Initial Environmental Examination

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Cambodia: Tonle Sap Poverty Reduction and Smallholder Development Project (Additional Financing)

Prepared on behalf of the Ministry of Agriculture, Forests and Fisheries for the Asian Development Bank (ADB).

CURRENCY EQUIVALENTS

(as of 7 June 2017)

Currency unit	–	Cambodian Riel (KR)
KR1.00	=	$0.000245
$1.00	=	KR4,076

ABBREVIATIONS

ADB	–	Asian Development Bank
AF	–	additional financing
CARD	–	Council for Agriculture and Rural Development
CCAM	–	Conformal Cubic Atmospheric Model
CDP	–	commune development plan
CDRA	–	climate and disaster risk assessment
CSIRO	–	Commonwealth Scientific and Industrial Research Organisation
DRR	–	disaster risk reduction
DSC	–	Design and Supervision Contractor
EARF	–	Environmental Assessment and Review Framework
EHS	–	Environmental, Health and Safety
EIA	–	environmental impact assessment
ESO	–	Environmental Safeguards Officer (National)
EMP	–	environmental management plan
GHG	–	greenhouse gas
GRM	–	grievance redress mechanism
ICT	–	Information and Communication Technology
IEE	–	Initial Environmental Examination
IPCC	–	Intergovernmental Panel on Climate Change
IPM	–	Integrated Pest Management
IWR	–	Irrigation Water Requirement
ESCC	–	Environmental Safeguards and Climate Change Specialist (of the PIC)
LIG	–	livelihood improvement group
MAFF	–	Ministry of Agriculture, Forest and Fisheries
MCA	–	mobile commune access
MOE	–	Ministry of Environment
MOWRAM	–	Ministry of Water Resources and Meteorology
NCDDS	–	National Committee for Sub-National Democratic Development Secretariat
PPTA	–	project preparatory technical assistance
PRC	–	procurement review committee
PST	–	provincial support team
RCP	–	Representative Concentration Pathway
SRES	–	Special Report on Emission Scenarios
SSP	–	special service provider
TSSD	–	Tonle Sap Poverty Reduction and Smallholder Development

US EPA	–	United States Environmental Protection Agency

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
kW	–	kilowatt
kWh	–	kilowatt-hour
m	–	meter
m^2	–	square meter
m^3	–	cubic meter
mm	–	millimeter

NOTE

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

EXECUTIVE SUMMARY

A. Background

1. This report is prepared as part of the Asian Development Bank (ADB) project preparatory technical assistance (PPTA) TA9167-CAM: Tonle Sap Poverty Reduction and Smallholder Development Project (TSSD) - Additional Financing (AF). This PPTA is based on agreement between ADB and the Royal Government of Cambodia (the government).

2. 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.

3. The impact of the overall project, which is aligned with the Cambodia Country Partnership Strategy 2014-2018, ADB's Assessment, Strategy and Roadmap for the Agriculture, Natural Resources and Rural Development Sector, and the government's Rectangular Strategy for Growth, Employment, Equity, and Efficiency Phase III, will be improved livelihoods and resilience in target communes in seven provinces (Banteay Meanchey, Battambang, Kampong Cham, Kampong Thom, Prey Veng, Siem Reap, and Tboung Khmum provinces) in the Tonle Sap Basin by 2023. The outcome of the overall project will be agricultural productivity increased, climate resilience strengthened, and access to markets improved in 271 communes in seven provinces in the Tonle Sap Basin. This will include improved rural infrastructure, improved agricultural support and rural financial services, increasing diversification of household economic activities, and the creation of on- and off-farm livelihood opportunities.

4. The project will focus on assisting communities establish livelihood improvement strategies for resource-poor farming households with assets that give them the potential to increase their farm based income. Outcomes will be measured on the basis of (i) average rice yields increasing to more than 3.5 t/ha; (ii) average rice yields of ID Poor households in target communes increased to minimum 3.0 t/ha for wet season rice production; (iii) diversified farming systems reduce share of household income from rice by 20%; (iv) marketed farm and off-farm products increased by 25%; and (v) awareness of climate smart agriculture and disaster risk reduction (DRR) planning increased.

5. The project has three major Outputs:

6. Output 1: Rural productive infrastructure and livelihood improved with capacity in disaster risk management enhanced.

(i) rural roads, small scale irrigation, and other production related infrastructure;
(ii) support to new and old livelihood improvement groups (LIGs); and
(iii) Capacity building in disaster risk management.

7. Output 2: Improved enabling environment for increased agricultural productivity, diversification and climate resilience created.

(i) Value chain and agribusiness support;
(ii) Support to market improvement groups; and
(iii) ICT/Mobile Commune Access (MCA) program.

8. Output 3: Project management strengthened.

B. Project Components

9. Under Output 1 the project will invest in commune infrastructure development focusing on improvements in irrigation and village roads. A long list of candidate subprojects in irrigation and roads 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 (referred to as "core" subprojects). These are the **Lvea Commune irrigation rehabilitation** in Prey Veng Province and the **Banthaey to Chbar village road rehabilitation** in Kampong Cham Province.

10. The two proposed core subprojects which are the subject of this initial environmental examination (IEE) and environmental management plan (EMP), comprise works to improve selected secondary canals of an irrigation command area in Lvea commune and to rehabilitate and enhance flood resilience of a small rural road running between villages in Banthaey and Chbar communes. These subprojects are considered representative of the types of subprojects that will be prepared after board approval. An environmental assessment and review framework (EARF) has been prepared setting out environmental screening, assessment and reporting requirements for subsequent subprojects.

C. The Initial Environmental Examination Report

11. The objectives of the IEE report are to:

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

12. The IEE was prepared following the formats in the ADB Safeguards Policy Statement (SPS, 2009).

13. ADB projects are assigned to an environment category depending on the significance of the potential environmental impacts and risks. This project has been classified as Category B for environment. The impacts of such projects are judged to be site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects. An IEE, including an EMP is required.

14. Since the subprojects involve the refurbishment of existing small-scale infrastructure, they do not require environmental impact assessment under government sub-decree No. 72 ANRK.BK.

15. The two core subprojects which are the subject of this IEE have been chosen using a set of selection criteria which included environmental screening. This ensured that candidate subprojects with significant adverse environmental impacts that are irreversible, diverse, or unprecedented were not included. The full list of environmental selection criteria is in Section V.A.

D. Assessment Findings

16. Pre-construction and design issues for the irrigation subproject focus on matching the total irrigation area for a new dry season crop to the availability of water. For the road rehabilitation subproject, careful design will be needed to ensure a longer flood-free access period than is presently the case and through-drainage of the road embankment so that it does not act as a flood barrier, but which also protects the integrity of paddy dykes for individual field inundation and drainage for rice growing during non-flood periods.

17. During construction of both subprojects, the main issues will be air and water pollution and soil erosion, all of which must be managed by strict control of construction contractors and effective implementation of EMP mitigation and monitoring measures. Additional localized traffic congestion is anticipated and this must be minimized by responsible transport planning. Health and safety of construction workers and the community is also, as always, a primary concern.

18. Post-construction, the main concerns for the irrigation subproject 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. There is also a concern that the irrigation scheme must be sustainable and responsibly managed, to ensure that agreed irrigation flows are maintained and other water users are not disadvantaged.

19. Post-construction impacts for the village road rehabilitation subproject will be from noise and dust from traffic and road safety issues. Increases in traffic impacts will be limited since the road will not open up new access or opportunities. Rather, it will provide an increased certainty of getting to and from markets and services for the villages it connects.

20. 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 implementing agency's Environmental Management Officer and the commune councils.

21. The project's civil works will be complemented by a wide range of capacity building and livelihood integration and diversification activities. Particularly relevant to the environmental impact of the civil works is commune-based DRR which will be supported by the project through the preparation of a commune action plan and training plan for DRR relevant to the irrigation and village road subprojects. This will be integrated with existing Cambodian government national DRR training and planning programme through the National Committee for Disaster Management Secretariat, which aims to undertake all commune level DRR training and planning.

22. Greenhouse gas (GHG) emissions from the increased area of paddy as a result of the subprojects total approximately 968 tons/annum.

23. Adaptation to predicted future increases in irrigation water demand in the subproject areas have been covered in the design by the use of conservative estimates of irrigation water requirements (IWRs) for potential cropping patterns. The IWRs which were used in the water availability analysis already exceed the predicted crop water demands in 2020 and 2050 under climate change by 20% and 10% respectively, so the irrigation design is already climate change adapted. Key adaptation measures for the village road subproject focus on flood resilience from seasonal floods and extreme weather events.

24. The rapid environmental assessment for the project identified a medium climate risk. Therefore, a climate and disaster risk assessment (CDRA) was undertaken for the whole project[1] and its recommendations incorporated into project design. These include improving irrigation efficiency through conveyancing improvements, irrigation management, raising of road surface above normal flood level and significantly increasing the number of culverts and capacity of flow-through drainage structure.

E. Capacity Building

25. The project includes extensive capacity building outputs directed at support to LIGs and FWUGs, promotion of value chain arrangements for produce, introduction of ICT and MCA technology for agricultural extension and capacity in agricultural machinery. These will include specialized training which will cover environmental management measures in agricultural chemicals and water resource management which are identified in this IEE.

F. Public Consultation

26. Public consultation commenced in the core subproject communes in March 2017, with information dissemination meetings in Lvea commune, Prey Veng, on 7-8 March 2017 and at the Banthaey and Chbar Ampov communes, Kampong Cham, on 10 March 2017. This was followed by a round of public consultation in the second half of April 2017 in all three communes in conjunction with the project household surveys.

G. Grievance Redress Mechanism

27. A project-specific grievance redress mechanism (GRM) has been established to receive and manage any public environmental issues that may arise due to the project. The environment officer in the implementing agency will coordinate the GRM. All project agencies and staff will be initiated into the GRM procedures by the implementation team and will take an active role in supporting the GRM when necessary.

H. Environmental Management Plan

28. The 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.

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

[1] This used climate change scenarios in current ADB projects in rice and roads as well as the ADB Guidelines for climate proofing agriculture and transport infrastructure.

I. LEGAL AND ADMINISTRATIVE FRAMEWORK

1. This initial environmental examination (IEE) has been prepared for two core subprojects of the Additional Financing (AF) to the Tonle Sap Poverty Reduction and Smallholder Development Project (TSSD) in the Kingdom of Cambodia. It has been designed to satisfy both ADB and relevant Cambodian environmental guidelines and regulations.

A. ADB Environmental Requirements

2. On the basis of subproject screening in the feasibility stage, using a rapid environmental checklist, the subprojects have been determined to be Category B for environmental impact as impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for Category A projects. This consolidated IEE has been prepared under the provisions of the ADB's Safeguard Policy Statement (SPS) 2009 which requires a number of critical considerations, including: (i) project level grievance redress mechanism (GRM), including documentation in the environmental management plan (EMP); (ii) physical cultural resources damage prevention analysis; (iii) climate change mitigation and adaptation; (iv) occupational and community health and safety requirements, including emergency preparedness and response); (v) economic displacement that is not part of land acquisition; (vii) meaningful consultation and participation; and (viii) an EMP which comprises implementation schedule and (measurable) performance indicators.

B. Cambodian Government Environmental Regulations

1. Law on Environmental Protection and Natural Resource Management

3. 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:

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

4. Under this law the developers or project owners need to prepare an initial environmental impact assessment or a full environmental impact assessment (EIA) report for their proposed or existing development projects.

2. Environmental impact assessment process sub-decree

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

(i) to determine an EIA for every private and public project or activity, through review by the Ministry of Environment (MOE), prior to the submission for a decision from the government;
(ii) to determine the type and size of the proposed project(s) and activities, including existing and on-going activities in both private and public sector prior to undertaking the process of EIA; and
(iii) to encourage public participation in the implementation of the EIA process and take into account their input and suggestions for re-consideration prior to the implementation of any project.

6. The sub-decree includes an annex which provides a schedule of developments which require EIA. An excerpt for relevant industries is at Table 1 below.

Table 1: List of Projects Required an Environmental Impact Assessment

No.	Type and activities of the projects	Size / Capacity
B.	**AGRICULTURE**	
1.	Concession forest	≥ 10,000 Hectares
2.	Logging	≥ 500 Hectares
3.	Land covered by forest	≥ 500 Hectares
4.	Agriculture and agro-industrial land	≥ 10,000 Hectares
5.	Flooded and coastal forests	All sizes
6.	Irrigation systems	≥ 5,000 Hectares
7.	Drainage systems	≥ 5,000 Hectares
D	**INFRASTRUCTURE**	
1.	Urbanization development	All sizes
2.	Industrial zones	All sizes
3.	Construction of bridge-roads	≥ 30 Tonnes weight
4.	Buildings Height	≥ 12 meter or floor ≥ 8,000 square meter
5.	Restaurants	≥ 500 Seats
6.	Hotels	≥ 60 Rooms
7.	Hotel adjacent to coastal area	≥ 40 Rooms
8.	National road construction	≥ 100 Kilometres

Source: Sub-Decree No. 72 ANRK.BK on Environment Impact Assessment Process. 1999.

7. **Irrigation subproject.** Since subproject complies with the selection criteria and will involve the refurbishment of existing irrigation canals providing water for an additional 344 hectare (ha) only, it will not require environmental impact assessment under sub-decree No. 72 ANRK.BK.

8. **Village road subprojects.** The rural village road rehabilitation and realignment does not qualify as national road construction and will be in the range 5-10 kilometer. Drainage structures and culverts will be rated for farm vehicles, farm machinery and small haulage, with maximum loads of 10-15 tons. It will therefore not require environmental impact assessment under the government's regulations.

C. Evaluation Standards

1. Law on the Management of Pesticides and Fertilizers

9. The Law on the Management of Pesticides and Fertilizers was enacted on 14 January

2012. This law has the following objectives:

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

10. The scope of the law shall apply to the management and the implementation of standard requirements for:

(i) 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; and
(ii) 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

11. The Law on Water Resources Management was adopted 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 socio-economic development and the welfare of communities.

12. The Law determines:

(i) the rights and obligations of water users;
(ii) the fundamental principles of water resources management;
(iii) the institutions in charge of its implementation and enforcement; and
(iv) the participation of users and their associations in the sustainable development of water resources.

13. Under this law, the Ministry of Water Resources and Meteorology (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

14. 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 bio-diversity can be ensured.

15. 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

No	Parameter	Unit	Standard Value
A. River			
1	pH	mg/l	6.5 – 8.5
2	BOD_5	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coli-form	MPN/100ml	< 5000
B. Lakes and Reservoirs			
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1 – 8
3	Suspended Solid	mg/l	1 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	0.1 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05
C. Coastal water			
1	pH	mg/l	7.0 – 8.3
2	COD	mg/l	2 – 8
4	Dissolved Oxygen	mg/l	2 - 7.5
5	Coliform	MPN/100ml	< 1000
5	Oil content	mg/l	0
6	Total Nitrogen	mg/l	0.2– 1.0
7	Total Phosphorus	mg/l	0.02 – 0.09

BOD_5 = biochemical oxygen demand, COD = chemical oxygen demand, l = liter, mg/l = milligram per liter, ml = millilitre, MPN = most probable number per 100ml, pH = potential of hydrogen.
Source: Sub-Decree No. 27 ANRK.BK on Water Pollution Control. 1999.

4. Drinking water quality standards

16. For well water used for domestic purposes, including drinking, the Ministry of Industry Mines and Energy's 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		0.03
Total Dissolved Solid	mg/l	800
Chlorine	mg/l	0.2-0.5
Copper	mg/l	1
Sulphate	mg/l	250
Nitrite	mg/l	3
Nitrate	mg/l	50
Lead	mg/l	0.01
Mercury	mg/l	0.001

Parameter	Unit	Standard Value
Coliform	CFU/100ml	0

CFU = Colony Forming Units, mg/l = milligram per liter, ml = millilitre, NTU = Nephelometric Turbidity Unit, pH = potential of hydrogen.
Source: Ministry of Industry Mines and Energy.

5. Solid waste management sub-decree

17. 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.

18. 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

19. The sub-decree No. 42 ANRK.BK on Air Pollution Control and Noise Disturbance dated 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

Parameters	Period 1h Average mg/m^3	Period 8h Average mg/m^3	Period 24h 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 Particulate (TSP)	-	-	0.33	0.1

mg/m^3 = milligram per cubic meter.
Note: This standard applied to evaluation of ambient air quality and to monitoring of air pollution status.
Source: Sub-Decree No. 42 ANRK.BK on Control of Air Pollution and Noise Disturbance. 2000.

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

Location	Period		
	06:00 to 18:00	18:00 to 22:00	22:00 to 06:00
Silence Area - Hospital - Library - School - Nursery	45	40	35
Resident Area - Hotel - Administration place - House	60 (55)	50 (55)	45 (45)
Commercial, Services Areas and mix	70	65	50

Location	Period		
	06:00 to 18:00	18:00 to 22:00	22:00 to 06:00
Small Industrial factories intermingling in residential areas	75 (70)	70 (70)	50 (70)

Notes: This standard is applied to control of noise level of any source of activity that emitted noise into the public and residential areas. ( ) denotes World Bank/IFC EHS targets.
Source: Sub-Decree No. 42 ANRK.BK on Control of Air Pollution and Noise Disturbance. 2000.

7. Silt/Sediment quality

20. For the re-use and disposal of silt from canal cleaning or dredging, there is no government standard. Standards applying to paddy field environments from China 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 Programme

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

(i) to reduce dependence on agricultural chemical, especially pesticides, in agricultural production and to minimize hazards to the human health, animals and environment;
(ii) 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
(iii) to 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.

22. At the national level, the position of the IPM Programme was strengthened by a Prakas (Ministerial Declaration) in July 2002, recognizing the National IPM Programme 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.

23. For pesticides, while Cambodia is a signatory to the Stockholm Convention of persistent organic pollutants, it lacks restrictions on distribution and use of these chemicals, and can be accessible to personnel without proper training, equipment, and facilities to handle, store, apply and dispose of these products properly. In this case, international good practice such as the Food and Agricultural Organization's International Code of Conduct on the Distribution and Use of Pesticides will be enacted by the project.

D. International Agreements

24. International Conventions and Agreements to which Cambodia is a signatory and to which

the country has ratified are the following:

(i) Kyoto Protocol ratified – 2002;
(ii) United Nations Framework Convention on Climate Change (UNFCCC) ratified - 1995;
(iii) Convention on Biological Diversity (CBD) - 1995;
(iv) Cartagena Protocol on Biosafety – 2003;
(v) UN Convention to Combat Desertification (UNCCD) ratified – 1997;
(vi) CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) – 1997;
(vii) World Heritage Convention – 1991;
(viii) ASEAN Heritage Convention (National Parks: Bokor and Virakchey) (regional) – 2003;
(ix) Convention on the Prevention of Marine Pollution from Ships - 1994;
(x) Measures on prevention of climate change, ozone depletion, on freshwater resource protection and on sustainable forest ASEAN - 1999;
(xi) Convention on Wetlands of International Importance (RAMSAR) – 1999;
(xii) Basel Convention on Control, Transport and Disposal of Trans-boundary Hazardous Waste - 2001;
(xiii) Stockholm Convention on Persistent Organic Pollutants – 2001; and
(xiv) Vienna Convention and Montreal Protocol on Substances that Deplete Ozone Layer – 2001.

E. Environmental, Health, and Safety Guidelines

25. 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 EHS Guidelines provide the context of international best practice and contribute to establishing targets for environmental performance. The noise standards in the EHS Guidelines will be used to complement the government standards in this document where needed. The EHS Guidelines provide no targets for water quality or soil quality. For these parameters United States Environmental Protection Agency (US EPA) Drinking Water Standards were used.

26. Occupational and community health and safety, as laid out in the EHS Guidelines, will be a cross-cutting assessment for the subprojects.

II. DESCRIPTION OF THE PROJECT COMPONENTS

A. Overall Project

27. The TSSD-AF will modify the on-going project scope by strengthening activities in the existing 196 communes of the TSSD project and scale up the current project activities in an additional 75 communes. With the AF, the overall project impact will be improved livelihoods and resilience in target communes in five provinces in the Tonle Sap Basin[2] where TSSD activities have been undertaken. These five provinces, plus Battambang, and Prey Veng will be included in TSSD-AF. The project outcome will be increased agricultural productivity and improved access

[2] Banteay Meanchey, Kampong Cham, Kampong Thom, Siem Reap, and Tboung Khmum provinces.

to markets in 271 communes in the Tonle Sap Basin.

28. The project has three major Outputs:

29. Output 1: Community-driven development through improved rural productive 30. achieved.

(i) rural roads, small scale irrigation, and other production related infrastructure;
(ii) support to new and old livelihood improvement groups (LIGs); and
(iii) value chain support.

30. Output 2: Improved enabling environment for increased agricultural productivity, diversification and climate resilience created.

(i) quarterly value chain cluster meetings;
(ii) information and communication technology (ICT)/mobile commune access (MCA) program;
(iii) developing capacity to service agricultural machinery at commune level.

31. Output 3: Effective project management.

32. TSSD-AF subproject outputs under Output 1 which require civil works will require EIA. These are:

1a - Rural Roads: will rehabilitate a total of 175 km of DRR road in commune areas prone to floods and a further 300 km of laterite roads in remote commune areas with low transport volumes.
1b - Small Scale Irrigation: will rehabilitate a total of 6,000 ha of irrigation capable of year round water provision and support tertiary irrigation construction where indicated as viable after a feasibility study.

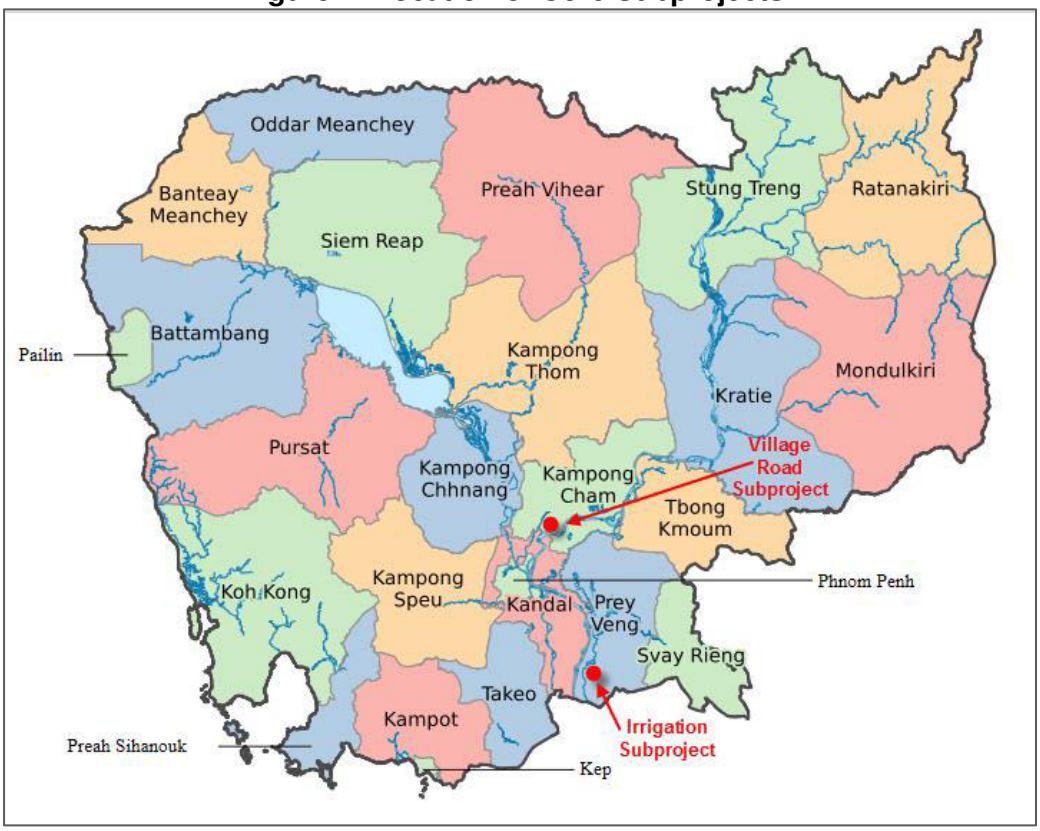
33. Outputs 1a and 1b will be delivered under similar methodologies. Road and irrigation subprojects will be included in commune development plans (CDP), confirming community interest.

34. The civil works under Output 1 will be complemented by support to communes, water user groups and farmers under Output 2. Under this output, at each irrigation scheme the design and supervision consultants will ascertain if tertiary canals should be constructed or if pumping remains the better technical option. Should tertiary canals seem the appropriate option they will include the project on the CDP and make a request to the national design and construction supervision contractor to undertake a feasibility study. Once the feasibility study is approved by ADB tertiary canal construction can be supported. The environmental assessment of these works would be carried out in accordance with the EARF.

35. Capacity building in support of the civil works to ensure their sustainability will include training of trainers in the national climate smart curriculum being developed between the Ministry of Agriculture Forestry and Fisheries (MAFF) and the Food and Agriculture Organization of the United Nations under the service provision contract, rice and diversified production elements using training methodologies adapted from farmer field schools. The project will also facilitate quarterly meetings in each commune between input suppliers, farmers, and processors/traders to develop value chain clusters.

36. 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 core subprojects to be funded. These are the Lvea Commune irrigation rehabilitation in Prey Veng Province and the Banthaey to Chbar village road rehabilitation in Kampong Cham Province. (Figure 1).

Figure 1: Location of Core Subprojects



Source: NIRVn - Map created using QGIS, CC BY-SA 3.0, https://en.wikipedia.org/w/index.php?curid=43121523.

B. Subprojects

1. Irrigation rehabilitation in Lvea Commune

37. Irrigated agriculture in Prey Veng Province is rice-based with irrigation used mainly for a second crop in the dry season. If sufficient irrigation water is available a second crop of rice is sown. In general, lands have level topography and the poor condition of the canals is the primary constraint to irrigation. At the subproject site in Lvea commune, due to poor design, failed connections, and silting up, the condition of secondary canals constrains irrigation penetration into the area and during dry season, many lands are observed to be fallow.

38. 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 moderate to good in general between 1.5 and 3 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.

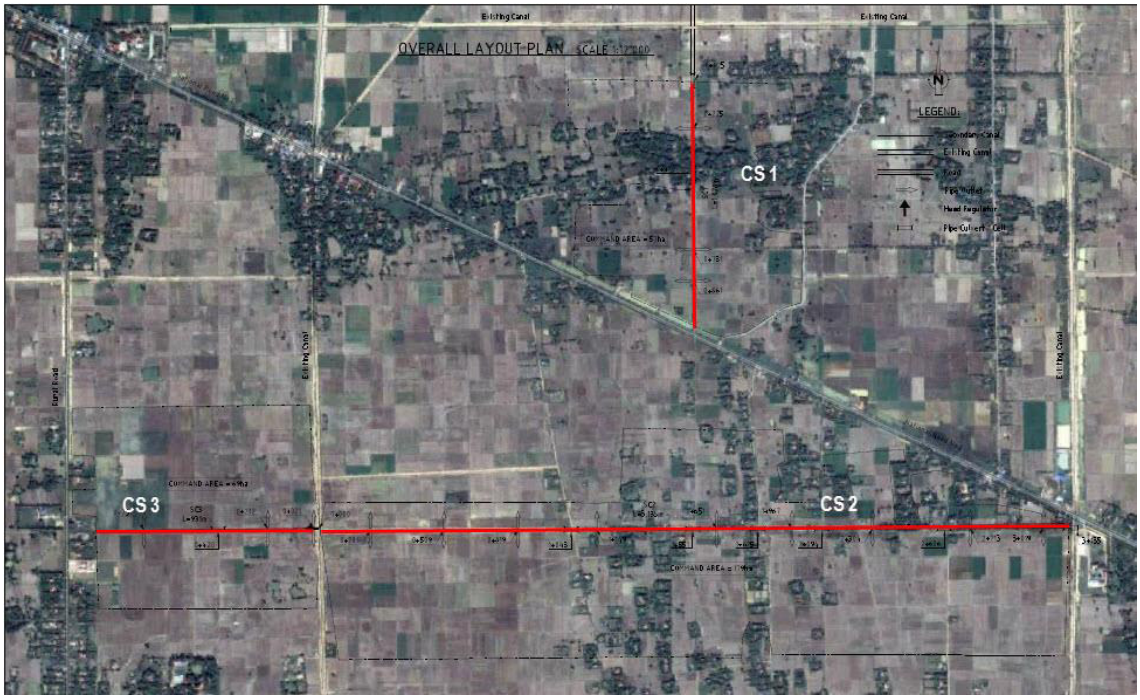
39. Under this subproject it is proposed to rehabilitate three secondary canals with a total

length of 4 km. Water will come from primary and secondary canals supplied by Pumping Station No. 2 on the Traebek River. These are:

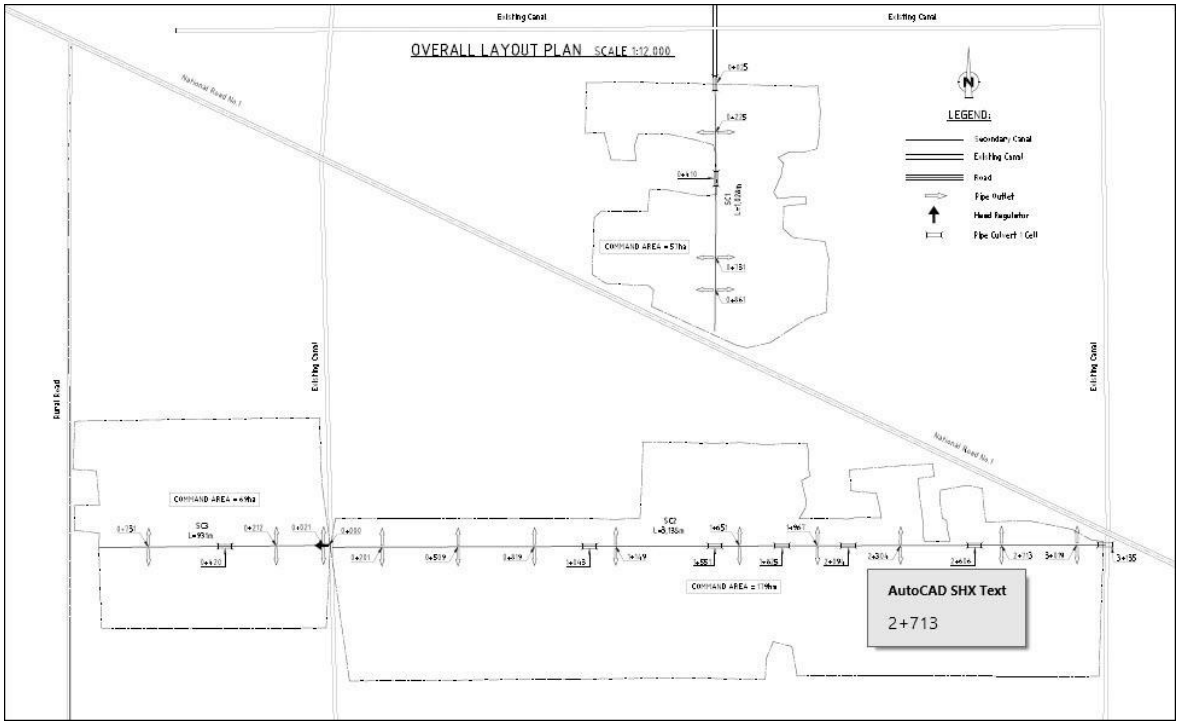
(i) Secondary canal 1: a 1 km canal north of Highway 1 in Thnaot village, flowing south from a secondary canal: adding a command area of 57 ha for a dry season crop.
(ii) Secondary canal 2: a 3 km long canal south of Highway 1, starting at an intake gate on main canal (no. 10) and flowing eastward through Boeung Snao and Takork villages and finishing at a ruined Pol Pot era gate: adding 179 ha for a dry season crop.
(iii) Secondary canal 3: a 1 km long canal south of Highway 1, starting at an intake gate on main canal (no. 10) and flowing westward: adding 69 ha for a dry season crop.

40. Rehabilitation will involve the excavation of existing canals to re-establish efficient flow rates and carrying capacities and the installation or repair of regulators at the junctions with main canal, and road/track crossing points.

Figure 2a and 2b: Location of Lvea Commune Irrigation Subproject Components (red)



Source: PPTA team.



Source: PPTA team.

41. Expected increases in dry season cropping areas from the rehabilitation of these three secondary canals is 305 ha:

(i) 57 ha at Thnaot Village;
(ii) 179 ha at Boeung Snao and Takork Villages; and
(iii) 71 ha at the western extension of the Boeung Snao and Takork canal

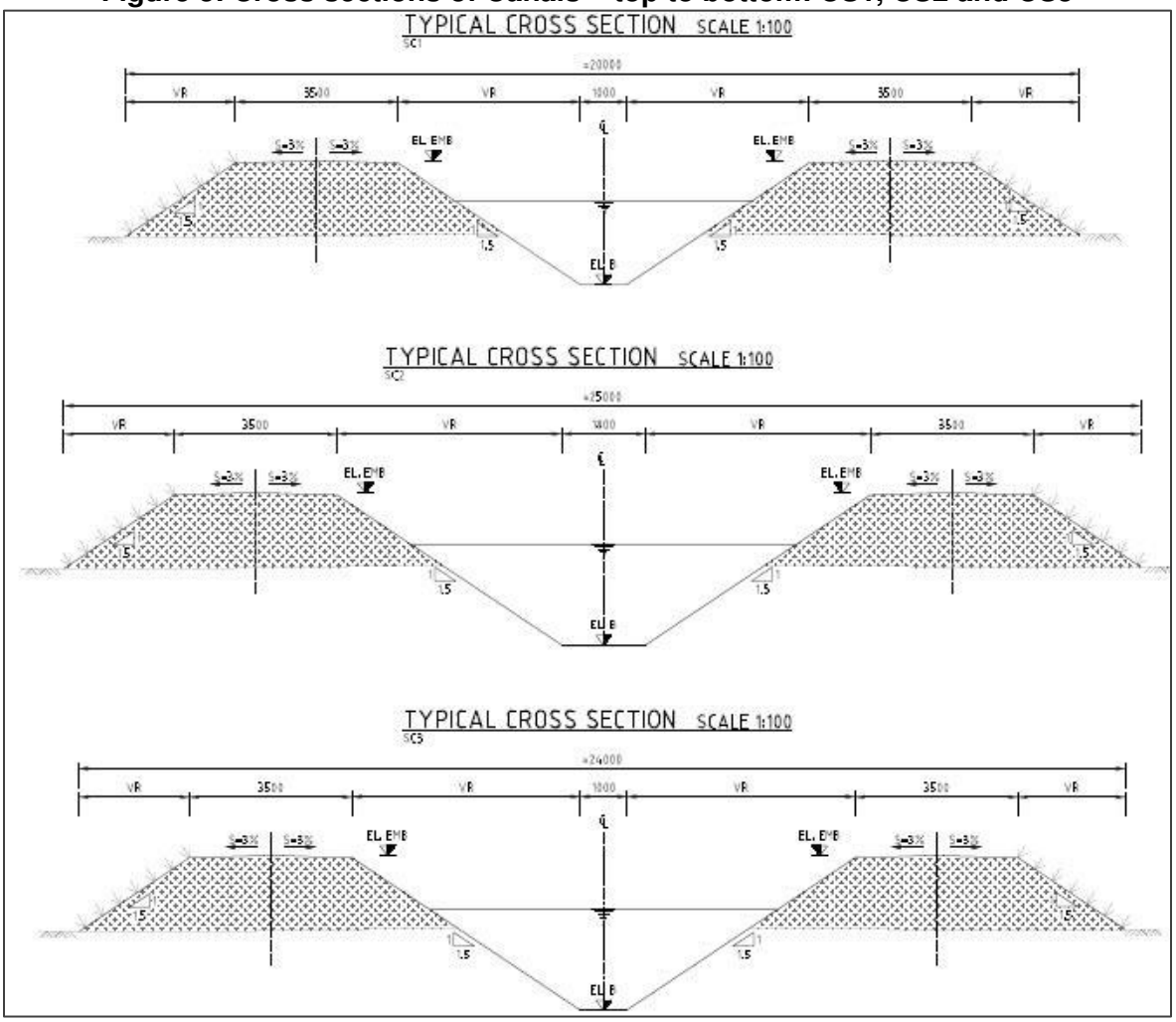
42. The specifications of the subproject comprise works to improve the secondary canals. The proposed works are summarized in Table 6 and cross sections for the three canals at Figure 3.

Table 6: Summary of Subproject Structures, Works and Equipment – Lvea Commune

No	Description of works	Unit	Quantity
1.0	**Mobilization, Site preparation and Site cleaning**		
1.1	*Staff mobilization and site preparation*	*LS*	*1.00*
1.2	*Demolish existing building, tries, fance, and other necessaries item for site security and site preparation*	*LS*	*12.00*
1.3	*Site clearing after completed work*	*m2*	*143,605.29*
2.0	**Earthwork (Excavation and Backfill)**		
2.1	*Excavation*	*m3*	*46,594.92*
2.2	*Backfill with 90% DD compaction*	*m3*	*45,599.14*
3.0	**Crossing Structures**		
3.1	*Concrete*	*m3*	*143.25*
3.2	*Rebar*	*Ton*	*15.76*
3.3	*Lean Concrete 50mm Thick*	*m3*	*31.73*
3.4	*Stone Masonary 250mm Thick*	*m3*	*315.34*
3.5	*RC Pipe Diameter 800mm*	*m*	*43.80*
3.6	*Steel Gate*	*Item*	*1.00*
4.0	**PVC Pipe Outlets**		
4.1	*PVC Pipe Diameter 200mm with standard 8.5*	*m*	*309.00*

Source: Bills of Quantities prepared for the PPTA survey team by Aruna P/L, May 2017.

Figure 3: Cross sections of Canals – top to bottom: CS1, CS2 and CS3



Source: PPTA team.

2. Village road rehabilitation in Bathaey-Chbar Ampov Communes

43. Under this subproject it is proposed to rehabilitate a 7.6 km long rural road which starts at Highway 6 in Batheay Commune and finishes in Chbar Ampov village, Chbar Ampov Commune. Rehabilitation will involve the widening and elevation of the road (without changing the alignment), incorporation of constructed embankments and batters, installation of culverts and laying of surface material. The road will be rehabilitated in four sections. The first priority will be the section across the floodway, spanning the border between Banthaey and Chbar Ampov communes. The remaining sections will be implemented as separate future subprojects and in an order and schedule yet to be finalized. The impact assessments in this IEE however apply to the whole road alignment.

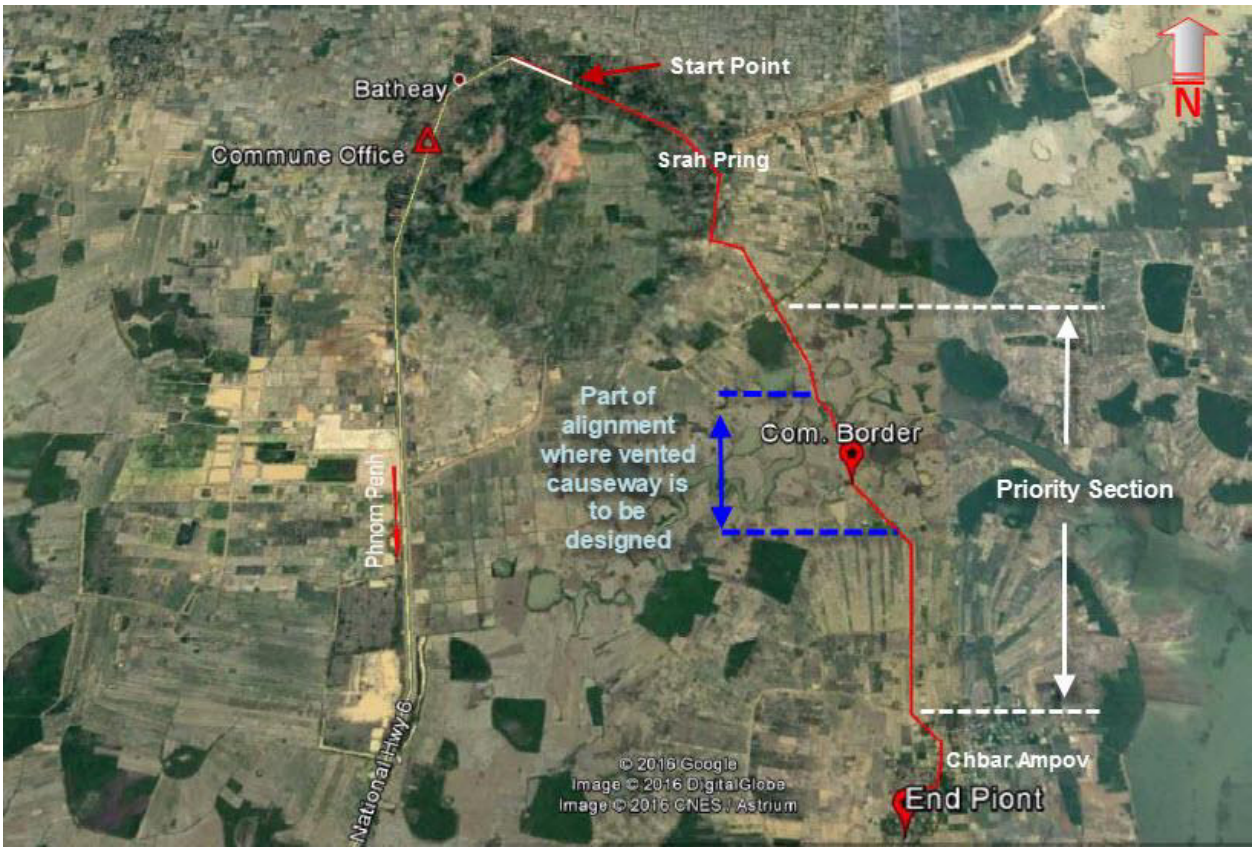
44. The location of the subproject and the priority section for construction is in Figure 4.

45. A track from a quarry joins the road 621 meters (m) from where it meets Highway 6 which means that trucks of up to 40 tons use this road section. The quarry operators maintain this small section of the road through an agreement with the commune council and this section is therefore omitted from the subproject.

46. The major constraint which is considered during subproject design is that every year up to 3.5 km of the road floods to a depth of about 0.5 m and twice in the last 20 years sections of the road have flooded to a depth of 2 m. This is the priority section identified in Figure 3.

47. Design of the road and structures will conform to the National Committee for Sub-National Democratic Development Secretariat's (NCDDS) Project Implementation Manual (2009), Volume II: Specification for Construction Materials and Works and any other relevant guidelines and specifications.

Figure 4: Location of Planned Village Road Rehabilitation - Bathaey-Chbar Ampov Communes

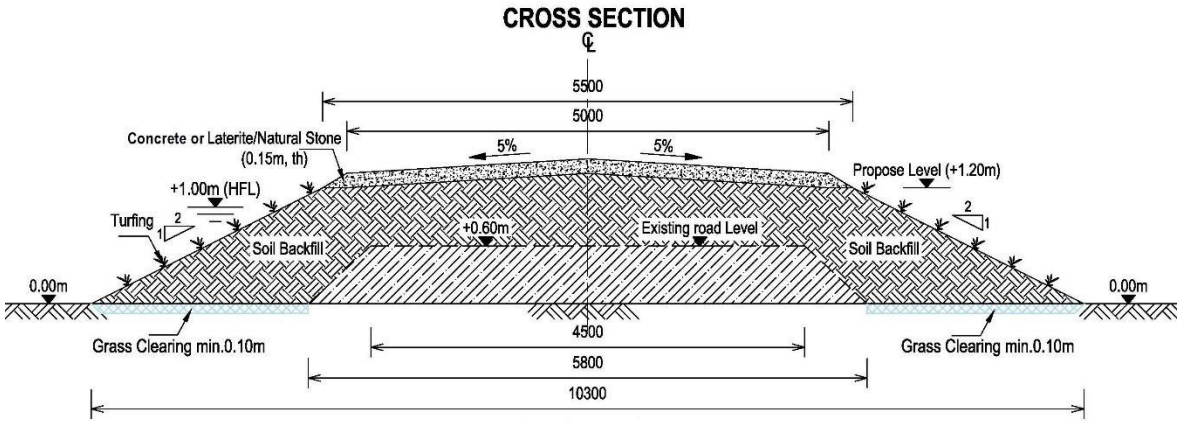


Source: PPTA team.

48. Preliminary survey for the village road subproject has developed a typical road and embankment profile (Figure 5) and estimated Bill of Quantities (Tables 7 and 8) below. This raises the new road surface in the Priority Section by up to 1 m with a narrow concrete road surface (3.5 m) with passing places, and a 50 m vented causeway to ensure that flood flows can pass. The surface in the priority section will be reinforced concrete for flood resilience. Either laterite or a stone surface will be used for other sections which are not overtopped by flood waters. Final budgets have not yet been confirmed, so the draft Bills of Quantities below are presented as two options: (i) with a laterite surface in the non-flood sections; and (ii) with a natural stone surface in the non-flood sections.

49. Bills of Quantities for these options have not yet been finalized. For the purposes of EIA, the following specifications have been estimated.

Figure 5: Typical Village Road and Embankment Cross-Section



Source: PPTA team.

Table 7: Estimated Bill of Quantities – Concrete in Priority Section and Laterite Surface on all Other

Item	Estimated quantity
Bush & grass clearing (m^2)	14,110 m^2
Scarify and levelling existing road surfacing with compaction (m^2)	18,225 m^2
Reshape forming camber (m^2)	9,900 m^2
Earth work/soil (m^3) (min. 4 km transportation)	32,900 m^3
Laterite (m^3) (min. 15 km transportation).	7309.25 m^3
Reinforced concrete (m^3) at Priority Section	1,764 m^3
Turf/Grass planting (m^2)	11,880 m^2
Side drain excavation dimension 1x2x1m	1.65 km
50 m long multiply vented causeway at Priority Section	1 Location
Single Concrete pipe culvert A1000mmx10m (Unit/Place)	3 Locations
Single Concrete pipe culvert A800mmx6m (Unit/Place)	6 Locations
Single Concrete pipe culvert A600mmx6m (Unit/Place)	5 Locations

km = kilometer, m = meter, mm = millimetre, m^2 = square meter, m^3 = cubic meter.
Source: Bills of Quantities prepared by the PPTA team, May 2017.

Table 8: Estimate Bill of Quantities –Concrete in Pririty Section and Stone Surface on all Other

Item	Estimated quantity
Bush & grass clearing (m^2)	14,110 m^2
Scarify and levelling existing road surfacing with compaction (m^2)	18,225 m^2
Reshape forming camber (m^2)	9,900 m^2
Earth work/soil (m^3) (min. 4 km transportation)	32,900 m^3
Natural stone (m^3) (min. 4 km transportation).	7309.25 m^3
Cement for mixing with natural stone	7310 bags
Reinforced concrete (m^3) at Priority Section	1,764 m^3
Turf/Grass planting (m^2)	11,880 m^2
Side drain excavation dimension 1x2x1m	1.65 km
50 m long multiply vented causeway at Priority Section	1 Location
Single Concrete pipe culvert A1000mmx10m (Unit/Place)	3 Locations
Single Concrete pipe culvert A800mmx6m (Unit/Place)	6 Locations
Single Concrete pipe culvert A600mmx6m (Unit/Place)	5 Locations

km = kilometer, m = meter, mm = millimetre, m^2 = square meter, m^3 = cubic meter.
Source: Bills of Quantities prepared by the PPTA team, May 2017.

50. Final quantities will be confirmed from the engineering survey. Final culvert numbers and sizes will be confirmed by the drainage survey.

C. Project Implementation

51. The implementation arrangements are summarized in the Table 9 below.

Table 9: Institutional Arrangements

Aspects	Arrangements
Management	
(i) Oversight body	The Council for Agriculture and Rural Development (CARD)
(ii) Executing agencies	Ministry of Agriculture Forestry and Fisheries (MAFF) and National Committee for Democratic Development Secretariat (NCDDS)
(iii) Key implementing agencies	NCDDS: responsible for Output 1, MAFF: responsible for Output 2. Each implementing agency will designate a staff member to be the project Environmental Safeguards Officer (ESO). The Ministry of Posts and Telecommunications will be the implementing agency for the specialized telecommunications tasks in Output 2.
(iv) Provincial support team (PST)	A PST will be established in each project province, incorporating provincial staff of the implementing agencies ministries.
(iv) Implementation units	Commune councils will implement infrastructure subprojects – contracting and supervising construction contractors and owning and operating the finished facilities.

52. The subproject civil works for irrigation and village road will be included in the Commune Development Plan, confirming community interest and funds to contractors will be paid by relevant commune councils.

53. Final design for subprojects, support in bid preparation, and construction supervision will be undertaken by a Design and Supervision consultants (DSC) selected by a procurement review committee (PRC) composed of representatives from the implementing agencies.

54. A provincial support team (PST) will be established for each province incorporating provincial staff of the executing and implementing agencies ministries. The PST will ensure that all subproject designs are technically cleared by relevant provincial technical departments and in particular that road designs are approved at provincial level by the provincial department of rural development, and that irrigation designs are approved by the provincial departments of water resources and meteorology.

55. The DSC will support commune councils and PST to prepare tender documents and contract construction. The commune councils will therefore act as the project implementation units for the infrastructure outputs. The commune councils will remain the project owners and will award the contract, manage the contract and monitor the construction. The DSC will assist commune councils to monitor construction standards and facilitate monthly coordination at provincial level.

56. For the environmental aspects of the project, the safeguard unit within the NCDDS will assign a suitably qualified staff member to be the national Environmental Safeguards Officer (ESO). A TOR for the ESO position is at Annex A of the EMP.

57. Project implementation consultants (PIC) will include an Environmental Safeguards and Climate Change Specialist (ESCC) who will work with the ESO and assist the PSTs and commune councils to fulfil their environmental responsibilities in implementing subproject EMPs. TORs for

the ESCC positions (international and national) are at Annex B and C of the EMP.

58. To enable effective national government oversight of the project, the innovative steering committee arrangement of TSSD will be continued, and will provide guidance to the executing and implementing agencies without creating excessive additional institutional burden. CARD will handle the steering committee functions as part of its regular meetings and other meetings as needed and will ensure that project performance is monitored throughout implementation up to completion.

III. DESCRIPTION OF THE ENVIRONMENT

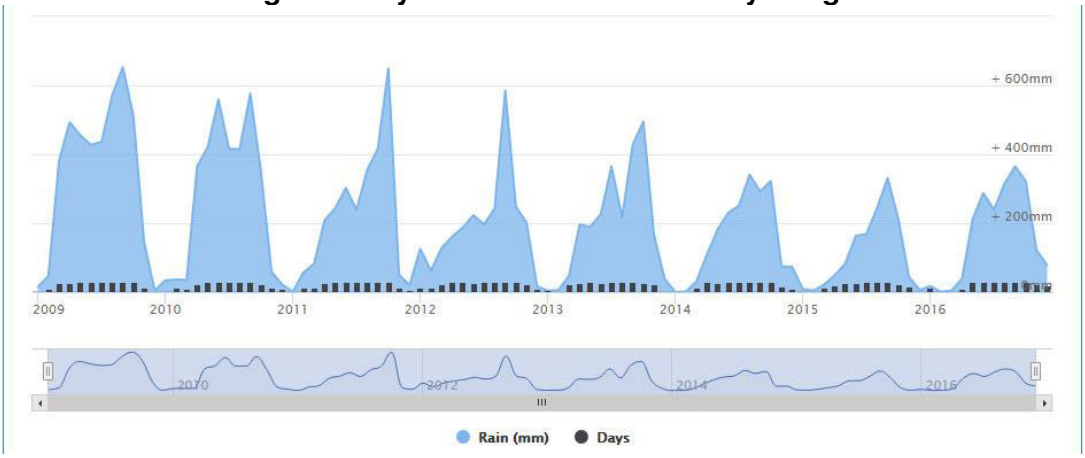
A. Environmental Setting

1. Climate

59. The climates of Prey Veng and Kampong Cham areas are characterized by distinct rainy and dry seasons. The southwest monsoon starts early in April/May and lasts until October, while from November to March the dry northeast weather patterns predominate.

60. For Prey Veng, the average annual rainfall ranges from 1300 mm to 1400 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 23°C and the highest in April with an average maximum of 36°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.

Figure 6: 8-year Rainfall Data for Prey Veng



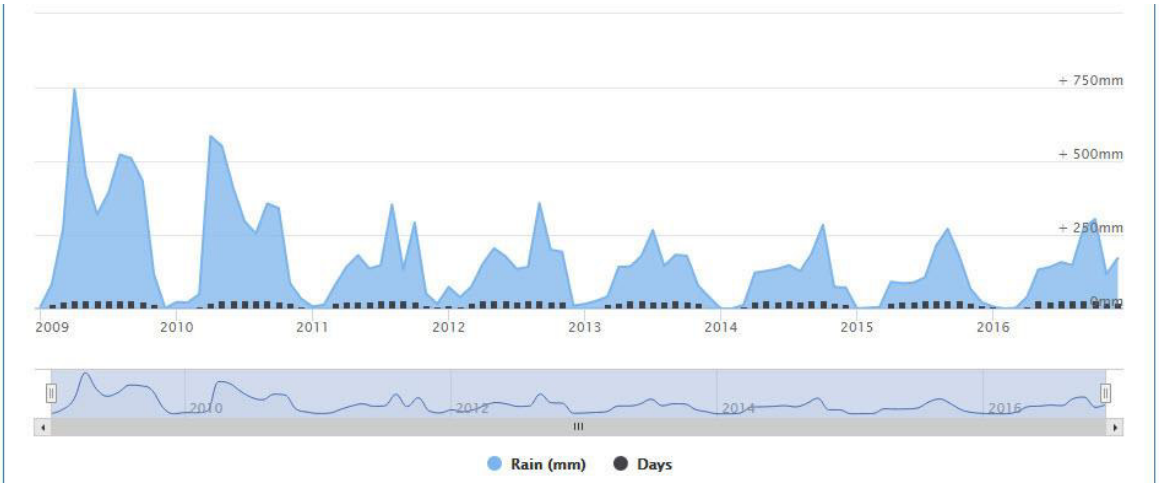
Source: https://en.climate-data.org.

Figure 7: 8-Year Temperature Data for Prey Veng

Source: https://en.climate-data.org.

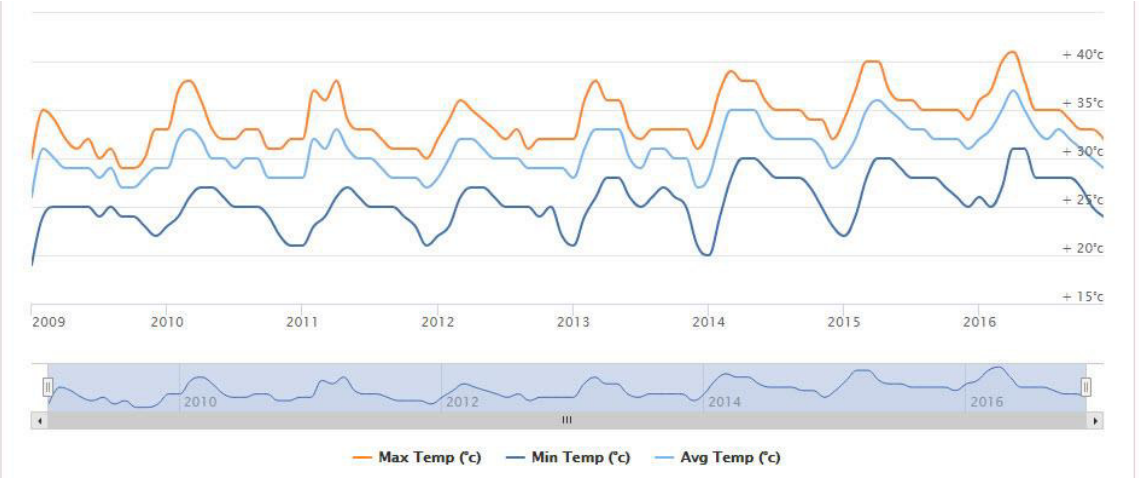
61. For Kampong Cham, the rainfall is lower, with average annual falls of 1200 mm to 1300 mm, with peak rainfall occurring in September/October and the lowest rainfall in February. Temperature and wind patterns are similar to those of Prey Veng.

Figure 9: 8-Year Rainfall Data for Kampong Cham



Source: https://en.climate-data.org.

Figure 10: 8-Year Temperature Data for Kampong Cham

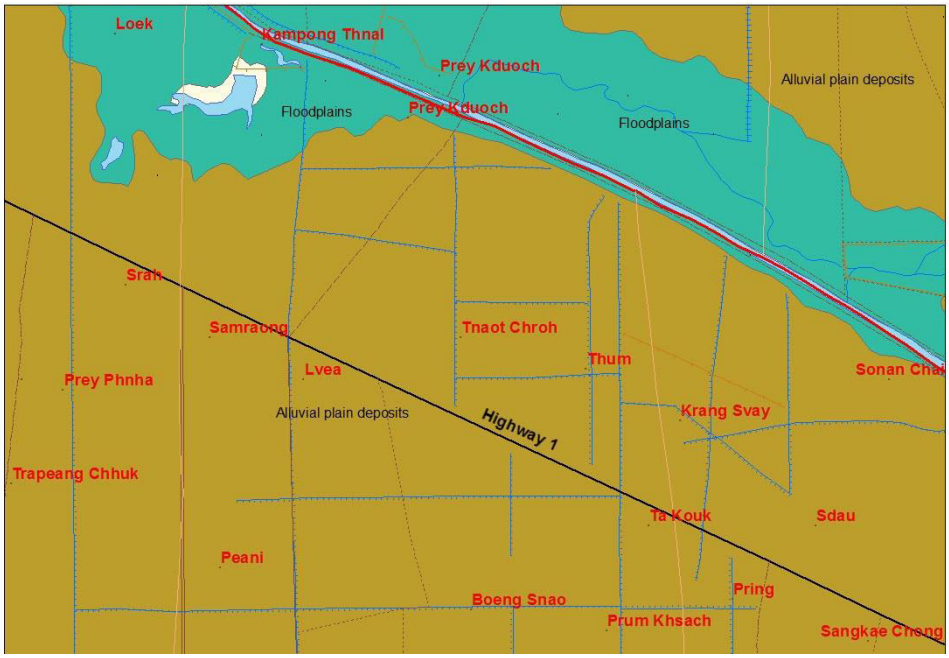


Source: https://en.climate-data.org.

2. Topography and Geology

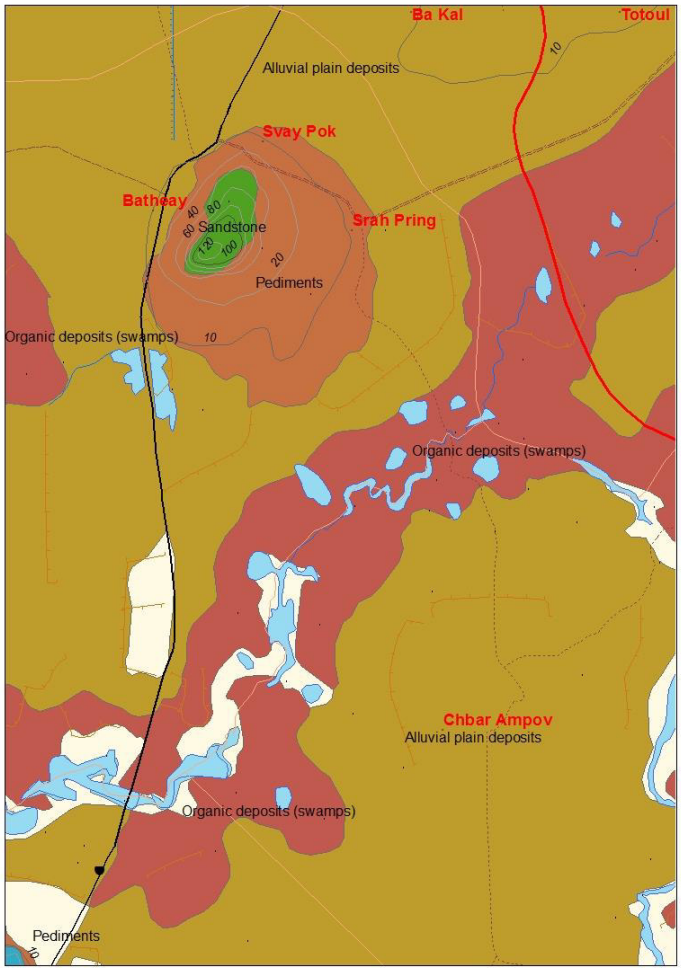
62. The topography of the irrigation subproject area in Lvea commune (Prey Veng) is a very flat alluvial plain of clays and sands bounded along the Trabaek River by floodplain silts. The area of the village road project spanning Banthaey and Chbar Ampov communes in Kampong Cham is more variable with elevation at the Bathaey end of the road at around 20 m on sandstone pediment formation. The road then aligns southwards, traversing alluvial plain deposits and organic swamp deposits in the lowest areas. (see Figure 11 and Figure 12).

Figure 11: Surface Geology of the Lvea Irrigation Subproject Area (Prey Veng Province)



Source: JICA GIS Survey of Cambodia, 2005.

Figure 12: Surface Geology of the Banthaey-Chbar Ampov Road Subproject Area (Kampong Cham Province)

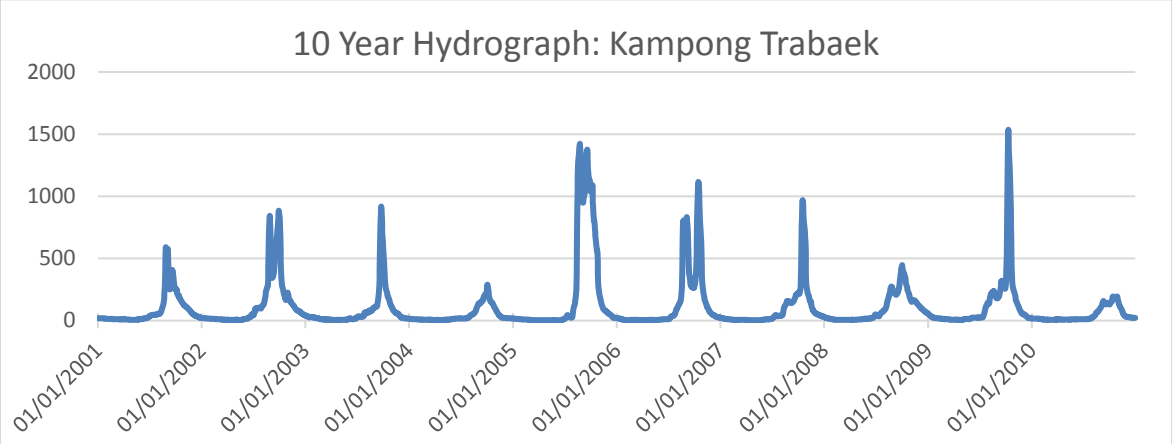


Source: JICA GIS Survey of Cambodia, 2005.

3. Hydrology

63. Total flows of the Trabaek River, which provides water for the irrigation subproject in Prey Veng are taken from a 10 year hydrographic data (2001-2010) taken near the mouth of the Trabaek with the Mekong River (Figure 13). The Trabaek is a distributary of the Mekong, with water flowing “upstream”, away from the Mekong. From this data flows were calculated for a wet year (2005), dry year (2010) and an average year (2001). These are presented in Table 10. Low seasonal river flows are apparent in all years in March-April-May.

Figure 13: Trabaek River Flows 2001 – 2010
(vertical units are m^3/s)



Source: PPTA team.

Table 10: Wet, Dry and Average Year Flows in the Trabaek River

Wet Year 2005			Dry Year 2004		Average Year 2001	
Month	**Ave Flow (m^3/s)**	**MCM**	**Ave Flow (m^3/s)**	**MCM**	**Ave Flow (m^3/s)**	**MCM**
Jan	13.39096774	35.86637	12.05938	32.020704	18.56419355	48.40992
Feb	8.315	20.11565	7.991034	20.022336	13.91785714	34.982496
Mar	4.64516129	12.4416	6.400968	17.144352	10.92967742	29.274048
Apr	4.417666667	11.45059	4.443667	11.517984	8.673666667	23.071392
May	3.441612903	9.218016	8.293871	22.214304	7.944193548	20.68848
Jun	5.359333333	13.89139	15.87467	41.147136	18.98866667	49.218624
Jul	30.81419355	82.53274	19.55871	52.386048	45.10774194	120.816576
Aug	786.4254839	2106.362	66.93871	179.28864	184.0087097	492.848928
Sep	1140.133333	2955.226	170.1667	441.072	354.3	918.3456
Oct	731.7419355	1959.898	167.6087	448.923168	185.0322581	495.5904
Nov	110.7236667	286.9957	44.78333	116.0784	92.266	239.153472
Dec	36.32419355	97.29072	19.48355	52.184736	35.38258065	94.768704
Total		**7591.288**		**1433.999808**		**2567.16864**

m^3/s = cubic meter per second, MCM = million cubic meter.
Source: PPTA team.

64. The data shows that the annual flows in a wet year can be three times higher than an average year and up to 5-6 times higher than a dry year. In the dry season however, flow rates for a wet, dry, and average year are all uniformly low.

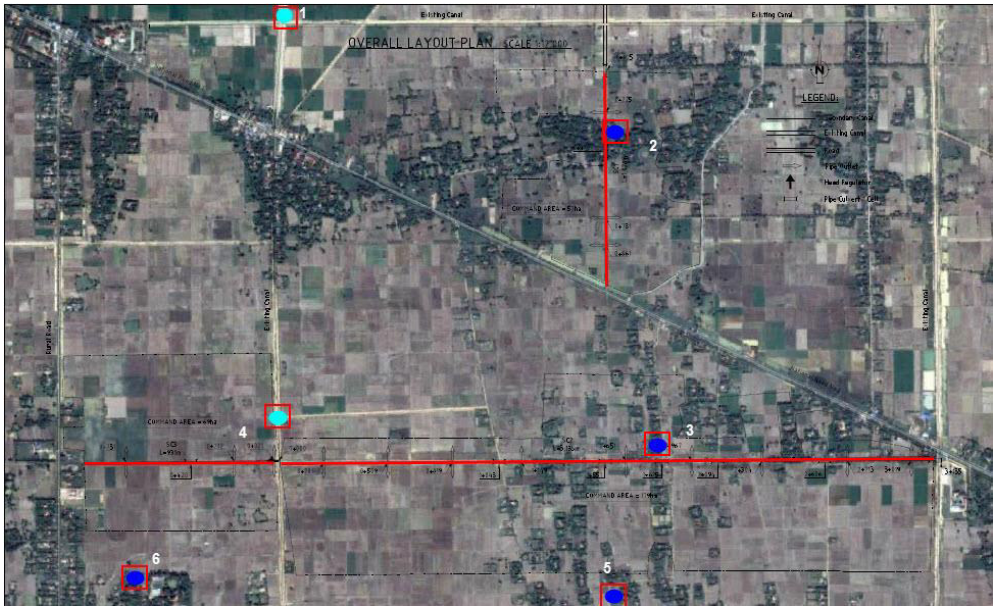
4. Water Quality

a. Surface water

65. No comprehensive water quality data for the subproject areas water bodies currently exist. For the irrigation subproject, dry season water quality was sampled by the PPTA team using field test kits to give an indication of water quality and a basis for comparison at different locations. The sampling was at the beginning of the main (primary) canal at the pumping station. Another

sample, analyzed only for coliforms and pesticide contamination, was taken half way along the canal where two of the subproject's three secondary canals link with the main canal. For the village road subproject, the water quality in the main intermittent creek line over which the road passes was sampled by the PPTA team. Both areas were sampled in March during the dry season when water levels were low and would therefore show the most concentration of any contaminants. Sampling locations are shown in Figures 14 and 15.

Figure 14: Sampling Points for Surface Water, Groundwater and Noise, Lvea Commune



Source: PPTA team.

Figure 15: Sampling Points for Surface Water, Groundwater and Noise, Banthaey and Chbar Ampov Communes

Source: PPTA team.

Table 11: Water Quality Results of Surface Water in the Main Canal, Lvea Commune

Parameter	Unit	Main Canal, Lvea Commune		No. 27 ANRK.BK on Water Pollution Control (Rivers)	No. 27 ANRK.BK on Water Pollution Control (Lakes and Rivers)
		At Headwater	Half way along		
pH		6.5	-	6.5-8.5	6.5-8.5
Total alkalinity	mg/l	120	-	-	-
Hardness ($CaCO_3$)	mg/l	85	-	-	-
NO_2^-	mg/l	Nd	-	-	0.1-0.6
NO_3^-	mg/l	Nd	-	-	-
Cl	mg/l	<0.25	-	-	-
S	mg/l	220	-	-	-
Fe	mg/l	0	-	-	-
Hg	mg/l	Nd	-	-	-
Cu	mg/l	0.08	-	-	-
Pesticide	mg/l	Positive	positive	-	-
Coliform	>1CFU/100ml	Positive	positive	<5,000	<1,000
Coliform	$>10^3$CFU/ml	Positive	negative	-	-

$CaCO_3$ = calcium carbonate, Cl = chlorine, CFU = Colony Forming Units, Cu = copper, Fe = iron, Hg = mercury, mg/l = milligram per liter, ml = millilitre, Nd = not detected, NO_2 = nitrogen dioxide, NO_3 = nitrate, pH = potential of hydrogen, S = sulfur, US EPA = United States Environmental Protection Agency.
Source: PPTA team.

Table 12: Water Quality Results of Surface Water in the Creek Midway along the Village Road

Parameter	Unit	Creek Line, Banthaey Commune	No. 27 ANRK.BK on Water Pollution Control (Rivers)	No. 27 ANRK.BK on Water Pollution Control (Lakes and Rivers)
pH		6	6.5-8.5	6.5-8.5
Total alkalinity	mg/l	80	-	-
Hardness ($CaCO_3$)	mg/l	50-120	-	-
NO_2^-	mg/l	Nd	-	0.1-0.6
NO_3^-	mg/l	Nd	-	-
Cl	mg/l	0.25	-	-
S	mg/l	250	-	-
Fe	mg/l	0	-	-
Hg	mg/l	0.002	-	-
Cu	mg/l	0.5-1.0	-	-
Pesticide	mg/l	Positive	-	-
Coliform	>1CFU/100ml	Negative	<5,000	<1,000
Coliform	$>10^3$CFU/ml	Negative	-	-

$CaCO_3$ = calcium carbonate, Cl = chlorine, CFU = Colony Forming Units, Cu = copper, Fe = iron, Hg = mercury, mg/l = milligram per liter, ml = millilitre, Nd = not detected, NO_2 = nitrogen dioxide, NO_3 = nitrate, pH = potential of hydrogen, S = sulfur, US EPA = United States Environmental Protection Agency.
Source: PPTA team.

66. Samples of surface water from both subproject areas were positive for pesticide contamination, indicating runoff of pesticides from paddy applications. The main canal at the Lvea irrigation subproject showed high indicative coliform counts where it receives water from the Trabaek River, but decreasing levels downstream in the canal thus indicating that the coliform

pollution is sourced from the Trabaek River. The Cambodian standard for public waters,[3] Sub-decree No. 27 ANRK.BK on Water Pollution Control, includes permissible levels for coliforms, a range of pesticides and pesticide residues as well as heavy metals for public health protection. These require laboratory analysis which was not available within the resources of the PPTA team. A baseline for these parameters will need to be established for surface waters before operation of the irrigation subproject to enable monitoring of the effectiveness of the project's integrated pesticide management capacity building.

b. Groundwater

67. The vulnerability of groundwater quality in irrigation areas, especially where the water table is at a shallow depth, is high. However, in the Lvea commune irrigation subproject area, farmers' wells are routinely between 35 m and 40 m deep, and therefore are unlikely to share the same water table as the level of water in the canals. To check whether the quality of exploited groundwater is independent of local surface water quality, a series of samples from wells was analyzed by the PPTA team. The results are at Table 13. The results showed that some contamination occurs, especially in pesticides and coliforms, and that operational attention to the application of chemicals and domestic drainage is warranted.

Table 13: Groundwater Quality Results of Groundwater at Wells in the Lvea Irrigation Subproject Area

Parameter	Unit	Lvea				Cambodian Drinking Water standard 2009	US EPA Drinking water
		Well 1	Well 2	Well 3	Well 4		
Depth	m	39	35	39	35		
pH		6.0	6.5	6.5	-	5.5-8.5	6.5-8.5
Total alkalinity	mg/l	120	120	120	-	-	-
Hardness ($CaCO_3$)	mg/l	<50	50	<50	-	500	60-200
NO_2^-	mg/l	nd	nd	nd	-	1	3
NO_3^-	mg/l	nd	2	nd	-	15	50
Cl	mg/l	0.25	<0.25	<0.25	-	-	<250
S	mg/l	50	250	<50	-	-	<250
Fe	mg/l	0.02	nd	0.02	-	5	<0.3
Hg	mg/l	nd	nd	nd	-	0.5	0.001
Cu	mg/l	1.0	1.0	1.0	-	1.0	2
Pesticide	mg/l	positive	negative	positive	positive	-	Atrazine 0.02 Chlorpyrifos 0.01 Diuron 0.02
Coliform	>1CFU/ 100ml	negative	negative	positive	positive	3	positive
Coliform	$>10^3$CFU/ ml	negative	negative	positive	negative	3	negative

[3] Public water areas refer to water areas that are for public use such as: Tonle, Stung (rivers), stream, gully, lake, pond, well, sea, peam (river mouth) and include canal irrigation system and other waterways that are for public use and ground water.

$CaCO_3$ = calcium carbonate, Cl = chlorine, CFU = Colony Forming Units, Cu = copper, Fe = iron, Hg = mercury, mg/l = milligram per liter, ml = millilitre, Nd = not detected, NO_2 = nitrogen dioxide, NO_3 = Nitrate, pH = potential of hydrogen, S = sulfur, US EPA = United States Environmental Protection Agency.
Source: PPTA team.

68. Wells at houses along the alignment of the village road subproject were also sampled by the PPTA team to establish a baseline and also to check if capacity building and training is required in domestic water management. Two wells were sampled in Chbar Ampov village, and two in Bantheay village.

Table 14: Groundwater Quality Results of Groundwater at Wells in the Subproject Schemes

Parameter	Unit	Chbar Ampov		Banthaey		Cambodian Drinking Water standard 2009	US EPA Drinking water
		Well 1	Well 2	Well 3	Well 4		
Depth	m	45	35	5	67		
pH		7.5	-	6	6	5.5-8.5	6.5-8.5
Total alkalinity	mg/l	360	-	120	40	-	-
Hardness ($CaCO_3$)	mg/l	250	-	130	150	500	60-200
NO_2^-	mg/l	0.2	-	0.2	0.2	1	3
NO_3^-	mg/l	2	-	2	nd	15	50
Cl	mg/l	<0.25	-	0.25	<0.25	-	<250
S	mg/l	250	-	200	200	-	<250
Fe	mg/l	nd	-	nd	0.02	5	<0.3
Hg	mg/l	nd	-	nd	nd	0.5	0.001
Pb	mg/l	nd	-	nd	-	0.01	0.01
Cu	mg/l	<0.5	-	0.75	1.25	1.0	2
Pesticide	mg/l	negative	-	positive	negative	-	Atrazine 0.02 Chlorpyrifos 0.01 Diuron 0.02
Coliform	>1CFU/100 ml	negative	positive	positive	negative	3	positive
Coliform	$>10^3$CFU/ml	negative	positive	positive	negative	3	negative

$CaCO_3$ = calcium carbonate, Cl = chlorine, CFU = Colony Forming Unit, Cu = copper, Fe = iron, Hg = mercury, mg/l = milligram per liter, ml = millilitre, Nd = not detected, NO_2 = nitrogen dioxide, NO_3 = Nitrate, Pb = lead, pH = potential of hydrogen, S = sulfur, US EPA = United States Environmental Protection Agency.
Source: PPTA team.

69. The results indicate that shallow wells have poor water quality and the deepest wells have good water quality. Well No.2 at Chbar Ampov was positive for coliform at 35 m depth and indicates a local domestic runoff problem.

5. Air Quality and Noise

70. No ambient air quality data exists for the subproject areas (nor 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 good, with low NO_x and SO_x and minimal CO.

71. Ambient noise levels were sampled in the subproject areas (at water testing localities) by the PPTA team with a noise meter. Ten minute averages, maximum and minimum levels were recorded for locations along the main canals. The results for the village road alignment are at Table 15 and show typical rural environmental noise levels for minimum measurements. The average noise levels also comply with ANRK and EHS standards. The maximum levels show the temporary effect of passing trucks and rice harvesting machinery.

Table 15: Environmental Noise Levels in the Village Road Subproject Area

Parameter	Unit	Banthaey-Chbar Ampov				42 ANRK.BK Standard	EHS Target
		1	3	4	5		
maximum	dB	107.1	74.1	88.4	76.1.	-	-
minimum	dB	32.1	32.2	30.6	35.3	-	-
10 minute average	dB	54.3	55	50.25	55.3	60-50 (1 hour average)	55 (1 hour average)

dB = decibel, EHS = environment, health and safety.
Source: PPTA team.

72. Ambient noise levels were sampled along the village road alignment (at water testing localities) by the PPTA team with a noise meter (See Figures 14 and 15). Ten minute averages, maximum and minimum levels were recorded. The results for the village road alignment are at Table 16 and show typical rural environmental noise levels for minimum measurements. The average noise levels also comply with ANRK and EHS standards. The maximum levels show the temporary effect of passing traffic within 5 m of the testing points.

Table 16: Environmental Noise levels in the irrigation subproject area

Parameter		Unit	Lvea Commune					42 ANRK.BK Standard	EHS Target
			1	2	3	4	5		
maximum		dB	85.9	77	60.3	78.2	79.2	-	-
minimum		dB	36.2	37.4	33.4	37.2	30.5	-	-
10 minute average		dB	49.7	50	55	50.2	47.8	60-50 (1 hour average)	55 (1 hour average)

dB = decibel, EHS = environment, health and safety.
Source: PPTA team.

6. Land Use, Vegetation, and Habitat

73. Land use in the subproject areas is agricultural, comprising actively farmed paddy fields or fallow paddy fields. The distribution of land use and vegetative cover of the areas is shown in Figures 20 and 21 (overleaf).

74. In the irrigation subproject area in Lvea commune, sections of the secondary canals to be rehabilitated have become vegetated, with canal bank trees often extending into the silted up canal bed. Where the canals are clear, vegetation often lines the banks and also occurs infrequently along paddy dykes.

75. At Lvea commune, species comprise:

Overgrown canals	Canal banks and paddy dykes
Eucalyptus tereticornis	*Zizyphus mauritania*

Overgrown canals	Canal banks and paddy dykes
Acacia auriculiformis	*Streblus asper*
Bombax ceiba	*Pithecellobium dulce*
Shorea siamensis	*Aegle marmelos*
Pterocarpus indicus	
Ceiba pentandra	
Dendrocalamus giganteus	
Alstona scholaris	
Senna surattensis	

76. Overgrown canals and heavily vegetated canal banks occur along the 1 km canal north of Highway 1 in Thnaot village, and the first 800 m of the 3 km long canal south of Highway 1, starting at a ruined Pol Pot era gate and flowing through Boeung Snao and Takork villages. This vegetation is dense in places and may be habitat for local fauna. It also provides wind and sun protection and erosion and dust control functions for canals and villages. This is illustrated in Figures 16 and 17 below.

77. No vegetation species identified on site is included in the International Union for Conservation of Nature Red List for Cambodia. There are no recorded endangered wildlife species nor natural or critical habitats in the subprojects' area of influence.

Figure 16: Overgrown Banks and Canal Bed at Thnaot Village, Lvea Commune

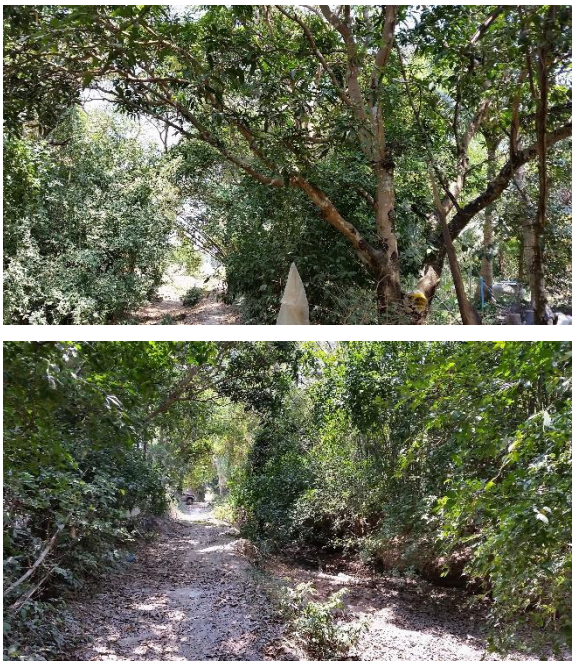


Figure 17: Overgrown Canal Banks at Takork Village, Lvea Commune

78. Where the road alignment in Batheay and Chbar Ampov communes in Kampong Cham passes through villages, trees, and other vegetation grow along the road verge. Many of these trees are productive trees for fruit and other products (e.g., mango and kapok). Out of the villages, in the farming areas vegetation is sparse and mainly confined to waterways and paddy dykes (See Figures 18 and 19). These comprise the following common species. No vegetation species identified on site are included in the International Union for Conservation of Nature Red List for Cambodia, and no natural or critical habitats will be affected by the road alignment.

In villages	**Along paddy areas**
Productive trees	*Zizyphus mauritania*
Anacardium occidentale	*Streblus asper*
Mangifera sp.	*Mimosa pudica*
Ceibra pentandra	*Borassus flabellifer*
Cocos nucifera	*Millingtonia hortensis*
Others (shade and wood)	
Samanea saman	**Along waterways**
Albizzia lebbek	*Pithecellobium dulce*
Streblus asper	*Albizzia lebbek*
Eucalyptus spp.	

Figure 18: Vegetation Along Road in Villages

Figure 19: Sparse Vegetation in Paddy Areas

Figure 20: Land Use and Vegetation at the Lvea Irrigation Subproject
(Canal subprojects in red)

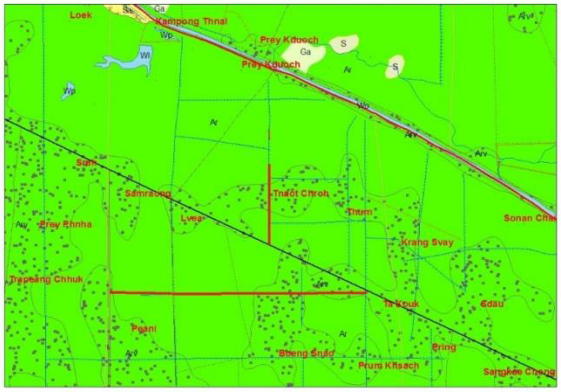
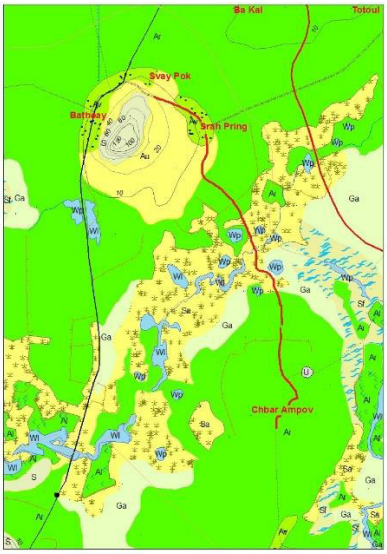


Figure 21: Land Use and Vegetation at the Banthaey-Chbar Ampov Road Subproject
(Subproject road in red)



Source: JICA GIS Survey of Cambodia, 2005, revised by PPTA Team 2017.

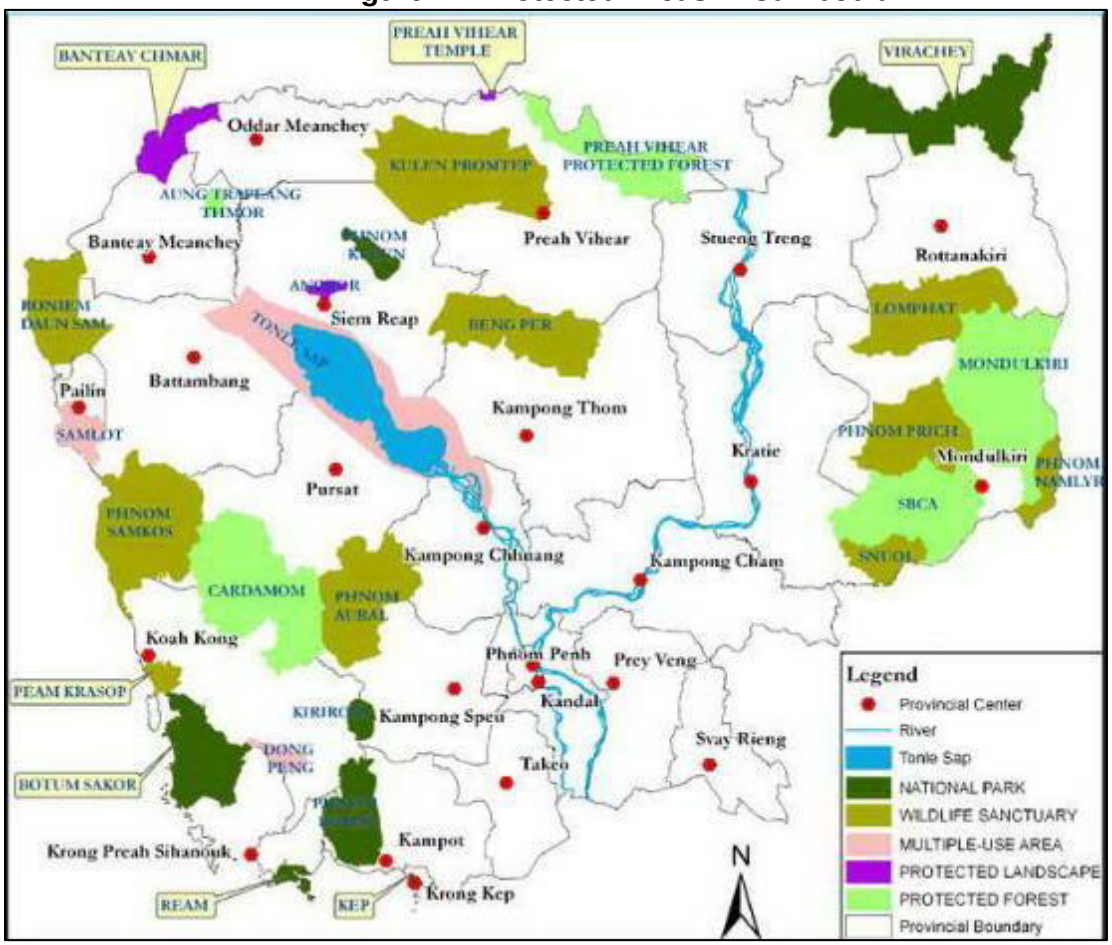
7. Protected Areas

79. Cambodia has a network of 23 protected areas managed through MOE. These areas cover 2.2 million ha 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 which are protected by Royal Decrees, Laws and Regulations.

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

(i) national parks;
(ii) wildlife sanctuaries;
(iii) protected landscapes;
(iv) multiple use areas;
(v) Ramsar sites;
(vi) biosphere reserves;
(vii) natural heritage sites; and
(viii) marine parks.

Figure 22: Protected Areas in Cambodia



Source: http://www.mekong-protected-areas.org/cambodia/pa-map.htm.

81. Neither of the two subproject provinces (Kampong Cham and Prey Veng) have protected areas. Cambodia's protected areas are shown in Figure 22. None are closer than 150 km to the subprojects. Neither subproject commune is listed in NCDD's Environmental Watch List (2011). No Key Biodiversity Areas or Important Bird Areas are in or adjoining the subproject communes. There are no identified ecologically sensitive area on the Trabaek river system (e.g., fisheries, or wetland) downstream of the irrigation extraction point.

8. Physical cultural resources

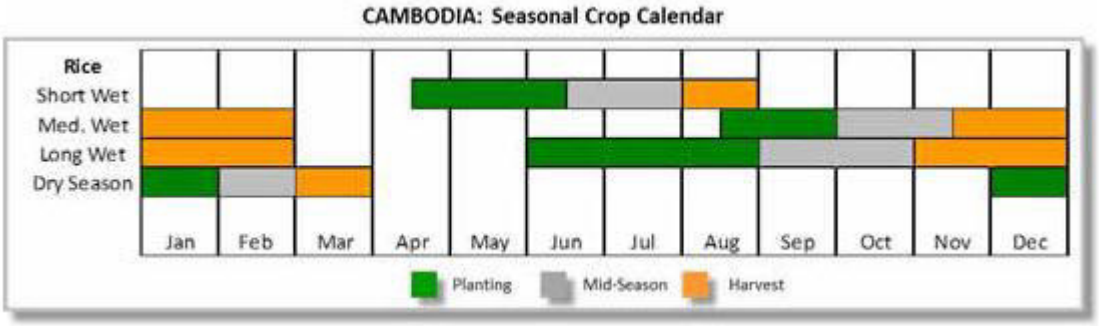
82. No significant physical cultural resources have been recorded for the subproject areas, however two temples and monasteries are located along the existing road alignment in Srah Pring Village, Bathaey commune. There are no temples or shrines along the proposed canal rehabilitation areas in Lvea commune.

B. Agricultural Practice

83. 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.

84. The cropping calendar at Figure 23 is from MAFF and applies to the rice-growing areas of Cambodia. The periods for planting and cultivation are therefore broad to cover local variations, but the mid-season periods accurately reflect the growing phase of the rice crop in most areas. The calendar illustrates the usual cultivation and growing cycle of one short (90 days) wet season rice crop per year which relies upon rainfed water. Where there is sufficient water through irrigation to grow a wet season and a dry season crop, a short dry season rice crop can be planted. Other alternatives include a medium wet season crop and a long wet season crop – neither of these is commonly practiced in the Lvea irrigation subproject site. The purpose of the subproject, in rehabilitating canals is to facilitate a dry season short (90 days) crop.

Figure 23: MAFF Crop Calendar for Rice Production



Source: MAFF. Cambodia. 2012.

85. 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

24), which require careful handling and separation from aquatic ecosystems. Pesticide residues have been recorded in both surface and groundwater in locations in this subproject (see Tables 13 and 15).

Figure 24: Agricultural Chemicals Used in the Lvea Subproject Area

Source: PPTA team.

86. Field observations indicated that handling, mixing, and application was often undertaken with a minimum of precaution for both the health of farmers and the environment.

C. Human and economic development

87. The PPTA social survey undertook data collection from commune records followed by household interviews of 100 households per subproject area. From commune records a breakdown of commune populations was assembled and is presented in Table 17 below. The road subproject area has a total population of over 15,000 persons. The irrigation subproject commune is much more sparsely populated, with a commune of almost 8,000 persons.

Table 17: Commune Populations and Gender Breakdown

Sub-Project	District	Commune	No of Villages	Families	Total Population	Total Male	Total Female
Village Road	Batheay	Batheay	6	3,689	15,294	7,714	7,580
		Chbar Ampov	4	1,557	6,363	3,123	3,240
	Total		10	5,246	21,657	10,837	10,820
Irrigation	Preah Sdach	Lvea	11	1,751	7,901	4,014	3,887

Source: PPTA team.

88. In the household survey, 100 households in each subproject area were surveyed. The more rural population of the irrigation subproject area is apparent with a mean income level which is almost a quarter of the road subproject area (Table 18). This is also reflected in the poverty levels of the subproject areas, with 52% of the sample in the irrigation area holding poor IDs, in contrast to the road subproject area with 38% with poor IDs (Table 19).

Table 18: Household Incomes of Sample Group

($)

Villages involved in subproject	Household income per month		
	Mean	Maximum	Minimum
Road Subproject	449.68	1,750.00	5.00
Irrigation Subproject	117.01	600.00	5.00
Total	273.42	1,750.00	5.00

Source: PPTA team.

Table 19: Households Holding ID Poor Card[4] in Sample Group

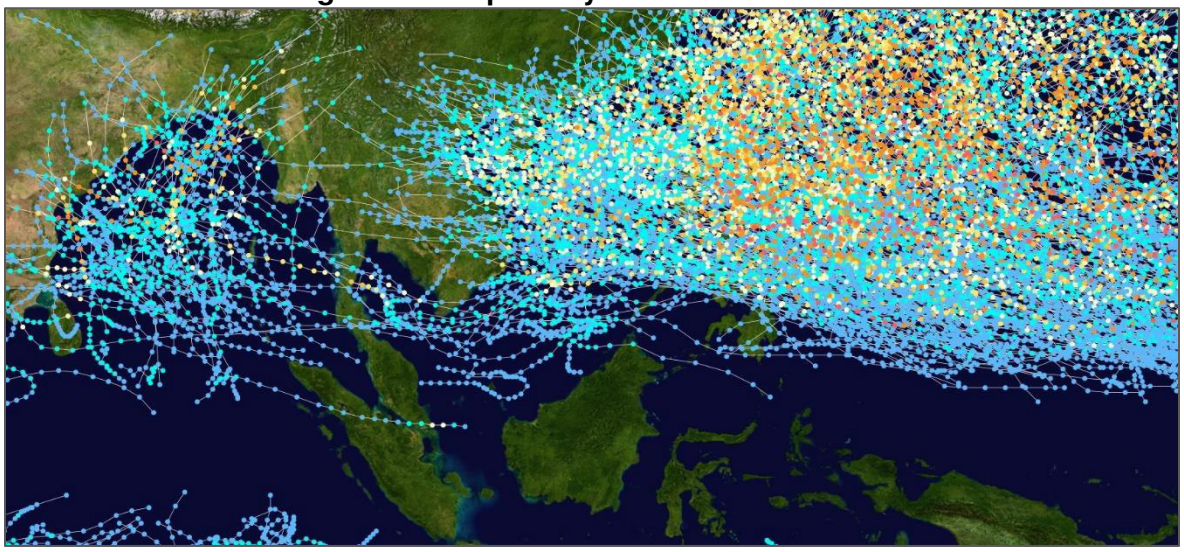
Subproject	Poverty Level	Total	
		Number	%
Village Road	Not poor	62	62.0%
	Poor 1	23	23.0%
	Poor 2	15	15.0%
	Subtotal	*100*	*100.0%*
Irrigation	Not poor	48	48.0%
	Poor 1	24	24.0%
	Poor 2	28	28.0%
	Subtotal	*100*	*100.0%*

Source: PPTA team.

D. Floods and Extreme Weather Events

89. 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. Additionally, though major tropical cyclone originating in the South China Sea rarely penetrate into Cambodia (see Figure 25), cyclonic effects in central Cambodia have been more common in the last decade. The flood statistics for the subproject provinces in Table 20 illustrate the levels of damage.

Figure 25: Tropical Cyclone Tracks[5] 1985-2005



Source: National Hurricane Center and the Central Pacific Hurricane Center.

[4] Poor Households as defined in Ministry of Planning Sub-decree of IDPoor, 2011.

[5] Tracking data for storms within the Atlantic and Eastern Pacific basins is taken from the National Hurricane Center and the Central Pacific Hurricane Center's Northeast and North Central Pacific hurricane database.

Table 20: Impact of flooding (18 October 2013)

Province		Kampong Cham	Prey Veng
Affected Districts		13	13
Affected communes		72	84
Affected Families		51,376	44,764
Affected people		236,330	205,914
Evacuated families		3.546	866
evacuated people		16,312	3,984
Houses affects		43,759	32,193
Victims	Deaths	29	26
	Injured		
Flood Affected	Schools	268	155
	Pagodas	144	53
	Health centers and hospitals	17	8

Source: Humanitarian Response Forum, Situation Report No.4, 23 October 2013.

90. Table 21 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 21: Affected and Evacuated Families in 2013 and 2011

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	
Kampong Cham	51,376	33,436	17,940	3,546	6,085	-2,539
Prey Veng	44,764	40,615	4,149	866	10,227	-9,361

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

91. The effects of flooding on rice production is an important part of the Lvea subproject due diligence. The following table, taken from the Humanitarian Response Forum Situation Report of October 2013 covering the devastating floods of September that year, show that the agriculture of the subproject provinces were among the worst hit.

Table 22: Damage to Agriculture Sector by Floods in 2013

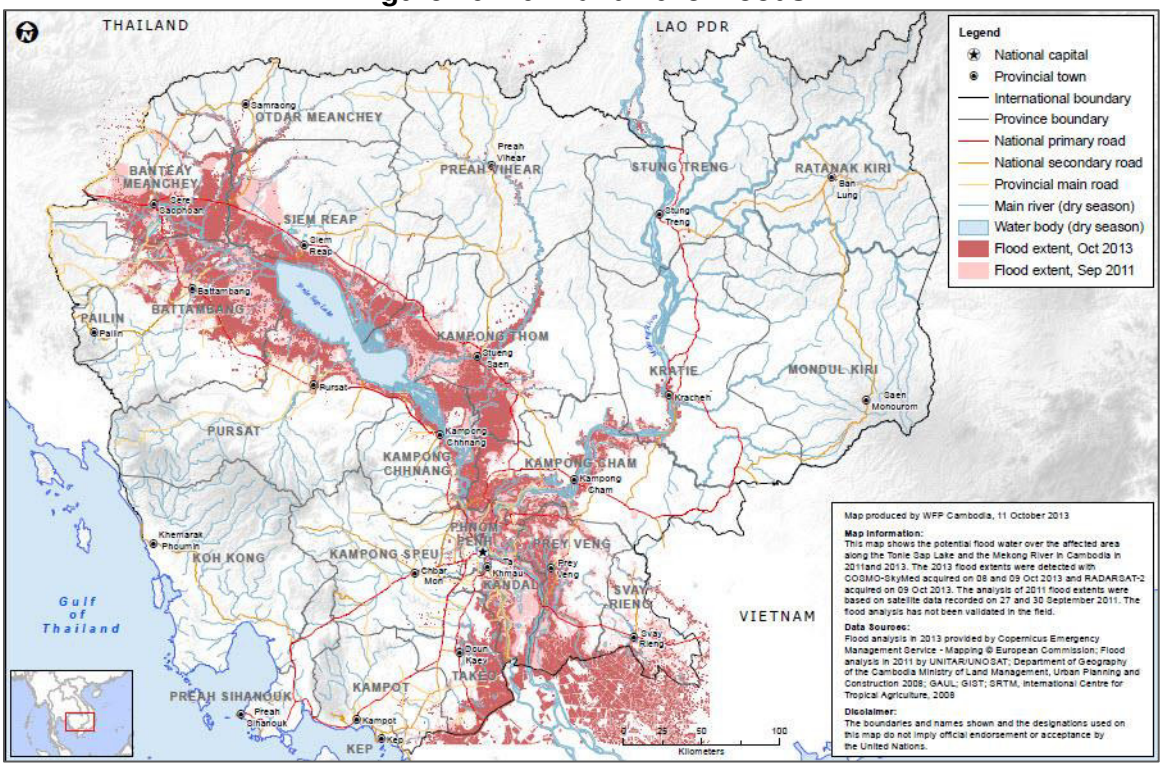
Province	District	Commune	Agriculture sector					
			Cattle/Livestock		Rice transplanting		Rice seedling	Secondary crop
			Evacuated	Death	affected (ha)	damaged (ha)	damaged (ha)	
Preah Vihear	7	22			4036	11		43
Kampong Thom	6	20	4361		2802			
B. Meanchey	9	9			25,943	30		3,389
Siem Reap	6	40		5	8,800			72
Otdar Meanchey	5	22			69,516			1,931
Kampong	13	72	2,398		10,798	60	28	166

Province	District	Commune	Agriculture sector					
			Cattle/Livestock		Rice transplanting		Rice seedling	Secondary crop
			Evacuated	Death	affected (ha)	damaged (ha)	damaged (ha)	
Cham								
Kratie	5	39	8,724		4,610		329	695
Steung Treng	5	29			8,367			1,012
Prey Veng	12	65	4,555		45,528			203
Kandal	7	53	1,013		4,632			1,759
K. Chhnang	3	3						
Phnom Penh	3	13			285			
Ratanakiri	5	21		34	2,792			316
Battambang	8				33,367			1,622
Pailin	2	8						300
Pursat	5							
Total	**101**	**416**	**21,051**	**39**	**221,476**	**101**	**357**	**11,508**

ha = hectare.
Source: Humanitarian Response Forum, Final Report No.07, December 2013.

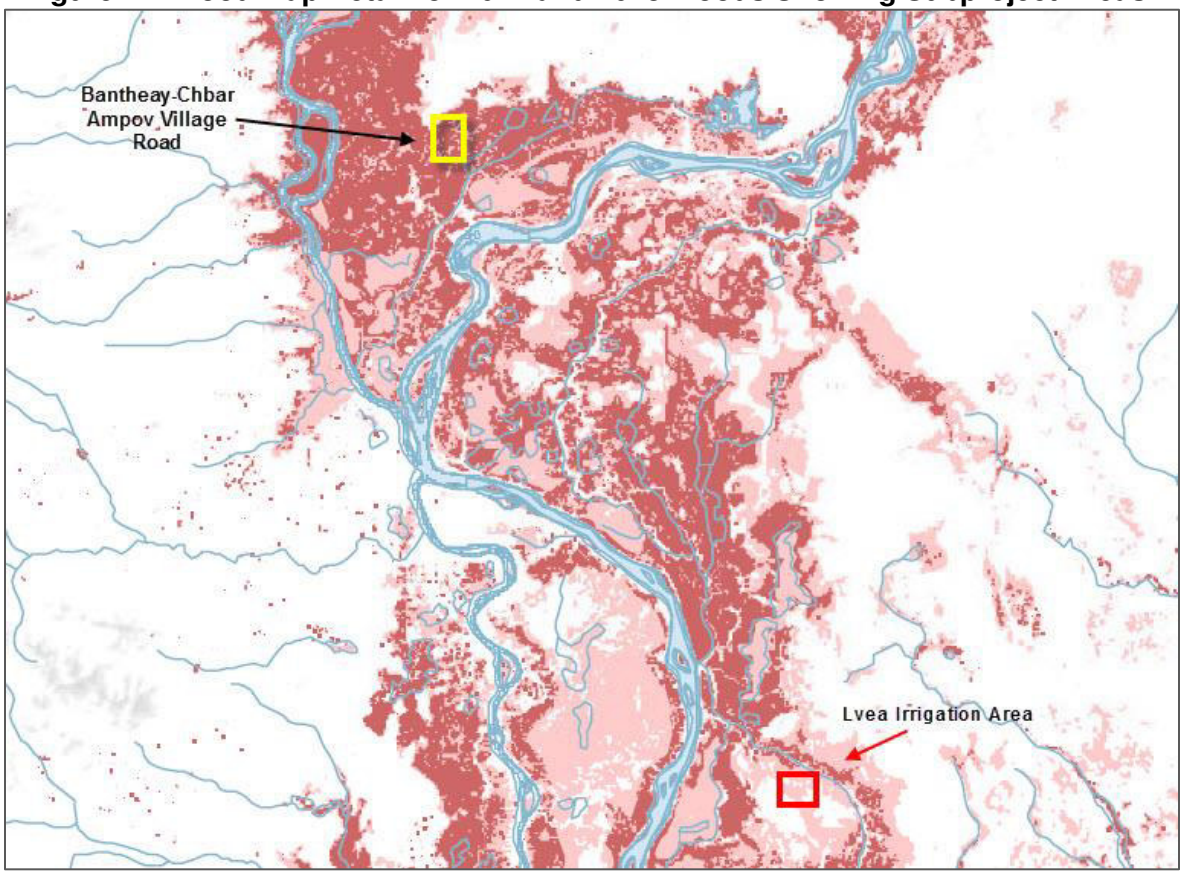
92. Data on flooding in the subproject communes is unavailable, but national mapping of the 2011 and 2013 floods (Figure 26 and 27) shows that the Village Road subproject in Kampong Cham was fully affected by these floods, but that the Prey Veng irrigation subproject area was only affected by the 2011 flood, and partly only.

Figure 26: 2011 and 2013 Floods



Source: World Food Programme. Cambodia. 2013.

Figure 27: Flood Map Detail for 2011 and 2013 Floods Showing Subproject Areas



Source: World Food Programme. Cambodia. 2013.

E. Climate Change Scenarios

93. In recent relevant climate change analyses for agriculture and roads in Cambodia[6] both the Intergovernmental Panel on Climate Change's (IPCC) latest "radiative" scenarios adapted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO, 2013) in its Conformal Cubic Atmospheric Model (CCAM) and the earlier IPCC Special Report on Emission Scenarios (SRES) using the A1, A2, B1, and B2 scenarios describing differing emission rates and geopolitical settings have been used to predict future climatic determinants for project design.

94. The CCAM projections use bias-corrected sea surface temperatures from six Coupled Model Intercomparison Project Phase 5 (CMIP5) global climate models to drive a global atmosphere-only model at 50 km horizontal resolution (CCAM). Downscaling for the 43309-CAM: Provincial Roads Improvement Project was carried out by using the 50 km simulations to drive a regional model at a 10 km grid spacing. Two emissions scenarios were considered: Representative Concentration Pathways (RCP)[7] 4.5 (a future with lower GHG concentrations)

[6] 43309-CAM: Provincial Roads Improvement Project and the 44321-CAM: Climate Resilient Rice Commercialization Sector Development Program.

[7] RCPs are four GHG concentration (not emissions) trajectories adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014. It supersedes SRES projections published in 2000.

and RCP 8.5 (a future with higher GHG concentrations).

95. The SRES projections for Cambodia have most recently been promoted by UNDP (2008), Mekong River Commission (2014), and MOWRAM (2013). They are statistically downscaled, by calibrating against current climate data sets, to 50 km scale and usually focus on two SRES scenarios for projecting future temperature and precipitation (A2 and B2). These scenarios and projections have been used in the 44321-CAM: Climate Resilient Rice Commercialization Sector Development Program.

Modeling	Comments
MOWRAM *Carried out by* TA 7610 – CAM: Supporting Policy and Institutional Reforms and Capacity Development in the Water Sector Project	The modeling was carried out in 2010 Data from nine GCMs (pixels 125-400 km) was downscaled to smaller pixels (data from World Bank web portal) Using statistical downscaling final pixel size 50 km Older generation IPCC models
Mekong River Commission *Carried out with assistance from* CSIRO and SEA START	The modeling was carried out in 2012 Data from 1 GCMs - Max Planck Institute for Meteorology's ECHAM4 (pixels ~250 km) was downscaled to smaller pixels Using a Regional Climate Model Final pixel size of 50 km Older generation IPCC models
ADB TA 7459-REG: Greater Mekong Subregion Biodiversity Conservation Corridors Project – Pilot Program for Climate Resilience Component – Cambodia *Carried out by* CSIRO	The model was developed and run in 2012. CCAM - This is a regional model that was run specifically for Southeast Asia. It uses six GCMs selected for best performance in Southeast Asia The model has a pixel size of 10 km It uses the latest IPCC standard set of model simulations

CAM = Cambodia; CCAM = Conformal Cubic Atmospheric Model; CSIRO = Commonwealth Scientific and Industrial Research Organisation; GCM = general circulation model; IPCC = Intergovernmental Panel on Climate Change; km = kilometer; REG = regional; SEA START = Southeast Asia SysTem for Analysis, Research and Training Regional Center; TA = technical assistance.

96. The different scenario generators have particular advantages for the different sectors of the project:

(i) The IPCC radiative scenarios regional downscaling techniques used in CCAM not only increase resolution to the provincial level, but also allow analysis of local extreme events such as 1 day and 5 days rainstorm intensities. Thus, in addition to general climate change, the scenarios can address flooding and extreme events – scenarios most relevant to road and infrastructure design.

(ii) The SRES scenarios can be applied readily to water balances by computing changes in temperature, seasonal rainfall, evaporation to calculate irrigation future water needs for crops. It is therefore most helpful in analyzing adaptation requirements for future irrigation needs.

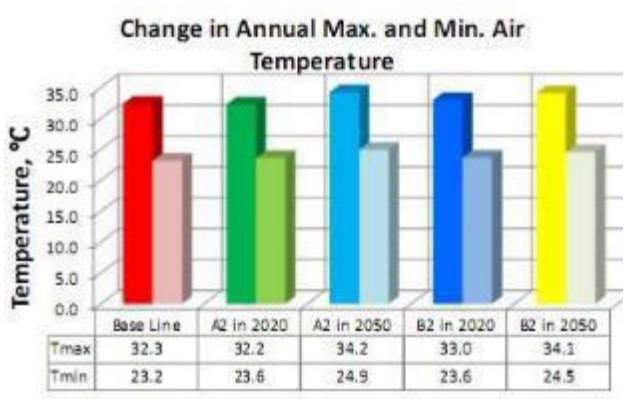
97. **SRES scenarios for irrigation planning (MOWRAM Model).** Under elevated CO_2 with low rate of emission scenarios (SRES-B1),[8] it is likely that wet season rainfall will continue to

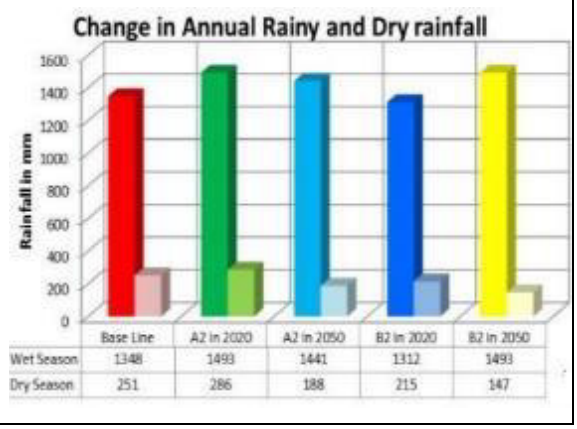
[8] IPCC's SRES has four scenarios A1, A2, B1, and B2 describing differing emission rates and geopolitical settings. In summary, A is economics driven rather than environmental; and B is more environmentally driven. 1 is countries operating in concert; and 2 is countries pursuing their own aims.

increase in future, and then might decrease again after 2050. But under high emission scenarios (SRES-A2), the direction of change will reverse.[9] 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.[10] The magnitude of these changes is illustrated in the following graphs (Figure 28), and their implications for irrigation subproject design are discussed in the following chapter.

Figure 28: 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.[11]

98. **CCAM scenarios for road planning (CSIRO Model).** Also shows warming occurring over Cambodia in the future, projecting warming of 0.03°C to 0.06 °C per year. This equates to a warming of 0.35°C to 2°C by 2050 and 1°C to 5°C by 2100. The projected change in temperature output by the CSIRO's CCAM model is very similar to the one produced by the MOWRAM modelling carried out in 2010.

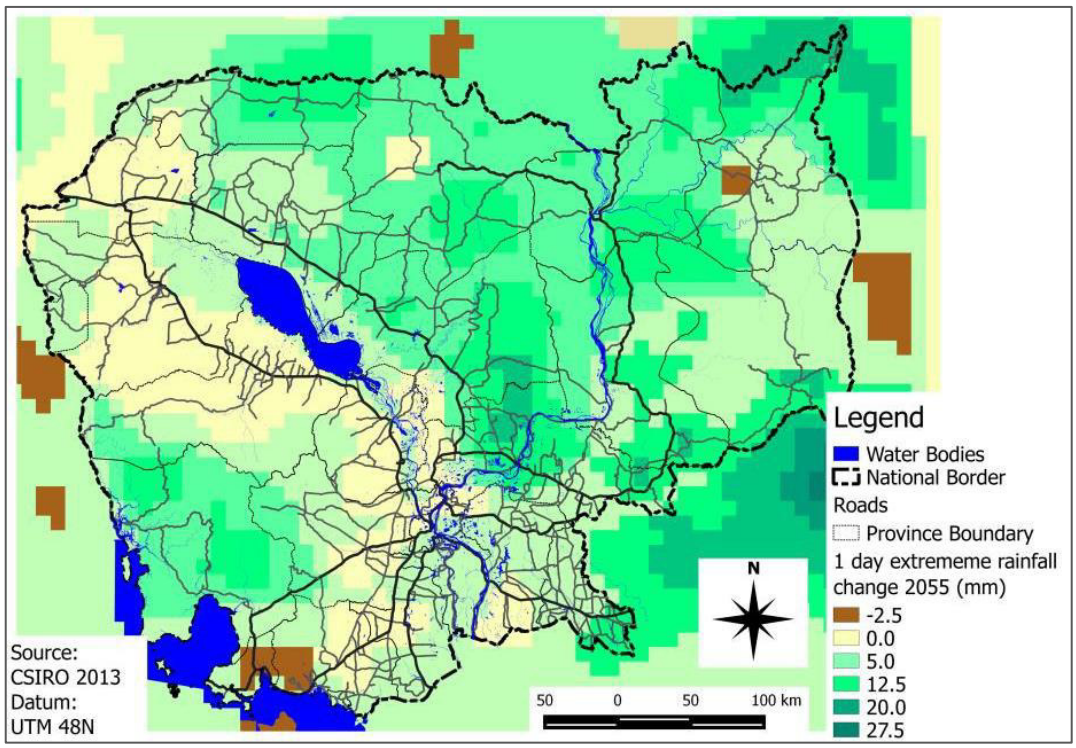
99. Although this model projects a decrease in total rainfall during the wet season, it does project an increase in rainfall at the start of the wet season. The CSIRO modelling also projects an increase in the amount of rain that falls in extreme events (i.e., is conservative for flood prediction purpose).

100. The projected one day extreme rainfall is the average result from the six CSIRO CCAM model which runs for a 20 year period centered on 2055 using an RCP of 8.5. The projected change in one day extreme rainfall is the difference between current and projected 2055 values and the map is presented in Figure 29. The model projects an increase in one day extreme rainfall over the coastal mountains and over the hilly regions in the north of the country. There is no change or only a small change projected for the central flat areas, except for a small area north east of Phnom Penh. The five days extreme rainfall map is shown in Figure 30. The distribution of the five days extreme rainfall reflects the spatial distribution of annual rainfall with high values of 300 mm or more in the mountainous region near the coast and in Mondul Kiri and in the far

[9] National Climate Change Committee. 2013. Cambodia Climate Change Strategic Plan 2014-2023.
[10] irri.org/news/hot-topics/rice-and-climate-change.
[11] Tes, S. Jan 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, Cambodiana Hotel, Phnom Penh.

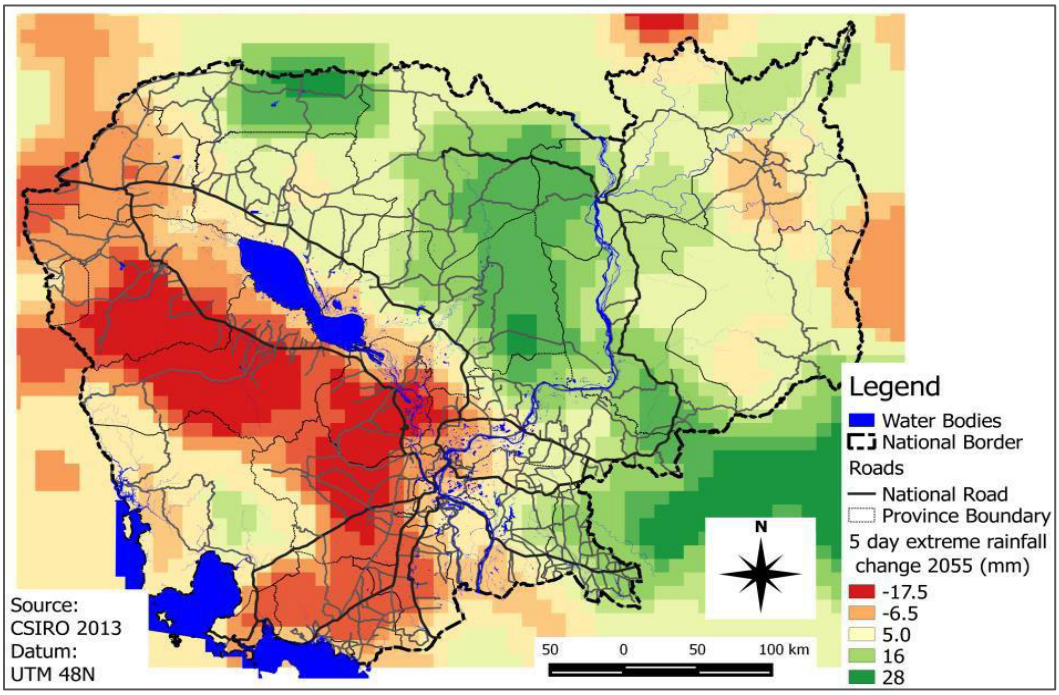
north east. Smaller five days extreme events of 150 mm to 180 mm occur in the central flat lands and hilly regions in the north. The model shows the lowest values around Tonle Sap.

Figure 29: Projected Change in one day Extreme Rainfall for 2055 for RCP of 8.5 from CCAM



Source: CSIRO 2013.

Figure 30: Projected Change in five day Extreme Rainfall for 2055 for a RCP of 8.5 from CCAM



Source: CSIRO 2013.

IV. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Environmental Screening of Subprojects

101. The two core subprojects which are the subject of this IEE have been chosen using a set of environmental selection criteria. When applied, these criteria led to the selection of relatively straightforward schemes without significant environmental impacts. The criteria were:

1. Irrigation

(i) The proposed subprojects will have sustainable water supply; Primary water source should be demonstrably capable of sustaining water extraction to suit the intended cropping calendar.
(ii) The proposed subprojects will not be subject to water use conflict or other water security issues.
(iii) The proposed subprojects will not encroach on or impact nature reserves or wildlife sanctuaries.
(iv) The proposed subprojects will not be undertaken where soil contamination requiring remediation occurs.
(v) Power demand for the operation of a subproject (pumps) will not result in net CO_2 equivalent emissions in excess of 100,000 tons/year in electricity generation.
(vi) The proposed subprojects will avoid monuments of cultural or historical importance.
(vii) Primary water source (main canal, waterbody) should be functional and operational and not in imminent need of repairs.

(viii) No groundwater should be used as primary water source.
(ix) Additions to irrigation command areas should not involve extensive land conversion or land levelling.
(x) Additions to irrigation command areas should not be upstream of ecologically sensitive areas (ensure protection of ecologically sensitive areas from elevated nutrients and agricultural chemicals in downstream runoff from irrigation).

2. Roads

(i) New or upgraded roads should not encroach on:
  a. natural areas;
  b. wetlands;
  c. flooded forest; and
  d. wildlife breeding areas.
(ii) New or upgraded roads should not encroach on heritage sites or sites of religious ceremony or community value.
(iii) New or upgraded roads should not encroach on wildlife reserves or protected areas.
(iv) New or upgraded roads should not open up new natural resource areas for exploitation (e.g. forests, wetlands).
(v) New or upgraded roads should not divide or isolate communities. Should not create safety hazards near schools and populated areas.
(vi) New roads should not cross a major waterway, requiring a bridge structure; alignment should be sought where drainage structures under road are culverts.

B. Areas of Influence for Impact assessment

102. The assessment areas for air, noise, water, and ecological impacts are defined by the technical guidelines for environmental standards cited above, based on the environmental sensitivity of the project areas and surroundings as well as the nature of each subproject and its components. The assessment areas for the infrastructure components are shown in Table 23.

Table 23: Assessment Areas of the Infrastructure Subprojects

Environmental Media	Assessment Area	
	Village Road Rehabilitation	**Irrigation Canal Rehabilitation**
Air	Within 50 meter (m) on both sides from the road center line in village areas (to cover all distances of dust and emissions impacts during construction).	Within 50 m of residences along Secondary Canal 1 and Secondary Canal 2 (to cover all distances of dust and emissions impacts during construction). Not applicable to Secondary Canal 3 (no receptors).
Noise	Within 300 m in the day and 50 m at night on both sides from the road center line in village areas (to cover all distances of noise impacts during construction).	Within 300 m in the day and 50 m at night along Secondary Canal 1 and Secondary Canal 2 (to cover all distances of dust and emissions impacts during construction). Not applicable to Secondary Canal 3 (no receptors).
Surface water	Nearest permanent waterbody (canal or river).	Nearest permanent waterbody (canal or river).
Groundwater	Any shallow domestic wells adjacent to (within 20 m) of road construction activities.	Within and adjoining irrigation command areas.

Environmental Media	Assessment Area	
	Village Road Rehabilitation	Irrigation Canal Rehabilitation
Solid waste	Adjoining village and paddy areas where waste could be deposited intentionally or accidently.	Adjoining village and paddy areas where waste could be deposited intentionally or accidently.
Ecology/Vegetation	Within 5 m both sides of the road center line.	25 m easement along canals for canal channel and levees.
Physical cultural resources	Construction "footprint"	Construction "footprint"
Occupational health & safety	Construction "footprint" and adjoining access ways and properties.	Construction "footprint" and adjoining properties.
Community health & safety	Residences and farmers working areas adjacent to construction sites. All road users.	Residences and farmers working areas adjacent to construction sites.

Source: PPTA team.

C. Positive Impact and Environmental Benefits

103. For the irrigation subproject, the result of the project irrigation and drainage facilities will be (i) the availability of additional area for a dry season crop where, due to failure of irrigation infrastructure, none currently exists; and (ii) an increase in certainty and control of existing irrigation areas.

104. In terms of areas sown, the project will increase potential rice growing areas by 305 ha. 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. Direct beneficiaries have been identified in preliminary surveys as:

(i) Secondary canal 1: a 1 km canal north of Highway 1 in Thnaot village, flowing south from a secondary canal: 30 households and 150 people.
(ii) Secondary canal 2: a 3 km long canal south of Highway 1, starting at an intake gate on main canal (no. 10 gate) and flowing eastward through Boeung Snao and Takork villages and finishing at a ruined Pol Pot era gate: 206 households and 1,187 people.
(iii) Secondary canal 3: a 1 km long canal south of Highway 1, starting at a main canal (no. 10 gate) and flows westward through the northern outskirts of Peany village. 45 households and 225 people.

105. For the village road subproject the main beneficial impact will be that the road will be flood-free for a longer period each year. This will have flow-on effects for increased access to goods and services for villages and farmers, as well as a more reliable means to transport the wet season harvest to markets. All residents of Chbar Ampov village will benefit from this increased access and farmers living in Srah Pring village of Banthaey commune will have better access to their fields. In peak floods, the new road will be overtopped but the design incorporating consolidated embankments, reinforced road surfacing and increased culverts will strengthen its resistance to flood damage.

D. Impacts and Mitigation Measures during Design and Pre-Construction Phase

1. Site Preparation

106. **Loss of vegetation**. The 25 m construction easement for canals (canal channel and levee banks) will require removal of vegetation where it has established along existing canal banks and,

in the case of secondary canal 1 and the eastern portion of secondary canal 2, in the disused canal itself. This vegetation and its local amenity has been described in Section IV.A.6. Trees and vegetation along the road in villages provide fruit and other products, protect residences from sun and wind and adjacent agricultural land from dust and run-off. Loss of mature native trees and productive fruit trees in these areas should be minimized. Before construction in all areas, the implementing agency's ESO and contractor will clearly mark trees which are to be retained. Contractors will convey these requirements to all machinery operators and residents to ensure that valuable trees are not damaged. After construction, removed trees and productive shrubs will be replanted.

107. **Loss of assets**. The alignment of the village road, canals, and working envelope will result in the loss of some built and livelihood assets. These have been documented by the PPTA team and informed consent and appropriate compensation will be implemented in compliance with ADB's SPS 2009. The affected people and assets are set out in Tables 24 and 25.

Table 24: Loss of Assets for the Village Road Subproject

Commune	Village	Household which will lose assets		Affected Area in square meter	
		Agriculture	Residential	Agriculture	Residential
Batheay	Srah Pring	9	16	3289.58	715.75
	Svay Pok	-	-	-	-
Chbar Ampov	Chbar Ampov	11	34	2151.2	1157.94
	Total	20	50	5440.78	1873.69

Source: PPTA team.

Table 25: Loss of Assets for the Irrigation Subproject

Commune	Village	Household which will lose assets				Affected Area in square meter (m2)	
		Agriculture	Residential	Other structures	Trees	Agriculture	Residential
Lvea	Thnoat Chros	24	5	-	6	4232.66	653.4
	Beoung	0	0	-	17	-	-
	Takork	2	4	2	20	121	1426.7
	Peany	-	-	-	-	-	-
	Total	26	9	2	43	4353.66	2080.1

Source: PPTA team.

2. Features of Detailed Design

108. The designs of both subprojects will be flood resilient and climate change adapted. Measures for flood resilience and climate change adaptation have been drawn from the project's climate and disaster risk assessment (CDRA), which references the ADB's Guidelines for Climate Proofing in the Transport and Agriculture Sectors, and current ADB Climate Resilience projects in Cambodia.

109. For the irrigation subproject these include: (i) the use of future possible crop water requirements in climate change scenarios for calculating the sustainability of irrigation design; (ii) robust canal infrastructure for future floods; and (iii) promoting canal bank and paddy dyke vegetation. For the village road subproject these include: (i) road and embankment heights, construction and surface finishes which combine flood resistance and flood resilience; and (ii) multiple large drainage structures to ensure unconstrained through-drainage of floodwaters. These measures are described in the section below on adaptation for climate change (Section I.2.4).

3. Construction Readiness

110. A number of environmental management measures will also be 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:

(i) updating EMP: mitigation measures defined in this EMP will be incorporated into the detailed design to minimize adverse environmental impacts and will be updated in respect of changes made during detailed engineering design. This will be the responsibility of the commune councils and PST.
(ii) final designs of embankments, siting of control structures and canal alignments will be completed after taking into account the provisions of the EMP.
(iii) contract documents: preparation of the environment section in the TOR for bid and construction contracts, and environmental contract clauses for contractors, namely the special conditions (referencing the EMP and monitoring plan). This will be the responsibility of the commune councils with the support of the ESCC.
(iv) establishment of the GRM during the subproject design.
(v) environmental protection training: environmental specialists (including ESCC) and/or officials from local MOE offices will be invited to provide training on implementation and supervision of environmental mitigation measures to contractors. This will be the responsibility of the commune councils.

E. Impacts and Mitigation Measures during the Construction Phase

1. Construction

111. The following impacts and mitigation measures refer to construction impacts which are common to both subprojects. Both will 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 work force. Occupational and community health and safety issues are discussed separately in Section H below.

112. **Spoil disposal.** The Bill of Quantities for the Lvea irrigation subproject indicates that excavation volumes from embankments and canal will be generally balanced with embankment fill volumes. The subproject only plans for the disposal of 1,000 m^3 of unsuitable spoil (too sandy for compaction). The Banthaey-Chbar Ampov village road subproject will not involve the disposal of excavated spoil since all will be used in the reformation of road base and side batters, and there will be a bulk importation of material for building up the road profile. Any surplus spoil will be made available to nearby communities for use as flood free refuge areas for livestock, building pads and bunds.

113. **Dredge spoil.** The Lvea canal improvement works will involve dredging of secondary canals to establish new design capacity contoured shape and slopes. The dredge spoil volume is estimated at 46,500 m^3. Since field canals are the sink for runoff and drainage from paddy fields, the bottom sediment in canals may accumulate agricultural chemical residues. The sediment quality of the dredge spoil will need to be 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. No material will be dredged from the main canal of the Lvea subproject. For the re-use and disposal of silt from canal cleaning or dredging, there is no government standard, and the most recent standards applying to soil contamination, Soil

Guideline Values of the UK Department for Environment Food & Rural Affairs, is recommended in the EMP. Contaminated soils can be used in the way described in the guidelines (buried in levees with clean soil on the top, sealing it from human contact) or taken to licensed disposal facilities. This will be checked by the PIC Environmental Safeguards and Climate Change Specialists.

114. **Erosion of disturbed surfaces.** The areas most vulnerable to erosion are temporary construction sites and other places where surface soil will be disturbed. This will total 143,000 m^2 of "clearing and grubbing work" along the length of the rehabilitated canals. The cleared construction surface for the village road subproject is estimated at almost 20,000 m^2. The most effective erosion control will be interception drainage to protect disturbed surfaces from surface flows. Construction plans will 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 sediment traps and then 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 shall be stabilized within 30 days after earthworks have ceased at the sites.

115. **Construction wastewater.** Construction wastewater is produced from the maintenance and cleaning of mechanical equipment and vehicles, maintenance water for mixing and curing concrete, cooling water, 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.

116. Construction wastewater will not be discharged onto the surrounding soil or into surface water systems. Sedimentation tanks will be built, and after settling out of solids the upper clear liquid will be recycled for spraying the construction site (dust control), and the waste residue in the tank will be cleared and transported to designated landfills. Oil-containing wastewater will require the installation of oil-water separators before the sedimentation tank.

117. **Gaseous air pollution.** Construction machinery on all sites will consume petrol and diesel, releasing gaseous SO_2, CO, and NOx. 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.

118. **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 will 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 will be standard site management practice. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered.

119. **Noise.** Noise can be expected during construction due to construction machinery operation and transport activities. Construction activities will 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 (5 m from operating

machinery). The transport of material, aggregate, concrete, and waste material to and from sites will also cause noise impacts along the haulage routes. Activities with intensive noise levels will not only have an impact on the residents, but may also cause injury to construction workers operating the equipment.

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

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

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

121. According to the model, noise levels at different distances are gained after calculating the impact scope of equipment noise during construction as in Table 26. The Cambodian noise standards for residential areas are shown as well as the International Finance Corporation's EHS standards.

Table 26: Construction Equipment Noise Impact Distance

Level dB (A) / Construction Machinery	Distance							Limit Standard for residential areas dB (A)		IFC/EHS targets		Impact Range (m)	
	10	20	40	60	80	100	150	Day	Night	Day	Night	Day	night
Loader	84.0	78.0	72.0	68.4	66.0	64.0	60.5	60	50	55	45	>150	300
Bulldozer	80.0	74.0	68.0	64.4	62.0	60.0	56.5	60	50	55	45	150	250
Roller	80.0	74.0	68.0	64.4	62.0	60.0	56.5	60	50	55	45	150	250
Excavator	78.0	72.0	66.0	62.4	60.0	58.0	54.5	60	50	55	45	125	200

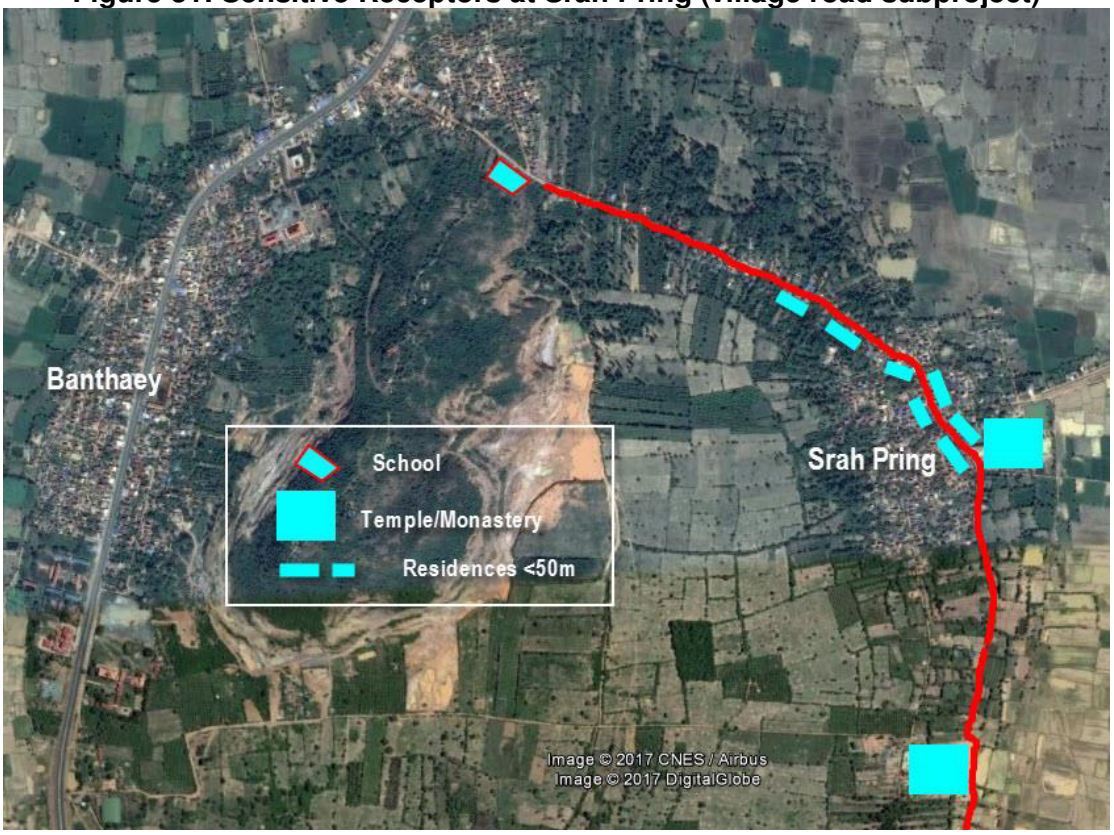
dB = decibel, m= meter.
Source: PPTA team.

122. The results show that, if construction machinery is used singly, the impact distance is >150m away from the source during the day and about 300 m at night. Beyond these distances, the noise levels meet both Cambodian and EHS 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.

123. 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 300 m of residences shall be strictly prohibited. During daytime construction, the

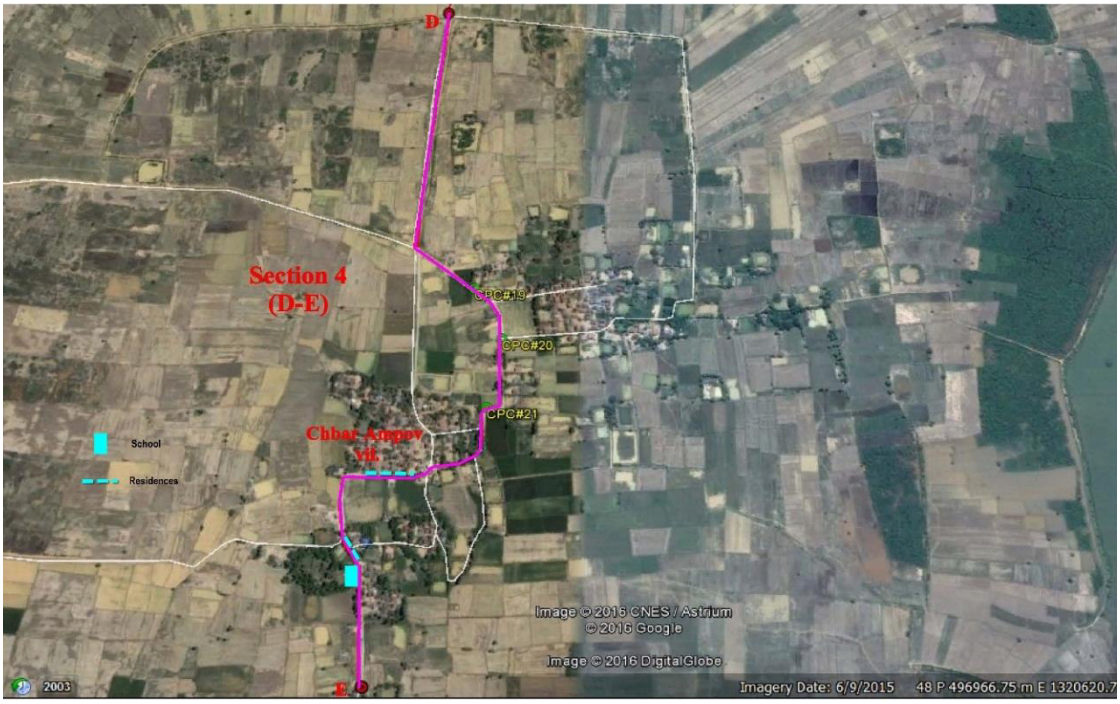
contractor will ensure that: (i) equipment with high noise and high vibration are not used in village or township areas and only low noise machinery or the equipment with sound insulation is employed; (ii) workers in high noise areas will be equipped with hearing protection; (iii) sites for concrete-mixing plants and similar activities will be located at least 500 m away from sensitive areas such as residences and schools; and (iv) temporary anti-noise barriers will be installed to shield any schools, temples, and medical centers within 100 m of the work sites. There is a school, two temple precincts and a number of houses within 50 m of the road alignment in Srah Pring. At Chbar Ampov village there is a primary school and a number of houses within 50 m of the road alignment. The locations of these sensitive receptors are shown on Figure 31 and 32. In the irrigation subproject residences are within 50 m of the canal alignment along CS1 and CS2. These are shown on Figure 33. These will require temporary noise barriers whenever construction work is within 100 m.

Figure 31: Sensitive Receptors at Srah Pring (village road subproject)



Source: PPTA team.

Figure 32: Sensitive Receptors at Chbar Ampov (village road subproject)



Source: PPTA team.

Figure 33: Sensitive Receptors at Canals CS1 and CS2 (irrigation subproject)

Source: PPTA team.

124. **Construction solid waste.** The construction contractors will establish site offices and vehicle/equipment parks in both subprojects. The construction workforce will generate domestic

wastewater and garbage (food wastes, kitchen wastes, paper, and other solid waste including food-laden wash water). Proper disposal of this waste will be essential. It will be the responsibility of the construction contractors to provide toilets with pump-out and disposal facilities which are at least 100 m from any domestic well, and sufficient garbage bins at strategic locations and ensure that they are (i) protected from birds and vermin; (ii) disposed regularly (using the nearest licensed solid waste landfill); and (iii) avoid overflow.

125. **Hazardous and polluting materials.** Construction material handling and disposal guidelines and directions that include spill responses will be prepared and implemented as part of the site environmental management and supervision manual of each construction site. The following measures will be taken 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, provided with bunds and cleanup installations; (ii) bunded areas will be designed to contain 110% of the volume of materials stored within; (iii) vehicles and equipment will be properly staged in designated areas to prevent contamination of soil and surface water; (iv) 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; (v) oil traps will be provided for service areas and parking areas; and (vi) permanent (at works site) and temporary 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.

126. **Flora and fauna.** All protected areas listed in Section IV (Description of the Environment) are more than 150 km distant 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. No commune within the subproject areas is on the NCDD environmental watch list.[12] The vegetation comprises cultivated crops, agricultural weeds and tree plantations along roads, canal banks and dyke walls. There will be no impacts on critical, natural or modified habitats or associated species of conservation significance.

127. Vegetation along overgrown canals however have potential habitat and amenity value as described in Section III. Similarly, trees and vegetation along the road in villages protect residences from sun and wind and adjacent agricultural land from dust and run-off. Before construction, site management plans must be prepared which detail the trees which must be removed but which also maximize retention of existing trees. During construction, contractors will convey these requirements to all machinery operators and residents to ensure that valuable trees are not damaged, and replace trees that are unavoidably removed.

128. **Cultural heritage.** During construction, contractors will ensure that any 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, and after construction is finished any disturbed surroundings will be restored to pre-construction standards. Procedures to be followed in the case of unexpected finds are included in the EMP.

2. Contractor Performance and Site Management

129. To ensure that construction contractors are able to implement the mitigation measures,

[12] NCDD. 2010. Finalization of Environmental and Highland People Watch Lists and Recommendations and Implications for the Further development and implementation of safeguards Work, report prepared for NCDD by Seak Sophat.

the commune councils and PST will put in place the following arrangements: (i) environmental specifications will be included in the bidding and contract documents; (ii) an appropriate environment section describing standards and responsibilities will be included in the TOR for bidders; (iii) material haulage routes, and waste disposal arrangements will be 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 commune councils and PST.

130. During construction, the ESO and each commune council will be active in site supervision, management and appraisal, so as 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.

3. Environmental Health and Safety

131. 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.

132. Measures to protect the community will include:

(i) Publicizing planned work schedules and locations well in advance of construction.
(ii) 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 on seasonal agricultural activities In particular construction adjacent to paddy fields during rice planting or harvesting should be avoided or carried on strictly in consultation with the appropriate farm operator. All land will be reinstated to its original condition after construction.
(iii) 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.

133. Measures to ensure occupational health and safety will include:

(i) Contractors shall be required by the commune councils to ensure that their workers and other staff engaged in the proposed constructions are in a safe environment.
(ii) Following the award of construction contracts, the successful contractors will prepare site environmental health and safety plan, for approval by the commune councils and PST.
(iii) 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) machineries 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.

F. Environmental Impact and Mitigation Measures During Operation

1. Irrigation Subproject

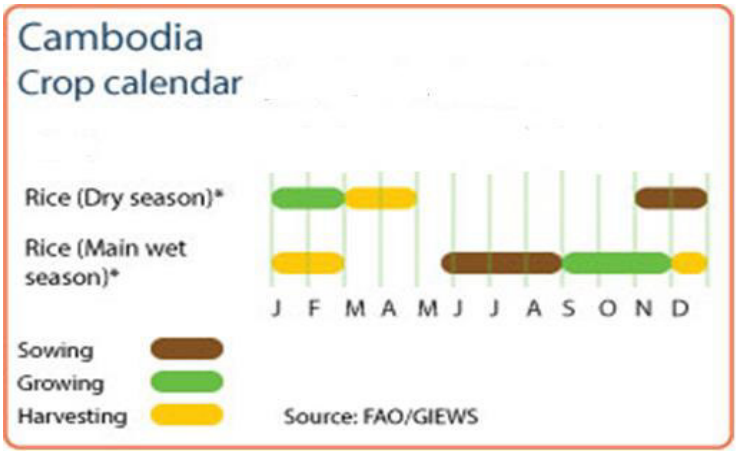
a. Hydrological impacts – seasonal water balances

134. The impact of increased water extraction for irrigation on existing water resources has been examined through water balances for the two schemes involving irrigation.

135. **Assumptions.** The assumption for seasonal water balances are based upon local cropping calendars for Lvea commune for irrigated rice which differ from the standard MAFF model, having a single medium season (130 days) rice crop spanning the main wet season (July-November inclusive) followed by a second short dry season rice crop under irrigation beginning from the harvest of the wet season crop and extending into the mid dry season (December-March inclusive).

136. Each cropping period includes up to a month's land preparation (pre-saturation and water layer establishment). The alternative cropping is depicted diagrammatically in Figure 34 below.

Figure 34: Cropping Calendar for Lvea Commune



Source: PPTA team.

137. The PPTA has derived expected irrigation efficiencies for the project. It is concluded that for both core subprojects, in estimating water needs, and resulting water design capacities of main canals, that 40% is an achievable efficiency.

138. **Water demand.** The water needs for the cropping alternatives illustrated above at a range of irrigation efficiencies, and including water requirements for pre-saturation of paddy and establishment of a 100 mm water layer for planting are listed in Table 27 below. These are taken from calculations for irrigated rice cropping in neighbouring Kampong Thom.[13]

Table 27: Irrigation Water Requirements for Different Cropping Alternatives

[13] TA 8702-CAM: Uplands Irrigation and Water Resources Management Sector Project.

			Wet Season Efficiency			Dry Season Efficiency		
			50%	40%	30%	50%	40%	30%
			Cu.M/ ha			Cu.M/ ha		
Low Rainfall Yr	Short season Variety	(90 day)	12,000	15,000	20,000	14,500	18,000	24,500
	Med season variety	(130 day)	13,000	16,000	22,000			
Normal Rainfall Yr	Short season Variety		9,000	11,000	15,000	14,000	17,500	23,000
	Med season variety		11,500	14,000	19,000			

Source: PPTA team.

139. Preliminary field surveys by the PPTA team have estimated the increase in cropping area of a single 90-day rice crop in the dry season as a result of the rehabilitation of the following canals in the commune:

(i) Secondary canal 1: a 1 km canal north of Highway 1 in Thnaot village, flowing south from a secondary canal: adding a command area of 57 ha for a dry season crop.
(ii) Secondary canal 2: A 3 km long canal south of Highway 1, starting at an intake gate on main canal (no. 10) and flowing eastward through Boeung Snao and Takork villages and finishing at a ruined Pol Pot era gate: adding 179 ha for a dry season crop.
(iii) Secondary canal 3: A 1 km long canal south of Highway 1, starting at an intake gate on main canal (no. 10) and flowing westward: adding 69 ha for a dry season crop.

140. A maximum total of 305 ha will be irrigated for an additional dry season crop, where none is currently grown. On the water demand figures in Table 28 for a dry season crop at 40% irrigation efficiency, this area of irrigation if cropped to the maximum would require a total of **4.422** million cubic meters **(MCM) and 4.27 MCM** for the growing season in a low rainfall year and normal rainfall year respectively. This calculation includes an allowance of water for pre-saturation of paddy and establishment of a 100 mm water layer for planting, although coming off the end of the wet season, ambient water levels in the paddy soils will already be high.

141. **Water supply.** The water inflow for the water balances has been taken from the flow data of the Trabaek River and presented in Table 10. The total monthly flows from the selected dry year (2004) and average year (2001) are used to derive water availability for the months of December-March (inclusive) in Table 28 below.

Table 28: Selected Dry and Average Year Flows in the Trabaek River for December-March (dry season cropping)[a]

	Dry Year 2004		Average Year 2001	
Month	**Ave. Flow (m^3/s)**	**MCM**	**Ave. Flow (m^3/s)**	**MCM**
Dec	19.48355	52.184736	35.38258065	94.768704
Jan	12.05938	32.020704	18.56419355	48.40992
Feb	7.991034	20.022336	13.91785714	34.982496
Mar	6.400968	17.144352	10.92967742	29.274048
Total		***48.684672***		***121.372128***

m^3/s = cubic meter per second; MCM = million cubic meter.
[a] Data from 2001-2010.
Source: PPTA team.

142. Since this is raw flow data at the point of water discharge into the Trabaek from the

Mekong, a number of assumptions are needed to account for water losses to existing irrigation schemes before it can be used as available water for the 305 additional ha of dry season irrigation at Lvea commune.

143. **Assumption 1.** There are five large pumping stations built in 2013 along the Trabaek in the vicinity of the Lvea commune subproject. These have been constructed later than the available hydrological data in Table 28 and the flow rates presented will need to be adjusted to account for this recent level of extraction. The stations are twin pump installations for irrigation water (pump in) and for draining (pump out). One of the pumping plants (Pumping Station #1) is "upstream" of the Lvea commune and its operation will extract water from the available water in the Trabaek. Similarly, another pumping plant (Pumping Station #2) services the current Lvea scheme and the neighboring Rumchechek and Chey Kampok schemes.

144. It is assumed that the current cropping in the Lvea commune comprising a wet season crop and an irrigated dry season crop (in those areas where existing irrigation infrastructure can service them) plus that of the Rumchechek and Chey Kampok schemes, uses all the current allocation from Pumping Station #2. Water available for the additional 305 ha of irrigated dry season rice made possible by the project, plus all the irrigation schemes "downstream" of Lvea will therefore draw water from the balance of water flow in the Trabaek after these two pumping schemes.

145. **Assumption 2.** The pumping stations operate only one pump at a time (using the second pump as redundancy/backup). The pumps are run an average of 10 hours per day. The pump unit is rated at 160 kW and the static head is estimated at 6 meters. This provides a pumping flow rate of 2.72 m^3/s. For the relevant period (December-March) each pumping station would extract:

*2.72 * 60 * 60 * 10 * 30 = 2.938 MCM/month*

146. Pumping stations #1 and #2 therefore remove the following volume of water from the Trabaek in the December-March 4-month period:

*2.938 * 4 * 2 = 23.5 MCM*

147. Water availability for each month in the projected growing season is calculated as:

(Monthly flow in Trabaek) – (Month extraction from Pumping Stations #1 and #2)

Table 29: Water Availability

Year Type	Water in Trabaek (Dec-Mar) MCM	Water extracted by Pumping Stations (Dec-Mar) MCM	Water Available for additional dry season crop at Lvea MCM
Average year	121.37	23.5	97.87
Dry year	48.682	23.5	25.182

MCM = million cubic meter.
Source: PPTA team.

148. **Water Balances.** The following seasonal water balances for a dry season crop in a normal year and a dry year (Table 30) are based upon the data and assumptions outlined above to estimate water demand and water availability. They compare seasonal water needs with water supply for the projected expansion of dry season irrigation area to 305 ha.

Table 30: Water Balance for an Additional 344 ha Irrigation Area of Dryland Cropping at Lvea Commune

Dry Season			
Year	**Crop**	**Water Need (MCM)**	**Water Available (MCM)**
Dry Season			
Low rainfall year	Short season variety (Dec-Mar) 90 day+	4.422	25.182
Normal rainfall year	Short season variety (Dec-Mar) 90 day+	4.27	97.87

ha = hectare, MCM = million cubic meter.
Note: 90 day+ and 130 day+ refers to the growing period plus land preparation.
Source: PPTA team.

149. The shaded cells in the water balance show where water availability is sufficient for irrigation needs. The balance shows that the dry season rice crop in the additional areas is possible and likely to be sustainable in average years and that surplus water exists for downstream uses. In a dry year, the balance demonstrates that the irrigation is possible but that extraction of the water may put pressure on future downstream supplies, since it takes about 17.5% of the available water.

150. No major new irrigation schemes on the Trabaek downstream (east) of Lvea are currently planned. New schemes in feasibility planning are on the Stung Slot and focus on drainage of late wet season water to provide cropping options. However incremental downstream use of the Trabaek's water in the future may experience water constraints and will need to plan future extraction and irrigation areas accordingly.

151. The new area of dry season cropping will require longer pumping duration at Pumping Station #2, since the water from the present pumping period is all allocated. The extra water would equate to an estimated additional pumping period at Pumping Station #2 of 3.76 hours per day over the 4 month dry season irrigation period.

152. To ensure that the irrigation schemes will be sustainable and responsibly managed, and that agreed irrigation and base flows are maintained and other beneficial water users are not disadvantaged, a clear and detailed extraction plan for the growing seasons will be prepared by the commune council in consultation with the farmers water user commune, as a prerequisite for project commencement. This will be documented and approved by the implementing agency and ADB before procurement and construction commences.

b. Impacts from agricultural chemical use

153. The benefits resulting from the augmentation of irrigation in the Lvea commune will accrue to the beneficiaries through both intensification and expansion of agriculture in the areas. With an increase in agriculture comes a potential increase in the use of agricultural chemicals.

154. At current application rates of approved chemicals the following increases in fertilizer and pesticide applications can be expected from the increases in agricultural activity (see Table 31 below). The increase in agricultural activity is based upon the maximum cultivation of each subproject area based upon available water (see water balances) – this is a medium season rice crop followed by a short season rice crop.

Table 31: Fertilizer and Pesticide Use Before and After the Project

Province	Subproject	Change (hectare)	Increment of fertilizer (ton/year)[b]	Increment of pesticides (liter/year)[c]
Prey Veng	Lvea commune irrigation[a]	305	61	3,050

[a] Irrigation area: two crops per year.
[b] Average fertilizer use: 0.1 tons/ha/crop.
[c] Average pesticide use: 5.0 litre/ha/crop.
Source: PPTA team.

155. The predicted incremental increase of fertilizer use for the whole project is 70 tons per year, and the increment increase in pesticide use is 3,440 litres per year. Nitrogen and phosphorus in liquid effluents can contribute to eutrophication in water and risk of oxygen depletion in waterbodies. Excessive nitrogen as ammonia can lead to gradual acidification of soils. Organochlorines, organophosphates, pyrethroids and carbamates (the common pesticide types used) can lead to direct poisoning of farmers through misuse and unsafe handling. Organochlorines and organophosphates can enter the food chain and groundwater resources. The PPTA monitoring found pesticide residues in deep groundwater in two of four wells sampled along the Lvea canals. It also found pesticide residues in the surface water of the primary canal (Tables 11 and 13).

156. Farmer surveys carried out by the PPTA team found that few farmers have received training in Integrated Pest Management (IPM), and that most farmers apply fertilizer, but that applications are not based on specific soil/crop needs. To address this, the project will deliver, as part of its capacity building and training component, training modules specifically tailored to the needs of farmers on IPM and low chemical cultivation applicable to cropping conditions and capacities in the subproject areas. Training in IPM will coordinate with the Cambodia National IPM Programme and include the safe storage, handling and disposal of agricultural chemicals. The Project will also undertake soil analyses in the command areas and provide farmers with recommendations on appropriate fertilizer regimes and cultivation practices.

157. The training package will emphasise environmentally sound farming and sustainability and will provide farmers with alternative approaches to a reliance on chemicals.

2. Village Road Subproject

158. Post-construction impacts for the village road rehabilitation subproject will be from noise and dust from traffic and road safety issues. Increases in traffic impacts will be limited since the road will not open up new access or opportunities. Rather, it will provide an increased certainty of getting to and from markets and services for the villages it connects.

a. Road safety

159. Cambodia experiences an extremely high accident rate that is three times that of other countries in the ASEAN region, and accidents, casualties and fatalities have all increased proportionally faster than the growth in road traffic and the population.

160. It is unlikely that the rehabilitated road will attract significantly additional traffic, since the road will not open up new access or opportunities. Rather, it will provide an increased certainty of getting to and from markets and services for the existing residents of the villages it connects. However, with improvement in alignment and surfacing, higher vehicle speeds may be expected. To address this, a road safety program will be implemented as part of the EMP training plan. The NCDDS Project Implementation Manual (2009) includes guidelines for road safety signage (speed, schools, etc.) and these should be incorporated in the finished road design. A road safety program will focus on: (i) raising awareness of road safety for all road users in target areas; (ii) working with local communities, in particular youth and women, to

161. On this last point, the community role in traffic calming and traffic control will be emphasized and the role of physical structures and village wardens discussed in the training.

b. Noise and pollution

162. These potential impacts are related to increases in traffic in the operational period. Since it is unlikely that road traffic will substantially increase due to the road rehabilitation, noise and pollution impacts from traffic are unlikely to be significant. New surfacing and the elimination of ruts and potholes will reduce road noise and increase engine efficiency with additional reductions in noise and pollution.

c. Maintenance

163. Strict maintenance of the road will be required to ensure that the road subproject's benefits will not be negated. In particular the road's surfacing, which promotes noise and pollution reductions, and flood resilience structures need to be regularly monitored and managed:

(i) Surfacing. Regularly inspect surface and fill potholes and ruts early before they enlarge;
(ii) Commune to have a stockpile of suitable gravel and fill material and sections of the road should be under the care and supervision of adjacent landholders or user groups;
(iii) Embankments and side batters of road across flood-liable land need to be checked regularly for stability and cracks. Embankments should be well vegetated to increase stability; and
(iv) All culverts and pipes must be regularly cleared to allow free passage of water. Any debris and silt must be totally removed from site to ensure it is not back into drainage structures by the next runoff event.

G. Unanticipated Impacts during Construction and Operation

164. 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 IEE including EMP. ADB will help the borrower mobilize the resources required to mitigate any adverse

unanticipated impacts or damage.

H. Climate Change Impact Assessment

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

1. Greenhouse Gas Emissions

166. Net greenhouse gas (GHG) emissions from the project will derive from GHGs emitted by agricultural activities, in particular the CH_4, N_2O and CO_2 emissions from rice paddy flooding and cultivation, and the power use in pumping.

167. **Paddy emissions.** GHG emissions from rice paddy fields have been studied in India, Japan, and Philippines (Table 32), and to a lesser extent in PRC and the USA. Only the studies in northern India have studied the emission of the suite of GHGs (CH_4, N_2O and CO_2) 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 32: Greenhouse Gas Emissions from Rice Paddy

Location	Methane (CH_4) from Rice Paddy
Northern India[a]	40 – 100 kg/ha
Philippines[b]	100 – 150 kg/ha
Japan[c]	150 – 200 kg/ha

CH_4 = methane; kg/ha = kilogram per hectare.
[a] Pathak H, C Li and R Wassmann (2005).
[b] Corton et al (2000).
[c] Yagi et al (1996).

168. 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 g/ha CH_4 : 690 kg/ha CO_2 : 1.93 kg/ha N_2O.

169. These emission rates are calculated for the project area in Table 33 below, and converted into equivalent levels of CO_2 using the following formula:

*Global warming potential (GWP) = CO_2 emissions + CH_4 emissions*21 + N_2O emissions*310*

Table 33: GHG Emissions and GWP from Rice Paddy Increases

Increase in Rice Paddy (ha)	CH_4 emissions (kg/yr)	CO_2 emissions (kg/yr)	N_2O emissions (kg/yr)	GWP (tons/yr CO_{2e})
Lvea				
344	22,704	237,360	664	920

CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalent; CH_4 = methane; GHG = greenhouse gas; GWP = global warming potential; ha = hectare; kg/yr = kilogram per year; N_2O = nitrous oxide; tons/yr = tons per year.
Source: PPTA team.

170. **Power for pumping.** Section D1.1 above calculated that the irrigation water for the additional 344 ha of dry season rice would require an extra 3.7 hours of pumping per day of a 160 kW pump unit at Pumping Station #2 for the 4-month preparation and growing season. This totals

67,776 kWh. Using the US EPA conversion of 7.03 * 10^{-4} tons CO_2/kWh, which is based on a mixture of coal and gas-fired base load generation, it is estimated that the pumping of irrigation water for the subproject will result in the emission of 47.65 tons CO_2.

171. **Total GHG emissions.** The total CO_{2e} emissions generated by the project will be approximately 967.65 tons/annum. This is below the threshold of 100,000 tons/annum where the ADB SPS (2009)[14] and therefore, no further monitoring is required.

2. Adaptation to Future Climate Change

172. The initial rapid environmental assessment (REA) undertaken by the ADB during project planning identified a medium climate risk. Therefore, a climate and disaster risk assessment (CDRA) has been undertaken for the core subprojects. The findings of the CDRA are presented below.

a. Irrigation water demand

173. 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.[15]

174. 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.

175. The predicted changes in rainfall and temperature under climate change scenarios (see Section IV) will combine to affect future irrigation water requirements (IWR). Figure 35 below shows predicted IWR for all SRES projections for nation states acting in isolation (A2 and B2 scenarios).

176. The crop of interest for Lvea commune is a short season dry season rice (90 days crop). The projections in Table 34 show that IWR for these crops will be in the following ranges in 2020 and 2050:

Table 34: Predicted IWRs from Climate Change and IWRs used in Subproject Water Balances

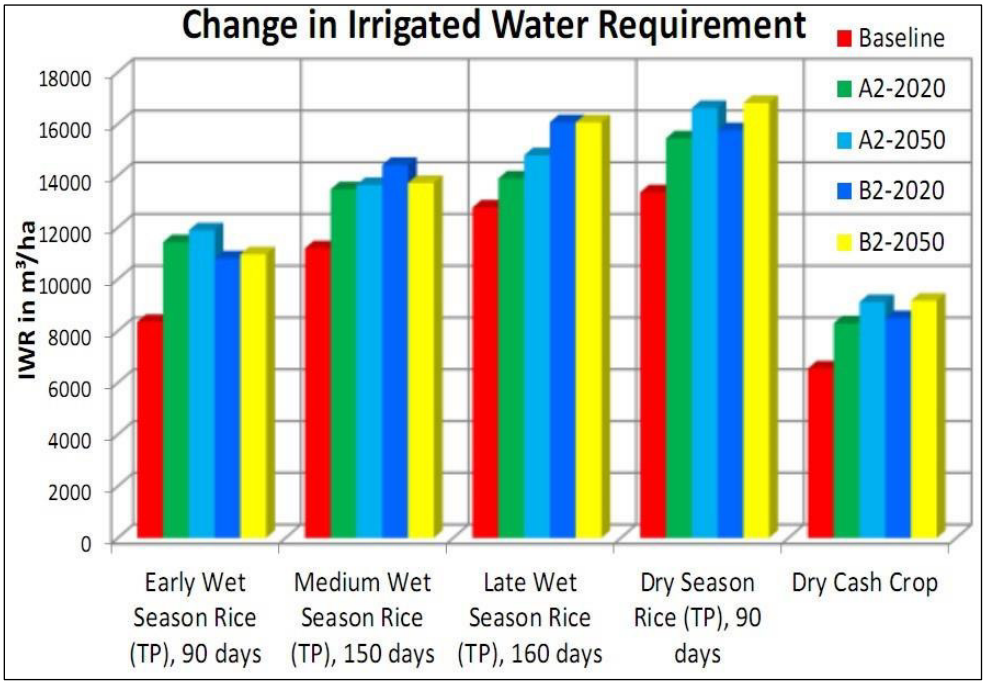
Crop	Predicted IWR in 2020 (m^3/ha)	Predicted IWR in 2050 (m^3/ha)	IWR used in Water Balances (Tables 30 and 31) for dry years (m^3/ha)
Dry season rice	15,000-15,500	16,250-16,400	18,000

IWR = irrigation water requirement; m^3/ha = cubic meter per hectare.
Source: PPTA team.

[14] Which requires an annual quantification of GHG emissions in accordance with internationally recognized methodologies.

[15] Tes, S. Jan 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, Cambodiana Hotel, Phnom Penh.

Figure 35: Irrigation Water Requirements from IPCC SRES



Source: Sopharith, 2015.

177. Table 34 shows that when the IWRs from future climate change scenarios are compared with the IWRs being used for the subproject water balance, the project design IWRs are consistently higher and already allow for the eventuality of future increased water demand in both 2020 and 2050.

178. Design of structures for 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. Sluice gates 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

179. 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 side walls from flood scouring and failure.

b. Biodiversity and Remnant Vegetation

180. There is a major role in climate change adaptation for agricultural systems provided by indigenous vegetation and plant community systems where root-mass, biomass and establishment of tiered planting communities, mimic naturalised systems and provide over time habitat corridors for those insects and birdlife important to integrated pest management systems, as well as mitigating impact from rainfall, and strengthening nutrient cycles.[16]

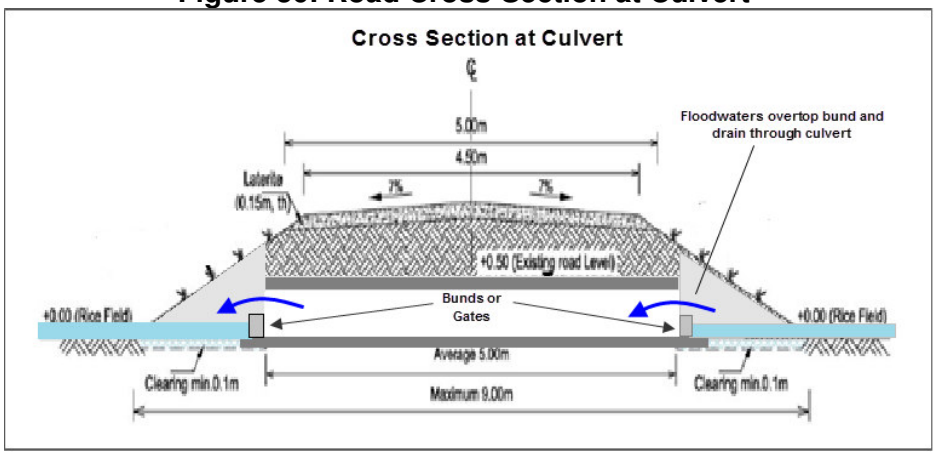
[16] 44321-CAM: Climate Resilient Rice Commercialization Sector Development Program, Draft Climate Change Toolkit for Subprojects, Tony McDonald, December 2016.

181. There is also a link between sustainable agriculture and maintaining ecological integrity in the landscape by the protection and establishment of remnant vegetation systems. This IEE has identified the need to minimize vegetation loss during construction, and this mitigation measure will be complemented by the retention, replacement and development of trees and shrubs along canal banks, creeks and drainage lines.

182. The following design measures, which comply with NCDD standards for rural road design, also contribute to climate resilience measures and disaster risk reduction for rural roads developed in the project CDRA. These measures necessarily pertain within the budgetary limitations for subprojects of the TSSD-AF. The CDRA concludes that within budget constraints, flood resistance of the road (raising the road above recorded flood levels) should be maximized and that this will involve identification of high priority flood proofing sections and lower priority sections along the road alignment. The budget limitations for the Banthaey-Chbar Ampov road mean that raising the road above recorded flood levels, even along a priority section, is not possible. However, the following design measures optimize flood resilience as set out in the CDRA.

(i) Armor road surfaces (natural stone or concrete to protect during overtopping by floods.
(ii) Road height will be increased by up to 1 m above existing alignment for the Priority Section and up to 600 mm on other sections.
(iii) Embankment batters will be at a slope no greater than 30^{o} (1 in 2) and using imported material which is more erosion resistant than local soil.
(iv) The embankment will be turfed and planted with local shrubs to increase stability and resistance to fast flowing water.
(v) The road surface will have a drainage slope of 2% from the center-line on the concrete surface of the priority section and 5% on other sections to shed water.
(vi) The road will have multiple through-drainage structures (culverts and pipes) to ensure that it will not be a flood barrier.
(vii) Culverts will be designed to exceed the height of the previous road by 13%.
(viii) Where paddy field directly abut the road embankment, culverts will have bunds or water gates at each end which will allow inundation of adjoining paddy fields but which can also be overtopped by floodwaters (Figure 36).

Figure 36: Road Cross-Section at Culvert



Source: PPTA team.

3. Natural Disasters

183. The TSSD-AF will improve on designs for roads and irrigation schemes under the project to incorporate climate resilience and to mitigate disaster risks in communes subject to flooding or drought. Two recent ADB projects have also made recommendations to the government on such measures.[17]

184. Commune-based DRR will be supported by the project through the preparation of a commune action plan and training plan for DRR relevant to the irrigation and village road subprojects. This will be integrated with existing Cambodian government national DRR training and planning programme through the NCDM secretariat, which aims to undertake all commune level DRR training and planning. At the sub-commune level and with livelihood improvement groups (LIGs) the projects action plan and training will dovetail with Oxfam's DRR delivery.

185. Commune councilors will be trained in disaster risk reduction (DRR). Training will be delivered through the national design and supervision service contract and through training applications prepared for commune extension workers to deliver. Capacity development in DRR to increase operational knowledge at commune and village levels will also be delivered through the ICT component including improved DRR and extension information transmitted through radio, TV and mobile access devices.[18]

[17] McDonald A, 2016, ibid.
[18] See project administration manual, Appendix 4 for TOR of Rural ICT Specialist.

V. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Consultation and Participation Process

1. Commune Consultative Process

186. Public consultation is an integral part of the preparation process of an annual commune investment plan. Villagers' needs and concerns related to a design of interventions and implementation will be taken into account through commune facilitators and village meetings in order to identify and tailor the design of interventions toward their needs. Once annual commune investment plans are developed, they are presented at the district integration workshop where the district and provincial government agencies will assess the appropriateness in terms of a linkage to their investment plans and other stakeholders such as community organizations and nongovernment organizations are invited to comment or expressed their interests as potential service providers. Consultation are documented in commune environmental assessment forms and other meeting minutes.

2. Project Information Dissemination

187. Public consultation commenced in the core subproject communes in March 2017, with information dissemination meetings in Lvea commune, Prey Veng, on 7 and 8 March and at the Banthaey and Chbar Ampov communes, Kampong Cham, on 10 March. This was followed by a round of public consultation in the second half of April 2017 in all three communes in conjunction with the project household surveys, which also included an information dissemination session.

188. At the beginning of the household surveys in mid April 2017, participants were asked about their support for the project. The responses are at Table 36.

Table 36: Awareness and Support of Project

Subproject	Response	Sex of head of household					
		Male		Female		Total	
		n	%	n	%	n	%
Road	No	0	0.0%	1	2.6%	1	1.0%
	Yes	59	96.7%	36	92.3%	95	95.0%
	Don't know	2	3.3%	2	5.1%	4	4.0%
	Sub-total	*61*	100.0%	39	100.0%	100	100.0%
Irrigation	No	1	2.1%	0	0.0%	1	1.0%
	Yes	44	93.6%	50	94.3%	94	94.0%
	Don't know	2	4.3%	3	5.7%	5	5.0%
	Sub-total	*47*	100.0%	53	100.0%	100	100.0%
Total	No	1	0.9%	1	1.1%	2	1.0%
	Yes	103	95.4%	86	93.5%	189	94.5%
	Don't know	4	3.7%	5	5.4%	9	4.5%
	Total	108	100.0%	92	100.0%	200	100.0%

Source: PPTA team.

189. The knowledge of, and support for, the project was high – demonstrating the effectiveness of the information dissemination phase and the introductory briefings carried out by the social survey team. Project approval by male heads of households exceeded 95% with women heads at 93%.

3. Consultation during Household Survey

190. Participants reported that the main expected benefit of the road to them was faster travel (44.3%) followed by easier delivery of farm products (16.1%) and lower cost of travel (14.9%). For the irrigation subproject, the main expected benefits were the increase in water and the ability to grow more (69.4% combined). This is shown in Table 37.

Table 37: Expected Benefits from the Project

Subproject	Response	Sex of head of household					
		Male		Female		Total	
		n	%	n	%	n	%
Road	Reduce other cost	7	6.3%	3	4.8%	10	5.7%
	Travel Faster	44	39.6%	33	52.4%	77	44.3%
	Receive more agriculture output	3	2.7%	6	9.5%	9	5.2%
	Reduce the cost of travel	18	16.2%	8	12.7%	26	14.9%
	Easy to deliver the agriculture products from home to market	20	18.0%	8	12.7%	28	16.1%
	Other	4	3.6%	2	3.2%	6	3.4%
	Don't know	8	7.2%	3	4.8%	11	6.3%
	Sub-total	111	100.0%	63	100.0%	174	100.0%
Irrigation	Reduce the cost of buying water for irrigate crop	6	6.6%	8	9.3%	14	7.9%
	Reduce other cost	1	1.1%	1	1.2%	2	1.1%
	Receive more agriculture output	15	16.5%	13	15.1%	28	15.8%
	More water supply for using	30	33.0%	29	33.7%	59	33.3%
	Farming more than twice	24	26.4%	12	14.0%	36	20.3%
	Other	2	2.2%	8	9.3%	10	5.6%
	Don't know	8	8.8%	8	9.3%	16	9.0%
	Sub-total	91	100.0%	86	100.0%	177	100.0%
	Total	202	100.0%	149	100.0%	351	100.0%

Source: PPTA team.

191. The responses relating to current environmental problems affecting all communities emphasized the problems of dust (11%) and improper waste disposal (21.5%). The majority response however (45% overall) was that that there was no significant environmental issue confronting them (Table 38).

Table 38: Current Environmental Issues Affecting Commune

Subproject	Response	Sex of head of household					
		Male		Female		Total	
		n	%	n	%	n	%
Road	None	16	26.2%	14	35.9%	30	30.0%
	Water pollution	7	11.5%	3	7.7%	10	10.0%
	Dusty	16	26.2%	5	12.8%	21	21.0%
	Improper waste disposal	13	21.3%	6	15.4%	19	19.0%
	Drought	0	0.0%	1	2.6%	1	1.0%
	Other	1	1.6%	4	10.3%	5	5.0%
	Don't know	4	6.6%	6	15.4%	10	10.0%
	Refuse	4	6.6%	0	0.0%	4	4.0%
	Sub-total	*61*	*100.0%*	*39*	*100.0%*	*100*	*100.0%*
Irrigation	None	32	68.1%	28	52.8%	60	60.0%
	Water pollution	1	2.1%	2	3.8%	3	3.0%
	Dusty	1	2.1%	0	0.0%	1	1.0%

Subproject	Response	Sex of head of household					
		Male		Female		Total	
		n	%	n	%	n	%
	Improper waste disposal	8	17.0%	16	30.2%	24	24.0%
	Drought	0	0.0%	0	0.0%	0	0.0%
	Other	2	4.3%	2	3.8%	4	4.0%
	Don't know	3	6.4%	5	9.4%	8	8.0%
	Refuse	0	0.0%	0	0.0%	0	0.0%
	Sub-total	*47*	*100.0%*	*53*	*100.0%*	*100*	*100.0%*
Total	None	48	44.4%	42	45.7%	90	45.0%
	Water pollution	8	7.4%	5	5.4%	13	6.5%
	Dusty	17	15.7%	5	5.4%	22	11.0%
	Improper waste disposal	21	19.4%	22	23.9%	43	21.5%
	Drought	0	0.0%	1	1.1%	1	0.5%
	Other	3	2.8%	6	6.5%	9	4.5%
	Don't know	7	6.5%	11	12.0%	18	9.0%
	Refuse	4	3.7%	0	0.0%	4	2.0%
	Total	108	100.0%	92	100.0%	200	100.0%

Source: PPTA team.

192. The potential environmental impacts, which participants wanted the subproject planning and implementation teams to be aware of, included dust generation (15%) and traffic accidents (3.5%). Both these concerns were significantly higher in responses from the group in the village road subproject area (27% and 6% respectively).

Table 39: Environmental Impacts from Project Implementation

Subproject	Response	Sex of head of household					
		Male		Female		Total	
		n	%	n	%	n	%
Road	None	20	32.8%	11	28.2%	31	31.0%
	Dusty	20	32.8%	7	17.9%	27	27.0%
	Traffic Accident	2	3.3%	4	10.3%	6	6.0%
	Disturbance from land preparation in longer period	0	0.0%	2	5.1%	2	2.0%
	Other	3	4.9%	4	10.3%	7	7.0%
	Don't know	6	9.8%	9	23.1%	15	15.0%
	Refuse	10	16.4%	2	5.1%	12	12.0%
	Sub-total	61	100.0%	39	100.0%	100	100.0%
Irrigation	None	31	66.0%	30	56.6%	61	61.0%
	Dusty	1	2.1%	2	3.8%	3	3.0%
	Traffic Accident	0	0.0%	1	1.9%	1	1.0%
	Disturbance from land preparation in longer period	1	2.1%	2	3.8%	3	3.0%
	Other	4	8.5%	2	3.8%	6	6.0%
	Don't know	9	19.1%	16	30.2%	25	25.0%
	Refuse	1	2.1%	0	0.0%	1	1.0%
	Sub-total	47	100.0%	53	100.0%	100	100.0%
Total	None	51	47.2%	41	44.6%	92	46.0%
	Dusty	21	19.4%	9	9.8%	30	15.0%
	Traffic Accident	2	1.9%	5	5.4%	7	3.5%

Subproject	Response	Sex of head of household					
		Male		Female		Total	
		n	%	n	%	n	%
	Disturbance from land preparation in longer period	1	0.9%	4	4.3%	5	2.5%
	Other	7	6.5%	6	6.5%	13	6.5%
	Don't know	15	13.9%	25	27.2%	40	20.0%
	Refuse	11	10.2%	2	2.2%	13	6.5%
	Total	108	100.0%	92	100.0%	200	100.0%

Source: PPTA team.

193. Both these issues are specifically addressed in the IEE and EMP, with construction practice measures designed to minimize dust and traffic dangers as well as a monitoring plan to check these issues during construction. Additionally, awareness-raising programs for road safety are included in the project's capacity building output. There was minimal complaint about water pollution during consultations, despite the baseline well water sampling indicating coliform contamination and some pesticide residues even in deep wells. These issues will be discussed as part of the IPM capacity building.

B. Future Information Disclosure and Public Consultation Program

194. Meaningful consultation to safeguard the environment and local residents will continue throughout the construction and operation phases. The implementing agencies will be responsible for organizing the public consultations, with the support of the project implementation consultant (ESCC). Civil works contractors will be required to frequently communicate and consult with the communities in the project area of influence, especially those near the project areas. Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractor, implementing agency), and the grievance redress mechanism (GRM). Consultation will focus on public complaints about public nuisances from construction and operation activities, such as water quality, noise, dust, traffic disturbance.

Table 40: Environment Consultation and Communication Plan

Organizer	Format	Frequency	Subject	Attendees
Pre-Construction Stage				
IAs, CCs, ESCC	Targeted public consultation & site visits	Before construction at each site	Agreement with affected persons and sensitive receivers on heavy machinery work. Consultation on safety of nearby communities.	Affected persons in impacts zone of construction activities
Construction Stage				
IAs, CCs, ESCC	Public consultation & site visits	Once each year during construction	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents in project areas
Operational Stage				
O&M Units (CC), ESCC	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents in project areas
ESCC	Public satisfaction survey	Once at PCR stage	Public satisfaction with EMP implementation. Comments and suggestions	Residents in project areas

CC = commune council; EMP = environmental management plan; IA = implementing agency; ESCC = Environmental Safeguards and Climate Change Specialist (of the PIC); O&M = operation and maintenance; PCR = project completion review.
Source: PPTA team.

VI. GRIEVANCE REDRESS MECHANISM

195. Public grievances related to project construction may include damage to commune or private property, damage to vegetation, interruption of public services, dust emissions, noise, soil erosion, inappropriate disposal of waste materials, and safety for the general public and construction workers.

196. Traditionally, complainants at the village level address their concerns to the village leader, commune leader or staff. The NCDD also has a complaints unit, but its focus is on land issues and resettlement rather than environmental concerns. Additionally, there are sanctions the 1996 Law on Environmental Protection and Natural Resources Management which can be sought by affected people or villages through the district offices of the MOE. The main weaknesses of these systems are: (i) the lack of a specialized unit to address environmental grievances; and (ii) the lack of a specific timeframe for the redress of grievances.

197. A project-specific grievance redress mechanism (GRM) has been developed in compliance with ADB's SPS (2009) requirement to address the weaknesses in existing complaints systems and provide an easy and immediate complaint-and-response link between affected persons and the contractors/implementing agencies.

198. The project GRM is designed to achieve the following objectives: (i) provide channels of communication for local communities to raise concerns about environmental grievances which might result from the project; (ii) prevent and mitigate adverse environmental impacts to communities caused by project construction and operation; (iii) improve mutual trust and respect and promote productive relationships between the implementing agencies and local communities; and (iv) build community acceptance of the project. The GRM is accessible to all members of the community, including women, youth, and poverty-stricken residents. Multiple points of entry are available, including face-to-face meetings, written complaints, telephone conversations, e-mail, and social media.

199. The details of the project GRM, including a time-bound flow chart of procedures, are included in the project Environmental Management Plan (Attachment 1 of this IEE).

200. The project GRM does not replace existing local complaints systems. Nor does any part of the project GRM affect the existing rights of affected persons to take their complaints to the courts. Instead, it provides a mechanism for immediate corrective action at the local level and where this is not possible imposes time constraints on corrective actions to be taken by higher levels of government.

201. All parties should employ their best efforts to solve problems that are reported through the GRM. Only when these are exhausted should the ADB's Accountability Mechanism be accessed.[19] The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures.

[19] See: www.adb.org/ accountability-mechanism.

VII. CONCLUSION AND ASSURANCES

A. Positive Impact and Environmental Benefits

202. With the additional financing of the present project activities, the overall project impact will be improved livelihoods in target communes in seven provinces in the Tonle Sap Basin. Two subprojects have been selected as core subprojects and are the subject of this IEE.

203. For the irrigation subproject, the result of the improvements in irrigation infrastructure in Lvea commune, Prey Veng will be (i) the availability of additional area for a dry season crop where, due to failure of irrigation infrastructure, none currently exists; and (ii) an increase in certainty and control of existing irrigation areas. In terms of areas sown, the project will increase potential rice growing areas by 305 ha. This will directly benefit 281 farmer households.

204. For the village road subproject the main beneficial impact will be that the 7 km road linking Bathaey and Chbar Ampov villages in Kampong Cham will be flood-free for a longer period each year. This will have flow-on effects for increased access to goods and services for villages and farmers, as well as a more reliable means to transport the wet season harvest to markets. All residents of Chbar Ampov village will benefit from this increased access and farmers living in Srah Pring village of Banthaey commune will have better access to their fields.

205. 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

206. During construction, the main issues will be air and water pollution and soil erosion, all of which must be managed by strict control of construction contractors. Additional localised traffic hazards are anticipated and this must be minimised by site access and road safety planning. Health and safety of construction workers and the community is also a concern. Mitigation of construction-phase impacts relies heavily on responsibility of works contractors to follow specification clauses specifically designed to minimise pollution of air and water and soil erosion. This mitigation will in turn rely on enforcement by the commune council and the ESO of the implementing agency.

207. Post-construction, the main concerns for the irrigation subproject are local increases in the levels of agricultural fertiliser 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 fertilisers and pesticides efficiently and responsibly. There is also a concern that the irrigation scheme must be sustainable and responsibly managed, to ensure that agreed irrigation flows are maintained and other water users are not disadvantaged.

208. Post-construction impacts for the village road rehabilitation subproject will be from noise and dust from traffic and road safety issues. Increases in traffic impacts will be limited since the road wilt open up new access or opportunities. Rather, it will provide an increased certainty of getting to and from markets and services for the villages it connects.

209. The project's civil works will be complemented by a wide range of capacity building and livelihood integration and diversification activities. Particularly relevant to the environmental impact of the civil works is commune-based DRR which will be supported by the project through

the preparation of a commune action plan and training plan for DRR relevant to the irrigation and village road subprojects. This will be integrated with existing Cambodian government national DRR training and planning programme through the NCDM secretariat, which aims to undertake all commune level DRR training and planning.

C. Assurances

210. The most important assurance, which should be guaranteed by a loan covenant is that the commune councils 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.

D. Conclusion

211. The majority of identified environmental impacts are not assessed as significant. It is concluded that the infrastructure subprojects have significant potential benefits for the rural populations of these areas. It is concluded that the design features, operational regimes and construction management safeguards will address the range of potential environmental impacts identified and will be actioned through the project EMP and continuously checked in the environmental monitoring program.

ENVIRONMENTAL MANAGEMENT PLAN

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 effective implementation of environmental mitigation measures. Relevant EMP management measures will be incorporated into the design, construction and operation phases of the 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 (SPS) 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, the performance of the environmental protection measures and any need for adjustments.

B. Responsibilities for Implementation

3. The implementation arrangements are summarized in the Table A1.1 below.

Table A1.1: Institutional Arrangements

Aspects	Arrangements
Management	
(i) Oversight body	The Council for Agriculture and Rural Development (CARD)
(ii) Executing agencies	There are two executing agencies. Ministry of Agriculture Forestry and Fisheries (MAFF) and National Committee for Democratic Development Secretariat (NCDDS).
(iii) Key implementing agencies	NCDDS: responsible for Output 1, MAFF: responsible for Output 2. Each implementing agency will designate a staff member to be the project Environmental Safeguards Officer (ESO). Ministry of Posts and Telecommunications (MPTC), will be the implementing agency for the specialized telecommunications tasks in Output 2.
(iv) Provincial Support Team (PST)	A PST will be established in each project province, incorporating provincial staff of the implementing agency ministries.
(iv) Implementation units	Commune councils will implement infrastructure subprojects – contracting and supervising construction contractors and owning and operating the finished facilities.

4. The subproject civil works for irrigation and village road will be included in commune development plans (CDP), confirming community interest and funds to contractors will be paid by relevant commune councils.

5. Final design for subprojects, support in bid preparation, and construction supervision will be undertaken by a Design and Supervision Consultants (DSC) and selected by a procurement review committee (PRC) composed of representatives from the implementing agencies.

6. A provincial support team (PST) will be established for each province incorporating provincial staff of the executing and implementing agencies' ministries. The PSTs will ensure that all subproject designs are technically cleared by relevant provincial technical departments and, in particular, that road designs are approved at provincial level by the provincial department of rural development, and that irrigation designs are approved by the provincial departments of water

resources and meteorology.

7. The DSC will support commune councils and PST to prepare tender and contract construction documents. The commune councils will therefore act as the project implementation units for the infrastructure outputs. The commune councils will remain the project owners and will award the contract, manage the contract, and monitor the construction. The DSC will assist commune councils to monitor construction standards and facilitate monthly coordination at provincial level.

8. For the environmental aspects of the project, the safeguard unit within the National Committee for Democratic Development Secretariat (NCDDS) will assign a suitably qualified staff member to be the project Environmental Safeguards Officer (ESO). A terms of reference for the ESO position is at **Annex A** of the EMP.

9. Project implementation consultants (PIC) will include an Environmental Safeguards and Climate Change Specialist (ESCC) who will work with the ESO and assist the PSTs and commune councils to fulfil their environmental responsibilities in implementing subproject EMPs. The role of the ESCC will be to work as part of the implementing agency, helping them fulfil their supervision and monitoring responsibilities. The ESCC will also prepare inputs for the quarterly project progress report and semi-annual environmental monitoring reports for ADB. The ESCC will be contracted for the duration of the loan implementation period. The major responsibilities of the environmental officer will be to ensure that:

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

10. Terms of reference for the PIC ESCC position is at **Annex B** and **C** (there is to be an International and a National position) of the EMP.

11. To enable effective national government oversight of the project, the innovative steering committee arrangement of TSSD will be continued, and will provide guidance to the executing and implementing agencies without creating excessive additional institutional burden. CARD will handle the steering committee functions as part of its regular meetings and other meetings as needed and will ensure that project performance is monitored throughout implementation up to completion.

12. Environmental monitoring during operation of the subprojects in the longer term is the responsibility of the commune.

C. Summary of Potential Impacts

13. Table A1.2 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

14. The mitigation measures will be incorporated into tender documents, construction

contracts, and operational management procedures. Contractors, commune councils and implementing agencies will implement these measures, depending upon subproject phases. The effectiveness of these measures will be carefully monitored to determine whether adjustments are needed.

Table A1.2: Summary of Potential Impacts and Mitigation Measures

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
Pre-construction						
1.1 Design stage	Final site designs	Final designs of embankments, siting of control structures and canal alignments will be completed after taking into account all the provisions of the EMP (below). Final alignment of road, embankments and drainage structures will be completed after taking into account all the provisions of the EMP (below). At all sites, trees to be retained will be clearly marked.	CC and ESCC	IA	Design costs	
	Irrigation extraction planning and command area management	Water allocations and drainage will be documented and approved by the farmers, IA and ADB before procurement and construction commences.	CC and ESCC	IA, ADB	Design costs and supported by SSPs	
		Where new irrigation areas not previously farmed or long abandoned, have regrowth shrubland or forest and provide habitat for local wildlife, key linked refuge vegetation, corridors and windbreaks should be reserved and retained by the plan. Where natural regrowth vegetation is removed from a locality during construction, replacement planting will be undertaken.	CC and ESCC	IA	Design costs	
	Baseline water quality	Establish baseline water quality for surface water and groundwater (see monitoring plan).	CC and ESCC	IA	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.	CC and ESCC	IA	Design costs	
	Update EMP	Updating EMP: Mitigation measures defined in this EMP	CC and ESCC	IA	Design costs	

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
		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).	CC and ESCC	IA	Design costs	
	Quarry and borrow sites	All sources of rock, aggregate and fill for construction will be identified and contracted with licensed quarry and borrow operators. Sites to be approved by ESCC.	CC and ESCC	IA	Design costs	
1.3 Construction support preparation	Environmental education and awareness	Environmental protection training: Environmental Specialists (including ESCC) and/or officials from local MOE offices will provide training on implementation and supervision of environmental mitigation measures to CC and contractors. This will include training in the preparation of a construction site environmental management plan	ESCC and MOE officers as required	IA	EMP training budget	
					1.5	1.5
	Complaints procedures	Grievance redress mechanism established and local contact points publicized.	IA and CC	ESCC	Part of project design	
					1.5	1.5
	Site planning	Prepare a construction site environmental management plan which incorporates the relevant provisions of this EMP for each subproject construction site. The plan will also include an emergency preparedness and response plan for construction emergencies, site environmental health and safety plan, identification of sensitive receptors and vegetation to be retained.	Contractors	CC	Part of construction costs	
					2.5	2.5
Construction						
2.1 Water	Construction wastewater	Construction wastewater will not be discharged directly onto the surrounding soil or into surface water systems.	Contractors	CC, ESO	1	4

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
		All wastewater to be passed through silt traps or temporary sedimentation screens. Oil-containing wastewater will be intercepted, collected and transported to vehicle servicing area for treatment and disposal.				
	Polluting 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, provided with bunds and cleanup installations; (ii) vehicle, machinery, and equipment maintenance and re-fuelling 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	CC, ESO	Construction costs	
					6.5	6.5
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	CC, ESO	Construction costs	
					1.5	1.5
	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	CC, ESO	Construction costs	
					2.5	3
2.3 Noise and vibration	Noise impacts on sensitive receivers	Construction at night within 300 m of residences shall be strictly prohibited. During daytime construction, the contractor will	Contractors	CC, ESO	Construction costs	

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
		ensure that: (i) sites for concrete-mixing plants and similar activities will be located at least 500 m away from residences and schools; and (ii) temporary anti-noise barriers will be installed to shield sensitive receptors within 50 m of the construction site. These are located in Figures A1.1, A1.2, and A1.3 below and comprise: Road subproject – residences along both sides of road in Srah Pring and Chbar Ampov villages; two temple/monastery complexes in Srah Pring. Irrigation subproject – residences along canals at CS 1 and CS 2.			2.5	5
2.4 Solid wastes	Demolition waste	Any waste from the demolition of structures will be either sold to building material recyclers or collected and transported to official landfill sites. Metal parts 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	CC, ESO	Construction costs	
					1.5	1.5
	Excavated channel spoil	The sediment quality of spoil from old channel clearing or deepening will need to be tested and assessed for contamination before reuse in levee banks or disposal. The sediment testing results will determine the requirements to ensure safe disposal or reuse. SGV of the UK Department for Environment Food & Rural Affairs, are recommended. Contaminated soils can be used in the way described in the guidelines (buried in levees with clean soil on the top, sealing it from human contact) or taken to licensed disposal facilities.	Contactor and CC	IA	Monitoring costs included in monitoring plan (Table A1.2)	
					Construction contingency costs (if disposal is required)	
					1.5	
	Waste from workers	Contractors will provide sufficient garbage bins at	Contractors	CC, ESO	Construction costs	

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
		strategic locations and ensure that they are (i) protected from birds and vermin; (ii) emptied regularly (using the nearest township licensed solid waste system and landfill); and (iii) are not left to overflow.			0.5	0.5
2.5 Soil erosion and ecology	Erosion impacts	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	CC, ESO	Construction costs	
					1.5	3.5
	Flora and fauna	Clearing of vegetation along canal embankments, levees and road verges will be minimized, to assist in stabilization and retention of habitat values. Trees marked for retention will be protected and any removed native trees will be replaced.	Contractor	CC, ESO	Construction costs	
					-	-
2.6 Social and cultural	Impacts to local cultural sites	The baseline survey reported no physical cultural sites in the subproject areas. There may still be sites or item which are important at a local or household level contractors will ensure that all local cultural sites (including small 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 restored to pre-construction standards. In the event of unexpected cultural heritage or archaeological finds during construction, work will cease while the responsible authorities assess the finds and will only continue under their direction.	Contractors	CC, ESO	Construction contingency costs	
					0.5	0.5

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
2.7 EHS	Community health and safety	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 and after consultation with the affected community. 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, barriers to prevent public access to construction sites and a watch person, where necessary. Avoid contamination of local wells by siting workers' domestic facilities at least 50 m from nearest wells.	Contractors	CC, ESO	Construction costs	
					1.5	3.5
	Occupational health and safety	Measures to ensure occupational health and safety will include: Contractors shall be required by the CC 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 CC and PST; and 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; (vi) safe water supply is provided for workers (not local wells); and (vii) means of access to and egress	Contractors	ESO	Construction costs	
					2	2

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
		from the site are without risk to health and safety.				
2.8 Unexpected environmental impacts		If unexpected environmental impacts occur during project construction phase, the CC and PST will update the EMP, and environmental protection measures will be designed and resources will be utilized to cope with these impacts.	CC	IA	Construction contingency costs	
					1.5	1.5
Operation						
3.1 Management of irrigation	Implementation of extraction and drainage plans	Irrigation schemes to be operated strictly in concurrence with agreed extraction and irrigation plans which ensure sustainability of supply.	IA and CCs	IA, ESCC	Operations cost and capacity building outputs supported by SSPs	
					3	
	Canal fisheries	Informal canal fisheries rights safeguarded for local farmers.	CCs	IA	Costs under project capacity building output and supported by SSPs	
	Pesticide use	Farmers will be trained in IPM to reduce chemical use. Training will include safe handling, application and disposal of pesticides.	SSP and CCs	IA, ESCC	Costs under project capacity building output and supported by SSPs	
	Vegetation on levee banks	Establish and maintain plantings on canal banks to provide local habitat, shade and wind protection.	CCs	IA	Operations cost	
3.2 Management of road	Increased safety hazards	Implement community road safety awareness training and traffic-calming resources.	IA and Communes	IA, ESCC	Costs under project capacity building output and	

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Costs ($1000)	
					Irrig.[a]	Road[b]
		Implement water safety awareness training at Thnaot village.			supported by SSPs	
	Road maintenance	Surfacing. Regularly inspect surface and fill potholes and ruts early before they enlarge; Commune to have a stockpile of suitable gravel and fill material and sections of the road should be under the care and supervision of adjacent landholders or user groups; Embankments and side batters of road across flood-liable land need to be checked regularly for stability and cracks. Embankments should be well vegetated to increase stability; and All culverts and pipes must be regularly cleared to allow free passage of water. Any debris and silt must be totally removed from site to ensure it is not back into drainage structures by the next runoff event.	IA and Communes	IA, ESCC	An O&M fund established under the project will assist with subproject maintenance costs (up to 10% of the subproject cost) during the life of the project.	
3.3 Emergency response planning	Floods and extreme weather events	The project will promote the enhancement of community based disaster risk reduction and disaster management programs at the irrigation and drainage communes with particular reference to flooding and other natural disasters.	Project output	ADB	Directly funded under project output and supported by SSPs	

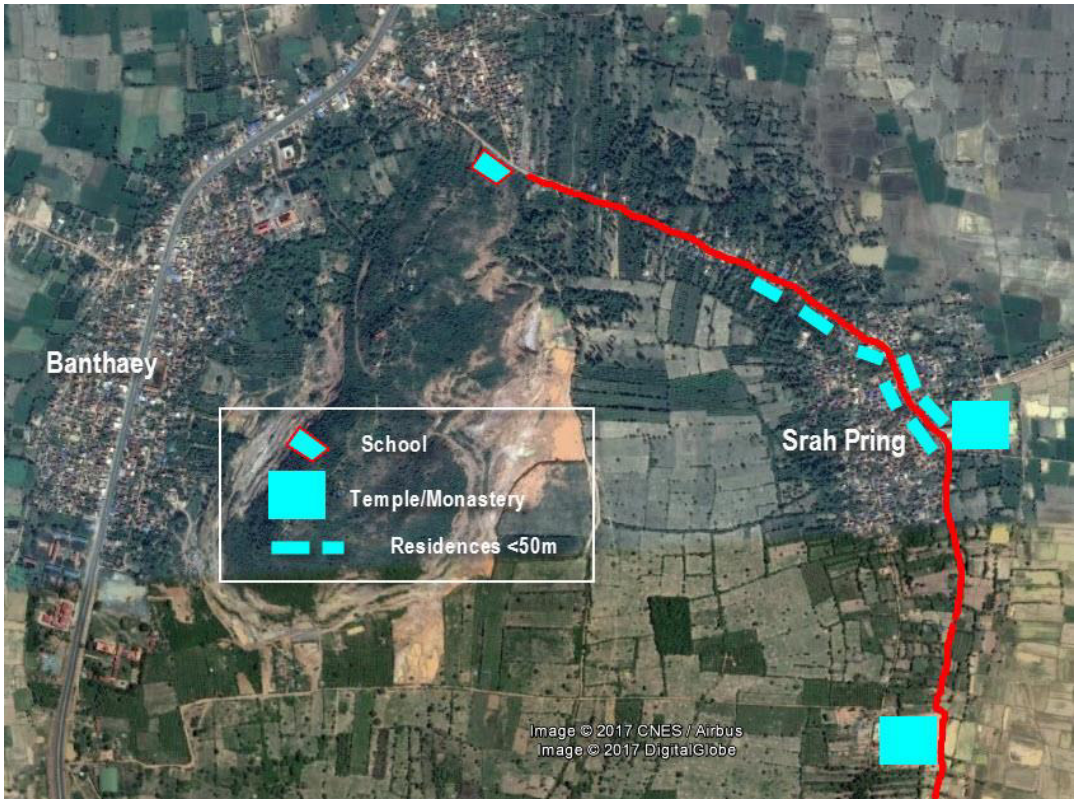
ADB = Asian Development Bank; CC = commune council; EHS = World Bank Group's Environmental, Health and Safety Guidelines; EMP = environmental management plan; ESO = National Environmental Safeguards Officer; IA = implementing agency; IPM = Integrated Pest Management; ESCC = Environmental Safeguards and Climate Change Specialist (of the PIC); MOE = Ministry of Environment; O&M = operation and maintenance; PST = provincial support team; SGV = Soil Guideline Values; SSP = special service provider.

[a] Irrig.* = irrigation subproject, Lvea Commune, Prey Veng.

[b] Road* = village road subproject, Banthaey-Chbar Ampov Communes, Kampong Cham.

Source: PPTA team.

Figure A1.1: Sensitive Receptors at Srah Pring (Village Road subproject)



Source: PPTA team.

Figure A1.2: Sensitive Receptors at Chbar Ampov (Village Road subproject)

Source: PPTA team.

Figure A1.3: Sensitive Receptors at Canals CS 1 and CS 2 (Irrigation subproject)

Source: PPTA team.

D. Environmental Monitoring

1. Monitoring Program

15. The project monitoring program will focus on the environment within the project's area of influence. An environmental monitoring program is summarized in Table A1.3 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 6 April 1999. (Table for Public Waters and for biodiversity protection of lakes and reservoirs)
(ii) Ministry of Industry Mines and Energy Drinking Water Quality Standards, January 2004.

16. For the re-use and disposal of silt from canal cleaning or dredging, there is no government standard, and the most recent standards applying to soil contamination, Soil Guideline Values of the UK Department for Environment Food & Rural Affairs (https://www.gov.uk/government/publications/contaminated-soil-assessing-risks-on-human-health), are recommended.

Table A1.3: Environmental Monitoring Plan

Parameters	Location	Frequency	Responsibility
Pre-Construction: Irrigation Subproject			
Baseline surface water quality: pH, SS, EC, NH_4+, NO_3-, PO_4 3-, DO, BOD5,	At the water source of the subproject canal (primary canal of the local command area) to establish baseline water quality for surface water entering subproject area.	Two times: once at beginning of construction period, and once	CC to contract an organization to do sampling and testing.

Parameters	Location	Frequency	Responsibility
COD, Oil& Grease, heavy metals, pesticides* and Coliforms		at beginning of wet season irrigation period.	
Baseline groundwater quality: "Priority Parameters": pH, Turbidity, Arsenic, Iron, TDS, Pesticides, coliforms.	At least one household well located within each of the water user commune area scheme.	Once at beginning of wet season irrigation period.	CC to contract an organization to do sampling and testing.
Pre-Construction: Road Subproject			
Traffic counts: Average daily traffic numbers	In selected village areas through which road passes and adjacent to any school.	Once before construction period	CC to contract an organization to do sampling and testing.
Dust and noise: Site inspection and visual appraisal.	In selected village areas through which road passes and adjacent to any school.	Once at beginning of wet season irrigation period.	CC to inspect
During Construction: Irrigation subproject			
Dust and noise: Site inspection and visual appraisal. Compare to baseline.	At all subproject sites	Monthly	CC to inspect
Surface water quality: Turbidity and petroleum products	Visual inspection of canal waters downstream of major construction sites.	Monthly	CC to inspect
Silt and canal excavation material: Organic matter, Zn, Cu, Pb, Hg, As, Cd, moisture content, phenols, mineral oil, pesticides*	Canal silt cleared from rehabilitated canal. Three sampling locations - at start, midpoint and end of main canal.	Once at each location to check disposal/reuse safety.	CC to contract an organization to do sampling and testing.
Construction site safety. Report incidents, accidents, injuries.	At all subproject sites	As needed.	Contractor and CC
During Construction: Road subproject			
Dust and noise: Site inspection and visual appraisal. Compare to baseline.	At all subproject sites	Monthly	CC to inspect
Surface water quality: Turbidity and petroleum products.	Visual inspection of canal waters downstream of major construction sites.	Monthly	CC to inspect
Construction waste: Storage and disposal. Site inspection and visual appraisal.	At all subproject sites	Once at each location to check disposal/reuse safety.	CC to inspect
Construction site safety. Report incidents, accidents, injuries.	At all subproject sites	As needed.	Contractor and CC
Operation Phase: Irrigation subproject			
pH, SS, EC, NH_4+, NO_3-, PO_4 $_3$-, DO, BOD5,	Canal waters at midpoint of each secondary canal.	Semi-annual until PCR	IA to contract an organization to do

Parameters	Location	Frequency	Responsibility
COD, Oil& Grease, heavy metals, pesticides* and Coliforms			sampling and testing.
Groundwater quality: "Priority Parameters": pH, Turbidity, Arsenic, Iron, TDS, Pesticides*, coliforms.	Five household wells located within each of the water user commune areas of the irrigation scheme.	Semi-annual until PCR	IA to contract an organization to do sampling and testing.
Operation Phase: Road subproject			
Traffic counts: Average daily traffic numbers	In selected village areas through which road passes and adjacent to any school.	Annually until PCR	CC to inspect
Dust and noise: Site inspection and visual appraisal.	In selected village areas through which road passes and adjacent to any school.	Semi-annual until PCR	CC to inspect
Drainage structures and culverts: Check for proper operation – snags and siltation.	All culverts along road.	Annually, before wet season	CC to inspect

* includes list of pesticides and pesticide residues in Annex 5 of Sub-decree No. 27 ANRK.BK on Water Pollution Control
CC = commune council; IA = implementing agency; PCR = project completion report; TDS = total dissolved solids.
Source: PPTA team.

2. Monitoring Management

17. During construction, the commune councils will make appropriate arrangements for monitoring according to the progress of implementation. When complaints are received from the public (either directly or via the formal grievance redress mechanism), commune council staff will conduct additional inspections immediately.

3. Monitoring Costs

18. The activities of the commune council's monitoring during construction and the initial operational period will be funded from the construction budget. The implementing agencies' ongoing monitoring costs will be covered by their operational budget. A summary of monitoring costs is at Table A1.4.

Table A1.4: Estimated Monitoring Costs

($)

Province	Subproject	Pre-construction and Construction Stage		Operation Stage		Total
		Year 1	Year 2	Year 4	Year 5	
Prey Veng	Lvea Commune Irrigation	4,500	4,500	2,500	2,500	14,000
Kampong Cham	Bathaey – Chbar Ampov Village Road	1,750	1,750	1,500	1,500	6,500

Source: PPTA team.

4. Environmental Monitoring Reports

19. To ensure proper and timely implementation of the EMP and adherence to the agreed environmental covenants, the implementing agency will submit quarterly project progress reports

and semi-annual environmental monitoring reports to the ADB including environmental performance based on the monitoring and inspection data provided by the commune councils. Overall environmental project performance will be assessed in the environment section of the project completion report (PCR). The ESCC will help the implementing agency to prepare these reports. The semi-annual environmental monitoring reports and PCR will be disclosed on the ADB website.

E. Training and Capacity Building

20. Training in the preparation and implementation of construction/site environmental management plans, targeted at commune councils and contractors, will be delivered by the ESCC and ESO. The costs have been estimated and included in the total EMP costs in Table A1.4.

21. The training requirements proposed in this EMP (other than the EMP implementation training above will be undertaken as part of the TSSD-AF capacity building outputs, delivered by special service provider (SSP) and consulting packages[1]. They include:

(i) Training for commune extension workers;
(ii) Livelihood improvement group (LIG) association support;
(iii) Aquaculture value chain;
(iv) Development of multi-media materials for mobile commune access program;
(v) Design and supervision consultants, including road safety awareness and training services;
(vi) Rice and vegetable value chain, including Integrated Pest Management;
(vii) New LIG establishment & support + service teams

F. Grievance Redress Mechanism and Public Consultation

22. 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.

23. 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 honoured where this is seen as important.

1. Proposed GRM

24. The implementing agency will establish a complaints unit which will act as a central recording and coordinating unit for all subprojects under the project. Each subproject commune council 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 implementing agency and its initial implementation through the commune councils will be supported by the environmental consultant of the loan implementation consultancy services.

25. When construction starts, a sign will be erected at each construction site providing the public with updated project information and summarizing the GRM process including details of

[1] A full list of special service provides is provided in the project administration manual

the GRM entry points. The contact persons for different GRM entry points; commune councils, 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 commune council noticeboards.

26. The preferred action sequence for complaints handling is that the complaint should be investigated and resolved by the unit receiving the complaint.

27. The complaints unit will maintain records of complaints and actions taken to correct them. This data will be included in the implementing agencies reports to the ADB. The complaints unit 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 in the periodic reports to the ADB.

2. GRM Procedure and Timeframe

28. The procedure and timeframe for the GRM are described as follows (see Figure A1.4). The stages are represented by different colours in the flow diagram:

(i) **Stage 1:** If a concern arises during construction, the affected person will submit a written or oral complaint to the contractor directly. Whenever possible, the contractor will resolve the issue directly with the affected person. The contractor will give a clear reply within one week. If successful, the contractor will inform the complaints unit accordingly.

(ii) **Stage 2:** If no appropriate solution can be found, the contractor should forward the complaint to the commune council within 5 working days. The complainant may also decide to submit a written or oral complaint to the commune council, either directly or via one of the GRM entry points (farmers representative groups). The commune council will investigate and identify the solution and provide a clear reply for the complainant within 5 working days. The environment consultants of the loan implementation consultancy service will assist the commune council in replying to the affected person. The commune council will timely convey the complaint/grievance and suggested solution to the contractors or operators of facilities. The contractors during construction and the operators during operation will implement the agreed upon redress solution and report the outcome to the complaints unit within 7 working days.

29. During construction, the complaints unit will be informed by contractors and construction supervisors, commune councils staff, if people complain about the project. During operation, the complaints unit will be advised of complaints by the commune council.The complaints unit will also inform the ADB project team and submit all relevant documents.

30. The project GRM does not replace existing local complaints systems. Nor does any part of the project GRM affect the existing rights of affected persons to take their complaints to the courts. Instead, it provides a mechanism for immediate corrective action at the local level and

where this is not possible imposes time constraints on corrective actions to be taken by higher levels of government.

31. All parties should employ their best efforts to solve problems that are reported through the GRM. Only when these are exhausted should the ADB's Accountability Mechanism be accessed.[2] The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures.

3. Public Consultation during Project Implementation

32. Meaningful consultation to safeguard the environment and local residents will continue throughout the construction and operation phases. The implementing agencies will be responsible for organizing the public consultations, with the support of the ESCC. Civil works contractors will be required to frequently communicate and consult with the communities in the project area of influence, especially those near the project areas. Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractor, implementing agency), and the GRM. Consultation will focus on public complaints about public nuisances from construction and operation activities, such as water quality, noise, dust, traffic disturbance.

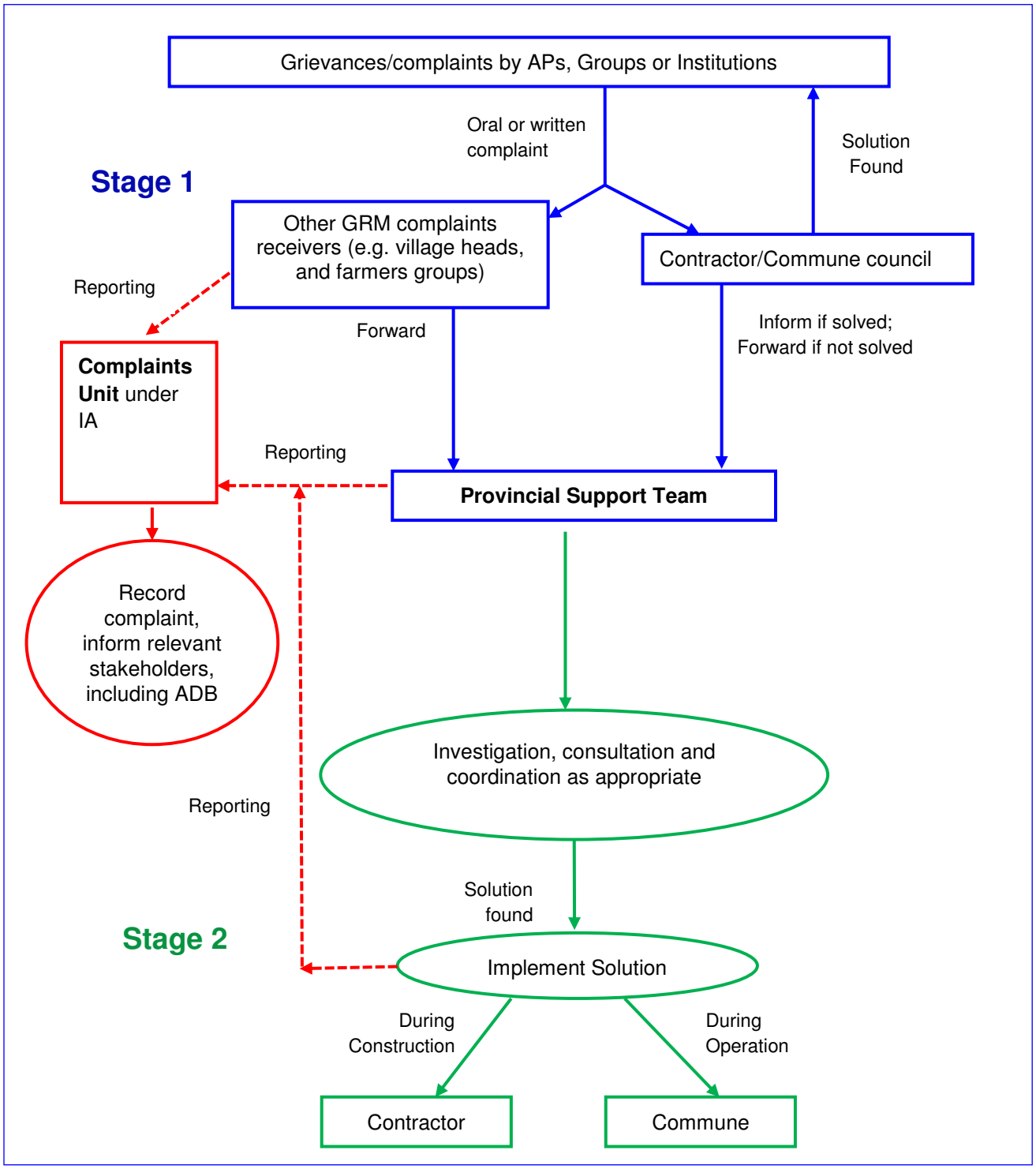
Table A1.5: Environment Consultation and Communication Plan

Organizer	Format	Frequency	Subject	Attendees
Pre-Construction Stage				
IAs, CCs, ESCC	Targeted public consultation and site visits	Before construction at each site	Agreement with affected persons and sensitive receivers on heavy machinery work. Consultation on safety of nearby communities.	Affected persons in impacts zone of construction activities
Construction Stage				
IAs, CCs, ESCC	Public consultation and site visits	Once each year during construction	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents in project areas
Operational Stage				
O&M units (CC), ESCC	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents in project areas
ESCC	Public satisfaction survey	Once at PCR stage	Public satisfaction with EMP implementation. Comments and suggestions	Residents in project areas

IA = implementing agency; CC = commune council; EMP = environmental management plan; ESCC = Environmental Safeguards and Climate Change Specialist (of the PIC); O&M = operation and maintenance; PCR = project completion report.
Source: PPTA team.

[2] See: www.adb.org/ accountability-mechanism.

Figure A1.4: Concept of Proposed GRM



ADB = Asian Development Bank; AP = affected person; CC = commune council; GRM = grievance redress mechanism; IA = implementing agency.
Source: PPTA team.

G. Total Environmental Management Costs

33. The costs of implementing the environmental management and impact mitigation measures listed in the EMP matrix (Table A1.2) are included in the design costs, construction contracts and operational budgets. The costs of the environmental monitoring program are set out in Table A1.4. These costs are combined in Table A1.6 below to give total EMP costs.

Table A1.6: Total Environmental Management Plan Costs

($)

Subproject	CEMP Training	Pre-construction and Construction Environmental Management	Pre-construction and Construction Environmental Monitoring (over 2 years)	Operational Environmental Management	Operational Environmental Monitoring (first 2 years)	Total
Lvea Commune Irrigation	1,500	29,000	9,000	3,000	5,000	47,500
Bathaey – Chbar Ampov Village Road	1,500	37,000	3,500	-	3,000	45,000
Total	3,000	66,000	12,500	3,000	8,000	92,500

CEMP = construction environmental management plan.

Source: PPTA team.

ANNEX A: TERMS OF REFERENCE FOR NATIONAL ENVIRONMENTAL SAFEGUARDS OFFICER (ESO)

I. BACKGROUND

The Royal Government of Cambodia will apply an Asian Development Bank (ADB) loan to implement the Additional Financing (AF) to the Tonle Sap Poverty Reduction and Smallholder Development Project (TSSD). Loan proceeds will fund a series of infrastructure subprojects, each one of which will require an environmental impact assessment which complies with ADB's Safeguard Policy Statement (SPS, 2009) and government regulations. The implementing agency is the National Committee for Sub-national Democratic Development Secretariat (NCDDS). The implementing agency requires an environment officer to supervise, coordinate and assist in the implementation of environmental safeguards for the project. These terms of reference describe the requirements for this position.

II. SCOPE AND DURATION OF WORK

The officer will work on behalf of the implementing agency and coordinate with the commune councils and provincial support teams (PSTs) to ensure that environmental safeguards are implemented in the subprojects. The officer will report directly to the Project Director and Project Manager in the implementing agency. The position is full time and its duration is for at least the first three years of the project.

III. DETAILED TASKS

In coordination with subnational government counterparts and working closely with the Environmental Safeguards and Climate Change Specialist (ESCC) of the project implementation consultants (PIC) and the environmental safeguards/climate change specialist of the Infrastructure Design and Supervision consultant team, the officer will:

1. Assist the commune councils to implement the environmental management plan (EMP) or Environmental Code of Conduct measures for each subproject.
2. Provide training to commune councils and contractors as necessary to facilitate implementation of the EMP or Environmental Code of Conduct.
3. Assist commune councils in their monitoring responsibilities under the EMP.
4. Working with the implementing agency's complaint unit, implement the project grievance redress mechanism (GRM), including: (i) instruct the commune councils and other local agencies on their responsibilities in the GRM; (ii) establish a simple registry system, to document and track grievances received (including forms to record complaints and how they have been resolved); and (iii) prepare reports on progress of the GRM for inclusion in the semi-annual environmental monitoring and quarterly project progress reports to ADB.
5. Assist the ESCC within the Infrastructure Design and Supervision consultant team to develop check lists for climate change impacts which can be applied for both rural infrastructure and livelihood supported activities and develop guidelines on how the commune councils and livelihood improvement group, market improvement group, and paddy selling group members can best respond to increasing climatic variability and the prospects of adverse changes during the design processes.
6. Assist in the preparation of materials for the training of commune councilors, commune mobile access workers, PST, district support team members, as well as trainers at provincial level, in the use of these tools, to enable them to deliver further training at commune level.

7. Assist the National Committee for Disaster Management Secretariat to include climate resilience training at the commune level in the national disaster risk reduction program.
8. Ensure that the environmental awareness and capacity building of the Project adequately covers the requirements for environmental safeguarding.
9. Provide the Project Director and Project Manager with progress reports which cover environmental performance of all parties, training progress, issues outstanding and further actions recommended.
10. Undertake other tasks as requested by the Project Directors and Project Managers.

ANNEX B: TERMS OF REFERENCE FOR INTERNATIONAL ENVIRONMENTAL SAFEGUARDS/CLIMATE CHANGE SPECIALIST – ON PIC TEAM (PIC ESCC)

I. SCOPE AND DURATION OF WORK

The specialist will report directly to the implementing agencies. Duration: 8 person-months over the project duration, mainly in Year 1 and 2.

II. QUALIFICATIONS

The specialist will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least 10 years of experience in environmental management, monitoring, and/or impact assessment; (iii) familiarity with ADB environmental safeguards requirements and national environmental management procedures; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; (vi) willingness to regularly visit the subproject sites; (vii) proficiency in spoken and written English; and (viii) a proven track record as an environmental safeguards specialist in at least three rural development projects funded by bilateral or multilaeral donors.

III. DETAILED TASKS

Working closely with the implementing agencies, other project implementation consultant (PIC) members, the National Safeguards Officer based at National Committee For Sub-National Democratic Development Secretariat, the Environmental Safeguards and Climate Change Specialist within the infrastructure design and supervision consultant team and other relevant personnel and agencies, the consultant will assist in all aspects of the implementation of the environmental management plans (EMPs) and Environmental Codes of Conduct requirements for all project activities that may have environmental impacts, including both hard infrastructure subprojects and other activities. The consultant will:

1. Monitor the compliance of all parties with the requirements of the EMPs and Environmental Codes of Conduct.
2. Guide the national PIC Environmental Safeguards and Climate Change Specialist with the preparation of all environmental safeguards and monitoring documentation for the project, including for hard infrastructure and non-infrastructure activites.
3. For environment Category B subprojects and interventions, assist in the delivery of training in EMP and çonstruction environmental management plan (CEMP) preparation and implementation to commune councils and contractors.
4. Support the implementing agencies, National Safeguards Officer and commune councils to fulfil their environmental responsibilities in implementing the subproject EMPs or Environmental Codes of Conduct.
5. Support the implementing agencies, National Safeguards Officer and commune councils in undertaking environmental monitoring of subproject construction and initial operation.
6. Monitor the compliance of all parties with the recommendations of the climate and disaster risk assessment (CDRA) and check that the adaptation measures in the CDRA are included in designs of subprojects
7. Assist the implementing agencies and commune councils to establish and publicize the grievance redress mechanism (GRM) for subprojects, ensuring that the GRM publicity is appropriate to the scale and complexity of the subproject and includes, as a minimum, the disclosure of all contact persons for lodging complaints.
8. Collaborate with the environmental safeguards and climate change specialist within the

infrastructure design and supervision consultant team, and assist the implementing agencies to prepare semi-annual project monitoring progress reports for submission to ADB.

ANNEX C: TERMS OF REFERENCE FOR NATIONAL ENVIRONMENTAL SAFEGUARDS/CLIMATE CHANGE SPECIALIST – ON PIC TEAM

I. DURATION OF WORK

Duration: 8 person-months over the project duration, mainly in Year 1 and 2.

II. QUALIFICATIONS

The specialist will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least 5 years of experience in environmental management, monitoring, and/or impact assessment; (iii) familiarity with ADB environmental safeguards requirements and national environmental management procedures; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; (vi) willingness to regularly visit the subproject sites; (vii) proficiency in spoken and written English; and a proven track record as an environmental safeguards specialist in at least three rural development projects funded by bilateral or multilaeral donors in Cambodia.

III. DETAILED TASKS

Working closely with the implementing agencies and the NCDDS National Safeguards Officer, and other relevant personnel and agencies, the consultant will assist in all aspects of the implementation of the environmental management plans (EMPs) and Environmental Codes of Conduct requirements for all project activities that may have environmental impacts, including both hard infrastructure subprojects and other activities. The consultant will:

1. In conjunction with the International Environmental Safeguards and Climate Change Specialist, monitor the compliance of all parties with the requirements of the EMPs and Environmental Codes of Conduct.
2. For environment Category B subprojects and interventions, deliver training in EMP and çonstruction environmental management plan (CEMP) preparation and implementation to commune councils and contractors.
3. In conjunction with the International Environmental Safeguards and Climate Change, support the implementing agencies, the national safeguard officer, and commune councils to fulfil their environmental responsibilities in implementing the subproject EMPs or Environmental Codes of Conduct.
4. In conjunction with the International Environmental Safeguards and Climate Change Specialist, support the implementing agencies, the national safeguard officer, and commune councils in undertaking environmental monitoring of subproject construction and initial operation.
5. In conjunction with the International Environmental Safeguards and Climate Change Specialist, monitor the compliance of all parties with the recommendations of the climate and disaster risk assessment (CDRA) and check that the adaptation measures in the CDRA are included in designs of subprojects
6. In conjunction with the International Environmental Safeguards and Climate Change Specialist, assist the implementing agencies and commune councils to establish and publicize the grievance redress mechanism (GRM) for subprojects, ensuring that the GRM publicity is appropriate to the scale and complexity of the subproject and includes, as a minimum, the disclosure of all contact persons for lodging complaints.