

# Environmental Management Plan

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January 2014

Lao People's Democratic Republic:  
Greater Mekong Subregion Tourism Infrastructure  
for Inclusive Growth Project

Subprojects in Luang Prabang Province

Prepared by the Ministry of Information, Culture and Tourism, Lao People's Democratic Republic, for the Asian Development Bank

## ABBREVIATIONS

ADB	Asian Development Bank
AH	affected household
BOD	biological oxygen demand
COD	chemical oxygen demand
DED	detailed engineering design
DPWT	Department of Public Works and Transport
DONRE	Department of Natural Resources and Environment
EA	environmental assessment
EA	executing agency
ECC	environmental compliance certificate
EIA	environment impact assessment
EMP	environment management plan
EMR	environmental monitoring report
EERT	external emergency response team
ERT	emergency response team
ERTL	emergency response team leader
EO	environmental officer
GMS	Greater Mekong Subregion
Government	Government of Lao PDR
GPS	global positioning system
IEE	initial environmental examination
MONRE	Ministry of Natural Resources and Environment
MPWT	Ministry of Public Works and Transport
O&M	operation and maintenance
PCU	project coordination unit
PIU	project implementation unit
SS	safeguard specialist
UDAA	urban development and administration authority
USD	United States Dollar
UXO	unexploded ordnance

## WEIGHTS AND MEASURES

km	Kilometre
kg	Kilogram
ha	Hectare
mm	Millimeter

## NOTES

In this report, "\$" refers to US dollars.

This environmental management plan is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

## TABLE OF CONTENTS

I.	INTRODUCTION	4
A.	Ban Xang Hai -Tham Ting Caves Access Improvements Subproject	4
B.	Chomphet Heritage District Access Improvements Subproject	5
II.	INSTITUTIONAL ARRANGEMENTS & RESPONSIBILITIES	5
A.	Organization of Management	5
B.	Worker and Community Health and Safety	8
C.	Regulatory Framework and Guidelines for Subproject	9
III.	SUMMARY OF POTENTIAL IMPACTS	9
A.	Public Consultation	11
1.	Follow-up Consultation	11
IV.	MITIGATION PLAN	11
V.	MONITORING PLAN	25
1.	Environmental Standards for Subproject Components	25
2.	Performance Monitoring	25
3.	Reporting	25
VI.	ESTIMATED COST OF EMP	29
VII.	EMERGENCY RESPONSE PLAN	29
A.	Alert Procedures	30
B.	Emergency Response Situations	31
VIII.	INSTITUTIONAL CAPACITY REVIEW AND NEEDS	33
	ANNEX 1: PROJECT MANAGEMENT ORGANIZATION IN LAO PDR	34
	ANNEX 2: INDICATIVE RESPONSIBILITIES OF KEY MANAGEMENT UNITS OF EMP	35
	ANNEX 3: INDICATIVE TOR FOR ENVIRONMENTAL SPECIALISTS OF DDSC	37
	ANNEX 4: REGULATORY FRAMEWORK FOR ENVIRONMENTAL PROTECTION	39
	ANNEX 5: ENVIRONMENTAL STANDARDS	42
	Table 1. Ban Xang Hai - Tham Ting Caves Access Improvements .....	4
	Table 2. Chomphet Heritage District Access Improvements.....	5
	Table 3: Regulations and Guidelines Applicable to Subprojects.....	9
	Table 4. Summary of Potential Environmental Impacts of Subprojects.....	10
	Table 5. Environmental Impact Mitigation Plan.....	12
	Table 6. Environmental Monitoring Plan.....	26
	Table 7. Performance Monitoring Indicators for Luang Prabang Subprojects .....	28
	Table 8: Estimated costs for Environmental Monitoring Plan of EMP .....	29
	Table 9: Roles and Responsibilities in Emergency Incident Response.....	29
	Table 10: Evacuation Procedure .....	31
	Table 11: Response Procedure during Medical Emergency .....	32
	Table 12: Response Procedure in Case of Fire.....	32
	Figure 1: Management framework for implementation of EMP .....	6

## I. INTRODUCTION

1. An environmental management plan (EMP) has been prepared for the two subprojects of Luang Prabang province defined by: 1) the Chomphet Heritage District Access Improvements subproject; and 2) the Ban Xang Hai – Tham Ting Caves Access Improvements subproject. The EMP is one of three provincial EMPs that have been prepared for the GMS Tourism Infrastructure for Inclusive Growth project (the project) in Lao PDR. The other two EMPs are for subprojects in the provinces of Oudomxay and Khammouane.

2. A single Initial Environmental Examination (IEE) was prepared for the three EMPs which is found under separate cover. Details of the subproject and the entire project in Lao PDR can be found in the parent IEE.

### A. Ban Xang Hai -Tham Ting Caves Access Improvements Subproject

3. The subproject is located at the Tham Ting Caves in Pak Ou District about 30 km upstream of Luang Prabang. The subproject will upgrade a 10 km access road to the ferry that takes tourists across the Mekong River to the Tham Ting caves, upgrade the tourist facilities at the cave including the ferry pier, and upgrade facilities in the two small villages of Ban Xang Hai and Ban Pak Ou. Table 1 reproduces the list of activities of the subproject from the IEE.

**Table 1: Ban Xang Hai - Tham Ting Caves Access Improvements**

<b>Activity</b>	<b>General Specifications</b>
Upgrade existing Xang Hai – Pak Ou access road	<ul style="list-style-type: none"> <li>• 10 km X 5–6 m carriageway</li> <li>• DBST surface standard</li> <li>• with viewing lay-bys</li> <li>• roadside drainage and culverts</li> </ul>
<b>In Ban Xang Hai:</b>	
Upgrade existing footpaths and drainage network	<ul style="list-style-type: none"> <li>• 1 km</li> </ul>
Construct new parking area	<ul style="list-style-type: none"> <li>• 4,000 m<sup>2</sup></li> </ul>
Rehabilitate existing concrete steps to 3 passenger piers	
Supply 3 new fabricated modular steel floating pontoons	<ul style="list-style-type: none"> <li>• with handrails and other safety features</li> </ul>
Construct new tourist information kiosk	
Install toilet blocks	<ul style="list-style-type: none"> <li>• with ABR system</li> </ul>
Install rubbish bins	
Install directional signage and information boards	
<b>In Ban Pak Ou:</b>	
Construct new parking area	<ul style="list-style-type: none"> <li>• 4,000 m<sup>2</sup></li> <li>• with toilet blocks</li> </ul>
Upgrade existing internal roads/footpaths with	<ul style="list-style-type: none"> <li>• 500 m</li> <li>• sealed gravel surface</li> </ul>
Install rubbish bins	
Install directional signage and information boards	
<b>At Tham Ting Cave:</b>	
Supply 2 new modular floating pontoons	<ul style="list-style-type: none"> <li>• with handrails and other safety features</li> </ul>
New ticket kiosks on pontoons	
Rehabilitate existing concrete steps and footpaths to lower and upper caves,	
Provide new electricity supply and lighting to caves	

Activity	General Specifications
Upgrade existing public toilet blocks	
Upgrade existing souvenir/handicraft kiosks at the upper cave	
Install rubbish bins	
Install signage and information boards	

## B. Chomphet Heritage District Access Improvements Subproject

4. The subproject is located in Chomphet District directly across the Mekong River from Luang Prabang town. The subproject consists of upgrades to the Mekong river ferry pier & access road, and various upgrades to tourist facilities in the villages of Ban Xieng Mene and Ban Chan Neua (Table 2).

**Table 2: Chomphet Heritage District Access Improvements**

Activity	General Specifications
<b>In Ban Xieng Mene:</b>	
Upgrade existing Mekong river vehicle ferry terminal ramp	<ul style="list-style-type: none"> <li>• 250m X 10m</li> <li>• concrete</li> <li>• with drainage and embankment retention</li> </ul>
Rehabilitate existing concrete paths and steps to passenger pier at the river	
Construct new tourism information kiosk	
Upgrade existing village road	<ul style="list-style-type: none"> <li>• 250m X 6m</li> <li>• to DBST standard</li> <li>• roadside drainage</li> </ul>
Construct new walking paths	<ul style="list-style-type: none"> <li>• 2.2 km</li> </ul>
Install 2 new public toilet blocks	<ul style="list-style-type: none"> <li>• with ABR system</li> </ul>
Upgrade other walking trails	
Rehabilitate 5 concrete river landings & steps to temples north of the village	
<b>In Ban Chan Neua:</b>	
Upgrade existing small passenger pier & footpaths	<ul style="list-style-type: none"> <li>• 500 m</li> </ul>
Construct new vehicle parking area with and male	<ul style="list-style-type: none"> <li>• 1,000 m<sup>2</sup></li> </ul>
Install new vendor kiosks	
Install new public toilet blocks	<ul style="list-style-type: none"> <li>• with ABR system</li> </ul>
Install directional signage and information boards	
Install rubbish bins	

## II. INSTITUTIONAL ARRANGEMENTS & RESPONSIBILITIES

### A. Organization of Management

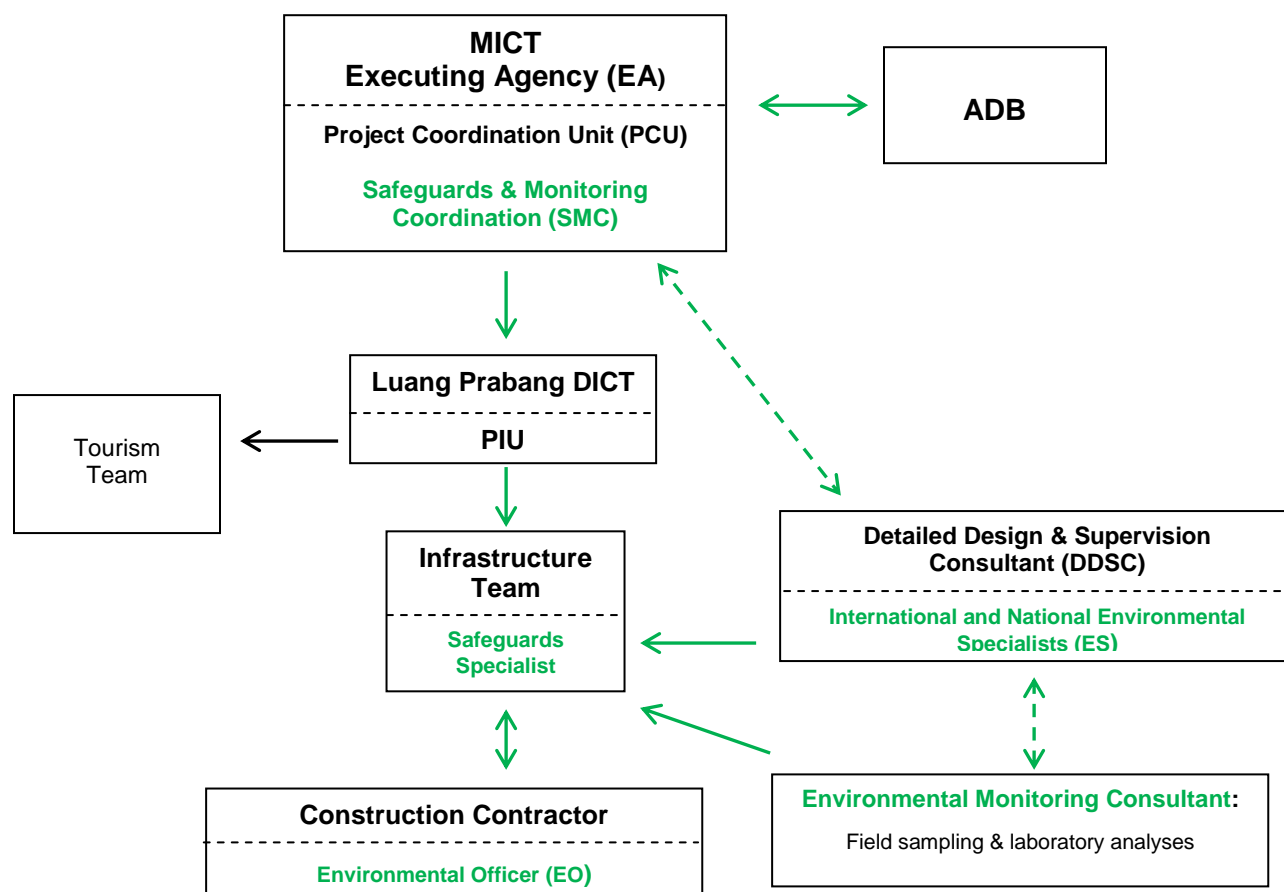
5. At the feasibility stage the primary management framework<sup>1</sup> responsible for the implementation of the environmental management plan (EMP) for Luang Prabang subprojects is summarized in Figure 1: Management framework for implementation of EMP which elaborates an excerpt of the full project management organization in Lao PDR (Annex 1).

<sup>1</sup> Adapted from the Project Administration Manual.

6. The Ministry of Information and Culture and Tourism (MICT) which is the executing agency (EA) for the project will take overall responsibility for successful implementation of the EMP. The EA will establish a Vientiane-based Project Coordination Unit (PCU) within the Tourism Development Department which, among other things, will provide Safeguards and Monitoring Coordination for the EMP. The provincial Department Information and Culture and Tourism (DICT) in which the project implementation unit (PIU) will be created, will implement the EMP with support from the PCU. The PIU will be comprised of two technical teams (Infrastructure and Tourism). The infrastructure team will be cross appointed from the Department of Public Works and Transport (DPWT). The infrastructure team will include a Safeguards Specialist who will lead the implementation of the EMP in conjunction with the Environmental Officer(s) (EO) of the construction contractor(s).

7. The Safeguards and Monitoring Coordination unit of the PCU will provide operational guidance to the PIU for implementation of the EMP, and will liaise with the ADB on safeguard reporting and issues. The Safeguards Specialist of the PIU will oversee the work of the EO of the contractor on the implementation of the CEMP<sup>2</sup> for the particular construction package.

**Figure 1: Management framework for implementation of EMP**



8. External support of the PIU for the implementation of the EMP will be provided by the International and National Environment Specialists (ES) of the Detailed Design and Supervision

<sup>2</sup> Contractor Environmental Management Plan prepared by contractor as part of bid documents based on updated EMP

Consultant<sup>3</sup> (DDSC), and an external Environmental Monitoring Consultant (EMC) which will be required to conduct the field sampling and laboratory analyses of field samples (e.g., water quality, air quality) that cannot be that cannot be performed by the contractor or PIU.

9. The responsibilities of the different agencies of the management framework in Figure 1 are listed in Annex 2. Found below is a summary of responsibilities for implementation of the EMP.

10. The responsibilities of the EA as supported by PCU include:

1. Provide coordination role for environmental and social safeguards and monitoring for PIU;
2. Liaise with ADB on the implementation of the EMP; and
3. Coordinate resolution with PIU, and ADB if necessary with issues arising from the implementation of EMP.

11. The responsibilities of the Safeguards Specialist (SS) of PIU include:

1. Initially assist DDSC with updating the EMP to meet final detailed subproject designs;
2. Notify DONRE to verify Government approvals of project are met, and that EMP compliant with Environmental Compliance Certificate (ECC) of project;
3. Assist DDSC with inclusion of CEMP requirements in contractor bid documents including bid evaluations based on updated EMP;
4. Undertake day to day management of EMP implementation activities;
5. Work with EMC on implementation of monitoring plan of EMP;
6. Ensuring compliance with loan covenants and assurances in respect of all subprojects, including EMPs (as well as IPPs, GAPs, resettlement plans);
7. Lead follow-up meetings with all affected stakeholders;
8. Prepare and submit quarterly reports on EMP implementation to PCU;
9. Oversee implementation of CEMP by contractor;
10. Coordinate with ES of DDSC for EMP implementation;
11. Undertake regular construction site inspections to ensure contractor implements CEMP properly; and
12. Ensure EO of contractor submits monthly reports on construction mitigations and monitoring.

12. The responsibilities of the ES of the DDSC are detailed in the Terms of Reference for the two positions in Annex 3. Key responsibilities for the EMP are listed below:

1. Updating the EMP to meet final detailed designs of subprojects;
2. Provide technical direction and support to PIU for implementation of EMP;
3. Oversee design and delivery of capacity development & training of PIU and EO of contractor(s);
4. Provide advice and support to EMC with their monitoring activities;
5. Review all reports prepared by PIU and EMC for PCU and ADB; and
6. Review location of any possible contaminated sites near subprojects.

13. The responsibilities of Environmental Officer (EO) of Contractor include:

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<sup>3</sup> DDSC to be defined.

1. Implement CEMP for construction phase of subprojects; and
  2. Prepare and submit monthly reports on mitigation and monitoring activities of CEMP and any environmental issues at construction sites.
14. The responsibilities of Environmental Monitoring Consultant (EMC) include:
1. Implement the environmental sampling required for monitoring plan of EMP that cannot be conducted by the contractor and PIU.
  2. Perform required laboratory analyses for monitoring program detailed in EMP; and
  3. Prepare and submit quarterly reports to PIU on monitoring activities.
15. The Department of Natural Resources and Environment (DONRE) is the provincial agency which oversees environmental management of Luang Prabang. The DONRE with District staff provides direction and support for environmental protection-related matters including application of the Law on Environmental Protection No. 02/99/NA (1999), EIA, and environmental standards.
16. The ADB provides guidance to EA/PCU with any issues related to EMP, and reviews biannual reports on EMP activities compiled and submitted by PCU.

## **B. Worker and Community Health and Safety**

17. Central to construction and operation phases of all subprojects is to ensure workers and the public are not harmed from construction activities and ultimately the operation of the completed subprojects.
18. Based on the New Global Strategies in Occupational Safety and Health (OSH) developed by the International Labour Organization (ILO) in 2003 the Ministry of Labour and Social Welfare (MLSW) of Government is currently developing the Lao PDR National OSH Programme<sup>4</sup>. To facilitate the development of the OSH the National Occupational Health & Safety Programme (2005-2010) was initiated.
19. The emerging OSH, *inter alia*, addresses worker and public safety in the construction and operation of small-medium enterprises and notably rural roads. The EA/PCU as supported by the PIUs must obtain and implement the directives of the OSH Programme. Pertinent associated laws and policy include the Labour Law of Lao PDR, and Decree No. 24/PR of the President of Republic, dated 21 April 1994, promulgating law No. 002/NA of 14 March 1994, concerning Labour. To supplement the OSH the IFC/World Bank Environment, Health, and Safety Guidelines (2007) should also be consulted the IFC EHS guidelines currently provide the international standard for worker and public safety.
20. DONRE with District staff provides direction and support for environmental protection-related matters including application of the Law on Environmental Protection No. 02/99/NA (1999), EIA, and environmental standards.
21. The ADB assists the PCU with timely guidance at each stage of project implementation following agreed implementation arrangements, review all documents that require ADB approval including environmental safeguards.

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<sup>4</sup> ILO. 2009. Asean-Oshnet, Occupational Safety and Health Practices.



### C. Regulatory Framework and Guidelines for Subproject

22. The complete list of environment-related laws and regulations of the Government are described in Annex 4. Applicable regulations and guidelines for the Luang Prabang subproject are summarized in Table 3. The regulations and guidelines, *inter alia*, identify how access road upgrades and Mekong river shoreline works should be implemented to prevent or minimize negative impacts on the environment.

**Table 3: Regulations and Guidelines Applicable to Subprojects<sup>5</sup>.**

<b>Road Upgrades</b>
<ul style="list-style-type: none"><li>• Lao PDR Road Design Manual with reference to AASHTO A Policy on Geometric Design of Highways and Streets, 5th edition.</li><li>• RDA's Lao Bridge Design Manual, 1998 with reference to AASHTO LRFD Bridge Design Specifications, 4<sup>th</sup>, Edition, 2007</li><li>• Transport Research Laboratory's (TRL) Road Note 31, 4th edition.</li><li>• Road Development Authority (RDA's) standards incorporating relevant standards from the AASHTO Highway Drainage Guidelines.</li><li>• MPWT (2006). Specifications for drainage system, culverts, street lighting and tree planting</li></ul>
<b>Mekong Riverbank Works</b>
<ul style="list-style-type: none"><li>• The Manual and Study on Mekong Riverbank Protection around the Vientiane Municipality, Lao PDR. Draft Final Report. JICA September 2004</li><li>• California Bank and Shore Rocks Slope Protection Design, Practitioner's Guide and Field Evaluations of Riprap Methods Final Report No. FHWA-CA-TL-95-10, Caltrans Study No.F90TL03, Third Edition - Internet October 2000, Prepared in Cooperation with the US Department of Transportation Federal Highway Administration</li><li>• Highway Design Manual, Chapter 870 Channel and Shore Protection Erosion Protection Control, 26 June, 2006.</li><li>• NRCS Stream Restoration Design Handbook, Stone Sizing Criteria, National Handbook, 210-NEH, August 2007.</li></ul>
<b>Occupational and Public Health and Safety</b>
<ul style="list-style-type: none"><li>• MSLW, Lao PDR Occupational, Safety, and Health Guidelines Programme, Draft 2005-2010</li><li>• IFC/World Bank, 2007. Environment, Health, and Safety Guidelines</li></ul>
<b>Environmental Standards</b>
<ul style="list-style-type: none"><li>• National Environmental Standard Order No. 2734/PMU-DONRE (2009): See Monitoring Plan (section V) below and Annex 5 for Government environmental standards.</li></ul>

### III. SUMMARY OF POTENTIAL IMPACTS

23. The potential impacts identified by the IEE of the two subprojects in Luang Prabang are summarized in Table 4.

24. The IEE indicates that potential impacts of the subproject at Ban Xang Hai – Tham Ting Caves concern the road upgrades between Ban Xang Hai and Ban Pak Ou villages, the minor civil works for the tourist facilities in both villages, the upgrades to the ferry piers at Ban Xang Hai village, and the upgrades to the pier, walkways, and facilities at the Tham Ting Caves. Potential environmental impacts of the subproject in Chomphet District focus on the upgrades to the ferry pier and tourist facilities at Ban Xiene Mene village in Chomphet district. The potential impacts of both subprojects are primarily construction-related and can be mitigated.

<sup>5</sup> Regulations and guidelines compiled by study from agencies, earlier IEEs, and internet.

25. The short-term construction-related upgrades to the roads, walkways, ferry piers, and tourist facilities of both subprojects require common mitigation measures. In addition to the short-term construction disturbances, road side vegetation will be removed for the widened access road. The widened carriageway will result in the loss of some trees, agricultural land for local residents. Loss of agricultural land is addressed by the social impact assessment and mitigation.

26. The potential impacts of the upgrades to tourist facilities at and inside the Tham Ting Caves including upgraded walkways, and rest areas are similar but much smaller in magnitude compared to the impacts of the access road upgrades to Ban Xang Hai and Ban Pak Ou villages. However, all subproject activities at and in front of the cave entrance will potentially disturb protected forest.

**Table 4: Summary of Potential Environmental Impacts of Subprojects**

<b>Pre-construction Phase</b>	
Ban Xang Hai -Tham Ting Caves Access Improvements Subproject	<ul style="list-style-type: none"> <li>Some loss of agriculture land along upgraded RoW of access road</li> </ul>
Chomphet Heritage District Access Improvements Subproject	<ul style="list-style-type: none"> <li>Temporary displacement of merchants in Xieng Mene village.</li> </ul>
<b>Construction Phase</b>	
Common potential impacts:	<ul style="list-style-type: none"> <li>Reduced and/or blocked public access, disrupted business and recreation, noise, dust and air pollution from NOx, SOx, &amp; CO caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, public and worker accidents, disruption of traffic, increased traffic accidents, land erosion and surface water sedimentation, drainage and flooding problems, solid and domestic waste from worker camps, social issues and community problems caused by migrant workers. These short-term impacts will vary in magnitude with construction activities of the different subprojects.</li> </ul>
Ban Xang Hai -Tham Ting Caves Access Improvements Subproject:	<ul style="list-style-type: none"> <li>Greater loss of vegetation agricultural land along the widened access road</li> <li>Disruption of the tourist elephant rides along access road</li> <li>Disruption of gillnet fishery in Mekong river primarily in front of Tham Ting Caves</li> <li>Increased turbidity and pollution of Mekong River caused by installation of floating pontoons and anchor systems, and discarded construction waste.</li> <li>Disruption of boat traffic in Mekong river, and tourists visits to caves</li> <li>Loss of trees of protected forest surrounding Tham Ting Caves</li> </ul>
Chomphet Heritage District Access Improvements Subproject	<ul style="list-style-type: none"> <li>Common construction impacts defined above impinge on objectives of development guidelines set out by the Department of Heritage for the UNESCO World Heritage Site (WHS).</li> <li>Increased turbidity and pollution of Mekong River caused by rehabilitation of passenger pier, and discarded construction waste.</li> </ul>
<b>Operation Phase</b>	
Ban Xang Hai -Tham Ting Caves Access Improvements Subproject	<ul style="list-style-type: none"> <li>Increased traffic on upgraded access road, risk of accidents, and air pollution</li> <li>Increased boat traffic on Mekong, disturbance to fishery, water pollution, and boat accidents</li> <li>Solid and domestic waste pollution due to insufficient garbage collection &amp; disposal, and un-maintained toilets and ABR septic systems.</li> </ul>
Chomphet Heritage District Access Improvements Subproject	<ul style="list-style-type: none"> <li>Increased boat traffic on Mekong, water pollution, and boat accidents</li> <li>Solid and domestic waste pollution due to insufficient garbage collection &amp; disposal, and un-maintained toilets and ABR septic systems.</li> </ul>

## **A. Public Consultation**

27. The stakeholder consultation strategy that was developed for the IEE will be continued with the start of the pre-construction phase of the subproject. The first step will be the disclosure of the IEE to the affected stakeholders identified in the IEE for their review and comment.

### **1. Follow-up Consultation**

28. As indicated in the IEE, the primary concern of the public and stakeholders of the subproject were disturbances during construction of the upgrades to roads, and the effect of the upgraded road on increased traffic, and traffic accidents. These issues plus any others will be reviewed during follow-up consultations throughout the pre-construction, construction, and operation of the completed subproject components.

## **IV. MITIGATION PLAN**

29. The mitigation measures of the EMP are presented in a comprehensive mitigation plan for the subproject in Table 5. Following the IEE, the mitigation plan is structured by the three development phases of the subproject defined by the pre-construction; construction; and post construction operational phase. The mitigation plan addresses the environmental issues and concerns raised at the stakeholder meetings.

30. The mitigation plan combines construction phase impacts common to all subproject components for which single mitigation measures are prescribed. In this way redundant mitigation measures are not re-stated numerous times. However, impacts and required mitigations specific to a subproject are also identified. Or, common mitigations that are particularly important for a subproject component are underscored.

31. The mitigation plan identifies potential impacts, required mitigations, responsible parties, location, timing, and indicative costs. The mitigation plan is comprehensive and will be updated to meet the final detailed designs of the subproject.

**Table 5: Environmental Impact Mitigation Plan**

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
Pre-Construction, Detailed Design Phase								
Confirmation of required resettlement, relocations, & compensation	No negative environmental impacts	1. Affected persons well informed well ahead of subproject implementation.	All affected persons in subproject areas	Before detailed designs initiated	See resettlement plans	See resettlement plan	PIU/SS	Resettlement committees
Disclosure, & engagement of community	No community impacts	2. Initiate Information Disclosure and Grievance process of IEE	For all construction sites.	Before detailed designs initiated	Quarterly	No marginal cost <sup>7</sup>	PIU/SS	PIU
Establish collaboration with Dept. of Heritage	No negative impact	3. Follow-up interim meeting with Department of Heritage in Luang Prabang to present detailed designs of subproject, to understand WHS development guidelines for subproject areas, and to establish working group for implementation of Chomphet Heritage District subproject.	All sites	Before detailed designs initiated	As required	No marginal cost	DDSC/PIU	DDSC/PIU
Recruit cave development consultant	No negative impact	4. Source and procure a cave specialist knowledgeable of Lao caves to assist with design of walkways and lighting in Tham Ting caves	Vientiane / Ban Pak Ou	Before detailed designs initiated	Single report , for detailed designs	tbd	DDSC/PIU	PIU
Government approvals	No negative impact	5. Notify DONRE of subproject initiation to complete EA requirements, and obtain required project permits and certificates.	Entire subproject	Before construction	As required	No marginal cost	PIU/DONRE	DONRE
Contact Elephant Asia	No negative impact	6. Obtain guidance on best surface for upgraded road b/n Ban Xang Hai and Ban Pak Ou and whether proposed DBST could become too hot, and maximum car and truck speed limits for elephants to use road safely.	Ban Xang Hai and Ban Pak Ou	once	once	No marginal cost	DDSC/PIU	PIU
Contact tourist company who provides elephant rides	No negative impact	7. Inform tourist company of locations and schedule and of construction works on access road	Pak Ou & Xang Hai	Before construction	As required	No marginal cost	DDSC/PIU	DDSC/PIU
Detailed designs of subproject.	Minimize negative environmental	8. Work by DDSC <sup>8</sup> to complete detailed designs of all components of both subprojects. Ensure the following measures are included:	Final siting	Before construction initiated	Once with detailed designs	No marginal cost	DDSC	EA/PIU

<sup>6</sup> Costs will need to be updated during detailed design phase.

<sup>7</sup> No marginal cost indicates that costs to implement mitigation are to be built into cost estimates of bids of contractors

<sup>8</sup> DDSC is detailed design and supervision consultant to be determined

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
	impacts	a) identification of spill management prevention plans, and emergency response plans for all construction sites; b) no disturbance or damage to culture property and values; c) minimal acquisition of agriculture and forested lands, no cutting of trees in protected forest; d) locate aggregate borrow pits and rock supply areas away from human settlements with fencing and access barriers; e) no, or minimal disruption to village water supplies along access roads, utilities, and electricity with contingency plans for unavoidable disruptions; f) no, or minimal disruption to normal pedestrian and vehicle traffic along all road segments with contingency alternate routes; g) for village areas include specific plan to notify & provide residents and merchants of construction activities & schedule to minimize disruption to normal commercial and residential activities.			documents			
Update EMP	Positive environmental impacts	9. Review final RoW of access road between Ban Xang Hai & Ban Pak Ou to confirm absence of valued ecological or cultural resources including aquatic biota in stream crossings. 10. Identify any new potential impacts of subprojects and include in EMP with special attention to all affected villages and tourist reception areas. 11. Re-clarify with DONRE that no known rare or endangered species inhabit the subproject areas 12. Confirm all ABR drainage field locations, and septage disposal site with DONRE 13. Update mitigation measures and monitoring requirements of EMP where necessary to meet detailed designs, and to protect affected environments. 14. Submit updated EMP with new potential	All sites	Before construction initiated	Once with detailed designs documents	No marginal cost	DDSC	EA/PIU

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		impacts to ADB to review. 15. Develop individual management sub-plans for: a) Construction drainage; b) Erosion; c) Noise and Dust; d) Contaminated Spoil Disposal; e) Solid and Liquid Waste Disposal; f) Construction & Urban Traffic; g) Utility and Power Disruption; h) Worker and Public Safety; i) Tree and Vegetation Removal and Site Restoration; j) Construction Materials Acquisition, Transport, & Storage, and k) Cultural chance finds.						
Update EMP	Positive environmental impacts	16. Obtain, review, and incorporate any extra mitigations required to satisfy the WHS development guidelines obtained from Dept. of Heritage in Luang Prabang	All sites	Before construction initiated	Once with detailed designs documents	No marginal cost	DDSC	EA/PIU
Confirm Government approved construction waste disposal sites	No negative impact	17. Notify DONRE, DAF, DPWT to confirm locations of sites for borrow pits and disposal areas for construction and hazardous waste for subprojects, and obtain required permits.	Entire subproject	Before construction	As required	No marginal cost	PIU/DONRE/DAF/DPWT	PIU
UXO survey, & removal	Injured worker or public	18. Ensure Government and UXO LAO is consulted and clears areas where necessary	All construction sites.	Beginning of subproject	Once	See Monitoring Plan below	EA/PIU	UXO LAO
Create awareness of physical cultural resources in area	No negative environmental impact	19. DICT to review potential locations of physical resources, and explain possible PCR to contractors and DDSC	All subproject areas	Before construction begins	Once	No marginal cost	DICT	DICT
Develop bid documents	No negative environmental impact	20. Ensure updated EMP is included in contractor tender documents, and that tender documents specify requirements of the CEMP must be budgeted. 21. Specify in bid documents that contractor must have experience with implementing EMPs, or provide staff with the experience.	All subproject areas	Before construction begins	Once for all tenders	No marginal cost	DDSC	PIU
Obtain & activate permits and licenses	Prevent or minimize impacts	22. Contractors to comply with all statutory requirements set out by Government for use of construction equipment, and operation construction plants such as concrete batching.	For all construction sites	Beginning of construction	Once	No marginal cost	DDSC	PIU & contractors

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
Capacity development	No negative environmental impact	23. Develop and schedule training plan for (PIU/SS) to be able to fully implement EMP, and to manage implementation of mitigation measures by contractors. 24. Create awareness and training plan for contractors whom will implement mitigation measures.	All subproject areas	Before construction begins	Initially, refresher later if needed	No marginal cost	DDSC	DDSC
Recruitment of workers	Spread of sexually transmitted disease	25. Use local workers as much as possible thereby reducing number of migrant workers	All work forces.	Throughout construction phase	Worker hiring stages	No marginal cost	EA/PIU	Contractor's bid documents
<b>Construction Phase of Subproject Components</b>								
Initiate EMP & sub-plans,	Prevent or minimize impacts	26. Initiate updated EMP & CEMP including individual management sub-plans for different potential impact areas that are completed in pre-construction phase (see sub-plan guidance below).	For all construction sites	Beginning of construction	Once	No marginal cost	DDSC	PIU & contractors
Cave walkways and lighting	Prevent unnecessary impact on cave wildlife and geology	27. Initiate construction of specially designed cave walkways & installation of cave lighting	Inside Tham Ting caves	Beginning of construction	Once	No marginal cost	DDSC	PIU & contractors
Worker camps	Pollution and social problems	28. Locate worker camps away from human settlements. 29. Ensure adequate housing and waste disposal facilities including pit latrines and garbage cans. 30. A solid waste collection program must be established and implemented that maintains a clean worker camps 31. Locate separate pit latrines for male and female workers away from worker living and eating areas. 32. A clean-out or infill schedule for pit latrines must be established and implemented to ensure working latrines are available at all times. 33. Worker camps must have adequate drainage. 34. Local food should be provided to worker camps. Guns and weapons not allowed in	All worker camps	Throughout construction phase	Monthly	No marginal cost	DDSC/PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		camps. 35. Transient workers should not be allowed to interact with the local community. HIV Aids education should be given to workers. 36. Camp areas must be restored to original condition after construction completed.						
Training & capacity	Prevent of impacts through education	37. Implement training and awareness plan for PIU/SS and contractors.	PIU office, construction sites	Beginning of construction	After each event	No marginal cost	DDSC	DDSC/PIU
Implement construction materials acquisition, transport, and storage sub-plan	Pollution, injury, increased traffic, disrupted access	38. All borrow pits and quarries should be approved by DONRE. 39. Select pits and quarries in areas with low gradient and as close as possible to construction sites. 40. Required aggregate volumes must be carefully calculated prior to extraction to prevent wastage. 41. Pits and quarries should not be located near surface waters, forested areas, critical habitat for wildlife, or cultural property or values. 42. If aggregate mining from fluvial environments is required small streams and rivers should be used, and dry alluvial plains preferred. 43. All topsoil and overburden removed should be stockpiled for later restoration. 44. All borrow pits and quarries should have a fence perimeter with signage to keep public away. 45. After use pits and quarries should be dewatered and permanent fences installed with signage to keep public out, and restored as much as possible using original overburden and topsoil. 46. Unstable slope conditions in/adjacent to the quarry or pit caused by the extractions should be rectified with tree planting. 47. Define & schedule how materials are extracted from borrow pits and rock quarries, transported, and handled & stored at sites. 48. Define and schedule how fabricated materials such as steel, wood structures, and	For all construction areas.	Throughout construction phase	Monthly	No marginal cost	DDSC/PIU	contractor



Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		scaffolding will transported and handled. 49. All aggregate loads on trucks should be covered. .						
DBST production, and application	Air pollution, land and water contamination, and traffic & access problems,	50. Piles of aggregates at sites should be used/or removed promptly, or covered and placed in non-traffic areas 51. Store DBST materials well away from all human activity and settlements, and cultural (e.g., schools, hospitals), and ecological receptors. Bitumen production and handling areas should be isolated. 52. Contractors must be well trained and experienced with the production, handling, and application of bitumen. 53. All spills should be cleaned immediately and handled as per hazardous waste management plan, and according to Government regulations. 54. Bitumen should only be spread on designated road beds, not on other land, near or in any surface waters, or near any human activities. 55. Bitumen should not be used as a fuel.	For all construction areas.	Throughout construction phase	Monthly	No marginal cost	DDSC & PIU	contractor
Implement spoil management sub-plan	Contamination of land and surface waters from excavated spoil, and construction waste	56. Uncontaminated spoil to be disposed of in Government-designated sites, which must never be in or adjacent surface waters. Designated sites must be clearly marked and identified. 57. Spoil must not be disposed of on sloped land, near cultural property or values, ecologically important areas, or on/near any other culturally or ecologically sensitive feature. 58. Where possible spoil should be used at other construction sites, or disposed in spent quarries or borrow pits. 59. A record of type, estimated volume, and source of disposed spoil must be recorded. 60. Contaminated spoil disposal must follow Government regulations including handling,	All excavation areas	Throughout construction phase	Monthly	See Monitoring Plan for contaminated soil analyses	DDSC & PIU & DONRE	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		<p>transport, treatment (if necessary), and disposal.</p> <p>61. Suspected contaminated soil must be tested, and disposed of in designated sites identified as per Government regulations.</p> <p>62. Before treatment or disposal contaminated spoil must be covered with plastic and isolated from all human activity.</p>						
Implement solid and liquid construction waste sub-plan	Contamination of land and surface waters from construction waste	<p>63. Management of general solid and liquid waste of construction will follow Government regulations, and will cover, collection, handling, transport, recycling, and disposal of waste created from construction activities and worker force.</p> <p>64. Areas of disposal of solid and liquid waste to be determined by Government.</p> <p>65. Disposed of waste should be catalogued for type, estimated weigh, and source.</p> <p>66. Construction sites should have large garbage bins.</p> <p>67. A schedule of solid and liquid waste pickup and disposal must be established and followed that ensures construction sites are as clean as possible.</p> <p>68. Solid waste should be separated and recyclables sold to buyers in community.</p> <p><u>Hazardous Waste</u></p> <p>69. Collection, storage, transport, and disposal of hazardous waste such as used oils, gasoline, paint, and other toxics must follow Government regulations.</p> <p>70. Wastes should be separated (e.g., hydrocarbons, batteries, paints, organic solvents)</p> <p>71. Wastes must be stored above ground in closed, well labeled, ventilated plastic bins in good condition well away from construction activity areas, all surface water, water supplies, and cultural and ecological sensitive receptors.</p> <p>72. All spills must be cleaned up completely with all contaminated soil removed and handled</p>	All construction sites and worker camps	Throughout construction phase	Monthly	No marginal cost	DDSC & PIU & DONRE	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		with by contaminated spoil sub-plan.						
Implement Noise and dust sub-plan	Dust Noise	73. Regularly apply wetting agents to exposed soil and construction roads. 74. Cover or keep moist all stockpiles of construction aggregates, and all truck loads of aggregates. 75. Minimize time that excavations and exposed soil are left open/exposed. Backfill immediately. 76. As much as possible restrict working time between 07:00 and 17:00. In particular are activities such as pile driving. 77. Maintain equipment in proper working order 78. Replace unnecessarily noisy vehicles and machinery. 79. Vehicles and machinery to be turned off when not in use. 80. Construct temporary noise barriers around excessively noisy activity areas where possible.	All construction sites.	Fulltime	Monthly	No marginal cost	DDSC & PIU	contractor
Implement utility and power disruption sub-plan	Loss or disruption of utilities and services such as water supply and electricity	81. Develop carefully a plan of days and locations where outages in utilities and services will occur, or are expected. 82. Contact local utilities and services with schedule, and identify possible contingency back-up plans for outages. 83. Contact affected community to inform them of planned outages. 84. Try to schedule all outages during low use time such between 24:00 and 06:00.	All construction sites.	Fulltime	Monthly	No marginal cost	DDSC & PIU & Utility company	contractor
Implement tree and vegetation removal, and site restoration sub-plan	Damage or loss of trees, vegetation, and landscape	85. Contact provincial forestry department for advice on how to minimize damage to trees and vegetation, and to work in protected forest at Xang Cave. No tree removal in protected forest 86. Restrict tree and vegetation removal to within RoWs. 87. Within RoWs minimize removals, and install protective physical barriers around trees that do not need to be removed. 88. All RoWs to be re-vegetated and landscaped	All construction sites.	Beginning and end of subproject	Monthly	No marginal cost	DDSC & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		after construction completed. Consult provincial forestry department to determine the most successful restoration strategy and techniques. Aim to replant three trees for each tree removed.						
Implement erosion control sub-plan	Land erosion	89. Berms, and plastic sheet fencing should be placed around all excavations and earthwork areas. 90. Earthworks should be conducted during dry periods. 91. Maintain a stockpile of topsoil for immediate site restoration following backfilling. 92. Protect exposed or cut slopes with planted vegetation, and have a slope stabilization protocol ready. 93. Re-vegetate all exposed soil immediately after activity is completed.	All construction sites	Throughout construction phase	Monthly	No marginal cost	DDSC & PIU	contractor
Implement worker and public safety sub-plan	Public and worker injury, and health	94. Proper fencing, protective barriers, and buffer zones should be provided around all construction sites. 95. Sufficient signage and information disclosure, and site supervisors and night guards should be placed at all sites. 96. Worker and public safety guidelines Government should be followed (Lao PDR OSH Programme section III) . 97. Population near blast areas should be notified 24 hrs ahead, and evacuated well before operation. Accepted Government blast procedures and safety measures implemented. 98. Speed limits suitable for the size and type of construction vehicles, and current traffic patterns should be developed, posted, and enforced on all roads used by construction vehicles. 99. Standing water suitable for disease vector breeding should be filled in. 100. Worker education and awareness seminars for construction hazards should be given at beginning of construction phase, and at ideal	All construction sites.	Fulltime	Monthly	No marginal cost	DDSC & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		<p>frequency of monthly. A construction site safety program should be developed and distributed to workers.</p> <p>101. Appropriate safety clothing and footwear should be mandatory for all construction workers.</p> <p>102. Adequate medical services must be on site or nearby all construction sites.</p> <p>103. Drinking water must be provided at all construction sites.</p> <p>104. Sufficient lighting is used during necessary night work.</p> <p>105. All construction sites should be examined daily to ensure unsafe conditions are removed.</p>						
Civil works	Degradation of water quality & aquatic resources	<p>106. Protective coffer dams, berms, plastic sheet fencing, or silt curtains should be placed between all earthworks and surface waters.</p> <p>107. Erosion channels must be built around aggregate stockpile areas to contain rain-induced erosion.</p> <p>108. Earthworks should be conducted during dry periods.</p> <p>109. All construction fluids such as oils, and fuels should be stored and handled well away from surface waters.</p> <p>110. No waste of any kind is to be thrown in surface waters.</p> <p>111. No washing or repair of machinery near surface waters.</p> <p>112. Pit latrines to be located well away from surface waters.</p> <p>113. No unnecessary earthworks in or adjacent to water courses.</p> <p>114. No aggregate mining from rivers or lakes.</p> <p>115. All irrigation canals and channels to be protected the same way as rivers, streams, and lakes</p>	All construction sites	Throughout construction phase	Monthly	No marginal cost	DDSC & PIU	contractor
Civil works	Degradation of terrestrial resources	116. All construction sites should be located away forested or all plantation areas as much as possible.	All construction sites	Throughout construction phase	Monthly	No marginal cost	DDSC & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		117.No unnecessary cutting of trees. No tree removal in protected forest at Than Ting Caves 118.All construction fluids such as oils, and fuels should be stored and handled well away from forested and plantation areas. 119.No waste of any kind is to be discarded on land or in forests/plantations.						
Civil works: Cultural chance finds sub-plan	Damage to cultural property or values, and chance finds	120.As per detailed designs all civil works should be located away from all cultural property and values.. DICT identified potential sites and types of PCR in pre-con phase. 121.Chance finds of valued relics and cultural values should be anticipated by contractors. Site supervisors should be on the watch for finds. 122.Upon a chance find all work stops immediately, find left untouched, and PIU notified to determine if find is valuable. Culture section of DICT notified by telephone if valuable. 123.Work at find site will remain stopped until DICT allow work to continue.	All construction sites	At the start , and throughout construction phase	Monthly	No marginal cost	DDSC & PIU	contractor
Implement Construction and urban traffic sub-plan	Traffic disruption, accidents, public injury	124.Schedule construction vehicle activity during light traffic periods. Create adequate traffic detours, and sufficient signage & warning lights. 125.Post speed limits, and create dedicated construction vehicle roads or lanes. 126.Inform community of location of construction traffic areas, and provide them with directions on how to best co-exist with construction vehicles on their roads. 127.Demarcate additional locations where pedestrians can develop road crossings away from construction areas. 128.Increase road and walkway lighting.	All construction sites	Fulltime	Monthly	No marginal cost	DDSC & PIU	contractor
Implement Construction Drainage sub-plan	Loss of drainage & flood storage	129.Provide adequate short-term drainage away from construction sites to prevent ponding and flooding. 130.Manage to not allow borrow pits and quarries	All areas with surface waters	Design & construction phases	Monthly	No marginal cost	DDSC & PIU	contractor

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
		to fill with water. Pump periodically to land infiltration or nearby water courses. 131. Install temporary storm drains or ditches for construction sites 132. Ensure connections among surface waters (ponds, streams) are maintained or enhanced to sustain existing storm water storage capacity. 133. Protect surface waters from silt and eroded soil.						
<b>Specific Mitigations for Civil Works for Upgrading of Ferry Piers on Mekong River</b>								
Shoreline works to upgrade piers	Erosion / Sedimentation	134. Implement subproject during the dry season 135. Isolate all digging or infilling away from river as much as possible, wet aggregate piles regularly, and cover until replaced, or removed. Use erosion berms, and install industrial silt curtain parallel in river to separate entire construction zone from river.	All pier sites	Throughout construction period	Monthly	No marginal cost	DDSC & PIU	contractor
Shoreline works to upgrade piers	Loss of nearshore aquatic habitat	136. Implement subproject during the dry season. Minimize in-river civil works	In river in front of pier areas	Throughout construction period	Monthly	No marginal cost	DDSC & PIU	contractor
Construction boat traffic on river	Disrupted community navigation & fishery, and increased collisions	137. Establish a well-marked, nearshore access lane for construction boat traffic away from gillnet fishing areas. Schedule construction boat during periods of low river traffic 138. Implement subproject during the dry season when gillnet fishery is suspended	In river in front of pier areas	Throughout construction period	Monthly	No marginal cost	DDSC & PIU	contractor
<b>Specific Mitigations for Upgrading Road between Ban Xang Hai and Ban Pak Ou</b>								
Civil works for road upgrades	Injury to elephants using road	139. Inform elephant camps of schedule of construction activities to enable camps to keep elephants away from construction areas. 140. After consultation with <i>Elephant Asia</i> select road surface that will not injury elephant feet such as mixture of gravel and bitumen in proposed DBST that can't become too hot, or insert dirt elephant crossover points in road.	Access road area	fulltime	As needed	No marginal cost	DDSC/PIU	SS

Subproject Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Location	Timing	Activity Reporting	Estimated Cost <sup>6</sup> (USD)	Responsibility	
							Supervision	Implementation
Specific Mitigations for Civil Works in Chomphet Heritage District								
Implementation of Subproject in Chomphet District	Possible oversight of WHS development guidelines	141.Obtain and integrate development guidelines for WHS into the mitigations which will be implemented as part of the EMP.	All sites of subproject	Throughout construction period	Monthly	No marginal cost	DDSC & PIU	contractor
Post-construction Operation of Upgraded Access Road between Ban Pak Ou and Ban Xang Hai Villages								
Operation of upgraded roads to Ban Xang Hai and Pak Ou villages	Increased risk of traffic accident or injury, including collisions with elephants.	142.Enforce well marked speed limits, provide guard rails along road where needed, and educate village communities on new road safety. 143.Place very visible signs indicating elephants share the road.	Upgraded road	Fulltime	Biannual	O&M	DPWT	
	Increased air pollution & noise	144.Ensure vehicles maintained in proper working condition	Upgraded road	Periodic checks	Biannual	O&M	DPWT	
Post-construction Operation of Improved Tourist Facilities at Subproject Sites								
Operation of improved tourist facilities	Solid and domestic waste pollution	145.Ensure ABR waste system is maintained with septage removed regularly and disposed in DONRE- approved areas. 146.Garbage bins must be emptied and garbage removed regularly, and disposed in DONRE- approved site	All improved tourist facilities	Regularly	Annually	O&M	DICT	
Post-construction Operation of Upgraded Ferry Piers on Mekong river								
Operation of ferry piers	Boat accidents due to increased traffic	147.Dedicated shoreline lanes should be set for ferry boats away from other boat traffic. Enforced speed limits for all boats should be posted in area	All upgraded pier sites	Fulltime	Biannual	O&M	DPWT	
Operation of ferry piers	Water pollution	148.Develop & enforce regulations that prevent Mekong ferry boat companies & operators from discharging waste oil and garbage into river. Boats should be inspected to ensure boats are in good working order.	Pak Ou and Chomphet Districts	Fulltime	Biannual	O&M	DPWT	



## **V. MONITORING PLAN**

32. The environmental monitoring plan for the EMP is provided in Table 6. The monitoring plan focuses on all three phases (pre-construction, construction, post-construction operation) of the subproject and consists of environmental indicators, the sampling locations & frequency, method of data collection, responsible parties, and estimated costs. The purpose of the monitoring plan is to determine the effectiveness of the impact mitigations, and to document any unexpected positive or negative environmental impacts of the subproject.

### **1. Environmental Standards for Subproject Components**

33. Environmental standards for ambient water quality in urban areas in Lao PDR are provided by the National Environmental Standard Order No. 2734/PMU-WREA (2009). The list of existing standards is found in Annex 5. The environmental standards provided by the Environmental, Health and Safety Guidelines of the IFC/World Bank (2007) (e.g., ambient air quality & noise) should be followed to supplement standards that are not provided by the Government.

34. An independent environmental monitoring consultant (EMC) will be required to implement the environmental monitoring program. The EMC will be responsible for the sampling of environmental parameters that must be analyzed in a laboratory. The SS and EO will coordinate with the EMC. The DDSC/PIU will provide logistical support to the EMC where necessary for the implementation of environmental monitoring plan.

35. After construction is completed and the upgraded access road, ferry piers, and tourist facilities at Ban Xang Hai - Ban Pak Ou villages, and Chomphet Heritage District are in operation the impact the road upgrades on traffic patterns and frequency of accidents should be monitored by the DICT with assistance from the DPWT. Similarly, the frequency of boat accidents near the upgraded piers should also be monitored DICT/DPWT. The natural environment of the cave should be monitored by the DICT. Monitoring of the success of the minor resettlement in the affected villages will be undertaken as part of the separate RAP prepared for the subproject.

### **2. Performance Monitoring**

36. Performance monitoring is required to assess the overall performance of the EMP. A performance monitoring system is normally developed by the EA for the entire subproject. Select indicators of major components of the environment that will be affected primarily by the construction phase are drawn from the mitigation and monitoring plans and summarized in Table 7.

### **3. Reporting**

37. Regular reporting on the implementation of mitigation measures, and on monitoring activities during construction phase of the subproject is required. Reporting is the responsibility of PIU and should be conducted in conjunction with regular meetings with stakeholders as part of the continuation of stakeholder communications. The mitigation and monitoring plans (Tables Table 5 and Table 6) summarize proposed timing of reporting. A report on environmental monitoring and implementation of EMP will be prepared quarterly for the EA/PCU by the PIU. The PIU report will compile monthly reports provided by the EO of contractor, the reports of the EMC on monitoring, and input from the ES of the DDSC. The PIU report will also be sent to the DONRE and the EA for consolidation and transmission to ADB. The reports will table all indicators measured with the monitoring plan of EMP including performance monitoring indicators (Table 7), and will include relevant Government environmental quality standards.

**Table 6: Environmental Monitoring Plan**

ENVIRONMENTAL EFFECTS MONITORING							
Environmental Indicators	Location	Means of Monitoring	Frequency	Reporting	Responsibility		Estimated Cost (USD)
					Supervision	Implementation	
Pre-construction Phase – Update Baseline Conditions							
Update baseline on sensitive receptors (e.g., cultural property & values, new schools or hospitals, rare/endangered species, critical habitat), and aquatic resources and human uses of Mekong river	A) Final RoWs for access road upgrades, and B) Tham Ting Caves area C) Mekong river from above Tham Ting caves downstream to below Ban Xieng Mene village	Original field work, community consultations	Once	Once	EA/PIU	Environmental Monitoring Consultant	\$3,500.
A) Air quality: dust, CO, NOx, SOx, noise, wind, temperature, and vibration levels B) Affected surface water quality: TSS, heavy metals (As, Cd, Pb,) oil and grease, pH, DO, COD, BOD <sub>5</sub> , temperature, TDS, NH <sub>3</sub> , NH <sub>4</sub> , other nutrient forms of N & P	A) In three villages  B) In Mekong pier at pier sites	Using field and analytical methods approved by DONRE.	One day and one night measurement during rainy & dry seasons.	One baseline supplement report before construction phase starts	PIU	Environmental Monitoring Consultant	A) \$2,000.  B) \$6,000.
Inventory of present and past land uses that could cause contaminated soil.	Possible contaminated lands at all excavation sites	Using field and analytical methods approved by DONRE.	Once	Once	PIU	Environmental Monitoring Consultant	\$1,000.
Construction Phase of Road Upgrades Between Ban Xang Hai and Ban Pak Ou Villages							
Analysis of soil quality (heavy metals (As, Cd, Pb, oil & grease, hydrocarbons).	Possible contaminated lands at all excavation sites	Using field and analytical methods approved by DONRE.	Once if needed	Once	PIU	Environmental Monitoring Consultant	\$2,500.
A) Air quality: dust, CO, NOx, SOx, noise, wind, temperature, and vibration levels B) Affected surface water quality: TSS, heavy metals (As, Cd, Pb,) oil and grease, pH, DO, COD, BOD <sub>5</sub> , temperature, TDS, NH <sub>3</sub> , NH <sub>4</sub> , other nutrient forms of N & P C) Analysis of soil quality (heavy metals (As, Cd, Pb, Hg, Mn), hydrocarbons.	A & B) Baseline sites of pre-construction phase.  C) At sites where contaminated soil is suspected.	A – C: Using field and analytical methods approved by DONRE.  Include visual observations of dust and noise from contractor & public reports.	(A – B): Quarterly during construction periods Daily visual records  C) Once at start of excavations	Monthly	(A - D):  PIU  Monitoring Consultant		A & B: \$15,000./yr  C: \$3,000./yr

ENVIRONMENTAL EFFECTS MONITORING							
Environmental Indicators	Location	Means of Monitoring	Frequency	Reporting	Responsibility		Estimated Cost (USD)
					Supervision	Implementation	D: \$0.0
					(E & F) & daily observations:		
					EA/PIU	contractor	E: \$1,500./yr F: \$0.0
D) Domestic (worker) and construction solid waste inside & outside construction sites including worker camps. E) Public comments and complaints  F) Incidence of worker or public accident or injury	D) All construction sites and worker camps  E) Using hotline number placed at construction areas  F) At all construction areas	D) Visual observation  E) Information transferred by telephone hotline number posted at all construction sites. F) regular reporting by contractors/PMU	D) Monthly  E) Continuous public input  F) Continuous				
G) Incidence of injury to elephants	Along entire access road	Information from elephant camp owners / DPWT	Continuous	Monthly	PIU/SS	contractor	No marginal cost
Construction of New Pier & Tourist Facilities at Tham Ting Caves & Ban Xang Hai							
Domestic (worker) and construction solid waste inside & outside construction sites including worker camps. Affected surface water quality: TSS, oil and grease, DO, COD, temperature, TDS, NH <sub>3</sub> , other nutrient forms of N & P	All construction sites at Tham Ting Caves	Using field and analytical methods approved by DONRE	Quarterly during construction periods with daily visuals	Monthly	PIU	Environmental Monitoring Consultant	\$8,000. yr
Operation of Upgraded Access Roads							
Air quality: dust, CO, NOx, SOx, noise and vibration levels	Baseline sites of pre-construction phase.	Using field and analytical methods approved by DONRE.	Quarterly for 5 years	Biannual	DPWT		\$5,000./yr
Traffic accidents	New or upgraded roads.	Regular record keeping.	Continuously	For each event	DPWT		\$0.0
Incidence of flooding	Adjacent to new or upgraded roads	Surveys, public complaints	Seasonal for 5 years	Seasonal	DPWT		\$1,000./yr
Road -related injuries of elephants	Along entire access road	Information from elephant camp owners / DPWT	Continuous	Quarterly	DPWT		\$500. / yr
Operation of Upgraded Tourist Facilities at Tham Ting Caves, Ban Xang Hai and Ban Pak Ou Villages, and Chomphet Heritage District							
Incidence of garbage and litter	Tourist reception areas and inside cave	Visual inspection	Weekly	Quarterly	MICT		O&M
Pollution caused by toilets and septic ABR: odor, fecal coliform bacteria, NH <sub>3</sub> , NH <sub>4</sub> , other nutrient forms of N & P	Near toilet blocks and infiltration fields	Smell, & Mekong river sampling	Biannually	Biannually	MICT/DONRE		\$5000./yr

**Table 7: Performance Monitoring Indicators for Luang Prabang Subprojects**

Major Environmental Component	Key Indicator	Performance Objective	Data Source
<b>Pre-construction Phase</b>			
Public Consultation & Disclosure	Affected public & stakeholders	Meetings with stakeholders contacted during IEE & new stakeholders convened for follow-up consultation & to introduce grievance mechanism	Minutes of meeting, and participants list
EMP	Updated EMP	All stakeholders contacted during IEE re-contacted for follow-up consultation	EMP
Bid Documents	Requirements of EMP (CEMP) <sup>9</sup>	EMP appended to bidding documents with clear instructions to bidders for CEMP	Bid documents
Training of PMU/PIU/SS	Training course(s) & schedule	By end of P-C phase, required course(s) that will be delivered are designed and scheduled	Course(s) outline, participants, and schedule
<b>Construction Phase</b>			
All subproject areas	Critical habitat, rare or endangered species, if present	All present critical habitat and R & E species if unchanged, and unharmed	Monitoring by EMC <sup>10</sup>
Affected water quality	TSS, DO, BOD, COD, pH, oil & grease, nutrient forms of T & N, metals (Pb, Fe, As) <sup>11</sup>	Government environmental standards & criteria met	Monitoring by EMC
Air quality	SOx, NOx, dust, CO, noise, vibration <sup>12</sup>	Levels never exceed pre-construction baseline levels	EMC & contractor monitoring reports,
Soil quality	Solid & liquid waste	Rigorous program of procedures & rules to collect and store all waste from construction camps and sites practiced.	Contractor and EMC monitoring reports
Hazardous materials & waste	Oil, gasoline, grease, alum, chlorine, soda	Rigorous program of procedures to manage and store all waste from construction camps and sites practiced.	Contractor and EMC monitoring reports
Public & worker safety	Frequency of injuries	Adherence to Government OSH Programme policy <sup>13</sup> and site-specific procedures to prevent accidents	Contractor reports
Cultural property	Incidence of damage, or complaints	No valued cultural property, or unearthed valuable relic is harmed in any way	Public input, contractor reports, public input, EMC reports
Traffic	Frequency of disruptions & blocked roadways	Disruptions, stoppages, or detours are managed to absolute minimum.	Public input, contractor reports, EMC reports
<b>Operation Phase of Upgraded Roads</b>			
Traffic safety	Frequency of accidents	No increase in pre-construction frequency	DPWT
Air quality	SOx, NOx, dust, , CO, noise along upgraded roads	Levels never exceed pre-construction baseline levels	MONRE,
Elephant Safety	Incidence of injuries / vehicle collisions	Zero incidence	DPWT / Elephant camps

<sup>9</sup> Contractor Environmental Management Plan developed from EMP in contractor bidding document

<sup>10</sup> Environmental Monitoring Consultant hired to assist implementation of Environmental Monitoring Plan

<sup>11</sup> See Annex 5 for environmental standards

<sup>12</sup> Footnote 11

<sup>13</sup> MLSW Government, Occupational Safety & Health Programme or IFC World Bank EHS (2007)

## VI. ESTIMATED COST OF EMP

38. The marginal costs for implementing the EMP are primarily for environmental monitoring because the costs for implementing impact mitigation measures are included with the construction costs in contractor bid documents. From Table 6 the preliminary costs for the implementation of the EMP for the Luang Prabang subprojects are summarized in Table 8. These costs include per diem technician fees. These costs include per diem technician fees. Note that contingencies have been provided to account for cost uncertainty to the total EMP cost

39. An estimated budget of USD \$15,000.00 is required for capacity building for environmental management in conjunction with other capacity development activities of the project such as occurring as part of Output 3. The costs will need to be updated by the DDSC in conjunction with the PIU during the pre-construction phase.

**Table 8: Estimated costs for Environmental Monitoring Plan**

Activity Type	Estimated Cost (USD)
Pre-construction Phase	
Updating Environmental Baseline	
cultural receptors	\$3,500.00
environmental quality	\$9,000.00
Construction Phase	
environmental quality	\$54,500.00
public consultation	\$3,000.00
Post-construction Operation Phase	
environmental quality	\$52,500.00
public input	\$5000.00
<b>Total</b>	<b>\$127,500.00</b>

## VII. EMERGENCY RESPONSE PLAN

40. The Contractor must develop emergency or incident response procedures during construction. In the operational phase the operator/civil authorities will have responsibility for any emergencies or serious incidents. The construction phase should ensure:

- i) Emergency Response Team (ERT) of the Contractor as initial responder;
- ii) District fire and police departments, emergency medical service, the Department of Public Health (DPH), collectively referred to as the External Emergency Response Team (EERT), as ultimate responders.

41. The Contractor will provide and sustain the required technical, human and financial resources for quick response during construction.

**Table 9: Roles and Responsibilities in Emergency Incident Response**

Entity	Responsibilities
Contractor Team (ERT)	<ul style="list-style-type: none"> <li>- Communicates / alerts the EERT.</li> <li>- Prepares the emergency site to facilitate the response action of the EERT, e.g., vacating, clearing, restricting site.</li> <li>- When necessary &amp; requested by the EERT, lends support / provides assistance during EERT's response operations.</li> </ul>
External Emergency Response Team (EERT)	<ul style="list-style-type: none"> <li>- Solves the emergency/incident</li> </ul>
Contractor Resources	<ul style="list-style-type: none"> <li>- Provide and sustain the people, equipment, tools &amp; funds necessary to ensure Subproject's quick response to emergency situations.</li> <li>- Maintain good communication lines with the EERT to ensure prompt help response &amp; adequate protection, by keeping them informed of</li> </ul>

Entity	Responsibilities
	Subproject progress.

42. The ERT will be led by the senior contractor engineer (designated ERTL) on site with a suitably trained foreman or junior engineer as deputy. Trained first-aiders and security crew will be the core members of the ERT.

43. The Contractor will ensure that ERT members are physically, technically and psychologically fit for their emergency response roles and responsibilities.

44. Prior to the mobilization of civil works, the Contractor, through its Construction Manager, ERTL, in coordination with the PCU/PIU, will meet with the ultimate response institutions to discuss the overall construction process, including, but not limited to:

- i) subproject sites;
- ii) construction time frame and phasing;
- iii) any special construction techniques and equipment that will be used;
- iv) any hazardous materials that will be brought to and stored in the construction premise and details on their applications and handling/management system;
- v) the Contractor's Emergency Management Plan
- vi) names and contact details of the ERT members

45. The objective of this meeting is to provide the ultimate response institutions the context for:

- i) their comments on the adequacy of the respective Emergency Management Plans
- ii) their own assessment of what types, likely magnitude and likely incidence rate of potential hazards are anticipated
- iii) the arrangements for coordination and collaboration.

46. To ensure effective emergency response, prior to mobilization of civil works, the Contractor will:

- i) set up the ERT;
- ii) set up all support equipment and facilities in working condition
- iii) made arrangements with the EERT;
- iv) conducted proper training of ERT members, and encouraged and trained volunteers from the work force; v) conducted orientation to all construction workers on the emergency response procedures and facilities, particularly evacuation procedures, evacuation routes, evacuation assembly points, and self-first response, among others; and vi) conducted drills for different possible situations.

47. To sustain effective emergency response throughout Subproject implementation an adequate budget shall be provided to sustain the capabilities and efficiency of the emergency response mechanism, the emergency response equipment, tools, facilities and supplies. Drills and reminders will take place regularly, the former at least every two months and the latter at least every month.

#### **A. Alert Procedures**

48. Means of communicating, reporting and alerting an emergency situation may be any combination of the following: i) audible alarm (siren, bell or gong); ii) visual alarm (blinking/rotating red light or orange safety flag); iii) telephone (landline); iv) mobile phone; v) two-way radio; and vi) public address system/loud speakers. Some rules relative to communicating/alerting will be:

- (i) Whoever detects an emergency situation first shall immediately :
  - call the attention of other people in the emergency site,
  - sound the nearest alarm, and/or
  - report/communicate the emergency situation to the ERT.
- (ii) Only the ERTL and, if ERTL is not available, the Deputy ERTL are authorized to communicate with the EERT. Exceptional cases to this rule may be necessary and should be defined in the Emergency Management Plans.
- (iii) When communicating/alerting an emergency to the EERT, it is important to provide them with at least: i) the type of emergency situation; ii) correct location of the emergency; iii) estimated magnitude of the situation; iv) estimated persons harmed; v) time it happened; vi) in case of a spill, which hazardous substance spilled; and vi) in case of fire and explosion, what caused it. Such details would allow the EERT to prepare for the appropriate response actions.

For an effective reporting/alerting of an emergency situation:

- (i) The names and contact details of the relevant persons and institutions should be readily available in, or near to, all forms of communication equipment, and strategically posted (at legible size) in all Subproject sites and vehicles:
  - Most relevant construction/operations staffs namely, the ERTL, Deputy ERTL, first-aiders, supervising engineers, foremen
  - EERT institutions/organizations
  - Concerned village authority/ies
  - PIU Office, SS
- (ii) All Subproject sites should have good access to any combination of audible and visual alarms, landline phones, mobile phones and two-way radio communication at all times.
- (iii) Contractor's construction vehicles should also be equipped with the appropriate communication facilities.

## B. Emergency Response Situations

The following tables suggest general procedures that will be refined in the final EMP during detailed design, and described in more detail in the Emergency Management Plans of the Contractor.

**Table 10: Evacuation Procedure**

Procedure	Remarks
<ul style="list-style-type: none"> <li>Move out as quickly as possible as a group, but avoid panic.</li> </ul>	<ul style="list-style-type: none"> <li>All workers/staff, sub-contractors, site visitors to move out, guided by the ERT.</li> </ul>
<ul style="list-style-type: none"> <li>Evacuate through the directed evacuation route.</li> </ul>	<ul style="list-style-type: none"> <li>The safe evacuation shall have been determined fast by the ERTL/Deputy ERTL &amp; immediately communicated to ERT members.</li> </ul>
<ul style="list-style-type: none"> <li>Keep moving until everyone is safely away from the emergency site and its influence area.</li> </ul>	<ul style="list-style-type: none"> <li>A restricted area must be established outside the emergency site, all to stay beyond the restricted area.</li> </ul>
<ul style="list-style-type: none"> <li>Once outside, conduct head counts.</li> </ul>	<ul style="list-style-type: none"> <li>Foremen to do head counts of their sub-groups; ERTL/Deputy ERTL of the ERT.</li> </ul>
<ul style="list-style-type: none"> <li>Report missing persons to EERT immediately.</li> </ul>	<ul style="list-style-type: none"> <li>ERTL/Deputy ERTL to communicate with the EERT.</li> </ul>
<ul style="list-style-type: none"> <li>Assist the injured in evacuation &amp; hand them over to the ERT first-aiders or EERT medical group</li> </ul>	<ul style="list-style-type: none"> <li>ERT to manage injured persons to ensure proper handling.</li> </ul>
<ul style="list-style-type: none"> <li>If injury warrants special care, DO NOT MOVE them, unless necessary &amp; instructed/directed by the EERT.</li> </ul>	<ul style="list-style-type: none"> <li>ERTL/Deputy ERTL communicates with EERT to get instructions/directions in handling the injured.</li> </ul>

**Table 11: Response Procedure during Medical Emergency**

<b>Procedure</b>	<b>Remarks</b>
<ul style="list-style-type: none"> <li>Administer First Aid regardless of severity immediately.</li> </ul>	<ul style="list-style-type: none"> <li>Fundamentals when giving First Aid:               <ul style="list-style-type: none"> <li>Safety first of both the rescuer and the victim.</li> <li>Do not move an injured person unless:                   <ul style="list-style-type: none"> <li>victim is exposed to more danger when left where they are, e.g., during fire, chemical spill</li> <li>it would be impossible for EERT to aid victims in their locations, e.g., under a collapsed structure</li> </ul> </li> <li>instructed or directed by the EERT.</li> </ul> </li> <li>First Aid to be conducted only by a person who has been properly trained in giving First Aid.</li> </ul>
<ul style="list-style-type: none"> <li>Call the EERT emergency medical services &amp;/or nearest hospital.</li> </ul>	<ul style="list-style-type: none"> <li>ERTL/Deputy ERTL or authorized on-site emergency communicator</li> </ul>
<ul style="list-style-type: none"> <li>Facilitate leading the EERT to the emergency site.</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>ERTL/Deputy ERTL to instruct:               <ul style="list-style-type: none"> <li>an ERT member on-site to meet EERT in access road/strategic location. He/she shall hold orange safety flag to get their attention &amp; lead them to site.</li> <li>Other ERT members to clear access road for smooth passage of the EERT.</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>If applicable, vacate site &amp; influence area at once, restrict site, suspend work until further notice.</li> </ul>	<ul style="list-style-type: none"> <li>Follow evacuation procedure.</li> </ul>

**Table 12: Response Procedure in Case of Fire**

<b>Procedure</b>	<b>Remarks</b>
<ul style="list-style-type: none"> <li>Alert a fire situation.</li> </ul>	<ul style="list-style-type: none"> <li>Whoever detects the fire shall immediately:               <ul style="list-style-type: none"> <li>call the attention of other people in the site,</li> <li>sound the nearest alarm, and/or</li> <li>Foreman or any ERT member among the construction sub-group contacts the fire department (in this case it should be agreed on that it is alright for any ERT member in the sub-group to alert the fire department)</li> <li>Report/communicate the emergency situation to the ERTL/Deputy ERTL.</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Stop all activities/operations and evacuate.</li> </ul>	<ul style="list-style-type: none"> <li>All (non-ERT) workers/staff sub-contractors, site visitors and concerned public to move out to safe grounds following the evacuation procedure.</li> </ul>
<ul style="list-style-type: none"> <li>Activate ERT to contain fire/control fire from spreading.</li> </ul>	<ul style="list-style-type: none"> <li>Guided by the training they undertook, ERT members assigned to mitigate the fire shall assess their own safety situation first before attempting to control fire spread.</li> </ul>
<ul style="list-style-type: none"> <li>Call the nearest fire &amp; police stations &amp;, if applicable, emergency medical services.</li> </ul>	<ul style="list-style-type: none"> <li>When alerting the EERT, ERTL will give the location, cause of fire, estimated fire alarm rating, any injuries.</li> </ul>
<ul style="list-style-type: none"> <li>Facilitate leading the EERT to the emergency site.</li> </ul>	<ul style="list-style-type: none"> <li>ERTL/Deputy ERTL to instruct:               <ul style="list-style-type: none"> <li>an ERT member to meet the EERT in the access road or strategic location and lead them to the site. He/she shall hold the orange safety flag to get their attention and lead them to the site.</li> <li>some ERT members to stop traffic in, &amp; clear, the access road to facilitate passage of the EERT.</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>ERT to vacate the site as soon as their safety is assessed as in danger.</li> </ul>	<ul style="list-style-type: none"> <li>Follow appropriate evacuation procedure.</li> </ul>



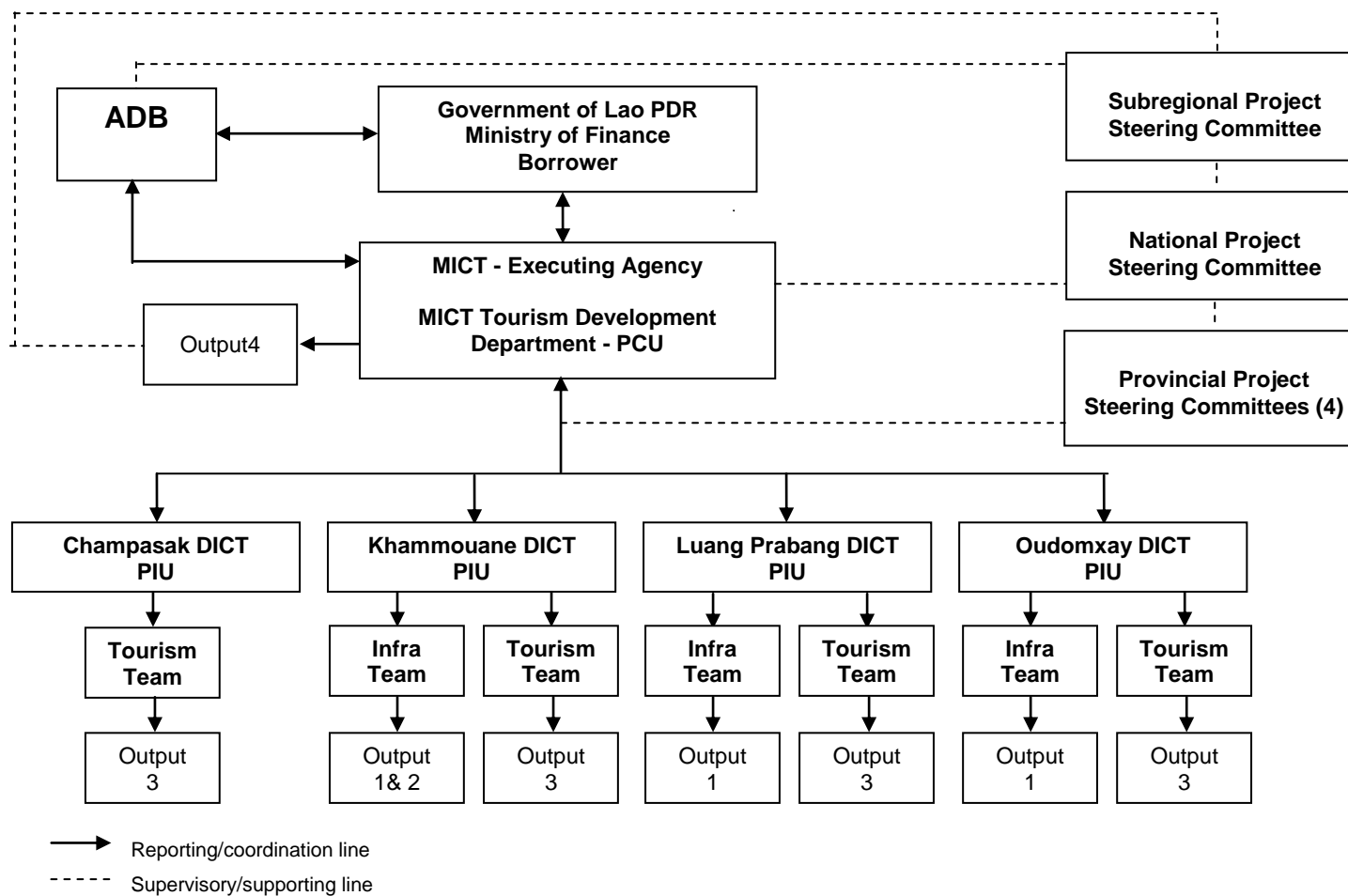
## **VIII. INSTITUTIONAL CAPACITY REVIEW AND NEEDS**

49. Currently there is little experience and capacity for environmental assessment and management amongst national counterparts responsible for the implementation of the EMP. i.e., DICT/PIU, and DPWT in Luang Prabang province. No dedicated environmental staff exist in the DICT and thus the PIU. The DDSC with assistance from the SS of the subproject will develop and deliver training courses to the DICT/PIU staff responsible for the implementation of the subproject. The purpose of the course(s) is to strengthen the ability of the PIU/PMU to oversee implementation of the EMP by construction contractors, and EMC

50. The SS who will be full-time environmental member of the PIU as well as the EO of the contractor should attend training courses as required. Costs for training should be included with costs for implementation of the EMP.

51. Training on the implementation of an EMP should address two thematic areas. The first area should be principles environmental management focused on the potential impacts of subproject activities on the natural and social environment. The second area should be environmental safeguard requirements of the ADB and Government with specific reference to the EMP.

## ANNEX 1: PROJECT MANAGEMENT ORGANIZATION IN LAO PDR



ADB = Asian Development Bank; DICT= Department of Information, Culture and Tourism; Infra = infrastructure; MICT = Ministry of Information, Culture and Tourism; PCU = project coordination unit; PIU = project implementation unit.

## ANNEX 2: INDICATIVE RESPONSIBILITIES OF KEY MANAGEMENT UNITS OF EMP

EMP Implementation organizations	Roles and Responsibilities
Executing agency (EA) (MICT)	<ul style="list-style-type: none"> <li>➤ Overall responsibility for the execution of the project</li> <li>➤ Reviews the project implementation progress</li> <li>➤ Reviews and endorses any proposed change in the project scope or implementation arrangements</li> <li>➤ Supervises compliance with loan covenants</li> </ul>
Project Coordination Unit (PCU), inside MICT	<ul style="list-style-type: none"> <li>➤ Project preparation, including the setting up of financial and management systems and procedures, and the procuring of PCU office equipment</li> <li>➤ Consultant recruitment and supervision</li> <li>➤ Review and approval of goods and civil works contracts, including bid documents</li> <li>➤ Coordination between the concerned agencies at the national and provincial levels</li> <li>➤ Coordination of activities of the PIUs and the inputs of concerned stakeholders</li> <li>➤ Coordination of all reporting aspects of the project</li> <li>➤ Coordination of institutional strengthening measures</li> <li>➤ Ensuring compliance with ADB Loan covenants, assurances and safeguard requirements, as well as with national and provincial policies and regulations</li> <li>➤ Provision of administrative and technical support to the PIUs</li> <li>➤ Preparation of consolidated Project accounts to be forwarded to ADB</li> <li>➤ Advice to PIUs on revenue-enhancing activities related to the recovery of costs of constructing, operating, and maintaining Project facilities and equipment;</li> <li>➤ Coordination of project audits</li> <li>➤ All specified monitoring, evaluation and reporting activities</li> <li>➤ Communication of Project's outcomes, outputs, and activities to all stakeholders</li> <li>➤ Provide coordination for safeguards and monitoring for PIU</li> </ul>
Provincial Project Steering Committee (PPSC)	<ul style="list-style-type: none"> <li>➤ Ensuring that concerns of all stakeholders are adequately reflected in the project</li> <li>➤ Coordination of project implementation between the concerned agencies</li> <li>➤ Confirming compliance with local regulations and provincial policies</li> <li>➤ Overseeing budgeting and disbursement of counterpart funds</li> <li>➤ Overseeing implementation of resettlement plans, compensation schemes and all other project safeguard procedures</li> </ul>
Project Implementation Units (PIUs) inside DICT	<ul style="list-style-type: none"> <li>➤ Coordination and supervision of consultants' inputs on the appraisal of feasibility studies, and conceptual and detailed designs construction</li> <li>➤ Procurement of goods and civil works contracts, including the preparation of bid documents and bid evaluations</li> <li>➤ Approving payments to contractors and maintaining disbursement records</li> <li>➤ Ensuring that institutional-strengthening and capacity-building initiatives involving DMOs, private partners, SMEs and CBTOS are implemented in line with agreed Project designs, schedules and budgets</li> <li>➤ Ensuring compliance with loan covenants and assurances in respect of all sub projects, including updating of IEEs, EMPs,</li> </ul>

<b>EMP Implementation organizations</b>	<b>Roles and Responsibilities</b>
	<p>IPPs, GAPS, resettlement plans</p> <ul style="list-style-type: none"> <li>➤ Oversee implementation of EMP by contractor EO, and EMC</li> <li>➤ Prepare quarterly reports on EMP implementation for PCU</li> <li>➤ Coordinate with DDSC to design and deliver capacity development &amp; training.</li> <li>➤ Coordinating the process of establishing appropriate cost-recovery mechanisms</li> <li>➤ Coordinating the implementation of identified Public-Private Partnership (PPP) initiatives;</li> <li>➤ Meetings with all concerned stakeholders</li> <li>➤ Quarterly progress and monitoring-and-evaluation reporting to the PCU</li> </ul>
Detailed Design & Supervision Consultant (DDSC)	<ul style="list-style-type: none"> <li>➤ Completes detailed designs of subprojects with PIU</li> <li>➤ Update EMP to meet final detailed designs of subprojects</li> <li>➤ Supervises and assists PIU with contractor management</li> <li>➤ Provides technical advice and support when needed to PIU and EMC</li> <li>➤ Designs and oversees delivery of all training and capacity development of PIU for construction and operation of completed subprojects including EMP.</li> <li>➤ Provides advisory role for implementation of EMP by PIU and EMC</li> </ul>
Environmental Monitoring Consultant (EMC)	<ul style="list-style-type: none"> <li>➤ Implements environmental sampling for EMP</li> <li>➤ Conducts laboratory analyses of environmental quality samples from field sampling</li> <li>➤ Prepares periodic monitoring reports for PIU</li> </ul>
Environmental Officer (EO) of Contractor	<ul style="list-style-type: none"> <li>➤ Implements the CEMP for the construction phase</li> <li>➤ Maintains a daily log of environmental issues at the construction sites</li> <li>➤ Prepares brief monthly summaries of mitigation activities and environmental issues at constructions site to PIU.</li> </ul>
ADB	<ul style="list-style-type: none"> <li>➤ Assists PCU through timely guidance at each stage of project implementation following agreed implementation arrangements</li> <li>➤ Review all documents that require ADB approval</li> <li>➤ Review of monitoring reports on EMP implementation to ensure EMP meets SPS (2009)</li> <li>➤ Approval of procurement activities</li> <li>➤ Periodic project review missions, a mid-term review and a completion mission for the project</li> <li>➤ Ensuring compliance of all loan covenants</li> <li>➤ Timely processing of withdrawal applications and release of eligible funds</li> <li>➤ Ensuring compliance of financial audit recommendations</li> <li>➤ Regularly updates project information disclosure on the ADB website</li> </ul>

### ANNEX 3: INDICATIVE TOR FOR ENVIRONMENTAL SPECIALISTS OF DDSC

**International Environmental Specialist.** With assistance from the national environmental specialist the international consultant will be responsible for updating the provincial EMPs at detailed design, and assisting the PIU with overall environmental management of the implementation of the subprojects in LAO. The consultant will: (i) update environmental management plans (EMP) for subprojects in Oudomxay, Luang Prabang, & Khammouane to ensure that EMPs address the detailed designs and engineering of subprojects. Updates to EMPs include mitigation and monitoring plans, budget, and capacity development needs of executing agency (EA/PCU) and PIUs (DICT / DPWT); (ii) with national consultant design comprehensive training plan for safeguards specialist/PIU and on principles of EIA, and the purpose, content, and roles and responsibilities for implementation of updated EMPs highlighting environmental issues of subprojects; (iii) ensure that all relevant safeguards of the EMPs are adequately addressed in the bidding documents (instruction to bidders), and in the evaluation criteria for awarding contracts; (iv) Coordinate and work with the PIUs to ensure that contractors finalize their respective site-specific CEMPs based on the updated EMPs and the actual site conditions; (v) oversee the implementation of all safeguards of the three EMPs relating to construction phase activities including handling of construction spoil and waste, water and air quality protection, public nuisance impacts (noise, dust, traffic, blocked access, workers, and camps), and public safety; (vi) Coordinate with the Department of Heritage in Luang Prabang to ensure UNESCO development guidelines are followed in Chomphet; (vii) coordinate with the three provincial Departments of Natural Resources & Environment (DONRE) on all relevant environmental regulatory compliance issues (e.g. noise and dust from construction sites, sanitation in workers campsite etc); (viii) prepare TOR(s) for the LAO UXO for the survey, detection, and removal of unexploded ordnance (UXO) at all civil works sites. Ensure that EA and/or PIUs consult LAO UXO and Government authorities to assist with ToR development and implementation; (ix) contact Asia Elephant Conservation to clarify road surface and walking space requirements for elephants at Ban Pak Ou and Ban Xang Hai in Luang Prabang; (x) with PIU/DPWTs, prepare TORs for the follow-up interviews and consultations with the same affected stakeholder and local residents contacted during the PPTA on issues and concerns arising during project construction. Of particular concern is upgrades to access roads; (xi) prepare TOR(s) for external national environment monitoring consultant (EMC) for conducting water and air quality sampling, and laboratory analyses for the monitoring plans for the provincial EMPs; (xii) coordinate with PWDTs to address vehicle traffic issues, respectively during road upgrades; (xiii) work with cave specialist as needed to identify least impact walkways and lighting inside Chom Ong Cave; (xiv) advise PIU/DPWTs on environment-related concerns arising during sub-projects construction, and recommend corrective measures; (xv) with PIU/DPWTs, ensure dissemination to stakeholders the results of environment quality monitoring and implementation of safeguards, especially among households or small businesses near the civil construction works areas; (xvi) assist EA and PIU/DPWTs prepare a table of contents for regular reports PIU must submit to the EA on implementation of EMPs, environmental issues, and corrective actions; (xvii) assist PIU/DPWTs prepare simple report template for construction contractors to report monthly on mitigation activities, and environmental issues that occur during construction phase; and (xviii) prepare a quarterly status report on implementation of EMPs, environmental issues, and public safety protection to be submitted through the PIU and EA to the provincial DONREs and ADB. The consultant should have an advanced degree in environmental sciences, and at least 7 years experience implementing and managing environmental assessment of infrastructure projects in southeast Asia countries (preferably Lao PDR). Other requirements include: a) understanding of ADB and national environmental safeguard requirements; b) experience working with and supervising the activities of provincial and national environmental management agencies with environmental safeguards; and c) designing and delivering training and capacity development programs to provincial environment, project implementing units.

**National Environmental Specialist.** Provide assistance to the international environmental specialist including acquisition of information new information to update the provincial EMPs at detailed design, and work with the PIU with overall environmental management of the

implementation of the subprojects in LAO. The national consultant will assist with: (i) updating environmental management plans (EMP) for subprojects in Oudomxay, Luang Prabang, & Khammouane to ensure that EMPs address the detailed designs and engineering of subprojects.; (ii) deliver initial training to M/DICT and DPWT on the purpose, content, and roles and responsibilities for implementation of updated EMPs; (iii) ensure relevant safeguards of the EMPs are addressed in the bidding documents in accurate local language and in evaluation criteria for awarding contracts; (iv) help PIUs to ensure that contractors prepare their respective site-specific plans based on the updated EMPs and the actual site conditions; (v) help international consultant oversee the implementation of all safeguards of the three EMPs relating to construction phase activities including handling of construction spoil and waste, water and air quality protection, public nuisance impacts (noise, dust, traffic, blocked access, workers, and camps), and public safety; (vi) assist coordination with the three provincial Departments of Natural resources & Environment (DONRE) on all relevant environmental regulatory compliance issues (e.g. noise and dust from construction sites, sanitation in workers campsite etc); (vii) with PIU/DPWTs, prepare ToRs for the follow-up interviews and consultations with the same affected stakeholder and local residents contacted during the PPTA on issues and concerns arising during project construction. Of particular concern is upgrades to access roads; (viii) assist DPWTs to address vehicle traffic issues, respectively during road upgrades; (ix) with international consultant advise the PIU/DPWTs on environment-related concerns arising during sub-projects construction, and recommend corrective measures; (x) with PIU/DPWTs, ensure dissemination to stakeholders the results of environment quality monitoring and implementation of safeguards, especially among households or small businesses near the civil construction works areas; (xi) assist with all reporting for the EMP. The consultant should have a university degree in the environmental sciences and at least 5 years experience with environmental assessment of infrastructure projects in Lao PDR) including: a) understanding of ADB and national environmental safeguard requirements; b) experience working with international consultants; and c) delivering training and capacity development programs to provincial project implementing units.

## ANNEX 4: REGULATORY FRAMEWORK FOR ENVIRONMENTAL PROTECTION

<b>Law or Decree</b>	<b>Article</b>	<b>Relating To</b>	<b>Content</b>
<i>Constitution of the Lao People's Democratic Republic (1991, amended 2003)</i>	17	Environment in general	"All organizations and citizens must protect the environment and natural resources: land, underground, forests, fauna, water sources and atmosphere."
<i>Environmental Protection Law (1999)</i>	5	Environment in general	Conservation takes priority over mitigation and restoration. Socio-economic development planning must include planning for environmental protection
<i>Environmental Protection Law (1999)</i>	8	EIA Process	MONRE is main agency to issue regulations for EIA. People affected by projects, mass organizations, and local administrations are to be involved in the EIA process
	10	Responsibility of those engaged in development works	Those engaged in development works must adhere to safeguards, and to standards and regulations issued by Government agencies
	14	Responsibility of those engaged in development works	Those engaged in development works must abide by laws on land, forests, water, etc.
	16	Responsibility toward cultural, historical, natural heritage sites	Those engaged in development works must abide by laws and regulations to protect such heritage sites
	22	Pollution control	All are responsible for control of pollution, and applying technologies appropriate to control such pollution
	23	Hazardous wastes / emissions	Restrictions to hazardous wastes and means to control such wastes and emissions
	28	Damage to environment	Those causing damage to environment are responsible for repair through appropriate Government agencies
	38, 39	Local environmental management and monitoring	Stipulates responsibilities of local administrations (provinces, municipalities, special districts, districts) to establish environmental management and monitoring units
	40	Local environmental responsibilities	Stipulates responsibilities of village administrations to follow environmental regulations

<b>Law or Decree</b>	<b>Article</b>	<b>Relating To</b>	<b>Content</b>
<i>Water and Water Resources Law (1996)</i>	4	Rights to use water resources	Defines rights, obligations, and procedures to gain approval for use of water resources
	18	Permission for use	Stipulates that medium and large scale uses require feasibility studies, EIAs, and mitigation plans, before permission is granted for use of the resource
	22	Principles in water resource development management	Stipulates that water resource development must be consistent with national and sector plans, must ensure preservation of the natural beauty of the resources, and must protect against harmful effects of water
<i>Water and Water Resources Law (1996)</i>	25	Promotion of Watershed and Water Resource Protection for Hydropower Development	Stipulates that 'hydropower projects must be developed with due concern for environmental protection, flood protection, water supply, irrigation, navigation, fisheries and others.'
	29	Water and water resource protection	Requires that water resources be protected from becoming spoilt, polluted, or drying up, and that forest and land resources be protected to help protect the water resources
<i>Lao Forestry Law (amended 2007)</i>	5	Policy on forest and forest land	The GOVERNMENT has the policy to preserve, regenerate, and develop forests and forest land to help preserve the environment, water resources, biodiversity, and people's livelihoods.
	9 to 13	Forest types	Classify the various types of forests according to use, including forests for village use
	26	Preservation of water resources in forest zones	Stipulates the preservation of water resources in forest zones for those areas where waterways originate and flow, including strict management and regulations to control logging, shifting cultivation, and destructive forest uses
	70	Conversion of forestland	Stipulates that forestland can be converted to other land type if it brings a high level of benefits to the nation and to livelihoods of the people, and is included in the national development plan
	71	Types of converted forestland	Stipulates that for uses such as dam construction, the timber and forest resources to be harvested in those areas are property of the State



<b>Law or Decree</b>	<b>Article</b>	<b>Relating To</b>	<b>Content</b>
<i>Wildlife and Aquatic Law (2007)</i>	31	Use for Household purposes	Allows use by village households of wildlife and aquatic species in the common and general category list in particular seasons or permitted areas, using tools or equipment that do not adversely affect habitats or compromise the species population.
	32	Customary Use	Allows use of wildlife or aquatic species in the common and general category list by village households for “necessary cultural beliefs.”
	52	Prohibitions	Prohibits taking of wildlife, including parts of the animals, from their habitats; tormenting wildlife and aquatics; illegal catching, hunting, trading and possession; catching aquatic and hunting in conservation zones, in breeding season, or when pregnant; devastation of habitats and feeding zones.
<i>Land Law (2003)</i>	6	Protection of Land and Environment	Declares that all individuals and organizations are obliged to protect the land from degradation,
	14	Changes in Land Category	Land use can be changed if it does not cause social or environmental harm and if prior approval is obtained from the authorities.
<i>Decree on Land Lease or Concession (2009)</i>	39	Obligation of Person or Legal Entity Who Leases or Obtains Concession	The person or legal entity that leases land or obtains a concession is obligated, among other things, “not to cause any damage to the quality of land and negative impact to the natural environment and the society.”
<i>Road Law (1999)</i>	15	Public Road Construction	Construction of public roads must include protection of the environment
<i>Prime Ministerial Decree No. 112/PM on Environmental Impact Assessment (2010)</i>		Stipulates the need for Environmental Impact Assessment	Stipulates rights of those affected by projects, and need for participation. Outlines the process of conducting the EIA, preparing environmental management and monitoring plans, social management and monitoring plans, issuing environmental compliance certificates, monitoring compliance with the various plans, establishing the institutional framework including grievance procedures.
<i>Decree on Compensation and Resettlement of People Affected by Development Projects (2006)</i>		Establish the procedures for compensation and resettlement for project affected people	Defines the principles, rules, and measures to mitigate adverse impacts and to compensate for damages that may result from involuntary acquisition or repossession of land and of fixed or movable assets, including changes in land use and restrictions to access of community or natural resources

## ANNEX 5: ENVIRONMENTAL STANDARDS

**Water Resources and Environment Administration No 2734 / PMO.WREA (now MONRE)  
Vientiane, 7 Dec 2009**

### Agreement on the National Environmental Standards

Based on the Environmental Protection Law No. 02/99/NA, dated 3 April 1999.

Based on decree on mandate of Water Resources and Environmental Administration dated 149/PM, dated 10 May 2007.

#### Surface water quality standards in Lao PDR

No	Substances	Symbol	Unit	Standard Value	Method of Measurement
1	Color, Odor and Taste	-	-	N	-
2	Temperature	t	°C	N'	Thermometer
3	Potential of Hydrogen	pH	-	5-9	Electronic pH Meter
4	Dissolved Oxygen	DO	mg/l	6	Azide Modification
5	COD	COD	ml/l	5	Potassium permanganate
6	BOD <sub>5</sub>	BOD <sub>5</sub>	mg/l	1,5	Azide Modification at 20 degree C, 5 days
7	Total Coliform Bacteria	Coliform Bacteria	MPN/100 ml	5000	Multiple Tube Fermentation
8	Fecal Coliform Bacteria	Fecal Coliform	MPN/ 100 ml	1000	
9	Nitrate-Nitrogen	NO <sub>3</sub> -N	mg/l	<5.0	Cadmium Reduction
10	Ammonia-Nitrogen	NH <sub>3</sub> -N	mg/l	0.2	Distillation Nesslerization
11	Phenols	C <sub>6</sub> H <sub>5</sub> -OH	mg/l	0.005	Distillation, 4-Amin anti-pyrene
12	Copper	Cu	mg/l	0.1	Atomic Absorption Direct Aspiration
13	Nickel	Ni	mg/l	0.1	
14	Manganese	Mn	mg/l	1.0	
15	Zinc	Zn	mg/l	1.0	
16	Cadmium	Cd	mg/l	0.005	
17	Chromium, Hexavalent	Cr <sup>6+</sup>	mg/l	0.05	
18	Lead	Pb	mg/l	0.05	Atomic Absorption Cold Vapor
19	Mercury	Hg	mg/l	0.002	
20	Arsenic	As	mg/l	0.01	Atomic Absorption Direct Aspiration
21	Cyanide	CN <sup>-</sup>	mg/l	0.005	Pyridine-Barbituric
22	Alpha -Radioactive	α	Becquere l/l	0.1	Counting machine
23	Beta -Radioactive	β	Becquere l/l	1.0	
24	Total Organochlorine	-	mg/l	0.05	Gas Chromatography
25	DDT	C <sub>14</sub> H <sub>9</sub> Cl <sub>5</sub>	mg/l	1.0	
26	Alpha -BHC	αBHC	mg/l	0.02	
27	Dieldrin	C <sub>12</sub> H <sub>8</sub> Cl <sub>6</sub> O	mg/l	0.1	
28	Aldrin	-	mg/l	0.1	
29	Heptachlor and Heptachlor Epoxide	-	mg/l	0.2	
30	Endrin	-	mg/l	None	

## Drinking Water Quality Standards

### Bacteriological Parameters

Parameters	Units	Concentration
Fecal Coliform	MPN/100ml	0
Total Coliform	MPN/100ml	<2.2
Enterovirus	MPN/100ml	0

### Physical-Chemical Parameters

No.	Parameters	Symbol	Unit	Concentration	
				Minimum	Maximum
1	Aluminum	Al	mg/l	0.1	0.2
2	Ammonia	NH <sub>3</sub>	mg/l	0.5	1.5
3	Chloride	Cl <sup>-</sup>	mg/l	200	250
4	Copper	Cu	mg/l	1.0	2.0
5	Iron	Fe	mg/l	0.3	<1
6	Manganese	Mn	mg/l	0.1	0.5
7	Sodium	Na	mg/l	200	250
8	Sulphate	SO <sub>4</sub> <sup>2-</sup>	mg/l	200	250
9	Hydrogen Sulphide	H <sub>2</sub> S	mg/l	0.05	0.1
10	Conductivity	Ec	µs/cm	-	<1,000
11	Total dissolved solids	TDS	mg/l	500	600
12	Sodium Chloride	NaCl	mg/l	100	300-350
13	Potential of Hydrogen	pH	-	6.5	8.5
14	Temperature	T	°C	25	35
15	Hardness	-	mg/l	50	300
16	Turbidity	-	NTU	-	<10
17	Taste and Odor	-	-	-	Acceptable
18	Color	-	TCU	-	5
19	Residual Chlorine (if Chlorine disinfection is used)	Cl <sub>2</sub>	mg/l	-	<0.2

### Health Significant Chemical Parameters

No.	Parameters	Symbol	Unit	Maximum Concentration
1	Antimony	Sb	mg/l	0.005
2	Arsenic	As	mg/l	0.01-0.05
3	Barium	Ba	mg/l	0.7
4	Boron	B	mg/l	0.50
5	Cadmium	Cd	mg/l	0.003
6	Chromium	Cr	mg/l	0.05
7	Cyanide	CN <sup>-</sup>	mg/l	0.07
8	Fluoride	F <sup>-</sup>	mg/l	1.5
9	Lead	Pb	mg/l	0.01
10	Mercury	Hg	mg/l	0.001
11	Nitrate	NO <sub>3</sub> <sup>-</sup>	mg/l	50
12	Nitrite	NO <sub>2</sub> <sup>-</sup>	mg/l	3
13	Selenium	Se	mg/l	0.01

### Priority Parameters

No.	Parameters	Symbol	Unit	Maximum Concentration
1	Iron	Fe	mg/l	<1
2	Manganese	Mn	mg/l	<0.5
3	Arsenic	As	mg/l	<0.05
4	Fluoride	F <sup>-</sup>	mg/l	<1.5
5	Nitrate	NO <sub>3</sub> <sup>-</sup>	mg/l	50
6	Nitrite	NO <sub>2</sub> <sup>-</sup>	mg/l	3
7	Nitrite Nitrogen	NO <sub>2</sub> <sup>-</sup> N	mg/l	1
8	Potential of Hydrogen	pH	-	6.5-8.5
9	Coliform	-	MPN/100ml	0
10	Conductivity	Ec	µs/cm	1000
11	Residual Chloride (if Chlorine disinfection is used)	Cl <sub>2</sub>	mg/l	0.2
12	Total Hardness	-	mg/l	<300
13	Turbidity	-	NTU	<10
14	Taste and Odor	-	-	Acceptable

### Groundwater Standards for Drinking Purposes

Characteristics	Parameters	Symbol	Unit	Permitted Standard Value	
				Suitable	Maximum
Physical	1. Color	-	Platinum-Cobalt (Pt- Co)	5	15
	2. Turbidity	-	JTU	5	20
	3. Potential of Hydrogen	pH	-	7.0-8.5	6.5-9.2
Chemical	4. Iron	Fe	mg/l	≤0.5	1
	5. Manganese	Mn	mg/l	≤0.3	0.5
	6. Copper	Cu	mg/l	≤1.0	1.5
	7. Zinc	Zn	mg/l	≤5.0	15
	8. Sulphate	SO <sub>4</sub> <sup>2-</sup>	mg/l	≤200	250
	9. Chloride	Cl <sup>-</sup>	mg/l	≤250	600
	10. Fluoride	F <sup>-</sup>	mg/l	≤0.7	1
	11. Nitrate	NO <sub>3</sub> <sup>-</sup>	mg/l	≤15	45
	12. Total Hardness as CaCO <sub>3</sub>	Total CaCO <sub>3</sub>	mg/l	≤300	500
	13. Non-carbo- nate hardness as CaCO <sub>3</sub>	Non CaCO <sub>3</sub>	mg/l	≤200	250
Toxic chemical substances	14. Total solids	TS	mg/l	≤600	1,200
	15. Arsenic	As	mg/l	None	0.05
	16. Cyanide	CN <sup>-</sup>	mg/l	None	0.1
	17. Lead	Pb	mg/l	None	0.05
	18. Mercury	Hg	mg/l	None	0.001
	19. Cadmium	Cd	mg/l	None	0.01
	20. Selenium	Se	mg/l	None	0.01
Bacteria	21. Coliform bacteria	Coliform	MPN/100 ml	<2.2	<2.2
	22. E. coli bacteria	E. coli	-	None	None
	23. Standard plate count	-	Colonies/ml	≤500	-

### Soil Quality Standards for Residential and Agriculture

No.	Substances	Symbol	Unit	Standard Value	Method of Measurement	
I. Volatile Organic Compound					Gas Chromatography or Gas Chromatography/. Mass Spectrometry (GC/MS) or other methods approved by DONRE	
1	Benzene	C <sub>6</sub> H <sub>6</sub>	mg/kg	0.5		
2	CarbonTetrachloride	CCl <sub>4</sub>	mg/kg	89		
3	1,2 Dichloroethane	CH <sub>2</sub> Cl-CH <sub>2</sub> Cl	mg/kg	230		
4	1,1 Dichloroethylene	CCl <sub>2</sub> =CH <sub>2</sub>	mg/kg	1,700		
5	Cis 1,2 Dichloroethylene	CHCl=CHCl	mg/kg	57		
6	Trans-1.2-Dichloroethylene	CHCl=CHCl	mg/kg	520		
7	Dichloromethane	CH <sub>2</sub> Cl <sub>2</sub>	mg/kg	28		
8	Ethly benzene	IC <sub>2</sub> ClC-CH <sub>3</sub>	mg/kg	630		
9	Styrene	C <sub>6</sub> H <sub>5</sub> -CH=CH <sub>2</sub>	mg/kg	8.4		
10	Tetrachloroethylene	C <sub>2</sub> Cl <sub>4</sub>	mg/kg	210		
11	Toluene	C <sub>6</sub> H <sub>5</sub> -CH <sub>3</sub>	mg/kg	6.5		
12	Trichloroethylene	Cl <sub>2</sub> C=CHCl	mg/kg	2.5		
13	1.1.1 Trichloroethane	Cl <sub>3</sub> C-CH <sub>3</sub>	mg/kg	3.5		
14	1.1.2 Trichloroethane	Cl <sub>2</sub> CH-CH <sub>2</sub> Cl	mg/kg	43		
15	Total Xylenes	(CH <sub>3</sub> -C <sub>6</sub> H <sub>4</sub> -CH <sub>3</sub> )	mg/kg	63		
II. Heavy Metals					Inductively Coupled Plasma-Atomic Emission Spectrometry or Inductively Coupled Plasma-Mass Spectrometry or Atomic Absorption, Gaseous Hydride or Atomic Absorption, Borohydride Reduction or other Methods Approved by DONRE	
1	Arsenic	As	mg/kg	3.9		
2	Cadmium and its compounds	Cd	mg/kg	37		
3	Hexavalent Chromium	Cr <sup>+6</sup>	mg/kg	300		Coprecipitation or Colorimetric or Chelation/ Extraction or other Methods Approved by DONRE
4	Lead	Pb	mg/kg	400		Inductively Coupled Plasma-Atomic Emission Spectrometry or Inductively Coupled Plasma-Mass Spectrometry or Atomic Absorption, Direct Aspiration or Atomic Absorption, Furnace Techniques or other Methods Approved by
5	Manganese and its compounds	Mn	mg/kg	1,800		

					DONRE
6	Mercury and its compounds	Hg	mg/kg	23	Cold-Vapor Technique or other Methods Approved by DONRE
7	Nickel, soluble salts	Ni	mg/kg	1,600	Inductively Coupled Plasma-Atomic Emission Spectrometry or Inductively Coupled Plasma-Mass Spectrometry or Atomic Absorption, Direct Aspiration or Atomic Absorption, Furnace Techniques or other Methods Approved by DONRE
8	Selenium	Se	mg/kg	390	
III. Pesticides					
1	Atrazine	C8H14ClN5	mg/kg	22	Gas Chromatography or other Methods Approved by DONRE
2	Chlordane	-	mg/kg	16	Gas Chromatography/ Mass Spectrometry (GC/MS) or other Methods Approved by DONRE
3	2,4 D	-	mg/kg	690	Gas Chromatography or High Performance Liquid Chromatography/ Thermal Extraction/ Gas Chromatography/Mass Spectrometry (TE/GC/MS) or other Methods Approved by DONRE
4	DDT	DDT	mg/kg	17	Gas Chromatography or Gas Chromatography/ Mass Spectrometry (GC/MS) or other Methods Approved by DONRE
5	Dieldrin	C12H8Cl6O	mg/kg	0.3	
6	Heptachlor	Cl7	mg/kg	1.1	
7	Heptachlor Epoxide	-	mg/kg	0.5	
8	Lindane	-	mg/kg	4.4	
IV. Others					
1	Benzo(a)pyrene	-	mg/kg	0.6	Gas Chromatography/ Mass Spectrometry (GC/MS) or Thermal Extraction Gas Chromatography/ Mass Spectrometry (TE/GC/MS) Chromatography/ Fourier Transform Infrared (GC/FT-IR) Spectrometry or other Methods Approved by DONRE
2	Cyanide and its compounds	CN <sup>-</sup>	mg/kg	11	Total and Amenable Cyanide: Distillation, or Total Amenable Cyanide (Automated Colorimetric, with off-

					line Distillation), or Cyanide Extraction Procedure for Solids and Oils or other Methods Approved by DONRE
3	PCBs	-	mg/kg	2.2	Gas Chromatography or other Methods Approved by DONRE
4	Vinyl Chloride		mg/kg	1.5	Gas Chromatography or Gas Chromatography/Mass Spectrometry (GC/MS) or other Methods Approved by DONRE

### Ambient Air Quality Standard

Parameters	Symbol	Average Time Unit: mg/m3					Method of Measurement
		Hours			1 month	1 year	
		1 hr	8 hr	24 hr			
Carbon monoxide	CO	30	10.26	-	-	-	Non dispersive infrared detection
Nitrogen dioxide	NO2	0.32	-	-	-	-	Chemilumine scene method
Sulphur dioxide	SO2	0.78	-	0.30	-	0.10	UV Fluorescence (1hr, 24hr, 1yr) or Pararosaniline (1hr,4hr)
Total Suspended Particulate	TSP	-	-	0.33	-	0.10	Gravimetric
Particulate Matter less than 10 microns	PM-10	-	-	0.12	-	0.05	Gravimetric or Beta Ray or Taper Element Oscillating Microbalance or Dichotomous
Ozone	O3	0.20	-	-	-	-	Chemiluminescence or UV Absorption Phoptometry
Lead	Pb	-	-	-	1.5	-	Atomic Absorption Spectrometer

### Noise Standard

Standards	Method of Measurement
Maximum Sound Level (L <sub>max</sub> ) should not exceed 115 dB(A)	Equivalent Sound Level (Leq) from Fluctuating Noise
Leq 24 hour not exceeding 70 dB(A)	Equivalent Sound Level (Leq) from Steady Noise

### Noise Standards for Other Places

Type of Area	Standard Value in dB(A)		
	6.00-18.00	18.00-22.00	22.00-6.00
Quiet areas: hospitals, libraries, treatment places, kindergarten and schools	50	45	40
Residential areas: hotels and houses	55	55	45
Commercial and service areas	70	70	50
Small industrial factories located in residential areas	70	70	50

**General Industrial Wastewater Discharge Standards**  
**Standards for General Industries**

No.	Parameters	Symbols	Unit	Maximum Concentration
1	BOD <sub>5</sub>	BOD <sub>5</sub>	mg/l	40
2	Ammonia Nitrogen	NH <sub>3</sub> -N	mg/l	4
3	Total Suspended Substances	TSS	mg/l	40
4	Potential of Hydrogen	pH	-	6-9.5
5	Total Dissolved Substances	TDS	mg/l	3,500
6	Phenols	C <sub>6</sub> H <sub>5</sub> OH	mg/l	0.3
7	Phosphorous	P	mg/l	1.0
8	Silver	Ag	mg/l	0.1
9	Zinc	Zn	mg/l	1.0
10	Sulphide	S	mg/l	1.0
11	Free Chlorine	Cl <sub>2</sub>	mg/l	1.0
12	Chloride	Cl <sup>-</sup>	mg/l	500
13	Iron	Fe	mg/l	2.0
14	Fluoride	F	mg/l	15
15	Cyanide	CN <sup>-</sup>	mg/l	0.1
16	Copper	Cu	mg/l	0.5
17	Lead	Pb	mg/l	0.2
18	Oil and Grease	-	mg/l	5
19	Nickel	Ni	mg/l	0.2
20	Mercury	Hg	mg/l	0.005
21	Manganese	Mn	mg/l	1.0
22	Arsenic	As	mg/l	0.25
23	Barium	B	mg/l	1.0
24	Cadmium	Cd	mg/l	0.03
25	Chromium	Cr <sup>+6</sup>	mg/l	0.1
26	Total Chromium	Total Cr	mg/l	0.5

**Wastewater Discharge Standards from the Urban Area**

No.	Parameters	Symbol	Standards				
			A	B	C	D	E
1.	Biochemical Oxygen Demand	BOD <sub>5</sub>	Not more than (mg/l)				
			30	40	50	60	200
2.	Suspended Solids	SS	Not more than (mg/l)				
			30	40	50	50	60
3.	Settle able Solids	-	Not more than (mg/l)				
			0.5	0.5	0.5	0.5	-
4.	Total Dissolved Solids	TDS	Not more than (mg/l)				
			3000	2500	2000	1500	-
5.	Chemical Oxygen Demand	COD	Not more than (mg/l)				
			120	130	150	350	400
6.	Sulphide	S <sup>2-</sup>	Not more than (mg/l)				
			1.0	1.0	3.0	4.0	-
7.	Total Kjeldahl Nitrogen	TKN	Not more than (mg/l)				
			35	35	40	40	-
8.	Fat Oil and Grease	-	Not more than (mg/l)				
			20	20	20	20	100
9.	Temperature	t	Not more than (degree Celsius)				
			40	40	40	40	40
10.	Potential of Hydrogen	pH	Not more than				
			6-9.5	6-9.5	6-9.5	6-9.5	6-9.5



## ANNEC 6: COST NORMS FOR ENVIRONMENTAL MONITORING

### LAO PEOPLE'S DEMOCRATIC REPUBLIC Peace Independence Democracy Unity Prosperity

Prime Minister's Office-PMO

Water Resources and Environment Administration-WREA (now DONRE)

Water Resources and Environment Research Institute-WERI

### QUOTATION

#### Customer

**Name:** \_\_\_\_\_  
**Address:** \_\_\_\_\_  
**City:** \_\_\_\_\_  
**Phone:** \_\_\_\_\_

**Date:** \_\_\_\_\_  
**Order Date:** \_\_\_\_\_  
**Rep:** \_\_\_\_\_  
**FOB:** \_\_\_\_\_

No	Description	Unit	Quantity	Unit Price US\$
1	pH	Sample	01	\$2.00
2	EC	Sample	01	\$4.00
3	Total Hardness (as CaCO <sub>3</sub> )	Sample	01	\$6.00
4	Biochemical Oxygen Demand (BOD <sub>5</sub> )	Sample	01	\$8.00
5	Chemical Oxygen Demand (COD)	Sample	01	\$8.00
6	Sulfate ion (SO <sub>4</sub> <sup>2-</sup> )	Sample	01	\$7.00
7	Total Dissolved Suspended (TDS)	Sample	01	\$8.00
8	Total Solid Suspended (TSS)	Sample	01	\$8.00
9	Dissolved Oxygen (DO)	Sample	01	\$6.00
10	Phosphate (PO <sub>4</sub> <sup>3-</sup> )	Sample	01	\$12.00
11	Chloride (Cl <sup>-</sup> )	Sample	01	\$8.00
12	Nitrate	Sample	01	\$7.00
13	Nitrite	Sample	01	\$8.00
14	Magnesium (Mg)	Sample	01	\$8.00
15	Potassium (K)	Sample	01	\$8.00
16	Sodium (Na)	Sample	01	\$8.00
17	Calcium (Ca)	Sample	01	\$8.00
18	Ammonia	Sample	01	\$8.00
19	Total Nitrogen (T-N)	Sample	01	\$8.00
20	Total Phosphorus (T-P)	Sample	01	\$8.00
21	Iron (Fe)	Sample	01	\$12.00
22	Lead (Pb)	Sample	01	\$12.00
23	Mercury (Hg)	Sample	01	\$15.00
24	Arsenic (As)	Sample	01	\$15.00
25	Zinc (Zn)	Sample	01	\$12.00
26	Copper (Cu)	Sample	01	\$12.00
27	Cyanide (CN)	Sample	01	\$12.00
28	Cadmium (Cd)	Sample	01	\$12.00
29	Chromium (Cr)	Sample	01	\$12.00
30	Manganese (Mn)	Sample	01	\$12.00
31	Selenium (Se)	Sample	01	\$12.00
32	Nickel (Ni)	Sample	01	\$12.00
33	Zinc (Zn)	Sample	01	\$12.00
34	Antimony (Sb)	Sample	01	\$12.00
35	Salinity	Sample	01	\$6.00

Items	Unit	Q'ty	Unit Price	Amount
			(US\$)	(US\$)
Environmental surveys				
(1) Water Quality (River water)	sample/parameter	400	18.00	7,200.00
(2) Water Quality (Groundwater/lake)	sample/parameter	400	18.00	7,200.00
(3) Sediment Quality	sample/parameter	36	18.00	648.00
(4) Soil Quality	sample/parameter	27	20.00	540.00
(5) Air Quality	sample	210	69.00	14,490.00
(6) Noise Survey	sample	42	230.00	9,660.00

#### Water Quality analytical parameters

<p>Fecal Coliform, Total Coliform, Aluminium (Al), Ammonia (NH<sub>3</sub>), Chloride (Cl), Copper (Cu), Iron (Fe), Manganese (Mn), Sodium (Na), Sulfate (SO<sub>4</sub>), Hydrogen Sulfide (H<sub>2</sub>S), Conductivity, Total dissolved solids (TDS), Salt (NaCl), Hardness, Turbidity, Color, Taste and Odour, pH, Temperature (water, atmosphere), Residual chloride (if chloride disinfection is used), Antimony (Sb), Arsenic (As), Barium (Ba), Boron (B), Cadmium (Cd), Chromium (Cr), Cyanide (CN), Fluoride (F), Lead (Pb), Mercury (Hg), Nitrate (NO<sub>3</sub>), Nitrite (NO<sub>2</sub>), Selenium (Se): (as stipulated in Drinking Water and Household Water Quality Standard, MOH(2005)),</p> <p>BOD<sub>5</sub> (at 20°C), Suspended Solid (SS), Settable Solid, TDS increase from regular use, COD, Sulfide, Total Kjeldahl Nitrogen (TKN), Fat oil and grease: (as stipulated in Standard for Wastewater Discharge, STEA (1998)),</p> <p>Phenol, Silver (Ag), Zinc (Zn), Nickel (Ni) (as stipulated in Provision on Discharge of Domestic Sewage and Wastewater from Industrial Factories, MOIC(2006)),</p> <p>And, DO, total nitrogen, total phosphorous, total organic compounds.</p>
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#### Sediment and soil analytical parameters

<p>Cadmium (Cd), Total Cyanide (CN), Lead (Pb), Chromium (Cr(VI)), Arsenic (As), Total Mercury (Hg), Selenium (Se), Fluoride (F), Boron (B)</p>
---

#### Air quality

Air quality survey items: nitrogen dioxides (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), total suspended particle (TSP) and particle matter 10 (PM<sub>10</sub>)

#### Noise

Noise survey: L<sub>Aeq</sub> level in accordance with the related guidelines in Laos