as the standard deviation or, better still, a non-parametric measure of "data spread" such as the median absolute deviation about the mean. This is important because the average discharge values used through much of the documentation provided do not provide a sufficient indication of the reliability of sufficient flow, and consequently the probability that decreased flows would limit power generation, or reduce the water available to maintain sufficient flows in the alternative fish passage channels and Khone Phapheng. This has also been relevant to the analyses undertaken for fish passage, sediment transport and environmental flows addressed elsewhere in this report.

Currently some 4% of the annual Mekong mainstream flow enters the Hou Sahong, this will increase to 15% after completion of the DSHPP. The hydraulic modelling shows that at most some 50% of the flow (in the dry season) will be diverted though the turbines, while some 7% of the wet season flows will be diverted. However, there are no changes to transboundary flow regimes, and the cross border delivery of flow to Cambodia remains the same in volumetric terms, with no seasonal modification of the flow regime. There may be diurnal changes due to small differences between inflow and outflows, but these would be inconsequential given the small volume of water stored in the head pond (23 million m^3).

5.5.3 Hydraulics

Modelling of the distribution of flows between the channels showed that increased flows in the Hou Sahong channel would lead to a corresponding reduction in the flows in the other channels, particularly the Hou Phapheng and Hou Xang Pheuak. This will affect the efficacy of these channels for fish passage. This will be addressed through excavation works at the upstream ends of these channels to divert more flow. The effects of this on flows across the channels was simulated by changing through the bathymetry in the 3D and 2D Telemac models (Finite Element Models) as well as Mike 21 model (Finite Difference Model) to allow for accurate modelling of the distribution of flow volumes[13]. In particular, the results of the detailed 3D Telemac model of the headpond revealed that the upstream excavations need to be extended for hydraulic optimization of the headpond inflow (to mitigate formation of rapids). Model results also show and turbulence close to the southern training wall of the power house is likely. This will result in loss of head for power generation, and suggests that a design refinement of the power house inlet is required. In addition, the overall annual energy production will decrease from 2,059 GWh to 2,028 GWh comparing the modelling results obtained with MIKE21 and Telemac 3D. The sensitivity of headwater levels to the depth of excavation was found to be greatest when river levels are relatively low and the power station is operating at full discharge capacity. This may make it difficult to assess the extent to which flows can be maintained in the other channels during low flow periods *a priori,* and more detailed modelling and monitoring – with adaptive management may be required.

As contractual penalties will be enforced if insufficient excavation work has been carried out to provide guaranteed water levels at the powerhouse, the Contractor will carry out further model studies during detailed design of the civil works. However, there is a risk that the Contractor would aim on the safe side to avoid the penalties – hence doing more excavation than needed, perhaps to the detriment of flows in the alternative fish passage channels. Importantly, the hydraulic modelling undertaken by the developer is not considered to be at a sufficiently high spatial resolution to support the design of the fish passage, and any further hydraulic modelling undertaken by the Contractor should accommodate these needs.

It is possible that the proportion of flows in the four main branches flowing into Cambodia at the border would change once the DSHPP becomes operational. The expectation based on the 1 dimensional HECRAS

[13] A finer resolution modelling is required to assess the viability for fish passage, and the hydraulics with respect to the requirements of migrating fish.

model is that there would be a modest increase in the discharge through the westernmost channels just across the border with Cambodia, virtually no change in the central channel, and a correspondingly modest decrease in the discharge in the eastern channel. However, it is noted that given the constraints of 1 dimensional modelling, that these conclusions should be considered preliminary.

5.5.4 Considerations for the Joint Committee

The HEG concludes that the DSHPP would not have any transboundary impacts with respect to the total volume of water flowing downstream in any one month, and is therefore consistent with the objectives of Article 6 of the 1995 Mekong Agreement and PDG in that respect.

There may be localized changes between the flows in the various channels just into Cambodia. If scouring or flushing of sediment in the headpond is done at low flows, this may result in sediment deposition on the transboundary islands and in the dolphin pool.

The fact that the Contractor[14] will need to undertake further detailed modelling studies provides an opportunity to address many of the issues raised in the HEG report, as well as for the fisheries and fish passage, and hence to optimise the mitigation proposals. These studies will also reduce uncertainties around the distribution of flows, and the ability to ensure sufficient flows for fish passage, of the Khone Phapheng and to ensure the economic viability of the DSHPP.

The following is noted for the Joint Committee to consider;

- It is doubtful whether the flows in the Hou Phapheng or other channels can be actively managed by changing the headpond levels through backwater effects, by only managing turbine operations.
- This could be addressed through a gated control structure at the entrance to the Hou Sahong, which would have benefits for both fisheries and sediment control.
- The hydropower operator will have economic incentives during dry years to minimize the flows to the Khone Phapheng waterfall and in the alternative channels for fish migration.
- The submerged weir proposed to arrest bed load ingress into the head pond may function in the short term but not in the long term, as sediment would quickly build up behind it.[15]
- The depth of excavation required to assure the design diversion of 1,600 m^3/s into the Hou Sahong should prescribed and modelled before construction starts.
- The impact studies for the immediate cross border area undertaken thus far, based on 1D modeling, should be viewed as exploratory and the conclusions preliminary.

[14] It is assumed that a separate construction company would be contracted to undertake the construction work.

[15] This issue has been addressed in the 3D Telemac modelling, but has not yet been reviewed in detail by the SEG.

5.6 Water Quality and Aquatic Ecosystems Expert Group

5.6.1 Background

The MRC Member Countries have, through Articles 3 and 7 of the 1995 Mekong Agreement, committed to maintaining the ecological balance of the Basin, and to make every effort to avoid, minimise and mitigate harmful effects that might occur to the environment, especially water quantity and quality, and the aquatic ecosystem.

The Joint Committee may wish to consider the extent to which the proposed DSHPP complies with these principles, as well as the Preliminary Design Guidance with respect to environmental flows.

5.6.2 Water quality

Given the small storage and run-of-river nature of the DSHPP no significant water quality problems are expected during the normal operation of the scheme. Furthermore, the following is noted in support of that conclusion:

- The headpond will not stratify into warmer surface and cooler bottom layers, and hence depletion of oxygen in the waters flowing through the turbines is unlikely;
- The residence time in the headpond will be 2-3 hours, this would be insufficient time for algal blooms or anoxia to develop.
- The dilution by flows in the other channels would reduce any left-over pollutants from construction activities.

However, possible impacts may occur during construction, mostly related to:

- Increased sediment in the water due to excavation in the river bed[16], earth moving e.g. construction of coffer dams and preparation of embankments, which might result in transient increases in sediment concentrations.
- Increased organic pollution from worker camps, canteens, and construction sites.
- Accidental spillage of construction materials, including washing of concrete.
- Accidental spillage of oils and grease, releases from vehicle and plant maintenance.

These impacts can largely be managed through good construction site practice, treatment of waste waters, and storage of construction materials and chemicals, including fuel and oils, in appropriate compounds that contain accidental spillages. These measures are all provided for in the documentation provided by the developer, and are adequately addressed.

During construction there may be occasional incidents of impaired water quality passing downstream into Cambodia. This may have a greater impact during the low flow seasons when the water is clearer, but are unlikely to significantly impair the use or enjoyment of the Mekong River in Cambodia. However, there is a

[16] It is noted that excavation is mostly planned to occur behind the coffer dam, thus limiting the introduction of sediments to the water.

potential for sedimentation in the deep pool just into Cambodia used by the resident dolphin population if drawdown flushing is used. Spillages and accidents and malfunction of waste water treatment plants may also occur, and may have a temporary impact upon the water quality downstream, and in some cases as far as the Stung Treng Ramsar[17] site.

The MRC Human Impact Water Index for Stung Treng indicates that the water quality has already been impacted by human activity (It is rated as Class C), but not severely so[18]. The construction and operation of the DSHPP are unlikely to change that rating, though the scores may decrease within that class.

It is probable that, with the measures proposed by the developer for managing water pollution during construction, and the nature of the reservoir and its residence time during operation, that the DSHPP will be consistent with the advice presented in the PDG on water quality, as well as the water quality aspects of Article 7 of the 1995 Mekong Agreement, in which the Member Countries agree to make every effort to avoid, minimize and mitigate harmful effects on water quality.

5.6.3 Impacts on aquatic and riparian habitats and key species

The Siphandone area in the Lower Mekong Basin offers a range of river and riparian habitats, supporting a diversity of aquatic and terrestial species, notably threatened aquatic and bird species are known to nest on sand bars that are exposed in the dry season.

The EIA appears to assume that all the channels are equally important or unimportant with respect to riverine and riparian habitats. While the documentation includes considerable information on the flows and on the changes to the morphology (riverine structure and habitat) in the channels that will be modified by the DSHPP, this only relates to the impacts on fish passage. It is important that information is provided about the riverine and riparian habitats, with respect to impacts on aquatic plants and fauna other than fish. This is particularly pertinent to habitats that will be lost or modified due to the construction or the changes in flow.

An assessment of the proportion of habitats that will be lost, in comparison with the total habitat available in the Siphandone area would enable a much better assessment of the potential environmental impact of the proposed DSHPP. In this regard, at a minimum, a morphological and habitat comparison of the different channels to assess the significance of the loss of habitat in Hou Sahong, and potentially the Hou Sadam and Hou Xeng Pheuak, should be undertaken by the developer. Similarly, the potential impacts of changes in flows in the Khone Phapheng not only with respect to the visual amenity value of the Falls, but also the potential changes caused by encroachment of riparian habitat into the riverine habitat, should be done, as the lower flows may result in bush encroachment and affect the visual amenity of the Falls.

Terrestrial habitats are covered to a limited extent, and the EIA suggests that the area of “island, rock and

[17] Convention on Wetlands of International Importance, to which all 4 Member Countries are party.

[18] An explanation of the scoring system and impact ranges is available at: http://portal.mrcmekong.org/cms/water-quality-monitoring-map

water" in the Hou Sahong channel and affected downstream areas totals 92.6 ha. However, there is no analysis of these aquatic habitats or an assessment of their ecological significance and rarity. The proposed mitigation measures are standard precautionary measures (for management of land affected by construction), which are likely to be effective provided that:

- Contractors follow best practice for soil erosion and disposal management measures during construction.
- Compliance monitoring of both the DSHPP and its contractors is effective.
- Water quality monitoring specified in the EMMP is carried out, and incidents of failure to comply with water quality standards are investigated and remedial measures followed up if necessary.
- Adequate emergency response measures are in place with staff trained to respond, and all accidents involving spillage and water pollution are investigated and remedial measures put in place.

Furthermore, the Siphandone area would be considered as a "critical habitat" under IFC Performance Standard 6, because of the presence of highly threatened species (6 Vulnerable, 3 Endangered and 3 Critically Endangered), and because of its importance for fish migration. This would recommend that far greater attention is paid to maintaining the aquatic habitats in the area and to ensuring no net loss in biodiversity.

5.6.4 Flow modification and the impact on the Khone Phapheng amenity value

The developer has committed to maintain the flow in the Hou Phapheng at a minimum of 800 m^3/s in order to protect the amenity value and visual impact of the Khone Phapheng. This means that flows through the turbines fall below the 1,600 m^3/s design flow on average for about 7 months of the year. This will be managed through establishing flow gauging on the Hou Phapheng, and automatically reducing flows through the turbines as the flows approach 800 m^3/s.

The selection of the 800m^3/s minimum flow appears to be somewhat arbitrary, and is based on the lowest recorded flows. It is noted that this is lower than the 1000 m^3/s used in an EIA on the possible Thakho - Khone Phapheng Hydropower option. Nonetheless, it is recognised that it would be difficult objectively determine an alternative minimum flow based on tourism amenity values at the Khone Phapheng without extensive further studies. The FEG report notes that the amenity value of waterfalls is based on flow and height. Tourism associated with other large Water Fall attractions has been shown to increase at higher flows. However, the impact of lower flows over the Khone Phapheng on tourism would be dependent on a number of factors which have not been analysed and there is insufficient information to draw conclusions in this particular case.

The selection of the 'best possible' flow over the Khone Phapheng would be a balance between the economic viability of the DSHPP (assuming a reasonable Internal Rate of Return), and diversion of more water away from the Hou Sahong channel. This is also related to total flows available and, in drier years the commitment to maintain flows over the Khone Phapheng (and the Hou Sadam and Hou Xang Pheuak), might be difficult to realize without severely compromising flows through the turbines. However, the operation of hydropower with significant storage further upstream will dampen these effects.

Conversely, improved access to the area because of the DSHPP could increase tourism, while the project could also include the construction of viewing areas and other tourism amenities.

5.6.5 Considerations for the Joint Committee

The Water Quality & Environment Expert Group notes that;

- The water quality issues during the construction period can be largely managed through good practice and attention to compliance and enforcement of construction.
- There may be periods such as construction of the coffer dams and when working in the Hou Sadam and Hou Xang Pheuak channels, when sediment will be temporarily released, and considerations need to be given to managing erosion and high sediment releases into the river.
- The short residence time in the DSHPP means that water quality degradation is unlikely to occur and cause problems downstream. The removal of vegetation from the reservoir area will further reduce this problem.
- The operation of the DSHPP is therefore unlikely to significantly change the water quality of the Mekong mainstream, and is considered to be consistent with the commitments made in the 1995 Mekong Agreement and the PDG.
- However, better descriptions of the aquatic habitats within the overall area, including the hydraulics and morphology of the channels likely to be affected, and their ecological significance will allow for better assessments of the possible impacts of the DSHPP on terrestrial, riverine and riparian habitats.
- Areas of uncertainty exist in terms of the temporary increase in flows through the other channels during the construction period in the Hou Sahong[19].
- Integrated monitoring of water quality, flows, hydraulics and habitats and ecosystem health is recommended.
- The transboundary flow regime in the immediate vicinity of the Lao-Cambodia border shows moderate to minor changes in flow, with a slight increase in the western channels, especially the Chheuteal Pool, and a corresponding decrease in flows in the eastern channels.
- This would be verified through both improved 2D modelling and water level monitoring, and the ecological impacts upon the habitats in these southern channels also monitored regularly.

Given the possibility (however remote) of chemical spills or other accidents, and the proximity of the Cambodian border, the development of local and cross-border emergency warning procedures would reduce the potential impacts of the DSHPP during construction. Similarly, the constructor's liability insurance should cover potential claimants from both Lao PDR and Cambodia. It is recommended that any cross-border emergency warning systems should include mechanisms to alert the MRC and the NMCs of any incidents.

[19] This has been addressed in updated modelling undertaken during 2014. However, this has not yet been analysed by the Review team.

5.7 Sediment and morphology

5.7.1 Background

The issue of the transport of sediments in the Mekong mainstream, and the potential long term impacts of this on the Mekong Delta, is a matter of considerable concern to both Cambodia and Viet Nam. Many non-governmental organisations also cite this as a major concern with respect to the transboundary impacts of mainstream dam development. This obliges considerable due diligence on behalf of the developer.

5.7.2 Potential impacts of sedimentation in the headpond

The SEG notes the potential uncertainty about the rate and volume of sediment deposition in the DSHPP headpond. There may be fourfold increase in sediment discharge through the Hou Sahong, as a result of the increased flows. This may increase the rate of sedimentation in the headpond, and the headpond *may* quickly fill with sediment. This would reduce the flows through the turbines, and alignment with the PDG would require the removal of the sediment. This may either be done through disposal on land by dredging, or through drawdown flushing[20].

However, the developer has suggested that a sediment inflow / outflow equilibrium would be quickly established based on sediment deposition modelling (see section 6.4). The information required to undertake a full independent review of this work has not yet been made available. Nonetheless, the SEG notes that the timeframe for modelling (only 5 years) would not be sufficient to fully establish whether an equilibrium would be established after 3-4 years.

Sedimentation in the excavated inlet to the Hou Sahong is likely to have some impact on flows into that channel. While the developer has proposed the development of a sill at the entrance to the Hou Sahong, this would only capture bed load sediments, and would rapidly fill up rendering it ineffective. Sedimentation in the Hou Sadam channel has already been observed. This may require constant maintenance to ensure that this channel continues to provide fish passage services as designed.

Should sedimentation in the headpond not reach an equilibrium, a sediment management plan would be required to align with the PDG. This may include either drawdown flushing or dredging. In the former case, this would affect downstream sediment concentrations, albeit on a transient basis. This may also have some local transboundary impacts. There is limited land available for disposal on land, and disposal (flushing) to the river would appear to be the only viable option, should the headpond accumulate sediment. This, particularly if done at low flows, could affect the dolphin pool and dolphin behavior.

A number of uncertainties and gaps in information are itemized in the SEG report (Annex G), which should be addressed by the developer.

[20] The Sedimentation Modelling Report, not yet analysed in detail by the Review team, recommends dredging if required. Drawdown flushing is not considered necessary.

5.7.2 Potential transboundary impacts

The SEG reports that the DSHPP will have no significant cumulative effects on sediment transport and geomorphology of the Lower Mekong River, as only a small proportion of the total sediment transported in the Mekong mainstream will be diverted into the Hou Sahong channel.

However, there may be some sediment deposition on the transboundary islands, and in the transboundary dolphin pool, if drawdown sediment flushing is undertaken.

5.7.3 Considerations for the Joint Committee

The DSHPP is not expected to have a significant impact on total sediment delivery further downstream into Cambodia and Viet Nam. Nonetheless, some local impacts on the transboundary islands and dolphin pool are plausible if drawdown flushing is used.

In the event of the headpond filling with sediments, and not reaching equilibrium, it will be important for the developer to prepare an effective headpond sedimentation management approach. This would be required to ensure alignment with the PDG. This should include sediment disposal mechanisms, either on land or to the river. In the latter case the impacts on sedimentation and turbidity in the Dolphin Pool should be considered.

Similarly, the sedimentation management approach should pay particular cognizance of the need to maintain design flows through the turbines. While a 'skimming wall' has been proposed, a gated inlet structure could be considered, as outlined elsewhere.

The SEG also notes that abrasion of the turbines is possible due to the quartz content of the sediments.

5.8 Dam Safety

5.8.1 Assessment of possible impacts

While the volume of the head pond is small, the proximity to the Cambodian border makes dam safety a matter to be considered.

In this regard the analysis of peak flood flows is adequate, and sufficiently rigorous. Hydraulic modelling of the headwater and tailrace systems is considered adequate for the purposes of designing and operating the hydropower plant.

Nonetheless, given the proximity of the Cambodian border, cross border emergency warning systems should be included as part of the operations and construction of the hydropower plant.

Alignment with the PDG can only be assessed once the final design is complete.

5.8.2 Considerations for the Joint Committee

The engineering evaluation is that the Dam Safety issues are well covered by the developer for this stage of the project development/design process.

5.9 Navigation

5.9.1 Assessment

The configuration of the Mekong mainstream in the Don Sahong area forms a natural barrier to navigation, and the DSHPP will not change the freedom of navigation. The matter is therefore not addressed in the developer's reports or in this assessment.

It is noted that there are long term plans to develop a series of navigation locks around the area.

5.9.2 Considerations for the Joint Committee

The maintenance of the freedom of navigation as provided for in Article 9 of the 1995 Mekong Agreement, and in the PDG, are not considered to be relevant to the development of the DSHPP.

6. Other considerations for the Joint Committee

6.1 Introduction

This section introduces other issues that are considered relevant to the discussions in the Joint Committee regarding the DSHPP, but which were not raised in the Expert Group Reports or in the documentation provided through LNMC for the Prior Consultation process. They are derived from the discussions at the Regional Public Consultation in Pakse on 12 December 2014[21] , and provide considerations for dealing with the uncertainty around assessing the impacts on fish passage, fisheries and hence the local transboundary socio-economic Impacts.

6.2 Dealing with uncertainty

The complexity of the response of ecosystems to impacts is always difficult to predict, and even in data and information rich environments decisions are made with an element of risk and uncertainty. This is particularly relevant in very diverse ecosystems, which are not yet fully understood, like the Mekong River System.

This uncertainty underpins the call by NGOs "*not to gamble*" with the Mekong by making decisions on an incomplete understanding and the opinion, expressed at the regional public consultation on 12 December 2014, that the DSHPP should be delayed for some 5-10 years (see the Public Consultation Report). The need to reduce the uncertainty around the Xayaburi Hydropower Project was also a key component of some Member Countries' responses in that case. The need to reduce the uncertainty with respect to Prior Consultation processes is also central to the 'Council Study'.

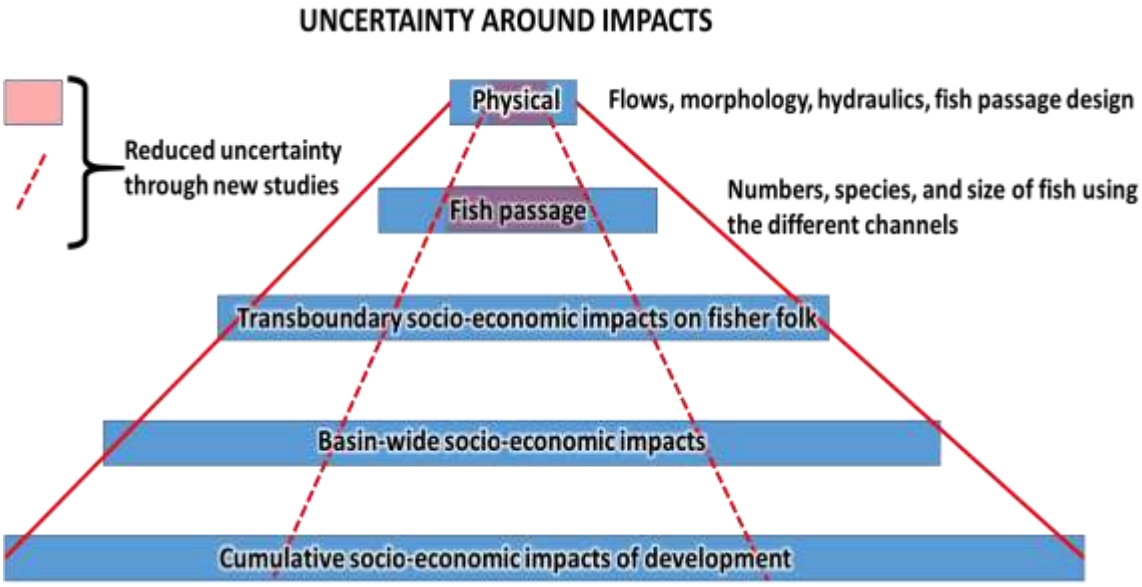
Most proposed developments pose a risk to the physical environment, in this case the DSHPP is likely to have some impact on fish passage by blocking the Hou Sahong with the dam and power plant and shifting proportion of flows carried by the various channels, thus posing risks for the numbers, species and size of fish migrating (upstream and downstream) through the area. The proposal by the developer is to alter the physical environment in alternative fish passage routes, and to remove the lee traps, to replace or compensate for the lost migration route through the Hou Sahong. However, as pointed out by the FEG, based on the information made available, there is uncertainty, for a variety of reasons, as to whether these proposals would sufficiently replace the lost passage.

As noted by the socio-economic assessments undertaken by the Expert Groups, these uncertainties are magnified when trying to determine the impacts on fisheries, and further amplified when assessing the socio-economic impacts of communities upstream and downstream along the mainstream. Uncertainties further increase when taking a basin-wide view of the potential socio-economic impacts of the DSHPP,

[21] The VNMC noted, at the Public Consultation meeting on the 12th December, that they appreciate the additional information presented by the developer, and requested the Secretariat to take this into account. However, the CNMC noted that some of the information presented was disputed.

which must introduce the socio-economic benefits to Lao PDR, and potentially to the other Member Countries through a stronger regional economy. Uncertainty is increased yet further when considering the cumulative impacts of multiple hydropower dams in the basin. The EIA and the other documents submitted through the LNMC as part of the prior consultation process do little to reduce this uncertainty. However,local impacts associated with individual developments may become spatially imperceptible at a larger scale. Therefore, the 'increasing' uncertainty at larger scale and in multiple sectors becomes less relevant for the assessment of a local intervention. Nonetheless, reducing uncertainty is key to any decision that the JC may make on the length of any extension to the prior consultation process, should this be considered.

The developer outlined, at the Public Consultation meeting on the 12 December 2014 that monitoring of fish passage had been undertaken during 2013, and 2014, and some modifications to the Hou Sadam and Hou Xang Pheauk had already been done[22] (see section 5.3 below). This includes assessments of fish passage across the various channels, the timing of migrations and the species and sizes of fish using the various channels.



The FEG has indicated that should these data be made available, and analysed, the uncertainty around the assessment of the impacts of the DSHPP on fish passage would be reduced. This, coupled with a review of other data available from the national University of Laos and the WorldFish group, and the activities recommended to reduce the uncertainty around other ecological and physical aspects (migration timing, fish passage design, and hydraulics), may reduce the uncertainty around the transboundary socio-economic

[22] The FEG notes that these changes have not been supported by detailed studies of the hydraulics and morphological requirements for fish passage.

impacts of the DSHPP, as suggested in the figure above. Longer periods of study (several years, including beyond the dam construction period) may further reduce the uncertainty.

An evaluation of whether *sufficient* certainty exists around fish passage across the various channels, and the consequent impacts on fisheries both upstream and downstream (after the mitigation measures are put in place), and whether the analysis of the additional data (described below) would provide the required certainty, is relevant to discussions by the Joint Committee particularly with respect to a possible extension of the prior consultation process.

6.3 Additional fish passage data

The developer presented their fish monitoring efforts during 2014 at the meeting of 12 December 2014 in Pakse, indicating the variety of methods used, and proposed for, ongoing monitoring. The presentation included the following information on the modified fish passages;

- The fish passage has been modified in 4 places - Hou Sadam (1 place); Hou Xang Pheuak (3 places), but this was not based on any formal design of channel morphology and hydraulics, and fish passage needs;
- As yet no data has been submitted for the PNPCA process on fish sizes, numbers, species, and most importantly the proportion of fish moving through;
- From May 2014, monitoring upstream and downstream of the main passages (Hou Xang Pheuak, Hou Sahong, and Hou Phabeng) has been undertaken for 1 day a week; and
- Some traps were placed upstream of the main natural barriers to fish passage.

No quantitative analysis of these data were made available at the Public Consultation. These data could form the basis for the additional studies suggested to reduce the uncertainties as outlined above. These analyses may be undertaken by the developer, or independently supported by the MRC and / or developer and should be made transparent for further evaluation.

It has also been noted, and corroborated to some extent by the FEG, that certain species of fish are caught in large numbers downstream of the Siphandone area, but have never been caught upstream – indicating that the area forms a natural barrier to some species. The developer suggested that these were largely marine species migrating up through the Delta.

6.4 Additional sedimentation modelling

The developer presented the results of modelling sediment deposition in the headpond using the Telemac hydraulic model, at the meeting of 12 December 2014. Sediment transport through the headpond was modelled over a 5 year period starting from the first year of operation, and based on normal turbine operations (without flushing). This modelling showed that an annual equilibrium of deposited sediment was found to occur in the first 4-5 years. Thereafter total sediment flows into and out of the headpond and through the turbines would be equal. The modelling showed that the equilibrium condition results in about 3.3 million tonnes of sediment permanently removed from the system. This is between 2.2 and 4.7 % of the *annual* sediment load in the Mekong mainstream.

6.5 Alternative hydropower options at the site

The FEG notes that the EIA provided by the developer lists four alternative hydropower options as follows;

1. Thakho (Khone Phapheng), 172 MW[23] capacity;
2. Don Sahong, 260 MW capacity;
3. Hou Xang Pheuak, 260 MW capacity;
4. Tad Somphamit, 56 MW capacity.

The Thakho (Khone Phapheng) option was discarded due to impacts on flows over the falls, however it is likely that the operation of the Don Sahong option will have similar impacts. The Hou Xang Pheuak option is not examined in any detail, although "adverse impacts on fish passage" is mentioned.

The Thakho and Hou Xang Pheuak options have not been investigated in the same level of detail, and are not the subject of this Prior Consultation process. Nonetheless, the Joint Committee may wish to note that these alternative hydropower options are likely to have smaller impacts on the critical Hou Sahong channel, and hence potentially fewer transboundary impacts.

6.6 Considerations for the Joint Committee

The Joint Committee may wish to note that new information has recently been made available by the developer, but this has not yet been independently verified by the Expert Groups due to time constraints. Analysis of this additional information may reduce key uncertainties around assessing the potential impacts of the DSHPP, and the likely efficacy of the mitigation options proposed. This additional information may also place the JC in a better position to propose conditions on the DSHPP should agreement be reached.

The Joint Committee may therefore wish to consider an extension to the PNPCA process to allow for these additional data to be analysed and reported. These data have already been collated and the developer is currently writing this up. A few months may be required to review these reports as well as other data available from the national University of Laos and the WorldFish group. This period could also be used by the developer to improve their designs for fish passage for review.

This additional work ***may sufficiently*** reduce the uncertainty around the potential impacts of the DSHPP to enable agreement in the JC, and to establish conditions as part of the record of the proposed use. An extension would provide the opportunity for a further round of public consultations.

[23] A separate study noted a possible 200MW from Thakho.

7. Conclusions, recommendations and conditions

7.1 Background

The Joint Committee's deliberations will be guided by the extent to which the DSHPP is consistent with the principles and objectives of the 1995 Mekong Agreement, whether it constitutes a reasonable and equitable use pursuant to all relevant factors and circumstances (Mekong Agreement, Article 5), and the extent to which it is consistent with the Preliminary Design Guidance.

This Technical Review Report aims to capture all the information necessary to support these deliberations. This final section of the Report summarises the expected impacts.

7.2 Summary of the Impacts

There are significant gaps in the information supplied by the developer with respect to some of the expected impacts of the DSHPP, particularly with respect to the transboundary impacts. This appears to be related to the fact that the notification process was initiated before some of the pre-construction monitoring data were available, hence limiting the conclusions the EIA and other documents could make. It should also be noted that the developer's mandate may restrict their ability to operate in the other Member Countries, and engage with affected communities across the border.

Nonetheless, further attention to the transboundary impacts of the DSHPP by the developer as recommended in the various Expert Group reports, and in the sections above, is suggested before the design of the DSHPP is finalised.

It seems unlikely that the construction, operation and decommissioning of the DSHPP will have *no* impact on the Mekong mainstream. Generally these impacts are associated with;

- The extent to which the modified (flow and morphology) Hou Sadam and Hou Xang Pheuak channels compensate for the lost fish passage in the Hou Sahong is uncertain and is not based on supporting evidence. This may have upstream and downstream impacts on fisheries, have transboundary socio-economic impacts, and affect the availability of prey for the dolphin population.
- The effect of noise especially during construction, and to a lesser extent operations of the hydropower plant on the local resident dolphin population.
- The plausibility, although remote, of sedimentation of the deep pool straddling the boundary with Cambodia. This may occur due to a local increase in sediment load resulting from amplified sediment discharge through DSHPP, if drawdown flushing is undertaken.
- The loss of important (and locally unique) aquatic habitat in the channels that will be affected by increased or decreased flows and engineering works.
- The reduced flow over the Khone Phapheng, particularly in the dry season and the possible loss of tourism amenity value.
- The extent to which flows in the other channels can be regulated *only* by turbine operations.

These impacts, particularly with respect to flows and sediments, are lessened because the DSHPP is on only

one of several distributaries and over the full annual cycle diverts some 15%. However, because 50% of the flow will be diverted through the turbines in the dry season, and because fish migration occurs in this period and adult fish may actively try to choose the Hou Sahong channel, the impacts could still be considerable.

Nonetheless, the other distributary channels are likely to pass some fish, particularly in the wet season. While the Hou Sahong has served as a vital dry season fish migration route, this may be to some extent replaced by measures taken in the other channels, although there is uncertainty in this regard. This report makes some suggestions that would reduce some of this uncertainty, which the Joint Committee may wish to consider.

Some of the impacts could be mitigated, and the Expert Group reports and this Technical Review Report consider that the present measures are insufficient in scope and detail and detailed recommendations have been made in this regard in each of the Expert Group reports. Implementation of these recommendations by the developer would increase the alignment of the DSHPP with the objectives and principles of the 1995 Mekong Agreement and the PDG.

The efficacy of mitigation measures may also be increased by diverting higher volumes of flow into the Hou Phapheng and Hou Xang Pheuak channels in the dry season. The extent to which this is viable while maintaining an acceptable IRR for the developer should be explored.

The impacts of the DSHPP on the Mekong mainstream and the other Member Countries is therefore described as probably significant, but possibly substantial (See Footnote 2 on page 1).

Probably significant, because with the mitigation measures in place;

- Some fish passage will occur in the upstream and downstream directions. Nonetheless, the following is relevant in this regard;
    - At high risk are dry season migrants and large-bodied fish
    - At low risk are wet season migrants and small to medium-bodied species
    - At high risk are fish passing through turbines
- There are unlikely to be significant transboundary impacts on sediment transport to the Delta;
- Sedimentation of the pool straddling the boundary with Cambodia immediately downstream of the DSHPP, which, although unlikely, is plausible if drawdown flushing is used.
- There are unlikely to be significant changes to the monthly volumes of water flowing into Cambodia;
- There are unlikely to be significant water quality impacts downstream (with the exception of water quality emergencies during construction);
- The socio-economic impacts would be related to the lost fishery potential, but this loss (*attributable <u>only</u> to the DSHPP*) have been noted by the BDP and the FEG as relatively small relative to other hydropower developments in the basin.

Possibly substantial, because the loss of fisheries for some of the local and immediately upstream and downstream communities could remove their only viable livelihoods. This would be more important in Cambodia and Viet Nam where the affected communities may not be able to gain benefit or alternative

livelihoods from the project. Engagement of the recommendations made in this Report would partially reduce that likelihood.

7.3 Recommendations

7.3.1 Key Recommendations from Expert Groups

These recommendations have been summarised out of those made in by the Expert Group reports (Annexes C-H), and refer to activities the developer could undertake to better align the proposed DSHPP with the principles and objectives of Chapter III of the 1995 Mekong Agreement and the PDG, as well as to establish a baseline against which to monitor change.

Fish

- The details of the fish passage design are developed and physical/hydraulic modelling used to optimise attraction and passage of fish; and these are provided to the MRC for evaluation.
- The developer investigates options for the dam location and arrangement to optimise fish attraction into Hou Xang Pheuak.
- The developers investigate options for screening the inlet of Hou Sahong to guide fish away from the turbines.
- Fish ecological and fisheries baseline information is provided as requested by the FEG.
- The FishMAP programme is expanded in detail, adopted and fully funded with contingency allowance for impacts that eventuate, as recommended in the FEG report.
- The FishMAP programme is extended upstream to Pakse and downstream to Stung Treng and includes other channels in the Siphandone Area.
- Fish passage through the Hou Xang Pheuak, and Hou Sadam is monitored and reported to MRC on an annual basis as part of the PWUM.
- That any changes to operating procedures that are implemented as a result of the monitoring programmes, are communicated to the LNMC for transmission to the MRC.

Hydrology and Sediment

- The developer investigates the option of a gated inlet structure and grids at the upstream end of the Hou Sahong and establishes operating rules for the structure which allow for the diversion of flows into the Hou Phapheng and Hou Xang Pheuak.
- The flows through the Hou Xang Pheuak, Hou Sahong, Hou Sadam and Hou Phapheng are monitored and reported to the MRC through the LNMC, and are considered part of the PWUM;
- In the event that scouring of the headpond becomes necessary, that a sediment monitoring system is established and communicated to the MRC including the timing of any planned scouring events.

Dolphin

- The implementation of internationally accepted guidelines for future seismic surveys conducted as part of the design phase of the DSHPP.
- A monitoring plan with exclusion zones should be developed based on sound propagation studies undertaken at the start of construction.
- The impacts on the local dolphin population should be monitored, preferably through an independent environment and social office part funded by the developer.

Ecological

- The developer should map the terrestrial and riparian habitat in the area to determine the proportion of the different habitats that would be lost through development of the DSHPP.
- Integrated monitoring of water quality, flows, hydraulics and habitats and ecosystem health is recommended, and that this should become part of the PWUM.

7.3.2 Strategic recommendations

In addition to the recommendations made in the Expert Group Reports with respect to expanded and improved design and monitoring programmes, the Joint Committee may wish to consider;

- Extending the Prior Consultation period by some months to process and report on the fisheries data collected during 2014, and sediment modelling. This period could also be used to engage the stakeholders with regard to the conclusions in this Technical Review Report.
- Preparatory work, modelling (especially physical modelling of the dam and hydraulic modelling of bypass channels, and sediment transport modelling of the headpond) and monitoring may continue during this period, pending the results of a review of the fish passage data collected during 2014 and more detailed hydraulic modelling, and that these data are used to improve fish passage designs;
- As with the Nam Theun 2 hydropower project, a mechanism to address Social and Environmental issues with independent oversight may be established. This may be staffed by experts from all the Member Countries. The funding intended for monitoring purposes and the dolphin conservation efforts be used to part fund this office. (Noting that both the FEG and DEG have indicated that the funding currently proposed by the developer is inadequate). The quasi- independent nature of this office would place it in a position to seek additional sources of funding to carry out its duties, and to align with other fisheries and dolphin conservation efforts.
- To recommend that provision of Water and Sanitation Services be expanded to directly affected fishing villages further upstream in Lao PDR, and downstream into Cambodia to increase the benefits to those likely to be directly affected by the project.
- Potential cumulative impacts are analysed in more detail as described in this report.

7.4 Way forward

This draft of the Technical Review Report was submitted to the JCWG for comment on 16 January 2015.

Agreed amendments and edits were included in the final version submitted to the Joint Committee for discussion at their special session on prior consultation on the DSHPP.

The JC were unable to reach agreement at the special session, and referred the matter to the Council for resolution. It was also noted that the opinions expressed in the Technical Review Report did not necessarily reflect the positions of the Member Countries, and that they may wish to provide a separate opinion to be uploaded to the MRC website (www.mrcmekong.org/news-and-events/consultations/don-sahong-hydropower-project- *Opinions and comments by NMCs after the Special Session of the Joint Committee on the Don Sahong Hydropower Project held on 28 January 2015*).