

Initial Environmental Examination (IEE)

Project Number: 44328-013

Loan: 3289

CAM: UPLANDS IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR PROJECT (UIWRMSP)

Taing Krasaing Irrigation Scheme (CW01, CW03 and CW04)
and Prek Chik Irrigation Scheme (CW06, CW07, CW08 and
CW09) – Implementation Stage

December 2018
(Updated)

Prepared by Ministry of Water Resources and Meteorology, the Kingdom of Cambodia for the Asian Development Bank.

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Cambodia (ADB LOAN 3289-CAM)**
Project Management and Implementation Consultant

Report Name: **Initial Environmental Examination (IEE) of Taing Krasaing Irrigation
Scheme (CW01, CW03 and CW04) and Prek Chik Irrigation Scheme
(CW06, CW07, CW08 and CW09) – Implementation Stage**

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ABBREVIATIONS

ADB	Asian Development Bank
AP	affected person
DFR	draft final report
EARF	environmental assessment and review framework
EIA	environmental impact assessment
EIRR	economic internal rate of return
EMP	environmental management plan
FERP	Flood Emergency Rehabilitation Project
FFS	farmer field school
FWUC	Farmer water user community
JICA	Japan International Cooperation Agency
ICM	integrated crop management
IEE	Initial Environmental Examination
IEIA	initial environmental impact assessment
IPM	integrated pest management
IWR	Irrigation water requirement
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MoE	Ministry of Environment
MOU	memorandum of understanding
MOWRAM	Ministry of Water Resources and Meteorology
PDWRAM	provincial department of water resources and meteorology
PMU	project management unit
PMIC	Project Management and Implementation Consultant
PPTA	project preparatory technical assistance
SPS	Safeguards Policy Statement
TNA	training needs assessment
ToR	terms of reference
UIWRMSP	Uplands Irrigation and Water Resources Management Sector Project

¹ (National Bank of Cambodia, 2018)

NOTE

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

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TABLE OF CONTENTS

	<u>Page</u>
Abbreviations	iii
List of Tables.....	ii
List of Figures.....	iii
Executive Summary	iv
I. INTRODUCTION	1
II. LEGAL AND ADMINISTRATIVE FRAMEWORK	2
A. ADB Environmental Requirements	2
B. Public Disclosure.....	2
C. Government Environmental Regulations	3
D. Evaluation Standards	4
E. Environmental, Health and Safety Guidelines	7
III. DESCRIPTION OF THE PROJECT COMPONENTS	8
A. Overall Project.....	8
B. Provincial Schemes.....	9
C. Subproject Components	13
D. Command Areas	22
E. Project Implementation	22
IV. DESCRIPTION OF THE ENVIRONMENT	23
A. The Subproject Province.....	23
B. Physical Environment	23
C. Biological Environment	27
D. Socio-economic Environment/Development.....	33
V. ANTICIPATED ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES	36
A. Positive Impact and Environmental Benefits	37
B. Environmental Impact and Mitigation Measures during Pre-Construction Phase.....	38
C. Impacts and Mitigation Measures during the Construction Phase	39
D. Environmental Impact and Mitigation Measures during Operation Impacts during Construction and Operation	43
E. Unanticipated Impacts during Construction and Operation.....	44
F. Climate Change Impact Assessment.....	44
VI. INFORMATION DISCLOSURE, CONSULTATION AND INSTITUTIONAL ARRANGEMENT	47
A. Consultation and Participation Process	47
B. Project Responses	49
C. Institutional Arrangement.....	50
VII. GRIEVANCE REDRESS MECHANISM	51
A. Proposed Mechanism	51
B. GRM Procedure and Timeframe.....	52
VIII. CONCLUSION AND ASSURANCES	54
A. Positive Impact and Environmental Benefits	54
B. Negative Impacts	54
C. Assurances	54
D. Conclusion	54
REFERENCES.....	55

LIST OF TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	List of Projects Requiring an IEIA or EIA.....	3
2	Water Quality Standard in Public Water Areas for Biodiversity Conservation	5
3	Drinking Water Standards.....	5
4	Ambient Air Quality Standard ^a	6
5	Maximm Permitted Noise Level in Public and Residential Area (dB [A])	6
6	Summary of Structures, Works and Equipment – Taing Krasaing Irrigation System	13
7	Summary of Works, Structures and Equipment – Prek Chik Irrigation Scheme.....	18
8	Command Areas of Taing Krasaing and Prek Chik Irrigation Scheme	22
9	Rainfall Data in Kompong Thom Province (From 2000-2011).....	24
10	Total Taing Krasaing Inflows Monthly Average, Dry, Minimum and Maximum Flows	25
11	Total Prek Chik Inflows Monthly Average, Dry, Minimum and Maximum Flows	26
12	Groundwater Quality Results of Groundwater at Wells in the Subproject Schemes	26
13	Environmental Noise Levels in the Subproject Schemes	27
14	Land Tenure Arrangement.....	28
15	Inventory of Fish Caught in the TK and PC Irrigation System	31
16	The CF Statistic in Kampong Thom Province	32
17	Social Indicators of Subprojects	34
18	Impact of Flooding (18 October 2013).....	35
19	Affected and Evacuated Families in 2013 and 2011 (Kampong Thom Province).....	35
20	Impacts of Flooded and Drought in Subprojects	35
21	Project Benefits through Agro-Inputs and Practices of the Two Irrigation Schemes	37
22	Construction Equipment Noise Impact Distance.....	41
23	GHG Emissions from Rice Paddy	44
24	GHG Emissions and GWP from Rice Paddy Increases	45
25	Predicted IWRs from Climate Change and IWRs Used in Subproject Water Balances	46
26	Profile of Participants in Public Consultation.....	47
27	Environmental/Agricultural Issues arising from Public Consultation	48
28	Instittional Roles and Responsibilities in EMP Implementation	50

LIST OF FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Location of Core Subprojects	8
2	Existig Taing Krasaing Scheme showing Main Canal and Irrigation Communes	10
3	Prek Chik Scheme Setting.....	11
4	Existing Prek Chik Scheme Showing all Packages	12
5	Location of Works along Main Canal - Taing Krasaing.....	15
6	Layout of Taing Krasaing Irrigation System – Chroab Distribution System (MOWRAM/NCB-CW03).....	16
7	ayout of Taing Krasaing Irrigation System – Korkoah Distribution System (MOWRAM/ICB-CW04).....	17
8	Layout of Prek Chik Irrigation System – Distribution System Package I (MOWRAM/ICB-CW07)	20
9	Layout of Prek Chik Irrigation System – Distribution System Package II (MOWRAM/ICB-CW08)	21
10	Location of O Tracheak Chit Reservoir – Package 3 (MOWRAM/ICB-CW09)	22
11	Taing Krasaing Monthly Average Inflows and Standard Deviation.....	25
12	Prek Chik Monthly Average Inflows and Standard Deviation	25
13	Land Use and Vegetation at the Taing Krasaing Subproject.....	29
14	Land Use and Vegetation at the Prek Chik Subproject	29
15	Present Crop Calendar for Taing Krasaing and Prek Chik with One Crop per Year (limited water).....	33
16	Present Crop Calendar for Prek Chik with Two Crops per Year	33
17	Agricultural Chemicals for Sale in the Prek Chik Subproject Area	34
18	Uneven Poverty Rates in Communes within the TK Scheme.....	34
19	Scenarios for the Critical Agricultural Parameters of Temperature and Rainfall Scenarios	36
20	Irrigation Water Requirement from IPCC SRES	46
21	Some Photos of Public Consultation during Project Implementation	48
22	Concept of Proposed GRM	53

LIST OF APPENDIX

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Environmental management plan (emps) of all packages for uplands project	67
2	Climate risk and vulnerability assessment	173
3	Public consultation meeting with relevant stakeholders	188
4	Pictorial of natural resources found in the project boundar	193

EXECUTIVE SUMMARY

A. Background

1. The overall goal of the proposed Uplands Irrigation and Water Resources Management Sector Project is to assist the Government of Cambodia to improve the management and governance of existing irrigation systems, increase agricultural production, and improve the productivity of subproject areas with the aim to increase the incomes of poor farmers. The project will focus on increased efficiency of irrigation systems and improved management of water resources in the uplands areas away from the Tonle Sap.

2. The IEE prepared in 2015 during PPTA covers two subprojects, Taing Krasaing Scheme in Kampong Thom province and Prek Chik Scheme in Battambang province. For these schemes, only the head-works and the main canal were assessed. Screening and categorization of environmental safeguards were made for five packages, including (i) Package CW03, (ii) Package CW04, (iii) Package CW07, (iv) Package CW08, (v) Package CW09. All the five packages were confirmed to be Category B for environment. According to ADB Mission on 15 December 2016, to update the 2015 IEE, including for all packages which is acceptable to ADB.

B. Project Components

3. The Taing Krasaing Scheme – TKS is located in the Tipo, Chroab, and Korkoah communes in Santuk District in the upland section of Kampong Thom province, approximately 17 km east of Kampong Thom Municipality. The rehabilitation and improvement of the TKS includes the following works:

- Rehabilitation of head-works, under-sluices, and spillway structures;
- Rehabilitation of 18.542 km of MC and 48 km of SCs and TCs;
- Installation of structures and gauges for water measurement, control, and distribution on TK; and
- Supply and installation of hydro meteorological (hydro-met) stations for water resources monitoring.

4. The rehabilitation and improvement of the Prek Chik Scheme – PCS includes the following work items:

- Rehabilitation of head-works, including raising of spillway by 0.5 m;
- Rehabilitation of 27.6 km Main Canal, installation of all structures for water control and distribution, and provision of all drainage works;
- SCs and TCs, Part 1, for a length of 70.2 km to cover 10,400 ha of net irrigated lands in Phase I;
- Increased focus and associated training on joint reservoir operations for Bassac Reservoir to improve water sharing and water scheduling arrangements between linked systems;
- Supply and installation of hydro-met stations for water resources monitoring (assisted by the ADB Flood and Drought Management Project);
- Provision of training to the PDWRAM, farmer water user community (FWUC), and the appropriate government agencies on water management, including planning for implementation; and
- Organization, mobilization, and training of FWUCs in the command area.

C. The IEE Report

5. The objectives of the IEE report are to:

- Describe the existing natural and socio-economical resources in and surrounding the project area;
- Identify and assess potential significant impacts based on existing environmental conditions including during project pre-construction, construction, and operation and maintenance (O&M) stages;
- Identify and recommend mitigation measures to minimize any potential impacts caused by project activities;
- Undertake public consultation to present subproject environmental issues to project stakeholders and local people of the subprojects' areas and to collect community concerns; and
- Develop an Environmental Management Plan (EMP) with cost estimates, and including monitoring plans during construction and operation stages to guide subproject implementation.

6. The original consolidated IEE was prepared following the ADB Safeguard Policy Statement (SPS) (2009), the 2003 ADB Environmental Assessment Guidelines, the ADB Environmental Guidelines for Selected Irrigation and Drainage Development Projects and relevant environmental policies and guidelines of the government. This update is from December 2018.

7. The project is classified under ADB guidelines/rules as a **Category B**, such-projects are judged to have some adverse environmental impacts most is occurring during construction phase, but of lesser degree and/or significance than those for category "A" projects. An IEE is required to determine whether or not significant environmental impacts warranting an Environmental Impact Assessment (EIA) are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

8. Environmental impact assessment in Cambodia is guided by the Royal Government of Cambodia Sub-decree No.72 on EIA, in compliance with this sub-decree, all individuals, private companies, joint-venture companies, public companies, ministries and government agencies are obliged to conduct an environmental impact assessment for proposed projects or activities, which must be submitted for approval by the MoE. The decree provides a list of project types that proponents use to screen projects for requiring either an EIA or initial EIA (IEIA). As project owner, the MOWRAM will have to prepare an IEIA or EIA for irrigation system depending on the command area where it is substantially expanded by refurbishment of a scheme to provide more than 5,000 ha of newly irrigated land or land previously without reliable irrigation, the provision of the sub-decree will apply. Since the project is rehabilitated the existing canal to 29,500 ha. This IEE will therefore not be forwarded to the Ministry of Environment by the Ministry of Water Resources and Meteorology (MOWRAM), the project executive agency has been established which is supported by 24 designated personnel from MOWRAM, MAFF, DHRW, and the PDWRAMs of Kampong Thom and Battambang provinces including safeguard officer.

9. The subproject which is the subject of this IEE has been chosen using a set of selection criteria. Although these criteria did not include specific environmental impact issues, the subproject when applied had the effect of selecting for relatively straightforward scheme without significant environmental impacts. These were:

- Subproject should not cause involuntary resettlement and should require as less land acquisition as possible. Subproject should not be a Category "A" and should

be a maximum of Category “B” for Involuntary Resettlement and Environment, and Category “C” for Indigenous Peoples.

- Irrigation system has low irrigation efficiency and water productivity, and would have scope for substantial enhancement of both irrigation efficiency and water productivity;
- Subproject should involve only rehabilitation of the existing systems or related schemes and should not involve construction of new systems;
- Subproject should be located outside the Tonle Sap basin;
- Subproject should involve rehabilitation of both primary and secondary canals to ensure that water reached the farm;
- Subproject should not be covered by other ongoing or proposed projects financed by ADB or any other Development Partner;
- Beneficiaries should include sharecroppers, poor farmers, and women farmers; and
- Subproject should be economically viable; and technically, socially and environmentally feasible. The economic internal rate of return (EIRR) of each subproject should be greater than 12%.

D. Assessment Findings

10. The environmental baseline study confirmed that the local communities are the most sensitive receptors in the project area. The project locations are dominated by rice fields and other agricultural land. No protected areas or habitats and species of conservation value were identified in the project area of influence.

11. During construction, the impacts are localized, short-term (construction period is 12–18 months), and limited to the common impacts associated with the construction activity. This includes the generation of air and water pollution, soil erosion, traffic accident, waste management, and occupational health and safety. All these impacts could be eliminated if the mitigation measures are implemented effectively.

12. The study shows that the current environment is being contaminated with agricultural pesticide consumption only. So during operation, the most significant environment risks associated with the project are local increases in the levels of agricultural fertilizer and pesticide residues and their effects on water quality and people. Operation mitigation measures will benefit from capacity building and training under the project to use fertilizers and pesticides efficiently and responsibly.

13. There is also a concern that the irrigation schemes must be sustainable and responsibly managed, to ensure that agreed irrigation flows are maintained and other water users are not disadvantaged. The EMP requires a clear and detailed extraction plan for the dry season to be prepared and submitted before construction.

14. Greenhouse gas emissions from the increased area of paddy produced by the subprojects equals approximately 98,238 tons/year, which is below the threshold of 100,000 tons/year and therefore requires no further monitoring under ADB’s SPS (2009).

15. Additionally, the initial rapid environmental assessment (REA) for the project identified a medium climate risk. Therefore, the climate risk and vulnerability assessment (CRVA) which was prepared during project preparation stage and the impact assessment, should be started up. The mitigation measures on climate change are proposed.

E. Mitigation Measures

16. The key mitigation measures for the project during pre-construction and construction include:

- EMP of each package were included in the bidding documents.
- Good construction practices are adopted to ensure minimal disturbance to affected people from construction related nuisance, such as noise, dust and pollutant emissions.
- The contractor submits the construction site planning for key activities which also require the contractor to develop appropriate maps to ensure all stakeholders are clear on where activities will take place.
- Access to properties and agricultural land are maintained and encroachment avoided to allow people to continue their activities unimpeded.
- A community and occupational health and safety plan is required as part of the construction site planning, emphasizing the need to address risks in particular to site operatives.

17. For the future operation phase, mitigation and monitoring measures are required. The importance of training on Integrated Pest Management – IPM, establishes FWUC and conflict resolution should be emphasized.

F. Environmental Management Plan

18. This consolidated IEE includes an EMP where the identified environmental impacts and mitigation measures are transformed into an action plan for their implementation. The plan includes methods of mitigation, responsibilities, indicators of progress, and frequency and nature of monitoring activities with cost estimates.

19. The EMP is a critical document for each subproject. The provisions of the EMP will be incorporated into tender documents and construction contracts.

20. A Grievance Redress Mechanism (GRM) will be established to receive and facilitate resolution of affected peoples' concerns and grievance about project social and environmental safeguards performance. It should address affected peoples' concerns and complaint promptly, using a transparent process that is readily accessible to all affected persons. It will contain multiple entry points to allow affected people to approach the Contractor, PMU, and local leaders, the Ministry of Water Resources and Mereology or ADB.

I. INTRODUCTION

1. The Royal Government of Cambodia (RGC), through the Ministry of Water Resources and Meteorology (MOWRAM), has received a loan from the Asian Development Bank (ADB) for the implementation of the Uplands Irrigation and Water Resources Management Sector Project (UIWRMSP) (ADB Loan 3289-CAM). The project will enhance agriculture and rural economic productivity through increased efficiency and climate resiliency of irrigation systems and improved management of water resources in upland areas of Kampong Thom and Battambang provinces.

2. The Loan, signed on 10 November 2015, became effective on 7 January 2016 and will close on 20 September 2021. The total project cost is about US\$66.12 million, financed through an ADB loan of Forty Three Million One Hundred Twenty One Thousand Special Drawing Rights (SDR 43,121,000)² equivalent to US\$60 million² and a government counterpart of about US\$6.12 million.

3. MOWRAM is the Executing Agency (EA), and the Department of Farmer Water-User Communities (DFWUC) is the Implementing Agency (IA). The Project Management Unit (PMU) in DFWUC, headed by the Deputy Director General for Technical Affairs as Project Director, oversees project implementation. The Project Director is supported by a Project Manager and some 24 designated personnel from MOWRAM, DFWUC, the Ministry of Agriculture, Forestry and Fisheries (MAFF), Department of Hydrology and River Works (DHRW), and the Provincial Departments of Water Resources and Meteorology (PDWRAMs) of Battambang and Kampong Thom provinces.

4. The original IEE was prepared following the ADB Safeguard Policy Statement (SPS) (2009), the 2003 ADB Environmental Assessment Guidelines, the ADB Environmental Guidelines for Selected Irrigation and Drainage Development Projects and relevant environmental policies and guidelines of the government. During PPTA, the first two subprojects to be funded (called “core” subprojects) were identified. These are the Taing Krasing scheme in Kampong Thom Province and the Prek Chik Scheme in Battambang Province. The project is classified as Category B for environment. The EARF and IEE conforming to the ADB’s SPS (2009) were completed for these two core subprojects (Contract Number: CW01 – Taing Krasing Main Canal and CW06 – Prek Chik Main Canal) and were disclosed in September 2015. During project implementation, Secondary Canals – SCs and Tertiary Canals – TCs (Contract Number: CW03, CW04, CW07, CW08 and CW09) of these two core subprojects were categorized as Category B for environment and the provisions of the EMPs were incorporated into construction contracts individually.

5. The main purpose of this updated IEE is to provide an assessment of environmental concerns that need to be undertaken in regard to the ongoing rehabilitation of existing irrigation structures of TK and PC irrigation Scheme which its scope of work is to cover sub-project package CW01, CW03, CW04, CW06, CW07, CW08 and CW09.

² Loan agreement between ADB and Kingdom of Cambodia, 10 November 2015

II. LEGAL AND ADMINISTRATIVE FRAMEWORK

6. This updated IEE has been updated for the subprojects of Taing Krasaing Irrigation Scheme (Contract number CW01, CW03, CW04) and Prek Chik Irrigation Scheme (contract number CW06, CW07, CW08 and CW09) of the Uplands Irrigation and Water Resources Management Sector Project in the Kingdom of Cambodia. It has been designed to satisfy both the ADB and relevant Cambodian environmental guidelines and regulations.

A. ADB Environmental Requirements

7. A Safeguard Policy Statement (SPS) describes common objectives of ADB's safeguards, lays out policy principles, and outlines the delivery process for ADB's safeguard policy. The SPS is designed for application to current and future lending modalities and caters to the varying capacities and needs of DMC clients in both the public and private sectors

8. Based on subproject screening by using a rapid environmental assessment (REA) checklist, the subproject is to be Category B for environmental impact. This category entails environmental impacts that can be mitigated. This consolidated IEE has been prepared under the provisions of the ADB's SPS (2009) which requires a number of critical considerations, including:

- Project level grievance redress mechanism, including documentation in the EMP;
- Physical cultural resources damage prevention analysis;
- Climate change mitigation and adaptation;
- Occupational and community health and safety requirements, including emergency preparedness and response;
- Economic displacement that is not part of land acquisition;
- Meaningful consultation and participation; and
- An EMP which comprises implementation schedule and (measurable) performance indicators.

9. The relevant ADB environmental policies and guidelines used in the preparation of this IEE are:

- Safeguard Policy Statement – SPS (2009);
- Operation Manual Bank Policies (BP) on SPS (2009);
- Environment Policy of the Asian Development Bank (2002);
- Environmental Assessment Guidelines (2003) – Appendix 3: Content and Format Initial Environmental Examination (IEE);
- Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects (November 1991); and
- Rapid Environmental Checklist (2013) for Irrigation project.

B. Public Disclosure

10. ADB will post the below safeguard documents on its' website and disclose relevant information in accessible manner in local communities.

- Final or updated IEE and EMP upon receipt, and
- Environmental monitoring report submitted for the project.

C. Government Environmental Regulations

1. Law on Environmental Protection and Natural Resource Management

11. The Law on Environmental Protection and Natural Resources Management was enacted by the National Assembly and launched by the Preah Reach Kram/NS-RKM-1296/36. It was enacted on 24 December 1996. This law has the following objectives:

- To protect and promote environment quality and public health through prevention, reduction and control of pollution;
- To assess the environmental impacts of all proposed projects prior to the issuance of a decision by the government;
- To ensure the rational and sustainable conservation, development, management and use of the natural resources of the Kingdom of Cambodia;
- To encourage and provide possibilities for the public to participate in the protection of environment and the management of the natural resources; and
- To suppress any acts that cause harm to the environment.

2. Environmental Impact Assessment Process Sub-decree

12. The Sub-decree No. 72 ANRK.BK in the Law on Environmental Impact Assessment Process dated 11 August 1999 sets out the EIA procedures. The main objectives of this sub-decree are:

- To determine an EIA for every private and public project or activity, through review by the MoE, prior to the submission for a decision from the government;
- To determine the type and size of the proposed project(s) and activities, including existing and ongoing activities in both private and public sector prior to undertaking the process of EIA; and
- To encourage public participation in the implementation of the EIA process and take into account their input and suggestions for reconsideration prior to the implementation of any project.

13. The sub-decree includes an annex, which provides a type and scale of the interventions that require an EIA. An excerpt for relevant industries is at **Table 1**.

Table 1: List of Projects Requiring an IEIA or EIA

Type and activities of the projects	Size/Capacity
Concession forest	≥10,000 Hectares
Logging	≥500 Hectares
Land covered by forest	≥500 Hectares
Agriculture and agro-industrial land	≥10,000 Hectares
Flooded and coastal forests	All sizes
Irrigation systems	≥5,000 Hectares
Drainage systems	≥5,000 Hectares
Fishing ports	All sizes

14. Since the subprojects involve the refurbishment of existing irrigation schemes and the command areas are less than 5 000 ha, so, they do not require IEE or EIA under Government Sub-decree No. 72 ANRK.BK. Therefore, the consolidated IEE will be submitted to ADB for review and approval to post on ADB website only.

D. Evaluation Standards

1. Law on the Management of Pesticides and Fertilizers

15. The Law on the Management of Pesticides and Fertilizers was enacted on 14 January 2012. This law has the following objectives:

- To support a policy promoting the effectiveness potentiality of agriculture sector, for the development of social and national economy;
- To ensure the safe and effective control of pesticides and fertilizers, whether in consistent with the international standards;
- To enhance public awareness on the implementation of standard requirements of pesticides and fertilizers for all relevant activities related to these products; and
- To reduce risks caused by the use of pesticides and fertilizers, for beneficiary of farmers and people in the nationwide, by ensuring food security, food safety, public health, and the sustainability of environment.

16. The scope of the law applies to the management and the implementation of standard requirements for:

- All type of pesticides and fertilizers, raw materials or active ingredients and other compositions of pesticides and fertilizers which are used as inputs in agricultural production.
- All activities of natural persons or legal entities who are traders, formulators, pests control services operators, advertisers, donors, and users of all types of pesticides and fertilizers.

2. Law on Water Resources Management

17. The Law on Water Resources Management was enacted by the National Assembly on 22 May 2007. This law provides procedures for the management of water resources within Cambodia. The purpose of the law is to foster the effective management of the water resources of the Kingdom of Cambodia to attain socioeconomic development and the welfare of communities.

18. The law determines:

- The rights and obligations of water users;
- The fundamental principles of water resources management;
- The institutions in charge of its implementation and enforcement; and
- The participation of users' and their associations in the sustainable development of water resources.

19. Under this law, MOWRAM may declare any basin, sub-basin or aquifer as Water Law Implementation Area when within that basin, sub-basin, ground water or aquifer there are likely to be conflicts among water users, problems of water pollution or watershed degradation.

3. Water Pollution Control Sub-decree

20. The Sub-decree No. 27 ANRK.BK on Water Pollution Control is dated on 6 April 1999. The purpose of this sub-decree is to regulate water pollution control in order to prevent and reduce the water pollution of public water so that the protection of human health and the conservation of biodiversity can be ensured.

21. This sub-decree applies to all sources of pollution and all activities causing pollution of public water areas. The sub-decree also provides the pollution types, effluent standards, and water quality standards in different areas. Water quality standards are stipulated in this sub-decree for public water (**Table 2**).

Table 2: Water Quality Standard in Public Water Areas for Biodiversity Conservation

Parameters	Unit	Standard Value
River		
pH	mg/l	6.5 – 8.5
BOD5	mg/l	1 – 10
Suspended Solid	mg/l	25 – 100
Dissolved Oxygen	mg/l	2.0 - 7.5
Coliform	MPN/100ml	< 5000
Lakes and Reservoirs		
pH	mg/l	6.5 – 8.5
COD	mg/l	1 – 8
Suspended Solid	mg/l	1 – 15
Dissolved Oxygen	mg/l	2.0 - 7.5
Coliform	MPN/100ml	< 1000
Total Nitrogen	mg/l	0.1 – 0.6
Total Phosphorus	mg/l	0.005 – 0.05
Coastal Water		
pH	mg/l	7.0 – 8.3
COD	mg/l	2 – 8
Dissolved Oxygen	mg/l	2 – 7.5
Coliform	MPN/100ml	< 1000
Oil content	mg/l	0
Total Nitrogen	mg/l	0.2 – 1.0
Total Phosphorus	mg/l	0.02 – 0.09

Note: l = liter; mg = milligram; ml = milliliter

Source: Government of Cambodia. 1999. Annex 4 of Sub-decree on Water Pollution Control. Phnom Penh.

4. Drinking Water Quality Standards

22. For well water used for domestic purposes, including drinking, the Ministry of Industry Mines and Energy Drinking Water Quality Standards of January 2004 is the evaluation standard. These are summarized in **Table 3**.

Table 3: Drinking Water Standards

Parameter	Unit	Standard Value
pH	mg/l	6.5 – 8.5
Turbidity	NTU	5
Arsenic	mg/l	0.05
Iron	mg/l	0.03
Total Dissolved Solid	mg/l	800
Chlorine	mg/l	0.2-0.5
Copper	mg/l	1
Sulphate	mg/l	250

Parameter	Unit	Standard Value
Nitrite	mg/l	3
Nitrate	mg/l	50
Lead	mg/l	0.01
Mercury	mg/l	0.001
Coliform	MPN/100ml	0

Note: l = liter; mg = milligram; ml = milliliter

Source: Government of Cambodia, Ministry of Industry Mines and Energy (2004).

5. Solid Waste Management Sub-decree

23. The Sub-decree No. 36 ANRK.BK on Solid Waste Management is dated on 27 April 1999. The purpose of this sub-decree is to regulate solid waste management in order to ensure the protection of human health and the conservation of bio-diversity.

24. This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste.

6. Air Pollution Control Sub-decree

25. The Sub-decree No. 42 ANRK.BK on Air Pollution Control and Noise Disturbance is dated on 10 July 2000. Its purpose is to protect the quality of environment and public health from air pollutants and noise pollution (**Tables 4 and 5**). This sub-decree applies to all movable sources and immovable sources of air and noise pollution.

Table 4: Ambient Air Quality Standard^a

Parameters	Period 1hr average (mg/m ³)	Period 8hrs average (mg/m ³)	Period 24hrs average (mg/m ³)	Period 1year average (mg/m ³)
Carbon Monoxide (CO)	40	20	-	-
Nitrogen Dioxide (NO ₂)	0.3	-	0.1	-
Sulfur Dioxide (SO ₂)	0.5	-	0.3	0.1
Ozone (O ₃)	0.2	-	-	-
Lead (Pb)	-	-	0.005	-
Total Suspended Particles (TSP)	-	-	0.33	0.1

Note: hr = hours, m³=cubic meters, mg = milligram. ^a This standard applied to evaluation of ambient air quality and to monitoring of air pollution status.

Source: (Government of Cambodia, 2000)

Table 5: Maximum Permitted Noise Level in Public and Residential Area (dB [A])

Locations	Period		
	06:00 to 18:00	18:00 to 22:00	22:00 to 06:00
Silence Area <ul style="list-style-type: none"> Hospital Library School Nursery 	40	40	35
Resident Area <ul style="list-style-type: none"> Hotel Administration Place House 	60	50	45

Locations	Period		
	06:00 to 18:00	18:00 to 22:00	22:00 to 06:00
Commercial, Services Areas and mix	70	65	50
Small industrial factories intermingling in residential areas	75	70	50

Note: hr = hours, m³=cubic meters, mg = milligram. ^a This standard applied to evaluation of ambient air quality and to monitoring of air pollution status.

Source: (Government of Cambodia, 2000)

7. Silt/Sediment Quality

26. For the reuse and disposal of silt from canal cleaning or dredging, there is no government standard. Standards applying to paddy field environments from the People's Republic of China (PRC) and Japan will therefore be referenced. These will include PRC: GB4284-84 Control standards for pollutants in sludge for agricultural use, PRC: GB/T23486- 2009 Sludge quality for afforestation in gardens or forests, and Japan's Environmental Quality Standards (EQS) for soil pollution, August 1991.

8. National Integrated Pest Management Program

27. The Integrated Pest Management (IPM) Program in Cambodia was established in 1993 after conducting national workshop on "Environment and IPM". The overall goal of National IPM Program is to promote food security in Cambodia by enhancing the sustainability of intensified crop production system through the promotion of integrated crop management (ICM) skills at farm level. The objectives of this program are:

- To reduce dependence on agricultural chemical, especially pesticides, in agricultural production and to minimize hazards to the human health, animals and environment;
- To develop the capacity of farmers and agricultural technical officers in conducting training and experiments so that they are able to identify problems occurring in agricultural production and find appropriate solution to deal with the problem by themselves; and
- Educate farmers on agricultural technology by enhancing their knowledge on field ecology and by developing skills among farmers in monitoring and analyzing field situations that enable them to manage crops properly.

28. At the national level, a Prakas (Ministerial Declaration) strengthened the position of the IPM program in July 2002, recognizing the National IPM Program as coordinating body for all IPM related activities in Cambodia. The Prakas also established a steering committee and a deputy director to act as the national coordinator.

E. Environmental, Health and Safety Guidelines

29. ADB's SPS 2009 applies pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. The guidelines provide the context of international best practice and contribute to establishing targets for environmental performance. The air and noise standards in the EHS guidelines will be used to complement the government standards in this document where needed.

30. Occupational and community health and safety, as laid out in the EHS guidelines, will be a crosscutting assessment for the subprojects.

III. DESCRIPTION OF THE PROJECT COMPONENTS

A. Overall Project

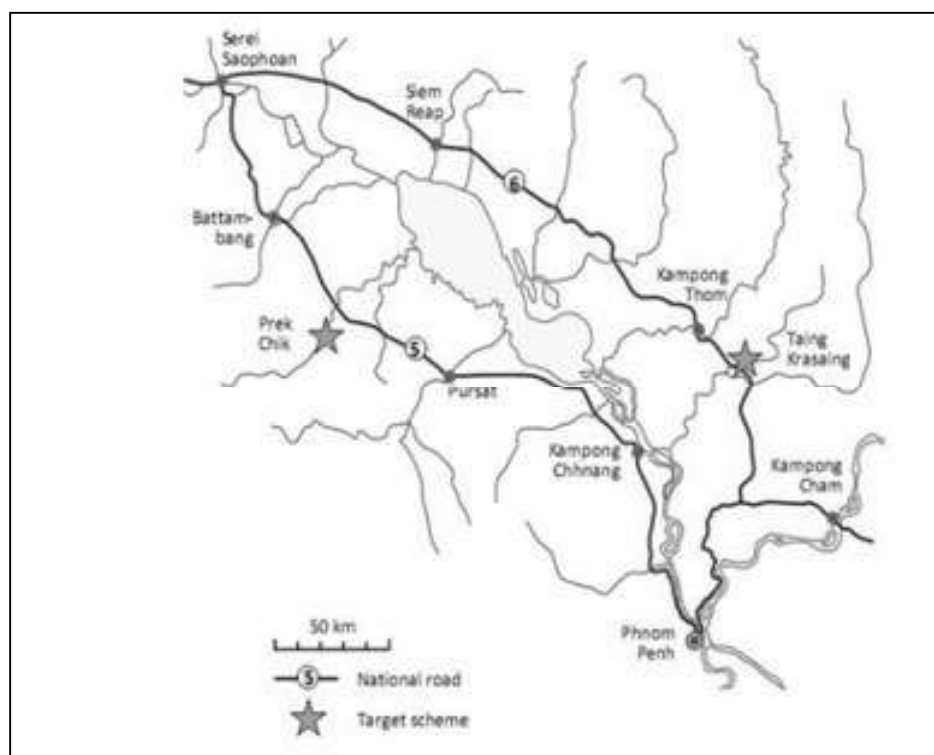
31. The project is implemented in Kampong Thom and Battambang provinces. These provinces have potential for improved land and water productivity through improved irrigation systems and water resource management. The project area comprises 3 selected irrigation systems in the two provinces, which have potential for growing vegetables and fruits with paddy being the main crop.

32. The project supports the Government's strategy to enhance economic growth in the project area through the rehabilitation, modernization, and climate proofing of selected existing irrigation systems in the provinces of Battambang and Kampong Thom. The project outcome is enhanced water and agriculture productivity in the project provinces, and the project outputs are: (i) enhanced efficiency and climate resilience of irrigation systems in the project area; and (ii) improved water resources management.

33. This works comprise rehabilitation and upgrading works to the main canals and side canals including embankments and headwork as well as refurbishment or replacement of cross regulators, offtakes, sluices and bridges. Works will also encompass the construction of new secondary and tertiary canals and drains with regulators, off-take structures and tertiary structures.

34. A long-list of candidate subprojects was developed during the course of the PPTA, along with selection criteria for finalizing the preferred ones. These criteria identified the first two subprojects to be funded (called "core" subprojects). These are parts of the Taing Krasaing Scheme in Kampong Thom Province and the Prek Chik Scheme in Battambang Province (**Figure 1**).

Figure 1: Location of Core Subprojects



Source: (ADB, 2015)

B. Site Conditions

35. Irrigated agriculture in both Kampong Thom and Battambang provinces is wet season rice-based. If sufficient water is available a second crop of either rice or vegetables and fruits such as pineapple and water melon is sown. During dry season, many lands are observed to be fallow. In general, lands are quite level. In the wet season, the schemes also have drainage problems during the wet season; and water-logged areas are observed in several places.

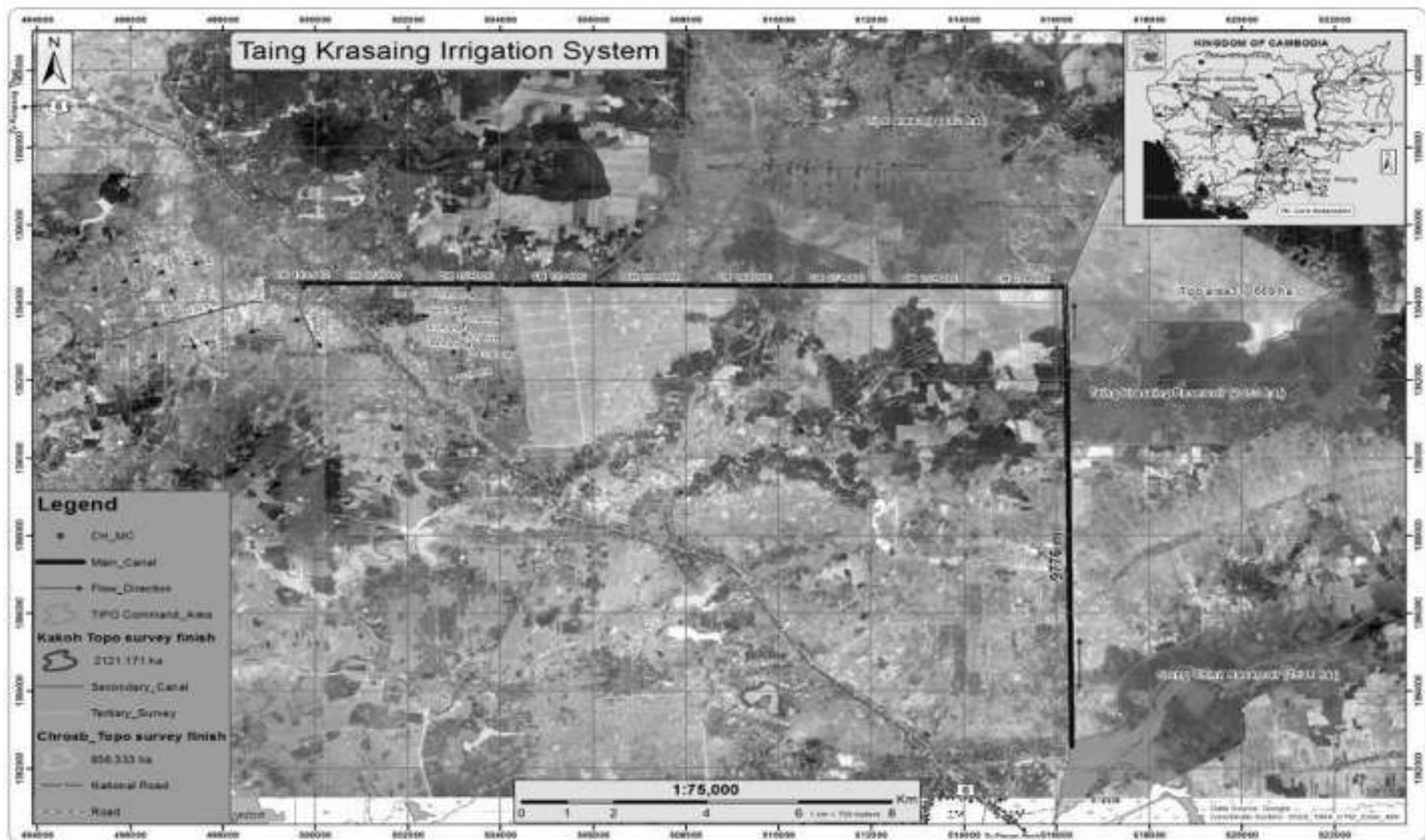
36. Prior to the start of the project the infrastructures were in poor maintenance conditions. Many canals were subject to embankment erosion, especially in the many sandy soils. Recently built systems were observed to be either still incomplete and under delayed construction or abandoned and not usable after just a few seasons. During dry season, several lined canal parts/systems were also observed as dry as they were not connected to the main irrigations system.

37. In some cases farmers employ low-head portable diesel pumps (owned or rented) where the water level in canals or even drains are too low to service lands by gravity. Rice yields are low in general between 0.8 to 1.5 ton/ha, with only a few places reaching 2.5 tons/ha. Post-harvest drying and processing are potentially wasteful with significant losses. Seed quality is often poor. Most planting is broadcast, and requires both rain and some irrigation to meet the large needs of land soaking and land preparation.

1. Taing Krasaing Scheme

38. The Taing Krasaing system is located some 25 km south-east of the city of Kampong Thom, close to National Highway No.6, with Phnom Penh a 185 km drive away. The Taing Krasaing system is supplied by 2 inter-connected reservoirs, the Taing Krasaing and Stuing Chinit reservoirs. The Taing Krasaing system was constructed during the period 1975-1978, underwent rehabilitation in 2000, and had partial sections improved and modernized in 2005 and 2012. The watershed upstream is estimated at 1,100 km². Figure 2 shows the main canal, supply reservoirs and irrigation communes.

Figure 2: Existing Taing Krasaing Scheme showing Main Canal and Irrigation Communes



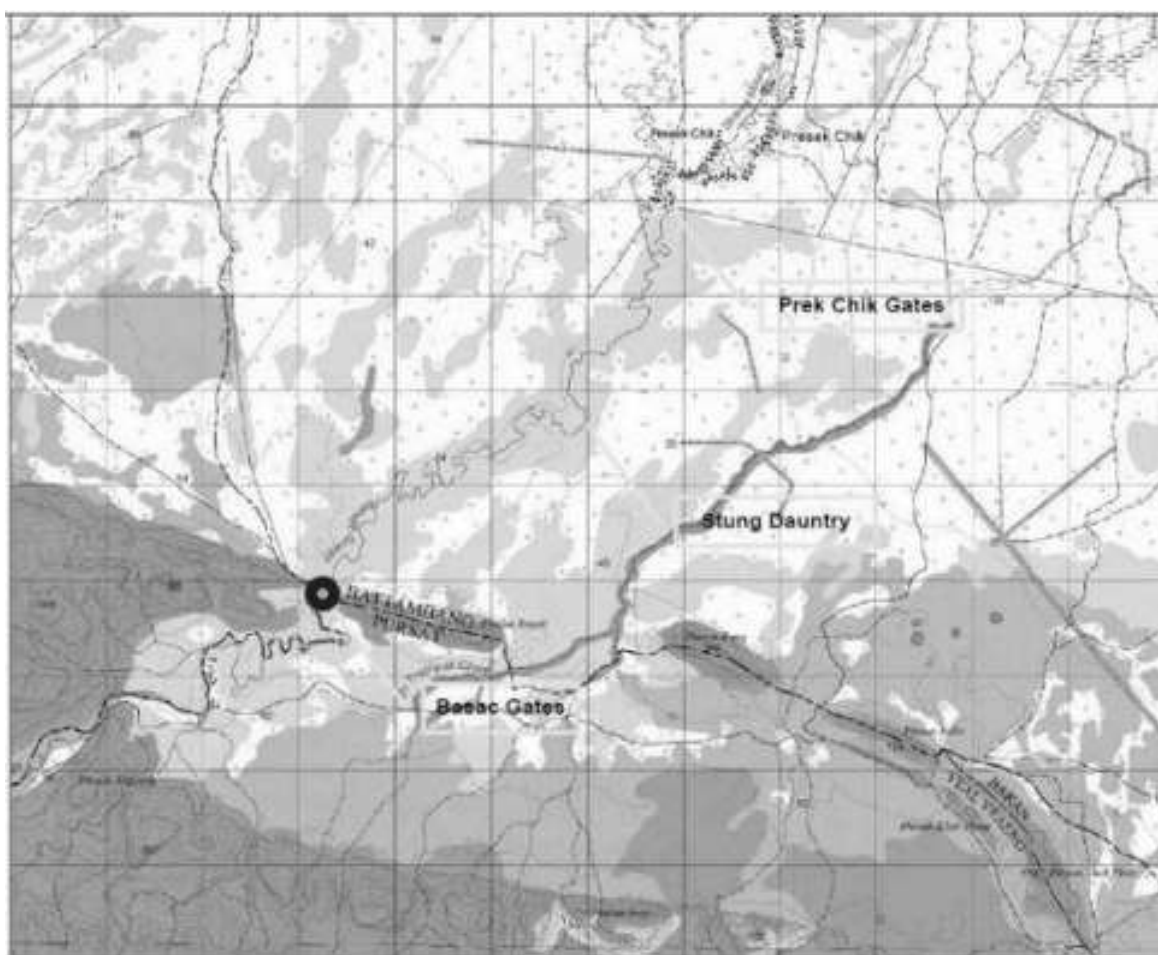
Source: (PMIC, 2018)

2. Prek Chik Scheme

39. Scheme construction of the 28 km long Prek Chik Canal, linked to the Bassac reservoir via Stung Dauntry, was started during 1977. It was unfinished when construction work ceased in late 1978. After 1979, the partly finished canal was largely unused until the Battambang provincial department of water resources and meteorology (PDWRAM) in 2003 made some small repairs. Major rehabilitation work was done by MOWRAM in 2010 using funding from the Japanese government with the aim of bringing the Prek Chik Canal into effective operation. This construction work was completed at the beginning of 2012. The MOWRAM rehabilitation plan focused on the main canal and its irrigation structures.

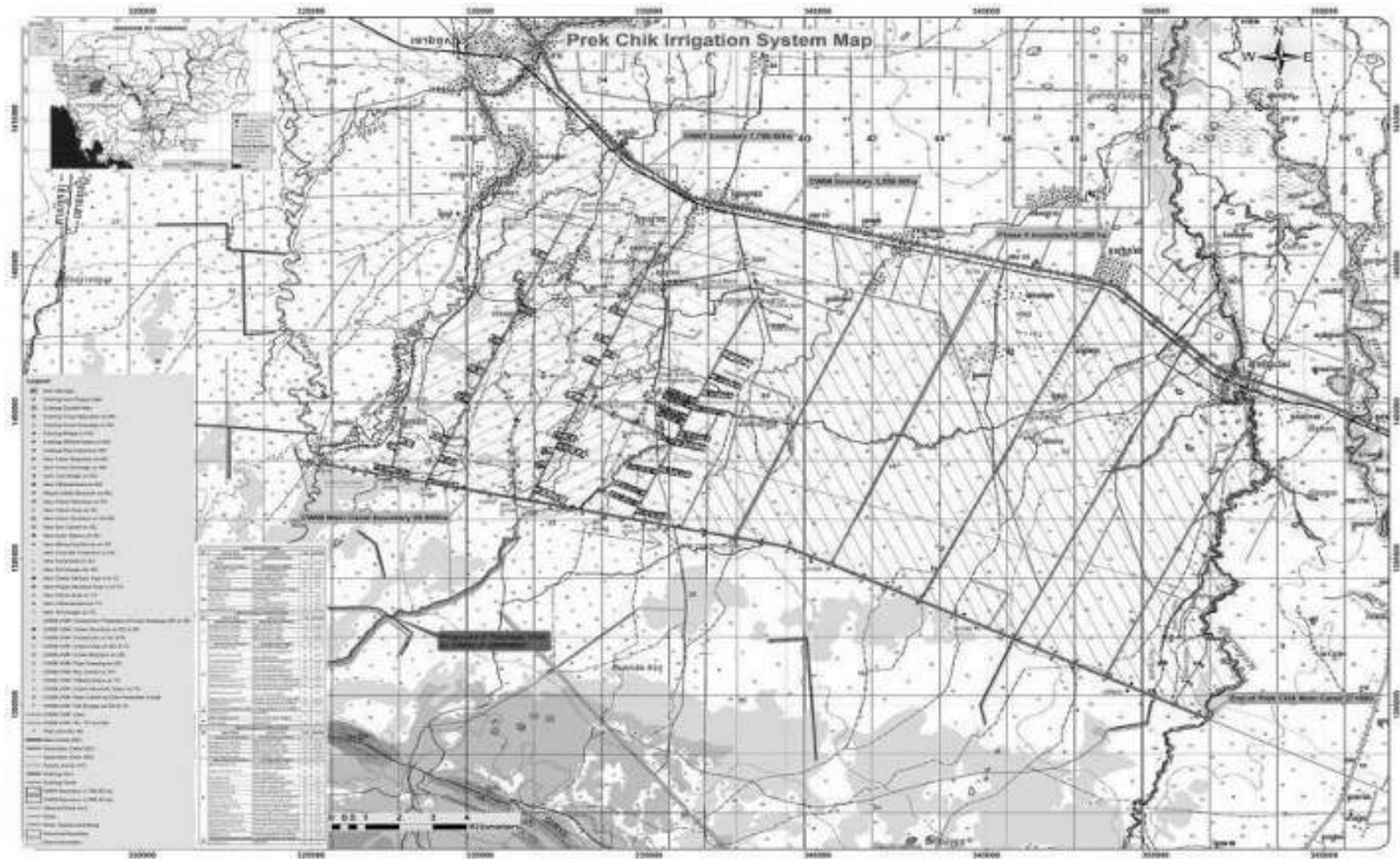
40. Improvement of O Tracheak Chit reservoir and its irrigation system (Prek Chik Package III) has been added to the Prek Chik system – PC system. The proposed Dauntry reservoir, which was supposed to supplement the PC system, is yet to be investigated and implemented however; implementation of the new package will serve this purpose. The survey, design work and cost estimates have been completed and the bidding documents are being prepared.

Figure 3: Prek Chik Scheme Setting



Source: (ADB, 2015)

Figure 4: Existing Prek Chik Scheme Showing all Packages



Source: PMIC, 2018

C. Subproject Components

41. The specifications of the 2 core subprojects in the Uplands Irrigation and Water Resources Management Sector Project, which are subject to this IEE, comprise works to improve the both main canal, and secondary and tertiary canal of each. The works are summarized in the following.

1. Specifications of Work of Taing Krasaing (TK) Irrigation System

42. Taing Krasaing subproject (**Figure 5**) is located in the Tipo, Chroab and Korkoah Commune, Santuk district, Kampong Thom Province in the upland part of the Kampong Thom province in approximate distance of 25 km east of the Kampong Thom municipality. The rehabilitation and improvement of the Taing Krasaing Irrigation System includes i) rehabilitation of the headwork, under sluices and the spillway structures, ii) Rehabilitation of 18.542 km Main canal and 48 km of secondary and tertiary canals, iii) installation of structures and gauges for water measurement, control, and distribution on TK, iv). supply and installation of Hydro-Met stations for water resources monitoring. This subproject was divided into 3 (three) separated packages namely:

- **TK Main Canal and Headworks (MOWRAM/ICB – CW01).** The works include rehabilitation and improvement of the spillway, headwork structure, under-sluice gates structure, 18.5 kilometer (km) of main canal, and existing main canal structures. Concrete lining of the main canal from Chainage (ch.) 16+040 to 18+542 was also included. The total irrigable command area of TK main canal is 9,869 ha.
- **Chroab Distribution System (MOWRAM/NCB – CW03).** These works concern the rehabilitation and upgrading of the existing Chroab secondary system and the construction of new tertiary canals and structures. In addition the construction of a secondary inspection road of 2,650 meters length and 8 meters width. There are four villages in Chroab commune which three villages will get direct benefit from the project such as 1. Toul Vihear village, 2. Chey Mongkol, and 3. Sdok Sdam village. The total populations of these three villages are 1,049 households covering 2,835 ha. This distribution system is composed of 2,674 m long of secondary canals and Tertiary canals of 4,250 m for reinforcement concrete work and Side Drain (2,909 m) with related 142 structures. The total irrigable command area of Chroab is 858 ha, being part of the 9,869 ha.
- **Korkoah Distribution System (MOWRAW/ICB – CW04).** These works also concern the rehabilitation and upgrading of the existing Korkoah secondary system and the construction of new tertiary canals and structures in the Korkoah commune, Santuk District, Kampong Thom province. The secondary canal location is the old existing canal with 5 km length and 8 meters width. This distribution system is composed of 5,723 m long and consist of secondary canal and seven tertiary canals (See **Figure 7**).

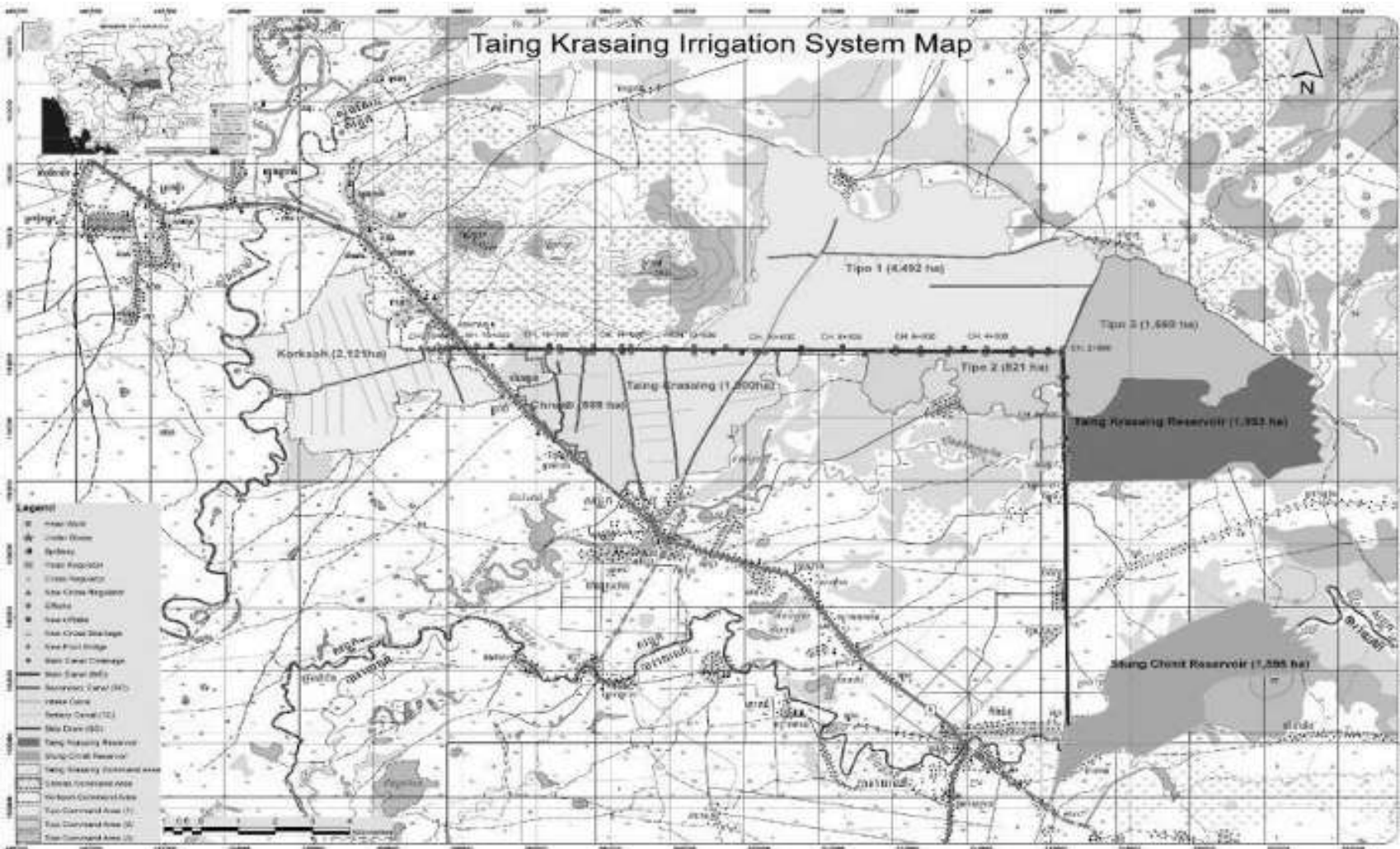
43. **Table 7, Figures 5, 6 and 7** describe the works for Taing Krasaing Irrigation System.

**Table 6: Summary of Structures, Works and Equipment –
Taing Krasaing Irrigation System**

Description	Quantity
1. Scope of Work (CW01)	
a). Improvement of Main Canal	18.542 km
b). Improvement of Headwork	01 location

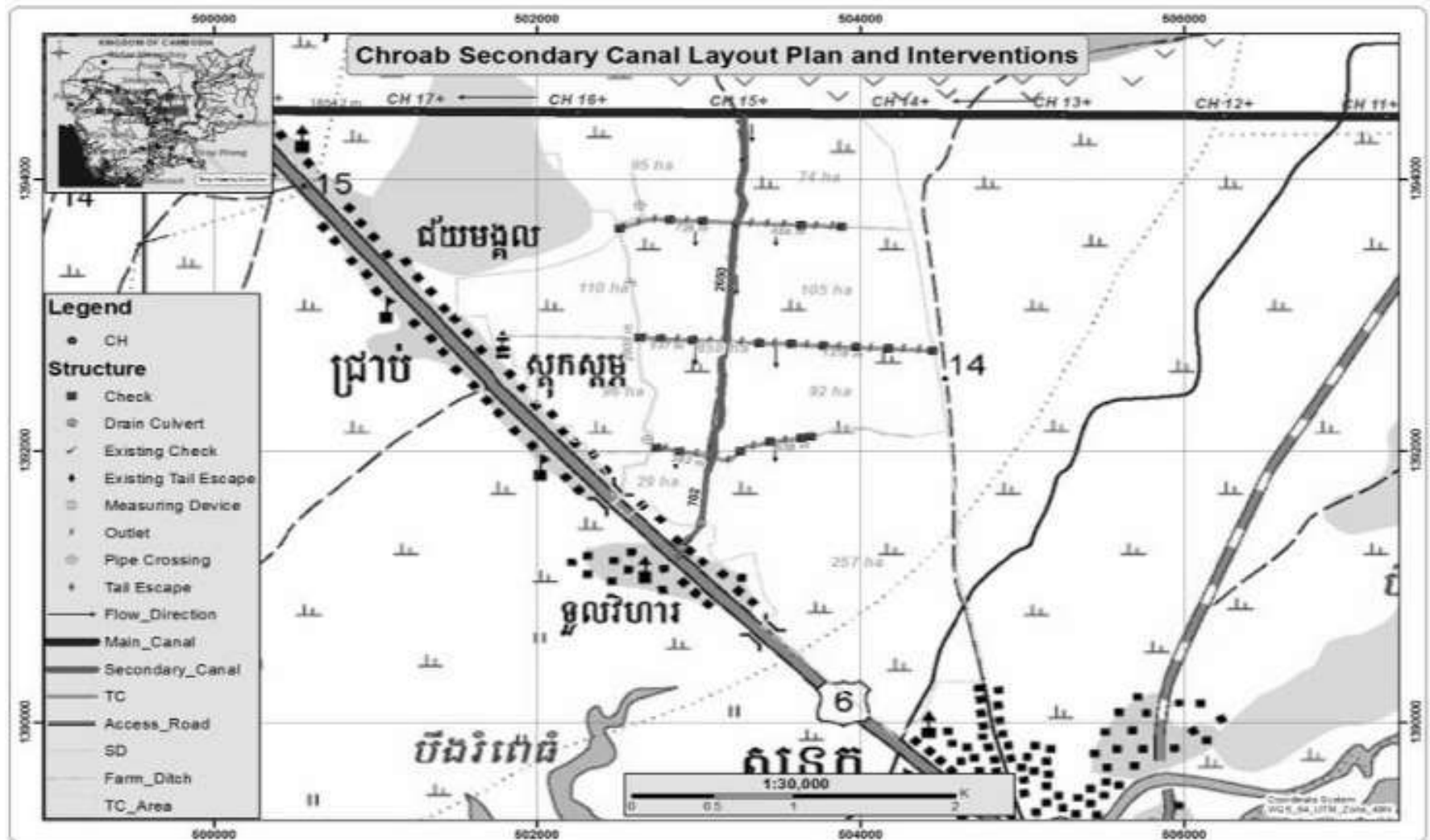
Description	Quantity
c). Improvement of Under Sluice	01 location
d). Improvement of Spillway	01 location
e). Improvement of Head Regulator	01 location
f). Improvement of Cross Regulator	04 locations
g). Improvement of Existing off-take	42 locations
h). Construction of New Cross Regulator	04 locations
i). Construction of New Off-take	13 locations
j). Construction of New Foot bridge	04 locations
k). Construction of New Cross drain	01 location
2. Scope of Work (MOWRAW/NCB – CW03)	
a). Improvement of Secondary Canal	2.7 km
b). Improvement of Road	0.67 km
c). Improvement of Tertiary Canal	4.250 km
d). Improvement of Side Drain	2.909 km
e). Off Take	85 Locations
f). Check Structure	19 Locations
g). Tail Scape	07 Locations
h). Cross Structures	06 Locations
i). Drain Culvert	02 Locations
j). Measuring Device Structure	01 Locations
3. Scope of Work (MOWRAW/ICB – CW04)	
a). Improvement of Secondary Canal 1	5,400 meter
b). Improvement of Secondary Canal 2	150 meter
c). Improvement of Tertiary Canal	6,750 meter
d). Improvement of Existing Bridge	1location
e). Head Regulator	2 locations
f). Inlet Structure	26 locations
g). Off Take	100 locations
h). Check Structure	27 locations
i). Tail Escape	18 locations
j). Cross Structures	26 locations
k). Slope Protection	04 locations
l). Measuring Device Structure	01 locations

Figure 5: Location of Works along Main Canal - Taing Krasaing



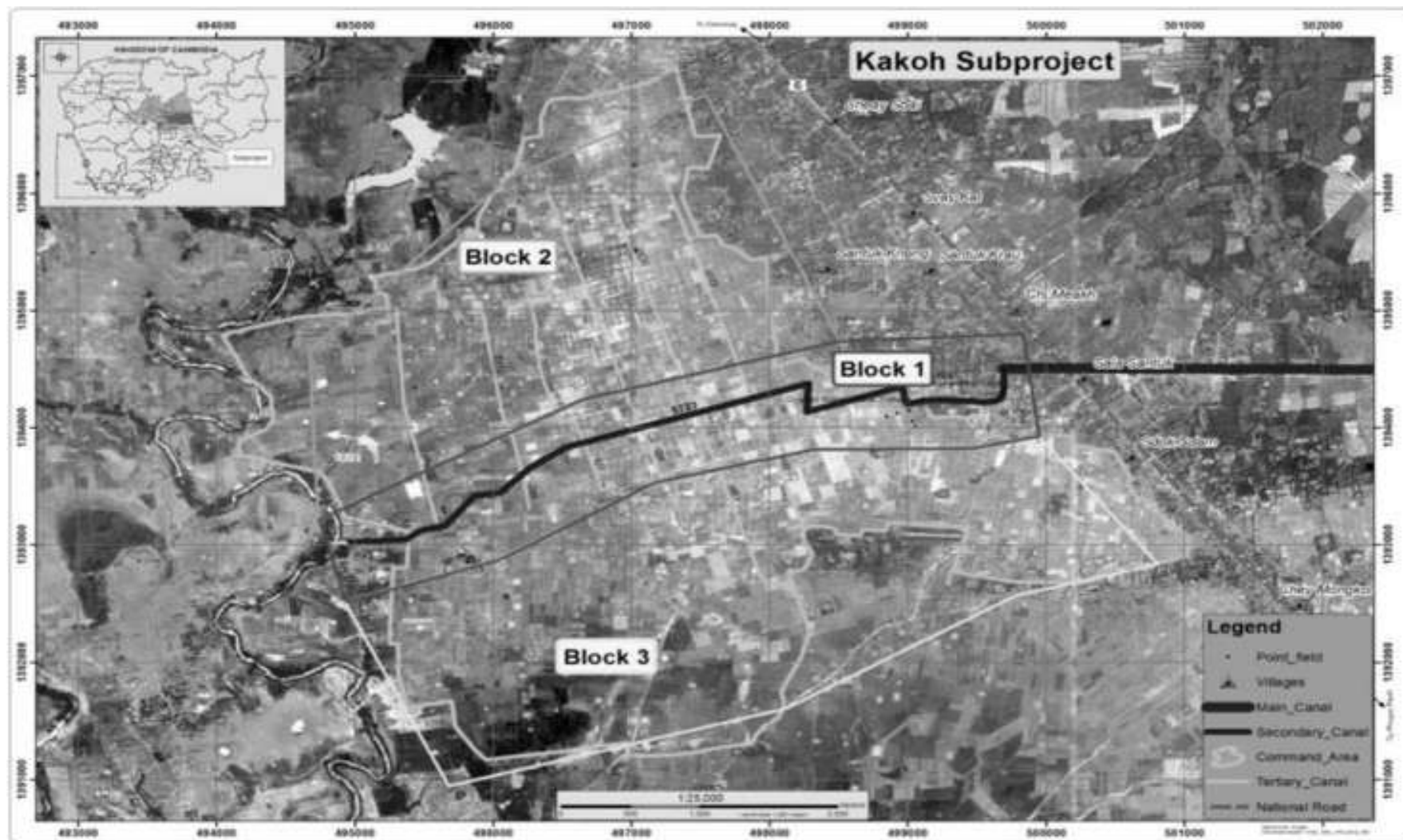
Source: (PMIC, 2018)

Figure 6: Layout of Taing Krasaing Irrigation System – Chroab Distribution System (MOWRAM/NCB-CW03)



Source: (PMIC, 2018)

Figure 7: Layout of Taing Krasaing Irrigation System – Korkoah Distribution System (MOWRAM/ICB-CW04)



Source: (PMIC, 2018)

2. Specifications of Work of Prek Chik Irrigation Scheme

44. The Irrigation system of Prek Chik is located in Rukhakiri and MOUNG District within 5 communes of beneficiary, Battambang province about 300km from Phnom Penh city, south of Battambang Province. It is accessible through National Road No. 5 between Pursat and Battambang province access to the site by Muong Russei district. The distance from Battambang municipality to Prek Chik headworks is about 59 km. The system is supplied from Bassac and Tracheak Chit Reservoir where is 14 km away to south-west. The civil work of rehabilitate and improvement of the system was divided into three separated packages, namely: (i) PC Main Canal and headworks (MOWRAM/ICB–CW06); (ii) PC Package 1 (MOWRAM/ICB–CW07); and (iii) PC Package 2 (MOWRAM/ICB–CW08). **Table 8, Figures 8 and 9** describe the work of Prek Chik Irrigation Scheme.

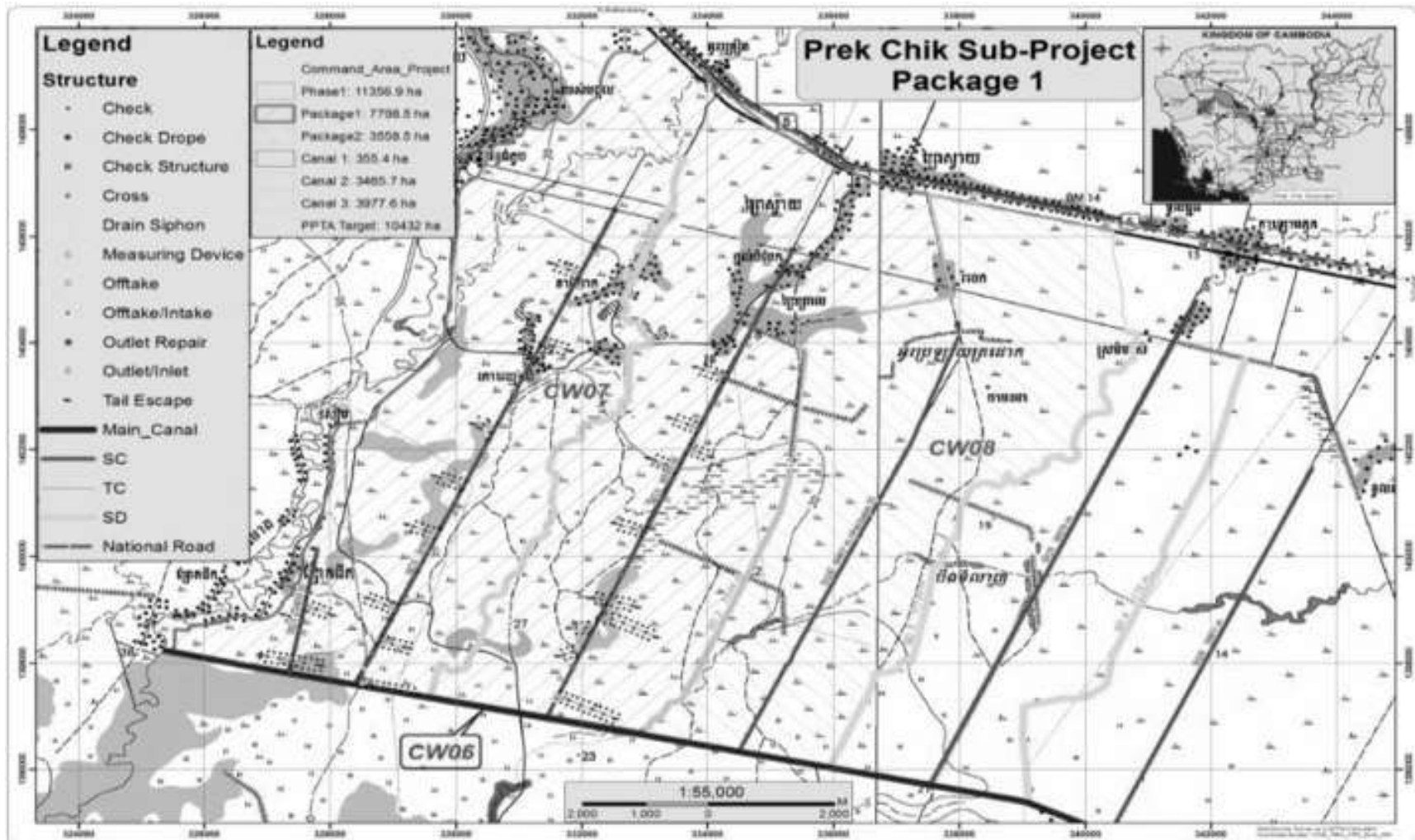
Table 7: Summary of Works, Structures and Equipment – Prek Chik Irrigation Scheme

No.	Description	Quantity
1	Scope of Work (CW-06)	
	1.1. Improvement of Main Canal	27.6 km
	1.2. Improvement of Auto flappy gate	01 No
	1.3. Improvement of Duckbill weir	01 No
	1.4. Improvement of Existing Off-take	54 Locations
	1.5. Construction of Cross regulator	10 locations
	1.6. Construction of New Off-take	20 locations
	1.7. Construction of New Foot bridge	4 locations
	1.8. Construction of New Cross drain	3 locations
2	Scope of Work (CW-07)	
	2.1. Earth works (Excavation and Back fill)	3 SCs & 26 TCs and other Structures
	2.2. General Structures about	398 Locations with different types
	2.3. FWUC's Building	01 No
3	Scope of Work (CW08)	
	3.1. Earth works	43.024 km
	3.2. Construction of New Structures	443 location with different types
	3.3. Improvement of Existing Structure	1 No
4	Scope of Work (CW09)	
	4.1. Dam Main Reservoir	4,021 m
	4.2. Access Road LHS	1,800 m
	4.3. Access Road RHS	500 m
	4.4. Drain Channel	120 m
	4.5. Feeder Canal (FC-01)	5,150 m
	4.6. Feeder Canal (FC-02)	9,327 m
	4.7. Secondary Canal (SC-A)	4,797 m
	4.8. Tertiary Canal (TC-A)	1,592 m
	4.9. Tertiary Canal (TC-B)	1,580 m
	4.10. Types of new and improvement structures, consist of:	
	Spillway on Dam Main Reservoir	1Nr. Ch: 2+125
	Repair Head Regulator	No.1 on Dam Main Reservoir for FC-01 (1Nr. Ch:1+600)
	Head Regulator	No.2 on Dam Main Reservoir for FC-02 (1Nr. Ch:1+975)

No.	Description	Quantity
	Head Regulator	No.3 on Dam Main Reservoir (1Nr. Ch:2+800)
	Intake Structure RHS on Prek Chik Main Canal	(1Nr. Ch:5+760)
	Repair Intake Structure RHS on Prek Chik Main Canal	(1Nr. Ch:7+810)
	Cross Drainage BHS on Prek Chik Main Canal	(1Nr. Ch:7+850)
	Pipe Culvert on Access Road LHS & RHS	(3Nr. LHS Ch: 0+600 & 1+200, RHS Ch: 0+250)
	Measuring Device on FC-01	(1Nr. Ch: 0+100)
	Check Structures on FC-01	(4Nr. Ch: 0+500, 1+550, 3+815 & 4+800)
	Check Drop Structures on FC-01	(3Nr. Ch: 1+000, 2+715, 4+450)
	Outlet Structure on FC-01	(1Nr. Ch: 2+710)
	Outlet/Inlet Structures BHS on FC-01	(10Nr. Ch: 0+100, 0+500, 1+000, 1+500, 2+060, 2+495, 3+300, 3+810, 4+300 & 4+800)
	Outlet/Inlet Structure LHS on FC-01	(1Nr. Ch: 0+700)
	Cross Structures on FC-01	(2Nr. Ch: 1+700 & 2+500)
	Concrete Slope Protection on FC-01	(5Nr. 0+070-0+090, 2+470-2+520, 4+320-4+360, 4+450-4+500, 4+600-4+700)
	Measuring Device on FC-02	(1Nr. Ch: 0+100)
	Outlet/Inlet Structures BHS on FC-02	(19Nr. Ch: 0+150, 0+500, 0+950, 1+500, 1+930, 2+500, 2+950, 3+500, 3+950, 4+500, 4+950, 5+500, 5+900, 6+500, 6+950, 7+500, 7+950, 8+300 & 9+000)
	Outlet/Inlet Structures LHS on FC-02	(2Nr. Ch: 0+300 & 3+200)
	Cross Structures on FC-02	(9Nr. Ch:0+950, 1+950, 2+950, 3+950, 4+950, 5+900, 6+950, 7+950, 8+800)
	Measuring Device on SC-C	(1Nr. Ch: 0+040)
	Check Structures on SC-C	(3Nr. SC-C Ch: 1+500, 2+500 & 3+500)
	Check Drop Structures on SC-C	(5Nr. SC-C Ch: 0+500, 1+000, 2+000, 3+000, 4+000)
	Outlet/Inlet Structures BHS on SC-C	(13Nr. SC-C Ch: 0+050, 0+490, 0+750, 0+990, 1+490, 1+750, 1+990, 2+490, 2+990, 3+490, 3+800, 4+200 & 4+500)
	Cross Structures on SC-C	(2Nr. SC-C Ch: 3+930 & 4+500)
	Concrete Slope Protection on SC-C	(2Nr. 1+390-1+430, 3+530-3+570)
	Check Structures Type I on TCs	(2Nr. TC-A Ch: 1+000, TC-B Ch: 1+000)
	Check Structures Type II on TCs	(5Nr. TC-A Ch: 0+200, 0+600 & 1+400, TC-B Ch: 0+250 & 1+300)
	Check Drop Structures on TCs	(5Nr. TC-A Ch: 0+400, 0+800 & 1+200, TC-B Ch: 0+500 & 0+800)
	Offtake/Intake Structures BHS on TCs	(32Nr. TC-A Ch: 0+000, 0+100, 0+200, 0+300, 0+400, 0+500, 0+600, 0+700, 0+800, 0+900, 1+000, 1+100, 1+200, 1+300, 1+400 & 1+500, TC-B Ch: 0+000, 0+100, 0+200, 0+300, 0+400, 0+500, 0+600, 0+700, 0+800, 0+900, 1+000, 1+100, 1+200, 1+300, 1+400 & 1+500)
	Tail Escape on TCs	(2Nr. TC-A Ch: 1+592, TC-B Ch: 1+580)

Source: PMIC, 2018

Figure 8: Layout of Prek Chik Irrigation System – Distribution System Package I (MOWRAM/ICB-CW07)



Source: (PMIC, 2018)

Figure 9: Layout of Prek Chik Irrigation System – Distribution System Package II (MOWRAM/ICB-CW08)

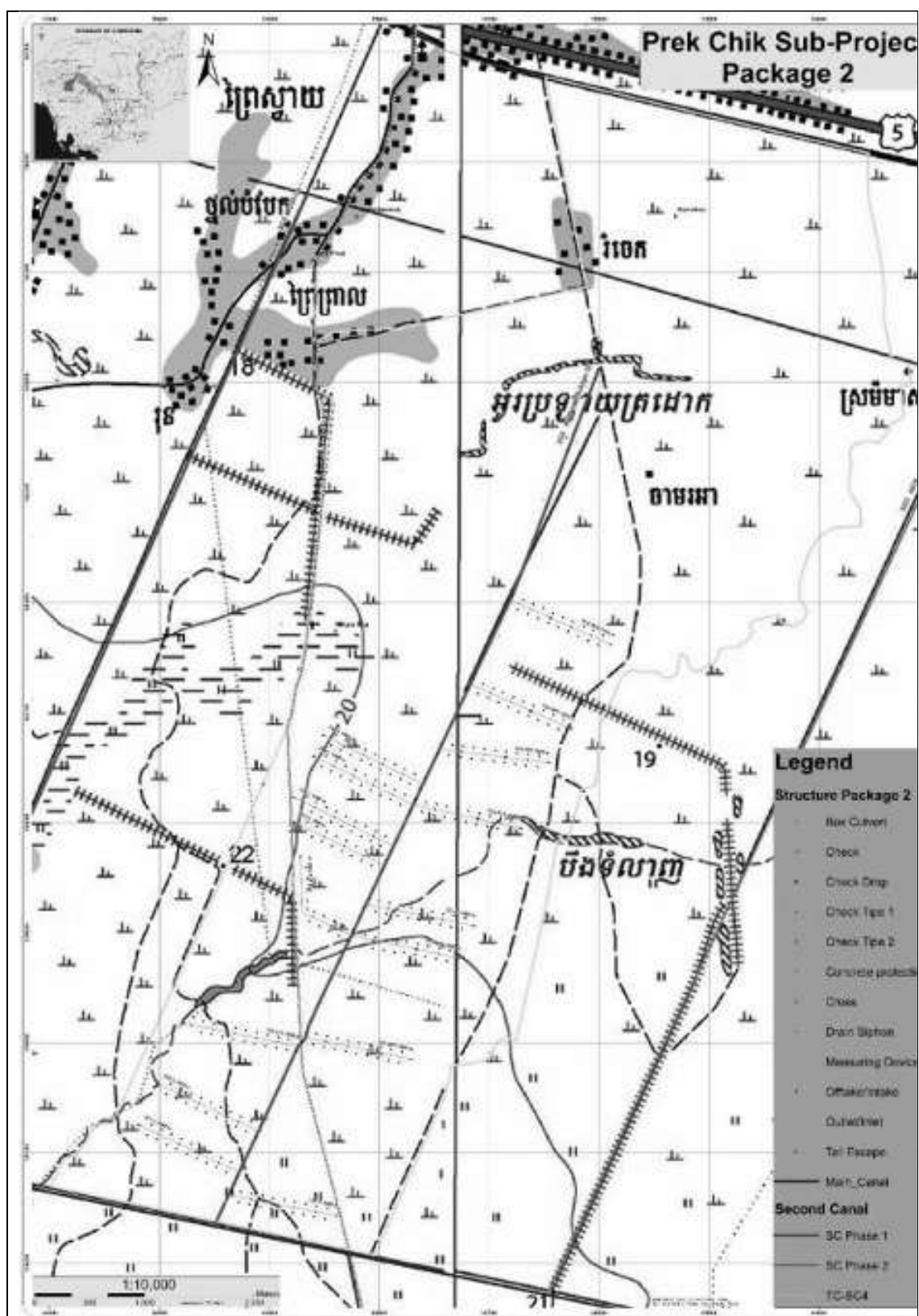
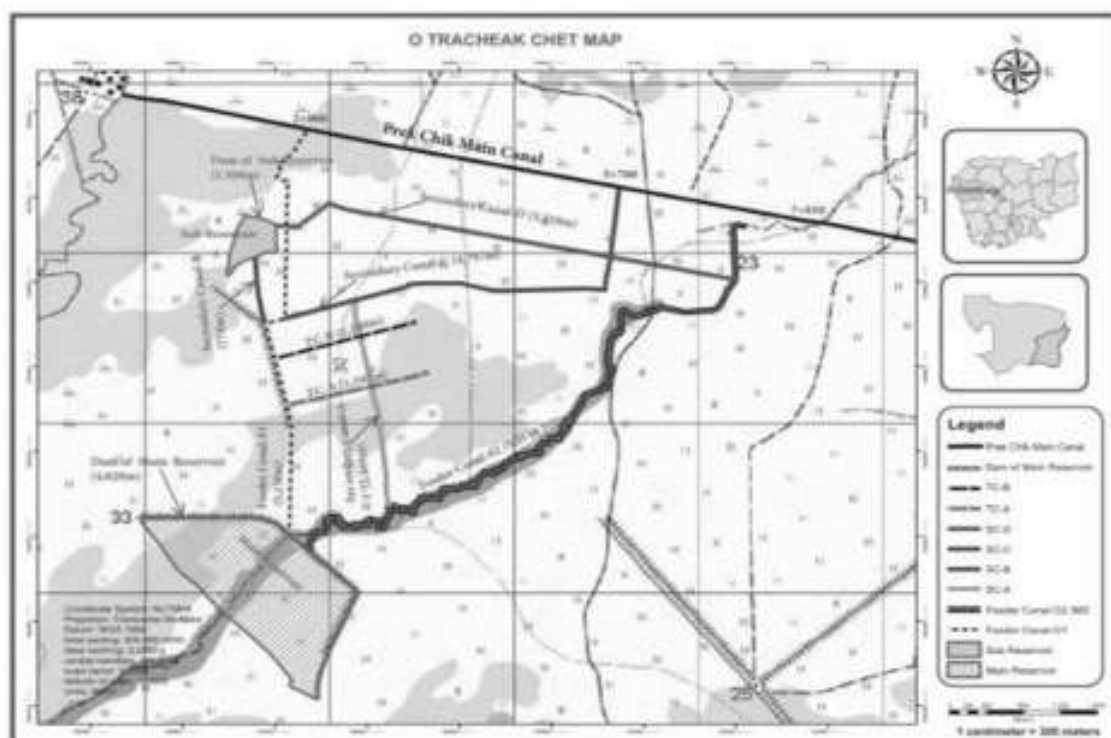


Figure 10: Location of O Tracheak Chit Reservoir – Package 3 (MOWRAM/ICB-CW09)



D. Command Areas

45. Work on the two core subprojects is on all canals of irrigation systems which are included extension of the main canal, secondary or tertiary irrigation canals. The project aims to rehabilitate, modernize and climate proofing of at two irrigation systems to increase the cultivated area in the project area in Kampong Thom (KT) and Battambang (BB) provinces from originally 10,000 to around 32,474 ha.

46. **Table 8** shows the potential changes in the irrigation area when the subprojects.

Table 8: Command Areas of Taing Krasaing and Prek Chik Irrigation Scheme

No.	Contract No.	Subproject Name	Command Area (ha) After project	
			Wet Season	Dry Season
1	MOWRAM/ICB-CW01	TK Main Canal	9,869	
2	MOWRAM/NCB-CW03	Chroab		858
3	MOWRAM/ICB-CW04	Korkoah		2,121
4	MOWRAM/ICB-CW06	Prek Chik Main Canal	20,800	4,000
5	MOWRAM/ICB-CW07	Prek Chik Package 1		2,800
6	MOWRAM/ICB-CW08	Prek Chik Package 2		1,200
7	MOWRAM/ICB-CW09	O Tracheak Chit Reservoir	1,800	1,800
Total			46,805	12,779

Source: (PMIC, 2018)

E. Project Implementation

47. MOWRAM is the executing agency. MOWRAM's Department of Farmer Water User Communities (DFWUC) will be the implementing agency. A Project Management Unit (PMU)

was established in the DFWUC before the project preparatory technical assistance began. The PMU is headed by a project director, who is Under-Secretary of State. A project manager, who is the director of DFWUC, assists the project director. The PMU was fully involved in the preparation of the project. The PMU has 22 designated staff members from MOWRAM, the DFWUC, the MAFF, the DHRW, and the PDWRAMs of Kampong Thom provinces. MAFF staff will coordinate the land leveling and other activities to be provided in support of the project by the Climate-Resilient Rice Commercialization Sector Development Program (CRRCSDP). The CRRCSDP will give the project access to quality seed and agriculture value chain facilities and services. The PDWRAMs is responsible for coordinating all field activities with the FWUCs and the DFWUC. The DHRW coordinates installation, operation, and data collection of the hydro-meteorological stations. It is also responsible for providing guidance to the PMU on operational challenges during implementation.

48. A steering committee oversees the project's implementation and management and provide policy guidance. It is chaired by the minister of the MOWRAM and comprise senior officials from MOWRAM, the MAFF, the Ministry of Economy and Finance, and the offices of the governors of this project provinces. Any resettlement and land acquisition is implemented by and under the management of an inter-ministerial resettlement committee of representatives from the relevant line ministries, which will be chaired by the Ministry of Economy and Finance. The committee cooperates closely with the Kampong Thom provincial resettlement subcommittees. The PMU is responsible for project implementation, planning, organization, monitoring, and reporting and will be supported by the project management and implementation consultants.

IV. DESCRIPTION OF THE ENVIRONMENT

A. The Subproject Province

49. The proposed subprojects are in Kampong Thom and Battambang provinces. These provinces are on the upper alluvial plains and piedmont to the east and west of Tonle Sap respectively. In keeping with the selection criteria for project investment, their water sources are from upland flows, rather than the Mekong/Tonle Sap system.

50. The GDP of both provinces are dominated by agriculture. Kampong Thom is Cambodia's second largest province by area and has a population of 710,000. There are a number of significant Angkorian sites in the area, including Prasat Sambor Prei Kuk and Prasat Andet temples. Battambang has a population of 1,036,523, and ranks as the fourth most populous province. In land area, it is the fifth largest province of Cambodia. The province's fertile rice fields have led to a mostly agricultural economy-giving rise to Battambang's reputation as "the Rice Bowl of Cambodia". Battambang province features a range of cultures as well as natural resources. Seventy five percent of its area is jungles and mountains.

B. Physical Environment

1. Climate and Rainfall

51. The climates of the Battambang and Kampong Thom areas are characterized by distinct rainy and dry seasons. The southwest monsoon starts in May and lasts until October, while from November to April the dry northeast weather patterns predominate.

52. For Battambang, the average annual rainfall ranges from 1,200 mm to 1,300 mm, with peak rainfall occurring in September–October and the lowest rainfall in January. Temperature is lowest in December–January with an average minimum temperature of 26°C and the highest in April with an average maximum of 34°C. The wind direction during the rainy season is prevalent from south-west to northeast and from the south-west during the dry season.

53. For Kampong Thom, the rainfall is slightly higher, with average annual falls of 1,300 mm, with peak rainfall occurring in September/October and the lowest rainfall in February. Temperature and wind patterns are similar to those of Battambang.

Table 9: Rainfall Data in Kompong Thom Province (From 2000-2011)

Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2000	0.0	1.0	0.0	93.7	141.2	335.6	292.0	211.1	337.7	243.2	58.6	6.9	1721.1
2001	5.9	0.2	193.9	4.7	227.7	173.7	65.5	230.8	160.2	419.2	109.4	3.0	1594.3
2002	0.0	0.0	11.2	100.4	159.8	326.9	93.7	149.5	472.6	162.9	44.6	2.3	1523.9
2003	0.0	0.0	144.3	48.0	255.6	212.2	224.3	155.7	188.9	144.2	12.7	0.0	1385.9
2004	0.0	7.0	0.3	96.7	84.6	414.3	116.3	176.1	291.0	127.1	15.4	0.5	1329.3
2005	0.0	0.0	13.8	33.7	140.1	176.3	299.1	99.4	243.3	119.0	142.1	6.5	1273.4
2006	0.0	112.7	16.3	177.2	314.3	73.7	271.6	451.2	288.5	187.8	39.3	6.5	1939.1
2007	0.0	0.0	65.7	158.4	174.4	109.8	167.5	95.1	281.1	198.2	105.0	0.0	1355.2
2008	23.1	48.9	29.7	113.9	291.3	97.6	50.6	265.7	349.6	316.2	87.6	4.2	1678.4
2009	0.0	130.0	31.0	123.6	267.8	165.2	81.4	143.5	499.6	181.5	68.8	0.0	1692.4
2010	23.8	0.0	1.4	27.6	129.0	223.0	185.2	218.2	137.0	323.0	41.2	1.2	1310.6
2011	0.0	0.0	44.5	115.2	69.7	245.4	276.8	254.4	475.0	194.0	52.4	12.0	1739.4

Source: Ministry of Water Resources and Metrology, 2012

2. Soil

2.1 Topography and Geology

54. The topography of the subproject areas is flat to gently sloping alluvium, grading to pediment bedrock formations on the upland fringes. Elevation for both areas is between 20 and 30 m ASL.

2.2 Soil Classification

55. Classified according to the FAO's soil classification system the command area has three main soil types, Acrisols, Arenosols and Cambisols. The Acrisols low fertility and low pH, which can bring toxic amounts of Aluminium into solution. It can pose limitations to its agricultural use for crop production. Arenosols are soils, which have a sandy textured profile extending deeper than 50 cm. These soils may be more free draining which can have implications for water requirement for irrigated rice production. They have high potential for other crops under irrigation. Cambisols are developed in medium and fine-textured materials derived from a wide range of rocks, mostly in alluvial, colluvium and Aeolian deposits. Most of these soils make good agricultural land and are intensively used.

3. Hydrology and Water Resources System

3.1 Water Resources System

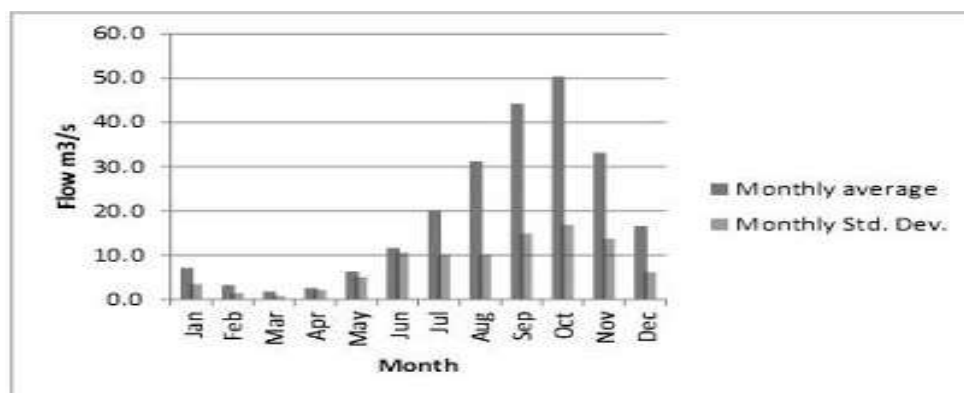
56. Taing Krasaing Irrigation Scheme. The Taing Krasaing River and Stung Chhinit are main water source for Taing Krasaing Irrigation system. The Stung Chhinit is one of the tributaries of the Tonle Sap River with a catchment area of 8,236 km². The Stung Chhinit catchment is bounded between the Stung Sen on the west and Mekong River on the east. The catchment area of Stung Chhinit lies on the slopes of the Dangrek Mountain Range bordering with the Lao PDR.

57. Prek Chik Irrigation Scheme. The Bassac reservoir embankments will play the key role as the water sources for the Prek Chik Core Subproject; Bassac is located on the Moug River

about 15 kilometers upstream the headworks for Prek Chik Canal. Bassac reservoir as an existing embankment, concrete weir and gates. This structure is now being rehabilitated by the ADB funded Flood Damage Emergency Reconstruction Project. Repair works for the gates at the Bassac Reservoir will be finished early in 2016. The reservoir is expected to be in operation in the following season. The live storage for this reservoir is about 7 million cubic meters (7 MCM).

58. Total inflows to the Taing Krasaing system are shown in **Figure 11** below. The yellow (m³/s) and orange (MCM) highlighted figures in **Table 10** show the very low dry season flows.

Figure 11: Taing Krasaing Monthly Average Inflows and Standard Deviation



Source: PPTA, 2015

Table 10: Total Taing Krasaing Inflows Monthly Average, Dry, Minimum and Maximum Flows

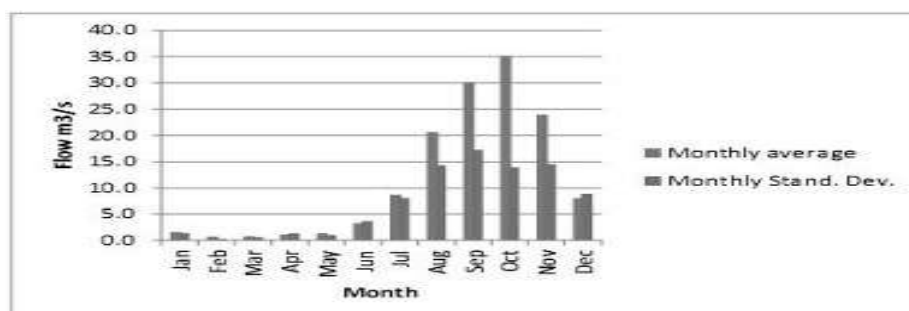
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m ³ /s)	7.1	3.2	1.8	2.6	6.3	11.6	20.2	31.3	44.2	50.4	33.2	16.6	19.1
Average (MCM)	19.1	7.8	4.9	6.7	16.9	30.2	54.0	83.8	114.6	135.0	86.1	44.6	603.5
Dry year (m ³ /s)	4.1	2.0	1.2	0.7	0.7	9.0	23.8	36.9	32.3	28.4	15.5	6.9	13.5
Dry year (MCM)	10.9	4.8	3.3	1.8	1.8	23.3	63.8	98.8	83.8	76.1	40.1	18.5	426.9
Max Year (m ³ /s)	16.2	7.1	3.3	9.2	16.6	53.1	41.5	52.3	76.2	87.9	74.9	32.8	28.4
Max Year (MCM)	43.4	17.2	8.8	23.8	44.9	137.7	111.2	140.0	197.5	235.4	194.2	88.0	900.1
Min Year (m ³ /s)	0.0	0.0	0.0	0.4	0.5	1.0	1.0	14.5	16.1	26.0	15.5	6.9	10.8
Min Year (MCM)	0.0	0.0	0.0	1.0	1.4	2.5	2.7	38.9	41.6	69.8	40.1	18.5	341.0

Note: The yellow (m³/s) and orange (MCM) highlighted figures show the very low dry season flows.

Source: PPTA Consultant, 2015

59. Total inflows to the Prek Chik system are shown in **Figure 12** below. The yellow (m³/s) and orange (MCM) highlighted figures in **Table 11** show the very low dry season flows.

Figure 12: Prek Chik Monthly Average Inflows and Standard Deviation



Source: PPTA, 2015

Table 11: Total Prek Chik Inflows Monthly Average, Dry, Minimum and Maximum Flows

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m³/s)	1.5	0.8	0.6	1.1	1.3	3.3	8.7	20.6	30.2	35.2	23.9	8.0	11.3
Average (MCM)	4.1	1.8	2.1	3.0	3.5	8.5	23.4	55.3	78.2	94.2	62.0	21.5	357.7
Dry year (m³/s)	0.6	0.4	0.3	1.0	0.9	2.4	6.2	29.7	29.2	10.7	14.7	2.9	8.3
Dry year (MCM)	1.7	0.9	0.8	2.7	2.3	6.2	16.7	79.5	75.8	28.7	38.2	7.7	261.1
Max Year (m³/s)	6.3	1.4	2.7	6.1	3.6	16.8	36.0	45.5	67.0	64.6	53.9	34.4	19.2
Max Year (MCM)	16.9	3.5	7.2	15.7	9.7	43.6	96.5	121.8	173.6	173.0	139.7	92.2	607.8
Min Year (m³/s)	0.6	0.4	0.3	0.2	0.2	0.5	0.6	1.6	5.3	10.7	5.6	0.9	3.7
Min Year (MCM)	1.7	0.9	0.8	0.5	0.6	1.3	1.7	4.4	13.8	28.7	14.4	2.5	118.2

Note: The yellow (m³/s) and orange (MCM) highlighted figures show the very low dry season flows.

Source: PPTA Consultant, 2015

4. Water Quality – Groundwater Quality

60. The vulnerability of groundwater quality in irrigation areas – especially where the water table is high and wells exploit that shallow level. In the Taing Krasaing scheme, farmers' wells are routinely between 2 m and 4 m deep, and therefore share the same water table as the level of water in the main canal. Water in these wells is vulnerable to contamination not only from irrigation water and the agricultural chemicals it might contain but also from domestic and animal waste. In the Prek Chik scheme no wells are used in houses along the main canal. The only wells are found in small house groups between 500 and 1,000 m away from the canal and average 7 m in depth. At this depth, the groundwater will be less vulnerable to surface contaminants. Wells were sampled in both schemes using field test kits in the period 24-28 May 2015. The results are listed in **Table 12**.

Table 12: Groundwater Quality Results of Groundwater at Wells in the Subproject Schemes

Parameter	Unit	Taing Krasaing		Prek Chik		Cambodian Drinking Water Standard 2009	US EPA Drinking water
		Well 1	Well 2	Well 1	Well 2		
Depth	m	4	2	7	7	-	-
pH		6.0	6.0	7-7.5	7	5.5-8.5	6.5-8.5
Total alkalinity	mg/l	40	40	240	180	-	-
Hardness	mg/l	50	0	180	180	500	60-200
NO- 2	mg/l	2	2	0.2	0.2	1	3
NO - 3	mg/l	0.2	0.2	20	>20	15	50
Cl	mg/l	<0.25	<0.25	<0.25	<0.25	-	<250
S	mg/l	nd	nd	nd	nd	-	<250

Parameter	Unit	Taing Krasaing		Prek Chik		Cambodian Drinking Water Standard 2009	US EPA Drinking water
		Well 1	Well 2	Well 1	Well 2		
Fe	mg/l	0.02	0.02	nd	<0.02	5	<0.3
Hg	mg/l	nd	nd	nd	nd	0.5	0.001
Pb	mg/l	nd	nd	nd	nd	0.01	0.01
Cu	mg/l	nd	0.2	nd	nd	1.0	2
Pesticide	mg/l	nd	nd	nd	nd	-	Atrazine: 0.02
Coliform	>1CFU/100 ml	positive	positive	positive	positive	3	Positive
Coliform	>103CFU/ml	negative	negative	negative	negative	3	negative

Note: nd = not detected

Source: PPTA Team, 2015

61. The results indicate that the wide use of wells by households in the Taing Krasaing scheme for all domestic water makes them vulnerable to pollution due to their shallow depth. The quality analysis showed coliform counts in excess of drinking water standard, but suitable for animals and washing. Water was slightly acid with low total alkalinity. Iron is present, but not at contamination levels. There are no detectable heavy metals or pesticide residues. Nitrites are elevated, but within standard, and may be a result of fertilizer applications. Salinity is low.

62. The results for the Prek Chik scheme samples are for much deeper wells. However, like Taing Krasaing, coliform counts are in excess of drinking water standard, but suitable for animals and washing. Water is very alkaline and “hard”. There are no detectable heavy metals or pesticide residues. Nitrites and nitrates are elevated, but within standard, and may be a result of excessive fertilizer applications. Salinity is low.

5. Air Quality and Noise

63. No ambient air quality data exists for the subproject areas or the provinces. As rural areas, the air quality is sometimes affected by dust from tillage and unpaved road users and smoke from rice stubble burning after harvest and swidden cultivation on the slopes. At most, times however, due to the absence of industry and low traffic volumes, the air quality can be expected to be high, with low NO_x and SO_x and minimal CO.

64. Ambient noise levels were sampled in the subproject areas with a noise meter. 10 min averages, maximum and minimum levels were recorded for locations along the main canals. The results are at **Table 13** and it shows typical rural environmental noise levels for minimum measurements. Maximum noise levels were result of trucks travelling at speed along roads atop the canal levee banks and have raised the 10 min average levels.

Table 13: Environmental Noise Levels in the Subproject Schemes

Parameter	Unit	TK			PC			42 ANRK.BK Standard	EHS Target
maximum	dB	62	65.5	61.5	72	69.5	63	-	-
minimum	dB	32.6	31	34.5	37	36.5	33	-	-
10 min average	dB	35.5	35	36.5	45.5	41	42.5	60-50 (1 hour average)	55 (1 hour average)

Source: PPTA Team, 2015

C. Biological Environment

1. Vegetation and Forestry

65. Land use in the subproject areas is agricultural, comprising actively farmed paddy fields or abandoned paddy fields. The distribution of land use and vegetative cover of the areas is shown in **Figure 13** and **Figure 14**. In both actively farmed paddy fields and abandoned paddies, a mixture of natural and plantation-escaped trees and shrubs have established along the bonded boundaries of fields, along roadsides and along canal banks. In abandoned paddies, there is adventitious growth of shrubs, weeds and grasses. At Taing Krasaing, these comprise:

Natural regrowth (along field, road and canal margins)	Escapes from orchards and plantations
<i>Dipterocarpus tuberculatus</i>	<i>Borassus flabellifer</i> (sugar palm)
<i>Diospyros</i> Sp	<i>Anacardium occidentale</i> (cashew)
<i>Peltophorum pterocarpum</i>	<i>Hevea brasiliensis</i> (rubber)
<i>Azadirachta indica</i>	
<i>Cistus</i> sp	
<i>Zizyphus mauritania</i>	

66. No vegetation species identified on site is included in the IUCN Red List for Cambodia.

67. Vegetation along the banks of the Taing Krasaing main canal is almost exclusively *Peltophorum pterocarpum*, and along the edges of paddy fields, *Dipterocarpus tuberculatus* dominates.



Dipterocarpus growing on field bunds, Taing Krasaing

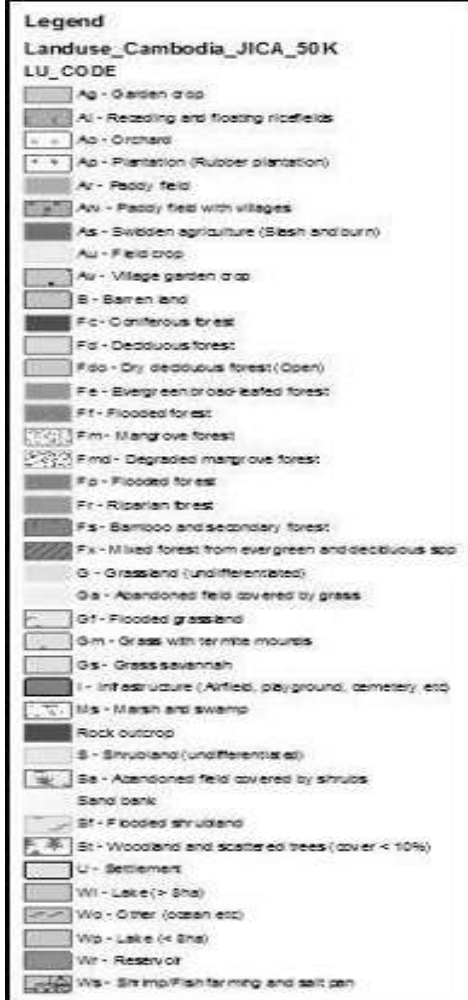


Peltophorum growing along canal bank, Taing Krasaing

Table 14: Land Tenure Arrangement

Regions	Agriculture Landholding (km2)	Proportion (%)
Plain	869,305	46.35
Tonle Sap Lake	614,369	32.75
Coastal	139,433	7.43
Plateau and Mountainous	252,605	13.47
Cambodia	1,875,712	100.00

Source: Feasibility Study of Taing Krasaing Irrigation System (PPTA) Consultant, 2015



Source: JICA GIS Survey of Cambodia, 2005, revised by PPTA Team 2015.

Figure 13: Land Use and Vegetation at the Taing Krasaing Subproject

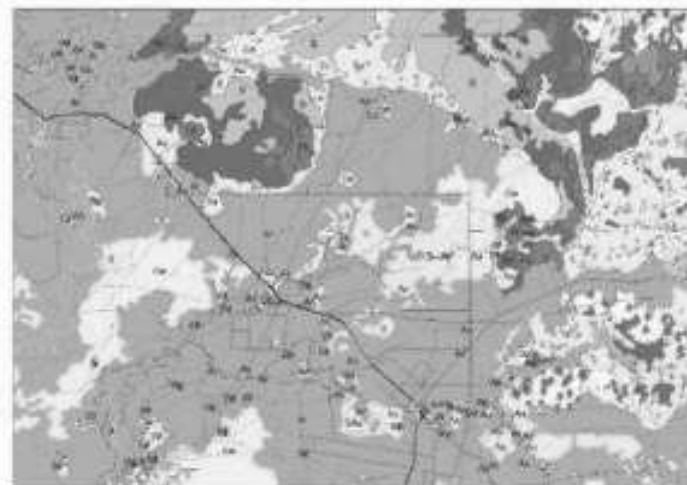
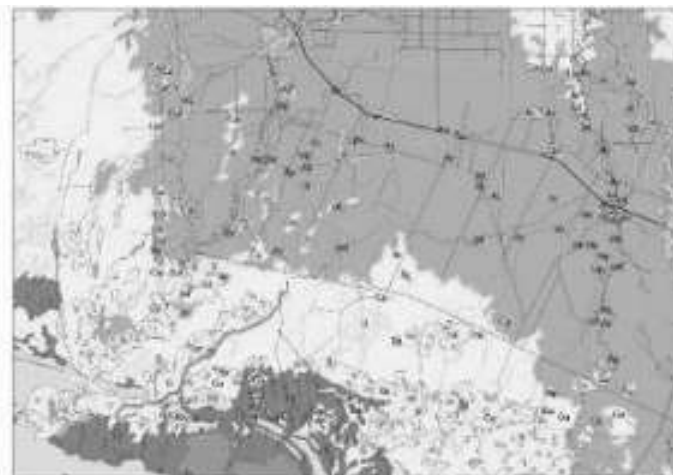


Figure 14: Land Use and Vegetation at the Prek Chik Subproject



68. At Prek Chik, which is more intensively cultivated, there is significantly less vegetation on field margins. Recent work on the main canal banks and roadmaking along the levee top has also denuded the main canal of fringing vegetation. What exists among the paddy fields comprises trees and shrubs, predominantly *Streblus asper*, *Diospyros* Sp and *Azadirachta indica*.



Streblus asper and *Diospyros* growing on field bunds, Prek Chik Main Canal showing sparse vegetable, Prek Chik

69. No vegetation species identified on site is included in the IUCN Red List for Cambodia.

70. In both actively farmed paddy fields and abandoned paddies, a mixture of natural and plantation-escaped trees and shrubs have established along the bonded boundaries of fields, along roadsides and along canal banks. In abandoned paddy, there is adventitious growth of shrubs, weeds and grasses. At Taing Krasaing and Prek Chik Irrigation Scheme, these comprise:

Natural Regrowth (along field, road and canal margins)	Escapes from Orchards and Plantations
<i>Dipterocarpus tuberculatus</i>	<i>Borassus flabellifer</i> (sugar palm)
<i>Diospyros</i> Sp	<i>Anacardium occidentale</i> (cashew)
<i>Peltophorum pterocarpum</i>	<i>Hevea brasiliensis</i> (rubber)
<i>Azadirachta indica</i>	
<i>Cistus</i> sp	
<i>Zizyphus Mauritania</i>	

71. No vegetation species identified on site is included in the IUCN Red List for Cambodia.

2. Fisheries

72. Limited household fishing is carried on in the main canals. Based on discussions with local farmers and fisher families, the common fish found in the project areas, especially within the main canals are listed in **Table 15**. The Taing Krasaing canal has a slightly larger species list, possibly due to its proximity to Chinit reservoir. In contrast, the Prek Chik scheme is water poor drawing its supply from the Stung Dauntry, which in turn flows only intermittently from the Bassac reservoir more than 13 km upstream. None of the species identified in this opportunistic survey are listed as endangered.

Table 15: Inventory of Fish Caught in the TK and PC Irrigation System

Local Name	Scientific Name	Comments	TK	PC
Trei Ros/ Ptuok	<i>Channa striata</i>	Migrates for	X	X
Trei Andeng Tun	<i>Clarias macrocephalus</i>	breeding Migrates	X	X
Trei Chhpin	<i>Barbodes gonionotus</i>	for breeding	X	X
Trei	<i>Henicorhynchus siamensis</i>		X	X
Riel	<i>Mystus filamentus</i>		X	X
Chhlag	<i>Micronema bleekeri</i>		X	-
Trei	<i>Botia modesta</i>		X	-
Kes				
Trei Kagnchruk				
Ta Aun/ Kramorm	<i>Ompok bimaculatus</i>		X	X
Sraka Kdam	<i>Cyclocheilichthys</i>	Migrates for breeding	X	X
Trei Kamphleanh	<i>Trichogaster</i>	Migrates for	X	X
Trei Kamphleav	<i>trichopterus</i>	breeding Migrates	X	X
Kanh Chanh	<i>Kryptopterus moorei</i>	for breeding	X	-
Chras Kanh Chos	<i>Pseudambassis notatus</i>		X	X
Kan Trob	<i>Mystus mysticetus</i>	Migrates for breeding	X	X
Khong Veng	<i>Pristolepis fasciata</i>		X	X
Kranh	<i>Dangila lineata</i>		X	X
Kros phnom	<i>Anabas testudineus</i>	Migrates for	X	X
Angkat	<i>Poropuntius deauratus</i>	breeding Migrates	X	X
Prak Slat	<i>Cyclocheilichthys</i>	for breeding	X	X
	<i>microlepis Notopterus</i>	Migrates for		
	<i>notopterus</i>	breeding		

Note: TK = Taing Krasaing; PC = Prek Chik

Source: PMIC, 2016



Fishing in main canal, Prek Chik



Main canal catch, Prek Chik



Main canal catch, Taing Krasaing

73. Migratory fish in the canals will travel upstream, through sluice gates or downstream to secondary and tertiary canals through their life cycle. The subproject works will not change this situation. No impoundment structures or over-topping weirs will be constructed by the subprojects, only existing gates will be rehabilitated.

74. No data on fisheries production or fishing effort was available, but observation and discussion indicate that fishing is undertaken as a supplementary activity during dry season when the paddy fields are in fallow. Fish catches are primarily for domestic consumption, with a proportion of the catch being dried and marketed locally.

3. Protected Areas

75. Cambodia has a network of 23 protected areas managed through MoE. These areas cover 2.2 million hectares or 18% of Cambodia's land area and include most of its important habitats. The Forest Administration has also designated protected forests (from cancelled logging concessions) bringing the total area under protection to around 25% which is more than

twice the global average. Protected Areas are sites that are protected by Royal Decrees, Laws and Regulations.

76. In 2008, Cambodia introduced the Protected Area Law (No. NS/RKM/0208/007), which defines these areas by their main conservation significance:

- National Parks
- Wildlife Sanctuaries
- Protected Landscapes
- Multiple Use Areas
- Ramsar Sites
- Biosphere Reserves
- Natural Heritage Sites, and
- Marine Parks

77. Tonle Sap Biosphere has distance less than 50 km far from Taing Krasaing and Prek Chik Irrigation System. In addition, there is no area of the protected site where is located in or adjacent to the TK and PC command areas.

4. Community Forestry in Kampong Thom and Battambang Province

78. The Ministry of Agriculture, Forestry and Fisheries issued the Prakas No. 489 BK.MAFF dated on 19 November 2008, Prakas No. 555 dated on 20 August 2010 and Prakas No. 078 dated on 19 February 2013 on the Establishment and Management of Community Forest (CF) area in Kampong Thom Province (See **Table 16**).

Table 16: The CF Statistic in Kampong Thom Province

CF Name	CF Area (ha)	Commune	District	No of village	CF member (Family)	Date Approved by MAFF	Date CF Agreement
Prey Hongchotet	1,016	Meanrith	Sandan	2	65	20.08.10	25.08.11
Ou Daskor	1,135	Meanrith	Sandan	1	143	20.08.10	25.08.11
Oukro Gnong	1,131	Meanrith	Sandan	1	120	20.08.10	29.06.12
Prey Tatey	1,395.44	Meanrith	Sandan	1	91	19.11.08	11.11.09
Prey Kbal Oukronhach	1,592.71	Meanrith	Sandan	1	219	19.11.08	11.11.09
Boeng Romdourl	1,201	Chheur Teal	Sandan	1	96		
Ke Rong	1,572	Chheur Teal	Sandan	1	140		
Orngdong Preng	1,945	Chheur Teal	Sandan	1	133		
Prey Kbal Dountey	1,812	Meanrith	Sandan	1	77		
Svay	1,786	Sandan	Sandan	1	105		
Kbal Khla	2,533	Sandan	Sandan	1	36		
Total	17,119	3	1	12	1225	5	5

Source: Department of Forest and Community Forestry, 2013

79. Regarding to CF statistic of Department of Forest Administration, 2013, none of community forestry areas are located in the subproject command areas.

D. Socio-economic Environment/Development

1. Agricultural Practice

80. Most farmers still use traditional rice varieties with low yield potential. Where modern varieties have been introduced farmers use self-saved seed or seed from neighbors. There is very little renewal by regularly purchasing commercial seed. The water requirement for pre-saturation of rice land is usually 150 to 200 mm but if the pre-saturation period is long (24 to 48 days) or where the soil is sandy and free draining this figure can rise considerably. In addition, a water layer (usually at 100 mm) is established at this time. 50% of the total irrigation water requirement can be used for pre-saturation and establishing a water layer.

81. The cropping calendars in **Figures 15** and **16** were developed by the PPTA team in discussion with subproject area farmers. It illustrates the usual cultivation and growing cycle of one 90 day wet season rice crop per year which relies upon rainfall. Less usually, where there is sufficient water to grow a wet season and a dry season crop, short season rice varieties are planted. Depending on water availability and on farmers' preferences and a market being identified, a vegetable or other cash crop may be planted.

82. Rice is now mostly harvested mechanically using combine harvesters and Prek Chik farmers estimate that harvesting losses can be 20% or more, mainly due to uneven ripening.

Figure 15: Present Crop Calendar for Taing Krasaing and Prek Chik with One Crop per Year (limited water)

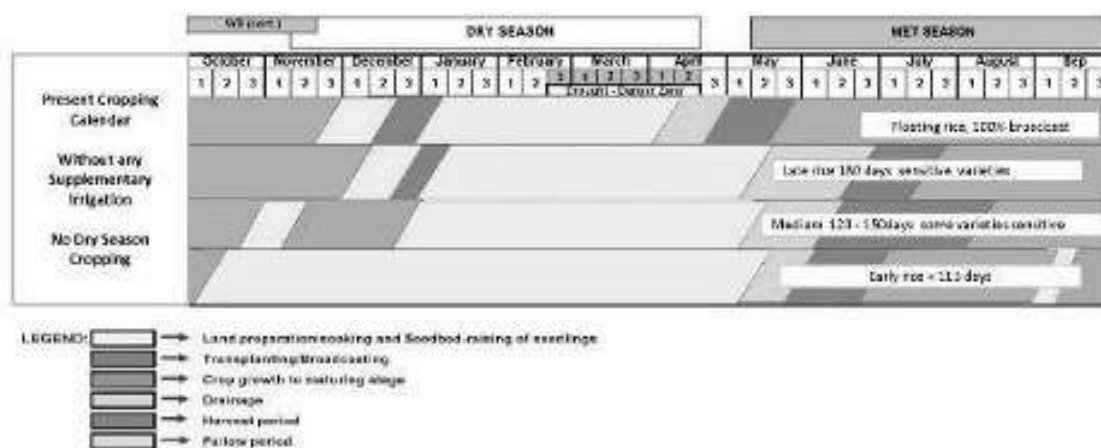


Figure 16: Present Crop Calendar for Prek Chik with Two Crops per Year



83. No quantitative data is available on the use of agricultural chemicals in the subproject areas. Discussions with farmers and local sales agents suggest that farmers are reasonably inflexible in their usage levels, following either past practice or packet instructions. Pesticides available in the subproject areas include highly toxic products such as diuron and atrazine (**Figure 17**) which require careful handling and separation from aquatic ecosystems.

Figure 17: Agricultural Chemicals for Sale in the Prek Chik Subproject Area



2. Human and Economic Development

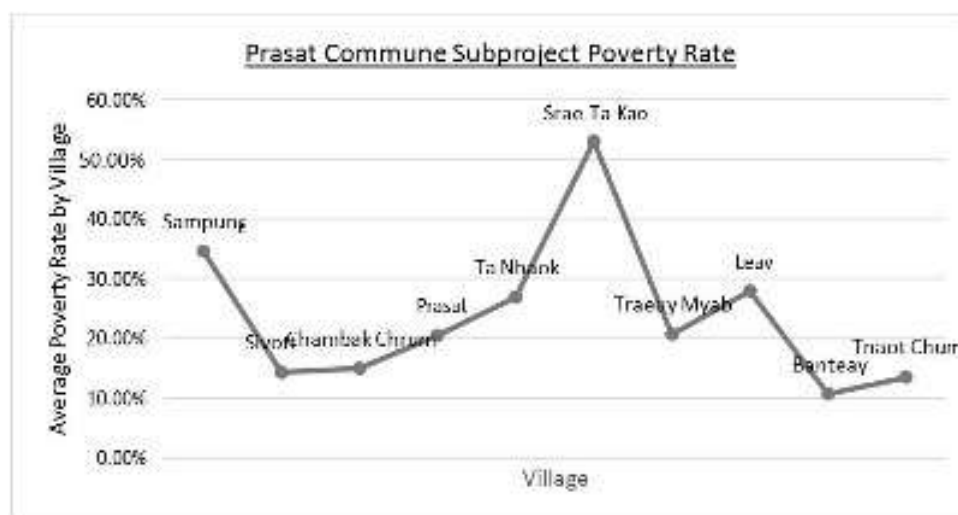
84. Indicative parameters for the human and economic development of the area are summarized in **Table 17**.

Table 17: Social Indicators of Subprojects

Key Indicators	Taing Krasaing	Prek Chik
Area Net (ha)	9,868	10,000
No. of Farmers	19,178	6,663
Population	39,357	48,890
No. of Villages	19	11
No. of Districts	1 (Santuk)	2 (Moung Ruissey and Rukh Kiri)
No. of Households	7,939%	10,367
No. of Women Households	1,056 (13%)	1,486 (14%)
Poverty Rate	24.3 – 39%	23.5 – 34.5%

85. Although the poverty rates in both areas have been steadily decreasing, the improvement is not consistent across the communes. This is illustrated in **Figure 18** below for communes in Taing Krasaing. It is possible that uneven cropping opportunities because of the non-functioning irrigation schemes contribute to this inequality.

Figure 18: Uneven Poverty Rates in Communes within the TK Scheme



3. Floods and Extreme Weather Events

86. Flooding is a regular phenomenon in Cambodia, with rainfalls commonly exceeding 500 mm per month in the rainy season. However, recent flooding in the Mekong region has been very damaging and the Mekong River Commission records show an increasingly shorter return period for major floods. The following flood statistics for the subproject provinces in **Table 18** illustrate the levels of damage.

**Table 18: Impact of Flooding
(18 October 2013)**

Province		Kampong Thom
Affected Districts		7
Affected Communes		61
Affected Families		1,7463
Affected people		80,330
Evacuated families		1,114
Evacuated people		5,124
Houses Affects		17,463
Deaths		24
Victims	Injured	3
Flood Affected	Schools	121
	Pagodas	41
	Health Center and Hospitals	4

Source: Humanitarian Response Forum (HRF), Situation Report No.4, 23 October

87. **Table 19** below compares data collected by NCDM in 2013 and 2011, at the peak of the floods in each year, by province. Changes in the number of affected or evacuated families in 2013 compared to 2011 are highlighted. **Table 20** shows the impact of flood and drought in subprojects.

**Table 19: Affected and Evacuated Families in 2013 and 2011
(Kampong Thom Province)**

Years	Affected Families	Comparison (affected families) 2013 and 2011
2013	17,463	- 36,951
2011	54,414	

Source: Humanitarian Response Forum (HRF), Final Report No.07, December 2013

Table 20: Impacts of Flooded and Drought in Subprojects

Provinces	Districts	Communes	Area affected by flood					Drought
			Total Area	Rice	Crop	Road	Bridge	Rice
Battambang	Moung Ruessei	Kear	0	0	0	0	0	0
		Prey Svay	0	0	0	0	0	0
		Ruessei Krang	0	0	0	0	0	0
		Chrey	0	0	0	0	0	0
		Kakaoh	0	0	0	0	0	0
		Robas Mongkol	0	0	0	0	0	0
	Rukh Kiri	Preaek Chik	0	0	0	0	0	0
		Prey Tralach	0	0	0	9500 m	0	0

Provinces	Districts	Communes	Area affected by flood					Drought
			Total Area	Rice	Crop	Road	Bridge	Rice
		Mukh Reah	0	0	0	0	0	0
		Sdok Pravoek	24	24	0	0	0	0
		Chroab	0	0	0	0	0	0
		Kakaoh	0	0	0	0	0	0
		Tang Krasaing	0	0	0	0	0	0

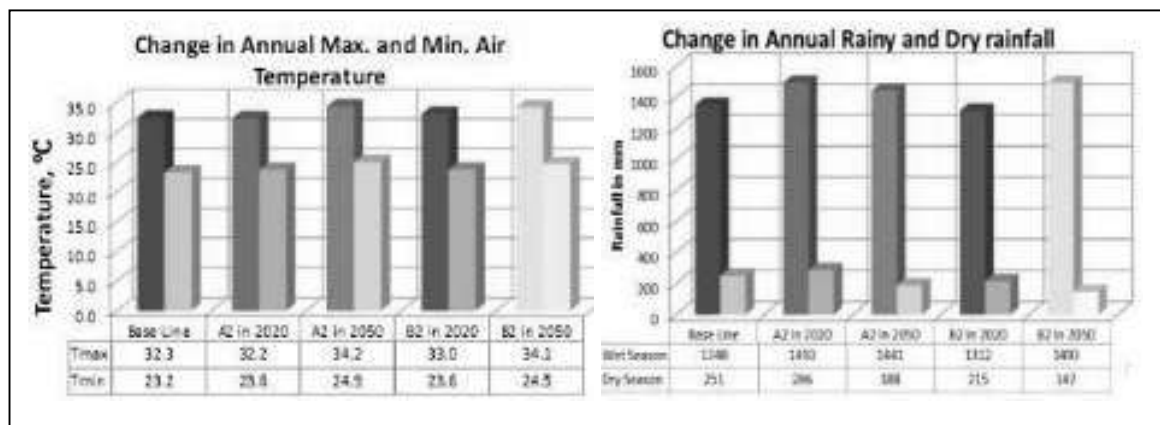
Source: (Planning, 2017)

4. Climate Change Scenarios

88. The result of modelling studies in the Initial National Communication (INC) and the Second National Communication (SNC) of the Cambodian National Climate Change Committee indicates that Cambodia's mean surface temperature has increased by 0.8°C since 1960, and that it will continue to increase at a rate of between 0.013°C and 0.036°C per year up to 2099. The rate of temperature increase will be higher in low altitude areas such as the subproject sites which are between 10 and 20 m ASL.

89. Under elevated CO₂ with low rate of emission scenarios (SRESB1)³, it is likely that wet season rainfall will continue to increase in future, and then might decrease again after 2050. But under high emission scenarios (SRESA2), the direction of change will reverse. The magnitude of these changes is illustrated in the following graphs (**Figure 19**), and their implications for subproject design are discussed in the following chapter.

Figure 19: Scenarios for the Critical Agricultural Parameters of Temperature and Rainfall Scenarios
are A2 (a more divided world) and B2 (a world more divided, but more ecologically friendly)



90. An increase in the temperature is likely to affect agricultural productivity. According to the International Rice Research Institute, rice grain yields decline by 10% for each 1°C increase in minimum (night) temperatures during the growing period in the dry season.

V. ANTICIPATED ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION

³ International Rice Research Institute. Rice and Climate Change, <http://irri.org/news/hot-topics/rice-and-climate-change>

MEASURES

A. Positive Impact and Environmental Benefits

91. The 2 core subprojects which are the subject of this IEE has been chosen using a set of selection criteria. Although these criteria did not include specific environmental impact issues, three of them when applied had the effect of selecting for relatively straightforward schemes without significant environmental impacts. These were:

- Subproject should involve only rehabilitation of existing systems or related schemes and should not involve construction of new systems.
- Subproject should be located away from the Tonle Sap.
- Subproject should not cause involuntary resettlement and should require as less land acquisition as possible. Subproject should not be a **Category “A”** for Involuntary Resettlement and Environment; maximum of **Category “B”** for Involuntary Resettlement and Environment; and **Category “C”** for Indigenous Peoples.

92. The result of the subproject irrigation and drainage facilities will be (i) an increase certainty and control of existing irrigation areas; (ii) expansion of reliable irrigation into new areas; and (iii) winning of longer cropping periods on areas previously unavailable for parts of the year due to flooding.

93. **Table 21** below compares—based on above assessment details—the two core subprojects with respect to the key agro-inputs and practices for the situation today (the “without” project case) and what can be expected in the “with” project case.

Table 21: Project Benefits through Agro-Inputs and Practices of the Two Irrigation Schemes

Characteristic	Season	Unit	Tang Krasang		Preuk Chik	
			Without TODAY	WITH - Future	Without TODAY	WITH Future
1 Cropping Intensity	WS	%	80	100	100	100
Cropping Intensity	DS	%	Zero	30	5	40
2 Yield	WS	t/ha	1.5	2.7	1.8	3.2
	DS		Zero	3.2	2.2	3.9
3 Fertilizer	WS	% using	< 30	90	80	100
	DS		Zero	100	100	100
4 Land Preparation	Mechanized	%	80	90	80	95
5 Planting	WS	Transplant	20	20	15	25
		Broadcast	80	80	85	75
	DS	Transplant	Zero			20
6 Seed type		Broadcast	Zero		100	80
7 Vegetable	See Note	Self-saved	100%		Self-saved	90%
8 Other Crops	See Note					
9 Harvest	WS	Combine	70	85	90	90
	DS			85	90	90

Notes: WS= Wet Season; DS = Dry Season

Vegetables and other crops to be included pending additional information collection

Source: PPTA, 2015

94. In terms of areas sown, the project will increase potential rice growing areas by 40%, and cropping area by 60%. The beneficiaries of these changes will be local farmers, with flow-on effects to local commercial enterprises. Since rural populations are the poorest sectors of the Cambodian population, poverty alleviation effects will be direct and sustainable.

95. **Flood Protection in Taing Krasang Irrigation Scheme.** Drainage is a key issue for Taing Krasaing System. Prior to project start there were two large breaches on the Main Canal and they are located in adjacent to each other, between RD 7+500 and RD 9+500. These two breaches received the runoff flood from a large catchment which used to drain into Taing Krasaing River. Before project start the Taing Krasaing Main Canal had never been able to command any area downstream of these breaches. The farmers with land a few hundred meters from the breach were flooded in dry season when water level in the main Canal is raised to commanding fields downstream of the breach. Meanwhile flash flood from the catchment on the right side threatens the Taing Krasaing Main Canal by overtopping the embankments, eroding the canal and its embankment slopes and destroying structures.

96. To avoid all above mentioned issues, the two breaches have been closed, and a cross drainage structure (over pass) was constructed on the Main Canal to release flood from right side into Taing Krasaing River. The main canal at that point runs under the drainage over pass as a siphon. Inception drain canals were also dug along the outside of the canal embankments in order to enhance to surface water collection and take drainage to the over pass structure.

97. **Flood Protection in Prek Chik Irrigation Scheme.** Drainage is also a major issue at Prek Chik. Even with medium rainfall there are flash floods from higher ground on the right side of the Prek Chik Main Canal. In fact, it was reported that before project start in many occasions the main canal served as drainage relief with inlets on the right side of the main canal passing water into the main canal which is subsequently discharged through off-takes on right side, which serve a dual function of irrigation and drainage, into secondary.

98. Therefore, four (4) cross drainage structures were designed and have been constructed on the Prek Chick Main Canal. These structures allow flash flood to drain from right side to the left side of the Canal without damaging the irrigation infrastructure. In addition, existing inlet drainage which had originally built from the previous projects have been improved and will be used to drain over demand water from the farmer rice fields into the Canal.

B. Environmental Impact and Mitigation Measures during Pre-Construction Phase

99. A number of environmental management measures were implemented in the pre – construction phase to ensure that appropriate plans and documentation to determine environmental performance of construction and operation of subprojects are in place. These include:

- Updating EMP. Mitigation measures defined in this EMP were updated and incorporated into the detailed design to minimize adverse environmental impacts. This will be the responsibility of the PMUs.
- Final designs of embankments, siting of control structures and canal alignments were completed after taking into account the provisions of the EMP.
- Contract documents. Preparation of the environment section in the Terms of Reference for bidders for construction contracts and environmental contract clauses for contractors, namely the special conditions (referencing the EMP and monitoring plan). This was the responsibility of the PMUs with the support of the PMICs.
- Establishment of the Grievance Redress Mechanism during the subproject design.
- Environmental Protection Training. Environmental specialists and/or officials from local MoE offices were invited to provide training on implementation and supervision

of environmental mitigation measures to contractors. This will be the responsibility of the PMUs.

- CEMPs. Preparation of Construction Environmental Management Plans (CEMPs) by the successful contractors for each subproject. These incorporate all relevant measures listed in the project EMP. The CEMPs include delineation of work areas and clear identification of areas to be protected. It provides work scheduling and temporary access information as a basis for further consultation with affected communities. The CEMPs identify sensitive receptors for special mitigation measures against noise and dust (see Construction Impacts below). They also include an emergency preparedness and response plan for construction emergencies and environmental health and safety plan. The CEMPs have been approved by the PMU in consultation with the PMIC.
- Public information booklet (PIB). PIB on environment were provided and circulate to local people as well as affected people. These PIB include the GRM process and responsible person on compliant mechanism.

C. Impacts and Mitigation Measures during the Construction Phase

1. Contractor Performance and Site Management

100. To ensure that construction contractors are able to implement the mitigation measures, the PMUs did put in place the following arrangements: (i) environmental specifications were included in the bidding documents to contractors; (ii) an appropriate environment section describing standards and responsibilities were included in the terms of reference for bidders; (iii) material haulage routes, and waste disposal arrangements were defined in the construction tender documents as appropriate; and (iv) clauses referencing the EMP mitigation provisions and monitoring plans will be written into the construction contracts. Following the award of construction contracts, the successful head contractor will prepare a Site Environmental Management and Supervision Manual, including an emergency preparedness and response plan for construction emergencies and site environmental health and safety plan, for approval by the PMUs.

101. During construction, the Environmental Management Officers of each PMU are active in site supervision, management and appraisal, to identify problems and solve them in a timely fashion. Environmental training, especially related to environmental management by the contractor, is included in the EMP.

2. Construction

102. The following impacts and mitigation measures refer to construction impacts, which are common to these subprojects. The subproject require earthworks, soil stabilization, dust and noise control as well as management of the impacts from machinery operation, transport and haulage of building materials and the domestic needs of the workforce.

103. **Wastewater.** Wastewater is produced from the maintenance and cleaning of mechanical equipment and vehicles, maintenance water for mixing and curing concrete, and lost water and soil during the construction period, which is discharged as pollutants. The effluent, comprised mainly of inorganic wastewater, commonly contains no poisonous and harmful substance, except suspended solid, but, if discharged in an improper manner, still has the potential to impact existing water bodies. Some oil-containing wastewater can arise from machinery repairs.

104. Construction wastewater is not discharged into the surrounding soil or into surface water systems. Sedimentation tanks have been built and the waste residue in the tank was to be be

cleared and transported to designated landfills. Oil-containing wastewater will require the installation of oil-water separators before the sedimentation tank.

105. **Hazardous and polluting materials.** Construction material handling and disposal guidelines and directions that include spill responses have been prepared and are implemented as part of the Site Planning of each construction site. The following measures will be taken to prevent pollution of soil and surface water/groundwater:

- Proper storage facilities for fuels, oil, cement, and chemicals within secured areas on impermeable surfaces, provided with bunds and clean-up installations;
- Vehicles and equipment are properly staged in designated areas to prevent contamination of soil and surface water;
- Vehicle, machinery, and equipment maintenance and re-fuelling is carried out in such a way that spilled materials do not leak into the soil;
- Oil traps have been provided for service areas and parking areas; and
- Fuel storage and refilling areas are located at least 50 m from canals and channels and will be protected by temporary drainage bunds to contain spills.

106. **Gaseous Air Pollution.** Construction machinery on all sites will consume petrol and diesel, releasing gaseous SO₂, CO, and NO_x. Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. High-horsepower equipment are provided with tail gas purifiers. All vehicle emissions are in compliance with relevant Cambodian emission standards.

107. **Dust.** Construction sites and access roads will potentially produce fugitive dust from material storage areas, dump sites, concrete mixing, excavation and general site usage – especially under windy conditions. Material stockpiles and concrete mixing equipment will be equipped with dust shrouds. The operators regularly maintain the shrouds to ensure their effective operation. For both construction sites and construction roads, water spraying for the suppression of dust and maintenance of driving surfaces is standard site management practice. Vehicles carrying soil, sand, or other fine materials to and from the construction sites are covered.

108. **Noise.** Noise is expected during construction due to construction machinery operation and transport activities. Construction activities involve haulage vehicles, bulldozers, excavators, concrete-mixing plants, rollers, and other heavy machinery. Noise intensity from these large machines operating is typically in the range of 80–90 decibels at the site (5m from operating machinery). The transport of material, aggregate, concrete and waste material to and from sites will also cause noise impacts along the routes. Activities with intensive noise levels do not only have an impact on the residents, but may also cause injury to construction workers operating the equipment.

109. Construction equipment noise source is considered as a point sound source, and the predictive model is as follows:

$$L_A = L_0 - 20 \log \left(\frac{r}{r_0} \right)$$

110. Where, L_A and L_0 are equipment noise sound levels at r and r_0 respectively.

111. According to the model, noise levels at different distances are gained after calculating the impact scope of equipment noise during construction as in **Table 22**. The Cambodian noise standards for residential areas are used here because many farmhouses are built along the main canals and small commercial villages have developed at the headworks. These mirror IFC EHS standards.

Table 22: Construction Equipment Noise Impact Distance

Level dB(A)	Distance							Limit Standard for residential areas dB (A)		Impact Range (m)	
	10	20	40	60	80	100	150	Day	Night	Day	Night
Construction Machinery											
Loader	84.0	78.0	72.0	68.4	66.0	64.0	60.5	60	50	150	300
Bulldozer	80.0	74.0	68.0	64.4	62.0	60.0	56.5	60	50	100	250
Roller	80.0	74.0	68.0	64.4	62.0	60.0	56.5	60	50	100	250
Excavator	78.0	72.0	66.0	62.4	60.0	58.0	54.5	60	50	80	200

Source: PPTA 2015

112. The results show that, if construction machinery is used singly, the impact distance is 150 m away from the source during the day and 300 m at night. Beyond these distances, the noise levels meet Cambodian standards for residential areas. However, it will often be the case that a number of machines will be at use simultaneously during construction, and the noise impact scope will be consequently larger.

113. Activities with intensive noise levels will not only have an impact on the residents, but also may cause injury to construction workers operating the equipment. Although the noise impacts will be transient and temporary the following mitigation measures are essential for construction activities to meet construction site noise limits and to protect sensitive receptors. Construction at night within 300m of residences shall be strictly prohibited. During daytime construction, the contractor ensures that:

- Equipment with high noise and high vibration are not used in village or township areas and only low noise machinery or the equipment with sound insulation is employed;
- Sites for concrete-mixing plants and similar activities will be located at least 1 km away from sensitive areas such as residences and schools; and
- Temporary anti- noise barriers will be installed to shield any schools, residences and medical centers within 100m of the work sites.

114. **Spoil disposal.** The Bill of Quantities (BOQ) for the Taing Krasaing subproject (CW01-Main Canal) indicates that excavation volumes from embankments and canal is generally balanced with embankment fill volumes. The subproject only has a disposal of 1,600 m³ of unsuitable spoil for main canal, 1,000 m³ for CW04-Korkoah, 500 m³ for CW03-Chroab, and 46,334 m³ for CW09- O Tracheak Chit. These spoils were made available to nearby communities for use as building pads and bunds. The spoils will not be allowed to dispose into water body or protected areas or unapproved areas by local authority.

115. **Dredge Spoil.** The Taing Krasaing canal improvement works involves dredging of the canal to establish contoured shape and design slopes. The dredge spoil volume was estimated at 74,000 m³ for main canal, 50,435 m³ for Chroab (CW-03), and 317,944 m³ for Kor Koah (CW-04). The sediment quality of the dredge spoil is tested and assessed against an appropriate standard before reuse in the structure of embankments (see Monitoring Plan in EMP). The sediment testing results will confirm safe reuse of the material.

116. **Erosion of Disturbed Surfaces.** Areas most vulnerable to erosion are temporary construction sites, and other places where surface soil will be disturbed. The most effective erosion control is the interception drainage to protect disturbed surfaces from surface flows. Construction plans include erosion control prescriptions for construction work areas, including;

(i) constructing intercepting ditches and drains to prevent runoff entering construction sites and diverting runoff from sites to existing drainage; (ii) limiting construction and material handling during periods of rains and high winds; and (iii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on. All earthwork disturbance areas are stabilized within 30 days after earthworks have ceased at the sites.

117. **Construction camps solid waste.** The construction contractors have established site offices and work camps at the headwork's end of the main canals in both subprojects. The construction workforce generate domestic wastewater and garbage (food wastes, kitchen wastes, paper, and other solid waste including food-laden wash water). Proper disposal of this waste is essential. It is the responsibility of the construction contractors to provide toilets with pump-out and disposal facilities and sufficient garbage bins at strategic locations and ensure that they are; (i) protected from birds and vermin, (ii) emptied regularly (using the nearest township solid waste system and landfill), (iii) do not overflow, and (iv) clean up the camps after construction. The camps site are a safe place.

118. **Flora and Fauna.** All protected areas listed in Chapter IV (Description of the Environment) are more than 50 km away from the subproject sites. The subproject areas have been intensively farmed and irrigated for generations. No natural terrestrial or aquatic habitats exist and natural biodiversity comprises only common wildlife living among humans in agricultural regions, domesticated animals and feral pests and rodents. The vegetation comprises cultivated crops, agricultural weeds and tree plantations along roads, canal banks and dyke walls. There will be no significant loss of native flora and fauna as a result of the Project.

119. **Cultural Heritage.** During construction, contractors ensure that any local cultural sites (including shrines and graves) are kept clear of construction material and protected from dust and other disturbance. Access to these sites is not impeded, and after construction is finished, any disturbed surroundings will be restored to pre-construction standards.

120. **Traffic accident and traffic jam of equipment transportation.** Some heavy equipment (heavy trucks, bulldozers, backhoes, etc.) have been brought to the construction areas for excavation and construction works. They were transported in and out during the construction period and in relatively small numbers. Even though the project area not heavily populated, no serious disturbance is envisaged; however it would possibly cause accident to local communities, traffic jam and dust. In order to minimize the traffic accident or jam, the contractor was required to implement some mitigation measures as follow:

- Construction vehicles to comply with national speed limitation.
- Construction vehicles to drive at low speeds, especially at market, school, hospital, urban areas.
- Keep road spaces or bypass for travellers to avoid traffic jams.
- Vehicles for construction to park at designated safe places.
- Water spraying be applied as needed to ensure there is no dust/air pollution in local community as mentioned in above section on dust control

121. **Environmental Health and Safety.** Safety and health of both workers and residents may be threatened by construction activities. Numerous workers will gather within the construction site, with potentially relatively low living conditions such as unclean water, poor food, and increased risk of diseases infection and transmission. Surrounding residents may also be affected by noise and dust. Workers will confront construction safety risks as well.

122. Measures to protect the community include:

- Planning construction activities (including demolition work) so as to minimize disturbances to residents, utilities and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be reinstated to its original condition after construction.
- Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public access to construction sites and unsafe areas.

123. Measures to ensure occupational health and safety include:

- Contractors are required by the PMUs to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment.
- Following the award of construction contracts, the successful contractors have prepared site environmental health and safety plan, for approval by the PMUs.

124. Contractors have ensured that: (a) all reasonable steps are taken to protect any person on the site from health and safety risks; (b) the construction site is a safe and healthy workplace; (c) machineries and equipment are safe; (d) adequate training or instruction for occupational health and safety has been provided; (e) adequate supervision of safe work systems is implemented; and (f) means of access to and egress from the site are without risk to health and safety.

D. Environmental Impact and Mitigation Measures during Operation Impacts during Construction and Operation

125. If any unanticipated impacts become apparent during project implementation, the borrower will (i) inform and seek ADB's advice; (ii) assess the significance of such unanticipated impacts; (iii) evaluate the options available to address them; and (iv) prepare or update the EIA including EMP. ADB will help the borrower mobilize the resources required to mitigate any adverse unanticipated impacts or damage.

1. Impacts from Intensification of Agriculture

126. Since the agriculture impacts will be identified and prepared by agriculture specialist, so this section will be included in the main report under agriculture study section.

2. Chemical Fertilizer Use

127. As mentioned in Section on Socio-economic Environment/Development, the chemical uses for agriculture are popular to all farmers in the area to improve agricultural product. A tendency of agricultural activities will increase when these irrigation systems has improved. Hence, pollution of chemical fertilizers will be expected to be increased respectively. Impacts can be reduced or avoided if the proposed mitigation measures will be properly implemented. Environmental training and public awareness on impact of chemical fertilizers, benefit of organic/compost fertilizers and environmental impacts.

3. Water Pollution – Water Quality Decreasing

128. The primary objective of the Project is to provide supplementary wet season irrigation. Thus, environmental consideration, especially about the toxic chemical used must be considered. To minimize the water pollution during operation phase, if the mitigation measures implement:

129. Educational program on the fertilizer uses and environmental impacts should be provided.

130. Environmental monitoring of a water quality is conducted by PDWRAM to assess any negative impact on the water bodies and collaborate with PDA to ensure appropriate use of agricultural chemicals

4. Water User Conflict

131. During operation there will be some conflicts which expected between water users at downstream and upstream respectively. Generally, conflicts will result from insufficient quantity of water uses, competition of water demand and in-understandability. The water users at upstream will be able to access water easily than users at downstream. Therefore, without proper management and water equitable share, the conflict cannot be avoidable.

132. The conflicts are reduced or avoided if mitigation measures below will be considered:

- Establishment of Farmer's Water User Group (FWUG),
- Development of Management and Operation Manual,
- Sufficient training on topics of management, conflict solution and water equitable uses to FWUG and public awareness to community.
- Capacity of reservoir.

E. Unanticipated Impacts during Construction and Operation

133. If any unanticipated impacts become apparent during project implementation, the borrower will (i) inform and seek ADB's advice; (ii) assess the significance of such unanticipated impacts; (iii) evaluate the options available to address them; and (iv) prepare or update the EIA including EMP. ADB will help the borrower mobilize the resources required to mitigate any adverse unanticipated impacts or damage.

F. Climate Change Impact Assessment

134. The environmental risks from climate change need to be addressed in two different but complementary ways: (i) consideration of greenhouse gas emissions; and (ii) adaptation to safeguard infrastructure against the effects of future climate change.

1. Greenhouse Gas Emissions

135. Net greenhouse gas emissions from the project will derive from GHGs emitted by agricultural activities – in particular the CH₄, N₂O and CO₂ emissions from rice paddy flooding and cultivation. The greenhouse gas emissions from rice paddy fields have been studied in India, Philippines and Japan (**Table 23**) and to a lesser extent in China and the USA. Only the studies in northern India have studied the emission of the suite of GHGs (CH₄, N₂O and CO₂) in combination with different ranges of nitrogen fertilizer applications and on a range of soils. Studies have also compared the GHG emission consequences of different periods of inundation of rice crops.

Table 23: GHG Emissions from Rice Paddy

Location	Methane (CH ₄) from Rice Paddy
Northern India ⁴	40 – 100 kg/ha
Philippines ⁵	100 – 150 kg/ha
Japan ⁶	– 200 kg/ha

⁴ Pathak H, C Li and R Wassmann. 2005.

⁵ Corton et al. 2000.

⁶ Yagi et al.1996.

136. The Indian study approximates the subproject conditions for comparable levels of fertilizer application and temperatures. The yearly emission levels used for this project are therefore:

66 kg/ha CH₄: 690 kg/ha CO₂: 1.93 kg/ha NO₂.

137. These emission rates are calculated for the Project Area in **Table 24**, and converted into equivalent levels of CO₂ using the following formula:

Global warming potential (GWP) = CO₂ emissions + CH₄ emissions*21 + NO₂ emissions*310

Table 24: GHG Emissions and GWP from Rice Paddy Increases

Cat. No.	Subprojects	Increase in Rice Paddy	CH ₄ Emissions (kg/yr)	CO ₂ emission (kg/yr)	N ₂ O emission (kg/yr)	GWP (tons/yr. CO ₂ e)
CW-01	TK	7,600	501,600	5,244,000	14,668	20,325
CW-02	Tipo	-	-	-	-	-
CW-03	Chroab	857	56,531	591,008	1,653	2,291
CW-04	Kor Koah	2,121	39,997	1,463,608	4,094	5,673
CW-06	PC	13,000	858,000	8,970,000	25,090	34,766
CW-07	PC1	7798	514,668	5,380,620	15,050	20,854
CW-08	PC2	3,559	234,861	2,455,365	6,868	9,516
CW-09	O Tracheak Chit	1,800	118,800	1,242,000	3,474	4,814
Total						98,238

Source: PMIC, 2018

138. The total CO₂e emissions generated by the project will be approximately 98,238 tons/year. This is below the threshold of 100,000 tons/annum of the ADB SPS 2009⁷ and therefore, no further monitoring is required.

2. Adaptation to Future Climate Change

139. Climate change is expected to alter the current runoff and rainfall regimes. Climate change assessments for Cambodia indicate greater but more variable rainfall, increased crop water demand, more frequent and severe floods, droughts and wind storms⁸.

140. Most of the increase in average annual rainfall predicted by models is expected to occur in the already wet months of the year, with only a minor or no increase over the dry season. The higher temperatures will increase crop water demands. These climate changes have the potential to influence both dry and wet season flow in the Project area, and this is examined below.

141. The predicted changes in rainfall and temperature under climate change scenarios (see Section IV) will combine to affect future Irrigated Water Requirements (IWR). **Figure 20** below

⁷ That requires an annual quantification of GHG emissions in accordance with internationally recognized methodologies.

⁸ Tes, S. 2015. *Assessment of Water Resources for Improved Water Governance under Climate Change: Stung Chinit River Catchment*. Presentation to Third Steering Committee Meeting Climate Change and Water Governance in Cambodia 20 January 2015, Phnom Penh.

shows predicted IWR for all SRES projections for nation states acting in isolation (A2 and B2 scenarios).

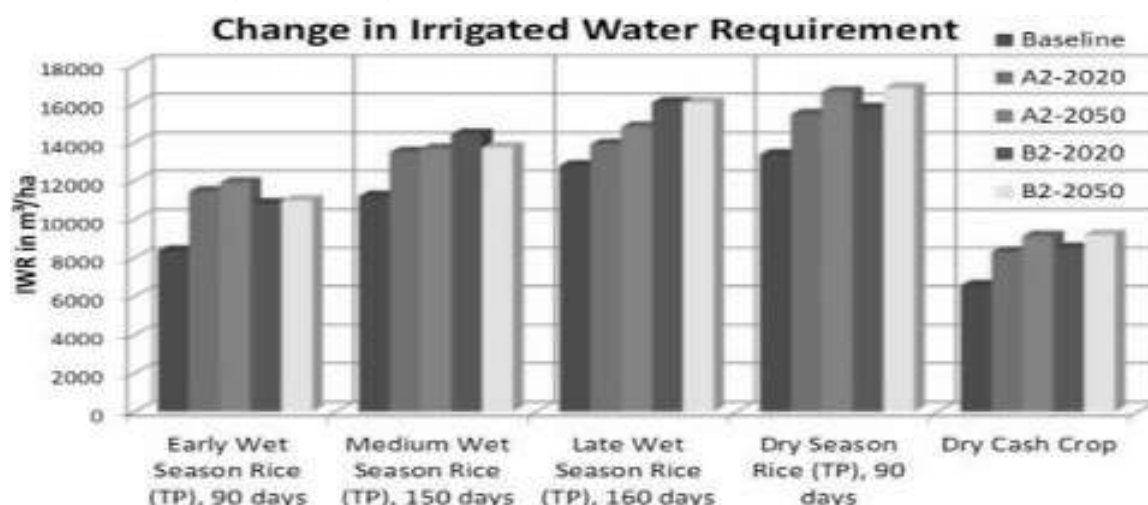
142. The crops of interest for Taing Krasaing are early wet season rice and late wet/dry season rice (both 90 days crops). For Prek Chik the relevant crop is medium wet season rice. The projections in **Table 25** show that IWR for these crops will be in the following ranges in 2020 and 2050.

Table 25: Predicted IWRs from Climate Change and IWRs Used in Subproject Water Balances

Crop	Predicted IWR in 2020 (m ³ /ha)	Predicted IWR in 2050 (m ³ /ha)	IWR used in Water Balance (Tables 21 and 22) for dry years (m ³ /ha)
Early wet season rice	10,000-12,000	10,000-12,000	15,000
Late wet/dry season rice	15,000-16,000	16,000-17,000	18,000
Medium wet season rice	13,000-14,200	13,000-14,000	16,000

Source: PPTA, 2015

Figure 20: Irrigation Water Requirement from IPCC SRES



Source: (Sopharith, 2015)

143. **Table 25** shows that when the IWRs from future climate change scenarios are compared with the IWRs being used for subproject design the project design IWRs are consistently higher and already allow for the eventuality of future increased water demand in both 2020 and 2050.

144. Increase in rainfall is predicted in future scenarios for 2020 with a decrease to near present levels in 2050. The need to drain wet season flooding of cultivation areas will therefore be highlighted in the short to medium term. The design of works to the main canals of the two core subprojects includes refurbishment of all cross drainage structures (which drain flood water). Prior to project start the majority of these have been inoperative for many years and their restoration to working order will alleviate local flooding and predicted flooding.

145. Design of structures for significantly higher flood return periods have been incorporated in subproject planning. Canal embankments have been reconstructed where needed and strengthened to withstand the above design flood flows. Headworks, spillways, sluice gates and

weirs have been provided with erosion/scour protection to maintain the integrity of control structures against high energy flood flows. The crest height of control gates were adjusted above the 1 in 100-year level to direct flood waters to control release sluices rather than overtopping and scouring.

146. Typical canal rehabilitation along high flow sections will involve replacement of structurally unsuitable material combined with an installed lining inside the canal slopes. This will retain a natural canal bed and benthic environment for the limited canal fisheries but protect sidewalls from flood scouring and failure.

147. The initial rapid environmental assessment (REA) undertaken by the ADB during project planning and project implementation identified a medium climate risk. Therefore, a Climate Risk and Vulnerability Assessment (CRVA) have been undertaken for the Taing Krasaing and Prek Chik Irrigation System (**Appendix 2**).

VI. INFORMATION DISCLOSURE, CONSULTATION AND INSTITUTIONAL ARRANGEMENT

A. Consultation and Participation Process

148. The first public consultation was undertaken by the PPTA team at the Taing Krasaing and Prek Chik Irrigation Schemes from 11 to 19 March 2014. The consultation was a combined information dissemination, agricultural and irrigation conditions data collection, and environmental investigation.

149. Meetings were held with individual farmer communes during PPTA as set out in below Table. The format of the meetings was a presentation of the project by the PPTA team followed by open discussion and the filling out of questionnaires. During project implementation, the number of public consultation meeting was held for other packages such as Chroab – CW03, Korkoah – CW04, Prek Chik Package I – CW07, Prek Chik Package II – CW08 and O Tracheak Chit Reservoir – CW09. A summary of environmental issues raised both during discussion is given in **Table 26**.

Table 26: Profile of Participants in Public Consultation

Date	Commune	Total Farmer Attendees	Female	People from villages
Taing Krasaing Scheme				
11/3/2014 am	Taing Krasaing	29	16	Vaing Khang Chhoeung village
11/3/2014 pm	Tipo	26	15	Tipor village and Nimith villages
12/3/2014 am	Chroab	32	17	Chey Mongkul and Sdok Sdam village
12/3/2014 pm	Kor Koh	25	17	Chi Meak and Santuk Krao villages
Sub-Total	4	112	65	-
Prek Chik Scheme				
17/3/2014 am	Prek Chik and Bassac	37	9	Siem village, Chhker Kham Pres, Khnach Ampor, Prek Chik, and Snam village
17/3/2014 pm	Prey Trolach	43	28	Chong Ampor and Prey Khlout villages
18/3/2014 am	Mouk Reah	58	37	Toul Svay, Mouk Reah I, Mouk Reah II villages
18/3/2014 pm	Sdok Pravoeuk	16	6	Prah Andong, Toul Korki villages
19/3/2014 am	Ruissey Kraing	24	0	Toul Roka, Chrey Ron villages
19/3/2014 pm	Svay Prey and Kear	43	22	Run, Thnal Bambek villages
Sub-Total	8	221	102	-

Date	Commune	Total Farmer Attendees	Female	People from villages
Grand total	12	333	167	Local authority and people who benefits the project.

Source: PPTA, 2015

150. During project implementation, Public Consultation Meetings on environment and social subject were arranged several times for Chroab (CW-03), Korkoah (CW-04) in October 2016 and for Prek Chik Package I (CW-07), Prek Chik Package II (CW-08) in 2017 and for O Tracheak Chit Reservoir – Package III (CW09) in 2018. The concern regarding to the project implementation is summarized in **Table 27**.

Table 27: Environmental/Agricultural Issues arising from Public Consultation

Scheme	Issues arising from Public Consultation
Taing Krasaing	<ul style="list-style-type: none"> No water and no functioning secondary and tertiary irrigation canals to serve farmers. Rain-fed rice areas are not properly levelled and most of soils are very poor with low productivity. Poor technical practice for land preparation, planting method (all broadcast), weed control, pest control with wrong decision of farmers in selecting chemicals without recommendation from agricultural extension workers. Poor technical transfer between farmers and agricultural extension workers and also from farmers to other farmers because lack training place in village and lack of field demonstration. Farmer's agro-technical knowledge is limited in rice production and livestock production. Lack of Agro-technical training to farmers in place including rice and livestock.
Prek Chik	<ul style="list-style-type: none"> No water and no functioning secondary and tertiary irrigation canals to serve farmers. Soils are very poor (unfertile) with low productivity. Poor technical practice for land preparation and planting method (all broadcast). No proper method in weed control, pest control. Poor decision-making of farmers in selecting agro-chemicals. Lack of training/meeting location. Support the establishment of a training hall in each target village Farmer's agro-technical knowledge is limited in rice production and livestock production.

Source: PMIC, 2018

Figure 21: Some Photos of Public Consultation during Project Implementation



Meeting at Chroab Commune, October 2016	Meeting at Korkoah Commune, October 2016
	
Photo taken on December 2016. Public Consultation with relevant stakeholder of Prek Chik Distribution System Package II (CW-08)	Photo taken on July 2016. Public Consultation with relevant stakeholder of Prek Chik Distribution System Package I (CW-07)
	
Meeting with local authority (20 June 2018) of CW09	Meeting with local people at Prek Chik Commune (21 June 2018 at 2:00 pm) of CW09
	
Meeting with local people at Prey Tralach Commune (21 June 2018 at 8:30 pm) of CW09	

B. Project Responses

151. Similar issues concern farmers in both schemes. The project will meet the farmers' water needs by its major works of canal rehabilitation (although provision of secondary and tertiary canals along with their water-regulating infrastructure will await implementation of long list subprojects).

152. The project will also address the issues of farmer training in rice agronomy and livestock. Training as recommended in the IEE and included in the EMP training requirements will focus among on integrated pest management (to guide pesticide application) and use of soil chemistry and crop needs to guide fertilizer use.

C. Institutional Arrangement

153. Ministry of Water Resources and Meteorology (MOWRAM) as the proponent of the Project has the overall responsibility of ensuring the compliance to environmental and social safeguard policies and the implementation of the EMP of the entire component. MOWRAM coordinates with Ministry of Environment and Ministry of Agriculture, Fishery and Forestry and other concerned agencies for their active participation in the implementation of EMP and to ensure compliance with national requirements. MOWRAM delegates the authority in implementing EMP of different components and ensuring the implementation of EMPs. Project Management Unit (PMU) and PMU of the Provincial Department of MOWRAM have the main responsibility of implementation of EMP during the construction and operation phase of the project. PMU has designated a liaison officer for environmental protection and mitigation for the subproject and assure compliance with EMP requirements. Project Management and Implementation Consultant (PMIC) do assist PMU in fulfilling their responsibilities. PMIC supports the PMU in the evaluation of the implementation of EMP and modify the EMP if needed, and in strengthening the institutional capacity of different involved parties in the project implementation.

154. The Contractor are responsible for compliance with environmental covenants as indicated in the contract. Farmers Water Users Community (FWUC) do have the very important role in the implementation of the forestry and watershed conservation programs to enhance the water availability in the river basin and use of water resources efficiently for maximizing the benefits of the projects. FWUC also raise awareness of farmers in the proper utilization of the chemical fertilizers, insecticides and pesticides to avoid the impacts on human health. The role and responsibilities of involved institutions are summed up in **Table 28**.

Table 28: Institutional Roles and Responsibilities in EMP Implementation

Institutions/ Communities	Roles and Responsibilities
MOWRAM	<ul style="list-style-type: none"> Overall responsibility in ensuring the project compliance of safeguard policies and compliance reporting Coordinating with other government institutions and donor to facilitate the implementation of the EMP
PMU	<ul style="list-style-type: none"> Support MOWRAM in the coordination with different government ministries and donor for obtaining necessary approvals Design and implement the capacity building programs for the ministry staffs and staffs of provincial department of the ministry Provide necessary resources for the implementation of the EMP Evaluate the effectiveness of the EMP and propose for update if needed Support PMU at each provinces in the implementation of EMP
PMU at provincial level	<ul style="list-style-type: none"> Day to day management of the implementation of the project including ensuring the implementation of EMP Supervise the work of CME and Contractors coordinate with local bodies and communities for their participation in the execution of EMP.
PMIC	<ul style="list-style-type: none"> Ensure that the project implementation fully complies with the ADB environmental and social safeguard policies Support PMU in the design and execution of the training programs for the capacity building of ministry and provincial department of the ministry Provide technical support to PMU, PMU at provincial level and the CME-PMIC in the evaluation of the monitoring results obtained from the monitoring programs and update the EMP if needed.

Institutions/ Communities	Roles and Responsibilities
CME-PMIC	<ul style="list-style-type: none"> • Technical support to PMU at provincial level in the execution of the project including in the implementation of the EMP • Monitoring the work of contractors in compliance with environmental covenants of the contract. • Work closely with PMIC head office in reviewing the effectiveness of EMP and update it if needed.
Contractors	<ul style="list-style-type: none"> • Implementation of the recommended mitigation measures during the construction phase of the project. • Ensuring the compliance with the Occupational Health and Safety standards. • Training of the workforce in Good Practices in construction management and waste management in the construction sites. • Prepare the quarterly environmental monitoring report and submit to PMU through PMIC.
FWUC	<ul style="list-style-type: none"> • Participate in the implementation of the programs related to the conservation of forestry and watershed in the river basin, aquatic weeds management, proper utilization of chemical fertilizers and pesticides and support the fishery conservation program. • Coordinate with different government departments and other FWUCs to maximize the benefits of the project.
Local authorities and communities	<ul style="list-style-type: none"> • Participate in the project developments and ensure that their views are incorporated. • Monitor contractor's activities to ensure compliance with requirements • Report field engineer and environmental liaison officer if any noncompliance.

MOWRAM: Ministry of Water Resources and Meteorology; PMU: Project Management Unit, PMIC: Project Management and Implement Consultant, CME: Construction Management Engineer, FWUC: Farmers Water Users Communities

VII. GRIEVANCE REDRESS MECHANISM

155. A grievance redress mechanism (GRM) has been established in each subproject province in compliance with ADB's SPS 2009 requirement to prevent and address community concerns and assist the project to maximize environmental and social benefits.

156. The GRM is accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, is available. Opportunities for confidentiality and privacy for complainants are honoured where this is seen as important.

A. Proposed Mechanism

157. The PMU has established a Project Public Complaint Unit (PPCU) which acts as a central recording and coordinating unit for all subprojects under the Project. Each subproject PMU ensures that the GRM is publicized locally so that the community is fully aware of the mechanism and the local points of entry to it. The setting up of the GRM in the PMU and its initial implementation through the PMUs are supported by the environmental consultant of the PMIC.

158. When construction started, a sign was erected at each construction site providing the public with updated project information and summarizing the grievance redress mechanism process including details of the GRM entry points. The contact persons for different GRM entry points; PMU, FWUC leaders, contractors, and operators of project facilities, have been identified prior to construction. The contact details for the entry points (e.g. phone numbers,

addresses, e- mail addresses, etc.) are publicly disseminated on information boards at construction sites and on the website of the local government.

159. The preferred action sequence for complaints handling is that the complaint should be investigated and resolved by the unit receiving the complaint. If this is not possible, the complaint should be referred to the PMU (whose wider membership will enable coordinated action in response).

160. The PPCU maintains records of complaints and actions taken to correct them. This data are included in the PMU's reports to the ADB. The PPCU has established a GRM tracking and documentation system. The system includes the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

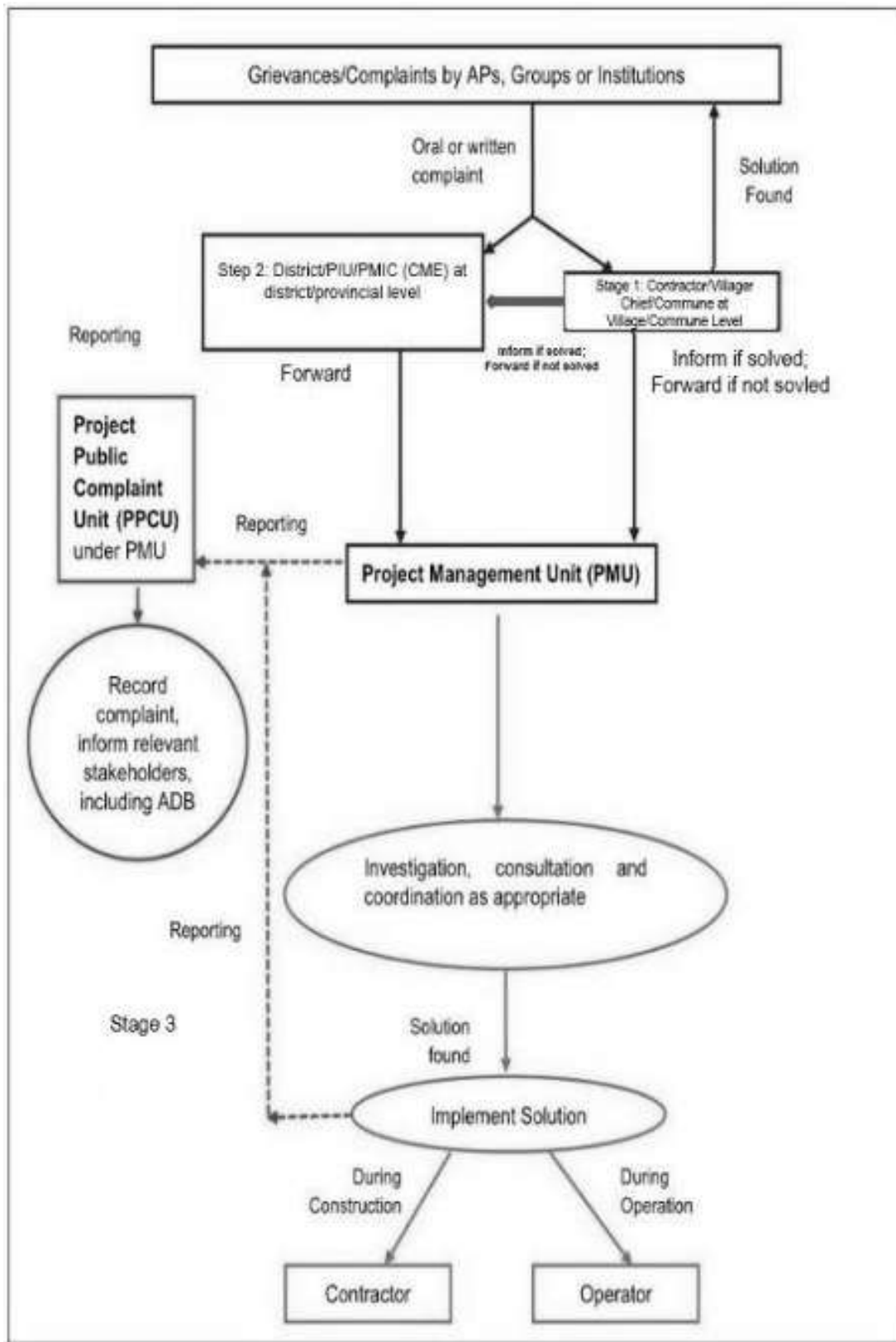
B. GRM Procedure and Timeframe

161. The procedure and timeframe for the grievance redress mechanism are described as follows (see **Figure 22**). The stages are represented by different colours in the flow diagram:

- **Stage 1: Contractor or villager chief at Village Level (5 working days).** Affected People (APs) present their complaints and grievances verbally or in writing to the contractor/village chief, or commune chief. The receiving agent is obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the aggrieved AP does not hear from taken in the first step, the complaint may be brought to the District Office/PIU/PMIC (CME) at district/provincial level.
- **Stage 2: District/PIU/PMIC (CME) at district/provincial level (5 working days).** This level has 5 working days within which to resolve the complaint to the satisfaction of all concerned. If the complaint not be solved at this stage, the District office/PMU/PMIC (CME) at provincial level will bring the case to the PMU/PMIC at national level.
- **Stage 3: PPCU/PMU/PMIC at national Level (10 working days).** This level has 10 working days within which meets with the aggrieved party and tries to resolve the situation. Within 10 working days of submission of the grievance, the PPCU must make a written decision and submit copies to the MOWRAM/PDOWRAM and the APs. If the complaint still not be solved at this stage, the complaint may be brought to ADB.

162. During construction, the PPCU are informed by contractors and construction supervisors, FWUC staff, or PMUs if people complain about the project. During operation, the PPCU will be advised of complaints by the PDWRAM and FWUC. The PPCU will also inform the ADB project team and submit all relevant documents.

Figure 22: Concept of Proposed GRM



Note: AP = Affected Person, PMU = Project Management Unit, FWUC = Farmer Water User Community

VIII. CONCLUSION AND ASSURANCES

A. Positive Impact and Environmental Benefits

163. The result of the subproject irrigation facilities will be (i) an increase in certainty and control of existing irrigation areas; (ii) expansion of irrigation into new areas; and (iii) winning of longer or new cropping periods on areas previously unavailable for parts of the year due to flooding. The beneficiaries of these changes will be local farmers, with flow-on effects to local commercial enterprises. Since rural populations are the poorest sectors of the Cambodian population, poverty alleviation effects will be direct and sustainable.

B. Negative Impacts

164. During construction, the main issues will be air, water pollution and soil erosion, all of which must be managed by strict control of construction contractors. Additional localized traffic hazards are anticipated and this must be minimized by site access and road safety planning. Health and safety of construction workers is also, as always, a primary concern. Mitigation of construction-phase impacts relies heavily on responsibility of works contractors to follow specification clauses specifically designed to minimize pollution of air and water and soil erosion. This mitigation will in turn rely on enforcement by the Environmental Management Officer in each project management unit and also by construction supervision consultants.

165. Post-construction, the main concerns are local increases in the levels of agricultural fertilizer and pesticide residues and their effects on water quality and people. Post-construction mitigation will benefit from capacity building and training under the project to use fertilizers and pesticides efficiently and responsibly.

166. There is also a concern that the irrigation schemes must be sustainable and responsibly managed, to ensure that agreed irrigation flows are maintained and other water users are not disadvantaged. The EMP requires a clear and detailed extraction plan for the cropping seasons to be prepared as part of each scheme's JOROP and submitted before construction.

C. Assurances

167. The most important assurance, which should be guaranteed by a loan covenant is that the PMUs will undertake the full range of effective measures set out in the IEE and EMP to ensure that the environmental management provisions and the environmental monitoring plan will be implemented effectively during project implementation, and that the implementation reports of the environmental management and monitoring plan in accordance with ADB requirements will be submitted in a timely fashion. Part of this monitoring and management commitment will be a commitment to implement and maintain an appropriate Grievance Redress Mechanism covering the construction and operation of the subprojects.

168. Other, specific assurances are that:

- The sediment quality of spoil from channel dredging will need to be tested and assessed against the relevant standards before reuse. The sediment testing results will determine the requirements to ensure safe reuse.
- The Project will deliver, as part of its Capacity Building and Training component, training modules specifically tailored to the needs of farmers on Integrated Pest Management (IPM) and low chemical cultivation applicable to cropping conditions and capacities in the local soil and climatic environments.

D. Conclusion

169. The majority of identified environmental impacts are not assessed as significant since it is the existing irrigation scheme and the negative impacts is minimized through project design till implementing. Due to above reason and as agreed in the ADB and MoWRAM during review mission in the end of 2016, no EIA study is required. In the meantime, the regular environmental monitoring and the environmental monitoring report have to be conducted and submitted to ADB to review and comment in every six month.

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**Appendix 1: Environmental Management Plan (EMPs) of All
Packages for Uplands Project**

**Appendix 2A: EMP for Taing Krasaing Main Canal
(MOWRAM/ICB – CW01) and Prek Chik Main Canal
(MOWRAM/ICB – CW06)**

Volume V- Environmental Management Plan

August 2015

Cambodia: Uplands Irrigation and Water
Resources Management Sector Project



A. Introduction

1. The environmental management plan (EMP) covers all phases of core subproject implementation from preparation through commissioning and operation, and it aims to ensure the monitoring of environmental impacts and activation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each subproject. Environmental protection measures will (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB safeguard Policy statement 2009.

2. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures.

B. Responsibilities for Implementation

3. The Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency (the EA) and Department of Farmer Water User Community (DFWUC) is the implementing agency (the IA). A Project Steering Committee, headed by Minister MOWRAM, will oversee the Project implementation and management. A Project Management Unit (PMU) was established before start of the PPTA and the PMU was fully involved in the Project preparation. The PMU is headed by a Project Director who is the Deputy Director General for Technical Affairs and a Project Manager who is the Director of the Department of FWWC. The PMU is composed of 24 designated personnel from MOWRAM, MAFF and PDWRAM. This will also include staff from the PDWRAM of the province within which the subproject is located. For the Prek Chik subproject the PMU will be:

4. The supervision and monitoring of project-related environmental activities during the pre-construction, construction and operation phases are the functions of the PMU. In line with this an Environmental Management Officer (EMO) in the PMU will be assigned to be responsible for supervision of environmental management and for environmental monitoring. The major responsibilities of the environmental officer will be to ensure that:

- (i) Mitigation measures and monitoring of these activities are carried out in accordance with the EMP;
- (ii) Environmental monitoring program, comprising the of taking samples and analysis are being carried out;
- (iii) Reporting is performed in compliance with ADB and GOKC requirements.

5. However, the main environmental guidance for the implementation phase will be provided by a the Environment Specialist in the Project Management and Implementation Consultants (PMIC) team. The role of the PMIC will be to work as part of the PMU, helping them fulfil their supervision and monitoring responsibilities. The PMIC will also provide monitoring reports for the ADB. The PMIC will be contracted by the PMU for the duration of the loan implementation period.

6. Contractors will be engaged by the PMU for construction. The construction impact mitigation measures contained in this EMP will be included as necessary activities in the contract documents. The incorporation of EMP provisions into the contract documents will be



undertaken by the PMU. The contractors will have the responsibility for implementing the impact mitigation measures in the construction phase and their performance will be supervised by the PMU.

7. Environmental monitoring during operation of the Project in the longer term is the responsibility of the respective PDWRAM.

C. Summary of Potential Impacts

8. Table A1.1 summarizes the potential impacts of the subprojects during construction and operation as identified by the initial environmental examination (IEE), as well as corresponding mitigation measures designated to minimize those impacts.

1. Mitigation Measures

9. The mitigation measures will be incorporated into tender documents, construction contracts, and operational management procedures. Contractors and PMU and PDWRAMs will implement these measures, depending upon subproject phases. The effectiveness of these measures will be carefully watched via the environmental monitoring to determine whether to continue them or to make improvements.

Table A1.1: Summary of Potential Impacts and Mitigation Measures

Table A1.1: Summary of Potential Impacts and Mitigation Measures					
Item	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)
					PC
Pre-construction					
1.1 Design stage	Final site designs	Final designs of canals, siting of control structures and canal alignments will be completed after taking into account the provisions of the EMP	PMIC	PMU	Design costs
	Irrigation extraction planning	Operational plans and operating practices for water allocations and drainage will be documented and approved by the PMU and ADB before completion of construction works and handing over of canals to FWUCs. This will be part of the Joint Reservoir Operations Plans (JROP).	PMU, FWUCs and PMIC	PMU, ADB	Design costs
	Baseline water quality	Establish baseline water quality for surface water (see monitoring plan)	PMIC	PMU	included in monitoring costs
1.2 Construction Preparation Stage	Environmental management budget	Confirm budgets for the implementation of environmental management measures and environmental supervisory responsibilities. Assign final budget allocations against each of the items in the EMP	PMU	PSC	Design costs
	Update EMP	Updating EMP: Mitigation	PMIC	PMU	Design costs



Item	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)	
		measures defined in this EMP will be updated and incorporated into the detailed design to minimize adverse environmental impacts.				
	Incorporate environmental management into contract documents	Contract documents: Preparation of the environment section in the Terms of Reference for bidders for construction contracts, and environmental contract clauses for contractors, namely the special conditions for the protection of the water, soil and air environments (referencing the EMP and monitoring plan).	PMIC	PMU	Design costs	
1.3 Construction support preparation	Environmental education awareness	Environmental Protection Training: Environmental specialists (including PMIC) and/or officials from local MOE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to PMU and PDVRAMs.	PMIC and MOE officers as required	PMU	Included in Project training budget	
		Environmental Protection Training: EMO, PMIC and/or officials from local MOE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to contractors.	PMU and PMIC	PMU	Part of EMP training costs	4,000
	Complaints procedures established	The Project Grievance Redress Mechanism will be established and local contact points for the subprojects publicized	PMU and PMIC	PSC	Part of Design costs	
	Site planning	Prepare a Site Environmental Management and Supervision Manual, including an emergency preparedness and response plan for construction emergencies and site environmental health and safety plan.	Contractors	PMU and PMIC	Part of Construction costs	2,800
Construction						
2.1 Water	Pollution from construction wastewater	Construction wastewater from the main construction sites will not be discharged onto the surrounding soil or into surface water systems (canals). Sedimentation tanks will be provided, and after settling out of solids the upper clear liquid will be recycled for spraying the	Contractors	PMU and PMIC	1,750	



Item	Environmental impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)	
					PC	
		construction site (dust control), and the waste residue will be transported to disposal sites where they will not contaminate agricultural soils or waterways. Oil-containing wastewater will require the installation of oil-water separators before the sedimentation tank.				
	Hazardous materials	To prevent pollution of soil and surface water/groundwater: (i) storage facilities for fuels, oil, cement, and chemicals will be within secured areas on impermeable surfaces, protected with bunds and cleanup installations; (ii) vehicle, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep into the soil; (iii) oil traps will be provided for service areas and parking areas; (iv) fuel storage and refilling areas will be located at least 50 m from canals and channels and will be protected by temporary drainage bunds to contain spills.	Contractors	PMU and PMIC	4,250	
2.2 Air	Air quality	Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. High-horsepower equipment will be provided with tail gas purifiers. All vehicle emissions will be in compliance with relevant Cambodian emission standards.	Contractors	PMU and PMIC	1,350	
	Dust	Material stockpiles and concrete mixing equipment will be equipped with dust shrouds. For both construction sites and construction roads, water spraying for the suppression of dust and maintenance of driving surfaces will be standard site management practice. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered.	Contractors	PMU and PMIC	2,000	
2.3 Noise and Vibration	Noise impacts on sensitive receivers	Construction at night within 280m of residences shall be strictly prohibited. During daytime construction, the contractor will ensure that (i) sites for concrete-pumping plants and similar activities will be located at least 1 km away from residences and schools; and	Contractors	PMU and PMIC	2,000	



Item	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)	
					PC	
		(i) temporary anti-noise barriers will be installed to shield any schools or residences within 100m of the construction site				
2.4 Solid wastes	Demolition waste	Any waste from the demolition or unrepairable stone and steel structures will be either sold to building material recyclers or collected and transported to official landfill sites. Metal parts, including pumps and pipes will be broken up and sold to scrap metal merchants. Any excess spoil will be made available to nearby communities for use as building beds and bunds.	Contractors	PMU and PMIC	1,350	
	Dredge spoil	The sediment quality of spoil from channel clearing or dredging will need to be tested and assessed for contamination before reuse. The sediment testing results will determine the requirements to ensure safe disposal or reuse.	PMIC	PMU		-
	Waste from worker camps	Contractors will provide toilets with pump-out and disposal facilities and sufficient garbage bins at strategic locations and ensure that they are (i) protected from birds and vermin, (ii) emptied regularly (using the mechanical vacuum toilet waste system and landfill), and (iii) do not overflow	Contractors	PMU and PMIC	3,650	
2.5 Soil erosion and ecology		Erosion control will include: (i) limiting construction and material handling during periods of rain and high winds, and (ii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while working and going out. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites.	Contractors	PMU and PMIC	5,750	
2.6 Social and Cultural	Impacts to local cultural sites	Contractors will ensure that all local cultural sites (including shrines and graves) will be kept clear of construction material and protected from dust and other disturbance. Access to these sites will not be impeded. After construction is finished any	Contractors	PMU and PMIC	-	-



Item	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)	
					PC	
		disturbed surroundings will be restored to pre-construction standards				
2.7 EHS	Community health and safety	<p>Community health and safety will be safeguarded by:</p> <p>1) Planning construction activities so as to minimize disturbances to residents, tribes and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be rehabilitated to its original condition after construction.</p> <p>2) Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public access to construction sites.</p>	Contractors	PMU and PMIC	1,350	
	Occupational health and safety	<p>Measures to ensure occupational health and safety will include:</p> <p>Contractors shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment;</p> <p>Following the award of construction contracts, the successful contractors will prepare and environmental health and safety plan, for approval by the PMU;</p> <p>Contractors shall ensure that:</p> <p>(a) all reasonable steps are taken to protect any person on the site from health and safety risks; (b) the construction site is a safe and healthy workplace; (c) machines and equipment are safe; (d) adequate training or instruction for occupational health and safety is provided; (e) adequate supervision of safe work systems is implemented; and (f) means of access to and egress from the site are without risk to health and safety.</p>	Contractors	PMU and PMIC	5,750	
2.8 Unexpected environmental		If unexpected environmental impacts occur during project	PMU and PMIC	PSC	Contingency	



Item	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)	
					PC	
Impacts		construction phase, the PMU will update the EMP and environmental protection measures will be designed and resources will be utilized to cope with those impacts.			1,350	
Operation						
3.1 Management of Irrigation	Implementation of extraction and drainage plans	Irrigation schemes to be operated strictly in concurrence with extraction and irrigation plans which ensure sustainability of supply.	PDWRAM and FWUCs	PMU	2,700	
	Canal fisheries	Informal canal fisheries rights safeguarded for local farmers	FWUCs	PMU	-	
3.2 Training in IPM and sustainable farming		The Project will support the national Integrated Pest Management program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites.	PMIC	PMU	Part of EMP training costs 17,550	
3.3 Emergency response Planning	Floods and extreme weather events	The Project will promote the development of community based disaster readiness programs at the irrigation and drainage communities with particular reference to flooding and other natural disasters.	Project output	ADB	2,700	

PK = Prek Chik; PMU = Project Management Unit (or PMO); PMO = Project Management Office; LMO = Environmental Management Officer (or PMU); PDWRAM = Provincial Department of Water Resources and Meteorology; ADB = Asian Development Bank; MDE = Ministry of Environment; PMIC = Project Management and Implementation Consultant; FWUC = Farmers Water User Commune; PSC = Project Steering Committee.
Source: PPTA Team

2. Environmental Management Costs

10. The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (Table A1.1) are included in the design costs, construction contracts and operational budgets. Final budget allocations against each of the items in the EMP will be developed by the PMU.

D. Environmental Monitoring

1. Monitoring Program

11. The Project monitoring program will focus on the environment within the Project's area.



of influence. An environmental monitoring program is summarized in Table A1.2 below. The program considers the scope of monitoring and frequency. The monitoring results will be assessed against the following standards and corrective management implemented in cases of non-compliance.

- (i) The sub-decree No 27 ANRK.BK on Water Pollution Control is dated on April 6th, 1998. (Table for Lake and Reservoir)
- (ii) The sub-decree No 36 ANRK.BK on Solid Waste Management is dated on April 27th, 1998.
- (iii) Ministry of Industry Mines and Energy Drinking Water Quality Standards January, 2004

12. For the re-use and disposal of silt from canal cleaning or dredging, there is no RGC standard, and standards applying to paddy field environments from China and Japan will be referenced.¹

Table A1.2: Environmental Monitoring Plan

Parameters	Location	Frequency	Responsibility
Pre-Construction			
Surface water quality pH, SS, EC, NH ₄ ⁺ , NO ₃ ⁻ , PO ₄ ³⁻ , DO, BOD ₅ , COD, Oil & Grease, Coliform	At main canal headworks to establish baseline water quality for surface water entering main canal	Two times: once at beginning of construction period, and once at beginning of wet season/irrigation period	PMIC and PMU
During Construction			
Dust and noise	Site inspection of all subproject sites	Quarterly	PMIC to supervise and PMU to inspect
Surface water quality pH, SS, EC, NH ₄ ⁺ , NO ₃ ⁻ , PO ₄ ³⁻ , DO, BOD ₅ , COD, Oil & Grease, Coliform	Canal waters 100m downstream of major construction sites	Quarterly	PMIC and PMU
Silt and dredge spoil: Organic matter, Zn, Cu, Pb, Hg, As, Cd moisture content, phenols, mineral oil	Canal silt cleared from waterway. Three sampling locations: at start, midpoint and end of main canal (Prek Chik).	Once at each location to check disposal/reuse safety	PMIC and PMU
Operation Phase			
Surface water quality pH, SS, EC, NH ₄ ⁺ , NO ₃ ⁻ , PO ₄ ³⁻ , DO	Canal waters at start, midpoint and end of main canal	Semi-annual	PDWRM to contract an organization to do sampling and

¹ PRC: GB4204-84 Control standards for pollutants in sludge for agricultural use, PRC: GB12348-2008 Sludge quality for afforestation in gardens or forests, Japan: Environmental Quality Standards (EQS) for soil pollution August 1981.



Parameters	Location	Frequency	Responsibility
BOD5, COD, Oil & Grease, Coliform			testing
Groundwater quality: "Priority Parameters": pH, Turbidity, Arsenic, Iron, TDS, Pesticides, coliforms	Five household wells located within each of the water user community areas of the Prek Chik scheme	Semi-annual	PDWRAM to contract an organization to do sampling and testing

2. Monitoring Management

13. During construction, the PMU will make appropriate arrangements for monitoring according to the progress of implementation. Monitoring reports will be made available to MOE as required, on a quarterly basis during construction. When complaints are received from the public (either directly or via the formal grievance redress mechanism), PMU staff will conduct additional inspections immediately.

3. Monitoring Costs

14. The activities of the PMU monitoring during construction and the initial operational period will be funded from the construction budget. The PDWRAMs' ongoing monitoring costs will be covered by their operational budget. A summary of monitoring costs is given in Table A.3.

Table A.3: Estimated Monitoring Costs (\$)

Province	Subproject	Construction Stage			Operation Stage		Total
		Year 1	Year 2	Year 3	Year 4	Year 5	
Battambang	Prek Chik	7,500	7,500	7,500	4,500	4,500	31,500

Table A.4: Total EMP Costs (\$)

Scheme	Construction Environmental Management	Construction Environmental Monitoring (over 3 years)	Operational Environmental Management	Operational Environmental Monitoring (first 2 years)	EMP Training Costs	Totals
Prek Chik	41,450	22,500	5,750	9,000	18,900	98,600
Totals	41,450	22,500	5,750	9,000	18,900	98,600



4. Environmental Monitoring Reports

15. To ensure proper and timely implementation of the EMP and adherence to the agreed environmental covenants, the PMU will submit semi-annual project progress reports to the ADB including environmental performance based on the monitoring and inspections data provided by the PMU. The PMIC will help the PMU to prepare the environment performance report, which will be disclosed on the ADB website.

5. Training Program

16. The training proposed in this EMP is in addition to the capacity building component within the Uplands Irrigation and Water Resources Management Sector Project design, which will target the strengthening of, and skills transfer to PDWRAMs and FWUCs. The training listed in the EMP (Table A1.1) is targeted at the PMU initially and later the construction contractors to enable them to implement environmental protection measures in construction; and to PDWRAMs to enable them to implement environmental protection measures in scheme operation.

17. The EMP training will be incorporated into the Project Training Plan when it is finalized.



**Appendix 1B: Environmental Monitoring Report (EMP) for
Chroab (MOWRAM/NCB – CW03)**

Volume V- Environmental Management Plan

August 2019

Cambodia: Uplands Irrigation and Water
Resources Management Sector Project



A. Introduction

1. The environmental management plan (EMP) covers all phases of core subproject implementation from preparation through commissioning and operation, and it aims to ensure the monitoring of environmental impacts and estimation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each subproject. Environmental protection measures will (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB safeguard Policy statement 2009.

2. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures.

B. Responsibilities for Implementation

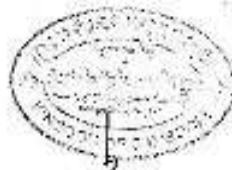
3. The Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency (the EA) and Department of Farmer Water User Community (DFWUC) is the implementing agency (the IA). A Project Steering Committee, headed by Minister MOWRAM, will oversee the Project implementation and management. A Project Management Unit (PMU) was established before start of the PPTA and the PMU was fully involved in the Project preparation. The PMU is headed by a Project Director who is the Deputy Director General for Technical Affairs and a Project Manager who is the Director of the Department of FWUC. The PMU is composed of 24 designated personnel from MOWRAM, WAFF and PDWRAM. This will also include staff from the PDWRAM of the province within which the subproject is located. For the Taing Krasaing subproject the PMU will be:

4. The supervision and monitoring of project-related environmental activities during the pre-construction, construction and operation phases are the functions of the PMU. In line with this an Environmental Management Officer (EMO) in the PMU will be assigned to be responsible for supervision of environmental management and for environmental monitoring. The major responsibilities of the environmental officer will be to ensure that:

- (i) Mitigation measures and monitoring of these activities are carried out in accordance with the EMP;
- (ii) Environmental monitoring program, comprising the of taking samples and analysis are being carried out;
- (iii) Reporting is performed in compliance with ADB and GOKC requirements.

5. However, the main environmental guidance for the implementation phase will be provided by a the Environment Specialist in the Project Management and Implementation Consultants (PMIC) team. The role of the PMIC will be to work as part of the PMU, helping them fulfil their supervision and monitoring responsibilities. The PMIC will also provide monitoring reports for the ADB. The PMIC will be contracted by the PMU for the duration of the loan implementation period.

6. Contractors will be engaged by the PMU for construction. The construction impact mitigation measures contained in this EMP will be included as necessary activities in the contract documents. The incorporation of EMP provisions into the contract documents will be



undertaken by the PMU. The contractors will have the responsibility for implementing the impact mitigation measures in the construction phase and their performance will be supervised by the PMU.

7. Environmental monitoring during operation of the Project in the longer term is the responsibility of the respective PDWRAM.

C. Summary of Potential Impacts

8. Table A1.1 summarizes the potential impacts of the subprojects during construction and operation as identified by the initial environmental examination (IEE), as well as corresponding mitigation measures designated to minimize those impacts.

1. Mitigation Measures

9. The mitigation measures will be incorporated into tender documents, construction contracts, and operational management procedures. Contractors and PMU and PDWRAMs will implement these measures, depending upon subproject phases. The effectiveness of these measures will be carefully watched via the environmental monitoring to determine whether to continue them or to make improvements.

Table A1.1: Summary of Potential Impacts and Mitigation Measures

Item	Environmental Impacts and Issues	Mitigation Measures and Safeguards	Who Implements	Who Supervises	Costs (US\$)
Pre-construction					
1.1 Design stage	Final site designs	Final designs of canals, siting of control structures and canal alignments will be completed after taking into account the provisions of the EMP.	PMIC	PMU	Design costs
	Irrigation extraction planning	Operational plans and operating practices for water allocations and drainage will be documented and approved by the PMU and ADB before completion of construction works and handing over of canals to FWUCs. This will be part of the Joint Reservoir Operations Plans (JROP).	PMU, FWUCs and PMIC	PMO, ADB	Design costs
	Baseline water quality	Establish baseline water quality for surface water (see monitoring plan)	PMIC	PMU	Included in monitoring costs
1.2 Construction Preparation Stage	Environmental management budget	Confirm budgets for the implementation of environmental management measures and environmental supervisory responsibilities. Assign final budget allocations against each of the items in the EMP	PMU	PSC	Design costs
	Update EMP	Updating EMP Mitigation	PMIC	PMU	Design costs

Item	Environment Impacts and Issues	Mitigation Measures and/or Safeguards	Who implements	Who Supervises	Costs (US\$)
		measures defined in this EMP will be updated and incorporated into the detailed design to minimize adverse environmental impacts			
	Incorporate environmental management into contract documents	Contract documents: Preparation of the environment section in the Terms of Reference for bidders for construction contracts, and environmental contract clauses for contractors, namely the special conditions for the protection of the water, soil and air environments (referencing the EMP and monitoring plan)	PMIC	PMU	Design costs
1.3 Construction support preparation	Environmental education and awareness	Environmental Protection Training: Environmental specialists (including PMIC) and/or officials from local MOE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to PMU and PDVRAMS.	PMIC and MOE officers as required	PMU	Included in Project training budget
		Environmental Protection Training: EMO, PMIC and/or officials from local MOE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to contractors.	PMU and PMIC	PMU	Part of EMP training costs
					10,950
	Complaints procedures established	The Project Grievance Redress Mechanism will be established and local contact points for the subprojects publicized	PMU and PMIC	PSC	Part of Design costs
	Site planning	Prepare a Site Environmental Management and Supervision Manual, including an emergency preparedness and response plan for construction emergencies and site environmental health and safety plan.	Contractors	PMU and PMIC	Part of Construction costs
					7,300
Construction					
2.1 Water	Pollution from construction wastewater	Construction wastewater from the main construction sites will not be discharged onto the surrounding soil or into surface water systems (canals). Sedimentation tanks will be provided, and after settling out of solids the super clear liquid will be recycled for spraying the	Contractors	PMU and PMIC	18,250

Item	Environment Impacts and Issues	Mitigation Measures and/or Safeguards	Who Will Implement	Who Supervises	Costs (USD)
		construction site (dust control) and the waste residue will be transported to disposal sites where they will not contaminate agricultural soils or waterways. Oil containing wastewater will require the installation of oil-water separators before the sedimentation tank.			
	Hazardous materials	To prevent pollution of soil and surface water/groundwater: (i) surface activities for fuels, oil, cement, and chemicals will be within secured areas on impermeable surfaces provided with bunds and cleanup installations; (ii) vehicle, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep into the soil; (iii) oil traps will be provided for service areas and parking areas; (iv) fuel storage and refilling areas will be located at least 50 m from canals and channels and will be protected by temporary drainage bunds to contain spills.	Contractors	PMU and PMIC	10,950
2.2 Air	Air quality	Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. High-horsepower equipment will be provided with tail gas purifiers. All vehicle emissions will be in compliance with relevant Cambodian emission standards.	Contractors	PMU and PMIC	3,850
	Dust	Material excavators and concrete mixing equipment will be equipped with dust shrouds. For both construction sites and construction roads, water spraying for the suppression of dust and maintenance of driving surfaces will be standard site management practice. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered.	Contractors	PMU and PMIC	7,200
2.3 Noise and Vibration	Noise impacts on sensitive receivers	Construction at night within 300m of residences shall be strictly prohibited. During daytime construction, the contractor will ensure that: (i) sites for concrete-mixing plants and similar activities will be located at least 1 km away from residences and schools; and	Contractors	PMU and PMIC	7,300

Item	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who implements	Who Supervises	Costs (US\$)	US\$
		(i) temporary and noise barriers will be installed to shield any schools or residences within 100m of the construction site.				
2.4 Solid wastes	Demolition waste	Any waste from the demolition of unrepairable sluice and gate structures will be either sold to building material recyclers or collected and transported to official landfill sites. Metal parts, including pumps and pipes will be broken up and sold to scrap metal merchants. Any excess spoil will be made available to nearby communities for use as building pads and bunds.	Contractors	PMU and PMIC	3,850	
	Dredge spoil	The sediment quality of spoil from channel clearing and dredging will need to be tested and assessed for contamination before reuse. The sediment testing results will determine the requirements to ensure safe disposal or reuse.	PMIC	PMU	18,252	
	Waste from worker camps	Contractors will provide toilets with pump-out and disposal facilities and sufficient garbage bins at strategic locations and ensure that they are (i) protected from birds and vermin, (ii) emptied regularly (using the nearest township solid waste system and landfill), and (iii) do not overflow.	Contractors	PMU and PMIC	3,850	
2.5 Soil erosion and ecology		Erosion control will include: (i) limiting construction and material handling during periods of rain and high winds; and (ii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites.	Contractors	PMU and PMIC	18,252	
2.6 Social and Cultural	Impacts to local cultural sites	Contractors will ensure that all local cultural sites (including shrines and graves) will be kept clear of construction material and protected from dust and other disturbance. Access to these sites will not be impeded. After construction is finished any	Contractors	PMU and PMIC		

Item No.	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs (US\$)	
					Estimated	Actual
		disturbed surroundings will be restored to pre-construction standards.				
2.7 R/S	Community health and safety	Community health and safety will be safeguarded by: 1) Planning construction activities so as to minimize disturbances to residents, utilities and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be reinstated to its original condition after construction. 2) Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public access to construction sites.	Contractors	PMU and PMIC	3,650	
	Occupational health and safety	Measures to ensure occupational health and safety will include: Contractors shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment. Following the award of construction contracts, the successful contractors will prepare site environmental health and safety plan, for approval by the PMU. Contractors shall ensure that: (a) all reasonable steps are taken to protect any person on the site from health and safety risks; (b) the construction site is a safe and healthy workplace; (c) machines and equipment are safe; (d) adequate training or instruction for occupational health and safety is provided; (e) adequate supervision of safe work systems is implemented; and (f) means of access to and egress from the site are without risk to health and safety.	Contractors	PMU and PMIC	18,250	
2.8 Unexpected environmental		(un)expected environmental impacts occur during project	PMU and PMIC	and BSC	Contingency	

Item	Environmental Impacts and Issues	Mitigation Measures and Safeguards	Who Implements	Who Supervises	Costs (US\$)	
					TK	
Impacts		construction phase, the PMU will update the EMP, and environmental protection measures will be designed and resources will be utilized to cope with these impacts.			3,553	
Operation						
3.1 Management of Irrigation	Implementation of extraction and waterage plans	Irrigation schemes to be operated strictly in concurrence with extraction and irrigation plans which ensure sustainability of supply.	PDWRM and FWUCs	PMU	7,300	
	Canal fisheries	Informal canal fisheries rights safeguarded for local farmers	FWUCs	PMU		
3.2 Training in IPM and sustainable farming		The Project will support the national integrated Pest Management program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites.	PMIC	PMU	Part of EMP training costs 25,200	
3.3 Emergency response Planning	Floods and extreme weather events	The Project will promote the development of community based disaster readiness programs at the irrigation and drainage communities with particular reference to flooding and other natural disasters.	Project output	ADB	7,300	

TK = Taing Krasaing; PMU = Project Management Unit (of PMO); PMO = Project Management Office; EMO = Environmental Management Office (at PMU); PDWRM = Provincial Department of Water Resources and meteorology; ADB = Asian Development Bank; MOE = Ministry of Environment; PMIC = Project Management and Implementation Consultant; FWUC = Farmers Water User Community; PSC = Project Steering Committee.
Source: PPTA Team

2. Environmental Management Costs

10. The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (Table A1.1) are included in the design costs, construction contracts and operational budgets. Final budget allocations against each of the items in the EMP will be developed by the PMU.

D. Environmental Monitoring

1. Monitoring Program

11. The Project monitoring program will focus on the environment within the Project's area

of influence. An environmental monitoring program is summarized in Table A1.2 below. The program considers the scope of monitoring and frequency. The monitoring results will be assessed against the following standards and corrective management implemented in cases of non-compliance:

- (i) The sub-decree No 27 ANRKBK on Water Pollution Control is dated on April 6th, 1996 (Table for Lake and Reservoir)
- (ii) The sub-decree No 38 ANRKBK on Solid Waste Management is dated on April 27th, 1996.
- (iii) Ministry of Industry Mines and Energy Drinking Water Quality Standards January 2004

12. For the re-use and disposal of silt from canal cleaning or dredging, there is no RGC standard, and standards applying to paddy field environments from China and Japan will be referenced.¹

Table A1.2: Environmental Monitoring Plan

Parameters	Location	Frequency	Responsibility
Pre Construction			
Surface water quality: pH, SS, EC, NH ₄ ⁺ , NO ₃ ⁻ , PO ₄ ³⁻ , DO, BOD ₅ , COD, Oil & Grease, Coliform	At main canal headworks to establish baseline water quality for surface water entering main canal	Two times: once at beginning of construction period, and once at beginning of wet season/irrigation period	PMIC and PMU
During Construction			
Dust and noise	Site inspection of all sub-project sites	Quarterly	PMIC to supervise and PMU to inspect
Surface water quality: pH, SS, EC, NH ₄ ⁺ , NO ₃ ⁻ , PO ₄ ³⁻ , DO, BOD ₅ , COD, Oil & Grease, Coliform	Canal waters 100m downstream of major construction sites	Quarterly	PMIC and PMU
Silt and dredge spot: Organic matter, Zn, Cu, Pb, Hg, As, Cd, moisture content, phenols, mineral oil, Operation Phase	Canal silt cleared from waterway. Three sampling locations - at start, midpoint, and end of main canal (Taing Krasaing)	Once at each location to check discoloration/safety	PMIC and PMU
Operation Phase			
Surface water quality: pH, SS, EC, NH ₄ ⁺ , NO ₃ ⁻ , PO ₄ ³⁻ , DO	Canal waters at start, midpoint and end of main canal	Semi-annual	PDWRAM to contract an organization to do sampling and

¹ PRO DB4294-94 Control standards for pollutants in sludge for agriculture use, PRO GB12943-2000 Sludge quality for application in gardens, or to water bodies; Environmental Quality Standards (EQS) for water pollution, August 1997.

Parameters	Location	Frequency	Responsibility
BOD5, COD, Oil Grease, Coliform			testing
Groundwater quality: Priority Parameters: pH, Turbidity, Arsenic, Iron, TDS, Pesticides conforms	<ul style="list-style-type: none"> Five household wells located within each of the water user commune areas of the Taing Krasing scheme 	Semi-annual	PDWRAM to contract an organization to do sampling and testing

2. Monitoring Management

13. During construction, the PMU will make appropriate arrangements for monitoring according to the progress of implementation. Monitoring reports will be made available to MCE as required, on a quarterly basis during construction. When complaints are received from the public (either directly or via the formal grievance redress mechanism), PMU staff will conduct additional inspections immediately.

3. Monitoring Costs

14. The activities of the PMU monitoring during construction and the initial operational period will be funded from the construction budget. The PDWRAMs' ongoing monitoring costs will be covered by their operational budget. A summary of monitoring costs is given in Table A.3.

Table A.3: Estimated Monitoring Costs (\$)

Province	Subproject	Construction Stage			Operation Stage		Total
		Year 1	Year 2	Year 3	Year 4	Year 5	
Kampong Thom	Taing Krasing	7,500	7,500	7,500	4,500	4,500	31,500

Table A.4: Total EMP Costs (\$)

Scheme	Construction Environmental Management	Construction Environmental Monitoring (over 3 years)	Operational Environmental Management	Operational Environmental Monitoring (first 2 years)	EMP Training Costs	Totals
Taing Krasing	124,100	22,500	18,250	9,000	32,850	206,700
Totals	124,100	22,500	18,250	9,000	32,850	206,700

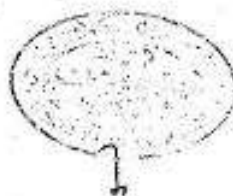
4. Environmental Monitoring Reports

15. To ensure proper and timely implementation of the EMP and adherence to the agreed environmental covenants, the PMU will submit semi-annual project progress reports to the ADB including environmental performance based on the monitoring and inspections data provided by the PMU. The PMIC will help the PMU to prepare the environment performance report, which will be disclosed on the ADB website.

5. Training Program

16. The training proposed in this EMP is in addition to the capacity building component within the Uplands Irrigation and Water Resources Management Sector Project design, which will target the strengthening of, and skills transfer to PDWRAMs and FWUCs. The training listed in the EMP (Table A1.1) is targeted at the PMU initially and later the construction contractors to enable them to implement environmental protection measures in construction; and to PDWRAMs to enable them to implement environmental protection measures in scheme operation.

17. The EMP training will be incorporated into the Project Training Plan when it is finalized.



Appendix 1C: EMP for Korkoah (MOWRAM/ICB – CW04)

KINGDOM OF CAMBODIA

Nation Religion King



MINISTRY OF WATER RESOURCE AND METHODOLOGY



ASIAN DEVELOPMENT BANK

ADB Loan No 3289-CAM

**CAMBODIA:
UPLANDS IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR
PROJECT, CAMBODIA**

**For (MOWRAM/NCB–CW03) – Chroab Distribution
System (MOWRAM/NCB – CW03)**

ENVIRONMENTAL MANAGEMENT PLAN

Phnom Penh, December 2018
(Update)

ABBREVIATION

ADB	Asian Development Bank
EA	Executing Agency
EARF	Environmental Assessment and Review Framework
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FDERP	Flood Damage Emergency Reconstruction Project
GoC	Government of Cambodia
GPS	Global Positioning System
IA	Implementing Agency
IEE	Initial Environmental Examination
MEF	Ministry of Economy and Finance
MoE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
NR	National Road
PDOE	Provincial Department of Environment
PDWRAM	Provincial Department of Water Resources and Meteorology
PMU	Project Management Unit
PIU	Project Implementation Unit
PPTA	Project Preparation TA
REA	Rapid Environmental Assessment
RP	Resettlement Plan
SPS	ADB's Safeguard Policy Statement (2009)

A. Introduction

1. The Environmental Management Plan (EMP) covers all phases of project implementation from preparation through commissioning and operation, and it aims to ensure the monitoring of environmental impacts and activation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each sub-project. Environmental protection measures will (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB Safeguard Policy Statement 2009.

2. Environmental Monitoring Programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures.

B. Responsibilities for Implementation

3. The Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency (the EA) and Department of Farmer Water User Community (DFWUC) is the implementing agency (the IA). A Project Steering Committee, headed by Minister MOWRAM, will oversee the Project Implementation and Management. A Project Management Unit (PMU) was established and the PMU was fully involved in the project preparation. The PMU is headed by a Project Director who is the Deputy Director General for Technical Affairs and a Project Manager who is the Director of the Department of FWUC. The PMU is composed of 24 designated personnel from MOWRAM, MAFF and PDWRAM. This will also include staff from the PDWRAM of the province within which the sub-project is located. For the Taing Krasaing Sub-project (Chroab) the PMU will be responsible for the supervision and monitoring of project-related environmental activities during the pre-construction, construction and operation phases as part of their functions. In line with this an Environmental Management Officer (EMO) in the PMU will be assigned to be responsible for supervision of environmental management and for environmental monitoring. The major responsibilities of the environmental officer will be to ensure that:

- Mitigation measures and monitoring of these activities are carried out in accordance with the EMP;
- Environmental Monitoring program, comprising of taking samples and analysis are being carried out;
- Reporting is performed in compliance with ADB requirements.

4. However, the main environmental guidance for the implementation phase will be provided by the Environment Specialist in the Project Management and Implementation Consultants (PMIC) team. The role of the PMIC will be to work as part of the PMU, helping them fulfill their supervision and monitoring responsibilities. The PMIC will also provide monitoring reports for the ADB. The PMIC was contracted by the PMU for the duration of the loan implementation period.

5. Contractors will be engaged by the PMU for construction. The construction impact mitigation measures contained in this EMP will be included as necessary activities in the contract documents. The incorporation of EMP provision into the contract documents will be undertaken by the PMU. The contractors will have the responsibility for implementation of the impact mitigation measures in the construction phase and their performance will be supervised by the PMU.

6. Environmental monitoring during operation of the Project in the longer term is the responsibility of the respective PDWRAM.

C. Summary of Potential Impacts and mitigation measures

7. **Table 1** summarizes the potential impacts of the sub-project during construction and operation as identified by the Initial Environmental Examination (IEE) as well as corresponding mitigation measures designed to minimize those impacts.

1. Summary of Key Issues

8. **UXO survey and removal.** During consultation with local people and authority on July 2016, project works will take place in areas that are already will trafficked. Thus, it is not likely to have a significant UXO risk. During the public consultation in 2016, no one raised about the UXO risk at the propose site as it was existing irrigation since Pol Pot Regime. However, a borrow pit site is unknown yet that it could be harmful on UXO.

9. **Air quality.** The temporary impacts on air quality in the construction stage of the Package 3 are anticipated because of fugitive dust generation associated with all construction works, earth works and waste movements.

10. **Noise Disturbance.** Noise impacts will be temporary and localized at all construction sites as construction machinery and vehicles generate noise as they operate. Other noise sources include loading and unloading of equipment and materials.

11. **Surface Water.** Surface Water will be polluted from human waste, oil contamination, and other hazardous material during construction phase. Short term construction impacts may be seen in terms of increased turbidity, when access roads improvement or other construction is taking place adjacent to the canals.

12. **Soil and Land.** Soil erosion is not anticipated given the nature of the Package 3 and their locations however borrow sites will cause local impacts to the land. The Package 3 is fertile agricultural locations and fertile top soil is a valuable resource which requires protection measures, particularly for the all construction areas which are located in and around rice fields where encroachment from inappropriate spoil disposal could have detrimental impacts. Channels with earth banks will be stabilized through planting.

13. **Solid Waste Management.** Impacts on resource use and impacts associated with disposal will arise from waste generated during construction. This includes generation of wastes e.g. demolition waste (any waste from the demolition of unrepairable sluice and gate structures), dredge spoil, and waste from worker camps.

14. **Community and Occupational Health and Safety.** During construction, local cultural sites, and other areas in community could be disturbed. Within 30 working days, after construction is finished any disturbed areas will be restored to pre-construction conditions. Occupational risks come from a range of activities including the use of heavy machinery, earth moving, and use of chemicals, the EMP includes health and safety measures and monitoring requirements.

15. **Socio-economic impacts (Accessibility).** The rehabilitation of Package 3 will require the excavation of parts of the existing canal. The people are living along the canals and rice paddy field. The community in and around the area will be disrupted by the noise and dust, as described above, and also by localized turbidity and potential impaired access.

Table 1: Summary of Potential Impacts and Mitigation Measures

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
1. Pre-construction					
Design stage	Final Site Designs	<ul style="list-style-type: none"> Final designs of canals, siting of control structures and canal alignments were completed after taking into account the provisions of the EMP. 	PMIC	PMU	Design cost
	Irrigation extraction planning	<ul style="list-style-type: none"> Operational plans and operating practices for water allocations and drainage will be documented and approved by the PMU and ADB before completion of construction works and handing over of canals to FWUCs. 	PMU, FWUGs and PMIC	PMO, ADB	Design Costs
1.2 Construction Preparation Stage	Environmental management budget	<ul style="list-style-type: none"> Confirm budgets for the implementation of environmental management measures and environmental supervisory responsibilities. Assign final budget allocations against each of items in the EMP 	PMU	PSC	Design Costs
	Incorporate environmental management into contract documents	<ul style="list-style-type: none"> Contract documents: Preparation of the environment section in the Terms of Reference for bidders for construction contracts, and environmental contract clauses for contractors, namely the special conditions for the protection of the water, soil and air environments (referencing the EMP and monitoring plan). 	PMIC	PMU	Design Costs
1.3 Construction support preparation	Environmental education awareness	<ul style="list-style-type: none"> Environmental Protection Training: Environmental specialists (including PMIC) and/or officials from local MoE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to PMU, PDWRAWs and contractors. The training could be arranged into two groups; one for PMU and PDWRAMs and another one for contractors. 	PMIC and MoE officers as required	PMU	Part of EMP training cost 4,000
	Complaints procedures established	<ul style="list-style-type: none"> The Project Grievance Redress Mechanism will be established and local contact persons for the sub-project published. 	PMU and PMIC	PSC	Part of Design Costs
	Site planning	<ul style="list-style-type: none"> Prepare a Site Environmental Management and 	Contractors	PMUC and	Part of

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		Supervision Guideline, including an emergency preparedness and response guideline for construction emergencies and site environmental health and safety guideline.		PMIC	Construction Costs
					2,000
1.4 UXO and Borrow pit	Project works will take place in areas that are already will trafficked. Thus, it is not likely to have a significant UXO risk. During the public consultation in 2016, no one raised about the UXO risk at the propose site as it was existing irrigation since Pol Pot Regime. However, a borrow pit site is unknown yet that it could be harmful on UXO.	<ul style="list-style-type: none"> To avoid any risks, on all sites where excavation or ground clearance needs to take place, where there is a reasonable doubt as to the safety of the area an approved mine clearance agency should be engaged for an agreed package of verification, detection and clearance work, to ensure that all areas where excavation, or access construction will take place are clear of UXO. 	Contractors	PMU and PMIC	Included in civil work contract
2. Construction Phase					
2.1 Water deterioration	Human wastes from construction. An adverse environmental impact could occur during the construction phase from workers' feces and domestic wastes. This will generate flies and transmitted diseases which will possibly result to sanitation issue in the areas.	<ul style="list-style-type: none"> Provision of sanitary facilities (toilets, burying, etc.) with proper waste disposal will be provided by contractors. 	Contractors	PMU and PMIC	Included in civil work contract
	Hazardous materials such as fuels, oil, cement and chemicals	<ul style="list-style-type: none"> To prevent pollution of soil and surface water/groundwater: <ul style="list-style-type: none"> Storage facilities for fuels, oil, cement, and chemicals will be within secured areas on impermeable surfaces, provided with bunds and clean up installations; Vehicle, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep into the soil; Oil traps will be provided for service areas and 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		<ul style="list-style-type: none"> parking areas; Fuel storage and refilling areas will be located at least 50m from canals and channels and will be protected by temporary drainage bunds to contain spills. 			
2.2 Air	Air quality	<ul style="list-style-type: none"> Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. All vehicle emission will be in compliance with relevant Cambodian emission standards. 	Contractor	PMU/PMIC	Included in civil work contract
	Dust	<ul style="list-style-type: none"> Material stocking and concrete mixing equipment will be equipped with dust shrouds. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered. For both construction sites and construction roads, water spraying for suppression of dust and maintenance of driving surface will be standard site management practices. 	Contractors	PMU and PMIC	Included in civil work contract
2.3 Solid wastes	Demolition or construction waste	<ul style="list-style-type: none"> Any waste from the demolition of un-repairable sluice and gate structures will be either sold to building materials recyclers or collected and transported to official landfill sites. Metal parts, including pump and pipe will be broken up and sold to scrap metal merchants. Any excess spoil will be made available to nearby communities for use as building pads and bunds. 	Contractors	PMU and PMIC	Included in civil work contract
	Domestic waste from worker camps	<ul style="list-style-type: none"> Contractors will provide disposal facilities and sufficient garbage bins at strategic locations and ensure that they are: <ul style="list-style-type: none"> Protected from birds and vermin; Emptied regularly (using the nearest township solid waste system and landfill); and Do not overflow. 	Contractors	PMU and PMIC	1,000
2.4 Soil erosion and ecology		<ul style="list-style-type: none"> Erosion control will include (i) limiting construction and material handling during periods of rains and high winds; and (ii) stabilizing all cut slopes, 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		embankments, and other erosion-prone working areas while works are going on. <ul style="list-style-type: none"> All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites. 			
2.5 Social and Cultural	No impacts to local cultural sites				
2.6 Environment, Health, and Safety	Occupational Health and Safety	<ul style="list-style-type: none"> Measures to ensure occupational health and safety will include: Contractor shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment. Contractors shall ensure that: <ul style="list-style-type: none"> All reasonable steps are taken to protect any person on the site from health and safety risks; Provide adequate personnel protection equipment The construction site is a safe and healthy workplace; Machineries and equipment are safe; Adequate training or instruction for occupational health and safety is provided; and Adequate supervision of safe work systems is implemented. 	Contractors	PMU and PMIC	3,000 (Included the costs of worker training, Personnel Protection Equipment and garbage bins)
	Community health and safety. The construction activities will be done through two communes namely, Chroab commune, Santuk district, Kompong Thom province.	<ul style="list-style-type: none"> Community health and safety will be safeguarded by: <ul style="list-style-type: none"> Planning construction activities so as to minimize disturbances to residents, utilities and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be re-instated to its original condition after construction. Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		access to construction sites.			
2.7 Unexpected environmental impacts		<ul style="list-style-type: none"> If unexpected environmental impacts occur during project construction phase, the PMU will update the EMP, and environmental protection measures will be designed and discussed. 	PMIC	PMU	Included in civil work contract
Operation					
3.1 Inadequate O&M	<p>- Poor and inadequate operation and maintenance (O&M) of the improved irrigation systems could cause unintended adverse environmental impacts. Establishment and operation of FWUG is part of the project design and support. The PDWRAM has been providing a technical support to set up FWUCs and Farmers Water User Groups (FWUGs). A FWUG is charged with undertaking or ensuring the key activities - operation and maintenance. The proposed UIWRSP provides support to PDWRAM and FWUGs through a technical assistance to strengthen overall water management capacity of FWUGs.</p>	<ul style="list-style-type: none"> Acceptable and appropriate O&M should be developed for sustainable operation and maintenance. Sufficient training to FWUGs/FWUC must be also provided thus they will be able to manage, operate and maintain the irrigation in sustainability. 	PDWRAM, FWUGs	PMU	Included in O&M Training costs
3.2 Conflict of water utilization	This will occur between water users of downstream and upstream in case of un-appropriate management and equitable share with understanding.	<ul style="list-style-type: none"> It should be avoidable with support of FWUG and proper O&M manual. Educational program for water saving uses should be also provided. Hence concepts of water equitable share and effective management should be applied. 	PMIC	PMU	Included in FWUG and O&M training

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
3.3 Training in IPM and sustainable farming	The chemical uses for agriculture are popular to all farmers in the area to improve agricultural product. A tendency of agricultural activities will increase when these irrigation systems has improved. Hence, pollution of chemical fertilizers will be expected to be increased respectively.	<ul style="list-style-type: none"> The project will support the national Integrated Pest Management Program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites. 	PMIC	PMU	Included in Agriculture Training Costs

PMU = Project Management Unit (of PMO), PMO = Project Management Office; EMO = Environmental Management Officer (of PMU); PDWRAM = Provincial Department of Water Resources and Implementation Consultant; FWUG/FWUC = Farmers Water User Group(s)/Community; PSC = Project Steering Committee; EHS = Environment, Health and Safety, O&M = Operation & Maintenance, PPE = Personnel Protection Equipment, IPM = Integrated Pest Management.

Source: PMIC, August 2016

2. Mitigation Measures

16. The mitigation measures will be incorporated into the tender documents, construction contracts, and operational management procedures. Contractors and PMU and PDWRAMs will implement these measures, depending upon sub-project phases. The effectiveness of these measures will be carefully watched via the environmental monitoring to determine whether to continue them or to make improvements.

3. Environmental Management Costs

17. The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (**Table 1**) are included in the design costs, construction contracts and operational budgets. Final budget allocations for the other items in the EMP will be developed by the PMU. The total environmental management cost is **\$10,000**.

D. Environmental Monitoring

18. Environmental Monitoring Reports (using ADB's integrated safeguards monitoring report format) will be prepared semi-annually for the EA by the PMIC in collaboration with PMU-Safeguard Officer and sent to ADB. EMP table with the column indicating how implemented will be attached in the report as Annex. **Table 2** gives the reporting requirements.

Table 1: Reporting Requirements

Report	Frequency	Purpose	From	To
Contractor's progress report	Monthly and quarterly	EMP Implementation Progress and Monitoring Results	Contractor	PMU
EMP Progress and Compliance Report	Monthly	Confirm Mitigation Measures	PMIC and PIU	PMU
Environmental Monitoring Report	Quarterly	Confirm EMP performance	PMIC and PMU-Safeguard officer	EA
Environmental monitoring Report (Integrated safeguards monitoring report format)	Semi-annual	Full EMP Implementation and adherence to environmental Covenants/Conditions	PMU	ADB

E. Training Program

19. The training proposed in this EMP is in addition to the capacity building component within the Uplands Irrigation and Water Resources Management Sector Project design, which will target the strengthening of, and skills transfer to PDWRAMs and FWUCs. The training listed in the EMP (Table 1) is targeted at the PMU initially and later the construction contractors to enable them to implement environmental protection measures in construction; and to PDWRAMs to enable them to implement environmental protection measures in scheme operation.

20. The EMP training will be incorporated into the EMP budget.

F. Grievance Redress Mechanism

21. A grievance redress mechanism (GRM) will be established in each subproject province in compliance with ADB's SPS 2009 requirement to prevent and address community concerns and assist the project to maximize environmental and social benefits.

22. The GRM will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available. Opportunities for confidentiality and privacy for complainants will be honored where this is seen as important.

G. Proposed Mechanism

23. The PMU will establish a Project Public Complaint Unit (PPCU) which will act as a central recording and coordinating unit for all subprojects under the Project. Each subproject PMU will ensure that the GRM is publicized locally so that the community is fully aware of the mechanism and the local points of entry to it. The setting up of the GRM in the PMU and its initial implementation through the PMUs will be supported by the environmental consultant of the PMIC.

24. When construction starts, a sign will be erected at each construction site providing the public with updated project information and summarizing the grievance redress mechanism process including details of the GRM entry points. The contact persons for different GRM entry points; PMU, FWUC leaders, contractors, and operators of project facilities, will be identified prior to construction. The contact details for the entry points (e.g. phone numbers, addresses, e-mail addresses, etc.) will be publicly disseminated on information boards at construction sites and on the website of the local government.

25. The preferred action sequence for complaints handling is that the complaint should be investigated and resolved by the unit receiving the complaint. If this is not possible, the complaint should be referred to the PMU (whose wider membership will enable coordinated action in response).

26. The PPCU will maintain records of complaints and actions taken to correct them. This data will be included in the PMU's reports to the ADB. The PPCU will establish a GRM tracking and documentation system. The system will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

H. GRM Procedure and Timeframe

27. The procedure and timeframe for the grievance redress mechanism are described as follows (see **Figure 1**). The stages are represented by different colors in the flow diagram:

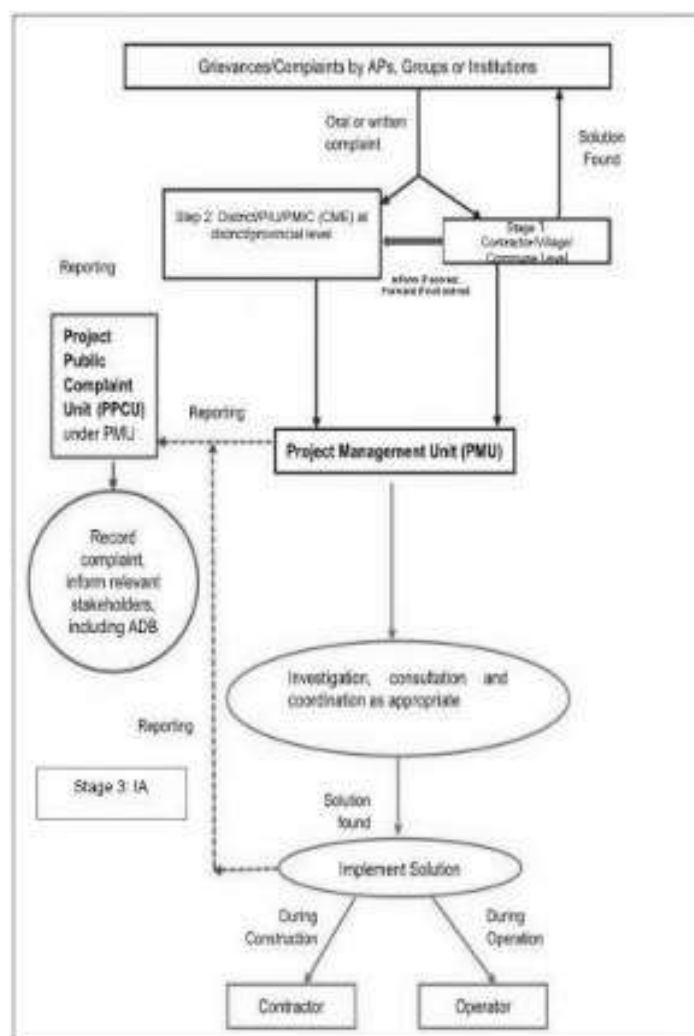
- **Stage 1: Contractor or villager chief at Village Level (5 working days).** Affected People (APs) will present their complaints and grievances verbally or in writing to the contractor/villager chief, or commune chief. The receiving agent will be obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the

aggrieved AP does not hear from taken in the first step, the complaint may be brought to the District Office/PIU/PMIC (CME) at district/provincial level.

- **Stage 2: District/PIU/PMIC (CME) at district/provincial level (5 working days).** This level has 5 working days within which to resolve the complaint to the satisfaction of all concerned. If the complaint not be solved at this stage, the District office/PMU/PMIC (CME) at provincial level will bring the caset to the PMU/PMIC at national level.
- **Stage 3: PPCU/PMU/PMIC at national Level (10 working days).** This level has 10 working days within which meets with the aggrieved party and tries to resolve the situation. Within 10 working days of submission of the grievance, the PPCU must make a written decision and submit copies to the MOWRAM/PDOWRAM and the APs. If the complaint still not be solved at this stage, the complaint may be brought to ADB.

28. During construction, the PPCU will be informed by contractors and construction supervisors, FWUC staff, or PMUs if people complain about the project. During operation, the PPCU will be advised of complaints by the PDWRAM and FWUC. The PPCU will also inform the ADB project team and submit all relevant documents.

Figure 1: Concept of Proposed GR



Note: AP = Affected Person, PMU = Project Management Unit, FWUC = Farmer Water User Community

Consultation / Interview Form

Date of Interview		Interviewer Name	
Interview Site: <i>Where is the interview held? In school, on the road, in shop</i>		Stakeholder Name & Status: <i>Full name, status is business owner, school teacher, religious leader, resident</i>	
Construction Site & Date Construction Started <i>Which road, GPS location if available</i>		Has this stakeholder been interviewed before? <i>Yes (when were they interviewed) No</i>	

Interview Discussion Points:

1. NOISE	Record of Discussion
Before the project started, was the person disturbed by noise? If yes, explain how and when. <i>Where did the noise come from? E.g. traffic, machinery, people, music</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
During the construction, is the person disturbed by noise from the project? If yes, explain how and when. <i>What type of noise and where did the noise come from? All day, at night, intermittently?</i>	
If noise from construction is a problem, what changes does the person suggest are made?	
2. AIR QUALITY	Record of Discussion
Before the project started, was the person affected by air pollution or dust? If yes, explain how and when. <i>Where did the pollution or dust come from? E.g. traffic, machinery, construction, burning garbage, cooking stoves</i> <i>When was the dust or pollution a problem? E.g. all day, at night, intermittently</i>	
During the project, is the person disturbed by dust or pollution? If yes, explain how and when. <i>What type of noise and where did the noise come from? E.g. increased traffic</i>	

<p>congestion, construction machinery, construction workers, burning construction garbage etc.</p> <p>When did it disturb the person? E.g. all day, at night, intermittently</p>	
<p>If dust or air pollution from the construction is a problem, what changes does the person suggest are made?</p>	
<p>3. VEGETATION AND LAND USE</p>	<p>Record of Discussion</p>
<p>Before the project started, what was the vegetation like in the project area?</p> <p><i>E.g. pasture land, trees, shrubs, rice fields.</i></p>	
<p>During the project, has the person found the vegetation situation has changed? If yes, explain how and when.</p>	
<p>If impact on vegetation is unacceptable, what changes does the person suggest are made?</p>	
<p>4 COMMUNITY SAFETY</p>	<p>Record of Discussion</p>
<p>Before the project started, can you describe the community safety situation in the project area?</p> <p><i>E.g. no problems, some accidents, difficulty crossing the roads</i></p>	
<p>During the project, has the person found the community safety situation has changed? If yes, explain how and when.</p> <p><i>Slower traffic so easier to cross the roads, construction vehicles are making a crossing harder / easier, more accidents / less accidents, construction site dangers</i></p>	
<p>If change in road safety is unacceptable, what changes does the person suggest are made?</p>	
<p>5. WATER QUALITY</p>	<p>Record of Discussion</p>
<p>Before the project started, was the person affected by poor water quality? If yes, explain how and when.</p> <p><i>Ground water? Surface Water? Which Water source? How was it polluted?</i></p>	
<p>During the project, is the person affected by water pollution? If yes, explain how and when.</p> <p><i>Ground water? Surface Water? Which Water source? How is quality being affected?</i></p>	
<p>If water quality from the construction is a problem, what changes does the person suggest are made?</p>	

6. ACCESS	Record of Discussion
<p>During the project, is the person affected by reduced access to their business, home or land?</p> <p>Access to what is limited, and how?</p>	
<p>If access limitations are not acceptable, please suggest changes which can be made?</p>	
7. OTHER ISSUES	Record of Discussion
<p>Any other issues about the construction sites that the person wants to discuss?</p> <p><i>E.g. wastewater concerns, waste disposal, Other concerns, labor force,</i></p>	

GRM – Complaint Recording Form

PIU Staff Responsible: (name and role)	
Date: (of this record)	
Date of Complaint:	
Date Resolution Required by (15 days from initial complaint):	
Complaint Made by: (Name & Contact Details)	
Method of Complaint: (direct to PMU, via Contractor, Via Commune People's Council)	
Details of Complaint: (issues, actions taken so far, when did it start – all details needed)	
PMU Actions: (Next steps for PMU to resolve the issue or to move complaint to next level)	
Follow Up Actions Needed and Date: (PMU to follow up on resolution if needed, e.g. check contractor actions)	

**Appendix 1D: EMP for Prek Chik Distribution Package I
(MOWRAM/ICB – CW07)**

KINGDOM OF CAMBODIA

Nation Religion King



MINISTRY OF WATER RESOURCE AND METHODOLOGY



ASIAN DEVELOPMENT BANK

ADB Loan No 3289-CAM

**CAMBODIA:
UPLANDS IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR
PROJECT, CAMBODIA**

**For (MOWRAM/NCB–CW07) – Upgrading,
Modernizing and Extending the Secondary and
Tertiary Canals of Prek Chik (PC) Irrigation System
in Battambang Province – Package I**

ENVIRONMENTAL MANAGEMENT PLAN

Phnom Penh, December 2018
(Update)

ABBREVIATION

ADB	Asian Development Bank
EA	Executing Agency
EARF	Environmental Assessment and Review Framework
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FDERP	Flood Damage Emergency Reconstruction Project
GoC	Government of Cambodia
GPS	Global Positioning System
IA	Implementing Agency
IEE	Initial Environmental Examination
MEF	Ministry of Economy and Finance
MoE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
NR	National Road
PDOE	Provincial Department of Environment
PDWRAM	Provincial Department of Water Resources and Meteorology
PMU	Project Management Unit
PIU	Project Implementation Unit
PPTA	Project Preparation TA
REA	Rapid Environmental Assessment
RP	Resettlement Plan
SPS	ADB's Safeguard Policy Statement (2009)

A. Introduction

1. The Environmental Management Plan (EMP) covers all phases of non-core sub-project implementation from preparation through commissioning and operation, and it aims to ensure the monitoring of environmental impacts and activation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each sub-project. Environmental protection measures will (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB Safeguard Policy Statement 2009.
2. Environmental Monitoring Programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures.

B. Responsibilities for Implementation

3. The Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency (the EA) and Department of Farmer Water User Community (DFWUC) is the implementing agency (the IA). A Project Steering Committee, headed by Minister MOWRAM, will oversee the Project Implementation and Management. A Project Management Unit (PMU) was established and the PMU was fully involved in the Project preparation. The PMU is headed by a Project Director who is the Deputy Director General for Technical Affairs and a Project Manager who is the Director of the Department of FWUC. The PMU is composed of 24 designated personnel from MOWRAM, MAFF and PDWRAM. This will also include staff from the PDWRAM of the province within which the sub-project is located. For the Prek Chik Distribution System-1 the PMU will be responsible for the supervision and monitoring of project-related environmental activities during the pre-construction, construction and operation phases as part of their functions. In line with this an Environmental Management Officer (EMO) in the PMU will be assigned to be responsible for supervision of environmental management and for environmental monitoring. The major responsibilities of the environmental officer will be to ensure that:

- Mitigation measures and monitoring of these activities are carried out in accordance with the EMP;
- Environmental Monitoring program, comprising of taking samples and analysis are being carried out;
- Reporting is performed in compliance with ADB requirements.

4. However, the main environmental guidance for the implementation phase will be provided by the Environment Specialist in the Project Management and Implementation Consultants (PMIC) team. The role of the PMIC will be to work as part of the PMU, helping them fulfill their supervision and monitoring responsibilities. The PMIC will also provide monitoring reports for the ADB. The PMIC was contracted by the PMU for the duration of the loan implementation period.

5. Contractors will be engaged by the PMU for construction. The construction impact mitigation measures contained in this EMP will be included as necessary activities in the contract documents. The incorporation of EMP provision into the contract documents will be undertaken by the PMU. The contractors will have the responsibility for implementation of the impact mitigation measures in the construction phase and their performance will be supervised by the PMU.

6. Environmental monitoring during operation of the Project in the longer term is the responsibility of the respective PDWRAM.

C. Summary of Potential Impacts and Mitigation Measures

7. **Table 1** summarizes the potential impacts of the sub-project during construction and operation as identified by the Initial Environmental Examination (IEE) as well as corresponding mitigation measures designed to minimize those impacts.

1. Summary of Key Issues

8. **UXO survey and removal.** During consultation with local people and authority on July 2016, project works will take place in areas that are already will trafficked. Thus, it is not likely to have a significant UXO risk. During the public consultation in 2016, no one raised about the UXO risk at the propose site as it was existing irrigation since Pol Pot Regime. However, a borrow pit site is unknown yet that it could be harmful on UXO.

9. **Air quality.** The temporary impacts on air quality in the construction stage of the Package 3 are anticipated because of fugitive dust generation associated with all construction works, earth works and waste movements.

10. **Noise Disturbance.** Noise impacts will be temporary and localized at all construction sites as construction machinery and vehicles generate noise as they operate. Other noise sources include loading and unloading of equipment and materials.

11. **Surface Water.** Surface Water will be polluted from human waste, oil contamination, and other hazardous material during construction phase. Short-term construction impacts may be seen in terms of increased turbidity, when access roads improvement or other construction is taking place adjacent to the canals.

12. **Soil and Land.** Soil erosion is not anticipated given the nature of the Package 3 and their locations however borrow sites will cause local impacts to the land. The Package 3 is fertile agricultural locations and fertile top soil is a valuable resource which requires protection measures, particularly for the all construction areas which are located in and around rice fields where encroachment from inappropriate spoil disposal could have detrimental impacts. Channels with earth banks will be stabilized through planting.

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16. The mitigation measures will be incorporated into the tender documents, construction contracts, and operational management procedures. Contractors and PMU and PDWRAMs will implement these measures, depending upon sub-project phases. The effectiveness of these measures will be carefully watched via the environmental monitoring to determine whether to continue them or to make improvements.

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	Irrigation extraction planning	<ul style="list-style-type: none"> Operational plans and operating practices for water allocations and drainage will be documented and approved by the PMU and ADB before completion of construction works and handing over of canals to FWUCs. 	PMU, FWUCs and PMIC	PMO, ADB	Design Costs
1.2 Construction Preparation Stage	Environmental management budget	<ul style="list-style-type: none"> Confirm budgets for the implementation of environmental management measures and environmental supervisory responsibilities. 	PMU	PSC	Design Costs
	Incorporate environmental management into contract documents	<ul style="list-style-type: none"> Contract documents: Preparation of the environment section in the Terms of Reference for bidders for construction contracts, and environmental contract clauses for contractors, namely the special conditions for the protection of the water, soil and air environments (referencing the EMP and monitoring plan). 	PMIC	PMU	Design Costs
1.3 Construction support preparation	Environmental Education awareness	<ul style="list-style-type: none"> Environmental Protection Training: Environmental specialists (including PMIC) and/or officials from local MoE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to PMU, PDWRAMs and contractors. The training could be arranged into two groups; once for PMU and PDWRAMs and another one for contractors. 	PMIC and MoE officers as required	PMU	Part of EMP training cost 4,000
	Complaints procedures established	<ul style="list-style-type: none"> The Project Grievance Redress Mechanism will be established and local contact persons for the sub-project publish. 	PMU and PMIC	PSC	Part of Design Costs
	Site planning	<ul style="list-style-type: none"> Prepare a Site Environmental Management and Supervision guideline, including an emergency preparedness and response guideline for 	Contractors	PMUC and PMIC	Part of Construction Costs

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		construction emergencies and site environmental health and safety guideline.			4,000
1.4 UXO and Borrow pit	Project works will take place in areas that are already will trafficked. Thus, it is not likely to have a significant UXO risk. During the public consultation in 2016, no one raised about the UXO risk at the propose site as it was existing irrigation since Pol Pot Regime. However, a borrow pit site is unknown yet that it could be harmful on UXO.	<ul style="list-style-type: none"> To avoid any risks, on all sites where excavation or ground clearance needs to take place, where there is a reasonable doubt as to the safety of the area an approved mine clearance agency should be engaged for an agreed package of verification, detection and clearance work, to ensure that all areas where excavation, or access construction will take place are clear of UXO. 	Contractors	PMU and PMIC	Included in civil work contract
2. Construction Phase (12 months)					
2.1 Water deterioration	Human wastes from construction. An adverse environmental impact could occur during the construction phase from workers feces and domestic wastes. This will generate flies and transmitted diseases which will possibly result to sanitation issue in the areas.	<ul style="list-style-type: none"> Provision of sanitary facilities (toilets, burying, etc.) with proper waste disposal will be provided by contractors. 	Contractors	PMU and PMIC	Included in civil work contract
	Hazardous materials such as fuels, oil, cement and chemicals	<ul style="list-style-type: none"> To prevent pollution of soil and surface water/groundwater: <ul style="list-style-type: none"> Storage facilities for fuels, oil, cement, and chemicals will be within secured areas on impermeable surfaces, provided with bunds and clean up installations; Vehicle, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		<ul style="list-style-type: none"> into the soil; Oil traps will be provided for service areas and parking areas; Fuel storage and refilling areas will be located at least 50m from canals and channels and will be protected by temporary drainage bunds to contain spills. 			
2.2 Air	Air quality	<ul style="list-style-type: none"> Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. All vehicle emission will be in compliance with relevant Cambodian emission standards. 	Contractor	PMU and PMIC	Included in civil work contract
	Dust	<ul style="list-style-type: none"> Material stocking and concrete mixing equipment will be equipped with dust shrouds. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered. For both construction sites and construction roads, water spraying for suppression of dust and maintenance of driving surface will be standard site management practices 	Contractors	PMU and PMIC	Included in civil work contract
2.3 Noise and Vibration	Noise impacts on sensitive receivers	<ul style="list-style-type: none"> Any waste from the demolition of un-repairable sluice and gate structures will be either sold to building materials recyclers or collected and transported to official landfill sites. Metal parts, including pump and pipe will be broken up and sold to scrap metal merchants. Any excess spoil will be made available to nearby communities for use as building pads and bunds. 	Contractors	PMU and PMIC	Included in civil work contract
2.4 Solid wastes	Demolition or construction waste	<ul style="list-style-type: none"> Contractors will provide disposal facilities and sufficient garbage bins at strategic locations and ensure that they are: <ul style="list-style-type: none"> Protected from birds and vermin; Emptied regularly (using the nearest township solid waste system and landfill); and Do not overflow. 	Contractors	PMU and PMIC	4,000

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
	Domestic waste from worker camps	<ul style="list-style-type: none"> Erosion control will include (i) limiting construction and material handling during periods of rains and high winds; and (ii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites. 	Contractors	PMU and PMIC	Included in civil work contract
2.5 Soil erosion and ecology		<ul style="list-style-type: none"> Contractors will ensure that all local cultural sites (including shrines and graves) will be kept clear of construction material and protected from dust and other disturbance. Access to these sites will not be impeded. After construction is finished any disturbed surroundings will be clean up. 	Contractors	PMU and PMIC	Included in civil work contract
2.6 Social and Cultural	Impacts to local cultural sites	<ul style="list-style-type: none"> Community health and safety will be safeguarded by: <ul style="list-style-type: none"> Planning construction activities so as to minimize disturbances to residents, utilities and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be re-instated to its original condition after construction. Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public access to construction sites. 	Contractors	PMU and PMIC	Included in civil work contract
2.7 Environment, Health, and Safety	Community health and safety. The construction activities will be done through three communes namely,	<ul style="list-style-type: none"> Measures to ensure occupational health and safety will include: Contractor shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment. 	Contractors	PMU and PMIC	12,000 (Included the costs of worker training, Personnel Protection)

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		<ul style="list-style-type: none"> Contractors shall ensure that: <ul style="list-style-type: none"> All reasonable steps are taken to protect any person on the site from health and safety risks; Provide adequate personnel protection equipment The construction site is a safe and healthy workplace; Machineries and equipment are safe; Adequate training or instruction for occupational health and safety is provided; and Adequate supervision of safe work systems is implemented. 			Equipment and garbage bin)
	Occupational Health and Safety	<ul style="list-style-type: none"> Measures to ensure occupational health and safety will include: <ul style="list-style-type: none"> Contractor shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment. Contractors shall ensure that: <ul style="list-style-type: none"> All reasonable steps are taken to protect any person on the site from health and safety risks; Provide adequate personnel protection equipment The construction site is a safe and healthy workplace; Machineries and equipment are safe; Adequate training or instruction for occupational health and safety is provided; and Adequate supervision of safe work systems is implemented. 	Contractors	PMU and PMIC	
2.8 Unexpected environmental		<ul style="list-style-type: none"> Acceptable and appropriate O&M should be developed for sustainable operation and 	PDWRAM, FWUGs	PMU	Included in O&M Training costs

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
impacts		<p>maintenance.</p> <ul style="list-style-type: none"> Sufficient training to FWUGs/FWUC must be also provided thus they will be able to manage, operate and maintain the irrigation in sustainability 			
3. Operation					
3.1 Inadequate O&M	<p>Poor and inadequate operation and maintenance (O&M) of the improved irrigation systems could cause unintended adverse environmental impacts. Establishment and operation of FWUG is part of the project design and support. The PDWRAM has been providing a technical support to set up FWUCs and Farmers Water User Groups (FWUGs). A FWUG is charged with undertaking or ensuring the key activities - operation and maintenance. The proposed UIWRSP provides support to PDWRAM and FWUGs through a technical assistance to strengthen overall water management capacity of FWUGs.</p>	<ul style="list-style-type: none"> It should be avoidable with support of FWUG and proper O&M manual. Educational program for water saving uses should be also provided. Hence concepts of water equitable share and effective management should be applied. 	PMIC	PMU	Included in FWUG and O&M training
3.2 Conflict of water utilization	<p>This will occur between water users of downstream and upstream in case of un-appropriate management and equitable share with understanding.</p>	<ul style="list-style-type: none"> The project will support the national Integrated Pest Management Program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites. 	PMIC	PMU	Included in Agriculture Training Costs

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
3.3 Training in IPM and sustainable farming	The chemical uses for agriculture are popular to all farmers in the area to improve agricultural product. A tendency of agricultural activities will increase when these irrigation systems has improved. Hence, pollution of chemical fertilizers will be expected to be increased respectively.	<ul style="list-style-type: none"> The project will support the national Integrated Pest Management Program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites. 	PMIC	PMU	Included in Agriculture Training Costs

PMU = Project Management Unit (of PMO), PMO = Project Management Office; EMO = Environmental Management Officer (of PMU); PDWRAM = Provincial Department of Water Resources and Implementation Consultant; FWUC = Farmers Water User Commune; PSC = Project Steering Committee.

3. Environmental Management Costs

17. The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (Table 1) are included in the design costs, construction contracts and operational budgets. Final budget allocations for the other the items in the EMP will be developed by the PMU. The total environmental management cost is **\$30,000**.

D. Environmental Monitoring

18. Environmental Monitoring Reports (using ADB's integrated safeguards monitoring report format) will be prepared semi-annually for the EA by the PMIC in collaboration with PMU-Safeguard Officer and sent to ADB. EMP table with the column indicating how implemented will be attached in the report as Annex. **Table 2** gives reporting requirements.

Table 2: Reporting Requirements

Report	Frequency	Purpose	From	To
Contractor's progress report	Monthly and quarterly	EMP Implementation Progress and Monitoring Results	Contractor	PMU
EMP Progress and Compliance Report	Monthly	Confirm Mitigation Measures	PMIC and PIU	PMU
Environmental Monitoring Report	Quarterly	Confirm performance EMP	PMIC and PMU-Safeguard officer	EA
Environmental monitoring Report (Integrated safeguards monitoring report format)	Semi-annual	Full EMP Implementation and adherence to environmental Covenants/Conditions	PMU	ADB

E. Training Program

19. The training proposed in this EMP is in addition to the capacity building component within the Uplands Irrigation and Water Resources Management Sector Project design, which will target the strengthening of, and skills transfer to PDWRAMs and FWUGs. The training listed in the EMP (Table 1) is targeted at the PMU initially and later the construction contractors to enable them to implement environmental protection measures in construction; and to PDWRAMs to enable them to implement environmental protection measures in scheme operation.

20. The EMP training will be incorporated into the EMP.

F. Grievance Redress Mechanism

21. A grievance redress mechanism (GRM) will be established in each subproject province in compliance with ADB's SPS 2009 requirement to prevent and address community concerns and assist the project to maximize environmental and social benefits.

22. The GRM will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available. Opportunities for confidentiality and privacy for complainants will be honored where this is seen as important.

1. Proposed Mechanism

23. The PMU will establish a Project Public Complaint Unit (PPCU) which will act as a central recording and coordinating unit for all subprojects under the Project. Each subproject PMU will ensure that the GRM is publicized locally so that the community is fully aware of the mechanism and the local points of entry to it. The setting up of the GRM in the PMU and its initial implementation through the PMUs will be supported by the environmental consultant of the PMIC.

24. When construction starts, a sign will be erected at each construction site providing the public with updated project information and summarizing the grievance redress mechanism process including details of the GRM entry points. The contact persons for different GRM entry points; PMU, FWUC leaders, contractors, and operators of project facilities, will be identified prior to construction. The contact details for the entry points (e.g. phone numbers, addresses, e-mail addresses, etc.) will be publicly disseminated on information boards at construction sites and on the website of the local government.

25. The preferred action sequence for complaints handling is that the complaint should be investigated and resolved by the unit receiving the complaint. If this is not possible, the complaint should be referred to the PMU (whose wider membership will enable coordinated action in response).

26. The PPCU will maintain records of complaints and actions taken to correct them. This data will be included in the PMU's reports to the ADB. The PPCU will establish a GRM tracking and documentation system. The system will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

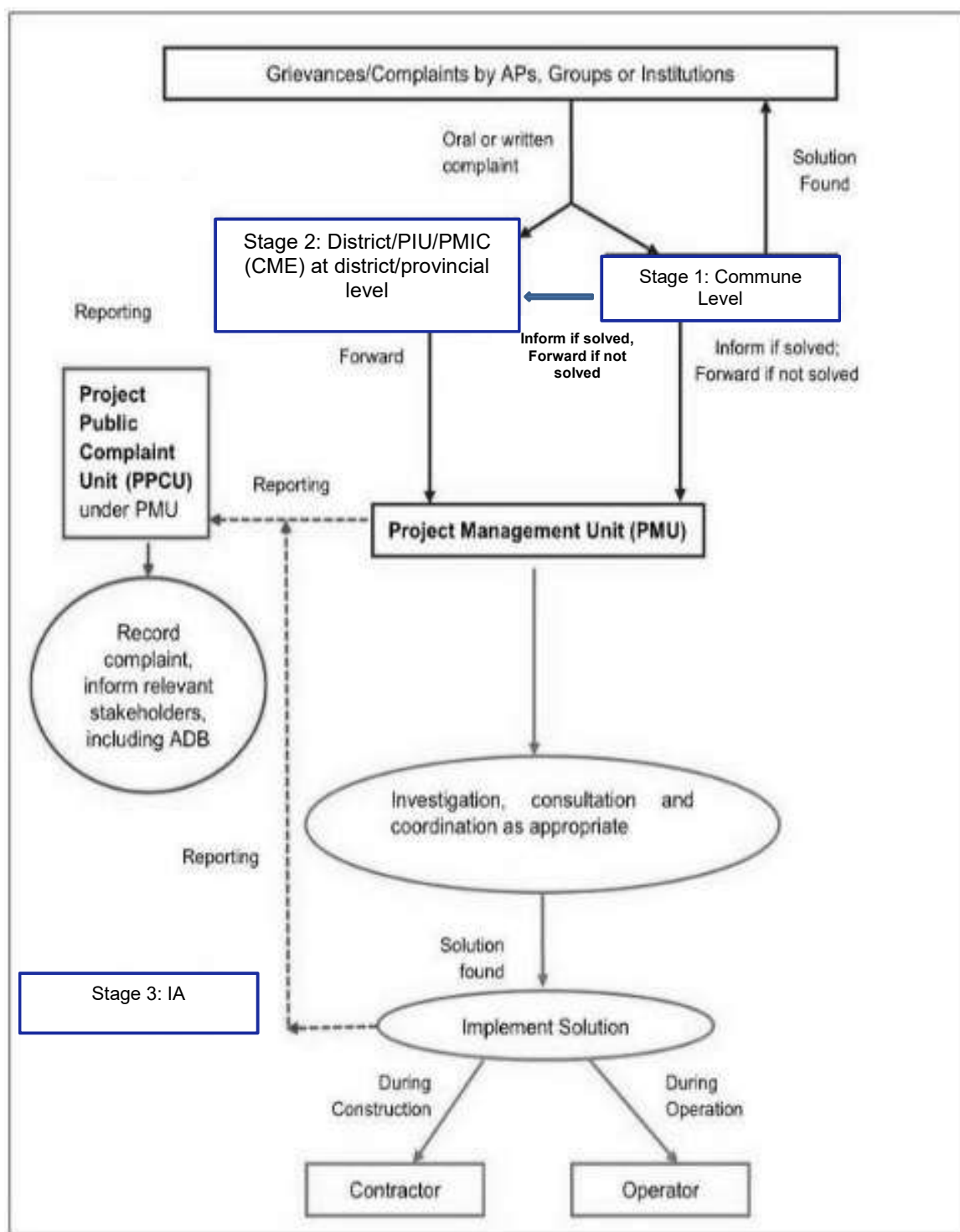
2. GRM Procedure and Timeframe

27. The procedure and timeframe for the grievance redress mechanism are described as follows (see **Figure 1**). The stages are represented by different colors in the flow diagram:

- **Stage 1: Contractor or villager chief at Village Level (5 working days).** Affected People (APs) will present their complaints and grievances verbally or in writing to the contractor/village chief, or commune chief. The receiving agent will be obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the aggrieved AP does not hear from taken in the first step, the complaint may be brought to the District Office/PIU/PMIC (CME) at district/provincial level.
- **Stage 2: District/PIU/PMIC (CME) at district/provincial level (5 working days).** This level has 5 working days within which to resolve the complaint to the satisfaction of all concerned. If the complaint not be solved at this stage, the District office/PMU/PMIC (CME) at provincial level will bring the caset to the PMU/PMIC at national level.
- **Stage 3: PPCU/PMU/PMIC at national Level (10 working days).** This level has 10 working days within which meets with the aggrieved party and tries to resolve the situation. Within 10 working days of submission of the grievance, the PPCU must make a written decision and submit copies to the MOWRAM/PDOWRAM and the APs. If the complaint still not be solved at this stage, the complaint may be brought to ADB.

28. During construction, the PPCU will be informed by contractors and construction supervisors, FWUC staff, or PMUs if people complain about the project. During operation, the PPCU will be advised of complaints by the PDWRAM and FWUC. The PPCU will also inform the ADB project team and submit all relevant documents.

Figure 1: Concept of Proposed GRM



Note: AP = Affected Person, PMU = Project Management Unit, FWUC = Farmer Water User Community

Annex 1

Consultation / Interview Form

Date of Interview		Interviewer Name	
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Interview Site: <i>Where is the interview held? In school, on the road, in shop</i>		Stakeholder Name & Status: <i>Full name, status is business owner, school teacher, religious leader, resident</i>	
Construction Site & Date Construction Started <i>Which road, GPS location if available</i>		Has this stakeholder been interviewed before? <i>Yes (when were they interviewed) No</i>	

Interview Discussion Points:

1. NOISE	Record of Discussion
Before the project started, was the person disturbed by noise? If yes, explain how and when. <i>Where did the noise come from? E.g. traffic, machinery, people, music</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
During the construction, is the person disturbed by noise from the project? If yes, explain how and when. <i>What type of noise and where did the noise come from? All day, at night, intermittently?</i>	
If noise from construction is a problem, what changes does the person suggest are made?	
2. AIR QUALITY	Record of Discussion
Before the project started, was the person affected by air pollution or dust? If yes, explain how and when. <i>Where did the pollution or dust come from? E.g. traffic, machinery, construction, burning garbage, cooking stoves</i> <i>When was the dust or pollution a problem? E.g. all day, at night, intermittently</i>	
During the project, is the person disturbed by dust or pollution? If yes, explain how and when. <i>What type of noise and where did the noise come from? E.g. increased traffic congestion, construction machinery, construction workers, burning construction garbage etc</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
If dust or air pollution from the construction is a problem, what changes does the person suggest are made?	
3. VEGETATION AND LAND USE	Record of Discussion
Before the project started, what was the vegetation like in the project area? <i>E.g. pasture land, trees, shrubs, rice fields.</i>	
During the project, has the person found the vegetation situation has changed? If yes,	

explain how and when.	
If impact on vegetation is unacceptable, what changes does the person suggest are made?	
4 COMMUNITY SAFETY	Record of Discussion
<p>Before the project started, can you describe the community safety situation in the project area?</p> <p><i>E.g. no problems, some accidents, difficulty crossing the roads</i></p>	
<p>During the project, has the person found the community safety situation has changed? If yes, explain how and when.</p> <p><i>Slower traffic so easier to cross the roads, construction vehicles are making a crossing harder / easier, more accidents / less accidents, construction site dangers</i></p>	
If change in road safety is unacceptable, what changes does the person suggest are made?	
5. WATER QUALITY	Record of Discussion
<p>Before the project started, was the person affected by poor water quality? If yes, explain how and when.</p> <p><i>Ground water? Surface Water? Which Water source? How was it polluted?</i></p>	
<p>During the project, is the person affected by water pollution? If yes, explain how and when.</p> <p><i>Ground water? Surface Water? Which Water source? How is quality being affected?</i></p>	
If water quality from the construction is a problem, what changes does the person suggest are made?	
6. ACCESS	Record of Discussion
<p>During the project, is the person affected by reduced access to their business, home or land?</p> <p>Access to what is limited, and how?</p>	
If access limitations are not acceptable, please suggest changes which can be made?	
7. OTHER ISSUES	Record of Discussion
<p>Any other issues about the construction sites that the person wants to discuss?</p> <p><i>E.g. wastewater concerns, waste disposal, Other concerns, labor force,</i></p>	

GRM – Complaint Recording Form

PIU Staff Responsible: (name and role)	
Date: (of this record)	
Date of Complaint:	
Date Resolution Required by (15 days from initial complaint):	
Complaint Made by: (Name & Contact Details)	
Method of Complaint: (direct to PMU, via Contractor, Via Commune People's Council)	
Details of Complaint: (issues, actions taken so far, when did it start – all details needed)	
PMU Actions: (Next steps for PMU to resolve the issue or to move complaint to next level)	
Follow Up Actions Needed and Date: (PMU to follow up on resolution if needed, e.g. check contractor actions)	

**Appendix 1E: EMP for Prek Chik Distribution Package II
(MOWRAM/ICB – CW08)**

KINGDOM OF CAMBODIA

Nation Religion King



MINISTRY OF WATER RESOURCE AND METHODOLOGY



ASIAN DEVELOPMENT BANK

ADB Loan No 3289-CAM

**CAMBODIA:
UPLANDS IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR
PROJECT, CAMBODIA**

**For (MOWRAM–CW08) – Upgrading, Modernizing
and Extending the Secondary and Tertiary Canals of
Prek Chik (PC) Irrigation System in Battambang
Province – Package II**

ENVIRONMENTAL MANAGEMENT PLAN

Phnom Penh, December 2018
(Update)

Cambodia: Upland Irrigation and Water Resources Management Sector Project
For (MOWRAM – CW08) – Upgrading, Modernizing and Extending the Secondary and Tertiary Canals of Prek Chik Irrigation System (PC) in Battambang Province –

Package II

Environmental Management Plan – EMP

A. Introduction

1. The Environmental Management Plan (EMP) covers all phases of non-core sub-project implementation from preparation through commissioning and operation, and it aims to ensure the monitoring of environmental impacts and activation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each sub-project. Environmental protection measures will (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB Safeguard Policy Statement 2009.

2. Environmental Monitoring Programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures.

B. Responsibilities for Implementation

3. The Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency (the EA) and Department of Farmer Water User Community (DFWUC) is the implementing agency (the IA). A Project Steering Committee, headed by Minister MOWRAM, will oversee the Project Implementation and Management. A Project Management Unit (PMU) was established and the PMU was fully involved in the Project preparation. The PMU is headed by a Project Director who is the Deputy Director General for Technical Affairs and a Project Manager who is the Director of the Department of FWUC. The PMU is composed of 24 designated personnel from MOWRAM, MAFF and PDWRAM. This will also include staff from the PDWRAM of the province within which the sub-project is located. For the Prek Chik Distribution System-2 the PMU will be responsible for the supervision and monitoring of project-related environmental activities during the pre-construction, construction and operation phases as part of their functions. In line with this an Environmental Management Officer (EMO) in the PMU will be assigned to be responsible for supervision of environmental management and for environmental monitoring. The major responsibilities of the environmental officer will be to ensure that:

- Mitigation measures and monitoring of these activities are carried out in accordance with the EMP;
- Environmental Monitoring program, comprising of taking samples and analysis are being carried out;
- Reporting is performed in compliance with ADB requirements.

4. However, the main environmental guidance for the implementation phase will be provided by the Environment Specialist in the Project Management and Implementation Consultants (PMIC) team. The role of the PMIC will be to work as part of the PMU, helping them fulfill their supervision and monitoring responsibilities. The PMIC will also provide monitoring reports for the ADB. The PMIC was contracted by the PMU for the duration of the loan implementation period.

5. Contractors will be engaged by the PMU for construction. The construction impact

mitigation measures contained in this EMP will be included as necessary activities in the contract documents. The incorporation of EMP provision into the contract documents will be undertaken by the PMU. The contractors will have the responsibility for implementation of the impact mitigation measures in the construction phase and their performance will be supervised by the PMU.

6. Environmental monitoring during operation of the Project in the longer term is the responsibility of the respective PDWRAM.

C. Summary of Potential Impacts

7. **Table 1** summarizes the potential impacts of the sub-project during construction and operation as identified by the Initial Environmental Examination (IEE) as well as corresponding mitigation measures designed to minimize those impacts.

1. Summary of Key Environmental Issues

8. **UXO survey and removal.** During consultation with local people and authority on July 2016, project works will take place in areas that are already will trafficked. Thus, it is not likely to have a significant UXO risk. During the public consultation in 2016, no one raised about the UXO risk at the propose site as it was existing irrigation since Pol Pot Regime. However, a borrow pit site is unknown yet that it could be harmful on UXO.

9. **Air quality.** The temporary impacts on air quality in the construction stage of the Package 3 are anticipated because of fugitive dust generation associated with all construction works, earth works and waste movements.

10. **Noise Disturbance.** Noise impacts will be temporary and localized at all construction sites as construction machinery and vehicles generate noise as they operate. Other noise sources include loading and unloading of equipment and materials.

11. **Surface Water.** Surface Water will be polluted from human waste, oil contamination, and other hazardous material during construction phase. Short-term construction impacts may be seen in terms of increased turbidity, when access roads improvement or other construction is taking place adjacent to the canals.

12. **Soil and Land.** Soil erosion is not anticipated given the nature of the Package 3 and their locations however borrow sites will cause local impacts to the land. The Package 3 is fertile agricultural locations and fertile top soil is a valuable resource which requires protection measures, particularly for the all construction areas which are located in and around rice fields where encroachment from inappropriate spoil disposal could have detrimental impacts. Channels with earth banks will be stabilized through planting.

13. **Solid Waste Management.** Impacts on resource use and impacts associated with disposal will arise from waste generated during construction. This includes generation of wastes e.g. demolition waste (any waste from the demolition of unrepairable sluice and gate structures), dredge spoil, and waste from worker camps.

14. **Community and Occupational Health and Safety.** During construction, local cultural sites, and other areas in community could be disturbed. Within 30 working days, after construction is finished any disturbed areas will be restored to pre-construction conditions. Occupational risks come from a range of activities including the use of heavy machinery, earth moving, and use of chemicals, the EMP includes health and safety measures and monitoring requirements.

15. **Socio-economic impacts (Accessibility).** The rehabilitation of Package 3 will require the excavation of parts of the existing canal. The people are living along the canals and rice paddy field. The community in and around the area will be disrupted by the noise and dust, as described above, and also by localized turbidity and potential impaired access

2. Mitigation Measures

16. The mitigation measures will be incorporated into the tender documents, construction contracts, and operational management procedures. Contractors and PMU and PDWRAMs will implement these measures, depending upon sub-project phases. The effectiveness of these measures will be carefully watched via the environmental monitoring to determine whether to continue them or to make improvements.

Table 2: Summary of Potential Impacts and Mitigation Measures

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
1. Pre-construction					
Design stage	Final Site Designs	<ul style="list-style-type: none"> Final designs of canals, siting of control structures and canal alignments were completed after taking into account the provisions of the EMP. 	PMIC	PMU	Design cost
	Irrigation extraction planning	<ul style="list-style-type: none"> Operational plans and operating practices for water allocations and drainage will be documented and approved by the PMU and ADB before completion of construction works and handing over of canals to FWUCs. 	PMU, FWUCs and PMIC	PMO, ADB	Design Costs
1.2 Construction Preparation Stage	Environmental management budget	<ul style="list-style-type: none"> Confirm budgets for the implementation of environmental management measures and environmental supervisory responsibilities. 	PMU	PSC	Design Costs
	Incorporate environmental management into contract documents	<ul style="list-style-type: none"> Contract documents: Preparation of the environment section in the Terms of Reference for bidders for construction contracts, and environmental contract clauses for contractors, namely the special conditions for the protection of the water, soil and air environments (referencing the EMP and monitoring plan). 	PMIC	PMU	Design Costs
1.3 Construction support preparation	Environmental Education awareness	<ul style="list-style-type: none"> Environmental Protection Training: Environmental specialists (including PMIC) and/or officials from local MoE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to PMU, PDWRAMs and contractors. The training could be arranged into two groups; once for PMU and PDWRAMs and another one for contractors. 	PMIC and MoE officers as required	PMU	Part of EMP training cost
					4,000
	Complaints procedures established	<ul style="list-style-type: none"> The Project Grievance Redress Mechanism will be established and local contact persons for the sub-project publish. 	PMU and PMIC	PSC	Part of Design Costs
	Site planning	<ul style="list-style-type: none"> Prepare a Site Environmental Management and Supervision guideline, including an emergency preparedness and response guideline for construction 	Contractors	PMUC and PMIC	Part of Construction Costs

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		emergencies and site environmental health and safety guideline.			4,000
1.4 UXO and Borrow pit	Project works will take place in areas that are already will trafficked. Thus, it is not likely to have a significant UXO risk. During the public consultation in 2016, no one raised about the UXO risk at the propose site as it was existing irrigation since Pol Pot Regime. However, a borrow pit site is unknown yet that it could be harmful on UXO.	<ul style="list-style-type: none"> To avoid any risks, on all sites where excavation or ground clearance needs to take place, where there is a reasonable doubt as to the safety of the area an approved mine clearance agency should be engaged for an agreed package of verification, detection and clearance work, to ensure that all areas where excavation, or access construction will take place are clear of UXO. 	Contractors	PMU and PMIC	Included in civil work contract
2. Construction Phase (12 months)					
2.1 Water deterioration	Human wastes from construction. An adverse environmental impact could occur during the construction phase from workers feces and domestic wastes. This will generate flies and transmitted diseases which will possibly result to sanitation issue in the areas.	<ul style="list-style-type: none"> Provision of sanitary facilities (toilets, burying, etc.) with proper waste disposal will be provided by contractors. 	Contractors	PMU and PMIC	Included in civil work contract
	Hazardous materials such as fuels, oil, cement and chemicals	<ul style="list-style-type: none"> To prevent pollution of soil and surface water/groundwater: <ul style="list-style-type: none"> Storage facilities for fuels, oil, cement, and chemicals will be within secured areas on impermeable surfaces, provided with bunds and clean up installations; Vehicle, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep into the soil; Oil traps will be provided for service areas and 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		<p>parking areas;</p> <ul style="list-style-type: none"> Fuel storage and refilling areas will be located at least 50m from canals and channels and will be protected by temporary drainage bunds to contain spills. 			
2.2 Air	Air quality	<ul style="list-style-type: none"> Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. All vehicle emission will be in compliance with relevant Cambodian emission standards. 	Contractor	PMU and PMIC	Included in civil work contract
	Dust	<ul style="list-style-type: none"> Material stocking and concrete mixing equipment will be equipped with dust shrouds. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered. 	Contractors	PMU and PMIC	Included in civil work contract
		<ul style="list-style-type: none"> For both construction sites and construction roads, water spraying for suppression of dust and maintenance of driving surface will be standard site management practices. 	Contractors	PMU and PMIC	6,000
2.3 Noise and Vibration	Noise impacts on sensitive receivers	<ul style="list-style-type: none"> Construction at lunch and night within 280m of residences shall be strictly prohibited. 	Contractors	PMU and PMIC	-
2.4 Solid wastes	Demolition or construction waste	<ul style="list-style-type: none"> Any waste from the demolition of un-repairable sluice and gate structures will be either sold to building materials recyclers or collected and transported to official landfill sites. Metal parts, including pump and pipe will be broken up and sold to scrap metal merchants. Any excess spoil will be made available to nearby communities for use as building pads and bunds. 	Contractors	PMU and PMIC	Included in civil work contract
	Domestic waste from worker camps	<ul style="list-style-type: none"> Contractors will provide disposal facilities and sufficient garbage bins at strategic locations and ensure that they are: <ul style="list-style-type: none"> Protected from birds and vermin; Emptied regularly (using the nearest township solid waste system and landfill); and Do not overflow. 	Contractors	PMU and PMIC	4,000

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
2.5 Soil erosion and ecology		<ul style="list-style-type: none"> Erosion control will include (i) limiting construction and material handling during periods of rains and high winds; and (ii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have creased at the sites. 	Contractors	PMU and PMIC	Included in civil work contract
2.6 Social and Cultural	Impacts to local cultural sites	<ul style="list-style-type: none"> Contractors will ensure that all local cultural sites (including shrines and graves) will be kept clear of construction material and protected from dust and other disturbance. Access to these sites will not be impeded. After construction is finished any disturbed surroundings will be clean up. 	Contractors	PMU and PMIC	Included in civil work contract
2.7 Environment, Health, and Safety	Community health and safety. The construction activities will be done through three communes namely,	<ul style="list-style-type: none"> Community health and safety will be safeguarded by: Planning construction activities so as to minimize disturbances to residents, utilities and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be re-instated to its original condition after construction. Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public access to construction sites. 	Contractors	PMU and PMIC	Included in civil work contract
	Occupational Health and Safety	<ul style="list-style-type: none"> Measures to ensure occupational health and safety will include: <ul style="list-style-type: none"> Contractor shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment. Contractors shall ensure that: <ul style="list-style-type: none"> All reasonable steps are taken to protect any person on the site from health and safety risks; 	Contractors	PMU and PMIC	12,000 (Included the costs of worker training, Personnel Protection Equipment and garbage bin)

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		<ul style="list-style-type: none"> ▪ Provide adequate personnel protection equipment ▪ The construction site is a safe and healthy workplace; ▪ Machineries and equipment are safe; ▪ Adequate training or instruction for occupational health and safety is provided; and ▪ Adequate supervision of safe work systems is implemented. 			
2.8 Unexpected environmental impacts		<ul style="list-style-type: none"> • If unexpected environmental impacts occur during project construction phase, the PMU will update the EMP, and environmental protection measures will be designed and discussed. 	PMIC	PMU	Included in civil work contract
3. Operation					
3.1 Inadequate O&M	Poor and inadequate operation and maintenance (O&M) of the improved irrigation systems could cause unintended adverse environmental impacts. Establishment and operation of FWUG is part of the project design and support. The PDWRAM has been providing a technical support to set up FWUCs and Farmers Water User Groups (FWUGs). A FWUG is charged with undertaking or ensuring the key activities - operation and maintenance. The proposed UIWRSP provides support to PDWRAM and FWUGs through a technical assistance to strengthen overall water management capacity of	<ul style="list-style-type: none"> • Acceptable and appropriate O&M should be developed for sustainable operation and maintenance. • Sufficient training to FWUGs/FWUC must be also provided thus they will be able to manage, operate and maintain the irrigation in sustainability. 	PDWRAM, FWUGs	PMU	Included in O&M Training costs

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
	FWUGs.				
3.2 Conflict of water utilization	This will occur between water users of downstream and upstream in case of un-appropriate management and equitable share with understanding.	<ul style="list-style-type: none"> It should be avoidable with support of FWUG and proper O&M manual. Educational program for water saving uses should be also provided. Hence concepts of water equitable share and effective management should be applied. 	PMIC	PMU	Included in FWUG and O&M training
3.3 Training in IPM and sustainable farming	The chemical uses for agriculture are popular to all farmers in the area to improve agricultural product. A tendency of agricultural activities will increase when these irrigation systems has improved. Hence, pollution of chemical fertilizers will be expected to be increased respectively.	<ul style="list-style-type: none"> The project will support the national Integrated Pest Management Program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites. 	PMIC	PMU	Included in Agriculture Training Costs

PMU = Project Management Unit (of PMO), PMO = Project Management Office; EMO = Environmental Management Officer (of PMU); PDWRAM = Provincial Department of Water Resources and Implementation Consultant; FWUC = Farmers Water User Commune; PSC = Project Steering Committee.

3. Environmental Management Costs

17. The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (**Table 1**) are included in the design costs, construction contracts and operational budgets. Final budget allocations for the other the items in the EMP will be developed by the PMU. The total environmental management cost is **\$30,000**.

D. Environmental Monitoring

18. Environmental Monitoring Reports (using ADB's integrated safeguards monitoring report format) will be prepared semi-annually for the EA by the PMIC in collaboration with PMU-Safeguard Officer and sent to ADB. EMP table with the column indicating how implemented will be attached in the report as Annex. Below Table gives reporting requirements.

Table 3: Reporting Requirements

Report	Frequency	Purpose	From	To
Contractor's progress report	Monthly and quarterly	EMP Implementation Progress and Monitoring Results	Contractor	PMU
EMP Progress and Compliance Report	Monthly	Confirm Mitigation Measures	PMIC and PIU	PMU
Environmental Monitoring Report	Quarterly	Confirm EMP performance	PMIC and PMU-Safeguard officer	EA
Environmental monitoring Report (Integrated safeguards monitoring report format)	Semi-annual	Full EMP Implementation and adherence to environmental Covenants/Conditions	PMU	ADB

E. Training Program

19. The training proposed in this EMP is in addition to the capacity building component within the Uplands Irrigation and Water Resources Management Sector Project design, which will target the strengthening of, and skills transfer to PDWRAMs and FWUGs. The training listed in the EMP (Table 1) is targeted at the PMU initially and later the construction contractors to enable them to implement environmental protection measures in construction; and to PDWRAMs to enable them to implement environmental protection measures in scheme operation.

20. The EMP training will be incorporated into the EMP.

F. Grievance Redress Mechanism

21. A grievance redress mechanism (GRM) will be established in each subproject province in compliance with ADB's SPS 2009 requirement to prevent and address community concerns and assist the project to maximize environmental and social benefits.

22. The GRM will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face

meetings, written complaints, telephone conversations, or e-mail, will be available. Opportunities for confidentiality and privacy for complainants will be honored where this is seen as important.

G. Proposed Mechanism

23. The PMU will establish a Project Public Complaint Unit (PPCU) which will act as a central recording and coordinating unit for all subprojects under the Project. Each subproject PMU will ensure that the GRM is publicized locally so that the community is fully aware of the mechanism and the local points of entry to it. The setting up of the GRM in the PMU and its initial implementation through the PMUs will be supported by the environmental consultant of the PMIC.

24. When construction starts, a sign will be erected at each construction site providing the public with updated project information and summarizing the grievance redress mechanism process including details of the GRM entry points. The contact persons for different GRM entry points; PMU, FWUC leaders, contractors, and operators of project facilities, will be identified prior to construction. The contact details for the entry points (e.g. phone numbers, addresses, e-mail addresses, etc.) will be publicly disseminated on information boards at construction sites and on the website of the local government.

25. The preferred action sequence for complaints handling is that the complaint should be investigated and resolved by the unit receiving the complaint. If this is not possible, the complaint should be referred to the PMU (whose wider membership will enable coordinated action in response).

26. The PPCU will maintain records of complaints and actions taken to correct them. This data will be included in the PMU's reports to the ADB. The PPCU will establish a GRM tracking and documentation system. The system will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

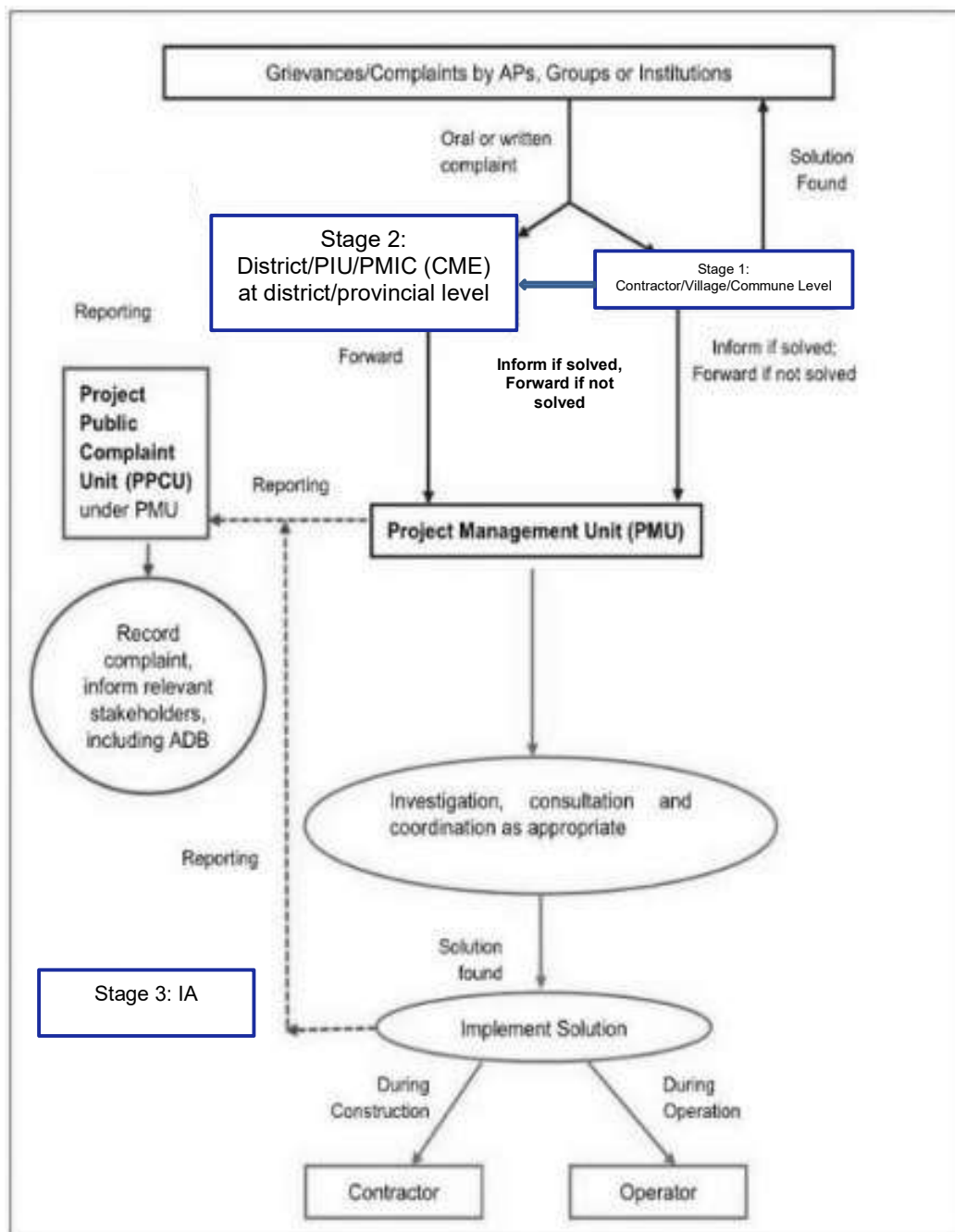
H. GRM Procedure and Timeframe

27. The procedure and timeframe for the grievance redress mechanism are described as follows (see **Figure 1**). The stages are represented by different colors in the flow diagram:

- **Stage 1: Contractor or villager chief at Village Level (5 working days).** Affected People (APs) will present their complaints and grievances verbally or in writing to the contractor/village chief, or commune chief. The receiving agent will be obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the aggrieved AP does not hear from taken in the first step, the complaint may be brought to the District Office/PIU/PMIC (CME) at district/provincial level.
- **Stage 2: District/PIU/PMIC (CME) at district/provincial level (5 working days).** This level has 5 working days within which to resolve the complaint to the satisfaction of all concerned. If the complaint not be solved at this stage, the District office/PMU/PMIC (CME) at provincial level will bring the caset to the PMU/PMIC at national level.
- **Stage 3: PPCU/PMU/PMIC at national Level (10 working days).** This level has 10 working days within which meets with the aggrieved party and tries to resolve the situation. Within 10 working days of submission of the grievance, the PPCU must make a written decision and submit copies to the MOWRAM/PDOWRAM and the APs. If the complaint still not be solved at this stage, the complaint may be brought to

28. During construction, the PPCU will be informed by contractors and construction supervisors, FWUC staff, or PMUs if people complain about the project. During operation, the PPCU will be advised of complaints by the PDWRAM and FWUC. The PPCU will also inform the ADB project team and submit all relevant documents.

Figure 1: Concept of Proposed GRM



Note: AP = Affected Person, PMU = Project Management Unit, FWUC = Farmer Water User Community

Annex 5

Consultation / Interview Form

Date of Interview		Interviewer Name	
Interview Site: <i>Where is the interview held? In school, on the road, in shop</i>		Stakeholder Name & Status: <i>Full name, status is business owner, school teacher, religious leader, resident</i>	
Construction Site & Date Construction Started <i>Which road, GPS location if available</i>		Has this stakeholder been interviewed before? <i>Yes (when were they interviewed) No</i>	

Interview Discussion Points:

1. NOISE	Record of Discussion
Before the project started, was the person disturbed by noise? If yes, explain how and when. <i>Where did the noise come from? E.g. traffic, machinery, people, music</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
During the construction, is the person disturbed by noise from the project? If yes, explain how and when. <i>What type of noise and where did the noise come from? All day, at night, intermittently?</i>	
If noise from construction is a problem, what changes does the person suggest are made?	
2. AIR QUALITY	Record of Discussion
Before the project started, was the person affected by air pollution or dust? If yes, explain how and when. <i>Where did the pollution or dust come from? E.g. traffic, machinery, construction, burning garbage, cooking stoves</i> <i>When was the dust or pollution a problem? E.g. all day, at night, intermittently</i>	
During the project, is the person disturbed by dust or pollution? If yes, explain how and when. <i>What type of noise and where did the noise come from? E.g. increased traffic congestion, construction machinery, construction workers, burning construction garbage etc</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
If dust or air pollution from the construction is a problem, what changes does the person suggest are made?	
3. VEGETATION AND LAND USE	Record of Discussion
Before the project started, what was the vegetation like in the project area? <i>E.g. pasture land, trees, shrubs, rice fields.</i>	
During the project, has the person found the	

vegetation situation has changed? If yes, explain how and when.	
If impact on vegetation is unacceptable, what changes does the person suggest are made?	
4 COMMUNITY SAFETY	Record of Discussion
Before the project started, can you describe the community safety situation in the project area? <i>E.g. no problems, some accidents, difficulty crossing the roads</i>	
During the project, has the person found the community safety situation has changed? If yes, explain how and when. <i>Slower traffic so easier to cross the roads, construction vehicles are making a crossing harder / easier, more accidents / less accidents, construction site dangers</i>	
If change in road safety is unacceptable, what changes does the person suggest are made?	
5. WATER QUALITY	Record of Discussion
Before the project started, was the person affected by poor water quality? If yes, explain how and when. <i>Ground water? Surface Water? Which Water source? How was it polluted?</i>	
During the project, is the person affected by water pollution? If yes, explain how and when. <i>Ground water? Surface Water? Which Water source? How is quality being affected?</i>	
If water quality from the construction is a problem, what changes does the person suggest are made?	
6. ACCESS	Record of Discussion
During the project, is the person affected by reduced access to their business, home or land? Access to what is limited, and how?	
If access limitations are not acceptable, please suggest changes which can be made?	
7. OTHER ISSUES	Record of Discussion
Any other issues about the construction sites that the person wants to discuss? <i>E.g. wastewater concerns, waste disposal, Other concerns, labor force,</i>	

GRM – Complaint Recording Form

PIU Staff Responsible: (name and role)	
Date: (of this record)	
Date of Complaint:	
Date Resolution Required by (15 days from initial complaint):	
Complaint Made by: (Name & Contact Details)	
Method of Complaint: (direct to PMU, via Contractor, Via Commune People's Council)	
Details of Complaint: (issues, actions taken so far, when did it start – all details needed)	
PMU Actions: (Next steps for PMU to resolve the issue or to move complaint to next level)	
Follow Up Actions Needed and Date: (PMU to follow up on resolution if needed, e.g. check contractor actions)	

**Appendix 1F: EMP for O Tracheak Chit Reservoir –
Package III (MOWRAM/ICB – CW09)**

KINGDOM OF CAMBODIA

Nation Religion King



MINISTRY OF WATER RESOURCE AND METHODOLOGY



ASIAN DEVELOPMENT BANK

ADB Loan No 3289-CAM

**CAMBODIA:
UPLANDS IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR
PROJECT, CAMBODIA**

**For (MOWRAM/ICB–CW09) – Improvement of O
Tracheak Chit Reservoir and Pertinent Canals and
Structures in Battambang Province – Package III**

ENVIRONMENTAL MANAGEMENT PLAN

Phnom Penh, September 2018

Project Name: **Uplands Irrigation and Water Resources Management Sector Project,
Cambodia (ADB LOAN 3289-CAM)**

Project Management and Implementation Consultant

Report Name: **Environmental Management Plan for (MOWRAM/ICB–CW09)
Improvement of O Tracheak Chit Reservoir and Pertinent Canals and
Structures in Battambang Province – (Package 3)**

PREPARATION, REVIEW, AND APPROVAL

Prepared by: Ms. Sao Sambatmorakath Signature: _____

Position: Environment Specialist/PMIC Date: _____

Reviewed by: Mr. Ung Kotaro Signature: _____

Position: Deputy Team Leader/PMIC Date: _____

Approved by: Mr. Keo Sovathapheap Signature: _____

Position: Safeguard Officer/PMU Date: _____

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ABBREVIATION

ADB	Asian Development Bank
EA	Executing Agency
EARF	Environmental Assessment and Review Framework
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FDERP	Flood Damage Emergency Reconstruction Project
GoC	Government of Cambodia
GPS	Global Positioning System
IA	Implementing Agency
IEE	Initial Environmental Examination
MEF	Ministry of Economy and Finance
MoE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
NR	National Road
PDOE	Provincial Department of Environment
PDWRAM	Provincial Department of Water Resources and Meteorology
PMU	Project Management Unit
PIU	Project Implementation Unit
PPTA	Project Preparation TA
REA	Rapid Environmental Assessment
RP	Resettlement Plan
SPS	ADB's Safeguard Policy Statement (2009)

Contents

	<u>Page</u>
List of Tables	131
Figure	131
List of Annexes	131
A. Introduction	132
B. Responsibilities for Implementation	132
C. Summary of Potential Impacts	133
1. Mitigation Measures	134
2. Environmental Management Costs	144
D. Environmental Monitoring	144
1. Monitoring Management	144
2. Environmental Monitoring Reports	147
3. Training Program	148
E. Grievance Redress Mechanism	148

LIST OF TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Summary of Receptors in Package 3 Area	133
2	Summary of Potential Impacts and Mitigation Measures	135
3	Project Readiness Assessment Indicators	144
4	EMP Compliance Monitoring	145
5	Reporting Requirements	148
6	Capacity Building and Training Requirements	148

FIGURE

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Concept of Proposed GRM	150

LIST OF ANNEXES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Consultation / Interview Form	151
2	GRM – Complaint Recording Form	153
3	Committee for Environment and Social Impact Assessment	154

A. Introduction

The Environmental Management Plan (EMP) covers all phases of non-core sub-project implementation from preparation through commissioning and operation, and it aims to ensure the monitoring of environmental impacts and activation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each sub-project. Environmental protection measures will (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB Safeguard Policy Statement 2009.

Environmental Monitoring Programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures.

B. Responsibilities for Implementation

The Ministry of Water Resources and Meteorology (MOWRAM) is the executing agency (the EA) and Department of Farmer Water User Community (DFWUC) is the implementing agency (the IA). A Project Steering Committee, headed by Minister MOWRAM, will oversee the Project Implementation and Management. A Project Management Unit (PMU) was established and the PMU was fully involved in the Project preparation. The PMU is headed by a Project Director who is the Deputy Director General for Technical Affairs and a Project Manager who is the Director of the Department of FWUC. The PMU is composed of 24 designated personnel from MOWRAM, MAFF and Battambang PDWRAM. For the O Tracheak Chit Reservoir, the PMU will be responsible for the supervision and monitoring of project-related environmental activities during the pre-construction, construction and operation phases as part of their functions. In line with this an Environmental Management Officer (EMO) in the PMU will be assigned to be responsible for supervision of environmental management and for environmental monitoring. The major responsibilities of the environmental officer will be to ensure that:

- Mitigation measures and monitoring of these activities are carried out in accordance with the EMP;
- Environmental Monitoring program, comprising of taking samples and analysis are being carried out;
- Reporting is performed in compliance with ADB requirements.

However, the main environmental guidance for the implementation phase will be provided by the Environment Specialist in the Project Management and Implementation Consultants (PMIC) team. The role of the PMIC will be to work as part of the PMU, helping them fulfill their supervision and monitoring responsibilities. The PMIC will also support PMU with preparation of monitoring reports for the ADB. The PMIC was contracted by the PMU for the duration of the loan implementation period.

Contractors will be engaged by the PMU for construction. The PMU will include EMP in the bid and contract documents. The bid and contract documents will specify requirement for contractors to develop Construction Environmental Management Plan (CEMP) based on this EMP. The Contractor will be responsible for implementation mitigation and monitoring measures in the construction phase and their performance will be supervised and monitored by the PMU. The PMIC will provide training to Contractor on EMP requirements and will review and approve the CEMP prior to civil works commencing. PMIC will also support Contractor to develop standard monitoring checklists and reporting template.

Environmental monitoring during operation of the Project in the longer term is the responsibility of Battambang PDWRAM.

C. Summary of Potential Impacts

The impacts of Package 3 (MOWRAM/ICB-CW09) are influenced by the presence of receptors in the package area. Without receptor, there will not be any impacts. The receptors are summarized in below table.

Table 1: Summary of Receptors in Package 3 Area

Project's Component	Surface Water Receptors	Socio-Economic & Cultural Receptors	Land Cover/Ecological Receptors	Protected Area Status
Main Reservoir	Feeder Canal 2	Residential nearby the main reservoir, Prey Tralach commune	Tall trees along the embankment	None
Sub-reservoir	Feeder Canal 1	Residential nearby the site, Prek Chik Commune.	Rice paddy	None
Feeder Canal 2	Prek Chik Main Canal	-	Tall trees along the canal	None
Feeder Canal 1, Secondary and Tertiary canal	-	-	Rice paddy	None

UXO survey and removal. During consultation with local people and authority on June 2018, it was confirmed about UXO risk. To avoid any accident and injury, UXO survey and removal will be done before the construction start. This item is already proposed in the civil work contract, which will be responsibility of the contractor, the contractor will hire a licensed UXO firm to conduct the activities prior to construction starting.

Air quality. The temporary impacts on air quality in the construction stage of the Package 3 are anticipated because of fugitive dust generation associated with all construction works, earth works and waste movements.

Noise Disturbance. Noise impacts will be temporary and localized at all construction sites as construction machinery and vehicles generate noise as they operate. Other noise sources include loading and unloading of equipment and materials.

Surface Water. Surface Water will be polluted from human waste, oil contamination, and other hazardous material during construction phase. Short term construction impacts may be seen in terms of increased turbidity, when access roads improvement or other construction is taking place adjacent to the canals.

Soil and Land. Soil erosion is not anticipated given the nature of the Package 3 and their locations however borrow sites will cause local impacts to the land. The Package 3 is fertile agricultural locations and fertile top soil is a valuable resource which requires protection measures, particularly for the all construction areas which are located in and around rice fields where encroachment from inappropriate spoil disposal could have detrimental impacts. Channels with earth banks will be stabilized through planting. The BoQ of the unsuitable materials including soil spoil is approximately 46,334 m³ which require to be managed

properly. These spoils will be made available to nearby communities for use as building pads and bunds. The spoils will not be allowed to dispose into water body or protected areas or unapproved areas by local authority.

Solid Waste Management. Impacts on resource use and impacts associated with disposal will arise from waste generated during construction. This includes generation of wastes e.g. demolition waste (any waste from the demolition of unrepairable sluice and gate structures), dredge spoil, and waste from worker camps.

Community and Occupational Health and Safety. During construction, local cultural sites, and other areas in community could be disturbed. Within 30 working days, after construction is finished any disturbed areas will be restored to pre-construction conditions. Occupational risks come from a range of activities including the use of heavy machinery, earth moving, and use of chemicals, the EMP includes health and safety measures and monitoring requirements.

Socio-Economic Impacts (Accessibility). The rehabilitation of Package 3 will require the excavation of parts of the existing canal. The people are living along the canals and rice paddy field. The community in and around the area will be disrupted by the noise and dust, as described above, and also by localized turbidity and potentially impaired access.

1. Mitigation Measures

The mitigation measures will be incorporated into the tender documents, construction contracts, and operational management procedures. Contractors and PMU and PDWRAMs will implement these measures, depending upon sub-project phases. The effectiveness of these measures will be carefully monitored to confirm if improvements needed.

Table 2: Summary of Potential Impacts and Mitigation Measures

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
1. Pre-construction					
Design stage	Final Site Designs	<ul style="list-style-type: none"> Final designs of canals, siting of control structures and canal alignments were completed to minimize environmental impacts. 	PMIC	PMU	Design cost
	Irrigation extraction planning	<ul style="list-style-type: none"> Operational plans and operating practices for water allocations and drainage will be documented and approved by the PMU and ADB before completion of construction works and handing over of canals to FWUCs. 	FWUCs and PMIC	PMU and ADB	Design Costs
1.2 Construction Preparation Stage	Environmental management budget	<ul style="list-style-type: none"> Confirm budgets for the implementation of environmental management measures and environmental supervisory responsibilities. Assign final budget allocations against each of items in the EMP 	PMU	PSC	Design Costs
	Incorporate environmental management into contract documents	<ul style="list-style-type: none"> Contract documents: Preparation of the environment section in the Terms of Reference for bidders for construction contracts, and environmental contract clauses for contractors, namely the special conditions for the protection of the water, soil and air environments (referencing the EMP and monitoring plan). 	PMIC	PMU	Design Costs
1.3 Construction support preparation.	Environmental Education awareness	<ul style="list-style-type: none"> Environmental Protection Training: PMIC Environment Specialist and/or PMU environment officer will be invited to provide on-the-job training on implementation and supervision of environmental mitigation measures to PMU, PDWRMs and contractors. 	PMIC	PMU	-
	Complaints procedures established	<ul style="list-style-type: none"> The Project Grievance Redress Mechanism will be established and contact persons for the sub-project provided to affected persons and included on sign boards at construction sites, camps and each village. 	PMU and PMIC	PSC	Part of Design Costs
	Site planning/Construction Environmental Management Plan	<ul style="list-style-type: none"> Prepare a construction environmental management plan, including an emergency preparedness and 	Contractors	PMU and PMIC	2,000

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
	(CEMP)	response guideline for construction emergencies and site health and safety guidelines.			
1.4 UXO	Project works will take place in areas that are not already well trafficked. Thus, it is likely to have a significant UXO risk. During the public consultation in June 2018, participants raised about the UXO risk at the proposed site as it was existing irrigation since Pol Pot Regime. In the meantime, a borrow pit site is unknown yet that it could be harmful on UXO.	<ul style="list-style-type: none"> To avoid any risks, on all sites where excavation or ground clearance needs to take place, where there is a reasonable doubt as to the safety of the area an approved mine clearance agency should be engaged for an agreed package of verification, detection and clearance work, to ensure that all areas where excavation, or access construction will take place are clear of UXO. 	Contractors	PMU and PMIC	Included in civil work contract
1.5 Borrow Pit	High level of dust due to excavation works, loading of trucks which could be caused to air quality. In addition, increased noise level in the area due to operation equipment of movement of trucks. It's possibility of ground water contamination from water ponding in the borrow pits.	<ul style="list-style-type: none"> Regular water spray in the dusty areas and cover of trucks Proper maintenance of equipment's and trucks Levelling of the area to prevent from water ponding 	Contractors	PMU and PMIC	Included in civil work contract
1.6 Development of Environment, Health and Safety Guideline	Labor will be required during construction. These will include skill or non-skill workers, operators, surveyors, and construction supervisors. Due to the limited number of workers from time to time during the construction, so there is relatively small scale and the construction activities is expected to be completed within one year.	<ul style="list-style-type: none"> The contractor is required Contractor to designate an Environmental Health and Safety officer to implement and monitor CEMP and health and safety guidelines. To orient/train workers regularly to ensure they know CEMP and health and safety requirements. Training will be conducted by responsible person who are working on Environment, Health and Safety. 	Contractors	PMU and PMIC	Included in civil work contract
2. Construction Phase (12 months)					
2.1 Water pollution	Human wastes from construction.	<ul style="list-style-type: none"> Provision of sanitary facilities (toilets, burying, etc.) 	Contractors	PMU and	Included in

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
from human waste, oil contamination, and other hazardous material.	An adverse environmental impact could occur during the construction phase from workers feces and domestic wastes. This will generate flies and transmitted diseases which will possibly result to sanitation issue in the areas.	with proper waste treatment and disposal will be provided by contractors.		PMIC	civil work contract
	Hazardous materials such as fuels, oil, cement and chemicals	<ul style="list-style-type: none"> To prevent pollution of soil and surface water/groundwater: Storage facilities for fuels, oil, cement, and chemicals will be within secured areas on impermeable surfaces, provided with bunds and clean up installations; Vehicle, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep into the soil; Oil traps will be provided for service areas and parking areas; Fuel storage and refilling areas will be located at least 50m from canals and channels and will be protected by temporary drainage bunds to contain spills. 	Contractors	PMU and PMIC	Included in civil work contract
2.2 Air	Air quality	<ul style="list-style-type: none"> Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. All vehicle emission will be in compliance with relevant Cambodian emission standards. 	Contractor	PMU and PMIC	Included in civil work contract
	Dust	<ul style="list-style-type: none"> Material stocking and concrete mixing equipment will be equipped with dust shrouds. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered. 	Contractors	PMU and PMIC	Included in civil work contract
		<ul style="list-style-type: none"> For both construction sites and construction roads, water spraying for suppression of dust and maintenance of driving surface will be standard site management practices. 	Contractors	PMU and PMIC	2,500
2.3 Noise and Vibration	Noise impacts on sensitive receivers (4 sites nearby residential	<ul style="list-style-type: none"> Construction at lunch and night within 280m of residences shall be strictly prohibited. 	Contractors	PMU and PMIC	4,000

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
	areas)	<ul style="list-style-type: none"> During daytime construction, the contractor will ensure that: (i) sites for concrete mixing plants and similar activities will be located at least 1 km away from residences and schools, and (ii) temporary anti-noise barriers will be installed to shield any schools or residences within 100m of the construction site. 			
2.4 Solid wastes	Demolition or construction waste	<ul style="list-style-type: none"> Any waste from the demolition of un-repairable sluice and gate structures will be either sold to building materials recyclers or collected and transported to official landfill sites. Metal parts, including pump and pipe will be broken up and sold to scrap metal merchants. Any excess spoil will be made available to nearby communities for use as building pads and bunds. There will be no dumping of spoil on adjacent land unless agreement reached with land owner in advance and compensation agreed for any damage. Written agreements should be attached to semi-annual safeguards monitoring report. 	Contractors	PMU and PMIC	Included in civil work contract
	Domestic waste from worker camps	<ul style="list-style-type: none"> Contractors will provide disposal facilities and sufficient garbage bins at strategic locations and ensure that they are (i) protected from birds and vermin; (ii) emptied regularly (using the nearest township solid waste system and landfill); and (iii) Do not overflow. 	Contractors	PMU and PMIC	5,400
2.5 Soil erosion and ecology	Erosion from main reservoir and construction sites.	<ul style="list-style-type: none"> Erosion control will include (i) limiting construction and material handling during periods of rains and high winds; and (ii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites. All tree along the right side of main reservoir to be protected from construction activities if they are not required to be removed. 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
	Flora	<ul style="list-style-type: none"> All trees over 3m in construction sites to be protected from construction activities if they are not required to be removed. Borrow sites will not be selected within forested areas and will be vegetated with native species following re-contouring. 	Contractor	PMU and PMIC	Including in civil work contract
	Soil spoil	<ul style="list-style-type: none"> Contractor will ensure that all soil spoil needs to be managed properly and re-used as below: (i) the spoils were made available to nearby communities for use as building pads and bunds. (ii) the spoils will not be allowed to dispose into water body or protected areas or unapproved areas by local authority. (iii) ensure that the spoils will not be blocked on any local access road (including access road to villager home or public road). 	Contractor	PMU and PMIC	Included in civil work contract
2.6 Social and Cultural	Impacts to local cultural sites Maintaining access Damage restoration	<ul style="list-style-type: none"> Contractors will ensure that all local cultural sites (including shrines and graves) will be kept clear of construction material and protected from dust and other disturbance. Access to these sites will not be impeded. Access to property, land and water supply will be maintained at all times. After construction is finished the site will be restored to pre-project condition, unless otherwise agreed with owner. The PMIC will confirm clean-up is adequate and confirmed in semi-annual environmental monitoring report. 	Contractors	PMU and PMIC	Included in civil work contract
2.7 Environment, Health, and Safety	Community health and safety. The construction activities will be done through two communes namely, Prey Tralach and Prek Chit commune, Rokh Kiri district, Battambang province.	<ul style="list-style-type: none"> Community health and safety will be safeguarded by: Planning construction activities so as to minimize disturbances to residents, utilities and services. Temporary land occupation will be planned well ahead of construction to minimize its impact. Land will be re-instated to its original condition after construction. 	Contractors	PMU and PMIC	Included in civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
		<ul style="list-style-type: none"> Implementing safety measures around the construction sites to protect the public, including warning signs to alert the public to potential safety hazards, and barriers to prevent public access to construction sites. 			
	Occupational Health and Safety. Some workers will be recruited for construction activities and workers' camp will be constructed. These will include non-skilled workers, operators and drivers as well as surveyors and construction supervisors. Since the works will be relatively small scale and expected to be completed within one and a half year, large numbers of workers are not expected. However, safety and health impacts will be also expected.	<ul style="list-style-type: none"> Measures to ensure occupational health and safety will include: Contractor shall be required by the PMU to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment. Contractors shall ensure that (i) all reasonable steps are taken to protect any person on the site from health and safety risks; (ii) the construction site is a safe and healthy workplace; (iii) machineries and equipment are safe; (iv) adequate training or instruction for occupational health and safety is provided; (v) adequate supervision of safe work systems is implemented; and (vi) means of access to and egress from the site are without risk to health and safety. Contractor shall ensure that all workers are equipped with, and use Personal Protective Equipment (PPE) Contractor will provide sufficient signage giving occupational health and safety warnings and information disclosure within all construction sites. Contractor shall provide details of weekly/monthly toolbox meetings (safety briefings) 	Contractors	PMU and PMIC	4,000
2.8 Road safety /accident (by transportation of heavy trucks...)	Some heavy equipment (heavy trucks, bulldozers, backhoes, etc.) will be brought to the construction areas for excavation and construction works. They will only be transported in and out during the construction period and in relatively small numbers. Even though the project area is not populated (rural	<ul style="list-style-type: none"> The contractor is required to implement some mitigation measures as follow: Construction vehicles will comply with national speed limitation. Construction vehicles will drive at low speeds, especially at market, school, hospital, urban areas. Keep road spaces or bypass for travelers to avoid traffic jams. Vehicles for construction should park at designated 	Contractor	PMU and PMIC	Including in 2.2. Air – Dust control

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
	area), no serious disturbance is envisaged; but it will possibly cause accident to local communities and dusty.	<p>safe places.</p> <ul style="list-style-type: none"> Water spraying should be applied as needed to ensure there is no dust/air pollution in local community (See 2.2. Air). 			
2.9 Transmitted Disease (e.g. HIV ...)	Workers will be recruited for construction activities and workers' camp will be constructed. These will include non-skilled workers, operators and drivers as well as surveyors and construction supervisors with different gender. Thus, transmitted diseases, especially HIV, will be also expected.	<ul style="list-style-type: none"> The contractor will be required To develop a guideline on health and safety management during construction. To orient/train the workers on health and HIV program. 	Contractor	PMU and PMIC	-
2.10 Conflict between the workers and community	Workers will be recruited for construction activities and workers camp will be constructed. These will include non-skilled workers, operators and drivers as well as surveyors and construction supervisor. Since the works will be relatively small scale and expected to be completed within one year large numbers of workers are not expected. But conflict will be also expected.	<ul style="list-style-type: none"> Contractor is required to implement the mitigation measures as follow: The guideline on staff management, internal policy and internal rule should be prepared in advance or at the same time of preparing the site planning or called construction environmental management plan (CEMP). Site manager or staff who is responsible for environment, health and safety should regularly orient/train workers or staff to avoid any conflict may happen in advance. 	Contractor	PMU and PMIC	-
2.11 Damage on trees along the bank of existing dam and feeder canal	Based on design team, the tree along inside the reservoir do not plan to clear, while some trees along the bank of existing dam (outside the reservoir) and feeder canal will be affected during clearing activities.	<ul style="list-style-type: none"> The contractor shall: Avoid to clear the trees as much as possible Re-planting trees will be considered in consultation with engineering team. 	Contractor	PMU and PMIC	Including in the civil work contract

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
2.12 Unexpected environmental impacts		<ul style="list-style-type: none"> If unexpected environmental impacts occur during project construction phase, the PMU will update the EMP, and environmental protection measures will be designed and discussed immediately. 	PMIC	PMU	Included in civil work contract
3. Operation					
3.1 Inadequate O&M	Poor and inadequate operation and maintenance (O&M) of the improved irrigation systems could cause unintended adverse environmental impacts. Establishment and operation of FWUC is part of the project design and support. The PDWRAM has been providing a technical support to set up FWUC. A FWUC is charged with undertaking or ensuring the key activities - operation and maintenance. The proposed UIWRSP provides support to PDWRAM and FWUC through a technical assistance to strengthen overall water management capacity of FWUC.	<ul style="list-style-type: none"> Acceptable and appropriate O&M should be developed for sustainable operation and maintenance. Sufficient training to FWUC must be also provided thus they will be able to manage, operate and maintain the irrigation in sustainability. 	PDWRAM, FWUC	PMU	Included in O&M Training costs
3.2 Conflict of water utilization	This will occur between water users of downstream and upstream in case of un-appropriate management and equitable share with understanding.	<ul style="list-style-type: none"> It should be avoidable with support of FWUC and proper O&M manual. Educational program for water saving uses should be also provided. Hence concepts of water equitable share and effective management should be applied. 	PMIC	PMU	Included in FWUC and O&M training
3.3 Training in IPM and sustainable farming	Pesticide/chemical fertilizer use	<ul style="list-style-type: none"> The project will support the national Integrated Pest Management Program and deliver IPM training modules and low chemical cultivation training modules applicable to cropping conditions and capacities in the Project sites. 	PMIC	PMU	Included in Agriculture Training Costs

Items	Environmental Impacts and Issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Total Cost (USD)
3.4 Emergency response Planning	Floods and extreme weather events	<ul style="list-style-type: none"> The project will promote the development of community-based disaster readiness programs at the irrigation and drainage communes with particular reference to flooding and other natural disasters. The development program on disaster is also updated with national and local level on disaster preparedness and response mechanism of National Risk Management Plan of Cambodia. 	Project Output	ADB	-

PMU = Project Management Unit; EMO = Environmental Management Officer (of PMU); PDWRAM = Provincial Department of Water Resources and Meteorology; ADB=Asian Development Bank; PMIC=Project Management and Implementation Consultant; FWUC = Farmers Water User Commune; PSC = Project Steering Committee.

Source: PMIC, August 2018

2. Environmental Management Costs

The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (Table 2) are included in the design costs, construction contracts and operational budgets. Final budget allocations for the other the items in the EMP will be developed by the PMU. The total environmental management cost is **\$ 17,900**.

D. Environmental Monitoring

1. Monitoring Management

The project monitoring conducted under the EMP includes:

Project Readiness Monitoring. Monitoring to check progress on project readiness and close gaps through corrective actions. Before construction, the PMIC will monitor the project's readiness on environmental management based on a set of indicators (**Table 3**) and report it to ADB and PMU. This assessment will formally demonstrate that environmental commitments are being carried out and environmental management systems are in place before construction starts, or suggest corrective actions to ensure that all requirements are met.

Table 3: Project Readiness Assessment Indicators

Indicator	Criteria	Are the Criteria met?	If No, What Corrective action is needed?	Date for Corrective Action Completion
		Yes/No		
1. EMP update	EMP updated after detailed design & approved by ADB	Y/N		
2. Compliance with loan covenants	The borrower complies with loan covenants related to project design and environmental management	Y/N		
3. Public Involvement effectiveness	Meaningful consultation completed	Y/N		
	GRM established with entry points	Y/N		
4. Environmental Supervision and monitoring in place	Recruitment of external staff as set out in the Institutional Arrangements for this EMP	Y/N		
	Nomination of government staff for PMU and PIU roles as set out in the Institutional Arrangements for this EMP	Y/N		
5. Bidding documents and contracts with environmental safeguards	Bidding documents and contracts incorporate the environmental activities and mitigation measures required by this EMP	Y/N		
6. EMP financial support	The required funds have been set aside for EMP implementation including training and capacity building	Y/N		

EMP Compliance monitoring. To be conducted by the PMIC-ES (contracted via the Project Management and Implementation Consultants) and the PMIC-CME (Construction Management Engineer) to verify EMP compliance during project construction. To be effective EMP, all the mitigation measures shall be monitored to ensure they are implemented properly.

Note this applies to construction only; during operation, it is the responsibility of the appropriate ministry or its line department to ensure monitoring of operational facilities is completed. Compliance monitoring requirements are summarized in **Table 4**.

Table 4: EMP Compliance Monitoring

Environmental Indicators	Location	Method and Frequency	Responsibility	
			Verification	Implementation
Environmental Budget	Bidding document & contract	One time only before the construction start (Review the bidding document and contract)	PMU	PMIC-Procurement Specialist
Construction Environmental Management	1 st quarterly report from the contractor	One time only before the construction start (Through review document which is submitted by contractors).	PMU and PMIC	Contractor
Environmental Education awareness	Project Site, Project Office	As needed, the training could be conducted at the project site; Battambang province or at Project Office in Phnom Penh.	PMU	PMIC
Complaints procedures established	-	Complaints procedure with both English and Khmer Language.	PMU	PMIC
Site Planning	Project Site	Once before the contractor move equipment and workers to the construction site (through site planning document submitting to PMU and PMIC office).	PMU and PMIC	Contractor
UXO and borrow pit remove	Implementation site and borrow pit site	Once when the UXO removing agency complete their task (through the report for submitting to PMU and PMIC office)	PMU and PMIC	Contractor (UXO removal agency)
Development of CEMP and health and safety guidelines.	Project Site	Once before the equipment and workers move to the project site. The guideline could be integrated into site planning document.	PMU, and PMIC	Contractor
Water Quality	Implementation Site of Spoil and Borrow Site management	Monthly checking against mitigation measures specified in this EMP (through observation on borrow pit and spoil sites management)	PMIC	Contractor
Air quality	Civil Work sites	Monthly checking against mitigation measures specified in this EMP (through interview with villagers,	PMIC	Contractor

Environmental Indicators	Location	Method and Frequency	Responsibility	
			Verification	Implementation
		or villager chief and observation)		
Noise and vibration	Civil work sites	Monthly checking against mitigation measures specified in this EMP (through interview with workers, villagers, or villager chief and observation)	PMIC	Contractor
Solid Wastes	Implementation of construction workers management	Monthly checking against mitigation measures specified in this EMP	PMIC	Contractor
Flora	Civil work sites	Monthly checking against mitigation measures specified in this EMP	PMIC	Contractor
Soil erosion and resources	Implementation site of spoil and borrow site management	Monthly checking against mitigation measures specified in this EMP (through observation on borrow pit and spoil sites management)	PMIC	Contractor
Social and Culture	Local cultural sites	Monthly checking against mitigation measures specified in this EMP (Through observation, and interview with villagers and local authority)	PMIC	Contractor
Human Health and safety	Implementation of community and occupational Health and Safety and Emergency Response	Monthly checking against mitigation measures specified in this EMP (Through observation, and interview with villagers and local authority)	PMIC	Contractor
Community Health and Safety Environmental Impacts of civil works Any unforeseen impacts caused by accidentally Civil nuisance Impaired use of access roads	At all construction locations	Focus group discussion/interview with affected People Using the form in Annex 1 .	PMIC	Contractor
Road safety/accident (by transportation of heavy trucks ...)	All along the access road to construction site	Monthly checking against mitigation measures specified in this EMP (Through observation, and interview with villagers and local authority)	PMIC	Contractor

Environmental Indicators	Location	Method and Frequency	Responsibility	
			Verification	Implementation
Transmitted disease for an example, HIV ... etc.)	All workers camp sites	Monthly checking against mitigation measures specified in this EMP (Through observation, and interview with worker on environment, health and safety)	PMIC	Contractor
Conflict between the workers and community	At construction and villages where is nearby or within subproject command area.	Monthly checking against mitigation measures specified in this EMP (Through observation, and interview with villagers and local authority)	PMIC	Contractor
Damage on trees	Along the bank of dam and feeder canal	Monthly checking against mitigation measures specified in this EMP (Through observation)	PMIC	Contractor
Unexpected environmental impacts	-	Monthly checking and through observation to identify any issue occur.	PMIC	Contractor

Affected People Monitoring (Interview/Focus Group Discussion). This is to be conducted by the PMIC (ES and CME in each province) via discussing with affected people on the impacts during construction phase. During IEE preparation, details of consultation was undertaken (on 20 – 21 June 2018). Additionally, consultation will take place during implementation. The PMU Safeguard Officer will undertake consultation interviews every 3-month until the end of construction phase. This is set out in the Environmental Monitoring Plan provided in the Environmental Management Plan.

Informal monitoring interviews with affected people will focus on complaints about community disturbance from construction activities, such as construction noise, dust, solid waste and wastewater, as well as public concerns about ecological protection, soil/land concerns and access issues. A sample Environmental Monitoring Interview Form is given in **Annex 1**. This will contribute to project monitoring.

Operational Monitoring. This is required as part of the operations of the sub-project and will be undertaken by the relevant government department or a nominated private sector operator.

2. Environmental Monitoring Reports

Environmental Monitoring Reports (using ADB's integrated safeguards monitoring report format) will be prepared semi-annually for the EA by the PMIC in collaboration with PMU-Safeguard Officer and sent to ADB. EMP table with the column indicating how implemented will be attached in the report as Annex. Below Table gives reporting requirements.

Table 5: Reporting Requirements

Report	Frequency	Purpose	From	To
Contractor's progress report	Monthly and quarterly	EMP Implementation Progress and Monitoring Results	Contractor	PMU
EMP Progress and Compliance Report	Monthly	Confirm Mitigation Measures	PMIC and PIU	PMU
Environmental Monitoring Report	Quarterly	Confirm EMP performance	PMIC and PMU-Safeguard officer	EA
Environmental monitoring Report (Integrated safeguards monitoring report format)	Semi-annual	Full EMP Implementation and adherence to environmental Covenants/Conditions	PMU	ADB

3. Training Program

A training program is set out in below table which address the safeguard reporting and implementation requirements during construction. The engagement of a PMIC will be critical to ensuring the capacity of the PIU staff and to ensuring monitoring and reporting are managed effectively during implementation. This person will also work closely with the PMU Safeguard Officer (PMU-SO) in order to ensure safeguards are implemented and monitored.

Training for EMP Implementation. The proposed training required for project implementation is set out in **Table 6**.

Table 6: Capacity Building and Training Requirements

Subject/Content	Participants	Trainer	Frequency
EMP adjustment and implementation – Development and adjustment of the EMP, roles and responsibilities, monitoring, supervision and reporting	PMU, PIU, Contractors	PMIC	Once prior to construction
Grievance Redress Mechanism – roles and responsibilities	PMU, PIU, Contractors, Commune councils	PMIC	Once prior to construction
Environmental Protection Pollution control on construction sites (air, noise, wastewater, solid waste)	PMU, PIU, Contractors	PMIC	Once during the project construction
Environmental Monitoring – monitoring methods, data collection and processing, reporting systems	PMU, PIU, Contractors, PMIC-Deputy Team Leader, PMIC-CME	PMIC-ES	Once prior to construction

E. Grievance Redress Mechanism

The procedure and timeframe for the grievance redress mechanism are described as follows (see **Figure 1**). The stages are represented by different colors in the flow diagram:

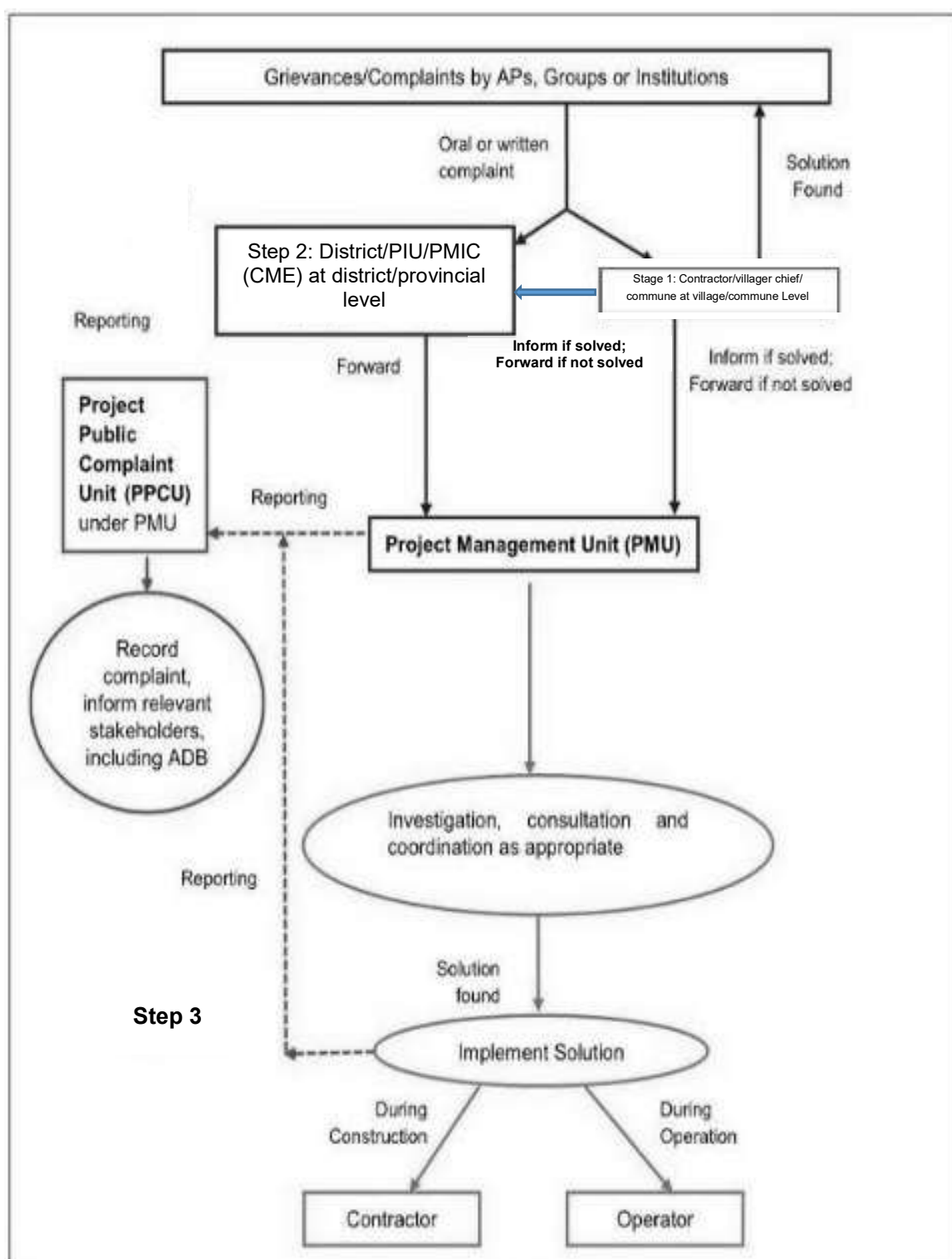
- **Stage 1: Contractor/villager chief/commune at village and commune Level (5 working days).** Affected People (APs) will present their complaints

and grievances verbally or in writing to the contractor/village chief, commune chief and PIU at project site. The receiving agent will be obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the aggrieved AP does not hear from taken in the first step, the complaint may be brought to the District Office/ PIU/PMIC (CME) at provincial level.

- **Stage 2: District/PIU/PMIC (CME) at district and provincial level (5 working days).** This level has 5 working days within which to resolve the complaint to the satisfaction of all concerned. If the complaint not be solved at this stage, the District office/PMU/PMIC (CME) at provincial level will bring the case to the PMU/PMIC at national level.
- **Stage 3: PPCU/PMU/PMIC at national Level (10 working days).** This level has 10 working days within which meets with the aggrieved party and tries to resolve the situation. Within 10 working days of submission of the grievance, the PPCU must make a written decision and submit copies to the MOWRAM/PDOWRAM and the APs. If the complaint still not be solved at this stage, the complaint may be brought to ADB.

During construction, the PPCU will be informed by contractors and construction supervisors, FWUC staff, or PMUs if people complain about the project. During operation, the PPCU will be advised of complaints by the PDOWRAM and FWUC. The PPCU will also inform the ADB project team and submit all relevant documents such as contact persons for the sub-project provided to affected persons and including the sign boards at construction sites, camps and each village that show the contact person information.

Figure 1: Concept of Proposed GRM



Note: AP = Affected Person, PMU = Project Management Unit, FWUC = Farmer Water User Community

Consultation / Interview Form

Date of Interview		Interviewer Name	
Interview Site: <i>Where is the interview held? In school, on the road, in shop</i>		Stakeholder Name & Status: <i>Full name, status is business owner, school teacher, religious leader, resident</i>	
Construction Site & Date Construction Started <i>Which road, GPS location if available</i>		Has this stakeholder been interviewed before? <i>Yes (when were they interviewed) No</i>	

Interview Discussion Points:

1. NOISE	Record of Discussion
Before the project started, was the person disturbed by noise? If yes, explain how and when. <i>Where did the noise come from? E.g. traffic, machinery, people, music</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
During the construction, is the person disturbed by noise from the project? If yes, explain how and when. <i>What type of noise and where did the noise come from? All day, at night, intermittently?</i>	
If noise from construction is a problem, what changes does the person suggest are made?	
2. AIR QUALITY	Record of Discussion
Before the project started, was the person affected by air pollution or dust? If yes, explain how and when. <i>Where did the pollution or dust come from? E.g. traffic, machinery, construction, burning garbage, cooking stoves</i> <i>When was the dust or pollution a problem? E.g. all day, at night, intermittently</i>	
During the project, is the person disturbed by dust or pollution? If yes, explain how and when. <i>What type of noise and where did the noise come from? E.g. increased traffic congestion, construction machinery, construction workers, burning construction garbage etc</i> <i>When did it disturb the person? E.g. all day, at night, intermittently</i>	
If dust or air pollution from the construction is a problem, what changes does the person suggest are made?	
3. VEGETATION AND LAND USE	Record of Discussion

<p>Before the project started, what was the vegetation like in the project area? <i>E.g. pasture land, trees, shrubs, rice fields.</i></p>	
<p>During the project, has the person found the vegetation situation has changed? If yes, explain how and when.</p>	
<p>If impact on vegetation is unacceptable, what changes does the person suggest are made?</p>	
4 COMMUNITY SAFETY	Record of Discussion
<p>Before the project started, can you describe the community safety situation in the project area? <i>E.g. no problems, some accidents, difficulty crossing the roads</i></p>	
<p>During the project, has the person found the community safety situation has changed? If yes, explain how and when. <i>Slower traffic so easier to cross the roads, construction vehicles are making a crossing harder / easier, more accidents / less accidents, construction site dangers</i></p>	
<p>If change in road safety is unacceptable, what changes does the person suggest are made?</p>	
5. WATER QUALITY	Record of Discussion
<p>Before the project started, was the person affected by poor water quality? If yes, explain how and when. <i>Ground water? Surface Water? Which Water source? How was it polluted?</i></p>	
<p>During the project, is the person affected by water pollution? If yes, explain how and when. <i>Ground water? Surface Water? Which Water source? How is quality being affected?</i></p>	
<p>If water quality from the construction is a problem, what changes does the person suggest are made?</p>	
6. ACCESS	Record of Discussion
<p>During the project, is the person affected by reduced access to their business, home or land? Access to what is limited, and how?</p>	
<p>If access limitations are not acceptable, please suggest changes which can be made?</p>	
7. OTHER ISSUES	Record of Discussion
<p>Any other issues about the construction sites that the person wants to discuss? <i>E.g. wastewater concerns, waste disposal, Other concerns, labor force,</i></p>	

GRM – Complaint Recording Form

PIU Staff Responsible: (name and role)	
Date: (of this record)	
Date of Complaint:	
Date Resolution Required by (15 days from initial complaint):	
Complaint Made by: (Name & Contact Details)	
Method of Complaint: (direct to PMU, via Contractor, Via Commune People's Council)	
Details of Complaint: (issues, actions taken so far, when did it start – all details needed)	
PMU Actions: (Next steps for PMU to resolve the issue or to move complaint to next level)	
Follow Up Actions Needed and Date: (PMU to follow up on resolution if needed, e.g. check contractor actions)	

Committee for Environment and Social Impact Assessment

(Decision Letter No. 15/18 on the Establishment the Committee for Environmental and Social Impact Assessment and monitor)

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ជាតិ សាសនា ព្រះមហាក្សត្រ

លេខ: ០៩៩/២០១៨.ស.ស.វ

សេចក្តីសម្រេច
ស្តីពី
ការបង្កើតគណៈកម្មការត្រួតពិនិត្យ និងវាយតម្លៃផលប៉ះពាល់បរិស្ថាន
និងសង្គមនៃការទាញស្រទាប់ស្រូវនៅក្នុងតំបន់ប្រាសាទបាវ៉ា

អធិបាល នៃ គណៈអធិបាលស្រុកត្រួតពិនិត្យ

បានឃើញអនុវត្តចាប់ពីថ្ងៃទី ១៤ ខែធ្នូ ឆ្នាំ២០១៨ របស់គណៈអធិបាលស្រុកត្រួតពិនិត្យ ក្នុងកិច្ចប្រជុំគណៈអធិបាលស្រុក
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សម្រេច

ប្រការ១: ត្រូវបានបង្កើតគណៈកម្មការត្រួតពិនិត្យ និងវាយតម្លៃផលប៉ះពាល់បរិស្ថាន សាមាស
 ភាព ដូចខាងក្រោម៖

១.លោក	ផែន ផល	អធិបាលស្រុក	ជាប្រធាន
២.លោក	ឌីអូ វ៉ាន	ប្រធានការិយាល័យស្រុក	ជាអនុប្រធាន
៣.លោក	ឈី វ៉ាន	ប្រធានការិយាល័យស្រុក	ជាសមាជិក
៤.លោក	ស៊ីន សំរុង	អធិការនៃអធិការដ្ឋាននគរបាលស្រុក	ជាសមាជិក
៥.លោក	ស៊ីន សុផល	មេបញ្ជាការនៃអធិការដ្ឋាននគរបាលស្រុក	ជាសមាជិក
៦.លោក	ឈី សុផល	ប្រធានការិយាល័យសាមាស	ជាសមាជិក
៧.លោក	គីន ផល	មេឃុំព្រៃក្រឡា	ជាសមាជិក
៨.លោក	ឌីអូ វ៉ាន	មេឃុំព្រៃក្រឡា	ជាសមាជិក
៩.លោក	មេឃុំព្រៃក្រឡា		ជាសមាជិក
១០.លោក	មេឃុំព្រៃក្រឡា		ជាសមាជិក

អំពីតួនាទីការពាររបស់គណៈកម្មការត្រួតពិនិត្យ និងវាយតម្លៃផលប៉ះពាល់បរិស្ថាន
និងសង្គមនៃការទាញស្រទាប់ស្រូវនៅក្នុងតំបន់ប្រាសាទបាវ៉ា

- ដឹកនាំ ត្រួតពិនិត្យ និងវាយតម្លៃផលប៉ះពាល់បរិស្ថាននៃការទាញស្រទាប់ស្រូវនៅក្នុងតំបន់ប្រាសាទបាវ៉ា

- លើកសំណើ និងផ្តល់យោបល់ជូនអភិបាលស្រុក ដើម្បីធ្វើការសម្រេចចិត្តក្នុងការដោះស្រាយបញ្ហាប្រឈមចំពោះមុខដែលបានកើតឡើងក្នុងពេលអនុវត្ត
- រៀបចំផ្សព្វផ្សាយឱ្យបានទូលំទូលាយអំពីគោលបំណងនៃការចុះសិក្សាវាយតម្លៃផល អ្នកពាក់ព័ន្ធ ដើម្បីអនុវត្តប្រកបដោយប្រសិទ្ធភាព
- បូកសរុបរបាយការណ៍ចុះវាយតម្លៃ ឬឯកសារពាក់ព័ន្ធខាង ចុងលោកអភិបាលស្រុក ពិនិត្យ និងសម្រេច ។

ប្រការ២: សេចក្តីសម្រេចទាំងឡាយណាដែលផ្ទុយពីនេះត្រូវចាត់ទុកជាឱកាសរំលោភ ។

ប្រការ៣: រដ្ឋបាលស្រុក ការិយាល័យពាក់ព័ន្ធ រដ្ឋបាលឃុំព្រែកដីក ឃុំព្រៃត្រពាំង និងអស់លោក លោកស្រី ដែលមានឈ្មោះក្នុងប្រការ១ ត្រូវអនុវត្តសេចក្តីសម្រេចនេះ ចាប់ពីថ្ងៃចុះហត្ថលេខាតទៅ ។

ថ្ងៃចុះហត្ថលេខា ៥/៩/២០១៨ ខែបឋមសាឍ ឆ្នាំច សំរឹទ្ធិស័ក ព.ស ២៥៦២

លោក ឧបនាយករដ្ឋមន្ត្រី ទី១ ឆ្នាំ២០១៨



ជ សម្បត្តិ

ចម្លងចុះ:

- ក្រុមប្រឹក្សាស្រុក
- រដ្ឋបាលឃុំព្រៃត្រពាំង
- អង្គភាព ការិយាល័យជំរឿនស្រុក
- សាលាឃុំ ពាក់ព័ន្ធ
- រដ្ឋបាល និងអនុវត្ត
- ឯកសារ កាលប្បវត្តិ

Appendix 2: CLIMATE RISK AND VULNERABILITY ASSESSMENT

CLIMATE RISK AND VULNERABILITY ASSESSMENT

I. OVERVIEW

A. Background

1. The overall goal of the Project is to assist the Government to improve the management and governance of existing irrigation systems, increase agricultural production, and improve the productivity of subproject areas with the aim to increase the incomes of poor farmers. The project will focus on increased efficiency of irrigation systems and improved management of water resources in the uplands areas away from the Tonle Sap.

B. Project Components

2. A long list of candidate subprojects was developed during the course of the PPTA, along with selection criteria for finalizing the preferred ones. These criteria identified the first two subprojects to be funded (called “core” subprojects). These are parts of the Taing Krasaing Scheme in Kampong Thom Province and the Prek Chik Scheme in Battambang Province (Figure A2.1).

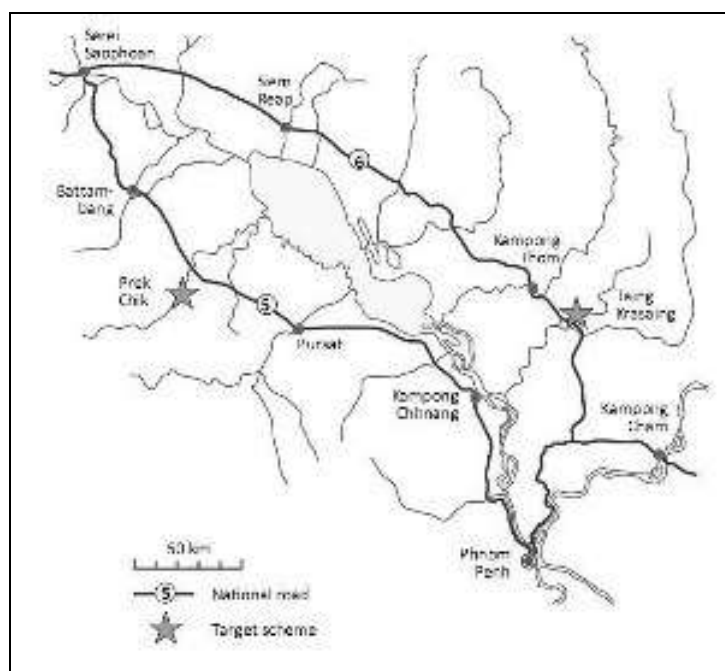


Figure A2.1: Location of Core Subprojects

3. The specifications of the proposed core subprojects in the Uplands Irrigation and Water Resources Management Sector Project comprise works to improve the headworks and main canal of each. Secondary and tertiary canals, as well as extensions to the main canal (in the case of Taing Krasaing) have been included in the “long list” which is covered by the Project Environmental Assessment and Review Framework.

4. Irrigated agriculture in both Kampong Thom and Battambang provinces is wet season rice-based. If sufficient water is available, a second crop of either rice or vegetables and fruits such as pineapple and water melon is sown. During dry season, many lands are observed to be fallow. In general, lands are quite level. In the wet season, the schemes also have drainage problems during the wet season; and water-logged areas are observed in several places.

5. Systems, in general, show poor maintenance of their facilities. Many canals are subject to embankment erosion, especially in the sandy soils. Recently built systems were observed

to be either still incomplete and under delayed construction or abandoned and not usable after just a few seasons. Several lined canal parts/systems were also observed as dry and not connected to a water supply.

6. Rice yields are low in general between 0.8-1.5 ton/ha. Seed quality is often poor. Most planting is broadcast, and requires both rain and some irrigation to meet the large needs of land soaking and land preparation.

C1. Taing Krasaing Scheme

7. The Taing Krasaing system is located some 25 km south-east of the city of Kampong Thom, close to National Highway No. 6, with Phnom Penh a 185 km drive away. The Taing Krasaing system is supplied by a simple reservoir with outlet-control gates on the Taing Krasaing River. The system was constructed during the period 1975–1978, underwent rehabilitation in 2000, and had partial sections improved and modernized in 2005 and 2012. The watershed upstream is estimated at some 1,100 km².

C2. Prek Chik Scheme

8. Construction of the 28 km long Preuk Chik canal, linked to the Brassac Reservoir via the Stung Dauntry, was started during 1977. It was unfinished when construction work ceased in late 1978. After 1979, the partly finished canal was largely unused until some small repairs were made by the Battambang PDWRAM in 2003. Major rehabilitation work was done by MOWRAM in 2010 using funding from the Japanese government with the aim of bringing the Prek Chik Canal into effective operation. This construction work was completed at the beginning of 2012. The MOWRAM rehabilitation plan focused on the main canal and its irrigation structures.

C3. Command Areas

9. Work on the two core subprojects will be on the main canals only. No extension of the main canal or secondary or tertiary irrigation canals are included in the core subprojects. However, rehabilitation of the irrigation systems starting with the refurbishment of the main canals and extending to later secondary and tertiary canals and their control structures will enable a greater area of irrigation to ultimately become available for cropping. The full irrigation command area must therefore be considered in assessing the sustainability of proposed water resource use under current circumstances and future impacts on sustainability due to climate change.

10. **Table A2.1** shows the potential changes in the irrigated area when the subprojects, including the secondary and tertiary canals, are complete.

Table A2.1: Increases in Irrigated Areas as a Result of the Project

	Taing Krasaing		Prek Chik	
	Before Project	After Project	Before Project	After Project
Irrigated Area (ha)	1,400	9,000	6,000	19,000

II. CLIMATE RISK SCREENING

A. Climatic and Hydrological Trends

11. The climates of the Battambang and Kampong Thom areas are characterized by distinct rainy and dry seasons. The southwest monsoon starts in May and lasts till October, while from November to April dry northeast weather patterns predominate.

12. For Battambang, the average annual rainfall ranges from 1200mm to 1300 mm, with peak rainfall occurring in September-October and the lowest rainfall in January. Temperature is lowest in December-January with an average minimum temperature of 26oC and the highest

in April with an average maximum of 34 °C. The wind direction during the rainy season is prevalent from south-west to north-east and from the south-west during the dry season.

13. For Kampong Thom, the rainfall is slightly higher, with average annual falls of 1300 mm, with peak rainfall occurring in September/October and the lowest rainfall in February. Temperature and wind patterns are similar to those of Battambang.

14. Total inflows to the Taing Krasaing system in Kampong Thom are shown in Figure A2.2 and Table A2.2 below. The yellow (m³/s) and orange (MCM) highlighted figures in Table A2.2 show the very low dry season flows.

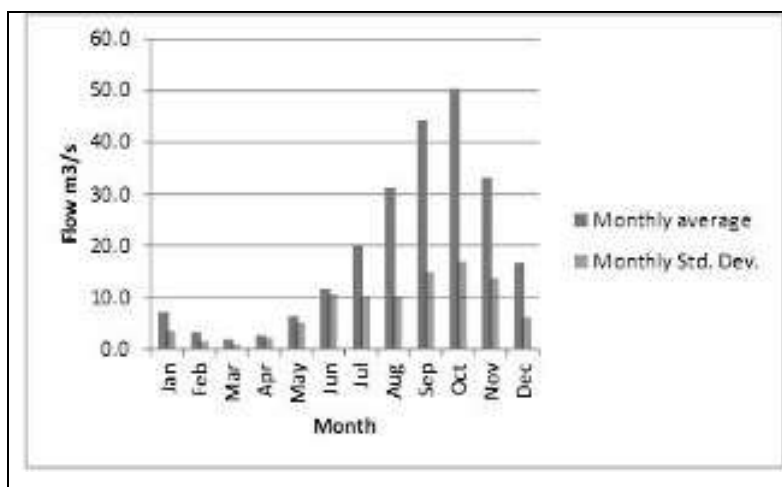


Figure A2.2: Taing Krasaing Monthly Average Inflows and Standard Deviation

Table A2.2: Total Taing Krasaing Inflows Monthly Average, Dry, Minimum and Maximum Flows

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m ³ /s)	7.1	3.2	1.8	2.6	6.3	11.6	20.2	31.3	44.2	50.4	33.2	16.6	19.1
Average (MCM)	19.1	7.8	4.9	6.7	16.9	30.2	54.0	83.8	114.6	135.0	86.1	44.6	603.5
Dry year (m ³ /s)	4.1	2.0	1.2	0.7	0.7	9.0	23.8	36.9	32.3	28.4	15.5	6.9	13.5
Dry year (MCM)	10.9	4.8	3.3	1.8	1.8	23.3	63.8	98.8	83.8	76.1	40.1	18.5	426.9
Max Year (m ³ /s)	16.2	7.1	3.3	9.2	16.8	53.1	41.5	52.3	76.2	87.9	74.9	32.8	28.4
Max Year (MCM)	43.4	17.2	8.8	23.8	44.9	137.7	111.2	140.0	197.5	235.4	194.2	88.0	900.1
Min Year (m ³ /s)	0.0	0.0	0.0	0.4	0.5	1.0	1.0	14.5	16.1	26.0	15.5	6.9	10.8
Min Year (MCM)	0.0	0.0	0.0	1.0	1.4	2.5	2.7	38.9	41.6	69.8	40.1	18.5	341.0

Note: The yellow (m³/s) and orange (MCM) highlighted figures show the very low dry season flows. Source: PPTA Consultant.

15. Total inflows to the Prek Chik system in Battambang are shown in Figure A2.3 and Table A2.3 below. The yellow (m³/s) and orange (MCM) highlighted figures in Table A2.3 show the very low dry season flows.

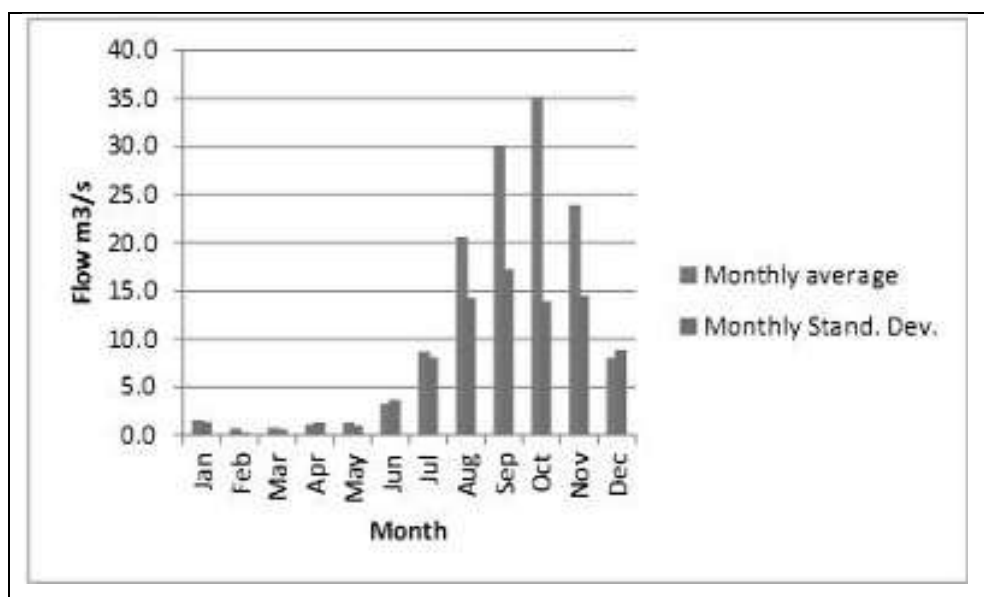


Figure A2.3: Prek Chik Monthly Average Inflows and Standard Deviation

Table A2.3: Total Prek Chik Inflows Monthly Average, Dry, Minimum and Maximum Flows

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m3/s)	1.5	0.8	0.8	1.1	1.3	3.3	8.7	20.6	30.2	35.2	23.9	8.0	11.3
Average (MCM)	4.1	1.8	2.1	3.0	3.5	8.5	23.4	55.3	78.2	94.2	62.0	21.5	357.7
Dry year (m3/s)	0.6	0.4	0.3	1.0	0.9	2.4	6.2	29.7	29.2	10.7	14.7	2.9	8.3
Dry year (MCM)	1.7	0.9	0.8	2.7	2.3	6.2	16.7	79.5	75.8	28.7	38.2	7.7	261.1
Max Year (m3/s)	6.3	1.4	2.7	6.1	3.6	16.8	36.0	45.5	67.0	64.6	53.9	34.4	19.2
Max Year (MCM)	16.9	3.5	7.2	15.7	9.7	43.6	96.5	121.8	173.6	173.0	139.7	92.2	607.8
Min Year (m3/s)	0.6	0.4	0.3	0.2	0.2	0.5	0.6	1.6	5.3	10.7	5.6	0.9	3.7
Min Year (MCM)	1.7	0.9	0.8	0.5	0.6	1.3	1.7	4.4	13.8	28.7	14.4	2.5	118.2

Note: The yellow (m3/s) and orange (MCM) highlighted figures show the very low dry season flows. Source: PPTA Consultant.

B. Floods and Extreme Weather Events

16. Flooding is a regular phenomenon in Cambodia, with rainfalls commonly exceeding 500mm per month in the rainy season. However, recent flooding in the Mekong region has been very damaging and the Mekong River Commission records show an increasingly shorter return period for major floods.

17. The table below compares data collected by NCDM in 2013 and 2011, at the peak of the floods in each year, by Province. Changes in the number of affected or evacuated families in 2013 compared to 2011 are highlighted.

Table A2.4: Affected and Evacuated Families in 2013 and 2011 (Kampong Thom and Battambang)

Province	2013	2011	Comparison (affected families) 2013 and 2011	2013	2011	Comparison (Evacuated families), 2013 and 2011
	affected families	affected families		Evacuated families	Evacuated families	
Battambang	74,160	13,921	+60,239	4,504	1,194	+3,310
Kg. Thom	17,463	54,414	-36,951	1,114	2,448	-1,334

Source: Humanitarian Response Forum (HRF), Final Report No.07, December 2013

18. Data on flooding at the subproject sites is unavailable, but national mapping of the 2011 and 2013 floods shows that the Taing Krasaing subproject was fully affected by these floods, and that the Prek Chik area was only marginally affected.

C. Climate Screening

19. The potential for the project to be affected by future climate change was considered during the Rapid Environmental Assessment (REA) undertaken by the ADB SEER Division during project planning, using the Checklist for Preliminary Climate Risk Screening for irrigation projects (Annex A).

20. The screening identified drought and floods as the key risk areas affecting siting/design, maintenance and performance. Droughts were identified as affecting water availability and requiring irrigation planning and careful calculation of crop water needs as a response. Floods were identified as dangers to canal walls and structures, which will need to be designed to withstand them.

21. The screening checklist summarized the potential climate risks as follows.

Table A2.4: Potential Climate Risks

Location and Design of project	Affected sections of the canals will be strengthened to withstand anticipated <u>floods</u> and landslides and drainage facilities will be improved. For <u>droughts</u> irrigation scheduling will be done based on crop water requirements and joint reservoir operation will be designed and adopted
Materials and Maintenance	<u>Floods</u> may affect the infrastructure if not designed to withstand those.
Performance of project outputs	<u>Droughts</u> may affect irrigation supplies

22. The overall score for potential climate risk was 3 (with no individual score of 2) and was assigned a medium risk category.

III. ASSESSING ADAPTATION NEEDS

23. The adaptation measures appropriate to the project are derived in a three step process namely: impact, vulnerability and adaptation analyses.

24. Impact assessments consider climate trends and climate predictions. The vulnerability assessment considers the degree to which the objectives of the irrigation subprojects could be adversely affected by climate change impacts. The assessment of adaptation in design and operation considers engineering and non-engineering solutions. Finally, the implementation of adaptation measures is described.

A. Impact Assessment

25. The result of modelling studies in the Initial National Communication (INC) and the Second National Communication (SNC) of the Cambodian National Climate Change Committee indicates that Cambodia's mean surface temperature has increased by 0.8°C since 1960, and that it will continue to increase at a rate of between 0.013°C and 0.036°C per year up to 2099. The rate of temperature increase will be higher in low altitude areas such as the subproject sites which are between 10 and 20 m ASL.

26. Under elevated CO₂ with low rate of emission scenarios (SRESB1), it is likely that wet season rainfall will continue to increase in future, and then might decrease again after 2050. But under high emission scenarios (SRESA2), the directions of change will reverse. The magnitudes of these changes are illustrated in the following graphs (Figure A2.4).

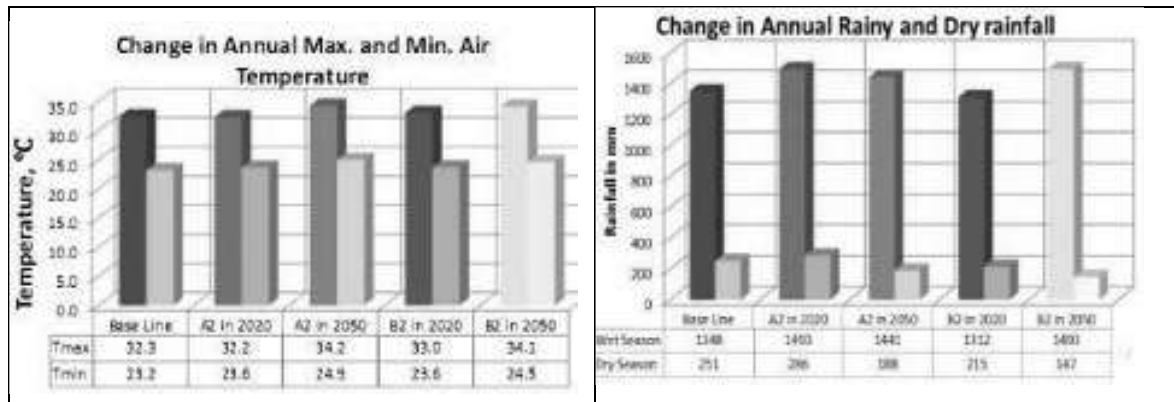


Figure A2.4: Graphs showing future scenarios for the critical agricultural parameters of temperature and rainfall. Scenarios are A2 (a more divided world) and B2 (a world more divided, but more ecologically friendly). Source: Sopharith, 2015

27. Climate change is expected to alter the current runoff and rainfall regimes. Climate change assessments for Cambodia indicate greater but more variable rainfall, increased crop water demand, more frequent and severe floods, droughts and wind storms.

28. Most of the increase in average annual rainfall predicted by models is expected to occur in the already wet months of the year, with only a minor or no increase over the dry season. The higher temperatures will increase crop water demands. These climate changes have the potential to influence both dry and wet season flow in the Project area.

29. The predicted changes in rainfall and temperature will combine to affect future irrigated water requirements (IWR). Figure A2.5 below shows predicted IWR for all SRES projections for nation states acting in isolation (A2 and B2 scenarios).

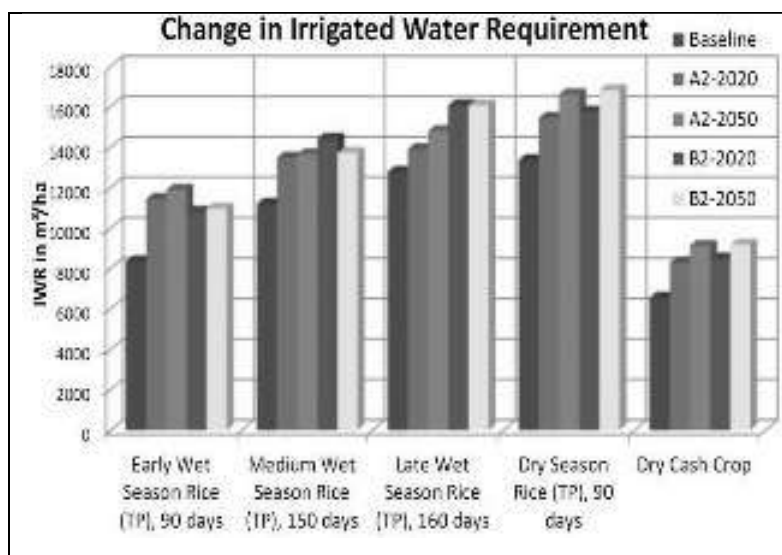


Figure A2.5: Irrigation water requirements from IPCC SRES. Source: Sopharith, 2015

B. Vulnerability Assessment

B1. Crop Water Demand

30. The subprojects will increase existing levels of water extraction for irrigation. The impact of this on existing water resources has been examined through seasonal water balances for each of the two cropping alternatives applicable to the subproject schemes.

31. The assumptions for calculating seasonal water balances are based upon cropping calendars for upland irrigated rice in the subproject provinces derived from consultation with farmers. These show two main cropping schemes:

a. Cropping alternative I: two short season (90 day) rice crops with the first in the first part of the wet season (May-Aug inclusive) followed by a second short season rice crop beginning in the last part of the wet season and extending into the early dry season (Sept-Dec inclusive); and,

b. Cropping alternative II: a single medium season (130 days) rice crop spanning the main wet season (July-Nov inclusive).

32. The PPTA also calculated the water needs for the cropping alternatives at a range of irrigation efficiencies (including water requirements for pre-saturation of paddy and establishment of a water layer for planting). All these calculations are presented in the core subprojects IEE.

33. The following seasonal water balances are based upon the inflow data for Taing Krasaing and Prek Chik calculated by the PPTA team with an irrigation efficiency of 40%. They compare seasonal water needs with water supply for the projected expansion of irrigation areas (total irrigated areas after the project of about 9,900 ha for Taing Krasaing, and about 10,400 ha for Prek Chik).

Table A2.5: Water Balance for a 9,000 ha Irrigation Area at Taing Krasaing

Taing Krasaing			
Wet Season			
Year	Crop	Water Need (MCM)	Water Available (MCM)
Low rainfall year	2x Short season variety (May-Aug) 90 day+	135	188

Taing Krasaing			
Wet Season			
	1x Medium season variety (July-Nov) 130 day+	144	473
Normal rainfall year	2x Short season variety (May-Aug) 90 day+	99	185
	1x Medium season variety (July-Nov) 130 day+	126	363
Dry Season			
Low rainfall year	1x Short season variety (Sept-Dec) 90 day+	162	277
Normal rainfall year	1x Short season variety (Sept-Dec) 90 day+	157.5	400

Note: 90 day+ and 130 day+ refers to the growing period plus land preparation. Source: PPTA team.

34. The shaded cells in the water balance show where water availability is sufficient for irrigation needs. The balance for Taing Krasaing shows that all cropping alternatives are sustainable and that surplus water exists for cash crops in addition to rice. The surplus of available water also indicates that other beneficial users of the water, either at the reservoir or directly from the main canal will not be disadvantaged.

35. For Prek Chik however the water balance indicates that only a 130 day (medium) crop grown July-November in a normal rain year is sustainable over the projected irrigation area. If the command area was smaller, more cropping options would become possible for the available water. However, the results for Prek Chik indicate that water is a significantly limiting factor and any level of irrigation use will have the potential to impact on other beneficial water uses.

36. The surplus water available for the Taing Krasaing irrigation system, shown by the water balance, indicates a relatively low vulnerability to increased crop water demand. However, the limited water availability shown in the Prek Chik water balance indicates a significant vulnerability to increased crop water demand.

B2. Flooding

37. The assessment of the condition and functionality of the schemes was undertaken by the PPTA team and the results are presented in as inventories DFR Appendix 2. The conditions which relate to floods are summarised as follows:

38. At Taing Krasaing, the headwork weir has severe erosion on the downstream side of the ogee crest. The damage has been caused by large magnitude flood flows over the weir. As water falls over the weir, creating shear stress on the rip-rap and inducing erosion. The foundations of the next weir immediately downstream have washed into the stilling pool. This structure is not performing its intended function to reduce sediment intake into the main canal. It should have lower sill level than the sill of the main canal. Similarly, the present under-sluice is located too distant from the main canal and its crest is too high, even higher than the ogee crest.

39. Cross regulators in the upstream reach of the canal show serious damage from piping through side walls and beneath the structures. The design of the structures does not include a stilling basin to dissipate energy before water re-enters the earthen section of the channel. This problem has caused collapse in the stone pitching and the canal embankments downstream. A similar situation exists for the off-take structures and drainage inlets that are located along the canal.

40. At Prek Chik, there are several breaches in both side canal embankments and severe scouring downstream of some cross regulators. These problems are caused by high flows which result from the diversion of flood water from the river during wet season. Problems with the operation of the existing automatic flapped gate weir and the duck bill weir downstream of Prek Chik Canal intake caused flooding. The automatic flap gate weir and the duck bill weir have insufficient capacity to pass river floods. Because the canal has been used to reduce the impacts of the flood resulting in Prek Chik canal flows exceeding its conveyance capacity.

41. There are insufficient cross drainage works at Prek Chik. Wet season paddy cultivation on the southern side of the scheme is affected by flooding caused by the natural runoff from the southern mountain range and backing up by the right canal bank.

42. These findings indicate that there is a significant vulnerability in both schemes to increased flooding as a result of climate change.

C. Adaptation Assessment

43. The crops of interest for Taing Krasaing are early wet season rice and late wet/dry season rice (both 90 day crops). For Prek Chik the relevant crop is medium wet season rice. The projections show that IWR for these crops will be in the following ranges in 2020 and 2050:

Table A2.7: Predicted IWRs from Climate Change and IWRs Used in Subproject Water Balances

Prek Chik			
Wet Season			
Year	Crop	Water Need (MCM)	Water Available (MCM)
Low rainfall year	2x Short season variety (May-Aug) 90 day+	285	105
	1x Medium season variety (July-Nov) 130 day+	304	239
Normal rainfall year	2x Short season variety (May-Aug) 90 day+	209	91
	1x Medium season variety (July-Nov) 130 day+	266	314
Dry Season			
Low rainfall year	1x Short season variety (Sept-Dec) 90 day+	342	150
Normal rainfall year	1x Short season variety (Sept-Dec) 90 day+	332.5	256

Source: PPTA Team

44. Table A2.7 shows that when the IWRs from future climate change scenarios are compared with the IWRs being used for subproject design the project design IWRs are consistently higher and already allow for the eventuality of future increased water demand in both 2020 and 2050.

45. Increases in rainfall are predicted in future scenarios for 2020 with a decrease to near present levels in 2050. Flooding events are expected to occur with greater frequency. The

current poor condition of the structural elements at both Taing Krasaing and Prek Chik is largely due to their inability to cope with flood flows, compounded by low maintenance efforts. The redesign and refurbishment of the schemes offers many opportunities to correct this, and to provide robust structures for future flooding.

46. Additionally, the need to drain wet season flooding of cultivation areas will be highlighted in the short to medium term. The works designed for the two main canals include refurbishment of all cross drainage structures (which drain flood water from farmland). The majority of these have been inoperative for many years and their restoration to working order will alleviate local flooding and predicted flooding.

D. Implementation

47. The Cambodia Climate Change Strategic Plan, 2014 – 2023 (CCCSP) identifies two strategic objectives to enhance adaptation to the impacts of future climate change. Strategic Objective 1 (Promote climate resilience through improving food, water and energy security) includes a provision to ... Rehabilitate and build water infrastructures including small-, medium- and large-scale irrigation schemes. Strategic Objective 2 (Reduce sectoral, regional, gender vulnerability and health risks to climate change impacts) includes Enhance the quality of rural infrastructure (roads, irrigation, wells and culverts) to be resilient to flood and drought. The implementation of the core subprojects will be in line with these strategic objectives.

D1. Project Response to Drought and Increased Crop Water Demand

48. The TA team has confirmed that the IWR calculations used in the subproject designs are consistently higher than the future increased water demand calculated for climate change scenarios for both 2020 and 2050. This means that IWRs from future climate change scenarios have already been incorporated in subproject designs. Table A2.8 shows the percentages by which design IWRs exceed predicted IWRs.

Table A2.8: Predicted IWRs from Climate Change and IWRs Used in Subproject Water Balances

Crop	Predicted IWR in 2020 (m ³ /ha)	IWR used in subproject design are higher by ...	Predicted IWR in 2050 (m ³ /ha)	IWR used in subproject design are higher by ...
Early wet season rice	10,000-12,000	25-50%	10,000-12,000	25-50%
Late wet/dry season rice	15,000-16,000	12.5-20%	16,000-17,000	6-12.5%
Medium wet season rice	13,000-14,200	12.5-23%	13,000-14,000	14-23%

49. The design IWRs for the subprojects already exceed the additional water requirements predicted for 2020 and 2050 by between 6% and 50%, so adaptation for this effect of climate change has been addressed.

50. Additionally, the PPTA team has also calculated irrigation efficiencies with and without the project for the Taing Krasaing and Prek Chik schemes. The total irrigation efficiency is shown in Table A2.9 below as et.

51. This shows that the subproject designs will be increasing irrigation efficiency in the irrigation schemes significantly (from <5% to 40% in Taing Krasaing and from 15% to 40% in Prek Chik). These gains in irrigation efficiency will be important adaptation measures against future drought and higher water demand conditions caused by climate change.

Table A2.9: Irrigation Efficiencies for the Subprojects

Table on Irrigation Efficiencies					
	In Percent (%) All numbers estimates/approximates	e_c	e_d	e_a	e_t
1.a	Taing Krasaing – If operated as is (WITHOUT – Before)	<5	<5	<5	
1.b	Taing Krasaing –upon modernization (lining) WITH At start	(70)	(60)	(40)	17
1.c	Taing Krasaing – WITH after 5 years	(70)	(70)	(50)	25
1.d	Taing Krasaing – WITH after 10 years	(70)	(80)	(70)	40
	Compare to CAVAC Area south of Taing Krasaing and Chraob as is Today	(70)	80	70	40
2.a	Prek Chik – if operated as is – water supply restored	(60)	(60)	(40)	15
2.b	Prek Chik –upon modernization (no lining) WITH Project	(70)	(60)	(50)	25
2.c	Prek Chik – With after 5 years	(70)	(80)	(70)	40

e_c = conveyance efficiency; e_d = distribution efficiency; e_a = field application efficiency; e_t = total efficiency.

Source: DFR Volume 2, Appendix 4.

52. Non-structural adaptations to future drought and higher water demand conditions caused by climate change will be primarily addressed by operational procedures for the sustainable and responsible management of irrigation schemes. These will ensure that agreed irrigation and base flows are maintained and other beneficial water users are not disadvantaged. They will provide a clear and detailed extraction plans for the growing seasons. The plans will be prepared by the PMU in consultation with FWUCs, as a prerequisite for project commencement. This will be part of the larger Joint Reservoir Operations Plans (JOROP) which will be developed by the PMU and FWUCs in collaboration with the Project Management and Implementation Consultants (PMIC). Operational plans and operating practices for water allocations and drainage will be prepared by the PMU with support from PMIC and by involving FWUCs during implementation, and will be adopted by PDWRAM and FWUCs before completion of works on main canals.

D2. Project Response to Increased Flood Potential

53. Currently floods overtop canal regulatory structures and canal walls on an indicated flood return period of 1 in 5 years. The PPTA team has calculated design flood levels and flows for structures along the main Taing Krasaing and Prek Chik canals. These are shown in Tables A2.10 and A2.11.

Table A2.10: Design Flood Estimates for Taing Krasaing Subproject

	Taing Krasaing weir (1 in 100)	Taing Krasaing Canal siphon (1 in 50)	Stung Chinit weir (1 in 100)	Downstream Taing Krasaing weir (1 in 50)
Design flow (m ³ /s)	494	6.2	1920	490

Table A2.11: Design Flood Estimates for Prek Chik Subproject

	Prek Chik offtake (1 in 50)	Prek Chik Canal siphon 1 (1 in 50)	Prek Chik Canal siphon 2 (1 in 100)
Design flow (m ³ /s)	410	130	120

Source: PPTA Consultant, 2015

54. Design of structures for these significantly higher flood return periods have been incorporated in subproject planning. Canal walls will be reconstructed where needed and strengthened to withstand the above design flood flows and drainage facilities will be improved. Headworks spillways, sluice gates and weirs will be provided with erosion/scour protection to maintain the integrity of control structures against high energy flood flows. The crest height of control gates will be adjusted above the 1 in 100 year level to direct flood waters to control release sluices rather than overtopping and scouring.

55. Typical canal rehabilitation along high flow sections will involve replacement of structurally unsuitable material combined with an installed lining inside the canal slopes (Figure A2.6). This will retain a natural canal bed and benthic environment for the limited canal fisheries but protect side walls from flood scouring and failure.

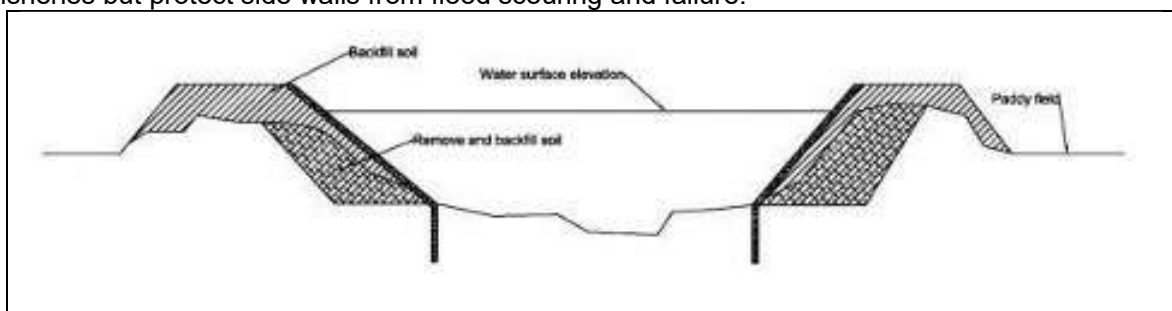


Figure A2.6: Typical canal rehabilitation incorporating side wall lining.

56. All cross regulators will be equipped with energy dissipation basins to ensure that excessive kinetic energy is dissipated before entering the earth channel section of the canals.

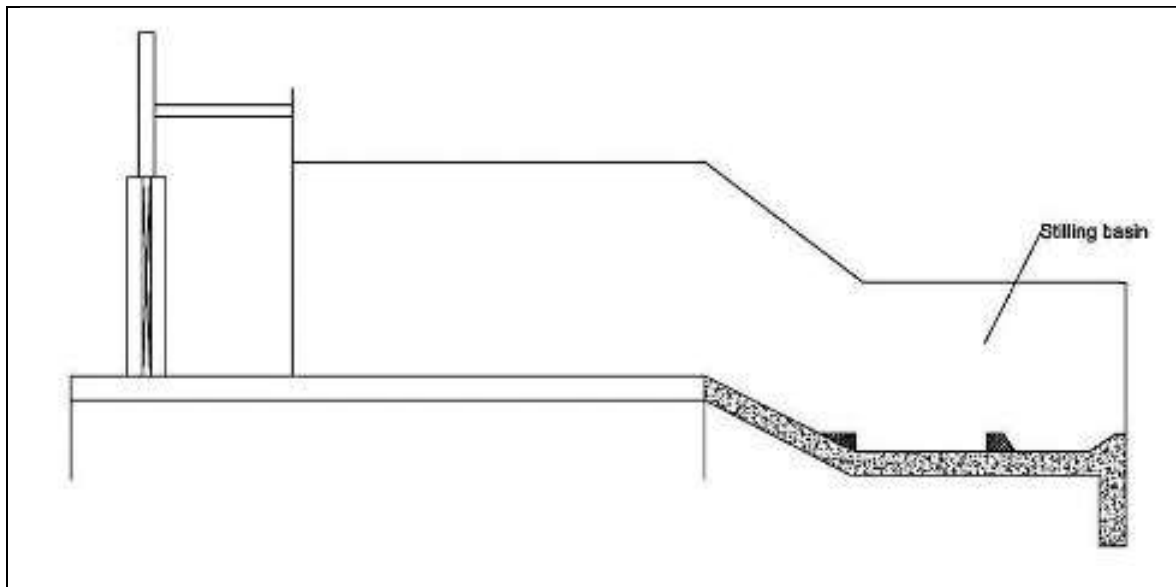


Figure A2.7: Downstream Erosion and Scour Protection of Cross Regulators on Main Canals

57. Cross-drainage of flood waters will be controlled by the construction of intercept drains on both sides of the main canals running parallel to the side canal embankments along their outside edges. The intercept drains will function to gather excess surface runoff from both sides of the canal and convey the accumulated water into the armored invert syphon to discharge safely into the canal.

D3. Watershed Management

58. Improved watershed management will act towards decreasing the flood potential and increasing the water availability of the irrigation schemes. Problems identified by the PPTA team were:

- a. Both the Taing Krasaing and the Prek Chik watersheds are in a state of degradation. There is a clear scope for rehabilitation across vegetation cover, topsoil management and surface drainage. The reservoirs in both core sites suffer from siltation, reportedly with increasing rates.
- b. There are strong indications of the economic, social and environmental benefits of improved watershed management for land owners, concessionaires and water users.
- c. The Taing Krasaing watershed is partly covered by land concessions, while there are no such concessions in the Prek Chik watershed.
- d. Watersheds improvement requires active participation (at the national and sub-national level) by MAFF and its Forestry Administration.

59. Many measures to directly improve the condition and performance of the watersheds supplying the irrigation schemes are outside the mandate of the project executing agency, MOWRAM. Corrective and preventative actions to improve watershed health have been considered by the PPTA and are discussed in the Draft Final Report Volume 2 Appendices. Actions common to the management of both subproject irrigation schemes include:

- a. Sediment control structures upstream of the supply reservoirs.
- b. Discontinuation of irregular forest clearance and replacement with voluntarily reforestation and fruit tree plantation.
- c. Re-development of idle lands (including reforestation and sustainable forest utilization).

- d. The potential for risk management and damage control related to forest fires should be considered
- e. Technological support and extension services in support of appropriate soil management.

60. Improvement of the Taing Krasaing watershed will also involve awareness-building and promotion of 'good practices', supported by documentation of the achievable, tangible benefits. Upgrading the Prek Chik watershed will involve technical and financial support to community- based, sustainable forestry, re-activating the dormant forestry community and provision of technological and extension services support.

APPENDIX 3: PUBLIC CONSULTATION MEETING WITH RELEVANT STAKEHOLDERS

List of Participants in Public Consultation Meeting of Taing Krasaing Irrigation System – Chroab Distribution System (MOWRAM/NCB – CW-03)

UPLAND IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR PROJET
LAND ACQUISITION, RESETTLEMENT AND COMPESNSATION (LARC)

បញ្ជីចូលរួម

ល/រ	ឈ្មោះ	ភេទ	តួនាទី	អង្គភាព	ហត្ថលេខា	ទូរស័ព្ទ
1	ឧប-ប្រធាន	ប	សម្រាប់សហគមន៍	U/HRMSP		012945190
2	គេ.កម្មវិធីបេតុង	ស	ផ្នែកបេតុង	U/HRMSP		012484378
3	ប្រធាន	ប	ផ្នែកបេតុង			012762578
4	ប្រធាន	ប	បេតុង	ប្រធាន		077509074
5	ប្រធាន	ប	បេតុង	ប្រធាន		0714459351
6	ប្រធាន	ប	បេតុង	ប្រធាន		0972982032
7	ប្រធាន	ប	បេតុង	ប្រធាន		0975986482
8	ប្រធាន	ប	បេតុង	ប្រធាន		0976711545
9	ប្រធាន	ប	បេតុង	ប្រធាន		099020864
10	ប្រធាន	ប	បេតុង	ប្រធាន		012851630
11	ប្រធាន	ប	បេតុង	ប្រធាន		017382-558
12	ប្រធាន	ប	បេតុង	ប្រធាន		095788243
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List of Participants in Public Consultation Meeting of Taing Krasaing Irrigation System – Korkoah Distribution System (MOWRAM/ICB – CW04)

UPLAND IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR PROJECT
LAND ACQUISITION, RESETTLEMENT AND COMPENSATION (LARG)

បញ្ជីចូលរួម

ល.រ	ឈ្មោះ	ភេទ	តំណក់	អង្គភាព	ហត្ថលេខា	ទូរស័ព្ទ
1	គាប-សិរីសុវណ្ណ	ប	និរ្ទាតិសម្រាប់	UWACF	<i>[Signature]</i>	012945190
2	ច័ន្ទ ធីតា	ប្រុស	ឧបនាយក	កង្កែប	<i>[Signature]</i>	012373427
3	ធីតា សិរី	ប្រុស	និរ្ទាតិសម្រាប់	U	<i>[Signature]</i>	017839304
4	សុខ ធីតា	ប្រុស	—	—	<i>[Signature]</i>	0387822845
5	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	085354499
6	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	017325611
7	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	092802410
8	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	014883313
9	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	0978633248
10	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	082.34.21.77
11	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	0974631517
12	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	076666471
13	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	012488378
14	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	012 762528
15	សុខ ធីតា	ប្រុស	និរ្ទាតិសម្រាប់	ក្រុមហ៊ុន	<i>[Signature]</i>	092920867
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List of Participants in Public Consultation Meeting of Prek Chik Irrigation System – Distribution System Package I (MOWRAM/ICB – CW07)

បញ្ជីចក្ខុវិស័យ

ស្តីពីការកែលម្អប្រព័ន្ធកសិកម្មប្រេកជីក

នៅភូមិ.....ឃុំ តាវត្សកមោឃបុរី ខេត្តបាត់ដំបង

ថ្ងៃទី ២១ ខែ មិថុនា ឆ្នាំ ២០១៦

ល.រ	ឈ្មោះអ្នកចូលរួម	ភេទ	ស្ថានភាព	មុខរបរ	ស្នាក់នៅ	លេខទូរស័ព្ទ
១	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
២	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៣	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៤	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៥	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៦	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៧	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៨	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
៩	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
១០	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
១១	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
១២	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
១៣	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧
១៤	ឈ្មោះ ហ៊ុន ហ៊ុន	ប	អគ្គនាយក	អគ្គនាយកដ្ឋានប្រកួតប្រជែង	ភ្នំពេញ	០៩៧៥៥៤៤៨៧

List of Participants in Public Consultation Meeting of Prek Chik Irrigation System – Distribution System Package II (MOWRAM/ICB – CW08)

UPLAND IRRIGATION AND WATER RESOURCES MANAGEMENT SECTOR PROJECT
LAND ACQUISITION, RESETTLEMENT AND COMPENSATION (IARC)
Dec 22, 2016
បញ្ជីអ្នកចូលរួម Environmental and Resettlement Screening (PCTI-CW08)

ល.រ	ឈ្មោះ	ភេទ	តួនាទី	អង្គភាព	ហត្ថលេខា	ទូរស័ព្ទ
1	ឈ. ភិរស្ស/ន	ប	Resettlement	PMIC	Southern	012945190
2	គឹម ឈន់	ប	Technical Assistant (MOWRAM)			012851630
3	គឹម ភិរស្ស/ន	ប	Engineers, Consultant			012888451
4	គឹម គីន	ប	CME	PMIC		077300189
5	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		012488378
6	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		012203259
7	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		017507855
8	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		017797529
9	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		012443543
10	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		096781285
11	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		012602837
12	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		089654946
13	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		077297581
14	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		094410825
15	គឹម ភិរស្ស/ន	ប	Environmental	PMIC		09439952
16						
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**APPENDIX 4: PICTORIAL OF NATURAL RESOURCES
FOUND IN THE PROJECT BOUNDARY**

Fish Species Found at Prek Chik Irrigation System – Distribution System Package II
(CW-08)

