

Initial Environmental Examination Report

November 2012

REG: Greater Mekong Subregion Flood and Drought
Risk Management and Mitigation Project (Kingdom
of Cambodia)

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AFD	Agence Française de Développement
AP	Affected Person
DOE	Department of Environment
EA	Executing Agency
EARP	Environmental Assessment and Review Procedures
EIRR	Economic internal Rate of Return
EMD	Ethnic Minority Development
EMDP	Ethnic Minority Development Plan
EMP	Environmental Management Plan
FIRR	Financial Internal Rate of Return
FMA	Financial Management Assessment
FSR	Feasibility Study Report
GDP	Gross Domestic Product
GPP	Grievance Point Person
IEE	Initial Environmental Examination
IMC	Irrigation Management Company
IOL	Inventory of losses
IR	Inception Report
ISF	Irrigation Service Fee
M&E	Monitoring and Evaluation
MOWRAM	Ministry of Water Resources and Meteorology
MRCFF	Mekong River Commission Flood Forecasting
O&M	Operation and Maintenance
PAP	Project Affected Person
PDWRAM	Provincial Department of Water Resources and Meteorology
PMU	Project Management Unit
PPMU	Provincial Project Management Unit
PPTA	Project Preparatory Technical Assistance
RAP	Resettlement Action Plan
RC	Resettlement Commission
RP	Resettlement Plan
SIEE	Summary Initial Environmental Examination
SPRSS	Summary Poverty Reduction and Social Strategy
SS	Suspended Solids
TA	Technical Assistance
ToR	Terms of Reference
USD	United States Dollar
VAT	Value Added Tax

I. INTRODUCTION

A. Background

1. This report is prepared and submitted as Annex of the Final Report for ADB TA 6456-REG, the Project Preparatory Technical Assistance (PPTA) for Preparing the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project in Cambodia. This PPTA is based on an agreement between ADB and the Government of Cambodia and funding of the PPTA is under a grant from ADB.

2. The main outcome of this PPTA is a feasibility study report for Preparing the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project in Cambodia to be financed by ADB and potential development partners. The structural subprojects provide for building and rehabilitation infrastructures such as: canal system, barrages, and gates to improve flood and drought risk management and mitigation of sub-project areas in two provinces in the Cambodia viz; Pursat and Battambang Province. The non-structural sub-project includes establishment of National Flood Forecasting Centre.

3. This report presents only the Initial Environmental Examination (IEE) of the structural subprojects. The IEE has been finalized and submitted to ADB and Royal Government of Cambodia (RGC) for the subprojects approvals. This IEE report follows the applicable laws and regulations in Cambodia and ADB's environmental assessment guidelines and policies including Safeguard Policy Statement, 2009, as well as Rapid Environmental Assessment (REA) Checklist, 2003. The IEE was undertaken during project preparation work and is to be updated during the implementation phase. The report also outlines the Environmental Management Plan (EMP) proposed for the subproject.

B. Objective

4. The overall objectives of the IEE report are to:
- (i) describe the existing natural and socio-economical resources in and surrounding subproject areas,
 - (ii) identify and assess potential significant impacts based on existing environmental condition during project preconstruction, construction, and operation-maintenance stages,
 - (iii) identify and recommend mitigation measures to minimize any potential impacts caused by subproject activities, and
 - (iv) develop environmental management plan and budget, including monitoring plan during construction and operation stage.

C. Purpose of the Report

5. This report gives an account of the Initial Environmental Examination (IEE) of the proposed subprojects under 'Preparing the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project', located in Pursat and Battambang Provinces. The IEE was conducted during subprojects' preparation to identify the impacts of the proposed activities on the environment. Measures are recommended to mitigate the identified adverse environmental impacts arising from the implementation of the subprojects.

6. The IEE was carried out following ADB's Safeguards Policy Statement, June 2009, Environmental Assessment Guidelines, 2003, and Environmental Guidelines for Selected

Irrigation and Drainage Development Projects of the Asian Development Bank (ADB) and relevant environmental policies and guidelines of the RCG.

D. Project Category

7. These subprojects are classified under ADB guidelines as a **Category 'B'** project. Such projects are judged to have some adverse environmental impacts mostly occurring during construction phase, but of lesser degree and/or significance than those of Category 'A' projects. An IEE is required to determine whether or not significant environmental impacts warranting an environmental impact assessment (EIA). If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

8. Since all the subprojects included rehabilitation activities, therefore only an initial environmental impact assessment (IEIA) is required under GOC regulations, Sub-Decree No. 72 ANRK.BK, dated 11 August 1999. Project owner/ responsible person must compile IEIA report and submit it to PEO for a review and approval on their existing/ ongoing activity for which previously allowed by the Provincial/Urban Project Approval Office in that province.

E. Extent of the Initial Environmental Examination (IEE)

9. The Initial Environmental Examination (IEE) involves the following activities:

- (i) gathering available baseline information on the physical / chemical, biological, and socio-economic environment of the subproject area,
- (ii) screening of potential impacts related to the sitting, design, construction, and operation phases, to distinguish those that are likely to be significant and would warrant further study,
- (iii) recommending measures to mitigate possible adverse impacts,
- (iv) provide guidance on appropriate institutional arrangements for environmental monitoring, and
- (v) findings of site reconnaissance, results of social surveys, results of water quality tests and analyses, technical descriptions based on the preliminary engineering designs (contained in the Draft Feasibility Study Reports of proposed components dated), as well as the outcome of discussions with PIS of Pursat Province, and provincial authorities, have been integrated into this IEE.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

10. Both, ADB and relevant national environmental guidelines and regulations of Royal Government of Cambodia, were followed for the preparation of the IEE for the Flood and Drought Risk Management and Mitigation Project in Cambodia. The relevant policies and regulations are:

- (i) The Environmental Law and Relevant Regulations of RGC
 - (a) Creation and Designation of Protected Areas, Kret of 1993
 - (b) PRAKAS (Declaration) No.1033 on Protected Areas. MoE, 1994
 - (c) Law on Environmental Protection and Natural Resources Management. MoE, 1996
 - (d) Law on Fisheries, MAFF, 2007
 - (e) Law on Water Resources Management, MOWRAM, 2006
 - (f) Sub-decree No: 27 ANRK.BK on Water Pollution Control, MoE, 1999

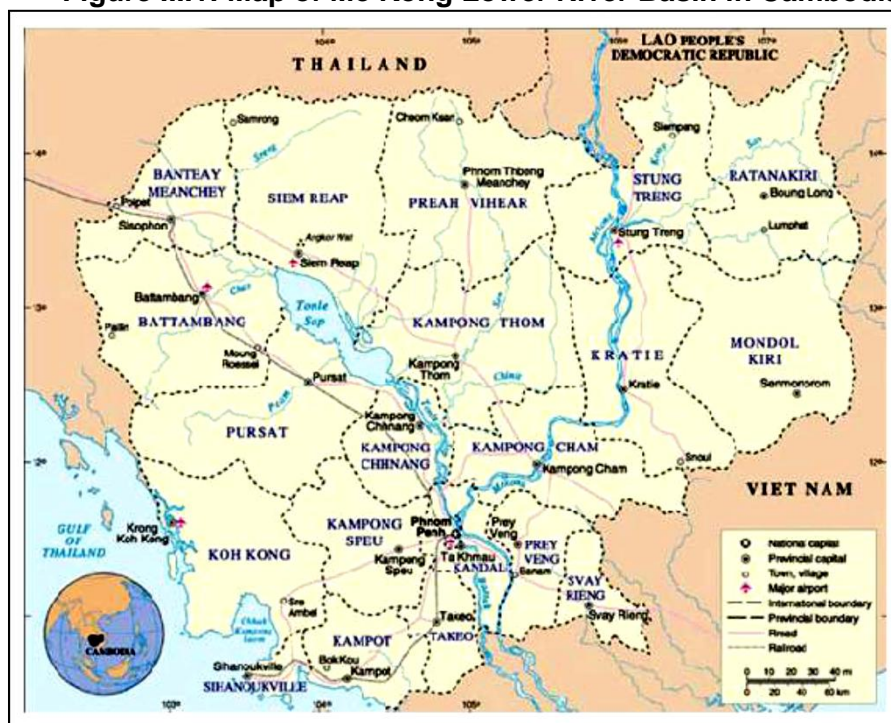
- (g) Sub-Decree No: 72 ANRK. BK on Environmental Impact Assessment Process, MoE 1999, and
- (h) Sub-decree on Air Pollution Control and Noise Disturbance adopted in 2000.
- (ii) The Environmental Guidelines and Relevant Policies of ADB
 - (a) Environmental Assessment Guidelines and Rapid Environmental Checklist, ADB, 2003
 - (b) Safeguard Policy Statement, ADB, 2009, and
 - (c) Operation Manual Bank Policies (BP) and Safeguard Policy Statement, ADB, 2009.

III. DESCRIPTION OF THE SUB-PROJECTS IN CAMBODIA

A. The Subproject Area

11. The subprojects within Cambodia components of the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project are located in the Mekong River Basin. The subprojects are related to rehabilitation of irrigation systems and also include improvement of human resources capacity development for MOWRAM staff and related agencies.

Figure III.1: Map of Me Kong Lower River Basin in Cambodia



B. The Prioritized Projects and Project Location

12. Two structural subprojects are selected in Cambodia aimed at improving and upgrading of flood and drought risk management in Cambodia. These subprojects are:

Sl. No.	Project type	Location
1	Rehabilitation of Damnak ChhoeKrom Irrigation (Drought Management) Project in Pursat Province	Pursat province
2	Pursat Irrigation Expansion Sub-project	Battambang province

1. Damnak ChhoeKrom Irrigation (Drought Management) Project in Pursat Province

13. Pursat Province is situated in the north-western part of the Cambodia. The provincial town is located about 189 km from the Phnom Penh City. The proposed project was built in Pol Pot regime, by Khmer Rouge about 30 years ago. Since then this system has not been ever rebuilt or rehabilitated.

14. The components/outputs of the subproject are as follows:

- (i) Irrigation system components
 - (a) Reconstruction of diversion structure (barrage) : 1 no.
 - (b) Reconstruction of main canal : 25 km
 - (c) Reconstruction of secondary canal No. 1 : 14 km
 - (d) Reconstruction of secondary canal No. 2 : 12 km
 - (e) Reconstruction of secondary canal No. 3 : 13 km
 - (f) Reconstruction of secondary canal No. 4 : 13 km
 - (g) Construction of intake structure : 1 no.
 - (h) Construction of head regulators : 4 nos.
 - (i) Construction of cross regulators : 4 nos.
 - (j) Construction of check structures : 4 nos.
 - (k) Construction of canal crossing structures : 6 nos.
- (ii) Main canal with a flood diversion capacity of 50m³/s from the Pursat river to Stueng Svay Doun Kaey
- (iii) Improved agriculture support program
- (iv) Construction of community water users group (CWUG committee office)
- (v) Capacity development of Community Commune Committee for Disaster Management (CCDM) and CWUG for drought risk management (irrigation) and flood risk management
- (vi) Formulation of water management operational framework for water allocation in the Pursat basin

**Table III.1: Flood and flash flood risk destruction in the proposed project zone
(Unit Conversion: 1 USD = 4,200 Riel)**

Year	Dam Destruction in (m ³)			Canal Destruction Length in (m)			Total Cost	
	Quantities	Cost in Riel	Cost in USD	Quantities	Cost in Riel	Cost in USD	Riel	USD
2008	120	504,000	120	1,500	9,450,000	2,250	9,954,000	2,370

15. On 21 August 2006 at 15:00p.m., two people died and 9 houses were destroyed due to severe flood in Sampov Meas district of Pursat Province.

Table III.2: Annual Petrol Expenditure to Pump Water for Irrigating Rice During the Drought Event Occurrence in the Proposed Project Zone

No.	Years	Petrol, Litre	Rice Area in hectare (ha)		
			Raining Season	Dry Season	Total
1	2000	8,500	9,500	0	9,500
2	2001	7,000	7,800	0	7,800
3	2002	7,500	7,400	0	7,400
4	2003	10,050	1,500	0	1,500
5	2004	12,100	1,100	0	1,100
6	2006	18,000	1,411	0	1,411
7	2007	24,000	1,570	872	2,442
8	2008	26,500	1,675	945	2,620
9	2009	24,300	1,544	841	2,385
Total		13,7950	33,500	2,658	36,158

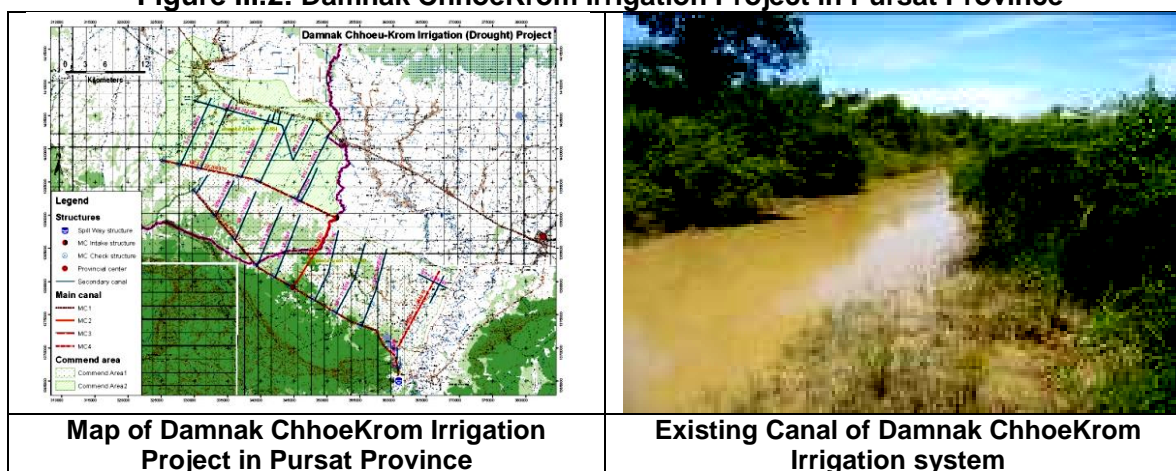
Table III.3: Total Cost Estimation for Damnak Choeu Krom Flood and Drought Proposed Project

No.	Description of Works	Unit	Q'ty	Unit Rate (USD)	Total Amount (USD)
A. Earthworks					
A.1	Cofferdam on Streams	Ls	1	60,000.00	60,000.00
A.2	Flood Diversion Canal (MC1)	m	43,900	150.00	6,585,000.00
A.3	MC2	m	12,900	120.00	1,548,000.00
A.4	MC3	m	27,900	120.00	3,348,000.00
A.5	MC4	m	13,100	100.00	1,310,000.00
A.6	Secondary Canal	m	180,700	25.00	4,517,500.00
B. Structure Works					
B.1	Automatic Spillway	no.	1	2,500,000.00	2,500,000.00
B.2	Head Regulator	no.	3	200,000.00	600,000.00
B.3	SC Intake Structures	no.	16	35,000.00	560,000.00
B.4	MC Check Structures	no.	23	60,000.00	1,380,000.00
B.5	TC Intake Structures	no.	133	12,000.00	1,596,000.00
B.6	SC Check Structures	no.	61	20,000.00	1,220,000.00
B.7	Site Clearance	Ls	1	50,000.00	50,000.00
Total cost estimation in USD around 25.3 millions					25,274,500.00

16. The main canals which are directly linked with the Stung Pursat River at the upstream part of the Pursat provincial town are:

- (i) Damnak Cheukrom canal (proposed project): bottom width 25 m, average depth 2.5 m, top width 32.5 m, cross section area 72 m²
- (ii) Damnak Ampil canal (partly proposed project): bottom width 6 m, depth 2 m, top width 12 m cross section area 18 m²
- (iii) Wat Lung canal: bottom width 6 m, depth 2 m, top width 12 m and cross section area 18 m²
- (iv) Oroka canal: bottom width 6 m, depth 2 m, top width 12 m and cross section area 18 m²

Figure III.2: Damnak ChhoeKrom Irrigation Project in Pursat Province



2. Pursat Irrigation Expansion Subproject

17. This subproject is considered as the Stage-II of the Damnak Chhoe Krom Irrigation (Drought Management) Subproject, It considers two options - to irrigate an incremental 12,000 ha or the larger area of 28,700 ha with associated changes in the capital development costs on the assumption that the Stage-I development is a sunk cost. Further environmental examination of the irrigation expansion is to be carried out prior to loan consideration by ADB's Board of Directors.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Climate

18. The climate in Cambodia is dominated by monsoon in which are known as tropical wet season and dry season. The rainy or southwest monsoon season is from mid-May to mid-October, bringing in warm moist air from the Indian Ocean causing abundant rain. While the dry northeast monsoon starts in November and continues until April. Summer or pre-monsoon season is from mid-February to mid-May. The weather is warmer, with April as the hottest month. The temperature in Cambodia had a small variation from annual average temperature around 28°C. The maximum average temperature is about 34°C and minimum average is about 21°C.

19. Cambodia is rich in water resources. The rainy season occurs from May to October. The annual rainfall is normally 1,200 to 1,900mm in the lowland area around Tonle Sap Lake and Mekong River Basin and is about 2,500 to 3,000mm, in the western mountainous area and the eastern plateau. About 80% of rainfall occurs during the southwest season.

20. Summary of climate data of the Project area is presented in Table 4.1.

Table IV.1: Meteorological data of the Project Area (3 provinces)

Indicators	Annual Average		
	Kratie	Pursat	Kandal
Temperature °C	28.4	28.5	28.0
Rainfall	1,593.0	1,500.0	
Relative humidity		69.0	
Evaporation		1,340.0	

2. Geology

21. Cambodia is divided into two distinct geological regions, the North East and the South West, by the Tonle Sap-Mekong Plain, which extends from the North West to the South East along the central part of the country. The Tonle Sap-Mekong Plain itself comprises a third Central region. The North East and the South West regions are composed of metamorphic, sedimentary, volcanic and intrusive rocks formed as a basement during the Precambrian and Mesozoic. The Mesozoic sediments are mainly continental. Over a large area of the regions, the basement rocks are covered with plateau basalt and soft sediment of the Neocene and Quaternary. The Central region is an area characterized by thick Quaternary sediments and isolated hills of basement rocks. The Paleocene is rarely observed at surface in Cambodia.

3. Topography and Soils

22. Topography of the Mekong River Basin and Tonle Sap Basin is the lowland part of the Cambodia. This part is containing thick sedimentation layer extensively distributed year to year from upstream areas by runoff. The sandstones were intruded in late Jurassic period, in Pursat province area. There is the sedimentary layer that covers the bedrock around the river basin.

23. In Cambodia the geomorphic and topography is characterized by low middle and south portion and high west, north and east portion. Its middle and south region are plain part, and accounting for 3/4 of its total area. The Tonle Sap Basin and Mekong downstream area as centre, ground elevation slowly raises from below 100 m. The southwest Kravah Mountains run in trend northeast-southeast, has elevation over 1,500 m and the highest part in the country is Phnom Aural with elevation 1813 m.

24. The soil classification in Cambodia: Major landform of soil are classified in the following five groups:

- (i) The soil is flooded for at least 3 months or longer by river or lake water.
- (ii) The soil occurs on the sides of hills or mountains.
- (iii) The soil occurs on a river levee or associated back-slopes.
- (iv) The landform occurs in an area of undulating topography.
- (v) The land form occurs in extensive flat areas.

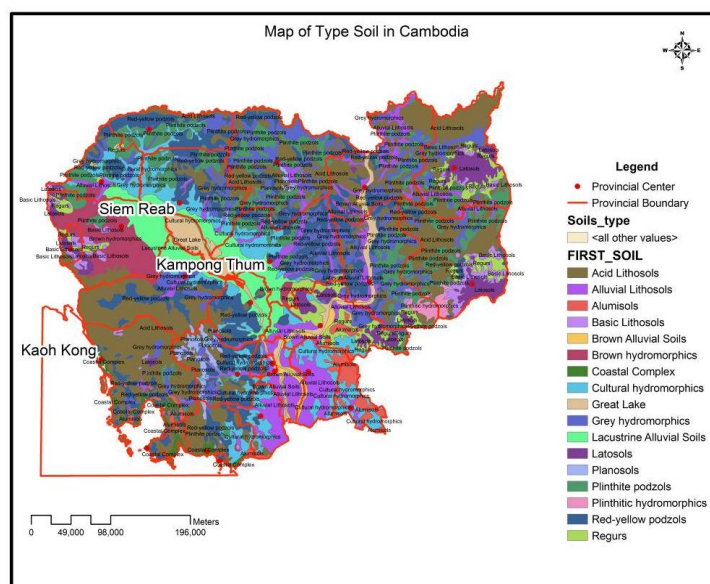
Table IV.2: Soil Group, Phases, and Fertility Capability Classification for Cambodia

Soil group and area	Soil phases	Fertility capability classification for Cambodia
Bakan (Pursat Province)	Bakan	Deficient in N P K, moderate water leaking, but high water holding capacity
Krakor (Pursat Province)	Cracking Non Cracking	Water leaking from log to high, but high water holding

Soil group and area	Soil phases	Fertility capability classification for Cambodia
Kbal Po	Thionic (PH subsoil smaller<4.5)	Low water leaking, high water holding. Deficient in Zn, thionic acid Fe, S, Al.
	Non thionic (PH subsoil bigger>4.5)	Low water leaking, high water holding capacity Deficient in Zn.
Kein Svay (Kandal Province)	Kein Svay	Moderate water leaking and holding capacity Deficient in N.

Source: MAFF-CARDI, 2006

Figure IV.1: Map of Soil Type in Cambodia



Source: JICA.2005.

4. Surface Water

a. Water Resources

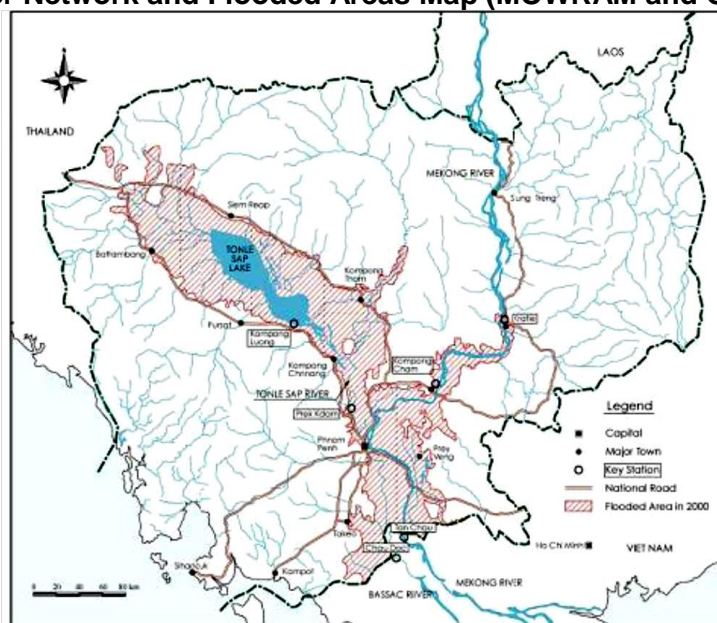
25. The Mekong River of Cambodia is started from upstream of Cambodia-Lao PDR border and flows through the country ultimately end at the downstream of Cambodia-Vietnam border. The Cambodia's Mekong River is 486 km long and its Basin is covered 86% of total country area. In Phnom Penh Cambodia's Mekong River is separated by 04 rivers (Chak Tomuk) such as: Up-Mekong, Down-Mekong, Bassac, and Tonle Sap. The Tonle Sap River is the most important water flow in Cambodia because it has 02 different water regimes. During the wet season used as big downstream reservoir, fish spawning and growing, and flood control, and during dry season water flows back from Tonle Sap Lake to bring more fish.

26. The year 2000 flood which had the highest flood volume in the records and caused widespread flooding in Cambodia and Vietnam with a longest period of flooding, especially in the Great Lake and Mekong River Basin. Peak flood in the Great Lake basin coincided with the peak rainfall period of the basin in August-September.

27. In the month of September, the whole Tonle Sap catchments received prolonged heavy rainfall. Rivers swelled and caused widespread flooding. The Lake reached its peaks at elevation of 10.34 m above msl, higher than most land level above the limit of the ring roads around the lake, National Road No. 6 and National Road No. 5.

The flood water in Cambodia comes mainly from the upper and middle reaches of the Mekong, mainly from the middle reach shows the location of the most flood prone areas in Cambodia. While the river reaches its highest peak, local rainfall also intensifies (second peak in September) adding more water to the swelling river. Moreover, poor management of the flood plain also increase flood risk in Phnom Penh and its surrounding. Flood plain region is highly productive in terms of agriculture potential but deep flood water allows only a single cropping per year. Due to its large open space, roads and bridges construction and maintenance are costly and subject to frequent damages.

Figure IV.2: River Network and Flooded Areas Map (MOWRAM and CNMC, June 2003)



b. Water Quality

28. MOWRAM and MRC are conducting an on-going water quality monitoring programmes based on water samples from designated sampling points in the Mekong River, Tonle Sap River, and Bassac River. According to their results, the quality of these water bodies is generally good in comparison with the other riparian countries, and the mean chemical composition of samples is lower than the worldwide (MCR, 2003).

29. In Cambodia the water quality control and management is identified by Sub-decree on Water Pollution Control (Ministry of Environment (MoE, 1999). It consists of effluent discharge permit, monitoring of the pollution sources, procedures and penalty. Sub-decree also concerns to Public water areas refers to water areas that are for public use such as : tonle, stung (rivers), stream, gully, lake, pond, well, sea, peam (river mouth) and include canal irrigation system and other waterways that are for public use and ground water (Sub-decree on Water Pollution Control, Article 3, 1999).

Table IV.3: Water Quality Standard in Public Water Areas for Bio-diversity Conservation**A. Rivers**

Sl. No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	BOD ₅	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 5000

B. Lakes and Reservoirs

Sl. No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1 – 8
3	Suspended Solid	mg/l	1 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	1.0 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05

Source: MoE. 1999. Sub-decree on Water Pollution Control.

Table IV.4: Water quality testing in Mekong River Basin

No	Parameters	Units	Results	Water quality standard for river
I. Mekong river water, Leuk Dek and Peam Ro, Kandal and Prey Veng province, December 2007.				
1	pH		6.50	6,5 - 8,5
2	BOD ₅	mg/l	4.07	1-10
3	DO	Mg/l	6.00	2.0 - 7.5
4	Turbidity	NTU	46	
5	Total Coliform	Count 100 ml	90	< 500
II. Basac river water, in Koh Thom, Kandal province, September 2005				
1	PH		7.34	6,5 - 8,5
2	BOD ₅	mg/l	2.37	1-10
3	COD	mg/l	22.2	
4	Turbidity	NTU	30.4	25-100
5	TSS	mg/l	226	

Source: Laboratory. MOE. 2005 & 2007.

Table IV.5: Surface Water (SW) Quality in Pursat River

Parameter	Unit	SW1	SW2	Protected public water area standard*	Public water area and sewer standard*
pH		6.51	7.03	6-9	5-9
TDS	mg/l	53.5	31.8	< 1000	< 2000
TSS	mg/l	61.2	24.2	< 50	< 80
DO	mg/l	5.4	6.6	>2.0	>1.0
Oil & Grease	mg/l	1.2	0.35	< 5.0	< 15
Hardness	mg/l	12.3	21.4	-	-
Nickel	mg/l	0.006	0.004	< 0.2	< 1.0
Copper	mg/l	0.010	0.022	< 0.2	< 1.0
Zinc	mg/l	0.167	0.167	< 1.0	< 3.0
Arsenic	mg/l	<0.001	<0.001	< 0.10	< 1.0
Cadmium	mg/l	<0.001	<0.001	< 0.1	< 0.5

Parameter	Unit	SW1	SW2	Protected public water area standard*	Public water area and sewer standard*
Lead	mg/l	0.004	0.003	< 0.1	< 1.0
Iron	mg/l	4.12	1.76	< 1.0	< 20
Mercury	mg/l	<0.001	<0.001	< 0.002	< 0.05

Source: Ministry of Environment and PGS Asia pacific Ltd. 2008.

5. Groundwater

30. Groundwater is used in Cambodia for both community and town water supply as well as for irrigation. The Mekong lowlands consist broadly of alluvial material overlying shale, slate and sandstone bedrock. The low hills and plateau areas are mostly underlain by igneous rocks and limestone. The depth of alluvium is 70 m or more. The alluvium consists of sandy silt in the upper part and of clayey silt in the lower. There are occasional sand beds of upto 1 m thickness. Two types of alluvium are recognized: an older one and a younger one. The younger alluvium is situated under the Mekong and Tonle Sap Lake flood Plain. Except for the occasional thin sandy beds and lenses, the alluvium has a low hydraulic conductivity and the yield is very low, typically 0.2 l/s. Yields from the sandy layer are higher, typically of the order of 1 l/s. The UNICEF wells for which records are available, many have a yield of more than 3 l/s, while less than 3% are reported with yields in excess of 10 m³/hr (2.7 l/s).

31. Groundwater in Cambodia generally has good quality, but high iron content and increasing salinity levels have been reported in Svay Rieng and southern Prey Veng Provinces. Also, water sampling in four provinces in northwestern and southern Cambodia shows that high levels of iron, TDS and fluoride are found in groundwater. Many shallow wells are contaminated by faecal coliforms. All water samples in Battambang failed to meet WHO water quality guidelines (Ground water quality standards have not been established in RGC). Contamination of water resources has led to frequent outbreaks of cholera.

32. According to report from MoE and PGS Asia Pacific Pte Ltd study on 'Onshore 2D Seismic Survey for Oil and Gas in the Tonle Sap Basin in year 2008' the results of surface and ground water quality testing of some location in Pursat province are shown in table below.

Table IV.6: Baseline Survey Sampling Locations in Pursat Province

Sample	District	Commune	Location	Lat	Long
Surface water - SW1	Kandieng	Sya	Pursat River	12°37.302'	104°00.394'
Groundwater - GW1	Kandieng	Kandieng	MRD/ADB well code no.07ADB 1502 036	12°35.200'	103°57.975'
Air & Noise - AN1	Kandieng	Sya	Banteyoun temple	12°37.324'	104°00.377'
Surface water - SW2	Phnom Kravanh	Leach Kravanh	Pursat River at PK Mt. Bridge	12°21.288'	103°45.373'
Groundwater - GW2	Phnom Kravanh	Leach Kravanh	Commune well installed 2001	12°21.910'	103°47.106'
Air & Noise - AN2	Phnom Kravanh	Leach Kravanh	House near Primary School	12°21.938'	103°47.100'

Source: Ministry of Environment and PGS Asia pacific Ltd. IEIA. 2008.

Table IV.7: Ground water (GW) Quality in Pursat Province

Parameter	Units	GW-1	GW-2	Standard
pH	-	6.48	7.26	6.5-9.2
TDS	mg/l	280	1118	1200
Oil & Grease	mg/l	0	0	-
Hardness	mg/l	309	372	500
Iron	mg/l	23.3	1.65	1.0
Nickel	mg/l	0.007	0.023	-
Copper	mg/l	0.020	0.050	1.5
Zinc	mg/l	0.024	0.383	15
Arsenic	mg/l	0.001	0.005	0.05
Cadmium	mg/l	<0.001	<0.001	0.01
Lead	mg/l	0.110	0.006	0.05
Mercury	mg/l	<0.001	<0.001	0.001

Source: Ministry of Environment and PGS Asia pacific Ltd, IEIA report, 2008.

6. Air Quality and Noise

a. Noise and Vibration

33. Currently in urban areas, there is a growing concern regarding increasingly poor air quality in Cambodia. Increased air pollution may be linked to the increase in the number of vehicles and industry. But air quality at the subproject site is good as these areas are located in rural areas and no industries are near the sites. There is no data available on air quality of the subproject areas. It is evident that there is very less air pollution at the subproject sites.

34. The noise levels on the sub-project sites are minimal. Like air quality there is no data on noise levels available in the sub-project areas. Both air quality and noise levels in subproject areas province are good.

35. According to report from MoE and PGS Asia Pacific Pte Ltd for study 'Onshore 2D Seismic Survey for Oil and Gas in the Tonle Sap Basin in year 2008', the Air and Noise Monitoring testing carried out at some of the locations in Pursat province and results are shown in the table below.

Table IV.8: Baseline Survey Sampling Locations in Pursat Province

Sample	District	Commune	Location	Lat	Long
Air & Noise – AN1	Kandieng	Sya	Banteyoun temple	12°37.324'	104°00.377'
Air & Noise – AN2	Phnom Kravanh	Leach Kravanh	House near Primary School	12°21.938'	103°47.100'

Source: Ministry of Environment and PGS Asia pacific Ltd, IEIA, 2008.

Table IV.9: Air and Noise Monitoring Results in Pursat Province

Parameter	AN-1	AN-2	Air Quality Standard*	Noise Standard*
TSP mg/m ³ N	0.46	1.55	0.33	-
Noise – L _{eq} -DAY (dB(A))	49.44	64.22	-	70
Noise – L _{eq} -EVENING (dB(A))	48.58	56.2	-	65
Noise – L _{eq} -NIGHT (dB(A))	52.87	50.5	-	50
Noise – L _{eq} -24hr Avg (dB(A))	50.25	54.44	-	60

*Cambodian Standard for the Control of Air Pollution and Noise Disturbance. 2000.

Source: Ministry of Environment and PGS Asia pacific Ltd. IEIA. 2008.

b. Air Quality

36. Across the country, only in Phnom Penh air quality is monitored regularly. All three monitoring points at Phnom Penh use passive tubes for 24 hours at the roadside. These stations are at Kbaltnal, Olympic and Tolkork. Carbon monoxide (CO), Nitrogen dioxide (NO₂), and Sulphur dioxide (SO₂) have been consistently monitored since the year 2000. Total suspended particulates (TSP) and PM with a diameter equal to or less than 10 micrometers (PM₁₀) are not routinely monitored. Ad-hoc air quality monitoring through research projects have also been done (Country Synthesis Report on Urban Air Quality Management. ADB. 2006).

37. Total suspended particulates (TSP) monitoring data for all locations indicate average concentration levels was 410 µg/m³, SO₂ from 8.0 to 216 µg/m³, NO₂ from 0.022-56.6 µg/m³, all values are within allowed standards, except TSP, 1.33 times exceed permissible value based Sub-Decree on Air Pollution Control and Noise Disturbance July, 2000- No : 42 ANRK, BK.

Table IV.10: Air Quality – Average values in Phnom Penh - 2006

Location		Year	TSP µg/m ³	PM ₁₀ µg/m ³	CO mg/m ³	SO ₂ µg/m ³	NO ₂ µg/m ³	Noise dBA
3 points Roadside in Phnom Penh	Average 24 hours	2005			4.32	106.6	0.022	
	Max				5.62	215.8	0.038	
Ambient Air Pollution in Phnom Penh	Average 24 hours	2002	410		3.5	7.8	30.19	
	Max		1000		5.71	13.0	56.60	
Ambient Air Quality- SUB- DECREE on Air Pollution Control and Noise Disturbance Oct, 2000	average 1 hour			Not applied	40	500	300	
	average 8 hour				20			
	average 24 hour		330	Not applied		300	100	Not applied

Source: Country Synthesis Report on Urban Air Quality Management. 2006. Asian Development Bank and Clean Air Initiative (CAI-Asia) Centre.

B. Ecological Resources and Sites of Archaeological Significance

1. Flora, Fauna and Biodiversity

a. Terrestrial fauna and flora

i. Forest

38. The flooded forest of the Tonle Sap of Mekong River Basin is the largest remaining example of this type of habitat in Southeast Asia. Despite the common name, this flooded forest is in fact a diverse unity of habitats, including shrub lands, stunted swamp forests, gallery forests, and submerged and floating aquatic vegetation. Approximately 200 plant species have been recorded and the flora as a whole is distinct from that of other wetlands associated with

the Mekong River, especially with regard to woody species. The flora of the Tonle Sap and its specific adaptations to withstand months of flooding are insufficiently studied and understood.

39. The forests resources in the site and immediate areas around the sub-projects are limited and a few in number, as the more sites are covered with rice fields, and the villagers are used to cultivate the receded rice in lowland areas in the Tonle Sap and Mekong Basin (Kratie and kandal subproject areas). For Pursat subproject area is almost covered by wet rice crop field in the plate upland areas. In and surrounding the sub-project sites, there are a few of forest resources such as: shrub-land, bamboo forest, grass land, and degraded forest-land in the upper watershed. The flooded forest land is covered in floodplain of Tonle Sap Lake and Mekong River Basin is far from subproject sites.

Figure IV.3: The Forest Resources are in the Canal Line and Wet Rice Field in Pursat Subproject



ii. Wildlife

40. Regarding to lack of forest resources in the sub-project areas, there are only a few wildlife reported. Only small common species of wildlife such as: common reptile, snakes species (cobra, King cobra, Black Marsh Turtle, and Asian Box Turtle) and many bird species were observed. Most of wildlife and water birds are reported in the protected areas in upland site and in TSBR. All these areas are located far away (more than 50 km) from the subproject area.

b. Aquatic life and fisheries

41. The Tonle Sap Lake is the most productive inland fisheries in the world and reportedly has a potential fish production of 65 kg/ha/year, based on the dry season area (FAO, 1994). Cambodia's inland fisheries are totally dependent on the seasonal increase in the water flow of the Mekong and other rivers that cause inundation of floodplains, forest and shrub-land. The increase of the area of the Tonle Sap Lake during the wet season ranges from 2,500-3,000 km² to 10,000-15,000 km² (NEDECO 1998, MoE 2004) and depth ranges from 1-2 meters to 8-10 meters, which has an immense effect on the fish production.

42. Aquatic ecosystems within the project area include year round and occasionally flooded rivers undergoing change over the annual cycle, upland streams, marshes, seasonally flooded fields and forests, ponds and impoundments that also vary in water depths and quality over the annual cycle.

i. Fish Migration

43. The important spawning areas for migratory fish are located in the northeast of Cambodia, while for spawning and feeding grounds the floodplains along the Tonle Sap Great Lake and the Mekong Delta, are important (Cambodia's Inland Fisheries, MRC 2004).

44. During the flood, fish migrate from downstream of Tonle Sap Great Lake and Mekong River to the floodplain areas of Tonle Sap and Mekong tributaries which have optimum pH and oxygen for spawning, growing and feeding. When water levels recede, during the dry season, fish migrate off to the floodplain and find refuge in deep pools in along the Mekong River, channels, and streams.

ii. Fish Catching Time

45. The freshwater capture fishery activity in Cambodia is divided into three categories:

- (i) large scale fishing, commercial fishing;
- (ii) middle scale fishing; and
- (iii) small scale subsistence or family fishery.

46. The fish catching period are described in the Fishery Law 2006. The large and medium scale activities are closed for many months during wet season for fish spawning. The official closed fishing season is from 1 June to 30 September for fishing area in north of Phnom Penh and from 1 July to 31 October for fishing area in south of Phnom Penh (MAFF 2006, Fishery Law Fishery Law, Article 16). The family fishery can catch fish whole year by using family fishing tools (MAFF 2006, Fishery Law Fishery Law; Article 3).

iii. Fish Species

47. There are many inland fish species in Cambodia, approximately 500 species are found in the Mekong River in Cambodia, but for any particular fishery most of the catch usually comprises 10 species or less, (Cambodia's Inland fisheries, MRC 2004). There are more than 200 fish species inhabit in the inland water of Cambodia and in Mekong Basin. Most of these fish are well adapted to a widely fluctuated water level, and a wide range of tolerance for temperature, pH, and dissolve oxygen (MoE, UNDP/ETAP, 1999). The major species of fish in Cambodia are normally divided into four groups:

- (i) species which are associated with the big rivers and Great Lake,
- (ii) species that are associated with the big rivers and streams but migrate to the flooded areas for spawning,
- (iii) species that can stay in the swamps and flooded plains all year round, and
- (iv) small fast growing and opportunistic species, which are able to utilize the flood period for rapid growth.

48. Regarding the field visits and discussions with local people about the fish species in the sub-project areas, mostly has the same species in the tributaries of Tonle Sap and Mekong flooded areas.

Figure IV.4: Some Fish Species Found in Sub-project Areas

49. Regarding Fish Species in Cambodia, Department of Fishery, 2001 and 2006, and Cambodia's Inland Fish MRC 2004, there are some important inland fish species usually seen in the Lower Mekong River and floodplain areas of Cambodia, which are depicted in Table 4.11.

Table IV.11: Example of some Fish Species, usually seen in River Basin and Flood Plains of Cambodia

Sl. No.	Khmer/Local name	Species/Scientific name	Family name
1	Trey Kraiy	Chitala	Notopteridae
2	Trey Slat	Notopterus notopterus	Notopterrus
3	Trey Reil	Henicorhynchus siamensis	Cyprinidae
4	Trey Kros	Osteochilus Microcehalus	Cyprinidae
5	Trey Chrakang	Puntioplites Proctozyron	Cyprinidae
6	Trey Chhpen	Hypsibarbus Lagleri	Cyprinidae
7	Trey Thman	Hampala Macrolepidota	Cyprinidae
8	Trey Leang	Thynnichthys Thynnoides	Cyprinidae
9	Trey Khaek	Morulus Chrysophekaion	Cyprinidae
10	Trey Krom	Osteochilus Melanopleurus	Cyprinidae
11	Trey Chhkork	Cyclocheilichthys Enoplos	Cyprinidae
12	Trey Kahei	Barbodes Altus	Cyprinidae
13	Trey Chan Va	Rasbora Myersi	Cyprinidae
14	Trey Chanva Moul	Rasbora Aurotaenia	Cyprinidae
15	Trey Pon Loug	Leptobarbus Hoeveni	Cyprinidae
16	Trey Khnang Veng	Dangila Lineata	Cyprinidae
17	Trey Proma	Boesemania Microlepis	Sdaennidae
18	Trey Phtong	Xenentodon Cancila	Belonidae
19	Trey Andat Chhke	Euryglossa Orientalis	Soledae
20	Trey Kampot	Chonerthinos Nefastus	Tetraodontidae
21	Trey Kass	Micronema Micronema	Siluridae
22	Trey Sanday	Wallago Attu	Siluridae
23	Trey Kromorm	Ompok Bimaculatus	Siluridae
24	Trey Ta Aun	Ompok Hypophthalmus	Siluridae
25	Trey Kdainhay	Belodontichthys Dinema	Siluridae
26	Trey Pra	Pagasianodon Hypophthalmus	Pangasiidae
27	Trey Por	Pangasiys Lamaudiei	Pangasiidae
28	Trey Chhveat	Pangasiys Pleurotaenia	Pangasiidae
29	Trey Chhlaing	Mystus Nemurus	Begridae
30	Trey Kachoch	Mystus Wotffi	Begridae
31	Trey Chhloch	Macragnathus Siamensis	Mastacembelidae
32	Trey Khcheng	Mastacembelus Armatus	Mastacembelidae
33	Trey Kachrouk	Botia Modesta	Cobitidae
34	Trey Deap/Chhdor	Channa Micropeltes	Channidae
35	Trey Rous	Channa	Channidae
36	Trey Andaing	Clarias batrachus	Clariidae
37	Trey Kantrawb	Pristolepis fasciata	Nandidae
38	Trey Kampheach	Trichogaster Microlepis	Belontiidae
39	Trey Kanthor	Trichogaster Microlepis	Belontiidae
40	Trey Kranch	Anabas Testudineus	
41	Trey Damrey	Oxyeleotris Marmorata	

Sources: Cambodia fish species, 2001 and 2006, FD/MAFF. Cambodia's Inland Fish MRC 2004.

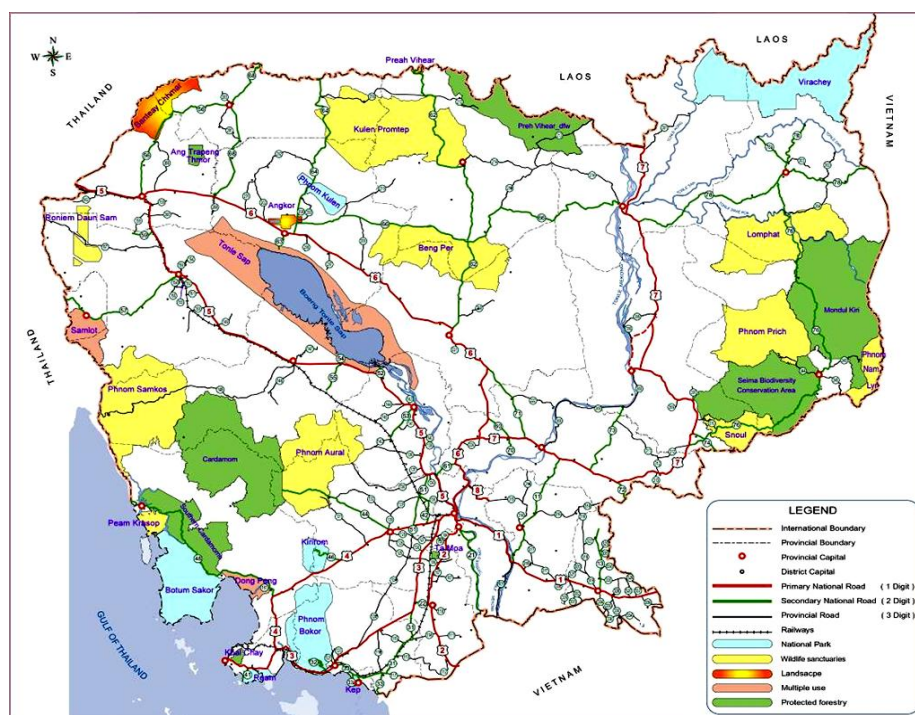
2. Protected Areas

50. There are 23 protected areas in Cambodia. All protected areas and protected forests are located in upland areas, except Tonle Sap Biosphere Reserve (TSBR) which is located in Tonle Sap Great Lake of Lower Mekong River Basin. All the protected areas are far from the subproject sites.

Table IV.12: List of Protected Area in Cambodia

No	Protected Area's Name	Area (ha)	Location
A. National Parks			
1	Kirirom	35,000	Kampong Speu and Koh Kong
2	Phnom Bokor	140,000	Kampot
3	Kep	5,000	Ket
4	Ream	150,000	Kampong Som (Preachsihanouk)
5	Botum Sakor	171,250	Kampong Som and Koh Kong
6	Phnom Kulen	37,500	Siem Reap
7	Virachey	332,500	Rattanakiri and Stung Treng
B. Wildlife Sanctuaries			
8	Aural	253,750	Koh Kong, Pursat, Kamp Chhnang and Kamg Speu
9	Boeung Per	242,500	Kampong Thom and Preach Vihear
10	Peam Krasop	23,750	Koh Kong
11	Phnom Samkos	333,750	Koh Kong
12	Roniem Daun Sam	178,750	Battambang
13	Kulen Promtep	402,500	Siem Reap and Preah Vihaer
14	Lomphat	250,000	Rattanakiri and Mondolkiri
15	Phnom Prich	222,500	Mondolkiri
16	Phnom Nam Lyr	47,500	Mondolkiri
17	Snuol	75,000	Kratie and Mondolkiri
C. Protected Landscapes			
18	Angkor	10,800	Siem Reap
19	Banteay Chhmar	81,200	Banteay meanchey
20	Preah Vihear	5,000	Preach Vihear
D. Multiple Use Area			
21	Dong Peng	27,700	Koh Kong
22	Samlaut	60,000	Battambang and Pailin
23	Tonle Sap	316,250	Kamp.Chhnang, Kamp.Thom, Siem Reap, Battambang, and Pursat

Figure IV.5: Map of Protected Areas in Cambodia

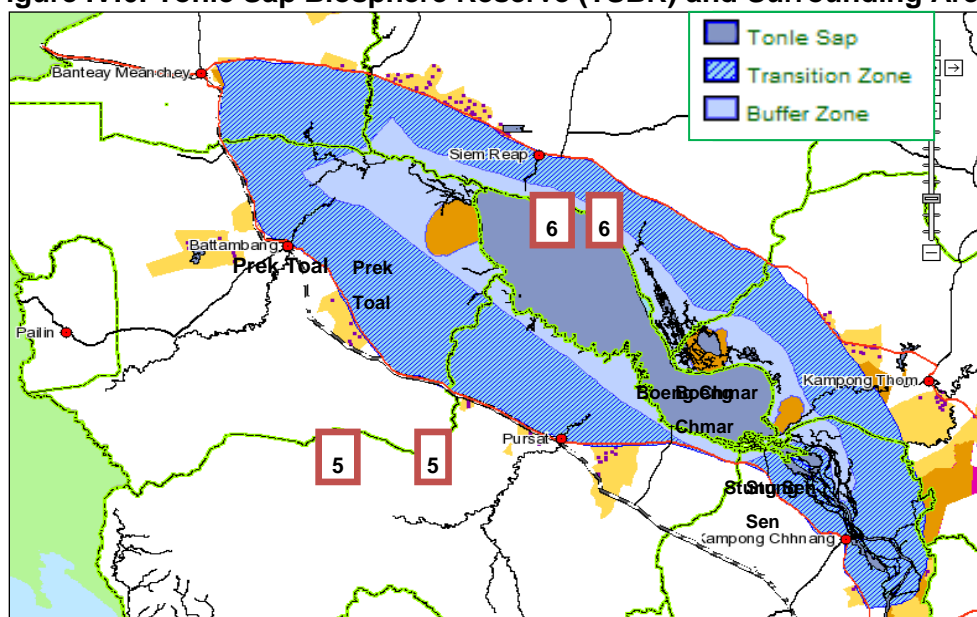


a. Tonle Sap Biosphere Reserve (TSBR)

51. The Tonle Sap is of great significance to the Cambodian people, and is often described as the heart of the country's culture and economy. Ancient Khmer civilization, exemplified by the Angkorian temple complexes, was based on the shores of the Tonle Sap, and the two products that formed the basis of this civilization are still produced in abundance, namely rice and fish.

52. The geographical scope of this project will be limited to the existing roads, of which National Road No. 5 and 6 form the boundary of the Transition Zone of the Tonle Sap Biosphere Reserve (TSBR). The one proposed sub-project is located in Pursat province in the Transition Zone of the TSBR is far from Buffer Zone and the three (3) core zone areas of the TSBR are Prek Toal, Boeng Chhmar, and Stung Sen Core Zone.

53. The Royal Decree in April 2001 was for establishing and managing the Tonle Sap Biosphere Reserve (TSBR) and the Prime Minister's Sub-decree (September 2001) on the establishment, role and functions of the TSBR Secretariat clearly recognize that the objectives of the TSBR will not be achieved without coordination and cooperation of relevant stakeholders.

Figure IV.6: Tonle Sap Biosphere Reserve (TSBR) and Surrounding Areas

C. Human and Economic Development

1. Population

54. The total population of Cambodia is about 14.163 million, of which 52% are female and 48% are male. The population growth rate is 2.5% per year, which is relatively higher in comparison to neighbouring countries and the third highest amongst the ASEAN member states. The population and provincial profile of the 03 provinces (Pursat, Kratie, and Dandal province) in the subproject areas is shown in table below.

55. As per National Institute of Statistic (NIS) data, the Khmer is a ethnic residents, which represents 90% of a total population, 5% is Chinese, Vietnamese is 5%, and small number is Cham, Burmese, and hill tribes (ethnic/minority).

Table IV.13: Ethnic group in Cambodia

Group	Khmer	Chinese	Vietnamese	Hill tribes (ethnicity)	Cham	Burmese
Percentage	90%	5%	5%	Small	Small	Small
Living place	Across the country	Urban 60% Rural 40%	Central and southeastern	Northeastern	Across	

Source: National Institute of Statistic. 2003.

56. The population and provincial profile of Pursat province is shown in table below.

Table IV.14: Population in Pursat province

Province	Areas (km ²)	Population					
		District	Commune	Family	Total	Male	Female
Pursat	12,692	6	49	75,538	383,709	188,670	195,039

Source: Siela Data, 2005 and National Institute of Statistics (NIS). 2008.

57. **The Damnak Chhoeunkrom irrigated canal system area.** The sub-project is located in Phtas Rung and Samraong commune, Phnom Kravach district and Ta lou commune Bakan district, Pursat. Four (4) villages of Phteah Rung commune, 5 villages of Samraong commune in Phnom Kravach district, and 6 villages of Ta Lou commune in Bakan will get benefits from Pursat sub-project. The population of these villages are presented in table below:

Table IV.15: Population in Damnak Chheukrom Irrigation Area

District	Commune	Village	Family	Female	Men	T. Population
Phnum	Phteah Rung	Phteah Rung	170	803	648	1451
	Kravanh	Phteah Rung	129	305	340	645
Bakan	Phteah Rung	Chong Ruk	326	792	730	1522
		Chrey Krem	181	454	452	906
	Samraong	Preaek Muoy	367	938	845	1783
		Preaek Bei	208	543	535	1078
	Samraong	Ou Heng	177	436	349	785
	Samraong	Samraong Muoy	115	409	354	763
	Samraong	Samraong Pir	346	1005	874	1879
	Ta Lou	Thmei	223	554	488	1042
		Boas Kor	172	510	602	1112
		Brohal	302	906	879	1785
		Rohaltel	294	640	710	1350
	Ta Lou	Prey kantout	202	514	519	1033
		Taing kok	119	298	314	612

Source: Commune data. 2009.

2. Economic Development

58. Agriculture is most important for social economical development, especially for people who are living in the rural areas. About 85% of the total population are farmers and living in rural areas, and 75% of which are engaged in agricultural sector. The GDP has been increasing for the 3 years consecutively since 2004. The major factors of economic growth are garments, tourism, construction and agriculture.

Table IV.16: Growth rate in GDP of Cambodia

Year	2004	2005	2006
Agriculture	11.1	16.4	4.4
Industry & Construction	16.8	12.3	17.1
Garments	24.9	10.3	21.9
Services	11.7	12.1	11.4
Tourism	23.4	17.3	23.2
Total GDP	10.0	13.4	10.4

Source: Cambodia Economic Watch. 2007. EIC.

59. Cambodian people are employed in agricultural sector and their villages are usually located in lowland area, because the soil is more fertile so intent for agricultural work. Chinese like to live in cities and towns and doing business or rather small scale business such as: shopkeepers, processors (buy and sell) of rice, fish, fruit, and money lenders. The Vietnamese prefer to live in central and south-eastern country; Phnom Penh, Kandal, Kampong Cham, and Prey Veng province. Other Vietnamese community lives along lower Mekong, Bassac River and Tonle Sap Great Lake, where they are involved in fishing.

3. Income, employment and poverty incidence

60. In 2004, an estimated 35% of the population was below the national poverty line. The methodology used is per capita consumption threshold to define the poor, which also reflects regional differences in the cost of achieving food and non-food consumption levels. For food in particular, the line is based on the cost of a food basket yielding about 2,100 calories, a basket that is more expensive in urban areas. The results give poverty line estimates, in 2004, ranging from about \$160 per capita in rural areas to a high of \$215 in Phnom Penh (this compared with a GDP per capita of about \$375 in 2004). On this basis, estimated 4.75 million people were poor in 2004, out of a total population of about 13.5 million.

61. According to 2004 CSES, total employed population was 7.5 million. The agriculture sector accounted for approximately 60.3% of employment, the industrial sector for 12.5% and the service sector for 27.2%. Approximately 68.1% of employed persons in rural areas worked in the agriculture sector, as compared to 2.6% and 40.3% of employed persons in Phnom Penh and other urban areas, respectively (NIS, 2006).

62. **The Subproject Areas.** Most people are living in Damnak Chhoeukrom subproject on Pursat and the irrigation expansion areas in Battambang prefer to grow wet rice. The wet rice crop in this area is divided by 3 seeds:

- (i) short time rice - taking 3 months, and now they plant about 60% of total rice field,
- (ii) medium time rice - taking 4 months, and now they plant about 20% of total rice field, and
- (iii) long time rice - taking 5 or 6 months, and now they plant about 20% of total rice field.

63. The wet rice start to grow in May and its harvesting time is till November, depending upon rice seed types and dry rice is planted from November on small sizes of land which are located near the canals. Other jobs involve growing fruits and other crops in small size for supporting their families while a few families are engaged in their own local business. They do fishing in their free time.

4. Land Use

64. Land use is of special relevance to Cambodia's socio-economic development, as 85% of population relies on agriculture and natural resources extraction for their primary livelihoods. The major economic uses that dominate rural land include rice paddy culture, small-scale aquaculture, and freshwater capture fisheries, the collection of fuel wood and foraged items, and timber harvesting. The land use area classification in Cambodia is shown in Table 4.17:

Table IV.17: Land use area distribution in Cambodia

Category	Area (million ha)	Percentage %
Forest	11.1	61.3
- Forest concession	3.3	18
- Protected area	3.3	18
- Protected forest	1.3	7.5
- Other forest	3.3	17.8
Cultivated areas	2.7	14.9

Category	Area (million ha)	Percentage %
Shrub land	1.4	7.7
Fishing concessions	1.0	5.5
Towns	1.0	5.5
Agricultural concessions	0.81	4.5
Land mine/UXO area	0.1	0.6
Total	18.1	100

Source: MAFF. 2003. (MoE/DANIDA, 2004).

Table IV.18: Forest cover and other land use in Pursat Province

Forest Types	Kandal	
	Area (ha)	%
Evergreen	0	0.0
Semi-evergreen	0	0.0
Deciduous	287	0.1
Wood Shrubland Dry	228	0.1
Wood Shrubland evergreen	0	0.0
Bamboo	0	0.0
Other Forest	30,952	8.7
Total Forest	31,467	8.8
Non Forest	324,907	91.2
Total Area	356,374	100

Source: Forest Administration. 2005.

Note: Other Forest: This land cover type includes re-growth, wood and shrub-land, stunted forest, bamboo forests, mangrove forests, inundated forest, and industrial forest plantations.

Non-Forest: This category merges agricultural areas, urban areas, bodies of water, and grassland.

5. Education and Health

65. Most Cambodian children attend some schooling, but a large share complete only a few grades-with 85% of 15 to 19 year olds completing only grade 1, while only 27% complete grade 7. There are also disparities in education participation rates by different regions, income groups and gender. Inefficiency and poor quality in education service delivery at primary, secondary and tertiary levels, weak local management capacity and a lack of reliability in education finance disbursement are other major challenges in the sector.¹

6. Access to water supply

66. The subproject areas are located in rural areas; traditionally use Rivers, lakes, ponds, and shallow dug, wells for their domestic water needs as there are no water treatment plants. In the rainy season, some people mainly use rainwater for drinking and cooking. Access to clean drinking water supplies varies significantly throughout the country. In year 2007, it was reported across the country, over 30% of the people in the rural areas lack access to clean water. In the urban areas water is also taken from surface sources. In Phnom Penh city, water is taken from the Mekong, Bassac, and Tonle Sap Rivers and is treated by three treatment plants, which have a production capacity is about 80,000 m³/day.

67. Access to sanitation and safe drinking water are the major indicators used for managing and controlling diseases such as Cholera, Diarrhea, and other water borne diseases. In whole Cambodia country, approximate 23.3% of total households have access to safe drinking water,

¹ World Bank Program. 2007. Education in Cambodia.

whereas in three sub-project provinces: 36.3% in Kandal, 32.8% in Kratie, 12.3% in Pursat have access to safe drinking water.

Table IV.19: Percentage of Households in 3 Provincial Sub-projects with Access to Safe Drinking Water

Province	Percentage of Household with Access Safe Drinking Water		
	Total (%)	Urban (%)	Rural (%)
Kandal	36.3	78	34
Kratie	32.8	46.3	27
Pursat	12.3	33.3	8.3
Whole country	23.2	47.5	19.8

Source: National Institute of Statistic. 2003.

7. Sanitation and Solid Waste Management

68. According to an estimate by UNICEF, the rural sanitation coverage in Cambodia is only 8%, making it the lowest in the region and the second lowest excluding of Africa. In the absence of sanitation facilities, most rural dwellers use rice paddies, banana groves, and other water sources to dispose of their own waste - thus polluting the water on which they depend (Source: Sanitation in Cambodia-UNICEF).

8. Public Health

69. The mission of the MOH is to ensure sector-wide, equitable, and quality healthcare for all people of Cambodia through targeting resources, especially for the poor and areas of greatest need. Health policy asserts that all people in Cambodia, regardless of gender, age, residence, or financial ability, should have access to good healthcare and information. The MOH administers health services through 24 Provincial Health Departments (PHD), 76 Operational Districts (OD), 69 referral hospitals, and 966 health centres (HC). NGO and private practitioners also provide health services.

70. The violent civil war decimated health infrastructure, personnel, and services. In 1991, Cambodia began rebuilding its political, social, and economic structures. However, the public health system is struggling to meet the needs of its population. Many revert to unregulated and often costly private healthcare providers.

71. Cambodia's high fertility, morbidity, and mortality rates compromise government efforts to achieve a just and peaceful society, and raise the living standard of Cambodians. Further reductions in mortality, especially among low-income mothers and children, are fundamental to socio-economic development and poverty reduction in Cambodia.

72. The proposed subproject areas are located in rural areas with low population density. The main sources of water supply are dug wells, streams, and rivers, sometimes these sources of water get polluted due to sewage, solid waste, agricultural development, and due to open defecation from households. Regarding National Health statistics 2001 by Ministry of Health, the common water related diseases in Cambodia are Malaria (4.72%), Diarrhea (3.83%), Dysentery (1.23%), Typhoid (2.19%), and Cholera (0.03%).

9. Transportation

73. Of the current total in Cambodia, only about 50% of the roads and highways were covered with asphalt and were in good condition; about 50% of the roads were made of crushed

stone, gravel, or improved earth; and the remaining approximately 30% were unimproved earth or were little more than tracks. Cambodia is upgrading the main highways to international standards and most are vastly improved since 2006. Most main roads are now paved and road construction is ongoing from the Thailand border at Poipet to Siem Reap (Angkor Wat).

74. Transportation is an essential element having direct influence on economy. The transportation in Cambodia is divided into land, water, and air transport; and the most used transportation for domestic and local is road transport. Cambodia's roads are divided as: national roads, provincial roads, regional roads, and rural roads.

75. Following Decree (PRAKAS) No. 307 by Ministry of Public Work and Transport (MPWT) 2009, national, provincial and regional roads are responsibility of MPWT.

76. **National road** is identified as:

- (i) the road joins from Phnom Penh to each provincial town
- (ii) the road joins from a provincial town to another provincial town
- (iii) the road joins from national road to national road
- (iv) the road isolates from national road to another provincial town
- (v) the road joins from national road to special areas such as: port, airport, train-station, tourist area, bordering point, and economical zone.

77. **Provincial road** is identified as:

- (i) the road joins from town a provincial town to district
- (ii) the road joins from national road to province
- (iii) the road joins from a provincial or town road to district town
- (iv) the road joins from provincial town to provincial road
- (v) the road isolates from provincial road to provincial road
- (vi) the road joins from provincial road to special areas such as: port, airport, train-station, tourist area, bordering point, and economical zone.

78. The **regional road** is the road that joins with neighbouring countries in region and is identified as international condition.

79. The rural roads (district and commune road) are the responsibility of Ministry of Rural Development (MRD) and MRD collaborates with local authorities as district, commune, and village authority. The rural roads seem very popular among rural people in Cambodia and sometime their building used to attract the support from the local people by budget of the government, donors, NGOs, generous people, and political parties. However, the rural roads are not enough access yet to serve the economic and social welfare demand of local residents. Thus, there is still a need to build more roads and enlarge the roads as demand increases and the economy grows from day to day, even less or more.

10. Industrial Development

80. There are no industrial sites or factories located in or near the sub-project areas as in Cambodia most industrial activities are located in urban areas like in Phnom Penh, Sihanouk province.

11. Tourism Resources

81. The result of field survey and assessment in the Pursat, Kratie, and Kandal of proposed sub-project areas show that there are no tourism resources located close to subproject sites. In Kratie province the Mekong Dolphin Conservation Place is about 16 km upstream of River Bank Protection Subproject.

12. Cultural Archaeological Resources

82. Table IV.20 gives the details of cultural properties in the project area.

Table IV.20: Pagodas and temples located near Sub-Project areas

Sl. No	Pagoda/Temple	Province	District	Village/Commune	Estimated distance from Subproject
1	Sarey Kong Kear Pagoda	Pursat	Phnom Kravach	Samrong	2.5 km from canal
2	Boeung Preah Ponlea Pagod	Pursat	Phnom Kravach	Phteah Rung	200 m from canal
3	Sras Rum Dagn Pagoda	Pursat	Phnom Kravach	Phteah Rung	2.5 km from canal
4	Chhoun Rouk	Pursat	Phnom Kravach	Phteah Rung	2 km from canal
5	Sam San Pagoda	Pursat	Bakan	Ta Lor	100 m from canal
6	Boeung Stock Pagoda	Pursat	Bakan	Ta Lor	200 m from canal
7	Damnak Trop Pagoda	Pursat	Bakan	Ta Lor	400 m from canal
8	Bro Hal Pagoda	Pursat	Bakan	Ta Lor	150 m from canal

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. General Potential Environmental Impacts

83. There are two proposed subproject investments for the Greater Mekong Subregion in Cambodia which include: (i) Subproject of Irrigation Development in Pursat Province, and (ii) Pursat Irrigation Expansion Project in Battambang Province.

1. Positive Impacts

84. Main positive impacts for all subprojects are as follows:

- (i) To irrigate a net area of 16,000 ha by Damnak Chhoeu Krom system and possible expansion to 37,000ha in Battambang province
- (ii) Beneficiaries from the sub-projects will be significant, it is estimated:
 - a. 49 communes, 75,538 households, and supplementary wet irrigation of 16,000 ha net area from subproject of Damnak ChhoeuKrom Irrigation Project in Pursat Province;
 - b. exact number of beneficiaries by the Pursat Irrigation Expansion is to be estimated during detailed design phase

2. Negative Impacts

85. In general, negative impacts are foreseen during the construction phase such as increase in noise and dust level, pollution of surface water from discharge of wastewater, disturbance of contaminated soils, effects on traffic and social-economic activities of local people. However, most of negative impacts would occur for the short time, temporary with less level of intensity because of the low population density and road traffic in the subproject areas. Mitigating measures could easily be taken to minimize the impacts. In the following sections a brief description of the main impacts is described.

86. Subprojects of Damnak ChhoeuKrom Irrigation Project in Pursat Province and Irrigation Expansion in Battambang Province:

- (i) Loss of land both temporary and permanent, mostly comprised of agricultural land;
- (ii) Relocation of affected household with moderate level. According to survey results of resettlement group, 103 households will be relocated while building main and secondary canal;
- (iii) Increase in dust level due to excavation, filling and transport work but will cause a small level impact as the population density is low;
- (iv) Effect the water quality of downstream of barrage or the adjacent area due to mainly increase of turbidity, and wastewater from the construction site and camp;
- (v) Aquatic flora and fauna will be indirectly affected; and
- (vi) Fishes migration will be affected by building of barrage on Pursat River during both construction and operation phases; and affecting the fish spawning in the Pursat River, which would reduce fish yield in the future.

87. **For all subprojects.** The two structural subprojects are related projects in Pursat and Battambang Provinces. The Damnak Chhoeu Krom (Pursat) Irrigation Subproject will be

expanded to irrigate additional areas in Battambang Province as part of the second sub-project. Exhaust fumes are mainly generated from construction machinery like compactors, excavators, generators; Exhaust fumes include NO_x, CO_x, Hydro Carbon. Scope of impacts is considered to be of small because number of machinery is small, and construction area is rather large and presents characteristics of rural areas of Pursat and Battambang Provinces with low population density, concentration level of dust and air quality are still not polluted due to less traffic volume and no industries are near the sites, So GHG emissions caused by the Project will be very insignificant.

B. Impacts and Mitigation Measures during Pre-Construction Phase

88. **Unexploded Ordnance (UXO).** In the case of both subprojects in Pursat and Battambang provinces, the UXO will be required to be cleared by CMAX (Cambodian Mine Action Centre) before project construction commence.

89. **Land Acquisition and Resettlement.** During pre-construction, the subprojects may be affected due to land acquisitions and some houses (most of these houses are cottages) need to be acquired.

90. The potential adverse environmental impacts and the proposed mitigation measures related to Project Location and Design (Pre-Construction Phase) of the Subprojects are presented in Table V.1.

91. The following abbreviations are used:

- (i) N: not applicable, no adverse effect;
- (ii) S: small/slight adverse effect;
- (iii) M: moderate adverse effect; and
- (iv) L: large adverse effect.

Table V.1: Subprojects in Pursat and Battambang Provinces - Pre-Construction Phase

SUBPROJECT <i>major characteristics of new outlet</i>	PROJECT ACTIVITIES	No	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	REMARKS	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
<ul style="list-style-type: none"> • Reconstruction of diversion structure (barrage) - 1 no. • Reconstruction of main canal- 25 km • Reconstruction of secondary canal No. 1 -14 km • Reconstruction of secondary canal No. 2 -12 km • Reconstruction of secondary canal No. 3 - 13 km 	Site selection and design	1	Land acquisition requirements & displacement of local residents	Land acquisition requirement will lead to loss of agricultural land	S	<ul style="list-style-type: none"> ▪ Prepare Resettlement Plan (RP) based on an agreed resettlement and compensation framework & implement accordingly
	Surveys and site investigations	2	Displacement of local residents	103 HHs to be relocated	S	
	Land acquisition	3	Proximity to human settlement	Human settlements not disturbed	N	<ul style="list-style-type: none"> ▪ It is not required
		4	Proximity to environmentally	No nature	N	<ul style="list-style-type: none"> ▪ It is not

SUBPROJECT <i>major characteristics of new outlet</i>	PROJECT ACTIVITIES	No	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	REMARKS	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
<ul style="list-style-type: none"> • Reconstruction of secondary canal No. 4 -13 km • Construction of intake structure - 1 no. • Construction of head regulators - 4 nos. • Construction of cross regulators - 4 nos. • Construction of check structures - 4 nos. • Construction of canal crossing structures - 6 nos. • Irrigation Expansion to about 37,000ha in Battambang Province 			sensitive areas / areas with aesthetic value	reserve at or nearby the sub-project sites		required
		5	Proximity to ethnic minority community	Not present	N	
		6	Proximity to natural habitats	Fishes migration will be affected by building of Coffe dam	S	<ul style="list-style-type: none"> ▪ Proper design and O&M
		7	Effect on historical / cultural monuments, grave yards	Historic / cultural monuments, grave yards not present	N	<ul style="list-style-type: none"> ▪ It is not required
		8	Changing land values	No or slight effect	N	
		9	Conflicts with other water users	No conflict with other users	N	
		10	Degradation of water quality	Construction of coffer dam, main canal, secondary canal, regulator .not affect to water quality	N	
		11	Degradation of fisheries	Negative Fishes migration will be affected by building of Coffe dam, Positive Creation of water source for aquaculture sustainably in due to water	S	<ul style="list-style-type: none"> ▪ Proper design and O&M

SUBPROJECT <i>major characteristics of new outlet</i>	PROJECT ACTIVITIES	No	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	REMARKS	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
				storage in dry season		
		12	Degradation of navigation / river transport	River transport is not available.	N	
		13	Vulnerability to erosion / landslide	Construction in flat area	S	▪ Proper design and O&M
		15	Risk for earthquakes		N	
		16	Accessibility to trunk infrastructure			
			Road	Construction material mainly to be transported by existing road Type of proposed coffer dam will be earth dam	N	
			Water supply		N	
			Power supply		N	

C. Impacts and Mitigation Measures during the Construction Phase

92. Some short-term and small negative environmental impacts could occur during the construction phase. The activities of construction of dams, regulator, canals for irrigation, may affect the natural and socio-economical environments, in case proper construction management not administered. Potential adverse environmental impacts that could result from activities during the Construction Phase are briefly discussed below and further presented in Table V.2.

93. **Air Quality/ Dust and Noise.** There could be an increase in dust, air pollution and noise from clearing, grubbing and excavation activities and movements of construction equipment (heavy trucks, bulldozers, backhoes, etc.). Emissions and noise from operation of construction equipment might have a considerable impact in residential area, especially densely populated areas, however the population in the Project Area near the subproject sites is not dense and dust, air pollution and noise can be controlled and mitigated.

94. **Water Resources and Water Quality.** Excavation and filling activities could be because of increase of turbidity in downstream of the canal or the adjacent area in general. For Damnak Chhoeukrom sub-project in Pursat province, the subproject will construct dam, regulator, canals, and any irrigation structures along the canals. So flow regime of Pursat River will be affected by construction diversion coffer during building barrage and regulator system across the river. For sub-projects in Kratie and Kandal provinces flow regime will not be impacted, because the construction phase will be implemented in dry season and during that time in there will be no water at the construction sites.

95. Water quality during construction may get affected by construction camp's wastewater and leak oil spillages and fuel into water bodies. Also water quality will be polluted by soil erosion from construction activities, while constructing dikes, excavating top soil and digging canals. All the impacts on water quality are small and of short term, because construction time will be operational during dry season only.

96. **Flooding and Spills.** Flooding and spills could be caused due to inadequate management of building materials, removed topsoil, stockpiles and construction debris. Proper management can avoid these impacts and if once already occurred mitigation measures should be taken. Deposits of construction wastes in nearby water bodies might have a detrimental effect to aquatic flora and fauna and should be therefore avoided.

97. **Socio-economic Environment.** Noise from construction activities, traffic congestions caused by transportation of construction materials, and accidents caused by trucks are potential adverse impacts could disrupt the socio-economic activities. However, the subproject sites are not situated in densely populated area. With a proper Traffic Management Plan and proper environmental management and monitoring, these impacts can be prevented and mitigated.

98. **Positive Impacts.** Temporary positive impacts include short-term employment of local population in construction activities and increased earnings in services in the vicinity of the construction sites. A permanent positive impact is the improvement of the functioning of the Mekong dyke embankment system and could be increased employment for local residents in the operational services for the Subproject for Vientiane Flood and Drought Mitigation and subprojects in Saravance, Savanakheth, Champasak, and Bolikhamsay Provinces.

99. In tables the following abbreviations are used:

- (i) N: not applicable, no adverse effect;
- (ii) S: small/slight adverse effect;
- (iii) M: moderate adverse effect;
- (iv) L: large adverse effect.

Table V.2: Subprojects in Pursat and Battambang Provinces - Construction Phase

SUBPROJECT major characteristics of the subprojects	PROJECT ACTIVITIES	POTENTIAL ADVERSE IMPACTS Socio-economic and physical/biological aspects	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES	
<ul style="list-style-type: none">• Reconstruction of diversion structure (barrage) - 1 no.• Reconstruction of main canal- 25 km• Reconstruction of secondary canal No. 1 - 14 km• Reconstruction of secondary canal No. 2 - 12 km• Reconstruction of secondary canal No. 3 - 13 km• Reconstruction of secondary canal No. 4 - 13 km• Construction of intake structure -1 no.• Construction of head regulators -4 nos.• Construction of cross regulators - 4 nos.• Construction of check structures - 4 nos.• Construction of canal crossing structures - 6 nos.• Irrigation Expansion to about 37,000 ha in Battambang Province	Base camp establishment and operation	1 Physical / Chemical Environment			
	Land clearance	<i>Air Quality</i>			
		Pollution by construction material exploitation activities	- Dust	M Temporary	<ul style="list-style-type: none">▪ Regular watering of exposed areas▪ Cover all trucks carrying dispersible materials to or from the site;▪ Ensure all construction vehicles and equipment are well-maintained;▪ Construction activities which can make noise should be carried out at day time;▪ Inform local community about schedule and duration of construction works;▪ Regarding to other material for construction such as sand, stone, contractor should choose legal service providers who had exploitation licenses and environmental protection commitment issued by local authorities;
		Pollution by construction material and solid waste transportation	- Odour	S Temporary	
		Earthworks / excavations	- Noise	S Temporary	
	Haulage of fill and construction materials				
	Effects from temporary storage yards of construction materials	<i>Water resources and quality</i>			
	Access Road construction	- Degeneration / contamination of surface water	S Temporary	<ul style="list-style-type: none">▪ Create drains & bund temporary to avoid spread of polluted alum water from filling & excavated alum soil ,▪ Diversion drains & bunds, temporary silt traps, ponds▪ Stockpiling of spoils in flat areas & far from drainage routes▪ Disposing of unwanted spoils as soon as possible▪ Adequate temporary toilet facilities with adequate water supply & strict enforcement of proper sanitation▪ Adequate temporary toilet	
		Drainage structures			

SUBPROJECT <i>major characteristics of the subprojects</i>	PROJECT ACTIVITIES	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
				<p>facilities with adequate water supply & strict enforcement of proper sanitation</p> <ul style="list-style-type: none"> Temporary disposal system for solid & hazardous waste
		- Generation of sewage / wastewater	S-M Temporary	<ul style="list-style-type: none"> Adequate water supply to meet construction needs & setting up of rain catchment tanks Adequate temporary toilet facilities with adequate water supply & strict enforcement of proper sanitation
		- Generation of solid wastes	S Temporary	<ul style="list-style-type: none"> Establish temporary latrines which meet regulations of Health Ministry and supply enough water to tents; Discussing with residents to choose the suitable waste dumping site when workers build camps; Collect solid wastes and temporary store at a safety place before transporting to disposal sites; Establish regulations on ensuring sanitation, stipulated dumping yard and waste treatment methods and disseminate those regulations to workers
		- Siltation / erosion	S Temporary	<ul style="list-style-type: none"> Install diversion drains & bunds, temporary silt traps/pond Stockpiling of spoil in flat areas & far from drainage routes
		Interruption of water flows due to building barrage	S	<ul style="list-style-type: none"> Install construction diversion canal
		2 Biological Environment		
		- Impairment of Sensitive vegetation / other natural habitats (affect to fish moving)	S	<ul style="list-style-type: none"> Setting temporary construction canal
		-Impairment of aquatic flora & fauna	S	<ul style="list-style-type: none"> Adequate temporary toilet facilities with adequate water

SUBPROJECT <i>major characteristics of the subprojects</i>	PROJECT ACTIVITIES	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
		downstream		supply & strict enforcement of proper sanitation ▪ Temporary disposal system for solid & hazardous waste
		- Loss of vegetation	N Temporary	▪ None required
		3.Socio-Economic Environment		
		-Traffic congestion (population density is low)	S Temporary	<ul style="list-style-type: none"> ▪ Strict enforcement of traffic rules & regulations ▪ Installation of traffic aides in critical routes during peak hours ▪ Coordination of traffic management plan with commune officials ▪ Posting of prior notice on construction schedules & traffic rerouting plan (at least a week prior to effective / implementation dates)
		- Public inconveniences. disruption of utility services	S Temporary	<ul style="list-style-type: none"> ▪ Traffic mitigation measures (as above) ▪ Temporary access to temporarily affected residences ▪ Close coordination with relevant utility companies / institutions (water, power, drainage) on proposed alignments, construction phases & schedules
		- Changed drainage/irrigation affecting farmers	S Temporary	<ul style="list-style-type: none"> ▪ The Contractor should coordinate with Pursat Province Department of Water Resources and Meteorology, commune's irrigation staff and cultivation households in water supply area of the main canal to reach agreement on water supply duration (construction suspension), construction time (should be implemented at the time when irrigation activities are not done);

SUBPROJECT <i>major characteristics of the subprojects</i>	PROJECT ACTIVITIES	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
				<ul style="list-style-type: none"> Commune's irrigation staff, Pursat Province Department of Water Resources and Meteorology or relevant authorities should soon inform the households and contractor about water supply schedule so that they can make plan on their own for initiative;
		- Disruption of socio-economic activities	S Temporary	<ul style="list-style-type: none"> Traffic mitigation measures (as above) Close coordination with relevant utility companies / institutions (water, power, drainage) on proposed alignments, construction phases & schedules
		-Health hazard	S Temporary	<ul style="list-style-type: none"> Dust control measures (as above) Sufficiently high temporary fence around construction sites that is in close proximity to residences & institutions Use of practicable available technologies that emit least noise & pollutants & adjusting of operational procedures to reduce noise & pollutants Adequate temporary toilet facilities with adequate water supply Strict enforcement of proper sanitation Temporary disposal system for solid & hazardous wastes
		- Accidents & safety hazard	S Temporary	<ul style="list-style-type: none"> Sufficiently high temporary fence around construction sites that is in close proximity to residences & institutions Disposing of unwanted spoils as soon as possible Temporary disposal system for solid & hazardous wastes Traffic mitigation measures (as above)

SUBPROJECT <i>major characteristics of the subprojects</i>	PROJECT ACTIVITIES	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
				<ul style="list-style-type: none"> Provisions for adequate lighting, safe pedestrian access, storm drains in construction sites Efficient emergency / contingency plans, adequate facilities & equipment & trained staff for handling emergencies
		+Short-term employment of local population	S Temporary	<ul style="list-style-type: none"> Local residents should be given priority in employing for simple construction works; therefore their living standard will be improved.

D. Impacts and Mitigation Measures during O&M Phase

100. **Negative Impacts.** Adverse impacts during operation of subprojects

101.

102. Table V.3.

103. **Positive Impacts.** The Subprojects will bring socio-economic benefits by improving of water supply for irrigation during dry season and flood benefits to Pursat town.

104. In the Tables the following abbreviations are used:

- (i) N: not applicable, no adverse effect;
- (ii) S: small/slight adverse effect;
- (iii) M: moderate adverse effect;
- (iv) L: large adverse effect

**Table V.3: Subprojects in Pursat and Battambang Provinces
– Operations and Maintenance Phase**

SUBPROJECT <i>major characteristics of subproject</i>	PROJECT ACTIVITIES	POTENTIAL ADVERSE IMPACTS <i>Socio-economic and physical/biological aspects</i>	MAGN. OF IMPACT	PROPOSED MITIGATION MEASURES
<ul style="list-style-type: none"> Reconstruction of diversion structure (barrage) - 1 no. Reconstruction of main canal- 25 km Reconstruction of secondary canal No. 1 -14 km Reconstruction of secondary canal No. 2 -12 km 	Inadequate operation and maintenance	Effects on water users in downstream of Pursat river	S	<ul style="list-style-type: none"> To ensure Environmental flow to downstream of The Barrage
		Erosion of canal bank and sedimentation of canal bed		<ul style="list-style-type: none"> Provide enough budget and enhance proper operation management and maintenance

<ul style="list-style-type: none"> • Reconstruction of secondary canal No. 3 - 13 km • Reconstruction of secondary canal No. 4 - 13 km • Construction of intake structure - 1 no. • Construction of head regulators - 4 nos. • Construction of cross regulators - 4 nos. • Construction of check structures - 4 nos. • Construction of canal crossing structures - 6 nos. 	Water quality management	Affect water quality in downstream of Pursat river	S	<ul style="list-style-type: none"> ▪ Enforce the compliance of Environmental Protection Law & Regulations ▪ Coordinate with Agriculture Extension Centre to ensure that farmers are trained in correct use of fertilizer and pesticides ▪ Adequate use of pesticide and fertilize for whole communes in Damnak Choeu Krom and Damnak Ampil areas
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E. Cumulative Effects

105. The two subprojects in Cambodia focuses on improving drought and flood risk management. The main objectives are: (i) to provide conveyance capacity to divert water from Pursat River to irrigate agricultural area in Pursat and Battambang Provinces; and (ii) to divert peak flood flows to minimize the impacts of floods in Pursat town. Selected subprojects proposed in the Project have been in the list of projects in National Strategic Development Plan of Cambodia Government.

106. The Government of Korea is investigating the feasibility and financing requirements for two storage schemes upstream of the proposed Damnak Cheukrom head-works. These reservoirs would improve timeliness of early wet season releases as well as create new dry season irrigation potential. The head-works and main canal from the sub-project will enable diversion of peak flood flows to minimize the impacts of floods in Pursat town.

107. Water source for irrigation supply under the two subprojects dealing with water management infrastructure upgrading in Pursat and Battambang Provinces will not be affect other water users. So the cumulative effects caused by the project to other projects in the vicinity of project area are likely to be insignificant.

VI. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

A. Consultation and Participation Process

108. The public consultations and participation process during the subproject preparation stage involves the following activities:

- (i) reconnaissance surveys of the subproject site; on-site discussions with district and town commune officials will provide information on the physical and biological resources, social-economic environment, opportunities and constraints relevant to the proposed subprojects, and
- (ii) participatory meetings with stakeholders and representatives from Provincial Department of Water Resources and Meteorology of Pursat, District and Commune, the Department of Health, and the Women's Union Organisation with

the objective to collect data and to present the subprojects (designs and locations), the Draft IEE, and to learn about social and environmental issues and concerns.

B. Consultation Meetings

1. Schedules and participation

109. Two public consultation meetings in Pursat province were held from 22 October to 6 November 2010.

110. The first public consultation meeting was organized at Damnak ChhoeKrom subproject on 29 October 2010 in Beung Preah Ponlea Pagoda, Phteah Rung commune, Phnom Kravach district, Pursat province. The second public consultation meeting was organized at Damnak ChhoeKrom subproject too on 30 October 2010 in Damnak Trop Pagoda, TaLou commune, Bakan district, Pursat province. Participants were representatives from the MOWRAM, PDWRAM, Subproject Commune Government, Subproject District's Environmental Management Division, the Women's Union, the farmer union at district, and commune level, and representatives from affected households in Subproject Communes. The details of the participants in the two Public Consultation Meetings are provided in Table VI.1.

Table VI.1: List of Subproject for Public Consultation's meetings

Date	Time	Subproject	Province	Districts/ Town	Communes	Meeting location	Number of participants
29 October 2010	2:30 p.m. to 5:00 p.m.	Damnak ChhoeKrom Irrigation Project, Pursat province	Pursat	Phnom Kravach	Samraong and Phteah Rung	Beung Preah Ponlea Pagoda	57
30 October 2010	1:30 p.m. to 4:30 p.m.	Damnak ChhoeKrom Irrigation Project, Pursat Province	Pursat	Bakan	Ta Lou	Damnak Trop Pagoda	86

111. The objectives of the meeting were to obtain the feedback from the participants on environmental impacts caused by project and their opinion on the project implementation.

112. The following contents were presented during the meeting:

- (i) Subprojects' objectives
- (ii) Subprojects' locations, designs and cost estimates
- (iii) GOV & ADB environmental policies and procedures
- (iv) Project's environmental category per ADB & GOV policies
- (v) Environmental issues per subproject locations and designs
- (vi) Potential environmental impacts caused by each subproject
- (vii) Proposed mitigation measures
- (viii) Environmental Management Plan and Environmental Monitoring Program

2. Feedback from Participants

112. At Beung Preah Ponlea Pagoda in Phnom Kravach district on 29 October 2010:
- (i) The rehabilitation of this canal will provide more benefits to local people and along the canal line. Will the project build rural road on embankment for use?
 - (ii) I think there some impacts to houses and cottages which are located in the existing canal area. But that is not a problem, because the commune village authorities has informed them that living in this canal is not allowed, though they can live temporary but when government needs they will move out.
 - (iii) 100% of these people support with this project as the local authorities have been informed them already that they will have enough water for rice cultivation (wet and dry season) and any potential crops.
 - (iv) As far as environment is concerned there will not be major impacts, because this canal is existing canal and there are not much forest and wildlife resources in this area. It has more of rice field, grass land, and small forest land.
 - (v) This rehabilitation of the canal will put silt of soil for making two embankments or one embankment along the canal?
 - (vi) The project should provide bights at some places of canal, to have roads for people to travel across canal.
 - (vii) For poor families those are living and making small business on the embankment, after the canal constructed, would they be able to come back to live next-to the bank of canal embankment?. Because they don't have any land as they are the new comers (migrated families).
113. Following to RGC we will compensate on property lands to local right. Regarding to Land Law, if these land belong to public land, government will not provide the compensation.
114. At Damnak Trop Pagoda, in Bakan district on 30 October 2010:
- (i) This subproject is important for local people in Ta Lou commune, because it will provide water for irrigating in wet rice season and some in dry season crop, and also to reduce flood risk in this area. So we are supporting this project.
 - (ii) We want to know where the canal alignment is. What is size of canal (width and size of embankment) to be constructed? Will it impact land field along the canal.
 - (iii) For environmental resources is not problem for rehabilitation this existing canal, because this area is mostly covered with paddy field, grass land, and shrub-land. It can impact pagodas, schools, and houses, which are located near the canal for short term during construction stage only.
 - (iv) The project should design for minimizing the impacts to rice field is along the canal as much as possible and should consider these land lose according to policies.
 - (v) Will the project compensate for the impacts on fruit trees e.g. mango and coconut trees?
 - (vi) I support to this project, but for poor people, who are living close and on to canal line and don't have others lands. How you plan to relocate them? And can they come back to live close the canal embankment, when the canal construction will be finished?

3. Conclusions of the meeting

115. Conclusions of the meeting include:

- (i) There is general agreement on the construction of Proposed Sub-projects and desired early construction.
- (ii) Consensus is achieved on socio-environmental impacts and mitigation measures recommended by the Project.
- (iii) All comments from participants and stakeholders will be considered fully in mitigation measures of Environmental Assessment and detailed design in next phase.

C. The Grievance Redress Mechanism

1. Purpose of the Mechanism

116. The grievance redress mechanism is meant for persons seeking satisfactory resolution of their complaints on the environmental performance of the subproject. The mechanism will ensure: i) the basic rights and interests of every person affected by poor environmental performance of the subproject are protected; and ii) their concerns arising from the poor environmental performance of the subproject during the conduct of pre-construction, construction and operation activities are effectively and timely addressed.

2. Access to the Mechanism

117. Any person who has complaint regarding the environmental performance of the subproject during pre-construction, construction and operation phases shall have access to the grievance redress mechanism described in the subsequent section. The subproject through the Grievance Point Person (GPP) shall ensure that:

- (i) the grievance redress mechanism is publicly disclosed, and posted in the offices of the affected communes and in strategic places of the subproject's area of influence;
- (ii) the grievance redress mechanism is accessible to all affected villages/communes; and
- (iii) the public, most especially the residents and passers-by in the vicinities of influence of the subproject, is aware of their rights to access, and shall have access to, the mechanism free of administrative and legal charges.

3. The Grievance Redress Mechanism

118. Managing grievances takes a step-by-step process. It requires assigning responsibilities and specifying timelines for prompt responses/ actions to grievances to avoid prolonging the misery of affected person/s (AP/s). Grievances raised on environmental impacts are critical to the health and wellness of affected persons. Hence, timelines for responses are critical.

119. The Project Environmental Management Unit (PEMU) will provide subproject's Government in subproject's Districts in Pursat and Battambang Provinces with standard Complaints Forms to be delivered by PGG to all households. Households or Groups of households desiring to complain about the effects of construction works on their property, production system, economic well-being, spiritual life, quality of surface and ground water, quality of air, health, safety, welfare, or any other assets of their lives shall make their complaint using these Complaints forms.

120. The Progress of Grievance Investigation and Resolution will follow these steps:

- (i) Step 1: Complaint form will be sent by APs, Affected households (AHs) or groups of households to subproject CPC.
- (ii) Step 2: Within 15 days, Subproject's Government in Subproject's Communes will investigate the complaints. If it is judged by them to be valid the Complaint Form will be forwarded to the PEMU.
- (iii) Step 3: within 15 days from the date the complaint is received, the PEMU, and Subproject's Government in Subproject's Communes will organize meetings to discuss how to resolve this matter. All meetings will be recorded and copies of the minutes of meetings will be provided to APs/AHs.
- (iv) Step 4: The PEMU shall take such mitigation measures as agreed in meetings from step 3 by PEMU and Subproject CPC within 15 days, or some other period acceptable to the parties referred to in step 3.
- (v) Step 5: When the complaint has been resolved, the Complaint Form need to be signed by Complainer/ head of Household, Subproject's Government in Subproject's Communes, PEMU and annotated at each stage of process by PEMU with copies to be sent to Subproject's Department of Environment.
- (vi) Step 6 : In case If no understanding or amicable solution is reached, or if no response is received from Subproject CPC within 15 days after the registration of complaint, the APs/ AHs can appeal to the Government in Subproject's Districts. The APs/AHs must lodge the complaint within 30 days of registering the original complaint and must produce documents with copies of appeal that support his/her claim. The Government in Subproject's Districts will provide a decision within 1 month of receiving the appeal.
- (vii) Step 7: If the APs/AHs is not satisfied with the decision, or in the absence of any response from Government in Subproject's Districts, the APs/AHs can appeal to the Government in Subproject Provinces. The Government in Subproject Provinces will review and issue a decision on the appeal within 30 days from the day it is received.
- (viii) Step 8: If the APs is still not satisfied with the decision of The Government in Sub-project Provinces or in the absence of any response within the stipulated time, the APs as a last resort may submit his/her case to the court, in which decision is final.

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Institutional requirements for Environmental Management and Monitoring

121. Ministry of Water Resources and Meteorology (MOWRAM) will be the executing agency for the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project in Cambodia. Three Project Management Units (PMUs) will be established to manage and monitor all day-to-day implementation activities of the Project. The PMU will include representatives from the Agencies and Departments as shown in Table 7.1.

Table VII.1: Representatives of Three PMUs

PPMUs	Name of Sub-Project	Representatives of agency/departments/organizations
Pursat PPMU	Subproject of Damnak Chhoeu Krom Irrigation (Drought Management) in Pursat Province	Pursat Provincial Department of Water Resources and Meteorology
Battambang PPMU	Pursat Irrigation Expansion Project	Battambang Provincial Department of Water Resources and Meteorology

122. The supervision and monitoring of Project-related resettlement and environmental activities during the pre-construction, construction and operation phases are some of the functions of the PPMU. In line with this, it is proposed that a Provincial Environmental Management Unit (PEMU) be set up within the PPMU, responsible for supervision on environmental management and for environmental monitoring. The major responsibilities of the PEMU will be to ensure that:

- (i) The mitigation measures and monitoring of these activities are being carried out as agreed,
- (ii) The environmental monitoring program, comprising of taking samples and analyses are being carried out,
- (iii) Reporting is performed in compliance with ADB and GOV requirements.

123. The PEMU shall be headed by qualified officer who is assigned full time to the PPMU. At least one full-time technical expert and one full-time administrative staff member shall be assigned to the PEMU. The PPMU will engage part time a local Environmental Consultant to provide for the PEMU technical assistance in environmental management and monitoring.

124. If Project Implementation Assistance (PIA) consultants are employed during implementation of the Project, then the PIA Team's Environmental Specialists will pass on expert advice and guidance and conduct capacity building on environmental management and monitoring.

125. To ensure that the ADB environmental requirements and all applicable RGC environmental laws, regulations and standards, are met prior to the start of construction and during construction and operation of the Project, an elaborate Environmental Management and Monitoring Plan should be prepared at the Detailed Design stage based on the concise Environmental Management and Monitoring Plan presented in current IEE. Environmental monitoring during long term operation of the GMS - Cambodia Subprojects is largely the responsibility of PDWRAMs in Pursat and Battambang Provinces.

126. The Terms of Reference for the detailed engineering design and the bid documents should specify the preparation of specific Environmental Management and Monitoring Plans for the Subprojects, which shall be presented for comments to the stakeholders.

B. Environmental Management and Monitoring Plan

127. For the stage of IEE, Tables 7.2 to 7.4 present concise Environmental Management and Monitoring Plans (EMPs) for the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project in Cambodia for the various project stages. However, at the stage of Detailed Design detailed EMPs shall be prepared for environmental management—including all required mitigation measures—and monitoring during the different stages of the Subprojects. The detailed costs for these environmental management and monitoring activities shall also be calculated at that stage and be incorporated in the various contracts.

128. Responsible for Environmental Monitoring during project implementation are the main contractor, the sub-contractors, the PEMU/PPMU, and the communities. The EMPs will be the guiding documents for environmental management and monitoring during execution of the Sub-Projects. It will guide the PEMU/PPMU in determining whether the recommended mitigation measures prior to construction, and during construction and operation, are being implemented effectively. Environmental monitoring results shall be documented and reviewed to ensure that signs of adverse impacts are detected at an early stage and that actions for mitigation are taken. Monitoring results will have to be reported monthly by the PEMU and be submitted to the head of the PPMU, who in turn will submit them to Department of Environment (DOE) and PMU for approval. The Project Management Unit will submit the EMP to the ADB. The format for the monthly and annual Environmental Monitoring Reports will be developed during the Detailed Design Phase and may have to be refined during implementation of the Project.

C. Costs for Environmental Monitoring

129. For the costs during the Pre-Construction/Design Phase for implementation and monitoring of the Resettlement Plan (RP)—based on the implementation schedule of the RP—is referred to Resettlement Report.

130. Monitoring, to be carried out by the PEMU/PPMU, of surface water quality, air quality (TSP) and noise, during the Pre-Construction, Construction and Operation Phases add up to an average amount of \$117,000 per Subproject. Appendix 1 provides for one Subproject the environmental monitoring activities and the costs during the various project phases of the Project. For the whole GMS in Cambodia Project (2 Subprojects) the costs for Environmental Monitoring are estimated at: $3 \times \$117,000 = \$234,000$.

D. Environmental Management and Monitoring

131. For the stage of IEE, Table 7.2, present a concise Environmental Management and Monitoring Plan (EMP) for (i) Subproject of Damnak Chhoeu Krom Irrigation (Drought Management) in Pursat Province, (ii) Pursat Irrigation Expansion Subproject in Battambang Province.

Table 7.2: Environmental Management and Monitoring: Sub-projects in Pursat and Battambang Provinces

Environmental Impacts	Environmental Management		Environmental Monitoring		
	Mitigation Measures	Responsibility	Activities	Responsibility	Costs
Pre-Construction					
Land acquisition requirements & displacement of local residents	<ul style="list-style-type: none"> Prepare Resettlement Plan (RP) based on an agreed resettlement and compensation framework & implement accordingly 	PPMU and Inter-ministerial Resettlement Committee	Monitoring of implementation of RP, based on implementation schedule of RP. Review of submitted PPMU and IMRC (Internal Ministry of Resettlement & Compensation) Progress Reports.	PPMU, EMA (independent external monitoring agency).	For resettlement costs see Resettlement Report.
Displacement of local residents					
Proximity to environmentally sensitive areas / areas with aesthetic value		It is not required			
flooding / odour / noise	<ul style="list-style-type: none"> Proper design, O&M; sufficient buffer. 	Consultants doing the design.	Monitoring of Technical Design.	MOWRAM	Included in cost of Technical Design.
Vulnerability to erosion / landslide	<ul style="list-style-type: none"> Proper design and O&M 	Consultants doing the design.	Monitoring of Technical Design.	MOWRAM	Included in cost of Technical Design.
During Construction					
1 Physical / Chemical Environment					
<i>Air Quality</i>					
- Dust	<ul style="list-style-type: none"> Regular watering of exposed areas Cover all trucks carrying dispersible materials to or from the site; Ensure all construction vehicles and equipment are well-maintained; 	Contractor	Periodic (plus in-between unannounced) inspection of construction activities Air quality monitoring (quarterly & more frequently when complaints / issues arise)	Contractor, PPMU, communities; also sub-contractors	

Environmental Impacts	Environmental Management		Environmental Monitoring		
Socio-economic and physical/biological aspects	Mitigation Measures	Responsibility	Activities	Responsibility	Costs
	<ul style="list-style-type: none"> Construction activities which can make noise should be carried out at day time Inform local community about schedule and duration of construction works; Regarding to other material for construction such as sand, stone, contractor should choose legal service providers who had exploitation licenses and environmental protection commitment issued by local authorities; 			have responsibility for environmental monitoring. EMA	
- odour					
- Noise			Periodic (plus in-between unannounced) inspection of construction activities Air quality monitoring (quarterly & more frequently when complaints / issues arise)	Contractor, PPMU, communities; also sub-contractors have responsibility for environmental monitoring. EMA	
<i>Water resources and quality</i>					
- Degeneration / contamination of surface water	<ul style="list-style-type: none"> Create drains & bund temporary to avoid spread of polluted alum water from filling & excavated alum soil , Diversion drains & bunds, temporary silt traps ponds Stockpiling of spoils in flat areas & far from drainage routes Disposing of unwanted spoils as soon as possible Adequate temporary toilet facilities with adequate water supply & strict enforcement of proper sanitation Temporary disposal system for solid & hazardous waste 	Contractor	Periodic (plus in-between unannounced) inspection of construction activities Surface water quality monitoring (quarterly & more frequently when complaints / issues arise)	Contractor, PPMU, communities; also sub-contractors have responsibility for environmental monitoring. EMA	
- Generation of	<ul style="list-style-type: none"> Adequate water supply to meet 	Contractor	Periodic & unannounced	Contractor,	Incorporated in

Environmental Impacts	Environmental Management		Environmental Monitoring		
	Mitigation Measures	Responsibility	Activities	Responsibility	Costs
sewage / wastewater	construction needs & setting up of rain catchment tanks <ul style="list-style-type: none"> Adequate temporary toilet facilities with adequate water supply & strict enforcement of proper sanitation 		inspections of waste disposal.	PMU, communities. EMA	recommended Contract provisions.
- Generation of solid wastes	<ul style="list-style-type: none"> Establish temporary toilet which meet regulations of Health Ministry and supply enough water to tents; Discussing with residents to choose the suitable waste dumping site when workers build camps; Collect solid wastes and temporary store at a safety place before transporting to disposal sites Establish regulations on ensuring sanitation, stipulated dumping yard and waste treatment methods and disseminate those regulations to workers 	Contractor	Periodic & unannounced inspections of waste disposal.	Contractor, PMU, communities. EMA	Incorporated in recommended Contract provisions.
- Siltation / erosion	<ul style="list-style-type: none"> Install diversion drains & bunds, temporary silt traps/pond Stockpiling of spoil in flat areas & far from drainage routes 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities. EMA	Incorporated in recommended Contract provisions.
Interruption of water flows,	<ul style="list-style-type: none"> Setting up temporary diversion canal. 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities. EMA	Incorporated in recommended Contract provisions.
2 Biological Environment					
-Impairment of Sensitive vegetation / other natural habitats	<ul style="list-style-type: none"> It is not required 				

Environmental Impacts	Environmental Management		Environmental Monitoring		
Socio-economic and physical/biological aspects	Mitigation Measures	Responsibility	Activities	Responsibility	Costs
-Impairment of aquatic flora & fauna downstream	<ul style="list-style-type: none"> Disposing of unwanted spoils as soon as possible Adequate temporary toilet facilities with adequate water supply Strict enforcement of proper sanitation Temporary disposal system for solid & hazardous wastes 	Contractor	Periodic (plus in-between unannounced) inspection of construction activities Surface water quality monitoring (quarterly & more frequent when complaints / issues arise)	Contractor, PMU, communities. EMA	Incorporated in recommended Contract provisions.
3.Socio-Economic Environment					
-Traffic congestion	<ul style="list-style-type: none"> Strict enforcement of traffic rules & regulations Installation of traffic aides in critical routes during peak hours Coordination of traffic management plan with town & commune officials Posting of prior notice on construction schedules & traffic rerouting plan (at least a week prior to effective / implementation dates 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities. EMA	Incorporated in recommended Contract provisions.
- Public inconveniences. disruption of utility services	<ul style="list-style-type: none"> Traffic mitigation measures (as above) Temporary access to temporarily affected residences & institutions Close coordination with relevant utility companies / institutions (water, power, drainage) on proposed alignments, construction phases & schedules 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities. External Monitoring Agency (EMA)	

Environmental Impacts	Environmental Management		Environmental Monitoring		
Socio-economic and physical/biological aspects	Mitigation Measures	Responsibility	Activities	Responsibility	Costs
- Disruption of socio-economic activities	<ul style="list-style-type: none"> ▪ Traffic mitigation measures (as above) ▪ Close coordination with relevant utility companies/ institutions (water, power, drainage) on proposed alignments, construction phases & schedules 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities. External Monitoring Agency (EMA)	
-Health hazard	<ul style="list-style-type: none"> ▪ Dust control measures (as above) ▪ Sufficiently high temporary fence around construction sites that is in close proximity to residences ▪ Use of practicable available technologies that emit least noise & pollutants & adjusting of operational procedures to reduce noise & pollutants ▪ Adequate temporary toilet facilities with adequate water supply ▪ Strict enforcement of proper sanitation ▪ Temporary disposal system for solid & hazardous wastes 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities. External Monitoring Agency (EMA)	
- Accidents & safety hazard	<ul style="list-style-type: none"> ▪ Sufficiently high temporary fence around construction sites that is in close proximity to residences & institutions ▪ Disposing of unwanted spoils as soon as possible ▪ Temporary disposal system for solid & hazardous wastes ▪ Traffic mitigation measures (as above) 	Contractor	Periodic & unannounced inspections of construction activities.	Contractor, PMU, communities.	

Environmental Impacts	Environmental Management		Environmental Monitoring		
Socio-economic and physical/biological aspects	Mitigation Measures	Responsibility	Activities	Responsibility	Costs
	<ul style="list-style-type: none"> Provisions for adequate lighting, safe pedestrian access, storm drains in construction sites Efficient emergency / contingency plans, adequate facilities & equipment & trained staff for handling emergencies 			External Monitoring Agency	
Operation & Maintenance					
Effects on water users in downstream of Pursat river	<ul style="list-style-type: none"> To ensure Environmental flow to downstream of The Barrage 	PDWRAM	Periodic & unannounced inspection of precautions and enforcement of regulations.	External Monitoring Agency	Annual administrative costs.
Erosion of canal bank and sedimentation of canal bed	<ul style="list-style-type: none"> Provide enough budget and enhance proper operation management and maintenance 	PDWRAM	Periodic & unannounced inspection of precautions and enforcement of regulations.	External Monitoring Agency	Annual administrative costs.
Affect water quality in downstream of Pursat river	<ul style="list-style-type: none"> Enforce the compliance of Environmental Protection Law & Regulations Coordinate with Agriculture Extension Centre to ensure that farmers are trained in correct use of fertilizer and pesticides Adequate use of pesticide and fertilize for whole communes in Damnak Choeu Krom and Damnak Ampil areas 	PDWRAM	Periodic & unannounced inspection of precautions and enforcement of regulations and sampling program.	External Monitoring Agency	Annual administrative costs.

VIII. CONCLUSION AND RECOMMENDATIONS

132. The objective of the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project in Cambodia is to improve flood discharge capacity in flood season and augmentation of fresh water resources for irrigation in supplementary wet season irrigation and dry season irrigation in parts of the command area.

133. Based on screening of potential environmental impacts in the design phases, the construction phases and the operation phases of the subprojects revealed some adverse effects. However, all identified adverse impacts appeared to be small or moderate and many are of a temporary nature during construction phase. No significant adverse environmental impacts are expected. Mitigation measures have been formulated that can diminish the adverse impacts (Part E) and concise Environmental Management and Monitoring Plans (EMPs) have been developed for the Subprojects (Part I). More detailed EMPs have to be prepared during the design phase to control and mitigate identified small and moderate negative environmental impacts.

A. Recommendations

134. The executed Initial Environmental Examination (IEE) for the Project is sufficient according to the ADB environmental guidelines and regulations. Only additional detailed Environmental Management and Monitoring Plans have to be prepared to control and mitigate the identified small and moderate adverse environmental impacts.

135. Under The GOV regulations, Sub-Decree No. 72 ANRK. BK. dated 11 August 1999, only an initial environmental impact assessment (IEIA) is required. The Project Owner must compile IEIA report and must submit it to PDOE for review and approval.

B. Conclusion

136. From the proposed Subprojects for Pursat and Battambang Provinces, only small and moderate adverse environmental impacts are expected. These adverse impacts can be resolved by proper design, specific mitigations measures, and by adequate operation and maintenance. For these reasons the executed Initial Environmental Examination (IEE) for the Subprojects is sufficient according to the ADB environmental guidelines and regulations.

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APPENDIX 1: Preliminary Cost Estimates for Environmental Monitoring (Cambodia Subprojects) –one year-01 Subproject

Cost Item			No of Engineer	Man month	No. of Months	Frequency in a Year (monthly)	No of Samples	No of Taking Sample's People	Total No of Sample or Car /boat rent day	No of working days	Unit Rate (\$)	Total Cost (\$)
PRE-CONSTRUCTION												
A	PEMU-PPMU											
	A.1	Irrigation Engineer (1 for full time for a year)	0	0								300
	A.2	Monitoring Activities										
	A.2.1	Measuring or Analysis										
		- Air Quality & Noise Level			1	One time before construction	2				150	300
		- Surface Water Quality			1		6				207	1,242
		-Ground Water Quality										
	A.2.2	Taking & Handling Samples										
		Per Diem:										
		- Air Quality & Noise Level			1			2		2	30	60
		- Surface Water Quality			1			3		2	30	60
		-Ground Water Quality										
		Transport:										
		- Air Quality & Noise Level			1				3		100	300
		- Surface Water Quality			1				3		100	300
	A2.3	Boat rent							1		20	20
	A2.4	Report (Result of Environmental Monitoring)					1				120	120
Sub-Total 1(Pre- Construction)												2,702
DURING CONSTRUCTION												
A	Consultants											
	A.1	International Environmental Specialist (part of PIA Team - TA Grant, 4 monthss. Intermittently for a year)										
	A.2	Local Environmental Specialist (part of PIA Team - TA Grant, 6 months intermittently for a year)										
B	PEMU-PPMU											
	B.1	Irrigation Engineer	1	6	6						500	3,000

[illegible]

Cost Item				No of Engineer	Man month	No. of Months	Frequency in a Year (monthly)	No of Samples	No of Taking Sample's People	Total No of Sample or Car /boat rent day	No of working days	Unit Rate (\$)	Total Cost (\$)
			- Surface Water Quality				4		3		12	30	360
			-Ground water										
			Transport:										
			- Air Quality & Noise Level										
			- Surface Water Quality				4		1	12 (3 days x 4)		100	1200
			-Ground water										
		B 2.3	Boat Rent				4			4		20	80
		B 24	Report (Result of Environmental Monitoring)					4				120	480
Sub-Total 3 (During Operation)													\$8,588
Total (1)+(2)+(3)													

Estimated Cost for Environmental Management Plan of the Proposed Component

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	Frequency	Responsibility Agencies	Before	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Amount without TAX-\$	Amount (with VAT) +10%	
Environmental Monitoring												\$
Pre-Construction												
Air quality/TSP	One time before construction (Baseline data)	Contractor	\$2,702									
Noise		Sub-Contractor										
Water Quality		PMU										
To clear the ground		Communities										
<i>Sub-Total 1</i>												
During Construction				\$27,024	\$27,024	\$27,024						
	Monthly	Contractor Communities										
Air quality (TSP & Noise)	Monthly											
Water quality	Monthly											
<i>Sub-Total 2</i>												
Operation												
Water quality	Monthly	IDMC Communities					\$8,588	\$8,588				
<i>Sub-Total 3</i>												
Total 1+2+3										100,950		
Contingency (5%)										5,048		
Tax 10%										\$105,998		\$116,998
Around										\$117,000		

Note: TSP & Noise is measured at Site – Measurement Cost based on MoE Laboratory
 Water quality sample is taken at Site & analyzed in Laboratory- based on MoE Laboratory
 Per diem, Transportation cost based on other project per diem and Current Vehicle transportation price

Average amount for one Sub-project = \$117,000
 Total estimate cost for 3 sub-projects = \$351,000

Appendix 1

Cost estimation of water quality analysis for one sample

			Cambodia	Lao PDR	Vietnam
No	Criteria	Unit	Price USD According to MoE Laboratory	Price USD According to LCG consultants	Price VND according to Circular 83/2002/TT-BTC
1	pH	Sample	1.5	6.00	30.000
2	DO	Sample	3.0	8.00	60.000
3	Turbidity	Sample	2.0	6.00	50.000
4	EC	Sample	1.5	6.00	40.000
5	SS	Sample	4.0	10.00	50.000
6	Cl	Sample	4.0	10.00	50.000
7	SO ₄ ⁻	Sample	6.0	10.00	50.000
8	Ca	Sample	13.0	25.00	60.000
9	Mg	Sample	13.0	25.00	60.000
10	Fe	Sample	10.0	20.00	60.000
11	NO ₂ ⁻	Sample	7.0	12.00	50.000
12	NO ₃ ⁻	Sample	7.0	15.00	50.000
13	NH ₄ ⁺	Sample	7.0		60.000
14	PO ₄ 3 ⁻	Sample	6.0	15.00	60.000
15	COD	Sample	10.0	15.00	70.000
16	BOD5	Sample	12.0	20.00	80.000
17	Faecal Coliform	Sample	8.0	15.00	60.000
18	Coliform	Sample	7.0	15.00	60.000
19	As	Sample	15.0	30.00	80.000
20	Pb	Sample	15.0	20.00	60.000
21	Hg	Sample	18.0	30.00	80.000
22	Cd	Sample	18.0	20.00	60.000
23	Cr6 ⁺	Sample	6.0	20.00	60.000
24	Potassium	Sample	13.0		600.000
Total	VND				1940000
	USD		207	353	110

RAPID ENVIRONMENTAL ASSESSMENT (ADB, REA)

1. Flood and Drought Project in Cambodia

Table A2.1: Rapid Environmental Assessment (REA) Checklist

Instructions:

- This checklist is to be prepared to support the environmental classification of a project. It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Regional and Sustainable Development Department.
- This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.
- This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on (i) involuntary resettlement, (ii) indigenous peoples planning, (iii) poverty reduction, (iv) participation, and (v) gender and development.
- Answer the questions assuming the “without mitigation” case. The purpose is to identify potential impacts. Use the “remarks” section to discuss any anticipated mitigation measures.

Country/Project Title:

Damnak Chhoeckrom Irrigation Project in Phnom Kravach and Bakan district, Pursat Province and Pursat Irrigation Expansion in Battambang Province

Sector Division:

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Sitting			
Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Protected Area		x	Protected areas are far from sub-project site: Phnom Samkos Protected area is about 60 Km and Phnom Kravah forest resources Conservation is about 20 km
▪ Wetland	x		Small part of Tonle Sap wetland is in downstream site far from the sub-project - about 50 km.
• Mangrove		x	No mangrove forest in this area
• Estuarine		x	
• Buffer zone of protected area	x		May affect the buffer zone of Tonle Sap Lake in downstream of sub-project about 30 Km, by runoff of fertilizer and pesticide during operation stage, if farmers use it in excess.

SCREENING QUESTIONS	Yes	No	REMARKS
<ul style="list-style-type: none"> Special area for protecting biodiversity 	x		50 km from the site to Tonle Sap Biodiversity Reserve may have small impact during operation stage
B. Potential Environmental Impacts			
Will the Project cause...			
<ul style="list-style-type: none"> loss of precious ecological values (e.g. result of encroachment into forests/ swamplands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)? 	x	x	Small impact to shrub forest and grass land during construction stage. Will impact fish species in Pursat River during construction & operation stage. Historical/cultural areas are far from sub-project site and will not be affected.
<ul style="list-style-type: none"> Conflicts in water supply rights and related social conflicts? 	x		Between farmer water user communities from upstream & downstream of the canal during operation stage.
<ul style="list-style-type: none"> Impediments to movements of people and animals? 		x	Will not affect movements of people and animals, due to most sub-project site is in the rice field.
<ul style="list-style-type: none"> Potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity? 	x		Occur for short term during construction & maintenance phase.
<ul style="list-style-type: none"> Insufficient drainage leading to salinity intrusion? 		x	Will not affect, the subproject far from the sea water.
<ul style="list-style-type: none"> Over pumping of groundwater, leading to salinization and ground subsidence? 		x	No sea water is near the subproject area.
<ul style="list-style-type: none"> Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water? 	x		Construction and operation stage will impact the downstream water quality
<ul style="list-style-type: none"> Dislocation or involuntary resettlement of people? 	x		There are some temporary cottages and small houses at the existing canal line, the relocation or resettlement plan should be done before construction.
<ul style="list-style-type: none"> Potential social conflicts arising from land tenure and land use issues? 		x	No social conflicts of land tenure because it is existing project and will follow to existing alignment.
<ul style="list-style-type: none"> Soil erosion before compaction and lining of canals? 	x		May be affected for short term during construction stage
<ul style="list-style-type: none"> Noise from construction equipment? 	x		Noise will increase during construction & maintenance phase
<ul style="list-style-type: none"> Dust? 	x		Dust will increase due to excavation activities during construction & maintenance phase

SCREENING QUESTIONS	Yes	No	REMARKS
▪ Labour-related social problems especially if workers from different areas are hired?		x	Normally, unskilled workers to be hired from local area
▪ Water logging and soil salinization due to Inadequate drainage and farm management?		x	No sea water in this area
▪ Leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?	x		Minor level will be changed in soil characteristics during construction & operation stage
□ Reduction of downstream water supply during peak seasons?		x	Not a problem during peak season, water will fill the fields.
□ Soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides.	x		Small impact; will affect soil and public health: Expect finding UXO canal line may affect the construction workers. Farmer normally uses fertilizers and pesticides for rice crop during operation.
▪ Soil erosion (furrow, surface)?	x		The soil erosion will erode for short term during construction & maintenance stage.
▪ Scouring of canals?	x		May be affected for short term during construction stage.
▪ Logging of canals by sediments?	x		Maintenance work (dredging of canal) should be done every two-three years.
▪ Clogging of canals by weeds?		x	Expect no clogging of canals by weeds.
▪ Seawater intrusion into downstream freshwater systems?		x	No sea water in this area.
▪ Introduction of increase in incidence of waterborne diseases	x		May be small impact on construction workers and people who are near to the subproject site during construction. The diseases also will affect farmers, who spray fertilizer or pesticide during operation stage.

Figure A3.1: Pictures and List of Participants of Public Consultation Meetings**Table A3.1: Attended List of Public Consultation In Somraong and Phataes Rong Commune, Kravanh District, Pursat Province at Beung Preah Ponlea Pagoda on 29 October 2010 from 2:30 to 5:00p.m.**

No	Name	Agency/Village/Commune	Position	Phone	Signature
1	Men Phorn	Brohas Kbal	Chive Village	089 994 463	
2	Chey Seng	Chhug Rouk	Chive Village	017 561 457	
3	Ngen Phouen	Phtaeh Rong	Commune council	017 938 505	
4	Hem Hoan	Samrong	Commune council	097 953 623 8	
5	Souen Neang	Phteah Rong	Farmer		
6	Yon Pheng	Pheah Rong	Farmer		
7	Rith Souen	Pheah Rong	Farmer		
8	Sun Mao	Chon Ruk	Farmer		
9	Chhoen Nart	Chon Ruk	Farmer		
10	Vann Mom	Chon Ruk	Farmer		
11	Sok Ron	Chon Ruk	Farmer		
12	Tear Chann	Chong Ruk	Farmer		
13	Sorn Ley	Chrey Krem	Farmer		
14	Prom Joy	Chrey Krem	Farmer		
15	Vaong Bros	Chrey Krem	Farmer		
16	Phat Phart	Chrey Krem	Farmer		
17	Loem Touen	Chrey Krem	Farmer		
18	Ly Chroem	Chrey Krem	Farmer		
19	Yun Phois	Chon Ruk	Farmer		
20	Suy Pheap	Chon Ruk	Farmer		
21	Charp Vy	Chon Ruk	Farmer		
22	Vart Srey	Preak Mouy	Farmer		
23	Ao Chanty	Preak Mouy	Farmer		
24	Keo Sophois	Preak Mouy	Farmer		
25	Roem Sary	Preak Mouy	Farmer		
26	Hun Srey	Chrey Krem	Farmer		
27	Ok bunnouen	Chrey Krem	Farmer		
28	Nup Touen	Chrey Krem	Farmer		
29	Bun Yun	Chrey Krem	Farmer		
30	Chen Sao	Chrey Krem	Farmer		
31	Hak Vodty	Chrey Krem	Farmer		
32	Nak Chhem	Chrey Krem	Chief Village		
33	Seng Sokha	Phteah Rong	Commune army		
34	Nouch Narch	Chrey Krem	Commune police		
35	Nouch Ron	Chrey Krem	Defending Leader		

No	Name	Agency/Village/Commune	Position	Phone	Signature
36	So Touen	Chrey Krem	Farmer		
37	Dol Pin	Chrey Krem	Farmer		
38	Pen Tum	Chrey Krem	Farmer		
39	Vorng Khnar	Chrey Krem	Farmer		
40	Ratt Rin	Pheah Rong	Farmer		
41	Youen Teav	Phaeah Rong	Farmer		
42	Yen Chhouen	Preak Mouy	Farmer		
43	Aon Team	Preak Mouy	Farmer		
44	Phoen Phea	Chrey Krem	Farmer		
45	Voan Pech	Chrey Krem	Farmer		
46	Voan mom	Chrey Krem	Farmer		
47	Vorng Phois	Chrey Krem	Farmer		
48	Pot Loeng	Chrey Krem	Farmer		
49	Loueng Kun	Chrey Krem	Farmer		
50	Vet Kouen	Chrey Krem	Farmer		
51	Pech Voan	Pheah Rong	Farmer		
52	Yim Chamnan	ADB-MRC	Env. Consultant		
53	Mil Sophanna	ADB-MRC	Social Consultant		
54	Maov Vanchann	Environmentalist	National Assistant		
55	Than Phaleap	MOWRAM	Vice chief office		
56	Touch Ang	MOWRAM	Officer		
57	Chab Sath	PDOE	Deputy director		

Table A3.2: Attendance List of Public Consultation in Ta Lou commune, Bakan District, Pursat Province at Damnak Trop Pagoda on 30 October 2010 from 1:30 to 4:30pm

N	Name	age	sex	Agency/Village/Commune	Position	Phone	Signature
1	Tauch Ang			MOWRAM	RU Officer		
2	Yim Chamnan			ADB-MRC	Env. Consultant		
3	Im Sokthy			ADB-MRC	Econ. Consultant		
4	Sae Hoan			Tangkok Thmei	Farmer		
5	Soum Samouen			Rohal Teal	Teacher		
6	Long Too			Brahal	Farmer		
7	Chhet Samnang			Rohal Teal	Farmer		
8	Preap Tong			Rohal Teal	Farmer		
9	Bour Bouen			Rohal Teal	Farmer		
10	Srau Sroy			Rohal Teal	Farmer		
11	Rous Chamrouen			Rohal Teal	Farmer		
12	Kus Khatt			Thmei	Farmer		
13	Chouen Net			Brahal	Farmer		
14	Erm Sokphea			Rohal Teal	Farmer		
15	Om Doan			Rohal Teal	Farmer		
16	Peang Pon			Brahal	Farmer		
17	Tat Ry			Brahal	Farmer		
18	Tak Vann			Brahal	Farmer		
19	Chroeng Harn			Brahal	Farmer		
20	Tak Em			Brahal	Farmer		
21	Uy Tuy			Rohal teal	Farmer		
22	You Rain			Thmei	Farmer		
23	Koun Chamrouen			Thmei	Farmer		
24	Morm Makara			Thmei	Farmer		
25	Roen Bros			Brahal	Farmer		
26	Srey Soueng			Rohal Teal	Farmer		
27	Pel Mom			Brahal	Farmer		
28	Orn Samut			Rohal Teal	Farmer		
29	Nart Ngar			Rohal Teal	Farmer		
30	Het Khar			Rohal Teal	Farmer		
31	Heng Khorn			Taing Kok	Farmer		
32	Hout Heang			Brahal	Farmer		

N	Name	age	sex	Agency/Village/Commune	Position	Phone	Signature
33	Has Kunthea			Brahal	Farmer		
34	Eang Chreb			Hatel	Farmer		
35	Nutt Phally			Hatel	Farmer		
36	Rouen Chreb			Hatel	Farmer		
37	Sous Chean			Brahal	Farmer		
38	Horm Chandy			Brahal	Farmer		
39	Seng Hoan			Thmei	Farmer		
40	Chea Channa			Thmei	Farmer		
41	Long Sreng			Thmei	Farmer		
42	Ok Kear			Prek KanTout	Farmer		
43	Chen Sarom			Prek KanTout	Farmer		
44	Tob Vanny			Thmei	Farmer		
45	Met Yi			Prek KanTout	Farmer		
46	Vong Phart			Prek KanTout	Farmer		
47	Korb Mom			Thmei	Farmer		
48	Soem Phal			Prek KanTout	Farmer		
49	Nget Mour			Thmei	Farmer		
50	Un Chim			Thmei	Farmer		
51	A Chantouen			Thmei	Farmer		
52	Tang Khorn			Thmei	Farmer		
53	Hoan Pov			Prek KanTout	Farmer		
54	Chhorn Un			Prek KanTout	Farmer		
55	Saor Chamrouen			Prek KanTout	Farmer		
56	Sok Sopheap			Prek KanTout	Farmer		
57	Chhun Mao			Brahal	Farmer		
58	Kom Malai			Hatel	Farmer		
59	Rous Savoan			Tang Kok	Farmer		
60	Chhouen Yan			Tang kok	Farmer		
61	Ya Tha			Tang kok	Farmer		
62	Mao Nget			Tang kok	Farmer		
63	Pun Joy			Tang kok	Farmer		
64	Chhoun Sorn			Damnak Trop	Farmer		
65	Oat Pheng			Hatel	Farmer		
66	Tith Eng			Brahal	Farmer		
67	Ma Veasna			Ta Lou	Commune police		
68	Phoem Pheap			Ta Lou	Commune Police		
69	Ket Sophal			PDWRAM	Vice chief office		
70	Moa VannChan			consultant	Env. assistant		
71	Mil Sophanna			ADB-MRC	Social consultant		
72	Chap Sath			PDOE	Deputy director		
73	Noung Sambath			Bakan district	District council		
74	Heng Sitha			Bakan district	District council		
75	Than Phaleap			MOWRAM	Deputy chief office		
76	Saov Dareun			Bakan	District governor		
77	Yam Yen			Ta Lou	Chief commune		
78	Nov Norn			Ta Lou	Vice chief commune		
79	Khev Chhon			Ta Lou	Commune council		
80	Lay Tha			Thmei	Vice chief village		
81	Phang Orn			Brahal	Chief village		
82	Vy Sarith			Tang Kok	Chief village		
83	Khet Touch			Prey Kan Tout	Chief village		
84	Chay Beat			Rohal Teal	Vice chief village		
85	Sok Chheam			Rohal Teal	Chief village		
86	Nup Dy			Tang Kok	Vice chief village		